The Industrial Centres
Factories and Workers' Housing

Thesis presented to
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for the Degree of Doctor of Technical Sciences by
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Akerets Erben AG, Dielsdorf, October 1963
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Preface

I wish to extend my sincere thanks to Professor Dr. W. M. Moser for his kind and constructive guidance, also to Professor W. Custer for his kind and valuable aid. Moreover I wish gratefully to acknowledge the precious help given by the technical staffs and architectural offices of the VW Industrial Centre in Wolfsburg, Germany, Olivetti Industrial Centre in Ivrea, Italy, Henkel Industrial Centre in Düsseldorf, Germany, the Neue Heimat Organization in Düsseldorf and Hamburg, the Harlow Town Council, England, and the architectural staff of the Egyptian Company of Urbanization and People's Housing in Cairo, Egypt.
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**The Zoning, Street Pattern and Architectural Composition and Workers' Houses in the Egyptian Industrial Colonies**

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The Industrial Centres

It is the environment that has to create the best conditions for human life in the age of machines and industrial production.

Introduction

The rapid growth and the ever-increasing application of technical knowledge, as well as progress in scientific research, are changing the features of the immediate surface of our earth (Fig. 1) and are leading to the conquest of outer space. The home and environment of man have always adapted themselves to suit his ever-changing modes of living and the development of technical progress. Now, in the machine age, we are facing the problem of maintaining the best conditions for human life. Even in the developing countries where total industrialization has not yet taken command, the problems of environmental planning, organization and re-shaping of the economical and social structure are increasing in gravity.

How can the industrial complexes be designed? How and where is industry to be located? How should the millions of industrial workers, employees and technicians and their families be housed? What are their needs and what are the best means of caring for them without sacrificing compatible human and social relations?

In short, how can we design an organic industrial environment involving these three components: driving power, mechanization, and human energy? How can these components be preserved and protected, and at the same time maximum productive efficiency achieved?

Such a design should not only be a technological idea, but must also be a vivid conception keeping pace with organic changes and technological progress.

In order to provide a definite answer to these questions we must analyse the role of the three components of the industrial complex.

Driving power:

Of major importance to an organic industrial complex is efficiency, and economy of operation. To achieve efficient utilization of energy, factors peculiar to energy sources such as coal, petroleum and hydro-electric and atomic energy, must be considered; for example, the location of the energy source, supply, maintenance, costs and duration of output.

Mechanization and automation:

The importance of the factory in the industrial complex has elevated it from the level of a mere box-shaped enclosure to a vast technological and architectural struc-

Fig. 1. The Fiat automobile industrial centre, Turin, Italy. Firm lines of factory and workers' colony contrast with the landscape and the surrounding agglomerations.
ture. Wide-spanning construction, contemporary building materials with insulation properties, control of climate and illumination, desirable working conditions and systematic organization networks are paving the way toward efficient mass production, automation, and consequently, progress (Fig. 2). With mass production, not only is a disciplined working situation created, but the quantity of production is increased on such an economical basis to offer a higher quality for a lower price (Fig. 3).

Fig. 2. The production line in the Volkswagen factory in Wolfsburg, Germany, produced 5000 cars/day in 1962.

Human energy:
This component often has two extremes: rare and precious in some industrial regions; and in others super-
abundant and cheap. The preservation of human energy is very important, and it differs greatly from the other two components. In contrast to the planning for driving power and mechanization, the design for the human element is dependent on both aesthetic values such as nationality, social life, personal needs, age, sex etc., and material factors, for example geographical and topographical situation, climate, building materials and constructional means. The key to the solution is to provide the workers and their families with educational, recreational, health and social facilities; family growth and extension of the complex should not be overwhelmed by the factory expansion. Labour welfare should be permanently integrated with technology and environment.

Research:
The aim of this research is to provide a foundation for the design of the industrial complex. An analysis of the relation between manufacturing concentrations and human agglomerations in the past gives a background to this problem. How has this relation been influenced by the industrial revolution and the subsequent invention of machines? How had the problems created by industry and workers' housing been dealt with? Which approaches and solutions were carried out, and what has been their success? Outstanding contemporary industrial centres of different types will be analysed in terms of function, form and relation to the whole. Likewise, the different architectural and planning theories concerning industrial complexes will be introduced to show how far they can be applied in practice.
The skeleton of an industrial complex is composed of two integrated frames, work and residence. Each is joined to the other with communal services, while partially separated by green belts. These two frames are part of a dynamic change relating the process of work to the prosperity of man (Fig. 4).

Three new factors have arisen. The first is the growing might of the workers' unions, such as in the USA and England, which have achieved sound success in obtaining more rights – protection, insurance and guaranteed wages – for the workers. The most important result is the change of the worker's position in society from a passive to an active member.

Fig. 3. The steel works of Rheinhausen, Germany
The second factor is the onset of automation. Workers’ unions fight against automation, as they believe it is an enemy which will throw millions of them into unemployment. However, automation can only prevail in countries having a high standard of living. It does not lessen the number of workers needed, but raises the standard of qualifications required in the workers. A new class of well-prepared, well-trained and highly qualified techni-

cians will become necessary for control, maintenance and research, leaving the heavy duty for the machines (Figs. 5, 6). The third factor is the increasing use of atomic energy as an unlimited source of power which is independent of environment, of raw materials and, when combined with automation, of human energy (Fig. 7).
From the standpoint of these three factors and the influences previously mentioned the position of the worker and his housing is to be considered. The house of the industrial worker should be equipped with all comforts of the up-to-date life; but it should also be his own private castle. His house should be near the factory, but he should not feel that his time at home is a prolongation of his time with the machines. The workers' colony should include all possible urban facilities, but without the chaos of the city. There should be green areas and efficient public utilities but at the same time protection against external disturbances. It should be able to assimilate the many personality types and avoid monotony.

Material collection and visits:

It has been a difficult job to collect the fundamental theoretical material as well as the practical information for this research. In the end, it had grown to such a value and volume that much effort has been expended to select the representative examples. Visits and personal contacts in the industrial centres in Italy, Switzerland, Germany, Denmark, Holland, England, Austria and Egypt were made. Even the prepared programs and questions did not make the meetings with the responsible persons a routine. In each industrial centre new conceptions, problems and solutions arose. It became clear that, although industrial experience and engineering practice have extended all over the world in the same form, yet the local planning procedures, regional differences of climate, topography, raw materials, culture and religion led to independent characteristics in each of the centres considered. Other factors were the beginnings of industry, its development, the nature of production and operational efficiency. The problems of the old and the new centres were different. The former suffered from slums, traffic congestion, lack of expansion and haphazard growth. Meanwhile, the latter have benefited from these experiences, but they now have other problems created by new social responsibilities, industrialization, technical inventions, organizational systems, administrative techniques and mass transportation and communication. Workers' housing has been turned from the mere provision of shelter to a social duty.

This theme concerns the design of the industrial complex, with the worker's home as its core. What is the general programme? How should this house be planned and financed? What special characteristics will it have? A specific part of the theme will deal with the case of the Egyptian industrial worker. This case will be examined in the light of the different experiences of this study. The industrialization of the Egyptian region will be considered with respect to analysis of the different types of industrial centres and the important characteristics of each.

Conclusion

As a conclusion of this study, a theory was evolved concerning the composition of the industrial structure of the Egyptian region in the UAR. This theory divides Egypt into seven industrial subdivisions each being independent and having its own characteristics. Each sub-division has its own frame of geographical factors, climatic conditions, availability of building materials and construction efficiencies, degree and type of industrialization, kind of energy and aspects of local social life. Suggestions and recommendations have been introduced for the improvement, development and expansion of industry and industrial centres. This theory paves a way towards detailed investigations. It is suggested here that an executive organization consisting of experts and experienced personnel should conduct work based on this theory.
PART I

History of the Relation between Agglomerations of Man and Collective Production
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History of the Relation between Agglomerations of Man and Collective Production

Introduction
Since long ago gatherings of men have taken either organic or geometric form. Wherever collective production of a certain craft took place, a pattern of work and storage and commercial centres were established. The very primitive type of the collective working societies is symbolically represented by the working societies of insects, namely bees and ants.

Bees and ants
The former represent a disciplined society of pyramidal structure and a very industrious manufacturing population. The location of home and work is geometrically concentrated and located near the raw material needed for production (Fig. 8).

Fig. 8. The bees' colony represents the disciplined organised society, living in a geometrical patterned structure. (E 4)

The latter emphasises the food-gathering society, a disciplined but more democratic structure, having organic linear settlements with a storage system, and two distinct dimensional expansion possibilities (Fig. 9).

Fig. 9. The ant colony is an organic structure organised to fulfil specific needs of the society, storage, sleeping, and egg keeping. Further expansion possibilities afforded.

The previously mentioned analytical comparison between bees and ants leads to a similar one between the different prehistoric conceptions.

Analyses of the prehistoric conceptions
For thousands of years, the agglomerations of man have always been dependent upon the following possibilities:
1. Means of energy
2. Resources of raw materials
3. Culture and religion

An analysis of the previously mentioned 3 points during the prehistoric periods will clarify the factors which created the different types of settlements.

Energy
Man-power and fire were the means of energy during the prehistoric epochs. Both allowed the man to house and settle himself wherever he found food and shelter.

Raw materials and products
Raw materials consisted of plants, stones, animal skins, wood and later iron and some other metals. Products were only for private use or for exchange.

Culture and religion
Man's cultural state was experimental. Religion was characterised by the respect of nature and its mysteries. In conclusion, the family and tribe relationships with production and manufacture, collective merchandising with the other settlements or tribes, defence purposes and religious duties differentiated the settlements into organic and geometric ones, as the following examples will show.

The prehistoric conception
The first clear comparative example was the Glastonbury settlements in England, with organic composition and small units. The leader's house was the core of the whole and the houses of the family heads were the centres of the small groups (Fig. 10).

Fig.10. Glastonbury: organic structure agglomeration in England.(PI 29)

The second example was the Castellazo di pontanellato, which was of geometric pattern with the orientation of streets as the main planning factor. (Fig. 11).
Classification of conceptions

During the prehistoric epochs man had gathered himself into tribes and settlements, both in dynamic moving groups carrying their products and goods from place to place or seeking new fertile land, and in stable passive groups settling in their place and defending it. These dynamic and passive groups can be classified into the following categories:

Dynamic:
1. Ship dwellers (Fig. 12).
   Burma, Scandinavia, Egypt, Japan, and Australia.
2. Wagon dwellers 'gypsies' (Fig. 13).
   Asia, Middle Europe and South America.
3. Tent dwellers (Fig. 14).
   Arabian deserts, Egypt, Russia, China, Iran, and the Americas.

The first two types were food-gathering societies. The third was agricultural, hunting and trade society. All were mobile groups:

Passive:
4. Cave settlements in natural or artificial caves (Fig. 15).
   Ararat in Turkey, Tibet, China and Moukattam in Egypt.
5. Hut settlements of stone or plants (Fig. 16).
6. Lake dwellers (Fig. 17).
   Switzerland. Lake of Zurich.
7. Water dwellers (Fig. 18).
   England and Egypt.

These are productive settlements, producing agricultural and animal products, clothes, leather, stone and metal tools, weapons and shields. Some settlements were purely productive-defensive (Fig. 19), while others were trans-commercial (Fig. 20). Corresponding examples of the primitive societies of today are the nomad tribes of the Middle East, Spain and South America, as well as African hut settlements and the ship dwellers of Burma and Indonesia.
Conclusion

The environment reflects itself upon man and his behaviour in establishing his settlements. Man also influences his environment by the activities he practises and the needs he should fulfill. The more simple the society, the less complications and problems it has. Man's environment can be mainly characterized by energy, materials and social structure. The dwelling offered man in the past shelter to sleep and storage facilities. Grouping of dwellings provided security, cooperation and social life.

The Ancient Egyptian conception

The valley of the Nile had developed a high stage of civilization thousands of years before the people of the west had dreamed of the possibilities of a fork or a wheel or a house. Hendrik Willem van Loon

Energy

The Egyptians possessed new means of energy, discovered organization and concentration of man-power, and a factory system. Tamed horses, donkeys and oxen were used for transportation. The Egyptians used the wheel and lever to carry heavy loads and transport people for long distances.

Materials and products

Discovery of many new fabrics and metals led to a flourishing manufacture of leather products (Fig. 21).

![Fig 21. The Egyptian leather industry. Chariot wheel covers, sandals, shoes, saddles, book and document covers, dog collars, gloves, whips, and tents. (A 22)](image)

Energy of wine, clothes, glass, furniture, bread, paper, honey sweets, sugar, chemicals, paints, lamps, candles, war weapons, chariots, tents, sails, and ships (Fig. 22) as well as the processes of weaving, spinning, washing, bleaching and dyeing.

Progress brought not only the foundation of new industry and manufacturing, but also the organisation of the factories employing hundreds of workers and the provision of their food, working time and housing. Standardization, specification and control of production were characteristics of that time.

Culture and religion

The belief in a second life and the pyramidal social structure, with the king and priests at the top, was the mould of the society. The artistic tendencies of the common people lead to a rise of the building industry, mainly in the field of temple, pyramid and palace construction. The housing of the workers and technicians engaged in these jobs was mostly pre-planned. Some industries had their own quarters in the cities, with their workers living nearby.

Characteristics of the Egyptian workers' colonies

Principles of design

The Egyptian workers' colonies which were mainly for those of the building industry, were located near the different projects. General design principles were based on disciplined planning with the aim of housing the workers where they could be easily controlled or assembled at any time. The colony was separated from the surroundings by a thick high wall with controlled entrances, an excellent example is that of the workers communal city of Khent Khaos of 2900 B.C. (Fig. 23).

![Fig 23. Perspective showing the shaded streets and the composition of 'Khent Khaos.'](image)
Zoning

The different sections of the colony were zoned in terms of the social structure (Fig. 24). In the worker city of Tal-El-Amarna, 1375-1358 B.C. (Fig. 25), Egyptian workers' and technicians' houses occupied the northern and eastern parts. The slave workers, who were in reality war prisoners, were housed in the western part facing the hot western wind. The chief of the workers had his house in the corner of the colony, thus controlling the entrance.

The same zoning is clear in the Illahun worker city 2100-1700 B.C. (Fig. 26). The king's residence and the Acropolis were in the North, the rich in the East, the Egyptian workers lived in the centre and the slave workers in the West. The slave zones in all three cases were connected to the market place and public activities.
Perspective of Illahun.

Zoning structure of Illahun in social terms. The same as in the later mentioned contemporary examples of Italy, Egypt, Finland, and USA.

Street pattern

In all cases, the Egyptian street planning represented geometrical order and discipline (Fig. 27). In the Khent Khaos colony the main double lanes with a wall in between. In Illahun two main perpendicular streets went through the main sector of the city. In the slaves' sector, another backbone street went through the whole quarter with secondary lanes branching right and left. The Tal-El-Amarna colony had both ring road and connecting streets. The orientation of main streets was always East-West to give northern orientation to one side of the houses and shadow on the other side. The subsidiary streets ran North-South to allow the cool northern wind to flow through. In Khent Khaos the streets were shaded with palm tree logs. Main streets led to the centre or to the market.

Streets covered with palm tree logs throw shadow and protect pedestrians.

Khent Khaos: One double lane main road with a central place.

Architectural composition

Concentrated bulks of buildings were always characteristic of the pattern. Climatic and economical conditions led to the use of one storey row houses with a clerestorey and passage streets in between.
Public buildings

The Acropolis, market place with its sheds, animal pens and water fountains, pigeon lofts, and the king's palace or residence were the main elements. Because of the nature of religious beliefs, most of the public activities—music, dancing, singing, sports, political meetings or military ceremonies—were held in the temple.

The worker's house

The built area occupied about 70% to 85% of the total area of the city or colony. Gross population density was about 455 persons/ha. Nett population density was about 550 persons/ha, in the city. But these numbers rose to 840 persons/ha and 1110 persons/ha in the slaves' quarters. The worker's house occupied about 40 m² of one floor built area.

The plan related to the social life (Fig. 28). Living room with kitchen and entrance in the north front as the core of the house, with a clerestory to allow cool wind in the low class houses or with a patio of front in the better ones. Bedrooms were always behind, of maximum privacy, small enough to allow each member of the family to sleep alone.

After the revolution of Akhnaton, and the rights given to the women in equality with men, the plan changed to include bigger bedrooms to allow the wife to share her husband's room. Living room about 18 m² and bedrooms about 8 m².

Mud bricks and burnt bricks were the main construction materials for the domestic buildings (Fig. 29a, b). Durable materials were only used for religious buildings to reflect the belief in eternity.
Conclusion

The ancient Egyptian technical standards and development, as well as the housing policy and planning, were parallel to the standards of social life and religious conceptions. The workers' colonies assumed equal importance in the projects in order to house the workers and fulfill their private and public needs. The leading factor of design was religion, climate and raw materials. This was reflected in the types of houses used, the general architectural composition and the street pattern. Social status influenced the zoning of the colony and the plan of the house.

Other historical conceptions up till the middle ages

The advancing ages have witnessed many different types of workers' housing:
1. concentrated workers housing in special colonies;
2. specialized city quarters, which included both workshops and worker's dwellings of the same profession;
3. scattered workers' housing mixed with the rest of the population.

Mexico

In Los Fricholis, Mexico, a six-storey circular unit contained the town's population, stores, workshops, warehouses, recreational and religious facilities in the centre of this one big communal cell (Fig. 30). Defence was the determining factor. Collective mass production was sold or exchanged with neighbouring settlements. An example of concentrated mixed integration of work, production and home with vertical extension possibilities. 

The same conception for concentration of economic and defence purposes is represented today in the agricultural-industrial colony of Beer Sabâ 1950 (Fig. 159). Where factories are centrally located, facilities encircling it, with residential areas on the outer circumference. Dwellings have direct contact with the green periphery. Disadvantageous were future core extension possibilities, poor internal and lengthy external connections.

China

A new source of energy had been added to the energy of man and animal in China with the introduction of the water-mill from central Asia in A.D. 650.

The Chinese industries consisted of silk, paper, chemicals, leather, lamps, fish and building. In the case of some professions, the workers lived in the same quarters as they worked. Others lived in the homes of their masters, similar to the Greek system. Cities were multi-compounds inside each other (Fig. 31).

Japan

Opposite to the Chinese conception was the case of the Japanese, because of the minute scale of the Japanese house. Workers and peasants lived together around the houses of the Samurai, the professional soldiers. And all lived around the castle of the prince, the Daimyos. The freedom of the Japanese life led to the use of a free house design and to the absence of the city walls. All houses were of standardized dimensions (Fig. 32), which if their number were known would enable us to know the size of the city.

African conception

Magical and animistic forces are the framework within which African social and economical forms developed. The structure of the settlement is conditioned mainly by the ties of family, clan and tribe. E. A. Gutiind

The pyramidal social structure of the African tribes produced and still produces settlements concentrated towards the chief's house. The nobles are nearest to him. The women live in rear huts (Fig. 33). Man and animal energy and some simple tools limit the production, thus limiting the prosperity, population, and size of the settlement.
Fig 33 Primary needs and natural organic growth are clear in the African settlements. Social structure and local building materials shapes the houses and forms the composition (M 45, PI 24).

Cretan conception
By the establishment of the kingdom of King Minos, Crete took its clear shape. Man power was his energy for crafts, animals were for agriculture and wind was for shipping. Production of raw materials, metals, and agricultural products, as well as fishing was the work of the population.
The limitation of the site and the influence of the economic conditions upon the social structure produced an integration between the working class and the upper class. Workers houses, stores, warehouses and industry were all concentrated within the city walls. Harbour workers made up the main population (Fig. 34).

Fig 34. The integration between the working class and the other citizens produced mixed residential area in Crete. (PI 29)

Greek conception
To the Romans organization meant everything, while to the Greeks, instinctive empathy was the driving power of which their specific ‘realism’ developed. E. A. Gutkind

Energy
Means of energy was water power on the hill-sides and wind-mills on a small scale more than man and animal power. The invention of the screw by a Greek mathematician added to the power available for industries needing high pressures.

Production and industry
Pottery, ceramics, wool and clothes (Fig. 35) were the most important industries, other products were pigments and paints, olive oil, ropes, sandals for the rich and wooden soles for the poor, mirrors of metal sheets, lenses of glass, leather and leather tanning, weapons and agricultural industries.

Social structure
Freedom and democracy were the bases of the social structure. Slavery was considered as a life necessity. The cities were divided into small estates. Colonization was carried on as a solution to the population increase.
Workers' housing

Usually both the workers and the slaves lived with their masters with the noblemen. Some professions had their own independent quarters where both work and residence were together, as in the potters' quarter at Keramaikos.

An example of the Olynthus colony 430 B.C.-348 B.C. (Fig. 36) expresses the way of housing of the craftsmen, their workers and slaves. Geometric plan, streets were directed east-west, service lanes were planned between the backyards of the houses. The patio was in the house core, with all rooms opened on to it. No windows were on the street side. The most important room was the dining room (Fig. 37). Area of a seven-room house was about 280 m² including the patio.

Conclusion of the Greek conception

The position of the worker and the slave in the Greek society reflected democracy in the housing system. Workers, slaves, masters and nobles lived in the same quarter, and sometimes in the same house. The Greek house was to a great extent fully independent of all home produced needs. This included everything from bread baking and dressmaking, to the teaching of the children, weapon preparation and poetry writing. All the necessary personnel lived together. Political conditions mastered the life and housing of the workers.

The Roman conception

Energy

Large scale industries were established near the waterfalls with water mills to produce much power (Fig. 38). Some aqueducts had been built to transport water to far places and to generate hydraulic power, the aqueduct at Arles rotated the military flour factory, while in the Roman camp in Memphis, Egypt, 150 prisoners were employed to move the wheel of the aqueduct to carry water. Otherwise, horses, oxen, donkeys, slaves, and free workers were the normal power resources for industry.

Raw materials and industries

The flourishing industries in the Roman epoch produced leather, tents, shields, saddles, honey, glass mirrors, lamps, candles, textiles, wine, pigments, inks, colours, furniture and pottery (Fig. 39).
Products were exported to the colonies in exchange for food imports and luxuries. A typical colonisation policy prohibited industrial patents and factory licences for the colonies to keep them as mere sources of raw materials without industry.

Social structure
The industrial magnificence of Rome was created by its position as capital of the Roman Empire. The merchants and the craftsmen were the powerful class. Slavery was taken for granted.

Workers' housing
The city of Rome was overcrowded. The workers lived in the poorest districts. Lack of transportation facilities. High blocks of flats 6-8 storeys rose. Streets were hindered the rise of suburbs on the city peripheries, narrow to leave more area for building. Size of the individual apartment decreased, atrium houses had been replaced by high rents apartments. The workers were given the worst places (Fig. 40).
Lack of sewage and drainage systems resulted in bad sanitary conditions. Big numbers of eight to twelve workers lived in one room, as happened later at the time of the industrial revolution.

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Fig. 40. A Roman street showing an eight storey house. The workers and the slaves lived usually in attics or on the upper floors. Bad sanitary conditions. Normally the bath and WC were absent. (A 58)

Conclusion
The workers and slaves had been looked upon as masses of mobile energy and not as individual human beings as was the case in Greece. Therefore the workers were dismissed from the atrium houses to small apartments in the worst quarters in the 7th or 8th floors, where no sanitary care was given. Lack of horizontal extension facilities compelled Rome to grow vertically and to decrease the area of the streets. Manufacturing and export industries were of highest importance.

The conception of industry and worker in the Early Islam
Energy
The Islamic world utilized the camel, horse, donkey and ox. Water mills were invented and used in Baghdad in A.D. 790. The Moslems added improvements to the old world constructions and spread them over their Empire. In Syria there were 32 big water mills with wheels in the city of Hama alone. Floating mills were established in the cities lying on the Euphrates and Tigris rivers. Tidal mills were in Basrah on the Persian Gulf. The first real windmills spread to Afghanistan where they worked by the northern wind (Fig. 41).

The Islamic design spread to Holland, then was introduced in France, Morocco and Spain to the west, and into Russia, Persia, Scandinavia and Germany to the north and east. The main difference between the western and eastern models was the direction of the axis of motion with respect to the wind. The axis was parallel to the wind direction in the former and perpendicular in the latter.

Raw materials and industries
The spread of the Islamic Empire produced a variety of industries which had never been known before in Arabia. Moreover, an exchange of technical knowledge, and technicians raised the standard of production. Wool industry, silk, tapestry, carpets, mats, weapons, jewellery, paints, pearls, leather products, glass, lenses and spectacles fishing and ship building. Clocks and spectacles were exported to Europe.

Social structure
In the beginning of Islam, the equality of all the people lead to a uniform horizontal standard of building and an integrated city zoning. In the later periods after the segregation of the different classes, some rich quarters were created in Cairo, Baghdad and Damascus. Privacy, separation of women, internal courts, gardens, baths and stores remained unchanged. The concentration of the building of the Islamic city in one bulk with narrow streets was alleviated by the insertion of Mosques in between. The big areas of the Mosques, their courtyards and the places in front of them served as recreational areas for sport, learning and political meetings. They were the breathing organ of the city.

The workers' housing
In Islam the workers' housing was dependent on the working systems. Industry had its specialized quarters in the town centres. The workers did not live in the same place of work. Living quarters and the workers' houses facing inner courts were approached through secondary lanes and were directed internally. Streets had no systematic pattern, but they were with dead-ends. The Sahn of the Mosque served as the quarter's square. Workers' houses were categorized. Masters and craftsmen lived in proportionally large houses. The lower class workers lived either in small houses, or in family groups together in one big house, each with a room for himself and his family, or sometimes with their masters (Fig. 42, 43).
Conclusion

The flourishing Islamic period led to the creation of complete industrial districts for certain types of industry, such as the weapons quarter, the saddle, the copper, the weaving and spinning industries in Cairo and other big Islamic towns. These quarters were called 'Suk' or market, as the products were manufactured and sold in the same place. Religious considerations, privacy and the hot climate, all led to the separation of living quarters from working places. They also created small streets of no pattern, dead ends, street and quarter gates, and the courtyard onto which all the windows looked. The women lived in upper floors for privacy.

The working system which was similar to that of the Guild System of the Middle Ages, classified the workers into three categories: the master of the profession, called Osta or Ostaz (teacher), the worker, and the Saby (boy). The chief of masters examined the boys who finished their apprenticeship, controlled the quality of the products of his quarter, fixed the salaries and prices, and solved the working problems. This system led to the housing of the boys in their masters' homes, where they could help their masters not only in the work but also in the household. The masters and craftsmen were rich enough to afford comfortable houses equipped with all necessities (Fig. 44).

Industry and workers' housing in the Middle Ages

Energy

In the Middle Ages in Europe, industry began to profit from the improved means of power such as water and wind mills independently of man power. Water mills were established from the time of the Roman Empire up till 1850 when they were replaced by the steam engine. Floating mills which were invented in 537 in Rome, were also used in Venice, Paris, London and Orleans. Windmills built in 1222 on the Medieval city walls, became a common feature in 1430. In the 14th Century windmills were used for turning flour mills as well as for drainage purposes (Fig. 45).

Raw materials and industries

In the Middle Ages, new industrial patterns were introduced from the Orient. Mining (Fig. 46), spinning and tapestry industries developed. Olive oil extracts, wine, beer, mirrors, pottery (Fig. 47), glass (Fig. 48), iron and metals were produced as well as door, window, horse, carriage and military accessories.

Fig. 42. A plan of Cairo in A.D. 1800

Fig. 43. A diagrammatic sketch showing the distribution of handicrafts, and commercial and residential areas.

Fig. 44. A typical house plan in the early Islamic periods in Cairo.

Fig. 45. The means of energy in the Middle Ages. Water, floating, and wind mills. (17,18)
Social structure

The change of the social structure in the Middle Ages into independent small units, each of a private political, social, and cultural conception led to the decline of the central authority, and absence of control and interests in the public services. Centres of industry and production moved wherever power, raw materials and hand-workers existed.

The handworkers and craftsmen were free to produce the quality and quantity they liked, to change their place of work and to fluctuate their prices, even if the resulting competition prevented them from making any profit. There were no working specifications.

Fig. 46. Mining and quarries of the middle ages. (I 7)

After the Crusades, the lords who had borrowed money from their people for the war expenses had to give their cities their freedom for the debt which they could not repay. Other cities got their freedom by war, others by buying it. Citizenship and freedom were given to serfs who fled from their lords. Population increased and defensive walls were built. Craftsmen and workers dominated city population. An elected mayor and his officials controlled the town administration. Guild systems were established to organize the different industrial regulations and specifications.

The Guild system

Established as associations for the workers of the same profession. Elected officers for each guild were responsible for the rules organizing wages, working hours and number of workers in each workshop. Measures and specifications for each industry and craft were laid down. Certain requirements had to be met by anyone desiring admittance to a trade before he was allowed to be an independent member.

First the applicant joined the profession as an apprentice 'boy' as in the Islamic system, without payment, but re-

Fig. 47. Pottery factory in the middle ages. (I 8)

Fig. 48. Glass factory in the middle ages.

Fig. 49. A graphic representation of the vertical zoning of work and residential places in the Medieval town. A sort of real zones integration.
1 Lodge of the apprentices, workers and sometimes for storage.
2 Residence of the master.
3 Workshops, stores, or residence of the master and owner of the house.
4 Workshops.
ceiving board and lodging and experience in the field he wished to enter. After seven years, the boy became a journeyman, or a 'workman' still working for a master workman but receiving wage. When his skill increased enough, he took only his masterpiece to be examined by the Guild masters. The factors allowing him to be admitted to establish his own workshop as a master were the quality of his work, honesty, good personality, and the need of the city for one more workshop. The boy usually married the daughter of his master, inherited his workshop and carried on.

The workers' housing

The system of work and the size of the Middle Age city, did not allow the rise of specialized industrial districts. Workshops and living places were integrated. Usually the workshop occupied the ground floor with the stores behind it, and sometimes the second floor too. The master lived on the third floor and owned the house. The workers and the apprentices lived in the attic or in the workshop, where they received board and lodging. The city had been zoned in vertical sections (Fig. 49). The house itself was small and had no corridors, its small rooms were arranged successively behind each other. Small windows, one entrance for the workshop and the dwelling. Internal stairs went direct from the inside of the workshop to the upper floor (Fig. 50). Streets were narrow, dark, muddy, no sidewalks, no lights except on bridges. No garbage, and the water wells mingled with the city sewage.

The cities were situated at a distance from each other to be covered by foot in half a day. Areas of cities were about 125 acres for the big ones and 10 to 15 acres for the small (Fig. 51).

Fig. 50. Plan of a Middle Age house: showing vertical connection between the working place and dwelling, and unity of house.

Conclusion

The growth of the industrial and trade guilds in the cities of the Middle Ages allowed the craftsmen and workers to take command from the Lords and dominate the city life.

Specifications for working standards, procedures, wages, working hours, and number of workers were organized for better production and working conditions. The limitation of the cities by their walls led to concentrations of crowded houses and to vertical growth. Freedom of life and the small scale, prevented the rise of specialised quarters.

The master and his workers and apprentices lived all in the same house. Work and living places were integrated. As the population was mixed, no workers' housing problem arose during that epoch.

Fig. 51. Walking distances, defence conditions and economy determined the form and size of the Middle Age towns.
The Industrial Revolution

Early movements

Man has always tried to improve his environment. Ikhnaton, the King of Egypt in the 18th Dynasty and the first reformer in history, led a social, political, religious and economical revolution. He turned upside down the known symbols and conceptions of life. Unity of God, democracy in political life and equality of rights between men and women were the principles of his philosophical call towards a new life and social progress. The organic design of the workers city of Tal-El-Amarna was a product of his revolution. Everything in the plan of the city, its integrated zoning, its composition, the plans and details of the houses and even the distribution and size of the bedrooms, all reflected his philosophy.

Since then many changes have taken place. But the most fascinating changes have occurred in the last 260 years, and are still occurring at an ever increasing acceleration.

Pre-industrialization

Just before the beginning of the industrial revolution, manufacture of materials into finished products had been done by hand all over the world by craftsmen and their skilled workers. Their production included leather products, fine silks, metal products, furniture, glass, fine clothes and fabrics.

But the less fine clothes and the garments of the well-to-do people were woven at home, especially in the countryside where every house contained a spinning wheel and a loom as part of the household. Without any commercial intentions girls had to learn to operate them in preparation for marriage.

The domestic system

At that time the domestic system appeared. Merchants took risks and bargained with the women and girls, provided them with the raw wool and flax fibre and paid them per square yard. In turn, women spun and wove the cloth. Every woman was happy to add profit to her husband's income without any obligation of working time or place. Older girls aided their mothers in the work, while the younger children were looked after during short interruptions. Contractors could sell the products at prices assuring good profits without much personal effort (Fig. 52). The result was serious; many men left the farm and joined their wives in the new profitable work.

People lived in their own homes. Work came to them.
Rise of the factory system

The domestic system was brought to an end by the inventions which appeared in the 18th century. The spinning jenny, water frame and automatic jenny had increased the production. The greatest influence happened after the invention of the steam engine which was successfully employed to run spinning and weaving machines. Accuracy and efficiency of the invented machines left no chance for handwork to compete with them in either quality or quantity.

Thus, the domestic system came to an end. Machinery was expensive, large, needed shelter and required maintenance which could be afforded only by men with capital (Fig. 53a, b, c). Big factories and the class of industrialists appeared.

Fig. 53b. French textile factory in 1787 with the workers’ houses in the vicinity. (I 11)

Fig. 53c. ‘Das Eisenwalzwerk’ Adolf Menzel. (I 16)

Fig. 54. The industrial worker. A new term arrived with the appearance of the machine. A new class of human beings appeared to suffer health, social, and moral diseases. In return had to work from sunrise to sunset. (I 2)

Men and women left their homes for the factory. They had enough work for the whole day, and had no longer to farm (Fig. 54).

That gave rise to the class of industrial workers. The free time left for the industrial workers was scarcely enough for rest and sleep. They thus had to live near the factory (Fig. 55).

The housing problem of the industrial workers became serious.

The worst result was the domination of industry over its surroundings. People had to join the factories or starve; the only defence of agriculture against industry was to rationalize farming, and to concentrate the small estates into big farms.

Workers’ housing at the beginning of the industrial revolution

With the appearance of the factory system, large factories were built to accommodate the machines and workers under shelter. Spinning and weaving at home vanished. Other home industries such as shoe-making, candle moulding and the knitting of clothes were subsequently affected. The individual worker could no longer produce an entire article. He had to run a single machine which performed a single operation. The advantage of mechanization was the great increase in efficiency, quantity and quality, and the disadvantage was the monotony which did away with the pride of individual workmanship. Society was divided into two main classes, the capitalists, who supplied money, and the workers, who did the actual work.

The capitalists considered only their own profits. Logically, workers housing was outside their plans. Under the need to live near the work, slums began to rise. The industrial atmosphere changed into bad living status, worse working conditions, low wages, long working hours, carelessness and absence of social and health services.

Philosophy of housing the workers

In many industrial complexes and centres, where a great number of workers existed; the problem of housing them was considered by the industrialists as a mere commercial necessity. The solution had been always based on how to gather the greatest number of the workers in the vicinity of the factory more than to solve the human question of how to offer the worker and his family satisfaction of their needs, comfort and security (Fig. 56).

Some examples of the period:

Spain

In Madrid an eight storey cell of 277 apartments (Fig. 57), accommodating 1500 industrial workers and their families gives us an example of the severity of the situation: No
Fig. 56. Philosophy of industrial housing. Financial profit was the focal aim.

Fig. 57. The eight storey workers housing project in Madrid (A 50)

direct illumination, no proper ventilation, lack of sunshine, rooms looked onto badly proportioned courtyards. Baths, WCs and convenient sanitary facilities were lacking. The area of a three room flat was about 30 m², allowing 6 m²/person. The population density was 6000 persons/ha. In Madrid were always a source of filth, crudity, dirt and moral degeneration.

Austria

After the introduction of industry in Austria, the industrial workers had concentrated in the cities so quickly that in a few years the prices of building lots increased 50 times. The 'Zinshaus' and 'Zinskaserne' were two titles used in Vienna for hired houses of very high rents. In the typical example in Fig. 58, many rooms had no direct illumination, no sun and the baths and WCs
were communal for many apartments. Living rooms were entered from the kitchen.

The area of a one-room apartment 27 m²
The area of a two-room apartment 42 m²
The area of a three-room apartment 56 m²

Population density 1000 persons/ha.

Holland and Belgium

In sharp contrast to the concentrated blocks of flats in other countries rows of two storey houses were established for the industrial workers.

Every house had a small court and a useful small garden, more care was paid to family needs. The general composition of the houses together provided both freedom and privacy with a feeling of unity. Each house consisted of two storeys each of about 28 m². Footpaths and lanes connected the houses together (Fig. 59).

Germany: The Ruhr

The heavy industrialized Ruhr region in Germany, gave birth to the first seriously established large-scale industrial complexes and their workers' colonies. Many workers' housing organizations had been established with Krupp works as the main partner.

One of the most important duties before the start of the building projects was the drainage of the swamps and underground water which covered large areas in the region (Fig. 60, 61).

Fig. 60. The «Katernberger Bach» before industrial organization. (PI 35)

Fig. 61. The «Katernberger Bach» after industrial organization. (Pl35)

Colony and industry

The whole region of the Ruhr is densely industrial (Fig. 62). Colonies covered most of the area uniformly. The railways were the main transportation facility. The industrial colonies were located on one side of the railway line with expansion possibilities in three directions (Fig. 63).

Fig. 62. The Krupp heavy industrial centre in the Ruhr region. Factories and workers houses are in one composition. (Pl35)
Design of the colony

The colony design followed a rigid geometrical composition. Buildings were set away behind the street and had entrance and back gardens. Although the buildings were in rows, a closing border around the colony, composed of a continuous row of houses was attempted. Semi-detached houses came in the middle and big green park spaces occupied the centre of the colony bringing the spirit of the country into its heart (Fig. 64, 65).

Buildings, greens and streets

The design of the colonies suffered many changes into informal composition and the loss of the axis and symmetry did not mean losing green, out frontal gardens become smaller and back gardens bigger. The main green area was the total of back gardens, bounded by the line created by the shift of the building line towards the street side. In many colonies, another big common green park had been provided in which the design and curves had been introduced to close the sight and give continuation and variable depth vistas to the perspective (Fig. 66). The internal design of street systems and traffic conceptions were according to the ideas of the time. In most cases no sidewalks and no garages were provided owing to the absence or to the low mobile traffic density (Fig. 67).

New elements in the Ruhr colony

For the first time the industrial colony developments realized the need of more than mere dwellings. Hospitals, schools, 'Kindergartens' (Fig. 68), home for the aged
Fig. 68. Kindergarten. (PI 27)

Fig. 69. A home for the aged. (PI 27)

Fig. 70. The market in a Krupp industrial colony. (PI 27)

The house of the industrial worker

The main characteristic of the house design in the Ruhr industrial colonies was the attempt at variety of plans. Two-storey houses composing a court in between, calm domestic atmosphere (Fig. 71), two-storey houses with a separate outside stair (Fig. 72), two-storey one-family houses with direct entrances from the street creating a sort of town atmosphere (Fig. 73), and big two-storey houses for one or two families of higher income were attempted (Fig. 74). Apartment houses of three, four and five storeys were also built for the workers (Fig. 75).

Most of the construction was in brick, stone, and timber, creating an intimate interior (Fig. 76).
Fig. 74. Two-storey houses for higher income workers and technicians. (Pl 27)

Fig. 75. Apartment houses for the industrial workers. Although more green area and a nice perspective through curvature are achieved, an atmosphere of a city wall is created from the continuity of the massive blocks. (Pl 27)

Fig. 76. An interior in the hall «Diele» of a worker’s house in the Altenhof industrial colony. (Pl 27)

**Apartments**

Most of the apartments consisted of three, four and five rooms of an area of 65 m² for the three rooms, and from 75 m² to 95 m² for the four and five rooms (Fig. 77). A staircase served two apartments and opened to the kitchen or to the living room. The sitting place, dinning corner and the fireplace were the main elements of the living room, ‘die gute Stube’ (Fig. 78). A balcony ‘Laube’ was always a main element, directly approached from

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**Fig. 77. Plans of 4, 5 room houses in Krupp housing projects. (Pl 27)**

1 Balcony
2 Livingroom
3 Bedroom
4 Kitchen
Fig. 78. Combined staircase for two apartments. Leading to the kitchen. The closet had been simply cut out from the kitchen area. The concentration of water installations was an economical purpose. The washing place was either in the bedroom or in the kitchen (Fig. 79).

Varieties of plans were achieved by inserting the staircase between the two kitchens to provide more area for the bedrooms, although the cost of sanitary installations had increased. Another variant was the division of larger rooms into two small bedrooms (Fig. 80).

4 persons had been considered for the 3 room apartment.
6 persons for the 4 room apartment.
8 persons for the 5 room apartment.

Various designs of one-family, semi-detached, and row houses were afforded. An internal stair connected the entrance directly with the second floor. The kitchen and WC were approached from the entrance and the back-yard. The ground floor consisted of a living-dining room connected with the kitchen and the parents' bedroom. Upstairs were 3 bedrooms for 5 persons (Fig. 81). In some cases, an internal stair connected the entrance directly with the second floor.
cases the bathtub was found in the kitchen. New elements such as workshop, store, cellar, pigs pin and wood bin appeared downstairs. These elements had been situated either in the backyard (Fig. 82) or on the sides of the houses (Fig. 83).

![Fig. 82. A semi-detached house with a backyard. (Pl. 27)](image)

![Fig. 83. A semi-detached house with auxiliary elements on the. (Pl. 27)](image)

1 Balcony 2 Livingroom 3 Bedroom 4 Kitchen

USA

The volume and the rate at which industry spread in the USA had been so great that whole new cities were created upon the growth of industry.

One of the industrial centre patterns attempted is that of Lawrence, Massachusetts, 1930, composed of factories 3 or 4 storeys high, sided by administration buildings, the housing quarters followed in sections for the supervisors and workers. The next zone was for the dormito-

![Fig. 84. Lawrence, Massachusetts in 1930. Factories with three to four storeys. Supervisors' and workers' houses bordered the industrial zone. Followed by one family houses.](image)

ries of the single workers and groups of the one-family houses for families with several children (Fig. 84).

Directors and merchants had their own expensive houses of Greek architectural style.

Female workers had their own club and separate store.

Another aspect of the industrial housing in the USA was the groups of gray wooden houses from 50 to 100 units each, mostly in western Pennsylvania. All the units were alike. Toilets on the outside. Treeless streets (Fig. 85).

Up till 1933 these ugly industrial colonies were ruled by the coal and iron mines police. No outsider dared to enter except the doctor and the undertaker.

The first industrial town especially designed by an architect for this purpose was Pullman, Illinois (Fig. 86). All houses built of brick and stones. Parks, a town hall and porticoed square were provided.

Further developments followed in Tyrone, New Mexico (Fig. 87). The architect provided a plaza with the railroad station. Office buildings, stores, movie theatres, churches, and hotels were built. The principal buildings of Spanish Baroque were joined together with arcades to give unity to the design and to shade the citizens.

The first industrial workers' apartment house in New York was the Philanthropy built in 1855 (Fig. 88), at a cost of $60,000. Monthly rents ranged from $5.50 to $8.50/apartment. Claimed to be the first ever multiple dwelling house in the USA having WC for each family.

![Fig. 85. Western Pennsylvania. Ugly industrial colonies of the coal and iron mines workers with groups of 50 to 100 units each.](image)

![Fig. 86. Pullman, Illinois, the first industrial town in USA.](image)

![Fig. 87. Tyrone, New Mexico. An industrial city with a real core including office buildings, stores, movie theatres, churches, railway stations, and hotels.](image)
England

Industry invaded the existing English towns and their peripheries. The factories attracted the workers like magnets to the area around it, producing slums. By law houses were built in long parallel rows attached to each other having the same size, area, light, rear court and installations. Monotony, over-population, unhealthy atmosphere, dull appearance and the loss of the worker’s individuality were disadvantages counterweighting the advantages of unity, economy of construction, good thermal insulation and the absence of humidity (Fig. 89).

France

No human considerations had been given to the workers’ housing, as in the mining region in the North of France (Fig. 90). The workers were often merely lodged within the factory buildings. Confusion and unhealthy working, living atmosphere and disturbed growth and expansion resulted.

Egypt

1816 saw the beginning of an industrial plan in Egypt. Industry had arisen mainly in Cairo, Alexandria and the Delta Region. One of the existing examples of the industrial colonies of the workers and employees is that of the old Delta barrages, now linked with the new colony of the new Delta barrages. Up until 1956 the workers’ colonies in Egypt had mostly been near the Nile barrages and built by the irrigation departments of the Ministry of public works, dams and electric power stations. Other colonies belonged to textile companies which could build them.

The colonies were designed in a decorative carpet pattern and the types of houses were usually a copy of the old existing ones. Other important elements like shopping centres, medical and social services, recreation activities and schools were almost entirely lacking (Fig. 91). More importance was given to other elements like the rest-houses for the inspectors, the colony wall and the guards’ observation rooms. More interest was paid to the richness of building materials and decorations than to the house design and the practical function of its elements (Fig. 92). Good heat isolation was achieved by thick wall construction. But roofs were badly insulated. Unfortunately, European house design was usually adopted with no consideration to climatic and social differences (Fig. 93).
Fig. 92. The residence of a high official or an engineer in the Delta barrages colony near Cairo. Richness of the facades and finish dominates function. The contrast with the workers and supervisors houses is apparent.

Fig. 93. Brick facing, marble steps, toothed parapets, are all elements used in the engineers' types of houses in the Delta barrages colony.

ties. This always created an economical unity between the colony and its surroundings, but a deep social split spoiled the human relations between the colony dwellers and the surrounding inhabitants.

Zoning

The Egyptian colony was zoned with regard to professional status. Directors, engineers, supervisors and workers were housed each in separate sections. The married and the single were always separated.

Street pattern

Streets had geometric checker-board pattern with a ring road encircling the whole colony.

Architectural composition

The composition of the buildings was usually after a checker-board pattern following the street pattern. Each house was located in the middle of a lot. Private gardens were spoiled by the false central location of the houses. The mosque was usually the focal point of the colony as was sometimes the water tower. Space conceptions were lacking. Grouping of houses and creation of form were not taken into consideration. Often the European plans were adopted.

House design

One-family houses were built for directors and engineers. They had four to eight rooms, each 15 to 20 m², kitchen 6 to 12 m², a service room about 6 m², one or two bathrooms and WCs and terraces in every direction. A big hall of about 20-30 m² served as a living and dining room (Fig. 94).

All or most of the rooms were orientated towards the north. Stone and burnt bricks were used for walls, reinforced concrete for roofs, and plaster for the inner and outer walls. Facing bricks were often used in the facades before the World War II. Wooden floors and tiles were used. Bathrooms were equipped with good sanitary installations including wash basin, WC, bathtub, and bidet.

Fig. 94. The hall as the central core of the house. All the rooms open directly into the hall. The kitchen has a second entrance to the garden. The house elements are: 1. Hall; 2. Study room; 3. Salon room 'Only for guests'; 4. Dining room; 5. WC; 6. Kitchen; 7. Service room; 8. Bedrooms; 9. Bathroom; 10. Service room or maid's room. The plinth is in limestone, the facades of red burnt facing bricks. Stairs are in marble, room floors in parquet on the ground floor and Swedish timber on the first floor. Balcony, kitchen, and bathroom floors are on tile. The house is situated in the middle of a garden and footpaths are sprinkled with red and yellow sand. The toothed parapet was designed to resemble the old barrages style.
Fig. 95b. A supervisor's house in the Delta barrages, Egypt. Formerly one single big house, it has now been divided into two new independent units. Sanitary installations have been provided. Climatic conditions are considered by the use of arches and thick walls to provide thermal protection against the heat.

Fig. 96b. Workers' houses in the Delta colony. Limestone walls, bricks, arched entrances, corniced parapets, and white plaster facades. Interesting element is the garden fence, which is made only for the privacy and not for security as in Olivetti, Ivrea.
Semi-detached (Fig. 95a, b) and row-houses (Fig. 96a, b) were built for the supervisors and workers. Three to five rooms of about 10–12 m², small kitchen 5 m², bath, hall 12 m² and terraces. The orientation of the buildings as well as the materials, although in lower quality are the same like the houses of the engineers previously mentioned.

The use of outmoded architectural designs, constructional methods and details of structure has continued up to the present. Shelter has been provided for the workers but without adequate supervision and maintenance of buildings (Fig. 97). Also facilities for education, health and recreation have been badly neglected (Fig. 97a, b, c, d). As a result, slums formed. The economic advantages of low rent were offset by a degenerated living atmosphere.

Fig. 96c. A former horse stable to which a new storey has been added serves as the primary school in the Delta barrages. 400 children from the workers' colony and the surrounding area attend the twelve-room school.

Fig. 96d. A general view showing the row-house in figure 96a and b. The adjoining primary school in figure 96c and the school playground.

Fig. 97. Degeneration of recent workers' housing in Cairo due to lack of building supervision and maintenance.
The Social Conceptions of Industry, Workers and Workers' Housing

Introduction

At the early beginning of the industrial revolution the whole economic and social structure of the industrialized countries changed to conform with the new relations existing between employers and employees (Fig. 98a). This new change was unsuccessful owing to the absence of experience and its unpremeditated growth. Therefore, many theories were evolved to pave the way for a better future. Some of them succeeded, some others failed or had to change direction to suit the development.

Karl Marx

In 1818 wrote 'The Communist Manifesto' and 'Das Kapital' two main sections which were dealing with the relations between capitalists and labourers. Considering it a scientific problem of means of production, his philosophy drew two conclusions:

1. The factories produce goods, and the goods bring money. The money should go to the workers who build the factory and not to the capitalists who grow more wealthy. Since the workers share in the establishment of the factory, they have put their human energy as a frozen capital and should gain from its investment.

2. Since labour forms the economic backbone of the society, it should take political command as the Kings, church and capitalists had done. His ideas found fertile field in Russia where corruption, poverty and severe inequality and economical stratas existed.

England: The Fabians

Socialistic parties and the Fabians arose to defend the communist ideas with social programmes and laws. The British Labour Party was established in 1906 as a result of their efforts and came into power in 1924. Ramsay MacDonald was the first Labour Prime Minister. Since then, the Labour Party has governed England twice.
Germany

Laws of insurance against illness, unemployment, and a penniless old age were introduced by Bismarck in 1880.

USA and France

Some similar laws were introduced later in USA, France and England. Since then, many nations have developed the labour laws for the good of the worker as a human being, but up till now the rights of the worker and his position in the society are fluctuating between the extremes of consideration and neglect.

The case after the world wars

The workers' housing was the most important problem which faced the governments after the first world war. It had been carried on as a duty of the government towards the working classes, especially for those who returned from the battle-field.

After the second world war, mighty labour unions arose in many nations and achieved over decisions of wages, working hours, holidays, specifications, insurance and the contract between the worker and his employer (Fig. 98b). They could even interfere by changing production price and quantity.

The future

The previous problems of the industrial countries in the 18th and 19th centuries will not appear again, even in the countries where industrialisation schemes are planned. Instead, new problems of two natures will rise:

1. Problems resulting from the insertion of the urban industrial compound characteristics into the rural agricultural structure.

2. Problems due to the dynamic changes in industry, rapid technical advance, variation in economic values and social measures.

The complication of these problems and the huge capacities required to solve them, necessitates co-operation on an international level. The UN shares to a great extent the arrangement of general and specific conferences to discuss the labour problems and to organize exchange of experts in this field.
Mass Production, Rationalization, Industry and Workers' Housing

The second industrial revolution introduced the rolling belt (Fig. 99a), and production line (Fig. 99b). Though criticized as monotonous, inhuman and far from art and talent, yet specialization and perfection of repetition raised production quality and quantity to a high grade. In the Olivetti typewriter factory in Ivrea, Italy, the production was raised from two machines/day in 1924 to more than two machines/minute in 1962. Also, the production of the VW cars in Germany was raised from about 9000 cars/year in 1942 to more than 1000000/year in 1962 or 5 cars/minute, owing to the rationalization systems adopted. The result has been the creation of highly populated industrial centres where many thousands of workers work and live in the same place. More developed industrial, architectural, and planning conceptions were introduced after the 2nd world war. Rationalization of procedure (Fig. 100) and production means, automation, organization plans and administration systems declared the dawn of a new industrial era. The results are:

1. Need for highly-qualified skilled labour.
2. Better standards of living, higher wages, lower prices.
3. New types of houses and colonies.
4. New living and working environments, with new interests, public activities and services.
5. Perfection of production.
6. Less waste in time, material and labour.
7. Creation of research centres.

8. New production fields opened up by tremendous efficiencies of the new machines and means of energy.
9. Encouragement of inventions by the great capabilities of realising new ideas.
10. New means of transportation for the huge masses of materials, workers, and production required.
11. More local and international exports and imports.
12. Change of values. Simplicity, function, utility and truth have replaced ornaments, decorative forms and traditional patterns.

As a matter of natural growth, industry has been segregated into light, middle and heavy grades, and into mining, manufacturing, transforming and transiential sectors. Industrial centres appear to replace the factories and workshops which were scattered everywhere. The same way as the shopping centre now replaces the many grocery, butchers and other small shops. Mighty, independent industrial centres in the form of industrial cities and industrial zones appear to replace the old random pattern of scattered factories and workshops, in the same manner as the small selling places and shops gave way to the big shopping centres. This allows perfect planning of the centre for both industrial and living purposes. The main problems of transportation, provision, zoning, and expansion possibilities can be dealt with as one unit.

To treat all these points in the next parts of this work as an architectural and planning problem, we have to take into account, beside the existing local conditions, the new factors such as the mobility of the labour force, the seasonal and durable emigration, the foreign workers and their families, automation and atomic energy, and the present and future role of the workers in the economical structure.
Leer - Vide - Empty
PART II

The Industrial Centres in Theory and Practice
Leer - Vide - Empty
Creation of the problem

The rapid acceleration of technical progress has attracted the attention of architects, planners, and sociologists to the necessity of laying down new principles for the newly arising environments which involve men and machines in the same enclosure. The aim of these principles has been to provide for the needs, comfort and security of the workers. As the machine changed from an element of simple construction and complicated form to a compound of complicated construction and simple fluid form, so did the factories and the workers' colonies of the industrial centres. The factory changed from a mere wall-and-ceiling shelter for machines and men against climatic conditions to a disciplined complex organism. Its developed structure is now based upon many complicated conceptions of technical organization, rationalization, and provision-production transportation factors, integrating with the new human aspects of social services and public relations.

The industrial colony, previously simply a facility for shelter, has now reached the stage of complexity. Modern design should include not only the workers' houses, but also all the necessary elements required by the worker and his family: health services; educational buildings; sports, recreation and shopping centres; transportation facilities; and, most important, connection between this complex and the factory, all planned in terms of location, transportation, connections, provisions, and future growth and extension considerations as an organic structure (Fig. 101).
...and in town planning and industrial architecture.
The Influence of Industry on Regional Planning

The changing shapes of increasing industrialization not only affected the industrial location, but spread to the immediate surroundings and often influenced more distant regions. The variables involved:

Power and energy

Dense concentration of energy means the presence of more fuel, machines, and human power in proportionally small areas. In cases where it is more economical to transport power and workers, industrial centres are created near the source of raw materials. Industrial workers' colonies are also established in the immediate area. Wherever raw material is light in weight and small in volume, industry establishes itself near concentrations of energy and labor. The first case is clear in mines and quarries, while the second is represented wherever waterfalls or populated areas exist (Fig. 102).

Urbanization

The form of an industrialized region changes from an agricultural landscape to a geometrically planned and patterned area with sharp lines of roads, highways and other means of communication, in the best cases to an integration of both. Change is caused by the introduction of factory structures which are foreign to the natural landscape; the workers' housing reaching highest concentration in the industrial centre; and by the complementary structures which belong to industrialization. Total urbanization occurs (Fig. 103).
Population density

As a natural result of the urbanization, the population density increases at a high rate owing to:

1. The growing need of industry for greater human power.

2. The magnet-like attraction of industry for the labour force in its vicinity (Fig. 104) with influence rays of higher wages, stable positions, and better standard of living.

3. The unlimited growth possibilities of industry which constantly demand more working power in spite of automation.

The comparison of the composition of the overpopulated urban areas (Fig. 104, 105) with the heavy industrial concentrations (Fig. 106) shows the clear positive relation between industry and the increase in population density.

The introduction of industry in an existing village changes it from a small rural location to a town, with full mechanization, increased population, heavier traffic, and more public services, through the attraction phenomena.

Transportation

Masses of workers, as well as of materials, raw or manufactured, have to be transported. Communication lines, railways, highways, harbours, and airlines must be occasionally provided. Widening of existing canals and docks, and building of airfields, is then an economic necessity. Quick movement of workers to and from industry has to be afforded.

Ring roads, clover-leaves, overways and underpaths, as well as undergrounds are all technical solutions to the problem of transportation of the workers (Fig. 107).

Fig. 107. New technical factors in the field of transportation.

Fig. 108 shows the heavy commercial transportation lines between the different industrial areas and the importing lands. Heavy contact between the industrial centres and the region surrounding them is shown in Fig. 254. The daily stream of workers to Wolfsburg from
the neighbourhood represents 52% of its working power. Railways, highways, and canal deal with all the transport of raw materials to, and automobiles from, the works of VW. The Olivetti centre in Ivrea, Italy, depends also to a large extent on the neighbouring villages (Fig. 241).

Agriculture

Mechanized industry brought with it a new time-production ratio, as well as a new power-production ratio and a worker-production unit ratio. All these ratios are considerably lower than earlier determined, and strikingly lower than earlier agricultural ratios. Agriculture has to defend itself, or the agricultural population in the industrial environment will starve.

Rationalization of agriculture through the re-organization of small parcels into big common fields, and higher efficiency by the use of new technical and economical possibilities in agriculture, is one way to follow. The other is the total mechanization of agriculture on the land and farm as well as in related agricultural industries (Fig. 109).

A good solution is to integrate industry with agriculture wherever the farmers have only part day or part season work, thus adding more to their income and working day output.

Commercial and shopping centres

The rise of industry in a region creates the need for new commercial centres to deal with the production and distribution which cannot be dealt with by the industrial centres, and to serve as meeting points for transport, export and import (Fig. 110).
Military conceptions

The military aspects influence the choice of the location of industry so long as it depends on the position of the raw materials.

An example is the VW industrial centre in Wolfsburg. It was chosen far from the western borders in spite of the presence of steel, coal, and labour force in the Ruhr region. These advantages, besides the short transportation distances and export possibilities, were sacrificed against the fear of another war (which really happened) and the fear that France would attack the Saar region. The centre was always selected far from the eastern borders for the same military reasons. It lies now to the south of Hanover, 300 km from the Ruhr region (Fig. 111).

Satellite towns

The congestion of capitals and big cities with overpopulated working-class quarters, traffic and noise chaos, slums, and factories, give birth to new ideas. In the first two decades of the 20th century, suggestions were offered for the design of the city itself for the solution of the problem of industrial zoning and its relations with the residential quarters. But after the second world war, the idea of satellite towns appeared. An experiment was made in England in the Greater London Plan (Fig. 112).

Fifteen new small towns have been built around London in a circle of thirty to fifty km radius. The new towns had to house a big part of the industrial bulk of London and the working population belonging to it. Aid was offered to all industrialists who wanted to go outside London, and industrial licences in London were severely restricted.

The same defence considerations are influential in the selection of the Ural mountain regions in Russia for the heavy industrial concentrations.

From this point of view, the selection of Cairo as a centre of the industrial concentration in Egypt is wrong. Meanwhile the distribution of industrial centres along the Nile between Qena and Aswan with heavier concentration in both of them means bringing life to the whole southern part of Egypt. Likewise, the concentrated industrial axes Tanta-Cairo should be spread out in a fan on the desert sides east and west of the Nile delta. The industrial region of the Red Sea desert should be strengthened with special care for the connection of Qosair-Qena. Most important aspects are two new regional elements.

Fig. 111. The military strategic choice of Wolfsburg as a great automobile industrial centre half way between eastern and western borders.

Fig. 112. The satellites towns of London. An experiment with centres that attract industry and residence away from the Metropolis.

Fig. 113. The dormitories 'Schlafstädte' and their mother city, perspective. (P 16)

Fig. 114. The dormitories 'Schlafstädte' and their mother city. (P 16)
Within the same satellite town industry, residence, public buildings and services had been studied and located on scientific principles and on the basis of statistics, with social life, the pedestrian, traffic and human aspects as main factors. Keen competition between the councils of these towns raised the standard of their design and execution, as in Harlow (Fig. 110), Stevenage, and Hook.

Dormitory Towns (Schlafstädte)

A new term in regional planning given to the new towns which are especially built to house only those who work in other big industrial towns and go home only after the working hours (Fig. 113). The term covers also the industrial colonies and the existing villages and towns around an industrial centre which are turned in time into sleeping places for its own population who have been attracted by industry to the near-by industrial centre and have left their activities at home (Fig. 114).

Industrial zones

The spread of industry, its growth and its influences upon the areas surrounding it, are considered in the present planning theories by keeping special regional or city zones for industry (Fig. 115).

Two new terms resulted:

Industrial districts

Created to concentrate the industries causing nuisance and disturbance for the residential areas together in one district, where more control, separation of the means of transportation and aesthetic unity are available advantages that are clear in the example of the Harlow industrial district (Fig. 116).

Fig. 116. An industrial district in the satellite town of Harlow, England.

Industrial parks

These are specified industrial areas which are set aside with or adjacent to a community for the location of diversified industries. The areas are generally restricted and zoned to meet local requirements with the necessary utilities such as water, power, sewage disposal and transportation. The American criterion of the industrial park is one which includes at least twenty to 200 acres of land comprehensively planned, like the example of an industrial park in New Jersey USA (Fig. 117).

Fig. 117. An industrial park in New Jersey, USA.

Conclusion

Industrial progress has broadened planning measures to regional scope and inserted the complicated industrial factors related there into regional organization. It is no more a matter of how to place an industry near a city, or of how to house the workers of an industry near it. The question has become how to mould the whole region so that it may act as an organic living unit with all functional necessities. Human aspects, in parallel to the technical factors mentioned, have to form the skeleton of our regional planning measures and principles.
The Influence of Industry on City Planning

Some theoretical and practical examples of the evolution in treatment and approach of the problem

Claude-Nicolas Ledoux

One of the earliest trial designs for a pure industrial centre is the project of ‘La Saline de Chaux,’ 1775-1779, by the Frenchman Claude-Nicolas Ledoux. The project includes the industrial factories, public buildings, director’s house, and the workers’ houses with their gardens (Figs. 118, 119, 120). Ledoux had shown an imagination broad and progressive enough to create a design of an industrial complex with all its necessities already in the early dawn of the machine age.

Sverre Pedersen

The second example was Stjordashalsen, a satellite of Trondhjem, Norway, designed by Sverre Pedersen in 1920 (Fig. 121). The railroad line separated the industry from the colony, allowing each of them an opposite direction for expansion. Area of the colony was 500 acres. A large agricultural green belt was retained for provisions. In the centre were the civic centre, church and park.

American scientific design

An American design called ‘scientific design’ in 1920 suggested a city of different sections (Fig. 122): the communal services in the middle, houses on both sides, and the public buildings in front. The two industrial zones lie flanking the public buildings. Parallel streets run through the whole city.
Garden city. Sir Ebenezer Howard

Sir Ebenezer Howard had concentrated his solution of the problem as in Fig. 123 'to create in the midst of the fresh air of the country, opportunities of profitable industry, and prospects of advancement, and pleasant forms of social life, more attractive than to be found in the great cities and towns.' His design could be considered as shifting most of the residential complexes into the green surroundings outside, thus not limiting himself in reality with practical restrictions of areas and dimensions (Fig. 124). The term garden city, first used by A.T. Stewart in 1869 for the development of an estate on Long Island N.Y., was adopted by Ebenezer Howard in his 'Tomorrow': A Peaceful Path to Real Reform, London 1898. The determination of the garden city population with 30000 was the start of a series of logical city planning principles.

The Garden Cities Association was formed in 1899 and the first garden city Letchworth was established in 1903 and the second Welwyn, in 1920.

The main features of Howard’s scheme were:

1. Purchase of a large agricultural area within a ring fence.
2. Planning of a compact town encircled by a wide rural belt.
3. Accommodation for residence, industry and agriculture.

4. Preventing the extension of the town from encroaching upon the rural belt.
5. The rise in land values to be secured for the town itself.

As Howard showed that reasonable rents would be amply sufficient to pay a return on the expenditure, leaving a considerable surplus, he attracted many people interested in the question of industrial housing. In garden cities, good houses could be cheaply provided for the working classes. Thus manufacturers and industrialists began to establish their works on the outskirts of cities and in country villages to escape the high costs, chaos and bad working conditions of the over-burdened cities.

<table>
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<th>Year</th>
<th>Letchworth</th>
<th>Welwyn</th>
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<tr>
<td>1903</td>
<td>3822 acres</td>
<td>2383 acres</td>
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<tr>
<td>1920</td>
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<td>increased to 5071 acres</td>
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<th>Welwyn</th>
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<table>
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<th>Letchworth</th>
<th>Welwyn</th>
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<td>50000</td>
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<table>
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<th>Welwyn</th>
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<tr>
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<td>250000 £</td>
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Dividends not to exceed 5%

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<th>1956</th>
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<td>20322 persons</td>
<td>18314 persons</td>
</tr>
<tr>
<td>Corset making</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bookbinding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radio</td>
<td></td>
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<tr>
<td>Breakfast food</td>
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<tr>
<td>Printing</td>
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<tr>
<td>Limited dividend</td>
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<tr>
<td>principle</td>
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</table>

In the USA private corporations developed industrial communities. They were mostly well-planned but more often lacking in spaciousness and attractiveness. No attempts were made to follow the principles of the English garden cities. Greenbelt towns were built before the second world war. New towns were built after it, a big example of which is Levittown, Pa. It was developed primarily to serve the needs of employees of a new steel plant built at a considerable distance from established population centres.

Raymond Unwin

Suggesting a zoning method, Raymond Unwin divided the town into distinct sections: Residential circumference surrounding a commercial centre; industry on one side, radiating satellites on the other; recreational areas in between. In Fig. 125, a detailed section of the garden city shows the different positions of the elements in relation to each other. Designed in 1922.

Paul Wolf

Introduced an industrial town in an oval form (Fig. 127) of many residential circumferences around a civic and business centre, with green belts in between, parks and forests on the one side, and industry and railways on the other. Paul Wolf was the official architect of the city of Dresden. His design gave an impression of Renaissance influence.

Adolf Rading, 1922

Suggested an ideal plan for the city of the future with allowance for further industrial development and requirements. The railways divided the city into four main sections. A thickly populated town in the city centre, industry on two sides, and the protected agricultural areas lying diagonally on four sides. This study had been suggested for the city of Breslau and its surroundings within 60 km (Fig. 128). The neighbouring villages were included in the design.
Robert Whitten

In 1923 introduced his theory of an industrial town. Circular ring railroad entering the core of the city from one side. City business centre in the middle with surrounding residential satellites with a population of 3000 to 10000 at about 15 km from the centre. Radial and ring connections tie the scheme together. Each of the satellites has its industrial area in front of it in the direction of the centre with the railways in between (Fig. 129).

Tony Garnier

Presented his theories in 1904 in 'La cité industrielle' for 35000 inhabitants in a form of linear city (Fig. 130a). The industrial zone lies at the end of the strip. The residential part was linear with long narrow lots running east-west, buildings separated by wide open spaces, separate levels provided for pedestrians, and flat-roofed houses with roof gardens and enough open spaces (Fig. 130b). His plans of the houses were more advanced than their time (Fig. 130c). Rational grouping of industrial, administrative, residential and activities buildings (Fig. 130d). Glass, concrete beams and columns were his materials (Fig. 130e). His forms and simple designs were outstanding forecasts of the future.

Fig. 129. Robert Whitten, circular industrial centre. (Pl 49)

Fig. 130a. Tony Garnier, la cité industrielle. (M 49)

Fig. 130b. Tony Garnier, industrial workers' houses.

Fig. 130c

Fig. 130d
Eric Gloeden

Developed in 1926 a network system of connected cells equal in importance and each having its own core. His suggested cells were 2 km in diameter and capable of accommodating a population of 100,000 (Fig. 131). The core consisted of business, industry, and administration. Sport fields and green areas lay in between the different cells. He developed his idea also in 1926 and gathered in complete parts of a city near each other with railways in between (Fig. 132). Each part was of a different population volume and had its own industries or crafts. The core of the city contained administration, business and cultural centres. The green areas lay between.

Gaston Bardet

Developed in 1939 his theory based on statistics and social-topographic studies (Fig. 133). He crystallized the structure of the existing cities. Each quarter and colony had its own characteristics, which lead to different planning schemes in each case. Thus his theory has remained theoretical and had to be developed in each solution to suit the practical conditions.
Soria y Mata put forward a theory of the linear strip city where each family had a parcel of 400 m² with private garden and all necessities (Fig. 134). The parcels were stretched 50 m on each side of the main road which he supposed to extend from Bruxell to Peking in an elevated system on columns. A strip part of this theoretical project had been executed between Chamartin and Barrio de la Concepción in Spain. It is a linear town 6 km long, with 1000 one-family houses and 6000 inhabitants.

Madrid

La Cité Linéaire of Madrid offers in turn a strip town connecting other existing towns and villages with a tram line (1924) (Fig. 134). Of the total area of the city, \( \frac{1}{5} \) was for housing and \( \frac{4}{5} \) for agriculture. One house for each family with front and back gardens. Economical construction and installations, as well as the streets were orthogonal. Advantages of living near the tram line only for those near the stations.

Frank Lloyd Wright

Frank Lloyd Wright invented his ‘Broad Acre City’ to mix the industrial, agricultural and civic components in one unique environment, combining the advantages of the all. A complete integration with nature and surroundings is afforded by the distribution of the small farms inside the composition (Fig. 136).

Hilberseimer

Hilberseimer tried to design a relationship between industry and its colonies with respect to wind direction. The idea in itself is sound and an application of it in the master plan of Chicago shows its advantages. But its application is restricted to the industrial areas with conditions already existing. Many other factors may outweigh the wind and smoke factor. Besides, the spread of the use of electricity and diesel machines leaves this factor with secondary importance, as in the case of the Olivetti centre in Ivrea (Fig. 137).
Berthold Lubtekin

Developed the principles of an industrial linear city with parallel zones of transportation, industry, residence, green areas, and communication (Fig. 138a). A green belt 500 m wide separates the residential area from the industrial zone. Volgograd in 1962 was renamed 'Stalingrad'. After the second world war in 1945, the destroyed city of Stalingrad was rebuilt with new considerations for industry (Fig. 138b).

Miljutin applied the principles of Lubtekin in the design of the new industrial city of Stalingrad. He laid down a linear plan 65 km long for a population of 200000. Industry is on one side of the railroad line and the highway on the other side. The business area follows the residential area. A green belt is on the periphery as well as between the different zones and industry.

Conclusion

Industry has turned the traditional conceptions of life upside down. Production, transportation, needs of daily life, and progress in economy and science develop at a high rate. The advent of machines and mechanized industry with all their disadvantages drove planners and architects to create new theories and solutions for the hitherto unknown problems.

The influence of industry on architecture

With the rise of the industrial revolution began a new era for architectural design which has been evaluated parallel with the later industrial revolutions. Not only had the factories necessitated new types, planning conceptions, and design forms of their buildings, but they have also influenced all the other types of buildings and created new ones.

The traditional design principles collapsed and had been replaced by new aesthetical principles:

1. Functional planning and design based on logical principles and real practical necessities.
2. Simplicity
Disappearance of ornaments and purely decorative non-functional features. No more obligations of symmetry or units imposed by other classical principles.

3. Technical development
Development in the field of building construction, rationalization of the building process to save material, effort and time.
New materials. New ventilation, heating, air-conditioning, lighting, and insulation installations.

4. Efficient structural potentialities
To meet the growing need for wider spans, bigger spaces and huge volumes.
Protections against industrial nuisances and dangers.

5. Creation of new architectural elements
New elements relating to industry such as power plants, standard factories, laboratories, research centres, social and recreational centres, shopping centres, medical centres and colonies to house the industrial workers and their families.

6. New transportation possibilities
Developed means of transportation have been invented and introduced to handle transportation of the raw material, the mobility of the industrial working population, and the distribution of the finished products.

The influence of industry on building construction
The influential needs and necessities of industry turned upside down the conventional means of construction to suit industrial progress.
The new aspects created changed even the architectural and planning measures.

1. Introduction of new supporting and covering materials with more rigidity, hardness and bearing capacity to meet the new wide spanning needs and the ever increasing dead and live loads, and the vibration of the machines.

2. The birth of prefabrication on a wide scale to fulfil the following two points:
a) To deliver within a short time on request, such constructional structural elements as beams, slabs and columns, or such constructional parts as windows, doors, and sanitary installations, required for the establishment of factories and plants, and the erection of the houses of the industrial workers. The time saved and the absence of material waste and the independence of climatic conditions are all points in favour of prefabrication.
b) To provide within a short time housing possibilities for the workers or covering shelter for machines and working place in a form of complete prefabricated finished units ready for use. This efficiency to deliver comfort and means of sheltering to deserted places extended the reaches of industry to new horizons.

3. New constructional technical trends are created, to serve in common both the plants and the residential colonies. The development of the central heating process made it possible to heat both the Wolfsburg industrial complex as well as the residential parts of the centre. Air-conditioning, artificial lighting, electricity, rolling belts, highly efficient reinforced concrete, and new means of covering such as shells and frameworks, are new concepts introduced in the constructional field by industry.

Fig 139a, b. Soviet building technology has made its biggest advances in prefabricated, precast concrete. The prefabricated whole one-room apartments are brought to the site on trucks, then piled one on top of another like bricks, using mobile straddling cranes.
Fig. 139c. New constructional techniques evolved to meet the difficulties of building for industry in inaccessible and deserted regions: the 450 industrial workers' housing project for the Grande Dixence power station in Switzerland.
New industrial production techniques have been introduced in the building industry to keep pace with industrial development and effect the necessary saving in time and cost: A prefabricated block of sanitary installation is brought on site. A simple assembly operation follows.

The philosophy of the relation between architectural design, art and industry

In face of the acceleration of industrial progress, many changes accurred in arts (Fig. 140) and the architectural design conception in the building field; moreover, architectural design potentialities have inserted themselves into the design and the forms of many industrial products. A certain logic has been created for the design approach concerning industry or whatever belongs to it (Fig. 141a). Many examples resemble the reflection of such architectural logic as the work of Tony Garnier, and Claude-Nicolas Ledoux, later followed by the Bauhaus movement in Germany in 1924 with the efforts of Walter Gropius to lay bases for new architectural conceptions in design, composition, function, form and realization. Another unique example is clearly seen in the conceptions of Eric Mendelsohn in the relationships between the form of building, its appearance and its function (Fig. 141b). This logic in design approach for industry explains the severe criticisms which have been levelled against the first prize-winning design of the English Electric Company (Fig. 142). This outstandingly progressive corporation, while producing its ‘Supersonic lightning’ jet aeroplane which achieves superior architectural qualities, houses itself in the same time in a non-functional cliché-ridden example of neohistoricism. This sharp contrast of design approach in 1961 can be compared with the use of donkeys and camels as means of transportation in the time of jets, or the spear and sword in the atomic age.
Philosophical aspects of sex in industry

One of the most interesting philosophical views of industry to date is the definition of industry introduced by Prof. C. Northcote Parkinson. He divides the industrial plants and centres into males and females. The former are supposed to be the ones with rough external appearance. They may be tidy but without effort to be attractive. Their layout is more practical than pleasing, the machinery unconcealed and the paint work conservative and drab. In addition to all this, is the normal male extravagance (Fig. 143). The latter are carefully and attractively designed factory buildings, prettily sited and smartly kept with pastel shades in the paint work and with flower beds near the gates. But with the attractive layout, there goes a certain modesty. Most parts of the production process are usually concealed.

Fig. 142. A sharp contrast of architectural qualities.

Fig. 143. ‘Female’ factory, attractive, simple and modest.

Fig. 143. ‘Male’ factory, rough appearance and unconcealed machinery.
The Theoretical Design Analysis of the Industrial Centres

Introduction
To achieve high quality design potentialities, the design principles of industry, its factories, workers' colonies and other necessary elements should be considered under the loop. The approach to the problem is based on a longitudinal sectional analyses through the conceptions which cast the influential factors that mould the design technically, as well as on a cross section through the previously mentioned conceptions to cover instantaneously their details from the economical, social, human and planning aspects. The structure of both sections is composed as follows:

Longitudinal sections
1. Analysis of industry today.
   - Classification of industry, its types, energy resources, transportation means, human power, modern contemporary future techniques.
   - Future progress of electronics and automation.
   - Influence upon employment and the market. Atomic energy.
   - The minimum physical human standards for the design of the factory and the house. Recommendations with consideration of local conditions.
   - Land, financing, installations, water, sewage, electricity, materials, experts and laws.

   - Classification of industry, its types, energy resources, transportation means, human power, modern contemporary future techniques.
   - Future progress of electronics and automation.
   - Influence upon employment and the market. Atomic energy.
   - The minimum physical human standards for the design of the factory and the house. Recommendations with consideration of local conditions.

3. The international approach to the problem.
   - The role of the governments.
   - The role of the industrialists.
   - The role of the building contractors.
   - The role of the workers and employees.

4. Architectural and town planning aspects.
   - Industry and colony relations:
     - Site selection, topography, area required, delivery provisions, and distribution.
     - Transportation, water supply and consumption, power and energy means, local materials and constructional possibilities.
     - Smoke, dust, ashes, smell, explosions, and fire.
     - Combined services and traffic means. Working human energy supply. Direction and tendencies of future extension.

5. Interaction between industry and its residential complex.


Lateral sections
8. Design of the worker's house.
   - The minimum needs of the worker, family size, local topographical and geographical site conditions.
   - House elements. The core and principles of design. Internal and external aspects.

9. General aspects.
   - Analysis of present-day industry
     - Classification
       - The following definitions classify industry into three flexible categories, light industry, medium and heavy industries.
       - 1. Light industry
          - Includes all the workshops and factories which treat raw materials mostly with man-power or with the possible use of light or small machines.
          - Light industry does not influence its surroundings, and does not change the environment.
          - No difficulties in obtaining labour are expected.
          - Electric motors up to 10 h. p. are normally predominant.
          - The power is delivered from the local power stations.
          - The use of solid or heavy fuel is almost absent. No railway junction or heavy transport facilities are essential.
          - An area from 300 up to 1500 m² is an average size of one light industry. It can thus be easily inserted into residential zones as well as agricultural outskirts with no disturbing interference or radical confusion.

       - 2. Medium industry
          - Medium industry includes all factories using machines heavier than in the light industry but not depending for their existence upon being placed on the spot with regard to raw materials or power resources as in the case of the heavy industries.
          - Most important in the case of middle industries is the supply of the man-power with the necessary skill to drive its complicated machines.
          - Medium industry includes all factories using machines heavier than in the light industry but not depending for their existence upon being placed on the spot with regard to raw materials or power resources as in the case of the heavy industries.
          - Medium industries thus need to be placed near the populated places. Higher salaries paid by the medium industries create a stream of man-power mobility from the lighter industrialized districts or sections to the heavier ones. The result is a segregation of the light industries into three different layers. The first would be centrifugally swept far away from the influential range of the medium industry. The second would be attracted to the vicinity of the medium industry to be a complementary part of it. In other words to provide the medium industry with the

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needed light accessories and spare parts. The third section which is more rigid and cannot change its base will obtain the essential human energy supply by employing female workers, whose ability is restricted to certain kinds of precise industries and limited types of work which require patience and precision. Air conditioning as well as light control and automatic operation of whole groups of machines, allow the medium industries to avoid the climatic local site restrictions which were design obstacles in the past.

High energy consumption, as well as extensive consumption of water supply and big waste discharge is a characteristic of medium industry that should be taken into consideration during the design stage. An area of 1500 to 4000 m² is an average size of each medium industry complex but it increases sharply in the case of the automobile industry up to 25000 m² to 40000 m². In the case of the textile industries or other manufacturing industries which integrate with each other in one big industrial complex the area of the main industrial complex exceeds millions of square metres. Examples of this case are the Olivetti industrial complex which is 1000000 m² and the VW automobile industrial complex exceeding 2000000 m². When the industrial area of the factory exceeds 40000 m², the industrial centre begins to gain complexity and the factory should be then separated as a work place from the residential area...

3. Heavy industry
The industry in this case is gigantic in size, type of machines, energy means, production and raw material consumption. It exists mostly where tremendous raw material resources exist, or where energy sources are adequate to generate the immense amounts of power it needs. Heavy industry changes the appearance and even the whole structure of the region wherever it dominates. Totally new conceptions introduce themselves into the means of life, transportation systems and physical and psychological living standards. The final complex which results from such a complex change is an integrated composition of many different industrial, civic, business, residential and recreational complexes to create an organic centre. Relatively rich corporations and capital and mighty organizations take command of the work from one side, while Labour Unions from the other side counterweight it to protect the workers and defend their rights. The creation of a heavy industry in a region would not only change the structure of its environmental surroundings in the region, but will also upset the whole economical and social structure even far from the neighbourhood regions. Heavy industry acts as a magnet attracting the working masses towards its quarters in such sweeping shifts, thus leading to cardinal progressive change in the economy of these regions or to its fundamental total destruction.

The mass of workers employed by heavy industry composed the main portion of the population of the region and its neighbouring cities. Complete new towns would even be created, and many villages would be turned into towns or urban centres to house the workers of a heavy industry and face the new factors.

New aspects of industry
Rationalization should not be looked upon as something directed against mankind, but as something that brings the working man to further his self-development and to strive for self-fulfilment. Dr. Seebohm

The influence of the new aspects upon industrial production, economics and industrial workers' colonies and environment.

The cardinal changes in industry wrought by electronics, atomic energy and automation after the Second World War produced a real new third industrial revolution. If we consider the first revolution to be the beginning of the machine age, steam engine and other inventions, and the second to be the start of mass production systems and rationalization procedures in production lines and organization methods and the creation of machines that make machines, then we should place automation and atomic energy under the title of the third industrial revolution. The similarity between the three industrial revolutions lies in the fact that in each case a large number of scientific discoveries and technical inventions culminated in the development of a new type of industrial production. These technical and social changes represent something more than step by step development from the old to the new. They have produced something new in a qualitative as well as a quantitative sense.

To put down a design for the working as well as living environments of the future industrial centres, we have to analyse the trends of the technological changes in these centres. Under this term come the new energy sources, new planning and design conceptions and their execution procedures and class of workers. The two commanding trends of today and the future are automation and atomic energy.

1. Automation
By this term, is not meant the high degree of mechanization so often indiscriminately referred to, but the use of highly automatic machinery or processes which not only eliminate human labour on a large scale, but also detailed human control as well (Fig. 144).

Fig. 144. The VW production line in Wolfsburg, Germany.

What was substantially new after the Second World War, was the possibility of applying automation to production processes in general, through the entry of electronic control and the electronic computer.
It now becomes possible for machines to control their own actions and carry through a manufacturing process from beginning to end. The huge oil refineries, chemical plants and steel works of today are operated with automatic control. Two workers can produce 1000 radios a day on the radio assembly line a production that needed 200 workers with the old methods. Formerly 400 workers took 40 minutes (267 man-hours) to turn out one engine block in Ford factory in Detroit, now 48 workers complete it in 20 minutes (16 man-hours). In the U.S.S.R. a fully automatic plant makes aluminium pistons for heavy truck engines. No human hands interfere throughout the process and even the waste metal is removed from the machines automatically. In the USA an automatic concrete plant, operated from an electronic control, produces and loads into ready mix trucks any one of more than 1500 different mixing formulae that may be demanded, without any manual labour. These electronic machines act without direct help from human beings.

Moreover they can take over many functions of control, inspection and even decision as well. These developments have a widespread application in all fields of manufacture and in all routine clerical work. The industrial pattern differs totally when automation, electronics and computers associate widely everywhere as they do now in the concentrated industrial centres in the monster factories and plants.

The two types of automation change the principle of factory design.

A. Transfer type of automation

One long machine replaces several small ones. The work, once loaded into the first station, passes automatically from station to station until the operation is complete. An example is the line for machining six cylinder blocks in the Ford plant in Cleveland, Ohio, which is over 500 m long and consists of 42 linked transfer machines which transfer a rough casting into a finished block ready for assembly, doing automatically all the 531 operations required. It is possible, although not ideal, to transfer many existing factories which are capable of change into this type. This will result in economical reduction in the number of operators and building areas for their accommodation rooms, cloaks, WCs, and administration, as well as for their circulation.

B. Programme-controlled automation

The machine is provided with a brain in the form of an electronic computer which can do and think over the work several times faster than any human being, with skill enough to keep the machines running continuously over long periods at high speed. The ability of this type of automation to achieve enormous increases in productivity is the secret of its revolutionary feature. It embodies also feed-back in the form of electronic controlling devices which control the quality of the work, ensure that it conforms in every respect to the instructions specified in the programme and make automatically any adjustments that may be necessary from time to time. Thus a great deal of supervision and human control is eliminated from maintenance.

The factories of this type will be of several storeys, and some developed underground basements, with vertical shafts to allow change of programmed automation and flexible movable services for production floors, or sandwiched on one floor in between several others. Greater productivity will necessitate better planning of the delivery of materials, waste disposal and product dispatch. In the heavy industrial centres, like steel plants, chemical production and nuclear power, the trend of 'out-door' production lines will create a collection of external apparatus linked together in continuous and automatic process supervised by remote control. The following words of Professor Einstein give clearly the point of view of science on the subject of automation. 'Ultimate automation based on atomic power could make our modern industries look as primitive as the methods of the stone age men look to us now. If we look hopefully upon the shape of things to come, we can visualize automation as the greatest blessing mankind has ever known.'

**Atomic Energy**

Forms of energy had been originally drawn from the sun. In this category come wood, coal, petroleum and gas. Later, water mills, windmills and direct heat of the sun have been used. Now man has entered the atomic age and began to release the energy which is locked up in the atomic nucleus, inside matter itself. So enormous is the energy in tiny quantities of matter that, if all the energy contained in two grams of coal could be fully utilized, it would be equal to the whole electrical energy consumption in western Germany for a whole year. In the beginning of the fourth quarter of the 20th century, the power generated by nuclear means will be cheaper than that by conventional means. The most important result is then, from the point of view of industry, the possibility of a universal, plentiful and cheap electrical power, with freedom of location and selection of site.

**Conclusion**

The development of automation and production of abundant energy have a powerful effect upon the economical structure of our society and the design and planning of the industrial environment. Both the two new factors influence the employment, production, quality (Fig. 145) and quantity, price and research progress. The influence on employment is clear in the declaration of President Kennedy in the USA in 1962 about automation.

![Fig. 145. Automation increases the need for more qualified workers.](image)

He stated that due to the progressive automation means introduced into the industrial field—an example of which is that 90% of all light bulbs in American are made by 14 workers at 14 machines—the machines will push weekly 25000 workers out of their jobs and will replace them (Fig. 146). That would result in a total of 13000000 working places being needed in the next ten years plus 1000000 yearly
to face this threatening unemployment danger. Moreover, the 3000000 annual increase in the American population adds 1000000 workers yearly. To face this problem, the working hours are reduced in the USA and some other countries as well, or the excess working population exported to other neighbouring countries, as in the case of Italy and Spain. This mobility sometimes happens internally, as between northern and southern Italy and Egypt.

The sharp classification of industrial workers into seven or eight categories today, will then be reduced to two only, or at most three.

The international approach to the problems

The problem of planning for industry has never been so important as it is today. The design of the industrial centres, their insertion into a region and the fulfilment of their requirements, need tremendous working effort, research studies, and thorough preparation.

The conditions of the working places of industry, factories and workers’ residential areas are still to be seen today in the developing countries as almost no better than at the beginning before the industrial revolution. The fact that the worker in the developing countries builds his house by himself within his social and financial means resulted in some sort of self-content which reflected itself upon the plan of the house and the form of his life. This gave the worker a feeling of having the roots of his destiny in his own land. Thus he has always felt proud of his home castle. In Asia there are 750000000 persons who live in 150000000 unhealthy and inhuman houses, within the borders of dirty quarters forming huge bulks of slums, mainly in Burma, India, Ceylon and Indonesia.

With the introduction of industry, the worker left his farm and went to the factory, and his connection with his house and land had been broken up. He lost calmness, fresh air, the routine cycle of his daily life in nature, and exchanged all this for the quick life and the chaos of the city. The worker lost his capacity to build his own house with his primitive methods which were out of date for town life and his new conditions. This change had been clearly apparent in the world crisis.

The unemployed industrial workers who lost their jobs and salaries, lost also their homes and means of life with them. Meanwhile the agricultural peasants had suffered the crisis equally severely but they were backed with some deep feeling of confidence and dependence on the home and land they live on.

The house of the industrial worker influences the quantity and quality of his production through its environmental influence upon his mentality and his internal physical and psychological condition.

The violent dash of the working masses into the industrialized areas is caused by the attractive dreams of more money and better life. This causes the overcrowding of many tenants in one dwelling and sometimes even the use of the utilities and services of some other neighbouring building. Moreover the rapid growth of population causes an accelerated human inflation in the industrialized areas leading consequently to higher death rates, more still-born children, many infectious diseases, physical and psychological illnesses, limb diseases and rheumatism, and diphtheria.

The large scale sharing of defective sanitary installations paves the way for many diseases like typhus and tuberculosis. The bad order of a worker’s house provides reasons for ill-brought up children who have to share with their parents in the centre of their intimate life. They will be spoiled in character and pushed a long way towards criminality. This would be one of the reasons why many industrial workers do not marry or why the married ones do not welcome having children.

In the beginning, factories had been built much faster than the workers’ houses, which usually had never been built. The workers collected themselves in crowded slums casting a shadow of dangers upon them. Afterwards, industry was established near heavily populated centres, seeking the labour force. If in our time an indus-

The design of industrial colonies

Automation leads the industrial colonies to a reduction in size and shrinkage of area proportional to the reduction in the personnel required. It would also dictate the integration of either the colony or the industry with the already existing agglomerations in the vicinity. Services and public buildings such as schools, clubs, shopping, social and recreational activities will be respectively reduced to a minimum allowing more contact with the neighbourhood. Superblocks would combine industry and residence together in one unit.

The colony will be much closer to the factory, as the dirt factor will be eliminated. The form of the colony will be more longitudinal and parallel to the factory to allow both of them direct contact between the technicians and their departments and sections, as the internal circulation will be absent or reduced to a minimum.

The design of the house of the industrial worker

The result of automation and the achievement of atomic energy in commercial terms will be reflected in the differentiations of the working classes, their life needs and necessities.

The international approach to the problems

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1. Free location of industry

Industrial centres will no longer be dependent on the energy resources in the place of its location. Automation will free industry from the necessity of being located near the overpopulated densely populated centres that could provide the labour force needed. Atomic energy will liberate the industrial centres from being stuck to the places where power resources exist.

2. Free composition of the industrial centres

The use of clean power, and eliminating the factor of dirt, will allow industry to be more interwoven into residential areas, thus reducing the distance between home and factory. This integration of components, if well designed, will give a nice architectural composition and introduce the large scale into towns.

The design of industrial colonies

Automation leads the industrial colonies to a reduction in size and shrinkage of area proportional to the reduction in the personnel required. It would also dictate the integration of either the colony or the industry with the already existing agglomerations in the vicinity. Services and public buildings such as schools, clubs, shopping, social and recreational activities will be respectively reduced to a minimum allowing more contact with the neighbourhood. Superblocks would combine industry and residence together in one unit.

The colony will be much closer to the factory, as the dirt factor will be eliminated. The form of the colony will be more longitudinal and parallel to the factory to allow both of them direct contact between the technicians and their departments and sections, as the internal circulation will be absent or reduced to a minimum.

The design of the house of the industrial worker

The result of automation and the achievement of atomic energy in commercial terms will be reflected in the differentiations of the working classes, their life needs and necessities.
try is suddenly established under the pressure of technical progress in a place which is unsuitable and over-populated then the remedy and solution of the problem will be almost a miracle. A crowded house is difficult to clean and a crowded city is difficult to organize and replan. Accidents, crimes and fire are unavoidable. Equally serious are also strikes, disorder and vice. The above-mentioned problems are international. They exist in all continents and countries with no regard to the degree of industrialization. What is then the role of the international organizations in solving it?

The International Labour Organization of the United Nations has organized many conferences to discuss the problem on an international level. It has succeeded in laying down recommendations for the industrial worker’s housing standards, of two kinds.

1. Minimum technical requirements in the design.
   a) Security.
   b) Durability.
   c) Fireproof.
   d) Flexibility for change, and possibility of future growth.

2. Minimum theoretical architectural and planning design conceptions.
   a) Comfort.
   b) Privacy.
   c) Light.
   d) Air.
   e) Insulation against temperature.
   f) Insulation against sound.
   g) Possibility to cook, to bath, and to wash.
   h) Place to store.
   i) Sanitary installations.

3. Minimum planning considerations of three categories.
   a) Water supply, sewage, waste removal.
   b) Street approach for delivery, electricity, fire guard.
   c) Green belts joining the houses with the industry and the main streets.

After discussing the case of many Asiatic and Indian industrial workers the minimum requirements have been concluded as:

Two bedrooms and hall and WC.

The Indian government had decided for its industrial workers’ housing schemes two bedrooms, kitchen, veranda, WC, bath, and court, as minimum requirements. For economical reasons one room instead of two has been accepted.

The second problem is, can the industrial worker run a house alone without being helped? A question the answer of which is surely in the negative. If he is helped to afford a house, how much then can he pay for his dwelling so as to be a reasonable proportion of his income?

In India a sum of 10% is considered reasonable. In the Sudan 15% is a fixed percentage. In the heavily industrialized regions of western Europe a percentage between 15% to 20% of income is normal for the house. In USA 20% is considered normal. In eastern Europe only 4% to 5% is the average.

To explain this big difference we should not forget that the American houses are installed with much equipment which is considered anywhere else as luxurious; thus the family has not to pay its full value from its budget. Meanwhile, in Russia and eastern Europe the land belongs to the state and all speculation is forbidden, and besides, commercial investment of the capital is eliminated.

Certain conclusions can be extracted from the recommendation of the ILO for the coal mining workers’ houses: Wherever possible and within the local conditions, the dwellings should be durable, and as a minimum composed of a kitchen with the required installations, a douche, with hot water, a private closet and a lavabo, a living room, a bedroom for the heads of the family, and an extra bedroom for each further member of the family.

The ILO recommended for the oil fields workers:

The minimum standards for a durable stay of the petroleum industrial workers in a certain region should fulfil the hygienic and comfort requirements demanded by the local authorities and the local housing policy and conditions. In addition, the following conditions are to be considered:

1. The use of the most suitable building materials.
2. The architectural composition and the planning should consider the climatic conditions.
3. Protection against insects.
4. A minimum area and volume must be laid down. Ventilation of the dwelling.
5. Drinking water supply, primary kitchen, washing and sanitary equipment and connection with public installations lines.
6. Light: preference should be given to electric light (F).

Another recommendation of the iron and steel industrial workers demands:

1. Possibility to establish workers’ houses on a healthy site which is not very far from their working place.
2. The design of both factory and residence so that the disturbance of smoke, ashes, dust, gases and noise should be restricted to a minimum.
3. Placing both the factory and the residence so that a good traffic connection exists between them.
4. Allowing room for the future extension of both industry and colony in the direction where they are supposed to grow up naturally.
5. Providing enough areas for recreation and sport.

From the international point of view, the last problem is: should the growth of the industrial centres be vertical or horizontal? Vertical growth allows shorter communication lines, less traffic, and less area for industry with location of industry near to the workers’ colony. Meanwhile, horizontal growth lessens the technical equipment problem of the industry and allows every worker in the residential colony to have his own house with a private garden even if he should live far from his work to a certain extent. The economical aspects are commanding in this case; the land price, its agricultural cultivability and the degree of motorization of the workers will then dictate the answer.

The role of the government

Just after the international aspects of the problem comes the role of the government in every country as the executive authority in power and its capacity to assist industrialists, unions, and workers.

This happens in two ways:

Conditional:
1. Providing streets and traffic connections with the industrial centres.
2. Installation of water, sewage, electricity and telephone lines.
3. Paying a big share of housing and building costs.
4. Reduction of the land registration taxes.
Building site organization

1. Architecture and planning
   The role of the architects, planners, engineers, and contractors of the building industry

2. Building site organization

3. Rational use of labour force

4. Building methods

5. Rational use of building materials

6. Technical standard of the workers

7. Technical management

8. Finance

9. Creation of a good contractors’ and workers’ relationship to stabilize the building market.

The role of the industrialists and the factories

Not by means only of hard work or by mere chance can this aim be realised; it can be a natural result of a systematic procedure covering the following points:

1. Architecture and planning
   All the plans of the project and the buildings should be drawn, all the specifications written and both should be finished before the actual start of the execution.

2. Building site organization
   Better on-site organization could be achieved through better ordering of machines, building materials and workers. Strict working programmes should be planned and checked occasionally during the execution.

3. Building materials
   Specialization in each building branch should be encouraged for better quality and more quantity. Mass production and big contracts of work and provision of materials facilitate the achievement of the most economic results at the least cost.

Mechanization of working methods.
Use of prefabricated elements on a wide scale.

5. Rational use of labour force
   A very effective means of lowering building costs is better distribution of the workers throughout the different building branches and different regions.

Regulations and methods and the specifications of scaffolding, cranes, and other security and protection instruction for the dangerous parts of the construction.

Life and health insurance.
Preparation of the unskilled handworkers and the trainees to replace the specialized ones in the simple heavy tasks, thus sparing the skill and precision of the latter for more complicated and specialized work.

6. The technical standard of the workers
   This can be upheld by teaching and awarding a diploma of a certain knowledge level for every branch of the building industry and arousing the pride of the workers in their work, as well as their will to work in the atmosphere of competition that leads to progress and development.

7. Technical management
   The technical standard of industrial management is one of the most important problems in industrial economics. To raise the management level in the field of the building industry, two methods are to be followed. Practical courses are to be offered to the architects and engineers who achieve in reality highly theoretical study only, as well as theoretical courses in programming, planning, and organization of rational building sites for the executers and foremen who already have more practical experience but lack disciplined thinking, the capacity to organize and flexible rationalizing potentialities.

8. Finance
   Whoever may provide the capital, the management of the building operation should avoid price fluctuations. The untrue rise in costs which can result from the untrue artificial increase in prices which may result from illegal agreements between the contractors to keep a minimum for their prices should be avoided.

9. Creation of a good contractors’ and workers’ relationship to stabilize the building market.

The role of the industrialists and the factories

The factories and the industrialists are responsible by law in most countries to provide houses for their workers. This responsibility is obligatory in the case of the mining workers of the mining industry in Egypt, France, Ghana, Burma, India, Indonesia, Japan, Canada, Congo, and Pakistan.
The same is true of the petroleum industry, for the workers of the oil fields and oil refineries in Egypt, Argentina, Brazil, Chile, West Germany, France, Iraq, Iran, Saudi Arabia, Turkey, Venezuela, and Trinidad. The housing of all industrial workers in general is obligatory in Burma, China, Hong Kong, India, Japan, Pakistan, Philippines, and Vietnam. In Egypt it is obligatory for all the industries which are located in the eastern or the western desert provinces, or Sinia, or if the industry is located at a distance more than 15 km from the nearest urban centre or agglomeration. The factories can provide the houses themselves or follow the system of either:

1. Sharing with the government in its financial and technical help to the workers or their co-operative committees to build their own houses.
2. Renting houses from the municipalities or the provincial administrations at real cost and passing it on to the workers.

The problem which the factories may face is mostly the movement of the whole industrial colony, if the type of the industry is temporary as in the case of the oil fields, or the case of workers who leave the factory after they have done much in their home and its garden. These problems can be solved with some sacrifice and good planning.

The role of the worker

The unstable life of the industrial worker, in the midst of a fast, noisy and chaotic environment, disturbs his mentality. The industrial worker’s daily life will be given a handful of dignity, stability and security if he can afford his own private house.

The way towards the realization of this aim follows one of the following methods:

1. The worker can build his house himself. The industrial organization to which he belongs can offer him some bearing and roofing materials and technical experience. The worker is then responsible for following this “do it yourself” working system with durable systematic completion of the house and the active and frequent maintenance and repair of the installations. This method has already been followed in Porto Rico and Taiwan.
2. Streets, installations and plans can be offered from the government or from the industrial organizations and corporations. A cheap parcel of land and partial financial help will allow the worker to build his own house under the direction of the top authorities. In America and Russia, this method is widely carried on with big success. The workers build their own houses in their leisure, during their week end or in their holidays.
3. Establishment of workers’ co-operative committees to build on a large scale and big numbers of houses to profit from the mass production. This procedure allows the contractors to offer lower prices and more rational management of the building operation. This conception will certainly abolish the possibility of causing overpopulation, in the residential parts of the industrial centre. Also the haphazard growth of ill planned residential quarters will be avoided.

Conclusion

Co-operative action is needed from all who are concerned in the design of industrial centres to produce a complete perfect integration of work and residence. The role of each of the members concerned from the government to the individual worker varies from place to place with regard to the local conditions.

In Australia, the industrialists are recommended to build houses for their workers, and even if the government builds the houses it calls on the advice of the industrialists. While the industrialists are invited in Germany to have their say on the problem to encourage them to finance the projects, the workers in Ghana are called on to give their opinion as dwellers, and both industrialists and workers in India meet together to co-operate on a solution.

In England and Egypt, the privacy of an undisturbed private life is given the most importance in the design, while in Brazil protection against insects, heat, fire, humidity and noise has priority.

In Czechoslovakia the minimum facilities of the dwelling are the kitchen, WC, bathroom, lavatory, store and gas installations, while in Russia the model unit and the standardization of the building elements is of top importance especially in the installations of the heating and sanitary equipment of bathrooms, kitchens, and waste disposal.

In Italy, the Italian Federation Organization of Industry applies technical control on the measurements and specifications of the workers’ new houses while leaving the old ones. In Germany this problem is left to the natural development, and in the Ukraine the norms and specifications are changed occasionally to suit the new needs. In the Ukraine a minimum area and number of rooms per person is fixed with regard to age, sex and size of family. In Tunis the length, breadth and height of the rooms has a fixed minimum.

In most of the industrial centres, ventilation, natural and artificial light, and cooking facilities are assured, but in Pakistan artificial light is not an essential requirement, and in the Sudan these points are left to the local conditions.

Green areas and parks and children’s playgrounds are usually provided in most of the workers’ housing projects, especially in Germany, Switzerland and Sweden. While it is asked in the Philippines that the workers’ housing should be near industry, it is not usually possible to realize that in England and Greece. Minimum distances are fixed between the different industries and the workers’ colonies in USA. In Egypt special regard is paid to the cases of dangerous industries or industries using explosives.

Thus we conclude that elastic recommendations can be published to suit each case. Minimum standards and planning conceptions should take into consideration both the type and size of industry, and the type, income, family size and quality of the industrial worker. The growth of the centre and the future change in the life of the workers should be considered.
Industry and Colony Relations

Introduction

In the industrial centres, both industry and its residential complex influence each other in terms of:

1. Layout and planning conception, their position, form.
2. Distance apart.
3. Size, area, proportion, and density.
5. Growth and extension possibilities.

Factors

The fundamental factors in the mutual influence of industry and its housing complex are of two kinds:

1. Existing passive factors. Site conditions, topography, surroundings, nature of land, climate, area of place, local building materials, existing roads or canals or other means of communication.
2. Dynamic factors. Nature of industry, light, medium or heavy manufacturing, mines, number and quality of workers required, type and size of machines, duration of centre, growth possibilities, type of energy used, social conditions and living standard of the workers, future change of the region, the presence of cities, towns or villages in the vicinity.

Considering the above-mentioned factors, we will analyse the above mentioned 5 influences.

Layout, planning conception, position and form

1. The most simple form is the mere gathering of workers' houses around industry, turning into slums after a short time, and to a field of social diseases and crimes (Fig. 153).

2. Primitive housing built for the workers so that they may be near their work. Barracks for the unmarried. Houses with minimum life necessities for the married. Like the Staffordshire Village industrial centre, England, where both potteries and workers exist in the same place with pits of raw materials lying around them (Fig. 154).

3. The colony is in the vicinity of industry, in a sort of haphazard order or in pattern. No clear connection. Mostly temporary. Like the petroleum centres colonies the existence of which depends on the productivity of the oil wells (Fig. 155).

4. Spot concentrated temporary or durable housing for concentrated works like the Swiss project of Grande Dixence power station by architect André Perraudin which has been built of prefabricated elements to house 400 workers. No big future extension possibility (Fig. 156).

5. A mixture of both residential and industrial buildings of a certain industry (Fig. 157). Like the Krupp early housing. Imagination of possible future development and prediction of the growth progress and problems is lacking.
Advanced housing forms

7. Radial composition with the industry and the services in the inside serving as a core. Residential ring encircles it but is directed inwards. Green belt in between to allow growth of industry and separate it from residence. Agricultural fields and gardens radiate outwards (Fig. 159).

Fig. 159. A circular composition with radial pattern. (G5)

8. Enclosed ring composition of the industrial colony, with the industry outside its circumference and the public services in the core inside. The growth of the colony and its services is inwards or vertically, while the industry expands further in the opposite direction. The academic project of Prof. P. Nelson at Pratt Institute of Architecture in USA of an industrial centre claims to offer the pedestrian a mastery of space and full superiority over the motor-traffic (Fig. 160).

Fig. 160. An American academic project for an industrial centre.

9. Radial composition with the industry outside. Housing directed outwards. Parallel or opposite growth of industry and housing (Fig. 161).
Aluminium industrial centre, Ardal.

Fig. 161. Workers' housing in Germany.

10. Linear relation. Industry and housing each on one side of the communication line. Parallel growth of both (Fig. 162a).
Or in perpendicular composition to the communication line as in the academic project by the 'Technische Hochschule in Karlsruhe', 1958. A linear industrial city of 4 integrals, (Fig. 162b), industry, public activities, residence and transportation.

a) Industry with its production and administration.
b) Collective activities, social, civic, health, educational and recreational activities.
c) Residential.
d) Transportation.

11. Industry and colony combined in an inward-growing structure limited with a ring road like the Kafr El-Dawar textile industrial centre, Egypt (Fig. 163).

Fig. 163. Kafr El-Dawar textile industrial centre, Egypt.

12. Industry and colony in a parallel position and an outwards growing structure. The VW auto industrial centre, Wolfsburg, Germany (Fig. 164).

Fig. 164. Wolfsburg industrial centre, Germany.

13. The colony is composed of a part or parts linked with the industry. But still dependent on the factory for installations and existence (Fig. 165).

Fig. 165. An Olivetti workers' housing project. Ivrea, Italy.
14. The colony is a part of a town, and so is industry. Examples, Olivetti in Ivrea, Mahalla El-Kubra in Egypt (Fig. 166a), Henkel in Düsseldorf (Fig. 166b). Workers enjoy advantages and independence of industrial colonies as well as the vivid motion and facilities of urban life.

Fig. 166a. The Mahalla El-Kubra industrial centre, Egypt. Sharp contrast of form between old and new.

Fig. 166b

15. The colony functions as a residence of workers of many unrelated industries. This helps to finance the public common services which cannot be covered from one industry alone (Fig. 167).

Fig. 167. Workers’ housing in Helwan, Egypt.

16. The workers’ housing as a whole, together with the industry, which may be a group of big and small industries, compose a town like Harlow, England. This forms an independent industrial satellite town and relieves its mother city London of much load and chaos (Fig. 168).

Fig. 168. The Harlow industrial satellite town, England.

17. A whole industrial centre, factory and housing created as one unit on one spot. E.g. the VW centre in Braunschweig, Germany (Fig. 169).

Fig. 169. The VW industrial centre in Braunschweig, Germany.

18. A normal city turned into an industrial centre, like the cities where petroleum appears suddenly and inserts a new bee-hive like busy activity (Fig. 170).

Fig. 170. A city yielding to industry, USA.
19. The workers' housing is a part of a public housing scheme comprising industrial workers and low-income employees (Fig. 171).

The industrial compound, factory and colony should be studied as one unit. The colony cannot be studied alone logically and functionally. Combined installations for both should be dealt with from practical points, size, area, density and proportion.

Size, area, density and proportion

The industrial area is calculated from the number of workers required for the factory $W_i$ multiplied by the coefficient $l_i$ mentioned below or the production tonnage/year $P_{yi}$ multiplied by coefficient $A_{pyi}$. The area of the colony is calculated as follows; number of workers $W_i$ multiplied by the average number of the family members + single workers + the number of the persons working in the colony services multiplied by average number in their families, and the total multiplied by the coefficient $A_{wi}$ which represents the gross area of the colony/person (Fig. 172).

\[ W = \text{Number of industrial workers in a town} \]
\[ W = \frac{P \times w}{100} \]
\[ W\% = \text{Percentage of industrial workers to town population} \]
\[ W_i = \text{Number of the workers of a certain industry} \]
\[ W_i = \frac{P \times w \times w_i}{10000} \]
\[ W_i\% = \text{Percentage of the workers of a certain industry to the whole number of industrial workers} \]
\[ I = \text{Area of industry in m}^2 \]
\[ I_i = \text{Area of a certain industry in m}^2 \]
\[ I_i/w = \text{Area of a certain industry in m}^2/\text{worker} \]
\[ I/w = \text{Total area of industry} = \sum I_i/w \]
\[ I\% = \text{Percentage of industrial area to the town area} \]
\[ I_i\% = \text{Percentage of a certain industrial area to the whole industrial area} \]
\[ C_0/\text{pers} = \text{Gross population density of the colony} \]
\[ C_n/\text{pers} = \text{Net population density of the colony excluding streets and public green areas} \]
\[ F = \text{Average size of a worker's family} \]
\[ P = \text{Total population of a colony} \]
\[ P = (W_{\text{married}} \times F + W_{\text{single}} + W_{\text{boy}} + W_{\text{girl}} + W_{\text{seasonal}}) \]
\[ C = \text{Area of the colony} = C_0 \times P \]
\[ D = \text{Distance from the colony borders to the borders of the industrial area} (\text{Fig. 175}) \]
The following table gives the areas of various industries/worker and the electric current annual consumption/worker, and the daily consumption of water/worker.

<table>
<thead>
<tr>
<th>Industry</th>
<th>Area m²/worker</th>
<th>kWh/worker</th>
<th>annual m³ water/worker daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric power stations</td>
<td>150-590</td>
<td>200-1000</td>
<td>1500-20000</td>
</tr>
<tr>
<td>Cement</td>
<td>60-200</td>
<td>1000</td>
<td>15000</td>
</tr>
<tr>
<td>Asbestos</td>
<td>50-200</td>
<td>1000</td>
<td>15000</td>
</tr>
<tr>
<td>Locomotives</td>
<td>70-200</td>
<td>1500</td>
<td>25000</td>
</tr>
<tr>
<td>Electrical machines</td>
<td>50-100</td>
<td>1500</td>
<td>25000</td>
</tr>
<tr>
<td>Precision instruments</td>
<td>30-60</td>
<td>1500</td>
<td>15000</td>
</tr>
<tr>
<td>Lenses, lenses</td>
<td>12-24</td>
<td>1500</td>
<td>15000</td>
</tr>
<tr>
<td>Chemical industries</td>
<td>300-1500</td>
<td>40000-25000</td>
<td>50000</td>
</tr>
<tr>
<td>Coke</td>
<td>200-1000</td>
<td>3000</td>
<td>30000</td>
</tr>
<tr>
<td>Bakery</td>
<td>40-120</td>
<td>1000</td>
<td>15000</td>
</tr>
<tr>
<td>Mills</td>
<td>200-400</td>
<td>5000</td>
<td>50000</td>
</tr>
<tr>
<td>Automobiles and tractors</td>
<td>30-60</td>
<td>1000</td>
<td>15000</td>
</tr>
<tr>
<td>Aeronautics</td>
<td>15-200</td>
<td>1000</td>
<td>15000</td>
</tr>
<tr>
<td>Textiles cotton</td>
<td>22-40</td>
<td>7000</td>
<td>12500</td>
</tr>
<tr>
<td>Ceramics</td>
<td>40-200</td>
<td>1500</td>
<td>25000</td>
</tr>
<tr>
<td>Paper</td>
<td>80-200</td>
<td>3000</td>
<td>15000</td>
</tr>
<tr>
<td>Glass</td>
<td>30-60</td>
<td>1500</td>
<td>15000</td>
</tr>
<tr>
<td>Book binding</td>
<td>50-150</td>
<td>3000</td>
<td>15000</td>
</tr>
<tr>
<td>Sugar</td>
<td>60-300</td>
<td>6000</td>
<td>30000</td>
</tr>
<tr>
<td>Surface industries</td>
<td>300-1500</td>
<td>40000</td>
<td>25000</td>
</tr>
<tr>
<td>Paper</td>
<td>80-200</td>
<td>3000</td>
<td>15000</td>
</tr>
<tr>
<td>Veal factories</td>
<td>100-200</td>
<td>2500</td>
<td>50000</td>
</tr>
<tr>
<td>Textiles</td>
<td>25-50</td>
<td>2000</td>
<td>15000</td>
</tr>
<tr>
<td>Ceramics</td>
<td>40-60</td>
<td>3000</td>
<td>15000</td>
</tr>
<tr>
<td>Paper</td>
<td>25-50</td>
<td>1500</td>
<td>15000</td>
</tr>
<tr>
<td>Printing machines</td>
<td>150-350</td>
<td>2000</td>
<td>50000</td>
</tr>
<tr>
<td>Textiles</td>
<td>25-50</td>
<td>2000</td>
<td>50000</td>
</tr>
<tr>
<td>Wallpaper</td>
<td>20-50</td>
<td>1500</td>
<td>15000</td>
</tr>
<tr>
<td>Book binding</td>
<td>60-150</td>
<td>3000</td>
<td>15000</td>
</tr>
<tr>
<td>Tobacco</td>
<td>20-40</td>
<td>3000</td>
<td>15000</td>
</tr>
</tbody>
</table>

Industries with a production ratio more than 50 tons/worker/year need separate street links.

Industries with a production more than 300 tons/worker/year need street link and railway line.

Industries producing more than 200 tons/worker/year need street link, railway line and water way.

<table>
<thead>
<tr>
<th>Industries</th>
<th>Services</th>
<th>Unemployed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big cities</td>
<td>Russia</td>
<td>50-55</td>
</tr>
<tr>
<td>Commercial</td>
<td>cities</td>
<td>30-33</td>
</tr>
<tr>
<td>Zürich</td>
<td>23 %</td>
<td>28 %</td>
</tr>
<tr>
<td>Midium cities</td>
<td>33-34</td>
<td>20-23 %</td>
</tr>
<tr>
<td>Small industrial cities (Harlow)</td>
<td>24 %</td>
<td>24 %</td>
</tr>
</tbody>
</table>

Industries with a production ratio more than 50 tons/worker/year need separate street links.

<table>
<thead>
<tr>
<th>Factors influencing the design</th>
</tr>
</thead>
</table>

The area of both light and medium industrial zones is influenced by the following factors:

1. Type of factory building adopted. Factory of one or more storeys.
2. The location of the different blocks relative to each other.
3. Size of factory, number of workers.
4. Production line, rolling belt, assembly line or collective methods, and the degree of automation.
5. Kind of industry, manufacture, processing or raw materials industry.
6. Open and covered storage area required for raw materials and products.
7. Type and frequency of the means of transport.
8. Presence of public activities buildings within or in and between the factory buildings.
9. Growth possibilities and the reserve area needed.
10. Natural restrictions such as rivers, mountains, existing agglomerations or heavy traffic lines and junctions.
11. The efficiency of the architectural composition of the whole complex.
13. Expansion possibilities with regard to the natural environment.

The factors affecting the residential area of the colony are:

1. Number of workers in the factory.
2. The number of working shifts per 24 hours and workers per shift.
3. Class of workers, their technical level and social standard, and personal tendencies.
4. Social conditions of the workers, single, married, how many children.
5. Degree of dependence on the surrounding neighbouring urban centres or residential agglomerations.
6. Type of buildings adopted, one-family houses, row houses or blocks of flats.
8. Type of ownership adopted.
9. Type and size of the necessary services and the public buildings planned within the colony borders.
10. Green, parks and recreational areas required and the type and size of sport fields provided.

The form and size of the industrial complex comprising industry and residence is shaped and moulded within a certain giving geographical site according to the existing means of transportation and its different ranges and the displacement of the central focal core of the complex, either industry or city.

Other influencing factors

Smoke, ashes and dust

In general, the factory should be put on the side of the residential area down-wind from the maximum prevailing wind of the maximum duration. More precisely, on the side of the minimum amount of the prevailing wind (Fig. 173). The location of the factories in a deep valley or underground should consequently be avoided. The use of electricity in light and medium industries lessens the danger of the smoke attack on residential areas, from which the heavy industry as well as much medium industry still suffer.

A striking example of this danger is the Ruhr region in western Germany (Fig. 174), which can be seen from the following:

1. In one night 130 private gardens were destroyed and trees 190 000 DM in value were burnt under the rain of ashes.
2. The costs of the inspection and the judgement of the case reached 20 000 DM.
3. The effective power of the sun is reduced to 1/2 of its real amount.
4. The 14-year children weigh 45.5 kg and are 160.5 cm tall against those of the neighbouring regions who are 48.5 kg and 160.5 cm.
5. In 1952, the deaths from cancer were 65, in 1954 105, in 1956 101, in 1958 125, that means an average of 50.31 per 100000 persons, while the average in the USA where cancer is a common illness is 31/100000. In comparison with the neighbouring regions, 15.1 % of the children are ill, against 7.6 % and 6.6 % have bad eyes against 1.7 % in the other neighbourhoods.

6. Diseases increase to a marked extent.

These are sample characteristics of the Ruhr region's heavy industrialized areas of blast furnaces where there are 56 Thomas steel convertors and 93 power stations using coal as fuel and 82 blast furnaces and 17 cement factories and oil refineries and 1976 steam factories and DBB locomotives. This mass of machines turns the environment into a small Pompeii over which it throws annually 1.5 million tons of dust, smoke and ashes and 4.5 millions of tons SO2, an amount that would need 75000 wagons to transport it. This danger reflects itself on the daily life of the region. As an example, the house No. 228 in Essener Strasse which falls directly under the shadow of smoke of the Oberhausen works pays a monthly rent of 24 DM instead of 80 DM. Washed automobiles stay clean no more than 24 hours. Automobile accidents are a daily occurrence. The Duisburger police registered 750 accidents in 1961 where the black smoky fog and the wax-like street surfaces covered with wet ashes are a main reason.

The extreme loss and restriction of freedom is apparent in the warning which is given to the population in the vicinity not to open the windows, ventilate their homes, allow their children to go outside or even the women to go on a walk or shopping during the time between 10 to 11 o'clock in the morning and between 8 to 9 o'clock at night, as experience showed that within this period the smoke output reaches an appalling and disastrous maximum. To absorb the smoke, dust and ashes before they spread in the air, aerodynamic electric filters are to be used in the industrial furnaces. Although they are very expensive, they can absorb successfully 40 % to 95 % of the dust and smoke produced. Besides, we should design the industrial centres so that green belts extend perpendicular to the direction of the main prevailing wind every about 600 m.

Thirdly, the streets and the buildings should be directed so that they avoid the direction of the flow of dust. This dust flow can be artificially directed to the other side of the industry.

The openings of the houses, their locations, their private gardens and the possible planning of calm internal courts and patios are devised to avoid direct facing by the dust flow.

Smell

Many industries produce smell during the production or transformation process. They can be classified into:
1. Industries with products which cause smell like tobacco, butcheries, gelatine, fish, rubber, cellulose and fertilizers.
2. Industries with production processes that smell, like chemicals, foods, drinks, and perfumes.

The problem of smell can be solved by considering the prevailing wind directions and by fixing a minimum distance between each of the industries mentioned and the nearest residential areas.

Noise

This kind of industrial disturbance is created either from the noise and the vibrations of the machines themselves, or from the manufacturing process of the product. It can be also due to the heavy means of transportation. The maximum bearable noise degree allowed is 30 to 45 phone in a working hall and 30 to 40 phone in houses, schools, offices and residential rooms.

These values could be proportionally measured compared with the following noise values:
The sounds would begin to be heard if it is of a 0 to 10 phones value. A calm street has about 40 phones. A typing machine or a ringing telephone bell have 70 phones at a distance of 1 m. Moreover, one should take into account design in terms of sound and noise the following points:

1. The sounds which are bearable in the morning are unbearable at night.
2. The strong sound, but far away, is of less influence than the near weak one.
3. The tone of the sound should be also taken into consideration.

The nuisance of noise can be eliminated by the following:

1. Using sound insulation materials in the construction of the factory and the workers' houses.
2. Providing insulated foundations for the machines.
3. Using sound absorbers for the machines of the factory and the transportation vehicles.
4. Maintaining a certain distance between the factory and the residential areas, enough to decrease the noise value.
5. Planting green belts round the factory or between it and the residential areas. If possible, locating the industry and its residential area with a stream of water or a river in between.

Other dangers

The danger of fire, explosions, and air raids or military attacks as well as disorder, strikes and political chaos and voting clashes, added to the complications of the transportation means, encourage the idea of the decentralization of industry.

The following list shows the different distances which should be left between the dangerous factories and the residential areas. Distances from 100 to 1000 m are to be left with the factories which have a store of explosives like dynamite, black powder or safe explosives between 50 to 1000 kg.

The danger of fire can be met by the use of fireproof materials and taking all possible fire precautions.

Radio-activity

This effect is new. Russia and Poland are the only two countries in the world which have laws concerning and regulating the subject of radio-activity. In Russia, five classes of industrial zones vary in their obligatory distances from any residential building; 1000, 500, 300, 100, and 50 metres according to classification.

In England there five classes of industries grouped after:

A Danger of smoke, ashes and smell.
B Dust.
C Poisonous gases.
D Explosion.
E Infection.

The danger of air raids can be met with camouflage which deceive the pilots from the air. This camouflage is naturally too weak against developed radar methods and the accurate detection possibilities of modern aeroplanes, but a development in camouflage technique is expected to counter it.

Distance between colony and factory (Fig.175)

Wages are now so standardized that workmen choosing between rival employers will naturally have a preference for the one whose factory gates are the nearest to their proposed homes or they will want an equivalent in wages for each kilometer that they have to walk or travel. When this travelling time is capitalized and multiplied by the number of workmen, it may often turn a cheap piece of land into a very dear speculation.

The converse opinion says that the homes and colonies of the industrial workers should not be too near to industry for the possible disadvantageous psychological influence which would occur.

Owing to the disturbances mentioned above caused to the colony owing to its presence in the vicinity of the factory, minimum distances are to be kept between them. The distances mentioned later are empirical figures which can be influenced by the following factors:

1. The type of disturbance considered, smoke, ashes, smog, slag, dust, noise, vibrations and explosion danger.
2. The direction of prevailing winds, time, season and duration.
3. Topography of site, and whether the colony is higher or lower than the factory.
4. The type of machines, nature of fuel, and source of energy used.
5. Type of production, its volume, frequency, and method of distribution.
6. The presence of natural or artificial screens between factory and colony, like trees, forests, rivers or other buildings.
7. Orientation of the houses, windows and streets.

The distances given are:

100 m from:
- lead factories,
- machine tool factories,
- painting and dyeing factories,
- crane factories,
- tobacco factories.

200 m from:
- transport wagons factories,
- agricultural machine factories,
- bakery machines,
- wire products factories.

300 m from:
- soap factories,
- fish industries,
- conserved food industries,
- oil and water tanks, blacksmith workshops.

800 to 1000 m from:
- tractors and crane wagon factories,
- trailer factories,
- accumulator factories,
- rubber works.
Fig. 175. Diagram showing relative minimum distances between residential colonies and various industries.

Industries
1. Printing, car repairing, measuring instruments, bakery, simple furniture, building companies, laundries
2. Heating installations, milk, furniture works, ceramics, iron works, sugar, chemicals, chocolates, gas-ovens, boat works, tobacco, cigarettes, coffee mills, wine vats, cheese factories, carpenter’s shops, sports goods, boot-making
3. Light metals
4. Agricultural machines, big carpenter’s works and saw mills, lacquer, wax and candles, vinegar, mustard, paper factories, milking and agricultural machines factories, automobile works, brick making
5. Cosmetics
6. Soap, dyes and paints
7. Fish industry
8. Preserved foods, iron smelting works
9. Metal tanks, tar and asphalt products
10. Lead factories, coal and charcoal industries
11. Ship propellers, steel mills
12. Iron construction works, ship building
13. Tinwares, accumulators, trailers and tractors
14. Asbestos factories, bronze plants, copper plants
15. Rubber factories, raw sugar factories
16. Mineral oils, blast furnaces and steel convertors, cellulose plants, internal combustion engines
17. Hydrogeneration plants
The Design of the Industrial Colony

The design structure of the industrial colonies within the framework of the previously mentioned design principles for industrial centres is a product of the following factors:

1. The regional conditions
   With regard to agriculture, topography and geographical position of the industrial centre and its characteristics. For example, if agricultural land is dear, the colony should be built on uncultivable land.

2. The class of industry
   Heavy industry, big working population, complete towns could be established. Proportionately far from factory. Medium industry, independent colonies. Light industries and workshops, housing as part of towns, districts, sometimes colonies.

3. The type of industry
   Mining industries
   a) Obligatory location of industry and working place. No free site selection, but possible displacements of colonies to suit some planning requirements or to achieve economic advantages like a combined shopping centre or transportation line with some other colonies or centres.
   b) Structures, machines and residential colonies are located wherever raw materials demand and not according to prepared geometrical plans.
   c) Usually situated far from urban life. Partially independent.
   d) Normally built only for the industrial workers.
   e) Simple houses, in both plan and construction.
   f) Future extension and duration of the colony is dependent upon the raw material supply.
   
   Manufacturing industries
   a) The manufacturing industries are the richest in most fields. Transforming raw materials into finished products adds work, experience, energy and profit to the price. More qualified workers required. The industry is more stable.
   b) Site selection wherever industrial conditions, or special weather conditions, markets, power, labor, or transportation facilities demand. Sometimes also near raw material resources.
   c) Industry and colony are located according to regional and city planning principles.
   d) Sometimes situated far from urban centres, but usually near to or part of an existing urban centre, or itself composing an urban centre. The Krupp steel industries create a complete industrial region in the Ruhr in Germany. The VW industrial centre creates a complete city of Wolfsburg.
   
   The industry can also dominate an existing town, as do the Olivetti centre in Ivrea, Italy, and the Mahalla El-Kubra centre in Mahalla, Egypt (Fig. 165a).
   The industry occupies, with its colony, a complete section or quarter of a town, e.g. the Henkel industrial centre in Düsseldorf, Germany (Fig. 166b), and Cairo Northern Power Station, Egypt. An industrial complex of different manufacturing industries may create a city housing the working population as in Harlow and Stevenage in England, and Suez and Aswan in Egypt.
   
   Integration of industrial and agricultural centres
   a) The centre is a mechanised farming area, with agricultural machines and chemical industries.
   b) Agricultural products are industrialised, as preserved food industries.
   c) Light industries and workshops joining industry where seasonal work and part-day or part-week work occurs, in agriculture.
   The housing of the farmers is the same as for the workers.

4. The type of raw materials
   It is mostly an economic question whether the colony and industry should go to the raw material with finished products to be transported, or if raw materials should be transferred to an urban area where industry and colony exist.

5. Human energy, number, qualifications and background of workers. Measure of their needs and social conditions.

6. Transportation
   Existing and potential transportation facilities for workers, materials and products. Other means of communication.

7. Utilities
   Materials, food, water, gas, fuel, steam, compressed air, electricity and shopping needs.

8. Financial resources
   Government, bank organisation, or individual. Influence of the share of the worker or the factory in the costs.

9. Short and long term maintenance possibilities.

10. Construction techniques, building materials and experience available on site for establishment of the colony.

11. Distribution markets

12. Future extension possibilities and duration of the centre. This relates to the growth of the industry, factory and the population of the colony, and the possible creation of other industries or activities in the future.

13. Military conceptions
   Camouflage possibilities. Defensive points.

14. Political conceptions
   The concentration of workers in one spot is influential in elections and strikes.

15. Social and traditional conceptions
   Avoidance of social split from the surrounding societies.
Elements of the Industrial Colonies

The elements which compose the structure of the colonies or the residential compounds of the industrial centres differ much in function and size with respect to the demands of industry and the needs of the workers and their colony. They vary with the following factors:
1. Type, size and location of the industry.
2. Rate of integration with or independence of other urban agglomerations if such exist, and the means of communication with them.
3. Type, class, sex, number, and social standard of the workers; size of families.
4. Duration of the centre and its growth possibilities.
5. Financial aspects.

These elements fall under the following classification:

Activities and services elements

The industrial colonies are no longer just a problem of sheltering workers. Social, sanitary, educational and recreational aspects are considered as most important.

The class of services elements involves the following:

1. Educational buildings

Different stages of educational buildings, kindergartens, primary schools and/or secondary schools. Technical training schools are also provided as needed and according to the population of the colony.

In Fig. 176 an example of a kindergarten and nursery of Olivetti industrial centre in Ivrea, Italy. The working mothers leave their children in good care, playing, eating and sleeping, from morning to the end of the working day. The building is situated in the middle of the factory (Fig. 177).

Another example from Olivetti is the kindergarten and school building in the centre of the Olivetti industrial workers' colony 'Canton Vesco'. Another school is now under construction to allow this building to accept more children of kindergarten age in the future. Capacity of the existing school is 80 children. It consists of a slightly inclined roof construction supported on steel cylindrical columns. East and west fronts consist of full-height glass sheets. Prefabricated elements close the north and south facades. Floor structure of a friendly scale and is proportionally sized for the colony.

Wolfsburg's school in Germany (Fig. 178) gives a contrasting example, showing educational facilities on another scale, proportional to the comparatively gigantic size of the Wolfsburg industrial town.

The location of the educational buildings is to correspond the walking distances of the different age-groups. In most of the industrial colonies both the centre and the sides of the area are usually within these ranges.

Three points are to be considered in the design of the educational buildings of the industrial colonies:
— The teaching staff has mostly to be housed in the colony, otherwise some transportation means must be provided.
— The buildings and playing fields have to serve other functions for the adult population after work to escape problems of limited site and budget. Also they should serve the neighbouring agglomerations as much as possible.
Growth of the colony and growing-up of the children should be allowed for, either leaving space for a school near a kindergarten, enlarging the existing buildings after a pre-plan, or organising the transportation of the grown ups to schools in the vicinity.

2. Health and sanitary elements

Their presence is of great importance in almost all categories of industrial colonies (Fig. 179). Their type and size differ with respect to the type of industry, the degree of probable dangers and accidents, the size of the colony and the distance of the nearest health service or hospital in the neighbourhood. A first aid service is necessary in every industrial factory or colony. It is compulsory by law everywhere.

A complete clinic and all necessary preparations for small operations are to be included in every workers' colony which is removed from urban centres or which lies in urban places that lack good health services. In many cases a doctor should be ready on duty all the time. In other cases when many neighbouring colonies lie near each other, as in the case of the phosphate mines colonies in the eastern Egyptian desert, a doctor has under his supervision many colonies at the same time, with assistants in the big ones. Hospitals and big clinics are to be provided in the case of big colonies or when many villages surrounding the colony depend on its health services. In this case the cost of the health centre is shared between them and is easily covered. Children's medical services can be combined with schools as in the kindergarten of the Olivetti centre.

3. Shopping services

Daily provisions, milk, bread, vegetables and meat must be at hand. But the kind of shopping centre needed must be proportional in size to the size of the colony and its relations and degree of dependence on the region and the neighbouring urban and rural centres. In the Olivetti typing and calculating machines industrial centre, Ivrea, and the Henkel chemical industrial centre, Düsseldorf, no local shopping centres exist, as the workers' colonies are in the middle of the district shopping area (Fig. 180).

In Harlow, England, and Wolfsburg, the automobile industrial centre, a central as well as a strip shopping centre are provided. Weekly markets are held in the market places. These places also serve other functions in festivals and ceremonies (Figs. 181 a, b). Three main points have to be considered in the design of the colonies' shopping centres: First, the location of the centre within walking distance for assuring protection from rain, sun and traffic. Second, the solution of the traffic problems, separation of motor vehicles and pedestrians, and separation of the normal motorised traffic from the delivery traffic to the stores and shops, either by differentiating levels or staggering in time (Fig. 181c, 182).
5. Recreational elements

These elements (Fig. 184) differ according to the locality of the industrial centre and its colony, to the social standard of the workers, their customs, traditions and hobbies and interests as well as their national sport tendencies, space available, financial limits and duration of the industry on the spot and the degree of relations with the neighbouring agglomerations as clubs, theatres, cinemas, city halls, meeting halls.

Third, the study of the future growth of the colony in size and direction, and the possible corresponding growth of the shopping and business centre according to the new needs. Housing of the staff employed in this centre is to be considered from all points of view.

Activities elements

This type of elements involves:

4. Religious buildings

Churches, temples, and mosques are to be provided as a complement to the social services (Fig. 183).

Firstly, they give a sort of psychological stability and internal confidence to the colony dwellers. Secondly, their towers or minarets give opportunity for many architectural forms that give a point of interest in a needle form to the whole architectural composition. Thirdly, they can be used for other educational or social purposes.

Size should be calculated according to the population of the colony.

Sports buildings, opened and closed, passive and active, are probably to be included in the program of an industrial colony.
Possibility of competition with other colonies or neighbours as well as acceptance of more members from other colonies or from the surroundings, decide the size and degree of importance of these elements, their buildings and their equipment.

6. Transportation and traffic

The transportation problems differ owing to the local circumstances of each colony (Fig. 185). Special transportation lines should be provided to carry the workers to and from their homes if the colony is far from the factory. An important item especially in winter or on rainy days. Enough connection roads, bridges, underpaths, parking facilities, footpaths and traffic control should be assured.

Good road links for private cars should connect the colony with the industry. Where there is a city nearby, a daily or weekly connection line as the case may be should be provided for the provisions and the shopping facilities which the colony lacks. This line can be used for the provision of the colony's needs and to spare special transport. If transportation lines already exist near the colony, they can be used as the fundamental main connection lines of the colony with the neighbouring city or villages, or with the factory. In this case an auxiliary reserve service should always be ready on call for special cases or during the rush hours of the morning and evening and for night services. The transport of children to and from the neighbouring village or city schools should be also provided for. Transportation expenses can be covered by the combination of the colony service with other similar traffic services of the surroundings. Subscriptions and tickets could be arranged with free tickets during working hours. Garages, private or public parking places, workshops, petrol and oil service stations, separate paths for bicycles, and pedestrians' footpaths should be provided to keep the cars in good condition, protected, serviced and isolated from traffic and passers-by when parking. The connection of the colony with the outside by systematic means, good administration and fixed traffic timetable, and a terminus, gives the dwellers confidence and a secure feeling of connection with the outside world and freedom from any trace of social division. The constructional methods for the roads, streets and paths depend on the local material available, size and plan form of the locality, the financial allowances, and the density, volume, peak hours and duration of the traffic.

Other elements

An unlimited number of other architectural elements and activities appear as basic parts of the industrial colonies (Fig. 186). The factors influencing the design of the industrial colony will also influence the type of elements used and the type of activities adapted.
The administration of the factory and the colony of 'Usine d'emboutis-
sage' near Paris, comprises offices, guards' houses, guests reception,
avatory, medical and social services, garages and refreshments' room.

The restaurant and the cafeteria of the Electronics factory of Blooming-
ton. It serves 3500 workers and can be converted into a meeting hall, a
movie theater or a place for social activities. An adjacent tree-shaded
terrace is joined.

The water tank in the Lacq
industrial centre, France. (M 40)

Fig. 186. The library in the Olivetti
industrial centre, Ivrea, Italy. (V 17)
Zoning and Landscaping of the Industrial Colonies

The main parts composing the structure of the industrial colony are its 4 fundamental sections:

1. Public
2. Residential
3. Recreational
4. Traffic

Zoning

The industrial colonies differ in their zoning principles from any normal housing project. They have in themself social structures which influence their shape and reflect themselves in the final form and composition of the whole industrial centre.

Public part

The public part consists of the zones of common services, shopping, social community activities, schools and educational, clinics and health, and religious.

Residential part

The internal sub-zoning of the residential part can be conceived in either of two ways. First, in terms of professional classification, as in the Henkel colony in Düsseldorf, the Suez colony in Egypt and the Castellamonde colony of Olivetti in Ivrea, Italy (Fig. 187). Second, the sub-zoning could be in terms of the different building types adopted. This allows the possibility of mixed housing for the different professions, but with the consideration of social equalities easily adopted in the industrial colonies, as in Wolfsburg VW centre, and the Canton Vesco colony in Ivrea (Fig. 188) or a mixture of the two principles as seen in the industrial centre of the Indian General Telegraph Company (Fig. 189).

a) Workers' housing zone
b) Supervisors' housing zone
c) Engineers' and technicians' zone
d) Employees' (office) housing zone
e) Directors' zone

Recreational part

Green, sports and park areas. Can comprise pools, lakes and natural elements such as shores, mountains and forests. Would also overlap with the recreational buildings of the public part.

Growth

An area for future extension should be preserved for the growth possibilities of colony, industry, and storage areas. Prediction of future traffic volume increase, meaning developments, new junctions, and other extended facilities, should always be a factor in deciding on the size and planning of this part.

The educational building should be integrated with green areas to increase the density of greens. Walking distances determine their location to a large extent (Fig. 190).

Landscaping

The industrial colony as an independent element in most cases has to benefit much from the already existing natural landscape to minimize the expenses of an artificial one.

The features of its landscaping are:
1. Desert, sandy or rocky landscape.
2. Forests with seasonal or durable green.
3. Sea, rivers, lakes, pools or canals, and beaches.
4. Mountains or hills with sharp or gentle slopes.
5. An already existing landscape of a neighbouring agglomeration.

These features will not only give the colony its own particular vivid artistic touch, but will also influence the architectural composition and the street pattern as well as traffic network and its relation with the industry and the environment and extension direction. A multi-use green area could be combined with the schools and the educational buildings, and the public recreational areas of the colony, if economically necessary.
The landscape and the green should give the impression of houses planted in the green and not of green planted between the houses (Fig. 191a, b).

In desert industrial colonies, where the expensive irrigation water has to be saved, green should be provided in the private gardens where it will be certain of individual care. The public green areas should be very concentrated and near each other in spots of oasis-like pattern. The houses of the oil companies’ workers, technicians and engineers in Kuwait (Fig. 192) give a good example of inserting green inside the houses wherever the industrial centre is in a region where water is dear. The converse example of planning houses on a green carpet is the colony of Olivetti in Ivrea, Italy. Fig. (192b)

Fig. 189. The zoning of the industrial colonies in terms of the professional classification of the working population. Project of a factory and industrial colony in India. Established by the project of an electrical and radio equipment factory and the workers’ colony, established by the General Telegraph Company Ltd. (M 5)

1. Public building and services.
2. Directors, 20 villas × 20 persons.
3. Engineers, 400 villas × 5 persons.
4. Office employees’ houses, 1000 persons.
5. Supervisors’ houses.
7. Girls and boys works if there are any or unmarried workers.
8. Playing fields for the engineers and employees.
10. Technicians’ houses.
11. Technical workers’ houses, 16000 in 3000 apartments.
12. Handworkers’ houses, 1500 in 450 apartments.
13. Servants’ and low class workers’ houses, 500 in 12 blocks.
15. Annexes, administration, repair shops.
16. Existing village.

Fig. 190. Zoning of Harlow, England. Four clusters and old Harlow. Sub-centres are within walking distances. (R 21)
Conclusion

The zoning of the industrial centres should integrate the different working classes and abolish any saggregation that would affect the work and the daily life of the industrial workers and technicians. Green areas and green belts should be essential parts in the design of the industrial centres.
Street Patterns in the Industrial Centres

The industrial area

The transportation density, frequency and volume as well as the duration of work and the size of the working population determine the type and kind of traffic, streets and junctions of an industrial centre. The industrial part of the centre needs more fluid means of communication for transportation of raw materials and workers as well as for the production distribution process. These factors relating to the industrial part affect the following:

1. The choice of means of transport used for external communications:
   - Roads, highways or streets
   - Sea, river or canal
   - Railways, heavy or light, double or single
   - Airways, heavy or light
   - Other means: pipelines, with or without reinforcement stations
   - Caravans, motorised or on animals
   - Cable-railway
2. The choice of means of transport used for internal communications:
   - Breadth of the streets, their crossing and approaches.
   - Thoroughfares or culs-de-sac.
   - Types of crossing with other streets as well as with pedestrian footpaths.

The form and the general shape of the centre is an additional factor in internal communications. Moreover, the nature of the raw material and the variety and type of the finished product and its package process as well as the degree of automation of the industry and the variety are all factors influencing the determination of the internal street pattern.

The residential colony

The industrial colony differs from any other housing project in its structural characteristics as an enclosed social and economical unit, in its buildings and street patterns, and in its very internal conceptions. Even if the colony is connected to a city, the street pattern is internally influenced by its own local traffic density, the connection system with its factory and the degree of integration of both the colony and the factory with the environment.

The factors determining the design of the industrial colony's street pattern are partially common to the ordinary neighbourhoods and partially are only a product of the relation of the colony to industry. The latter includes:

1. Location of the colony with respect to the factory, and the type of connection between them.
2. Services expected from the street network other than workers' traffic.
3. Population density, size and area of the colony.
4. Distances between buildings.
5. Types of buildings and of garages, private or common.
6. Proportions of the colony. Longitudinal or square.
7. Topography of the land.
8. Future extension possibilities of factory and colony and extension direction.
9. The type of communication lines outside the colony, and the colony's degree of independence of the them. Volume of foreign through traffic.
10. Installations which must be included in the construction of the streets and their characteristic constructions, (straight lines or allowing for curves and crossings and levels).
11. Degree of motorisation of the workers. Number of cars per family. Frequency, type and density of traffic.
12. Architectural composition, location of terminus with respect to the whole plan, public activities, garages and parking places. Walking distances.

In addition to the above mentioned factors, the pattern of the street system should be chosen to fulfil human and economical as well as the planning requirements. Street patterns which could be adopted for the industrial colonies and their industries are presented in the following analyses in terms of:

1. Type and nature.
2. Traffic conditions, internally and externally.
3. Their influence on the architectural composition.
4. Their influence on the future growth and extension.

1. Ring roads system

a) Ring road encircles the entire colony (Fig. 193), the colony has small area, one concentrated connection with industry.
   - Good traffic control.
   - No crossings, safe traffic line.
   - Green and public amenities are in the middle.
   - Restricted growth possibilities.

Fig. 193. An oil centre in the Egyptian desert.
b) Ring road with internal feeding branches (Fig. 194).
Colony can be big enough for many housing groupings, still having one concentrated connection with industry.
No main crossings, safe traffic.
Green and public amenities are in the middle but more complicated location study to suit different requirements.
Extension possibilities are better. Excess area could exist for that purpose. Growth is internal.
The internal feeding branches can have dead-ends to minimize the through traffic (Fig. 195).

c) Ring road with outer feeding branches (Fig. 196).
Colony is no longer limited in space.
Amenities are central. Underpaths or bridges may be provided to reach them. Green is in the centre of the colony and is integrated with the houses.
Growth possibilities are unlimited for the residential sections. The public section is limited in growth allowance. A pre-plan should be studied and enough area for internal growth should be provided. More than one connection could be afforded to industry.

2. Geometric checker board system
a) A grid-iron system of crossing roads (Fig. 203).
One main road, usually in the middle, connects the colony with the industry.
Amenities and green occupy a certain zone.
Traffic and installation crossings.
Not economical in construction.
Extension possibilities are available, simply by addition of more squares and extension of streets.
Practical only when control, numbering and plotting of streets, and execution of houses is very easy: in mining colonies or where no traffic is present and cheap street construction can be adopted.
b) Other additional elements complete the functions which the street is expected to serve.
A square can be added to give a central weight to the colony and a place for group activities, such as festivals and weekly markets for the neighbourhood.
Another main lateral road can be added to give a lateral main traffic line, or to create another connection with the factory to relieve the provision line and serve as secondary exit or access for the colony.
A staggered geometric streets system can be adopted in cases where traffic is too heavy, and crossings can be avoided (Fig. 197).

3. Free line street system
The system of streets is laid down in this case after the determination of the architectural composition of the colony.
The street passes freely between the buildings as required for communications. The contour lines of site and the planning considerations are the only factors influencing the design of street pattern.
Curves and twists are also arranged to achieve the best view, perspective and composition from every side during driving or walking (Fig. 198).
4. Combination of more than one system

a) Ring road with internal geometric system.

b) Ring road with internal or external free street system.

c) Geometric system with a connecting ring road.

d) Geometric pattern of parallel main and secondary roads (Fig. 199).

5. 'Cul de sac' system

Dead ends provided to avoid fast traffic and crossings of through traffic (Fig. 200).

Other elements can be added to the street patterns adopted for industrial colonies. Feeding roads for example isolate the traffic between the colony and the factory from the main traffic of a highway.

Conclusion

The industrial centres allow a big variety in the choice of the street pattern adopted but it is important to choose a pattern which allows an uninterrupted stream of traffic and maximum service at minimum costs. This will influence the total costs which in turn will influence the production costs and the rents of the houses.
The Architectural Composition of the Industrial Colonies

Influences

From the architectural composition point of view, the industrial colony is open to influences other than those affecting any normal housing project. The limitations and also the future extension of the colony decide the nature of its architectural composition. The factors which are common to the industrial colonies and the housing projects are:

1. Nature of site, area and topography of the colony and its proportions.
2. Climate, its technical and orientation requirements.
3. Materials used and constructional devices and building equipment.
4. The surrounding natural and artificial features, rivers and forests.
5. Personal taste of the architect and the planner.

The specific factors peculiar to only the industrial colonies are:

6. The type of buildings adopted with respect to the location of the colony and industry. Temporary buildings, durable, local materials, the height of buildings with consideration to land price, site and extension. Number of storeys, length, breadth and proportions of the buildings. Type of architectural grouping adopted.
7. Location of the public buildings and group activities, in the factory or in the colony.
8. Area of open spaces required for sports, schools, parks and future extension.
9. Inlets to the colony and the connections with the factory.
10. Degree of integration between the colony and the factory. Considered in zoning, streets and other features. Also integration conditions with the neighbouring villages or urban centres.
11. Type of inhabitants, traditions of the workers, married or single, age, standard of living, requirements for privacy, hobbies, household activities.
12. Zoning principles adopted, based on social class, professional classification, or building types.
13. Future extension possibilities. Direction of colony’s growth, with or against growth of the factory, allowance of the location of the colony’s growth.
14. Financial capability of the project. The share of the factory, government, banks and tenants.
15. The ownership of houses and land.
16. Tenant’s right to sublet one or more rooms in their houses or apartments.

Principles of architectural composition in the industrial colonies

The different architectural compositions of the industrial colonies fall under one of the two cases:

1. The plan pattern determines the composition (Figs. 201, 202, 203, 204, 205, 206, 207) with the following factors:
   a) Axis
   b) Vistas
   c) Parallelism
   d) Verticality
   e) Graphic balance of the plan or a particular motif
   f) Carpet conception. Bird’s-eye view is the most important.
2. The space consideration influences the composition (Figs. 208, 209, 210, 211, 212, 213) with the following factors:
   a) Conception of enclosed spaces
   b) Grouping system of different buildings
   c) Repetition frequency of certain types
   d) General vertical and horizontal silhouette of the colony perhaps including the factory
   e) Functional considerations such as walking distances and zoning principles
   f) Direction of growth
   g) Building type, closed, open, height and construction
   h) Street system
   i) Size and nature of public buildings
   j) Green areas, and their integration with the buildings.

Fig. 201. The architectural composition and the distances between the architectural elements may be greatly influenced by abnormal factors. In Wolfsburg, owing to the extraordinary number of cars (1 automobile for 5 persons including children, in Germany as a whole 1 automobile for 13 persons), the buildings are far away from each other in the area parallel to the VW works to a breadth of about 400 meters. (V 21)
Fig. 202. Motor car plant workers' houses in Gorki, USSR. Laid out spaciously with blocks of flats loosely grouped between large open spaces. Buildings are so arranged that maximum sun and air introduced. A constructive disintegration of old town pattern.

Fig. 203. The workers and personnel houses in the Persian Gulf petrol refineries. (M 5)

Fig. 201. The street pattern commands the architectural composition of the colony as well as the situation, internal planning, and form of garden of the industrial worker's house. 'Cité d'ouvrier Mülhausen in Elsass', 1853 up till 1860: 480 houses for 1800 to 2000 RM. First payment 200 to 300 RM, 18 to 25 RM monthly. (PI 59)

Fig. 207. The opposite of the above example. The design of the worker's house and the idea of an atrium and central installations, combine each 4 houses together and commands the design of the whole colony giving a big variety of architectural composition of houses' groups as well as wide freedom of planning the street pattern. (The workers and personnel houses in the Persian Gulf petrol refineries.) (M 5)
Fig. 203. The workers’ blocks of flats in barracks form ignoring the climatic conditions as well as the surroundings and the neighbouring character. It also loses domination through similar flat staggered composition. Better grouping of the houses, more calm, more playing space for the children and these houses would have been a core for a new residential neighbourhood. Besides the expensive land would be used for another suitable project or as a small recreational park in the overpopulated district. (M 50a)

Fig. 204. Circular composition of one-family houses. Non-functional monotony, form, and bad traffic conditions. Uneconomic installations, and difficult execution on site. Fairmeadows, near San Francisco, USA. (M 12)

Fig. 205. (V 9)

Fig. 206. (A 50)
Fig. 209. Contrasting different forms creating green spaces in the social housing in Paris.
Conclusion

The architectural composition of the houses and the other architectural elements should create the feeling of enclosure and space in a human scale. The security and comfort of the individual should not be sacrificed to other factors.
General Aspects in the Design of Industrial Colonies

Social divisions
A sort of feeling similar to nationalism usually spreads between the dwellers in the industrial colonies. I believed this feeling existed only in the colonies of the Sudan and Egypt, but my visits and tests in Olivetti colonies in Ivrea, Henkel in Düsseldorf, and Ford in Cologne, proved to me that this factor is a real phenomenon. This sense or feeling would be less recognized in the Wolfsburg and Harlow industrial centres but for its replacement by pride. This produces a sort of dangerous social split away from the neighbourhood societies. This danger is often greater when the colony is in direct contact with a town or a city district like Olivetti colonies in Ivrea, Henkel in Düsseldorf, or the Nile delta barrages colony, where the colony reaches high technical standards and wide social horizons while the surroundings are still in a bad condition or are even slums.

Order and maintenance
The order, maintenance and services of the industrial colony should be assured by a committee or an organization, consisting of members representing the factory as opener, the workers as dwellers, and the financing member which may be the factory, a bank or any similar organisation and the government, municipality or any governmental agency taking part in the execution of the colony and houses and the public services involved.

Duty and procedure
The duty of this organization should be:
1. Execution of the colony and its installations.
2. Connecting the colony with the neighbourhoods.
3. Organizing the integration of the colony and the neighbouring agglomerations. How can the colony use the market of the next village, and in return the village use the school of the colony.
5. Selection of the workers’ families who apply to have a house. Certain principles of choice should be laid down.
6. Elimination of ownership problems and financial difficulties.
7. Organizing the destiny of the houses and technology in case of temporary industrial centres, as in the colonies of the petroleum and mining industries.

Authority
The organisation has to gain power for its authority, by the following means:
1. Gathering experience and experts in industrial planning and industrial housing to face the problems.
2. Laws turning the theoretical suggestions and plans into practical action.
3. Laying down the principles for the execution and the details of the projects down to the smallest items.
4. Research and statistics of the different existing projects, their problems and solutions.

Rationalization process and progressive economic aspects
Constructional and structural rationalization procedures should be applied to raise to a maximum the comfort and profit of the industrial centre from the biggest factory to the smallest house, while reducing the financial costs, obligation, and the efforts and time of execution to a minimum. This process has a three-fold direction to follow:
1. Design and planning principles should be created, settled and respected as a general policy, while the details in every case should reflect the local conditions.
2. Standardization of the building element, and materials in respect of the first point.
3. Mass production and automation of the building process to variable extents, according to the local possibilities.

The three points mentioned should be centralized theoretically and decentralized practically. The details of such an effective process need special research work in the future.

The house of the industrial worker
Choice of house type
Specific considerations decide the selection of the industrial worker’s house. The factors are:
1. The financial efficiency.
2. The type of ownership
3. The local building materials, constructional means, and soil bearing capacity.
4. Land price.
5. Future extension.
6. The local customs, traditions and private wishes.
7. Nature of factory and colony relations.
8. Duration of the industrial centre.
9. Volume and proportion of different professional classes.

General classification
1. One-family houses are provided for directors, engineers and high officials.
2. One-family houses, semi-detached houses or flats are provided for supervisors and technicians.
3. Row houses, 3- and 4-storied blocks of flats and high skyscrapers for the workers.
4. Barracks for the single workers, girls and boy workers under age.
Either in case of temporary housing projects like that for the workers of a building scheme, or of very remote mining or petroleum research industries.

5. Camps with tents, huts in some cheap material if the financial resources are weak.

Height
The choice of height depends on the following factors:
1. Soil bearing capacity.
2. Privacy of bedrooms.
3. Age and social conditions of the dwellers.
4. Type of garden, private or common.
5. Type of industry, smoke, noise and other disturbances to the houses.

7. Land topography and the location of factory in relation to the houses.
8. Presence of water, lifts and other technical devices afforded.

Number, size, area and type of blocks of flats
Theoretically any number can be planned near each other, but in practice not more than six apartments on the same stair landing to avoid over-concentration in the end houses 'Punkthauser' and long walking distance in gallery houses 'Laubenganghäuser' (Fig. 214). With a row of houses (Fig. 215a, b, c, d), the monotonous continuation of the sight line can be broken by shifting some parts to project from or sink into the composition.
Special needs

The main needs to be met in the house of the industrial worker are:

1. Quietness:
The eight-hour day transfers the worker to another world of quick motion, noise, monotony, the feeling of the littleness of the human being in comparison with the machine. Calmness should be provided to assure a counterweight for half the day. Screening from street traffic, living and bedrooms at the back, a patio, and good sound insulation.

2. Integration with nature:
A garden, a back one at least, is to be attached to the house; a patio is a successful integration of outdoors with indoors. Green and plants should be inserted in the inside, but precautions should be taken against insects and stale air in hot regions.

3. Children's activities:
According to each case, the children's interests, hobbies and needs to study at home should be taken into full consideration, since they play an important role in the formation of the child's future personality and its present experiences.

4. Comfort:
Special provision of comfort should be included in the plan.

Means of comfort, such as washing, garbage disposal and storage and the worker's special needs, such as television installations, and garages should be provided as allowed by the following factors:

a) Financial capacity, costs and rent.
b) Class.
c) Special demands and agreements before construction.
d) Economic and technical possibilities (Fig. 216a, b, c).
Conclusion

Economy and cheapness

The cost of the industrial worker’s house should be kept down to allow him to enjoy more of his wage. Three ways are to be followed:

1. Economical design of plan, well-organized execution time table and constructional systems and devices, obtaining lower prices through norms, standardization and prefabrication to a certain extent.
2. Considering this factor in the factory design, its proportions, inlets and outlets and its growth direction, to obtain the most economical colony proportion, size, and the use of shortest installation lines and least expensive equipments.
3. Financial help. The factory would pay all or part of the expenses to allow the worker a home rent of 12% to 20% of his wage.

Extension and growth possibilities

Owing to the increase in the family size, a possibility for dwelling growth must be assured in the following two directions:

1. The possibility of adding some rooms to the dwelling or dividing an existing one without much internal or external disturbance.
2. The possibility of building more rooms, houses or blocks of flats to accommodate the growing families who leave their houses for new ones.
Analysis and Criticism of some Industrial Centres

Introduction

To apply the previous architectural and planning theoretical research in practice, we will introduce some distinguished existing industrial centres and criticize them, through a three-dimensional analysis in terms of:

1. Design conceptions and principles.
2. Statics of their structure.
3. Fundamentals which could be extracted from them will determine the degree of capability of coincidence of our architectural and planning theories to be applied in practice.

The Persian oil field colonies

In southern Persia, where oil fields stretch over vast areas, many colonies had been established for the workers and engineers of the petroleum companies. At first only nine engineer’s houses were built, healthy, stable, and secure but they lacked harmony with the surrounding atmosphere. Therefore, principles have been given more importance than formed plans, as this type of oil-field centres and colonies is unpredictable in size and rate of growth.

The factors influencing the design were:

1. Climate:
   Very hot and dry in summer, heavy northerly dust-storms. Hot winds at 160 km/hour velocity, very short heavy rains at 45°/13 cm in rain week, while it is 18 cm in the whole of the rest of the year.

2. Insects etc.:
   Flies in September and November; snakes are occasionally found.

3. Human:
   Open air sleeping is a traditional habit. Keeping animals inside the house. Security from thieves and burglars is very important, separation between married and single is necessary.

4. Constructional:
   No wood exists to make doors and windows. Shortage of water for construction and planting purposes. Bricks and stones as constructional means for the walls and insulation materials for the roof construction (Fig. 217).

The design principles of the colony:

Zoning:
The residential quarter is divided into 12 sections grading from senior engineers’ to workers’ houses.

Elements:
Bazar shop, mosque, local outdoor industry workshop shed, altogether giving a sort of centre.

The workers’ houses

Plan:
The houses of the engineers are about 170 m² built area, descending progressively to 25 to 30 m² for the smallest ones. The engineer’s house is composed of an entrance with a cloak-room, a big living room, a dining room directly connected with the kitchen which has a separate entrance and a back yard, 2 bedrooms equipped with a
bathroom, a servant's room outwards with a WC, stores, a garage and a water heater room (Fig. 219a, b). The small houses have two rooms, secure, shaded, cool in summer and warm in winter, and with burglar-proof windows. Central sanitary installations and open air sleeping possibilities.

Materials and construction:
Cavity bricks or stones. The steeply sloping roof is completely separated from the sub-ceiling but tightly fastened to walls against storms, expansion and contraction joints.

Conclusion
The design of the industrial colonies of the oil companies as well as other mining industries should be carried on after principles referring to the local conditions. Types and sizes of the houses should then be categorized with respect to existing needs. The construction should resist abnormal local conditions which are usually different from those of other centres. They should be capable of being dismounted as this type of centre is usually temporary.

Fig. 219. A bird's-eye view of an engineer's house, showing details of the design. (M 8)
1. Living room
2. Bedrooms
3. Kitchen
4. Bathroom
5. Dining
6. Entrance
7. Cloaks
8. Store
9. Water heater
10. Servant
11. WC
12. Garage
This 2320000 m² industrial centre lies in northern Egypt, in the Mahalla El-Kubra city (Fig. 220); this gigantic weaving and spinning factory has been established in 1927 by the Egyptian economist and business man Talat Harb who laid the foundations of the last 35 years of the Egyptian economy. He had chosen this part of the Nile Delta for the following factors:

Factors

1. The weather is suitable for the cotton and textile industry.
2. The town is central in the Nile Delta, a favourable position for materials, workers and products transportation facilities.

The industry is considered medium-heavy and has grown up at a remarkably high rate because of the suitability of the market conditions.

The number of workers increased from 6000 in 1933 to 20000 in 1938 and to 26000 in 1946 and more than 35000 to day. The rapid increase and arrival of workers from all parts of northern and southern Egypt before the war caused congestion and overpopulation in the city. Many workers shared one room and were obliged to exchange the same room and bed in three shifts.

The result had always been a permanent reduction in their working efficiency and much more social and physical illness and disease. At the beginning the factory had not been able to face the workers' housing problem, until the war when the refugees' colony was built. This central part of the colony had been established in 1941 as a refuge for those who lost their homes in the war. After the war's critical period in 1943, this refugees' colony had been turned into residence for the industrial workers of the textile company there.

Relation between industry and colony

Although the relation between the industry and the colony in this case falls under the type of independent industry with a colony comprising a part of a town, yet the colony appears as if it is a strange odd element stuck to the town anywhere without the slightest consideration to the

Fig. 220. An air view of the Mahalla El-Kubra old town and textile industrial colony.
organic growth conditions of the town. The building pattern, traffic facilities and landscape are thoroughly spoiled, and the old town was plunged deeper into the chaos of disorder (Fig. 221).

Colony and town are dependent on each other. The town market, business relations and contact potentialities with the neighbouring agglomerations and the capital Cairo, equal in importance the colony’s services, health, educational, recreational and economic role.

The design principles of the colony:

Zoning:
The colony is zoned, as is usual in all the industrial colonies in Egypt, in terms of professional classes (Fig. 222). Although this conception would be a technically unfavourable point from the planning and social point of view, yet it reflects the social living structure of the period of its erection.

But it differs clearly in the idea of the location of its public buildings at the edges and the houses in the middle. The market is central and so is its main green, and three gates lead to the inside of the colony.

Elements:
A boys’ school and girls’ school (Fig. 223), each of 12 classes for 360 pupils, hospital (Fig. 224), nursery, market with arcades (Figs. 225), shaded court, and 22 shops, a cinema (Fig. 226) and two coffee-houses, a restaurant, bakery, public laundry and baths, administration of the colony, stables, fire-station, a mosque (Fig. 227), a clock tower, and an automatic washing and laundry centre, and a police station with a dormitory hall for the policemen compose the public service organ for the colony and the town in a spreading scattered composition.

The housing elements comprise a 2-storey large 5-roomed house for the director and the doctor of the colony, 556 houses for the married, 2 blocks each 3 storied for the unmarried, 2 blocks each of 2 storeys for the girls, and a 2-storied block of 38 rooms for the hospital sisters. The new part of the colony built in 1957–1959 comprises houses for supervisors and engineers (Fig. 228).
Medical service for every worker and his family. A hospital of 70 beds and sanatorium of 150 beds. Medicines are free. A restaurant for 800 meals at a time offering bread, a light breakfast with tea for 1 Egyptian piaster (10 Swiss Cents) and a dinner for double this price with bread, vegetables, rice and meat. In the year 1955 a dormitory for 200 children (‘Kinderheim’) has been established, and later the new workers’ colony was started. The factory paid freely 40000 E£ (400000 sFr.) and gave building mortgages of 165000 E£ (1 650000 sFr.) to the workers without charge.

Street pattern:
Geometrically rigid (Fig. 229). Pure axial symmetry, and creation of vistas (Fig. 230). The unity and cheerfulness of concentrated green areas is spoiled by the rigid carpet-pattern design. Residential streets running E-W allow most of the houses to have a northern facade to receive the refreshing northern breeze.

Architectural composition:
Full symmetry and axially determine the shape of the plan. Each four residential blocks compose a unit together with back gardens. Each eight units make together a bigger complex with one corner always having a public building at its head. This type of plan integrates residential and public zones and protects the residential areas from noise and outside disturbances (Fig. 231). A wall with three gates surrounds the whole colony. Difficult control possibilities. Vistas are well studied and the highly-qualified, good arrangement of masses, proportions, and heights is clear.

Types of houses:
2 barracks of 2 storeys were built for the girls, and 12 barracks each 3 storeys built for 1500 unmarried workers (Fig. 232). Each storey is composed of a central staircase, with two halls on both sides and common baths at the ends: not an economic solution, but I think that this decentralized system was adopted for reasons of sanitation and cleanliness. A lounge and sitting room occupy half the ground floor of each block.
556 houses of two and three rooms are provided for the married people (Fig. 233). A kitchen, a low closet and a douche, and an entrance for each house. A back garden allows the keeping and breeding of tame animals and birds, also carpet cleaning, washing and drying. The area of the colony is 281,400 m², and the number of inhabitants is about 4000.

Construction

Bricks and reinforced concrete. Windows with wooden shutters. Sanitary pipes are seen in the facades. In the blocks of flats servant's rooms are placed on the roof where they protect the upper floor from the hot weather. Plaster for the facades and artificial stone for the plinth. Streets well paved in asphalt and reinforced concrete slabs, water, sewage, and electricity installations are provided. The cost was 1,500,000 ££ which would be 6,000,000 ££ today. The government paid 110,000 ££ or half of the primary foreseen costs.

Conclusion

The colony exemplifies the principles of its time. Richness and aesthetic considerations are more regarded than the economic and rationalization factors; no effort was made to integrate the industrial factory and colony centre with the town or at least to provide extension possibilities for the town on good bases in the direction of the colony. The elements produced by considering the climatic conditions and the traditions, such as small windows, deep balconies, sheds, arcades and the separation of girls, bachelors and the married have been very successful, as have the public baths, laundry and the colony wall. The colony badly lacks a sports place and a concentrated green area, for children and mothers. This lack is very clear in the school zone.

The second example is the one-storied strip dormitories competition project for 30 foreign workers in the brick industry in Lüdingshausen, Germany (Fig. 234). Bricks and roof tiles were to be used. The design had to consider the future need to turn the dormitory into a row of one-family houses at the least possible cost.
This type of housing for unmarried industrial workers which allows 6 m² of built area/worker can be compared with the following projects.

The Swiss residential unit built in 1954 to house 450 single industrial workers of the Grande Dixence dam power station at a height of 2100 m (Fig. 235). It has been built in winter at —30°C. The building is composed of 9 storeys with a structure of steel skeleton and light metal screening.

Two staircases are located on both sides of the building. The lavatories are located in the middle of the block, by contrast to the Mahalla El-Kubra colony. The Swiss construction is composed mostly of prefabricated elements. The plan is divided into sleeping units of 2, 4, or 6 bedrooms. Meanwhile in the Egyptian example there are sleeping halls for 25 workers. The Swiss example offers 11 m² built area per person and one staircase for 225 persons, 1 WC for 12 persons, one shower for 8 persons, one lavabo for 12 persons.

The Egyptian example offers one staircase for 125 persons, one WC for 8 persons, and one shower for 12 persons, one lavabo for 8 persons.

A third industrial workers' colony in the USA has been built for the single as well as the married industrial workers but without their families (Fig. 236). The public services are situated in the middle of the area. Each unit consists of bedrooms for one or two persons, with the
necessary sanitary installations, baths, WCs, administrative office and the medical services. Economy had been strictly followed in the construction and the material used.

This concentration of the labour force on site just near the factory, allowed continuous elaboration of the plant in three shifts without stopping.

In the project of the High Dam in Egypt, the workers are housed in a row of houses which achieve a proportionally good constructional standard, although it neglects the climatic conditions and the creation of family groups.

In the ground floor, a restaurant and a cinema serve the workers in their leisure. The characteristics of the building are: the light skeleton, durability and rust resistance, fireproof, good sound insulation, good heat preservation.

The fourth example is the one-storied strip housing project of the workers of the Saad El Aali project, Aswan, Egypt (Fig. 237). Rows of houses of 1, 2, 3 rooms with the essential installations. An expensive and unnecessary broken elevation had been adopted to break monotony of the design, neglecting the local climatic conditions which call for sheds and patios. Rationalization and economy are absent.
The Olivetti Industrial Centre
Ivrea Town, Italy

The industrial centre

The flourishing of the Ivrea town is due to the establishment of the Olivetti industrial centre in 1915, now producing computing machines, electronic machines, heavy machines and typewriters at a rate of 4000 per day. The area of the factory increased from a small workshop to 1000000 m² in 1960. Built factory area is 300000 m² (Fig. 238). The public buildings for service activities are integrated with the industrial elements of the factory (Fig. 239). The Ivrea town and the surrounding villages serve as dormitories ‘Schlafstädte’ for Olivetti (Fig. 240). Co-ordination between the town and factory supports transportation lines for the workers and their school-age children (Figs. 241).

Power

The works depends on its own power station for the energy consumption of 10000000 kWh/year.

Industry and colony relations

The site had been selected in Ivrea where skilled labour, good transportation means and power existed. The Olivetti colonies are a part of Ivrea and coincide with its master plan. The industry also lies in the heart of the town, with a main highway passing through it. A small housing project has been built in the centre of the complex, at the northern edge of the factory area (Fig. 242). The Olivetti philosophy had been to mix the industrial buildings with the public services to lessen the dry atmosphere of a pure factory centre. The workers and their families can use them more often than if they were in one colony only or far away on an independent site. The presence of the health service, restaurant and social centre with library in the factory gives the worker more comfort, security and feeling of stability.

Fig. 238. The integration of the public services with the industrial buildings in the Olivetti centre in Ivrea, Italy.

Fig. 239. A general view of the Olivetti industrial centre in Ivrea. (V 33)
Fig. 240. The position of the surrounding villages around Ivrea as dormitories 'Schlafstädte' for Olivetti industries.

Fig. 241

Fig. 243a. Zoning of the Olivetti industrial area, Ivrea, Italy.
The plan of the factory is designed according to need. No master plan is laid down. Growth and extension happen wherever there is enough room. This is clear in the design of the different elements. Also in the combination of a restaurant with a school and a cinema (Fig. 243a, b), in one building a long way from the social and cultural activities building (Fig. 244), and in the planning of the kindergarten and nursery near the power station and aluminium factory (Fig. 179).
The workers' housing

Many housing projects have been carried out. Olivetti built some of them for rent, some to sell to the workers on long-term payment, and in other cases helped its employees with part of the money. No social split with the town has been apprehended, as the colonies are in the natural periphery and depend to a large extent on the neighbouring market, transportation and services, and also as many workers still live in the town, which is itself dominated by the Olivetti industry. A committee representing the factory management, the factory staff, the management council, and one observer representing the applicants classify and judge the applications and distribute the houses. 200 private houses were built on long-term loans (Fig. 245). The first housing project is small-scale and was built in the factory and planned by architects Figini and Pollini at a corner where no more industrial buildings could be built. No future extension possibilities, but an example of a housing complex mixed with industry in one complex. Costs were paid by Olivetti in 1940-1941.

Castellamonde colony

The second project, Castellamonde road colony (Fig. 246), has an area of 60000 m² of which 26500 m² are common open green areas composing 44.2%.

Zoning

This colony is zoned in terms of professional classes. Directors', engineers', supervisors' and workers' sub-zones occur. Green areas are made up of the back to back gardens and the open public green area of the blocks of flats (Fig. 187).

Elements

The colony comprises a club, and five different residential groups. Other services are provided by the factory centre within the factory complexes outside the colony.

Street system

A main central road, branching right and left, with a ring connection, ties in the colony. Private garages are provided for both the one-family houses and the semi-detached, and common garages for the blocks of flats. Street area is 16.6% of total area, a sum of 10,150 m² (Fig. 247).

Architectural composition

Geometric location of the houses following the street pattern. No space conception. No contrast in heights, neutral, nearly horizontal silhouette line of the composition. The same character of no pre-planning as in the factory itself. Population is about 87 families totalling 435 persons. Future extension possibility is available internally, inwards, or vertically, upwards (Fig. 247).

Workers' houses

The residential area consists of 23350 m², which makes up 39.2% of the area of the whole colony and is divided into 5825 m² or 9.7% built-up areas and 17525 m² or 29.2% private gardens. All the designs of this colony include more elements than the other colonies. Architects Figini and Pollini designed 7 blocks with 4 maisonettes each, architects Nizzoli and Oliveri the other blocks. 6 individual houses,
Fig. 246. Castellamonde road colony.

Fig. 247. The elements of the Castellamonde colony.

Element

Apart from the residential buildings, the colony comprises a school for 80 pupils, serving at the moment as an kindergarten also, and a church with a tower of special character allowed by the novelty of the whole composition and its daring nature (Fig. 183).

Fig. 248. Plan of a flat in ‘Castellamonde’ colony in Ivrea showing also the garages on half a floor. (M 7)

1. House entrance.
2. Entrance hall.
3. Flat entrance hall.
4. Living-dining room.
5. Three bedrooms.
6. Study.
8. Maid’s room.
9. WC.

Canton Vesco colony

Zoning

The colony is divided into zones in terms of building types and not with respect to the professional classes. Total area is 156,405 m² composed of 3 lots, the largest of which is shown in Fig. 249.
Fig. 234. The street pattern of the Canton-Vesco colony, Ivrea. Backbone main roads with internal feeding branches system.

Fig. 251. The architectural composition of the Olivetti industrial colony 'Canton Vesco', and the pictures shows one type of the blocks of flats located just in front of the mountain. (V 33)

Fig. 251. The restaurant.
Fig. 249. Canton-Vesco colony.

Fig. 252. The new colony of Olivetti in Ivrea, Italy.
Volkswagen Industrial Centre in Wolfsburg, Germany

The industrial centre

Origin and development

Established in 1938 at the strategic point of Wolfsburg in northern Germany. Began production in 1940. Completely destroyed by bombs in 1945. Rebuilt and began production again in 1948 with 8719 workers and 28000 cars annual production. In 1961 reached 1,000,000 cars per year of which 57% are for export (Fig. 253). And a working population from the city of Wolfsburg and the neighbourhood of 37,000, of average age 32.6 years; of these 11.3% are women and 1800 are trainees. The mobility of workers is at the rate of 4000 annually changing their jobs. This number is a result of the arrival of about 7000 workers yearly as against the emigration of about 3000. 25% of the workers arrive to work in their own cars. Every 5 persons in Wolfsburg have a car, and out of the total number of cars in the city 75% are Volkswagen.

The annual energy consumption of the industrial centre was 22,555,432 kWh in 1960 of which 63.2% was for household, 18% for industry, 14% for public use, 4% for crafts and 0.8% for traffic purposes.

The conveyor lines of the works are 5 km long. The moving belts which transport the car from operation to operation measure 100 km.

Design

The architect Peter Koller aimed at creating a successful industrial city as a regional core for the surrounding villages. The city comprises 65,000 persons of whom 18,000 are workers at the VW works, 27.6% (Fig. 254). The total working population in the city including those who work in industry, public services and private shops is about 28,500 of which 20,287 = 70.3% are men, 7,906 = 28.63% are women, and 307 = 1.07% are unemployed.
Fig. 253

Fig. 254. The daily stream of workers to and from Wolfsburg, VW industrial centre, Germany, representing 32% of its total working man power. The distribution of the VW working population of Wolfsburg centre on the city of Wolfsburg and its neighbourhood. (V 21)

Fig. 254. The original design of Wolfsburg as planned by Reichow. (Pl 51)
Industry and city relations

The factory and the city lie on opposite sides of the transport backbone which consists of a canal, a railway line and main highway (Fig. 255). Seven bridges connect them together. Independent future extension is available for both.

48% of the VW workers live in the city and the remaining, 52% live in the surrounding villages and in Braunschweig city, although a big VW factory also exists there (Fig. 169).

The factory and the colony have common services. Electric current, heating, compressed air, steam and hot water are central for both the city and the factory.

Street Pattern

A city for the automobile. Peter Koller declared: 'Als ich 1937 die Stadt auf dem Reissbrett entwarf, war mir klar, dass hier fast jede Familie einmal ihren eigenen Wagen fahren würde. Dazu braucht man Strassen, die den Verkehr flüssig halten.' (When I designed this town on my drawing-board in 1937 I realized that here almost every family would one day have its own car. For that purpose streets are needed that will keep the traffic flowing.)

The streets of Wolfsburg occupy 1500000 m² or 5% of the city area. They have their own characteristics which distinguish them clearly from any other industrial city (Fig. 256).

Zoning

The city has a clear zoning system (Fig. 164).

1. An industrial zone including the factory, the power station, the experimental test ground, and the terminus of different transportation means.
2. City centre including shopping street and most public buildings, city hall, etc., and the old part of the city built by 1941 included 3000 rented houses of monumental style.
3. The old Wolfsburg village.
4. The new city residential quarters built after the Second World War and their recreational centres and local shopping areas.

Fig. 256. Pedestrians walk through galleries between shops and show-windows, Porschestraße. (V 21)
Fig. 256. The VW Industrial centre in Wolfsburg, Germany. Factory and workers' city. (V 21)

Characteristics of the street pattern

1. Wide main streets with two to three lanes in each direction.
2. Enough parking places planned for the distant future (Fig. 4).
4. Wide foot-paths capable of coping with rushhour pressure.
5. Good traffic organization.

The automobile is the master of the city, but the pedestrian is its king, in spite of that; galleries are later provided on both sides of the streets so that pedestrians can walk between shops and show windows to be covered and protected from rain, sun and traffic.

No action has been yet attempted to assure a wholly pedestrian area where pedestrians can go to work or shopping without traversing motor traffic, as projected in the Hook city, in England. This experiment is successfully applied in Harlow, England, and Rotterdam, Holland (Fig. 182).

In the residential areas, different street patterns are adopted for 2 reasons:

1. The long execution time of the city, many planning theories have been applied.
2. The many different authorities like the VW architectural and planning office and 'Neue Heimat', 'Neues Land' organizations and the cooperative building committees, which take part in the planning and share in the execution and financing.

Ring roads, dead ends, geometric patterns and free curve motifs are all used. A main ring road protects the city streets from the pressure of the regional through traffic by cutting off this outside traffic at the highway junctions of the city borders.

Architectural composition

The early architectural composition of the Wolfsburg's quarters had been in the form of closed barracks and closed patterns of rows of houses after the Hitler Reichs-stil. The new conceptions of composition differ from one
part of the city to another, according to the type of buildings and the form of their gardens, private or common. The same factors mentioned before which produced a variety of street patterns influenced the architectural composition and produced different building types and architectural compositions. In spite of that, each residential quarter is harmonious as a whole. The main design approach, building materials, colours, and planning conceptions give a powerful unity to every quarter. Local centres, vast green areas, and public services are provided in each quarter. The built area is 7000000 m² making up 23.3 % of the whole area, the public green areas are 2500000 m² or 8.3 %, private gardens are 300000 m² or 1 %, the cultivable fields belonging to Wolfsburg 3500000 or 11.65 % and forests 10000000 m² or 30 %. Besides there are uncultivable areas of 2900000 m² or 9.6 % and areas of shallow water and areas of marshes which cover 700000 m² or 2.33 %. Thus an open area of 53.28 % perforates the bulk of the city body.

Architectural elements
1. Main railway station (Fig. 257).
2. Municipality building (Fig. 258).
3. City hall (Fig. 259).
4. Market place (Fig. 260).
5. Swimming pool (Fig. 261).
6. Churches (Fig. 262).
7. Schools (Fig. 178).
8. Aalvar Aalto's cultural centre (Fig. 263).

Fig. 257. The main railway station. Strategic link between Wolfsburg and the surroundings. (V 21)

Fig. 258. Municipality building. (V 21)

Fig. 259. The Wolfsburg city-hall. (V 21)

Fig. 260. The market place. (U 21)
Fig. 261. The swimming pool given as a present from the factory the Wolfsburg city. (V 21)

Fig. 262. The old and the new churches of Wolfsburg. The industrial centres give opportunity to realize new ideas. (V 21)

Fig. 263. The cultural centre of Aalvar Alto, architect. The architect has been given a free hand to realise his ideas. (M 55)
Workers' houses

Types

There were about 16500 dwellings in Wolfsburg in 1962. This number includes apartments and one-family houses. The types mostly used are blocks with 2, 3 and 4 storeys of flats grouped in such a way as to create enclosed or half-enclosed spaces (Fig. 264). Higher houses of 8 to 10 storeys create focal points in different residential units (Fig. 265).

Garages are in common and lie at the dead ends of each street or on the sides of the through streets. Private garages are very few and are found only in some of the few one-family houses. In the semi-detached houses they are mostly absent.

Characteristics of plans

A typical block of flats (Fig. 266) has 4-flat storeys, and each consists of 3 rooms. The living room is 19 to 21 m², parent's bedroom of 14 to 15 m² and children bedroom of 7 to 8 m². The total area of the 3-room flat is from 80 to 90 m².

The government prevents exaggeration of areas, such as two-room apartments of more than 80 m². Priority of housing is given to families having three children and more, to war casualties and to refugees. Directors and engineers are not allowed to have popular houses.

The kitchen is directly connected to the entrance and lacks connection with the living room. Bathrooms are artificially ventilated, each combined with another bath or a kitchen to sanitary installations. Better design was available.

Fig. 264. The workers' houses in Wolfsburg (above) and in the industrial chemical centre of Henkel, Düsseldorf, Germany (below). (V 20)
by combining 4 units, 2 baths and 2 kitchens together on the right and left sides of the staircase, thus gaining more concentration for sanitary equipment and a better displacement for the main bedroom in the south.

The average area of the 1-room apartments is 30 m² which means about 90 to 100 m³. The monthly rent of apartments = 1.45 DM/m² while the average rent of all the houses in Wolfsburg is 1.60 DM/m², and is 1.80 to 2.00 DM/m in the high blocks of flats.

The average costs of the houses are calculated to be 15 DM/m² for the construction and 15 DM/m² for the installations and the other necessities, streets and landscaping, or a total sum of about 90 to 100 DM/m².

Houses for the single workers

Houses for the old

Conclusion

Wolfsburg is a unique example of an industrial centre. Although it has been established from the beginning only as a residential compound in the VW automobile industrial complex, it has influenced its whole neighbouring environment and as a reaction has been also invaded from its surroundings. The general aspects of life in such an industrial centre can be seen from the statistics. In 1960 there was a car for every five persons; in West Germany the average is 1:13. More than 52% of the VW workers come daily from the outside. The average income is 3.40 DM per hour. The number of deaths due to blood circulation diseases, 100 cases. Meanwhile deaths from cancer have numbered 72, from nervous breakdown 19, from poison 17, accidents 12, suicide 4 and from murder 1, and from all other causes 72.
The distinguishing characteristics of industry from the point of view of the responsible persons in VW:

1. Industry attracts population
2. The population in the industrial centres increase quickly
3. Higher wages
4. Have tighter relations with the towns, it even builds cities
5. Continuous work, not seasonal
6. Fixed holidays
7. Fixed working hours
8. Cleaner
9. Possibilities of medical services, sports, schools and recreation is greater

An industrial centre has usually, especially when new, more freedom from design traditions. It allows more design flexibility and creation possibilities which are clear in the design of the Alto’s cultural and social centre and the many other experiments in the city and the factory. Later, the problem of the foreign workers, the majority of which are Italians, Spaniards and Hungarians took a serious form as they reached a population of 4000. Many accidents, violence and clashes occurred between the Italians and the citizens, and other problems with some Spaniards and Hungarians arose. Although this work is too short to discuss the problem, we mention here the solution which has been adopted later. A completely isolated residential camp has been built for the foreign workers, who number about 4000, with a high wall surrounding it, a police guard at the gate, entrance with identity papers, and the camp gate closed at a fixed time at night. Fig. 267

In general this industrial centre shows a successful practical integration and cooperation between work and residence, as well as flexibility and development in design conception parallel to the progress in social life aspects.

Fig. 267. The quarter of the Italian workers encircled (left), the new city quarter of Detmerode (below right).
The Petroleum Company Workers' Colony, Suez, Egypt

The colony is limited from the four sides. It has its extension possibility within. The rate of growth is limited, thence a limited area has been left for this purpose (Fig. 268).

The design principles of the colony

Zoning

As in most of the Egyptian industrial colonies, the engineers have their own separate section; in this case it is too far from the workers' section, and the supervisors are given a strip at the border of the colony.

The worst criticism is the diffusion of the public activities at all the edges of the colony and its centre, which disturbed the whole circulation of the colony, scattered the green areas into small parcels, and made a complete split between the social life of the engineers and that of the workers. A reply to this criticism is that this plan, as plans always do, reflects the contemporary life aspects and standards of its period.

Street pattern

1. The colony has two entrances, double traffic control and more crossings.
2. The pattern is accidental. The cul-de-sac is successful in the section of the engineers, while the street layout in the workers' section clearly confuses the cul-de-sac system with the rigid geometric patterns. The connections between the supervisors' houses and the streets is successful.
3. Different breadths have been given to the streets according to their importance.
4. No park places are provided in the centre, especially in the sports area. Perhaps a high car-person ratio was not expected in the design, possibly because of the ignorance of the growth of vehicular traffic.

Architectural composition

1. The architectural composition follows the street pattern and vice versa.
2. The blocks of the same type of houses oppose each other. Sometimes they are directed east-west, and sometimes inclined at 45°.
3. The forms of the public buildings are rigid, as clear at the left side entrance, not only in their shape, but also in the spoiled space they create between each other and aesthetic line competence between their location.
4. Severe symmetry and free asymmetry clash with each other clearly in the design of the colony.
5. Vistas are tried for, but they are sometimes clear and sometimes hesitating between considerations of the street pattern or those of architectural composition of the elements.

Houses

Most interesting, economical and individual are the row houses of the supervisors (Fig. 269).
Types and plans:
Two storeys, living room, kitchen, WC, and entrance hall downstairs. Two bedrooms and a douche-room with WC upstairs. Balcony and wardrobes are provided in the first floor.
The $45^\circ$ inclination of these blocks give both bedrooms sun and a mild north-south breeze.
The economical placement of the douches and kitchen and WCs in a vertical concentration, hindered the use of the entrance shed as a balcony.
Local building materials have been used.
Limestone for the ground floor, and facades plaster for the first floor.
Stores and servants' rooms occupy part of the roof. The rest is used in summer evenings as a sitting terrace.
A decorative round side is provided to the corner house as an accentuation of the end. It gives a slight privilege for some higher rank supervisor or his fellows. The simplicity and economy of the whole project was very courageous compared with the architectural and planning concepts in Egypt at time of its planning and execution.

Fig. 269 (PI 34)
The Edéa Aluminium Industrial Centre in Cameroon

The Edéa aluminium industrial centre in Cameroon is composed of an aluminium factory and electric power station producing 100000000 kWh. Most of this sum is consumed in producing 45000 tons aluminium annually. Situated on the main route to the Capital of Cameroon Yooundé (Fig. 270). The area of the factory is 128000 m², of which 80000 m² are covered.

The design principles of the colony

Consists of 65 dwelling houses of two types of average area 130 m² are built in reinforced concrete with hollow concrete tiles for thermal insulation. Local timber is used for construction. Near the colony are the administrative buildings, lounge for 500 persons, restaurant for 100 persons, hotel for 30 persons (Fig. 271), club, and swimming pool. A kindergarten, a nursery and a shopping centre composed of shops, drug-stores and food-preserving frigidaires are in the vicinity. The workers live in the town of Edéa, 1 km from the factory.

Zoning

The colony is in two sections, residential and public services. Only the technical staff and the employees live in the colony. The workers live in the native town, 1000 metres away.

Street pattern

Free street pattern, composing of a ring road with internal and external feeding branches (Fig. 272).

Architectural composition

The buildings are situated in a free pattern following the contour lines and the climatic conditions. The architectural composition is totally independent of the street pattern. Touches of the native local taste are given to the design. Cream, grey, and light colours are adopted.
Fig. 271. The hotel of the workers and technicians in the Edéa Aluminium factory colony. (M 47)

Fig. 272. The plan of the colony.
The Industrial Workers' Housing Project Winning the First Prize from the Montanunion for the Coal and Steel Industries

This project occupies 45000 m² and houses 1920 persons (Fig. 273). It lies 2 km south of a city centre and near a river. It contains 400 apartments, which are distributed as follows:

**The design conception**

1. The main idea in the design is to create an atmosphere of collective life with all its economical advantages. At the same time, the risk of spoiling the privacy of each apartment is avoided.
2. High density is adopted to offset the high prices of land which lies only 2 km from a city centre.
3. The industrial working population follow the system of working 24 hours daily in shifts. This main factor has been considered in the design of everything concerning the men and the working times during day or night.
4. A module in the vertical as well as in the horizontal directions has been followed to facilitate the construction and give an impression of an industrial colony.
5. The colony is composed of four sections each containing about 100 apartments with a playground in the middle, 50 x 70 m in area, which is somewhat high.

**Zoning**

Practically the whole composition is designed as a simple whole which produces a harmonious mould from the two possible zoning aspects, social or professional classes or the classification in terms of the building types. We can characterize its zoning as merely a product of the architectural composition of the different volumes and areas, an excellent degree of aesthetic play with the space potentialities.

**Street pattern**

A horizontal and a vertical traffic contact scheme has been applied. Its idea is not to free the individual house from the neighbours, but to free the choice of neighbours for each house. The horizontal connection level streets are galleries in the form of the German open-air 'Laubengang' (Fig. 274). The opening of so many apartments on to a horizontal street loads some stairs very heavily, but it makes contact between the different apartments easy.
Architectural composition and the elements of the colony

1. The colony centre contains a shopping centre, a church, a meeting hall, and an automobile silo in a basement.

2. The houses include a high block of flats of 13 storeys, apartment houses of 4 storeys, and row houses of 2 storeys. The distributions of the apartments in the vertical and the horizontal directions is one of the most distinguished characteristics of the colony.

Workers' houses

As an example we will consider the apartments of 3 bedrooms (Fig. 275). They have a south-west and a south-east orientation. The apartment occupies 84 m² including the loggia (half its area is counted). The loggia gives the apartment the loggia atmosphere of a free-standing one-family house. Although it is approached from the gallery, it is screened from the scenery. This loggia is placed beside the apartment and not in front of it. This position provides a good sound insulation but at the same time it weakens the heat insulation.

The apartment has three entrances, a main one, one from the kitchen and one from the other side in the children's room. The third entrance allows an extension for the children's playing space.

The apartment lies longitudinally parallel to the gallery, a position that allows better orientation and cross ventilation to all the rooms. It is clear that within a small area more depth has been attained. Moreover, the use of changeable walls gave the plan movable flexibility. Simplicity is a dominant characteristic of the project.

Conclusion

The design of a colony for or in an industrial centre for the workers and the technicians should take into consideration the specific needs of the class of the population which will live in its atmosphere. This example lays much stress on facilitating the horizontal as well as the vertical connections between the dwellers who may all know each other, but each family would like to be more free in the choice of its friends and neighbours. The population density of this colony is about 426.6 persons per hectare, which means a total of 23.6 m²/person. The average room number/apartment is 2.2 and the ratio of persons/room is 2, the person/apartment ratio being 4.8. Average apartment area is about 70 m² and the area of the whole site makes 112.5 m². The land use ratio:

\[
\frac{\text{The total built living area}}{\text{The total land area of the site}} = \frac{27,800 \text{ m}^2}{45,000 \text{ m}^2} = 0.62 \text{ which is relatively low normal ratio.}
\]
The Pulp Mill in Sunila, Finland

A factory built by the five largest companies in Finland. The factory is located on an island in the Gulf of Finland, where the deep water permits direct loading of ocean freighters. Design by architect Alvar Aalto.

Zoning

The engineers' section is in the colony entrance. The workers' zone follows in three sections divided according to the type of house, class of worker, and number of the family members.

Street pattern

Follows the contour lines. Ring road with series of connections give access to all the parts of the three sections.

Architectural composition

Rows of houses for all the residential sections.

The blocks are perpendicular to the streets.

The shopping centre and the other public services are located central to the whole colony.

Fig. 276. The pulp mill in Sunila, Finland. A factory built by the 5 largest companies in Finland. The factory is located on an island in the Gulf of Finland, where the deep water permits direct loading of ocean freighters. Designed by architect Alvar Aalto. (M 15)

Fig. 277a. First step of construction. (M 15)

Fig. 277b. Second step of construction. (M 15)
The most interesting characteristics of this colony are the steps of establishment of the houses. The construction had been carried on in 3 steps (Fig. 276).

1. Step of 2 storeys. Three apartments per staircase. Inexpensive, conventional design (Fig. 277a).
2. One storey increased. Balconies added. Unit-costs are less than the initial ones (Fig. 277b).
3. Set back scheme. Outdoor living space increased. Costs per m² is greater (Fig. 277c).

Fig. 277c. The third step of construction. (M 15)
The Sabendé Aluminium Industrial Centre in Guinea

The aluminium factory as well as an industrial colony for 20000 workers have been built in 1957 after a planned program following the natural growth of the factory.

Zoning

The houses are grouped in four units each of 5000 persons, and having a community centre as its focal point (Fig. 278). Each unit has in addition a primary school and a local shopping centre. The green belts separate the units from each other, while the main centre emphasizes the unity of the whole.

Workers' houses

The simple houses of the African workers include one, two, or three bedrooms which create the main element of the design (Fig. 278). A veranda in front of the house instead of the living room and a backyard for domestic activities reflect the climatic necessities. The houses are protected from the sun by 1.25 m projected sheds. A WC, douche, and a lavabo are installed. A double skeleton roof of aluminium and wood give cover to the house, while the clerestorys allow through ventilation.

Street pattern

As the car density is very low, streets serve only for delivery and emergency service purposes. Many places and courts compose the colony.

Architectural composition

The absence of heavy traffic, the longitudinal form of the site and the flexible design of the houses allowed an interesting variety of compositions. Groups of 10 to 30 houses inspire an atmosphere of native yesterday feeling in a design of tomorrow.
Temporary housing of the industrial workers is known wherever industry has no stable roots for a long stay, as in the case of the oil-fields and some industrial mining centres. This temporary housing of the industrial workers would take the form of a camp with canvas tents (Fig. 280a) or small units made of prefabricated elements. During and after the World War II, movable units of caravan wagons have been used on a large scale (Fig. 280b, c).

This type of temporary housing is usually adopted in the following cases:

1. When the industry is located in a place where building materials are rare or difficult to deliver.
2. Where no skilful workers exist to build the project on site by conventional methods.
3. Where the building time is an important factor, thus reducing the building problem to a mere assembly operation.
4. If a sudden increase in the labour force in a certain industry occurs unexpected, without preparation to house the new workers.
5. If the industry is to change its location.

Characteristics of temporary industrial housing:

1. Simple plans for the units as well as for their grouping and composition.
2. Usually the sanitary installations are in common. Also electricity, power and other services.
3. Common administration and means of communications and transportation.
4. No private property, and usually no land problems.
5. The orientation of the units with respect to roads, privacy and climatic needs is simple and has no obstacles to overcome.
6. Light materials are usually used. They should be durable, fireproof, waterproof, easy to put up and dismantle, and cheaply transported.
Fig. 280c. Prefabricated temporary housing in USA.
The Satellite Town of Harlow, England

A plan for a greater London had been produced in 1944 under the leadership of Professor Patric Abercrombie for the dispersal of industry out of London. The plan encircled London with the green belt of countryside thus siting beyond the green belt eight new towns each with its own industry to absorb some 380,000 people from London.

The development corporation asked the town planner Frederick Gibberd to draw up a master plan for the town of Harlow to house 60,000 people, later increased to 80,000.

The town consists of 3 clusters of neighbourhoods. Each neighbourhood comprises about 5000 people, a public hall for 300 persons, a primary school, 4 or 5 shops. Each 3 neighbourhoods share a large shopping centre, a technical college, a church, (Fig. 281). Medical services, sports fields, crickets and indoor heated swimming pool are also provided.

Industrial districts (Fig. 282) are provided and a new type of factories has been developed and known as standard factories. These standard factories differ in size and are classified into small, medium and large ones (Fig. 283). The factories are let per m² and give flexible possibility for expansion and an aesthetic unity value to the whole complex.

Houses

Two-to-12 storey houses are built (Fig. 284). The houses of the Hornbeams area have a price of 2000 £ to 4000 £ and give a population density of 250 p/h.

Fig. 281. Harlow from the air.

Fig. 282. An industrial district in Harlow.

Standard factories

Factories built in groups after a master plan. They are to be rented per unit area for industrialists who cannot build the structure, and have been experimented with in England, Holland and Denmark.

The most important characteristic of the standard factories is that they can be located in the vicinity of cities, at their borders or in the heart of districts without spoiling the harmony of the environment. They can be built on boundary zoning to serve as a transition belt visually and heavy industry.

Further, the standard factories have the following advantages:

1. Allowing those who can afford capital for the machinery but not for the building to start production at once without the heavy burden of building costs.
2. Permitting control of location and appearance.
3. Harmonizing the industrial district.
4. Preplanned advantageous complex.
5. Cheap spaces for small manufacturers.
6. Growth possibilities by shifting to bigger neighbouring space or adding more units to the workshop.
7. Clean manufacture.
8. Unpolluted atmosphere.
10. Human scale.
11. Offering work for a large number of labourers.
12. Economy through combination of utilities.

The following points are to be considered in the design of standard factories:

1. Simple plans.
2. Rectangular forms.
3. Simple and economic utilities.
4. Accessibility at all points of the production line.
5. Grid or modular system.
6. Enough parking places.
7. Simple processes.
8. Good location in landscaping and screened outdoor storage.
9. They should be grouped with regard to size and type giving much to improve the appearance of the industrial district producing unity without monotony as the industrial structures assume interesting shapes without even trying.
Fig. 284. The houses of the workers in Harlow. Clever grouping in intimate atmosphere. Facing bricks and roof slates used. Green areas are under common ownership. (M 13)
PART III

The Case of Egypt
Leer - Vide - Empty
**Industrialization of Egypt**

The industrialization of the Egyptian region began in 1957. Two 5-year industrialization plans, inaugurated in 1957 and 1959, extended to all branches of industry, in order to maximize the utilization of the natural resources and energy supplies available in Egypt. The industry and other fields of the Egyptian economy and business have been classified into two sections: a general section under the direction and command of the government or semi-governmental authorities, and a private section where individuals and private companies can operate.

Up to 1952, industrial operations had been only of limited scope and confined to the fields of consumer goods and mining. Egypt had been considered as an agricultural land only, and all heavy as well as medium industry had been handicapped. Raw materials had been exported, then reimported as finished products at high prices from abroad.

The industrial workers' colonies in Egypt were created only because of location necessity near power stations and mines which are usually far away from the existing agglomerations, and weaving and spinning factories, which were the only other existing industries that could afford the constructional outlay and the expense. These colonies were either housing projects to merely shelter the workers, or carpet patterned colonies based on decorative conceptions more than on scientific and functional principles and functions.

**Position today**

Today, the government has taken over responsibility for all industries of the general section. Severe examination, testing and reorganization of the factories, production rationalization and administrative systems led to a progressive change in the whole Egyptian industrial structure qualitatively as well as quantitatively. Also, the necessary colonies for industrial workers were established by the government. Experiments in building materials, social fields and climatic conditions have been tried. But these studies have been carried on as if the industrial colony were a normal housing project in a district or town suburb, and not as a specific problem of special characteristics integrating with the problems of the factories and the industrial centres as a whole.

**Energy**

The available increase of energy

The main energy resources for Egyptian industry are electricity, coal and petroleum. Other resources such as wind and water are still in the experimental stage in the eastern and western deserts. Solar energy will be used for direct heating and generating electricity in the same process. An atomic research power station has been established in Anshass near Cairo.

Fig. 296 shows the increase in electric power and future predictions for generated power. On the left is the present (1960) situation. On the right are similar data corrected to take into account the completion of the new high dam and other power stations on the Nile barrages, the connection of all these resources together, and the resulting increase in efficiency and decrease in unnecessary conservation of energy.

Fig. 297 shows the high dam project with the power station providing 850000000 kWh. Fig. 298 shows the project of Wadi El-Kattara, expected to produce 2340000000 kWh. The 9 new power stations of the Nile barrages, with 4300000000 kWh annually, and the existing power stations in addition to the above projects will increase the electric power production per head in Egypt from 60 kWh in 1952 to more than 575 kWh in 1972, allowing for a population increase in this period of from 23 to 33 millions. In comparison, consumption is 4692 kWh in Norway, 2133 in Switzerland, 415 in Japan, 38 in Turkey, and 3 in Pakistan.

Fig. 299 shows the petroleum resources in Egypt. Most of the wells and refineries are concentrated in the eastern desert and in Sinai. New searches are being carried on in
the western desert and the Oases. Egyptian petroleum production increased from 2,361,197 tons in 1953 to 5,000,000 tons in 1962.

Fig. 300 indicates coal resources. They extend in a longitudinal strip from the Sinai Peninsula to Aswan, and in the southern parts of the Kattara depression.

Rationalization of agriculture is of prime importance. Mechanization of cultivating methods and the grouping of small owners in communities raises the production efficiency of the land (Fig. 301).

Fertilization of the desert, and the new level of the Nile after the execution of the high dam, will reclaim 2 million Feddans (1 Feddan = 4,175 m²) and enable irrigation of lands 20 m higher than the land cultivable today, as well as cultivation of 700,000 Feddans of rice and the new valley project in the western side of Aswan. The lakes created by the high dam and Kattara project will decrease the summer heat by about 5° to 6°C, and prevent the sandy winds of the south and west (Fig. 302). Touristic centres will be created. Salt industries and desert products can then be established.
Regional distribution of industry in Egypt

A special case of regional industrial distribution occurs in Egypt: The Nile runs south-north with an agricultural valley as well as agglomerations parallel to it. The distribution of the industrial zones on the map of the Egyptian region shows concentrated, heavily industrialized areas in Cairo, Aswan, Alexandria and Suez, including all types of industries; another zone comprises an industrial backbone including the Nile valley and areas around the Kattara depression on the Mediterranean and some areas along the Red Sea, consisting of manufacturing and intermediate industries; a third zone of mining industries and petroleum wells in the eastern and western deserts; and a fourth zone of agricultural industries, such as preserved foods and agricultural instruments and machines.

Fig. 304 shows the topography of Egypt and Fig. 305a provides a survey of the population distribution in Egypt which reached in 1960 26059000, of which 13113000 are males and 12946000 are females. A comparison between these two figures, and the figures showing the industrial distribution and the energy and power resources data, shows parallel positive relations between all of them.

The present Egyptian approach of the problem

The distribution of the industrialization process is executed in a uniform pattern to the greatest possible extent, to gain most benefit from decentralization. Yet some big projects are concentrated in or near Cairo because of the skilled labour force problem. Within the framework of the new industrial planning in Egypt, the industrial workers have won many new rights and the whole industrial structure has developed economically so far. The following points will give a general picture of the social and working situation of the Egyptian worker.

1. The total working hours are 42 weekly and 7 hours daily. This can be increased to 9 hours daily in the industries which do not need continuous work. A rest period totalling 1 hour interrupts the working time so that the maximum continuous working time is 9 hours. Maximum stay of the worker in the working place is 11 hours including the rest period.

2. Over-time is paid for with 25% extra payment for daytime, 50% for night-time and 100% for holidays.

3. The workers share 25% of the profits of the industry divided as follows:
   - 10% in cash for the workers and employees.
   - 5% in the form of internal services in the factory.
   - 15% for housing purposes and general services.

4. The industry is obliged to provide the workers with means of transport between the factory and the nearest existing transportation lines.

5. The industry is obliged to provide its workers with the necessary residential facilities if it is located in the provinces of the Red Sea, Sinai, the west, and the south, and also wherever the industrial centre is 15 km or more from the nearest urban or rural centre.

6. The Egyptian villages, which today number 4020, contain 16000000 persons. These villages, which compose the environment where most of the industrialization program will be executed, will have in 1980 a population of about 24000000. This increase will need 1680000 one-room residential units, 2160000 two-room residential units, and 960000 three-room residential units.

Thus a sum of 68000000 ££ is needed annually to cover the building and streets costs of 136000000 ££.

Fig. 303 shows the present and the future shape of agriculture in Egypt. Taking in account that the Nile valley comprises today 3% of the area of Egypt, the Western desert 69%, the Eastern desert 22% and the Sinai Peninsula 6%, the total area of Egypt is 621074 km² or about 15½ times the area of Switzerland. The arable land area today is 19309 km².

Fig. 301. Raising the efficiency of the agricultural land in Egypt through the rationalization of the work, fertilizers, mechanization of cultivation, grouping of small lots into big farms, and the industrialization of the agricultural products, to counterweight industry.

Fig. 302. The lakes of the High Dam and the Kattara depression projects. Each of an area 20000 km² together they have an area equal to the area of Switzerland.

Fig. 303. The present and the future shape of agriculture in Egypt.
Conclusion

The result of the previous analysis of the case of the industrial centres in the Egyptian region forms a new topology in this regard. Concrete studies will be given of the Egyptian region population, agriculture, social life, living standards, economical, climatic, geographical and topographical conditions. This scientific research, together with the author’s personal experience and residence in 14 industrial colonies in the Sudan and Egypt from 1934 to 1957, and personal technical studies and programmed visits to many distinguished Egyptian and European industrial centres between 1958 to 1962, produced a new abstraction of the whole conception. This new abstract is 'The theory of the industrial centres in Egypt, dealing in particular with the detailed architectural and planning aspects of Egyptian industrial residence areas, besides with the design of industrial centres as an integrated unity in general. Suggested is a large-scale program of further specific research covering the practical problems as well, offering theoretical statistical data which are of benefit as a fundamental basis for future development.

In the following paragraphs, we introduce the design and planning principles of the Egyptian industrial centres and colonies, which should form a basis for further research on the design of these centres and colonies in the future as well for the growth and extension considerations of the existing ones.
Fig. 304. The topography of the Egyptian region.
Fig. 306a. The distribution of population in Egypt in 1962.
Fig. 305b. The expected distribution of population in Egypt in 1980.
The theory, its aim and reason

For a fast developing land like Egypt, with a vast longitudinal shape of different characteristics, the difficulties which met the industrialized countries should be avoided. These difficulties are in fact the bad location of industry and the bad conditions of the industrial workers’ housing. Even with contemporary technology, it is a hard job to offer better solutions for the industrial centres which have already grown up on wrong planning bases. Therefore, we introduce in the following pages principles for the design of the different Egyptian sub-regions as classified in Fig. 310, in our new industrial topology of the Egyptian region. The aim of this topological theory is to specify each of the sub-regions mentioned in terms of the types of the existing or projected industries within its borders, its climatic conditions, its population, social conditions, building materials, transportation means and dynamic growth possibilities.

Skeleton of the new topological theory

For each of the seven sub-regions mentioned later, we introduce a design skeleton for the industrial centres within the framework of the following factors:

Factors of the design skeleton of the industrial centres:

1. The relation of the industrial centre to the neighbouring urban agglomerations.
2. The type of industry.
3. The relation between the industry and its workers’ and engineers’ colony or housing facilities.
4. The internal design of the colony.
5. The planning and design of the workers’ and engineers’ houses, their materials and construction.
6. The dynamics of growth and extension.
7. The mobility of the labour force and technical experiences from one sub-region to another (Fig. 306).

Pre-analysis

Before we define the seven industrial sub-regions of the author’s theory, we must make an analysis of the different types of industry. The black circles show the fixed focal point towards which all the other industrial structure elements are attracted and on which they are based. The three main problems are housing, transportation and growth and expansion (Fig. 308).

The definition of the expressions used is as follows:

1. Heavy industry:
   Of areas greater than 20000 m² per factory. Influences the surrounding environment. Needs radical changes in transport, zoning, housing, and population density and class. High wages. More working power. Special energy resources.

Fig. 306. Diagram showing the mobility of the workers and technicians in Egypt.

2. Manufacturing industry and transforming industries:
   Include medium and light industries. Of areas 1500 m² to 3500 m² per factory as average, reaching 20000 m² for some. Not bound to fuel or energy resources like heavy industry, but also not mobile, high wages, more qualified workers required. May also need unqualified ones. The light industries of areas 300 to 1500 m², movable, do not influence the surroundings. Motors up to 10 h.p., electric current from the existing power resources. Transportation, distribution, and market are important items.

3. Power stations:
   The power stations in Egypt are located near rivers or other water resources, and mostly at the city borders. Water works and sewage stations share the same characteristics. No big future growth possibilities for station or colony.

4. Mines and materials resources:
   Usually located far away from urban centres. Housing and transportation are their main problem. The lower costs of the workers’ house depends on the rationalization of the above-mentioned requirements, rather than on saving a window or door in the house.

5. Light industries
   Industries which do not influence their environment. They have the needed energy from the local means.
General aspects

For the special case of Egypt, there are two general design principles for the industrial centres, apart from the above mentioned six specific factors. Firstly, the principles of location of industry and colonies with respect to each other (Fig. 309). Secondly, the internal zoning or the classification of the sections of the industrial workers' and engineers' colony. These two general aspects will be treated later in detail.

Theory of industrial residence in Egypt

The first map shows the final topology of the Egyptian region in different sub-regions in terms of industry and workers' houses and colonies (Fig. 110). The topology mentioned is a product of the complex study of the industrial characteristics of the Egyptian region, the climatic conditions, the social and living conditions, the local building materials of each sub-region, the condition of agriculture, military factors, transportation facilities, and future growth possibilities.

The regions of this sub-order are:

1. **Cairo Metropolitan, Delta** middle and eastern parts, and **Alexandria** area. Its characteristics are explained later. The degree to which the areas belong to this sub-region is represented by the density of the grey shading.
2. **Aswan area**, covering the industrialized parts of the 'High Dam' sub-region, electric power stations, and chemical factories. Also includes the Nile transport centre to the north. The red colour overlaps the areas which will be heavily industrialized in the industrialization programs.
3. **The Delta** in the north is a complex region which falls under many categories as to its central location point. The quick mobility of the workers of this region may cause some slight changes in the future of this region as well as of the neighbouring ones. Dark blue.

4. **The 'Said' or southern Egypt.** Represented in light blue. Possesses great electrical energy which is not yet totally exploited.

5. **The eastern desert region,** well explored and covered with mines of metals, coal, phosphate, and other raw materials, but lacking good harbour services on the Red Sea for export.

6. **The western desert,** light green, represents the unripe land, where big opportunities exist for exploration, mining, industries, water wells, and a new era of new life, as in the American desert urbanization projects in USA.

7. **The northern coastal areas,** which also include parts of both eastern and western desert are represented in dark green from the Libyan borders in the west, to the Gaza region in the east.

The second map shows the topography of the Egyptian region. The area of cultivable land should be increased by raising the height of the irrigation level and by expanding agriculture east and west into the lowlands of the desert.

The third map shows the coal resources.

The fourth map shows the petroleum resources.

The fifth shows the increase of electric power, in generating power and in current production.

The sixth map shows the present and future areas of cultivable arable land, with respect to the different dam projects which are to be executed, and irrigation with better developed systems and capacities.

The seventh map shows the classification of the Egyptian region into specific industrial sections as follows:

1. Heavy industries, needing special transport considerations, special housing projects, and special planning for the future growth.
2. Medium and manufacturing industries which seek a labour force.
3. Mining, raw materials, and petroleum wells and resources.
4. Light and agricultural industries, preserved foods, and agricultural machines.

The above dynamic ever-changing measures are the fifth dimension by which the judgment, planning, and execution of the new industrial centres in Egypt, as well as the correct expansion of the ones already in existence will be successful.
Industry and colony are encircled by a ring road, internal expansion is possible.

Both industry and colony be on one side of the main road, with internal connection and feeding road. External expansion is possible.

A series of industrial locations connected with a continuous residential strip. Linear expansion and integration with existing agglomerations is possible.

A series of colonies serving as dormitories for a ribbon industrial complex. Linear expansion is possible. Colonies may also serve as urban cores for their surroundings.

Industries and colonies in reverse composition.

Industry and colony in a growing structure.

Fig. 309. Pre-analyses.

Industry and its colony are in the vicinity of an urban agglomeration. Both of them are dependent to a great extent upon city for provision, transportation, and existence.

A Factory and colony outside the city.

B Factory outside the city but workers are in a near residential quarter or colony inside the city borders.

C Factory is built within the city borders, the industrial colony has to be built in the direction of the town growth as a new quarter of the town.

D The industry is located outside an existing urban centre, the workers' residence composed of many residential lots from the near-by quarters.
The industry is located in an isolated industrial zone. The whole town acts as a workers' colony.

The industry dominates the whole region. Colonies are more sections attached to their factories, for workers' residences.

Industry and colony form an independent unity with growth possibilities afforded for each of them.

Colony belongs to industry, also independent. But they are far from each other. Transportation means have to be provided.

Industry and mines are dominating a big area. Small independent colonies are a necessity, all joined together.

A rich urban centre serves as residential base for the workers of an industrial region. Industry is scattered wherever it is possible to find energy means, raw materials, and workers. The urban centre delivers the required man power, as well as a distribution market.

A whole region is covered with distributed industries and colonies, may be uniformly. All are joined together and inter-relation may occur between any two or more.

Both industry and workers houses are located in a city quarter. Difficult future extension possibilities.

Industry depending on standard factories system. The near residential quarters will actions its colony.
The Seven Sub-regions

The first sub-region

The location of the first sub-region (Fig. 311a)
This type includes the Cairo Metropolis, which has a population of about '3000000, and is planned for 4000000'.
Alexandria and its circle, '1500000, planned for 2000000'.
Delta of the Nile, its left and right branches in the vicinity of the river Nile, 'about 8000000'.
The area of Suez, the canal, and the vicinity, '2000000'.
Thus a total population of 14500000.
Fig. 312 a, b, c shows the Cairo area as a section of this subregion.

Society and type of agglomeration

The environment of this heavily-populated sub-region is in almost all its parts an urban structure (Fig. 311b). Society is to a great extent free from traditional restrictions of daily life – severe privacy requirements in housing – and allows mixed social activities, especially in Alexandria and Suez, and Port-Said. But family life still retains an oriental turn, as well as European outlook.

Fig. 311a. Distribution of the different types of industry in the first sub-region.

Fig. 311b. The possibilities of location of industry and workers' houses to each other in the first sub-region.

Fig. 312a.
of this factory and the other industrial compounds belonging to it, such as its power station, public services, etc.

2. Medium and manufacturing industries
These industries are distributed all over the parts of these sub-regions in different densities as shown by the degree of darkness of the grey shading in Fig. 306. The textile industries are situated on the right and left parts of the delta and on the outskirts of Alexandria. Other medium industries, chemicals, furniture, leather, shoes, electrical installations, cigarettes, building materials and building elements, metals and metal products factories, are mostly located in the Cairo Metropolis and in Alexandria. The industries concerning export merchandizing are mostly concentrated in the Suez and Port-Said, and their surroundings.

3. Light industries
These industries, which are located within the borders of residential zones and do not require any special transport facilities or change in the site, like goldsmiths, car-repair workshops, bakeries, carpenters shops and dyeing, etc., are located everywhere all over the first sub-region. But in Cairo and Alexandria they tend to be partially independent in internal self gathering groups and self zoned professional quarters. Their workers can live nearby.

4. Light and agricultural industries
These industries depend for their existence upon the fields producing fruits, vegetables, and flowers. They are now concentrated in Cairo Metropolis and the eastern delta, for preserved foods and honey. In southern Cairo 'Maādī' there is a big perfumes industry that exports to Europe and the middle and far east, in Kahā canning and preserved food industries. Otherwise such industries spread everywhere in this sub-region.

The flourishing of industries depends on the following factors:

1. The preservation of the neighbouring fields to cultivate the required agricultural products for these industries within the general agricultural planning scheme.
2. Allowing no building extension in these fields (Fig. 310).
3. Benefiting from the presence and experience of the fellahin (farmers) in the vicinity to provide the required human energy and labour force. Especially by planning to use the seasonal farmers as part-time workers.

Housing the industrial workers of these types of industries can be combined with planning for the fellahins' houses, providing a better integrated society of both. Moreover, from the economical point of view, such a combination allows the establishment of common public services and social, medical, educational and recreational centres for the common use of the new integrated society.

Climatic conditions of the first sub-region
This sub-region has a generally mild climate with some local differences. In Alexandria and Suez the climate tends in general towards more humidity. In Cairo Metropolis and both delta branches, it tends towards dryness in the direction of the desert and towards humidity in the direction of the Nile. Temperatures vary between +5°C to +38°C from winter to summer.
Building materials

Powerful mechanical constructional resources. Most of the buildings in reinforced concrete skeleton type, with filling screen walls and partitions of burnt bricks. Tile floors, mosaic, marble, and plaster for the inside and outside, are the materials normally used for the finishing. Bad heat insulation is always noticeable in the new buildings. Rain insulation is simple.

A better quality of cheap burnt brick is now being developed to save plaster, to resist weathering and to face the sandy and dusty winds.

As an example we will consider more closely the case of Cairo Metropolis. The first sub-region as a whole including Cairo capital city is composed of the best precious cultivable land in Egypt. The first step towards a good planning solution is to expel industries from the region to allow more land for agriculture and a counter weight to more urbanization and industrialization of the desert.

Conclusion

In the first type, industries should be located in the desert surroundings and not in the heart of the cultivable area, as planned in Cairo’s master plan.

The industrial colonies should be as near as possible to the factories, but in case of good transportation, they should be considered as quarters of the nearest local urban centre and should be placed in the direction of natural growth, offering solutions for the combined planning and economical problems.

The different industrial projects should be studied together to combine colonies of similar characteristics or neighbouring ones in one big complex with the full economic advantages of centralized common services and general activities.

The industry and its colony are to be established on the outskirts of the towns and the arable land. We give here the main principles for the design of these new industrial centres in the first sub-region (Fig. 313):

1. Both industry and its residential areas are to be provided with a local feeding road if they are both on one side of the main road or on different sides. Thus allowing a link which is not crossed by another traffic line of a different function.

2. The centre of the colony is provided with another local feeding provision road which goes direct through the centre uncrossed and unbroken.

3. The location of the core of the centre should not be on the valley side of the industry but on the opposite side, which should be in the direction of the desert, to allow another future extension for the colony that does not clash with the extension of the factory’s growth, or invade the valley again.

4. Internal feeding branches will project from a ring road to provide for the required traffic which should go only to the garages and not through the whole colony.

5. The core of the colony should be reserved for recreational facilities and for obligatory, small-scale, unexpected additions and restricted growth conditions.

6. Greens should be inserted between the different elements. Wherever fertile land or water are dear, palm trees and desert plants are to be adopted and the creation of concentrated condensed green areas can depend on the existence of private gardens.
Proposals for the location of industry and the design of the first type of the Egyptian industrial centres in Cairo Metropolis

The master plan of Cairo 1957 had foreseen that the industrial zone should be located in the northern part of Cairo for the reasons mentioned below (Fig. 314 left). We introduce the opposite project for the same Cairo Metropolis taking into consideration the factors mentioned in the Fig. 314 right.

The master plan project of Cairo Metropolis

Official plan 1957

The industry is located in the northern part of Cairo. This choice is based on the following reasons:

1. Many industries, with their appropriate railways, garages and repair workshops, existed here at the time of planning. To shift industry to another area would have cost the government many millions of pounds which could be invested in other more beneficial ways.

2. All transportation lines and junctions with the whole Nile delta already existed before the planning. Also under the '1936 agreement', military roads to Alexandria in the west and Suez in the east had been established and had been in use for commercial and industrial purposes. It would have meant a big financial burden if these had to be changed or replaced by another lines.

3. This area in the northern part of Cairo lay adjacent to the rich Delta; workers, provisions, and installations were already at hand.

Criticism

1. The master plan led to a concentration of industry in the northern part of Cairo, creating an industrial belt between the capital and the delta.

2. The growth of industry to the north spoiled useful agricultural land (Fig. 315). Concentration of industry and working class on one side of the Metropolis creates a social split between the city's inhabitants. It has other political disadvantages, in elections, or strikes, as well as in social activities.

3. The natural residential and commercial growth in the north is prevented and blocked by the presence of industry, and its necessities and disturbances.

4. The growth of the Metropolis in the south and west is proceeding in the opposite direction from the industrial growth, thus increasing the work-home distances.

5. The existence of the raw materials in the southern and eastern Egyptian regions causes heavy traffic in the heart of the city.

6. The relations between industry, residence, and business zones are not integrated in a rational system, and will further cause multiple problems.

Proposals (Fig. 314 right)

1. All industries should be redistributed on the outside borders of Cairo region with consideration to the growth directions in the natural points. The entry and supply of raw materials, the export of finished products, and the presence of the kind of workers required should be respected.

2. Industry should be evacuated to the desert. The agricultural land should be totally cleared of industry and its workers' colonies. Even in the case of agricultural industries, very concentrated groups of industrial plants with vertical growth facilities and high workers' residential and service units should be adopted.

3. Industry should be placed where it can attract the labour force to the outside of the core of the Metropolis, to reduce the heavy population densities of Cairo's centre and sub-centres and abolish the traffic chaos and congestion through the Capital Metropolis.

4. Contrary to the official master plan, the redistribution of industry in all the four directions and in the south will open Cairo to the delta in the north, and benefit the southern provinces in the Pyramids, the Fayum, and the Beni-Suef directions. Neglect of the south has been always a fault of Egyptian governments in the past, although now more care is taken.

5. All industries causing smoke, dust, smell, and other disturbances whirling and blowing over Cairo with the north wind should be cleared from the northern part of the Metropolis.

The second sub-region

The location of the second sub-region

This type includes the newly industrialized Aswan province and its circle. 'Present-day population about 100000 and planned for 1 million' (Fig. 316).

The society and type of agglomeration

The original society is poor, financially dependent mainly upon seasonal agriculture and the seasonal winter tourist trade. Conservative traditional life to a certain extent, but rapidly changing with the progress of the industrialization schemes.

The new population structure is composed of immigrants from the north, well qualified, skilful workers and technicians, but unaccustomed to the region's climate and atmosphere; of the regional natives; and of the desert dwellers and the Nubians who will lose their land under the water of the High Dam. Aswan was originally a sort of big rural village. It should be turned now into an urban centre.

Fig. 315. An example showing the aggressive spoiling of arable land with a cover of industries, colonies, and streets. (Edfina colony, Egypt.)
Type of industry

The industries established in this sub-region are mostly new ones. The tendency is to establish colonies for these industries which are totally independent in location, but partially dependent on the public services and activities of the existing urban centres in its vicinity.

The different industries of this sub-region can be divided into:

1. Power stations
   In Aswan Dam and in the High Dam. Needing a large force of technicians and skilled labour, with big colonies for about 300 to 500 families each, which means a population of from 1800 to 3000 each.

2. Irrigation department colonies
   Comprise houses for inspectors, engineers, technicians, and workers, and manual workers. The latter are mostly drawn from the neighbouring desert nomads. This type of colony usually comprises 30 to 100 families or a population of 200 to 600 persons (Fig. 317).

3. Manufacturing industries
   Mostly chemical industries, depending to a large extent on the chemical quarries and mines in the vicinity of Aswan. The need is for two types of colonies. The first is for the technicians, engineers and workers of the factories, about 1000 persons, and the second comes under the next heading of mining industries.

4. Mining industries
   Granite quarries, chemical ores and powders, and building materials and elements.

5. Light industries, for tourism
   Leather, copper, and mahogany or marble or shell products.

6. Civil and industrial building, responsible for the building of dams, factories and colonies.
   The housing of the workers of this type of industry would more come under temporary mobile industrial housing which changes location with the mobility and completion of work.

We introduce the principles of creating and developing the centres already existing and take advantage of their present small size and undeveloped transportation means to plan a well studied centre on the modern planning principles. The industrial centres of the second type should be organized to avoid the establishment of...
The residential colony of the project lies between the dam and its aerodrome and includes the houses of the employees of both. Geometric location of the residential blocks, and the main road passing through the colony and its green areas. No grouping or space conception is applied to the planning of the colony.

Independent isolated industrial colonies (Fig. 318). Integration with the existing agglomerations is recommended. As much as possible should be built on non-arable land.

Fig. 318. Second type of the Egyptian industrial centres.

Climatic conditions of the second sub-region

The temperature of this region varies between the two extremes, in summer and winter, also by day and night. Very hot and very cold. Dry air because of the two desert sides. Very rare rain. Very hot sandy winds in summer. Heat insulation is very important, but unfortunately the poor living standard has always limited insulation means to the use of thick stone walls. In some houses clerestories are used to receive cool northern air draughts, but in the new houses and buildings, no attempt is made to benefit from this. But another solution with double cavity walls around the whole house is tried in the 'Kima' chemicals company in Aswan, in the engineers' and workers' houses. Clever use is made of the double cavity walls to ensure that the cool air passes through all the sides of the house to decrease the temperature of the inside and to insulate it. The inlets and outlets of the canals are closed with wire mesh to prevent insects from passing through them. This industrial colony is located in the desert where the temperature rises in shade to over 40°C for a long period in summer. Deep balconies and small southern windows protect the interior from the hot sun.

Building materials

The cheap and customary building materials in this second sub-region are limestone and granite, lime, sand, gravel, and gypsum. Recently the use of reinforced concrete has been developed. Steel and cement will be cheaper after the new factories reach their ultimate production.

Proposals

The existing colonies around Aswan, of the different industries, power stations, irrigation departments, and mines, serve only as mere dormitories. Some of them have their own local centre, but many others lack even that. They cannot all depend on Aswan as a mother city,
and any strengthening of Aswan will still be weak as it is isolated from these surrounding colonies socially and in services and activities. Therefore these colonies depend unfortunately direct on Cairo (Fig. 319a).

Our proposal is to create a one-unit strong centre on the other side of the Nile opposite to Aswan, and to create from the two centres, new and old, a disciplined integration to serve the whole region. The immense potentialities of the new centre as an application of modern regional and town planning, and architectural theories, necessitate a strict regulation of the contacts of this region with its surrounding ones in all its four sides. The connection of this region northwards with Cairo will be strengthened, disciplined and united on the bases of the existing capacities and installations in Aswan and its reputation as a touristic town (Fig. 319b).

Mostly colonies and industry are remote from the urban life and from each other, with the exception of power stations.

The third sub-region. The Nile delta

The location of the third sub-region

This type includes the delta, overlapping with Cairo and Alexandria, as well as with the coastal sub-regions (Fig. 320). Thus covering a gross population of 18 millions, but a real population of only about half i.e. 9 millions in the Delta.

Society and type of agglomeration

Mostly agricultural agglomerations. This rural environment has many medium and light industries which have been introduced in the last 30 years, and turned this sub-region into a much more developed one than the south, also causing a rapid social and cultural change in the whole area with work for women and education for girls. The living standard is also still more advanced than the south.
Most of the cases of this third sub-region are composed of industries growing inside existing towns. Workers, as well as transportation and services, of both are combined. In some cases, as in the textile industries, special workers' colonies are established but in connection with the existing agglomeration.

Types of industry
The existing industries in this sub-region can be classified as follows:

1. Medium manufacturing industries, textile industries, weaving and spinning, over all the four sides of the region, especially Mahalla El-Kubra.
2. Light industries in the main urban centres.
3. Agricultural industries, preserved foods, and extracts, in the eastern part of the Delta.
4. Mining industries, petroleum wells and refineries, fishing, sponge fishing, black sands, salt, radio-active materials, and other extracts, in the eastern and north-east delta, Suez, and Port-Said.

Climatic conditions
The climate of this area is more humid than that of any other sub-region in Egypt. Mild refreshing breeze from the sea during summer. Bearable cold in winter (7 to 10°C). However, insulation is very necessary in the construction to keep the houses and buildings cool and protected in the severe hot period from May to August, and warm in the cold period from December to February. The absence of heating as well as of cooling installations gives this factor major importance.

Building materials
Reinforced concrete, red brick, and limestone are the constructional materials normally used in this sub-region. Although the Iron and Steel company began production in Helwan, in the south of Cairo, steel construction is not yet popular and not much practical experience exists in the technical problems in this field. Wood comes from abroad, and the local product is of bad quality, leading to the handicap of high uneconomic prices.

Proposals
The situation of the industry in this sub-region is more or less a magnetic one. Industry attracts the labour force from the farms, offers them more wages, and fixed working time, better working conditions, better leisure distr-
bution and more means of entertainment and a sure systematic way of success in life (Fig. 321). These factors are gradually evacuating the heart of the delta of the agricultural labour force and turning the latter into industrial workers on the borders of the industrial centres. Mechanization of agriculture, as well as the grouping of cultivable parcels in big lots under big organizations, are necessary actions to solve the problem of the shortage labour. The second important problem is the insertion of industry into the heart of the Delta (Fig. 322). This process spoils the fertile land while the free, vast, suitable desert is on every side (Fig. 324). Industry should be located on the desert borders of this sub-region (Fig. 323), and only agricultural industries allowed where necessary on the cultivable land. In this case, only vertical growth possibilities for both the factory and its workers’ colony should be allowed.

The fourth sub-region

The location of the fourth sub-region

This sub-region includes the whole of southern Egypt (Said), covering the Nile valley from Cairo to Aswan (Fig. 325). Population is about 6 millions, without considering the Cairo Metropolis within.

Society and type of agglomerations

Conservative society, very attached to the land as well as to traditions. Agricultural rural agglomerations with strong urban centres forming the capitals of the southern provinces.

Social and cultural changes are expected after the industrialisation schemes. The start of the Assiut University in the middle of the region will also give an effective push in this direction.
Industries around existing agglomerations, which provide residence for the labour force.

The existing industrial pattern in the fourth sub-region
Both the industry and the workers' housing occupy parts of the urban centres, and the whole system occupies and spoils the rare cultivable fertile land.
The development of industry, and the growth of its centres, cause a dangerous decline of the agricultural area, and corruption in the southern cities which were not planned as industrial ones and repeat the failures of the past at the birth of the industrial revolution.
The whole system should be designed to break down the centralization of the industry inside the southern towns, and take it outside the valley.

Proposals
Our proposal consists of the following:
1. Industry goes to the desert outside the green valley borders (Fig. 326), except industries needing big quantities of water. Even in this case the industrial centres should not be established upon arable land.
2. A connection between the new industrial centres and the existing agglomerations give an exit to the former towards the river to connect with the water as a means of transportation, and connect the latter with the new centres, to benefit from their services and the public activities.
3. Each of the industrial centres and the existing agglomerations should grow in the direction of the other, thus benefiting from the combined services, and shortening distances.
4. The water problem: Should be solved as mentioned later when the new Nile water level rises as a result of the High Dam project. Canals should be dug out from the river Nile to the industrial centres in the desert as had been done in the Liberty Province on the western side of the Nile Delta, to provide:
   a) The drinking water for the new settlements.
   b) The water needed for industrial purposes.
   c) Water for irrigation of private and public green areas.
   Another advantage will be then gained, namely the increased irrigation efficiency of the already-cultivated land where the canals pass through.

The proposal recommends the execution of the project of Dr. A.A. Ahmed, where he suggests the erection of a power station in the semi-natural depression of Asiat. The depression will be filled at night with water by the excess electric power which is not needed at night. In the morning, electric power will be regenerated by the waterfall.

Besides we recommend the extension of electric power generation and the use of electricity for the following reasons:
1. The possibility of the free location of industry without dependence on the fuel provision conditions.
2. The possibility of connecting all the power stations of Egypt in one main network to support each other in case one should fail. The saving in necessary reserve power is of great worth.
3. The cleanliness of industry will facilitate the location of industry on the western desert ribbon parallel to the green fertile valley in spite of the prevailing wind.
4. Better electrical drainage systems for agriculture. A good vivid example is the Belkas drainage power systems which turned 1000000 feddans (420000 hectares) into good cultivable lands (northern Delta).
5. The electric motor is easier to use and operate for the fellah (farmer), and also gives a chance to private small industries and private crafts.

The electrification planning of the Egyptian region will be facilitated by the parallel extension of urbanization and industrialization in the desert and green agricultural areas near the river Nile (Fig. 326).
The development schemes should be started from the poorer south towards the north. Immediately afterwards the northern upper edge of the Delta, as will be mentioned, should be developed to counterbalance the southern progress from the economical as well as from the population density and social points of view.
Our proposal is to locate the industrial centres, factories and their colonies outside the cultivable ribbon to attract the extension of the existing agglomerations to the western direction (Fig. 327). If the new irrigation projects allow the cultivable land to extend in the western direction, then the new industrial centre...
should retreat to the west to leave a space for the agricultural development schemes. The building process should be restricted in the existing urban centres (Fig. 328), and it should be completely free in the new ones (Fig. 329).

Fig. 328. For rural agglomerations. The location of a new industrial centre with respect to an already existing village.

Fig. 329. For urban agglomerations.
The fifth sub-region

The location of the sub-region

This type comprises the eastern Egyptian desert, the Sinai peninsula, and the Suez bay. Population of 1 million, the biggest part concentrated in the north. The population of the southern part consists of immigrants from the north and the west, nomads from the desert, official governmental staff, and the technicians of the industrial and research undertakings (Fig. 330).

Shallow harbours on the Red Sea serve for the crude phosphates export. The Suez harbour in the north serves for petrol export and transportation. No railway connection with the west, and the military English line was removed after the second World War when the Egyptian government in 1945 refused to buy it for 2 million £ (20 million Swiss Francs), for the connection between Qena and Qosir (300 km). An asphalt road now exists and is covered by car in 7 to 9 hours (Fig. 326).

Society and type of agglomeration

The environment in this fifth sub-region is in the shape of desert settlements of concentrated bulk of houses which achieve good insulation efficiency and are located at short distances from each other or mostly wall to wall, to
shorten the water and power lines. In the coastal part of this sub-region, the houses are sometimes of two stories. In the heart of the desert, the settlements seem more or less temporary, especially those of the small mines or the pre-fabricated houses of the oil companies. In the vicinity of the miners' colonies there are always houses and huts of the excess workers or the seasonal ones. Sometimes, the colonies are built near already existing nomads' desert settlements but integration of the two is very difficult.

**Climatic conditions**

Dry, very cold at night and in winter, very hot by day and in summer.
Rare rainfall. Hot wind from April to July.
Heat insulation should be considered. The orientation of streets and houses should allow for the climatic factors. Many small mines exist in the same area, having their workers' colonies and settlements in the vicinity, but not completely independent ones.
More organization is required to gather them in one integrated whole with common services, and organized transportation facilities.
One big industrial centre with the corresponding its relating residential units surrounding it. Combination of a shopping centre with some other activities in one building is possible and sufficient.
This case exists in the area of the phosphates mines where the mines spread over a long distance, and many small separate colonies are needed to house the workers in the neighbourhood of the extended industrial area.

**Type of industry**

In the south and on the Red Sea coast there is a mining industry. Gold, phosphate, manganese, zinc, lead, asbestos, talc, copper, nickel, chromium, granite, sulphur, and kaolin.

**Proposals**

The fifth sub-region, comprising the eastern desert far towards the Red Sea (Fig. 330), will still be composed of scattered settlements, of temporary life means and outlook, and will always be lacking in the rich urban structure, as far as it is isolated from the remaining parts of the Egyptian region.

The author proposes that this sub-region should be connected from the north with the third and first sub-regions at Suez, and from its centre with the fourth sub-region at Qena in the west.
The connection will be in the form of three lines, electric power, electric railway lines, and a highway (Autobahn) with an adjoining water pipeline. The important part from Qena to the Red Sea costs 3.5 million Egyptian pounds or about 35 million Swiss francs for the pipeline and the electric power transmission line, about the same sum for the railway, and about the same again for the highway.
The pattern of the industrial scattered colonies should then be replaced by stable industrial centres of an organic structure, and growth possibilities. These new centres should have their own planning schemes and architectural conceptions which spring out of real integration with their situation and local conditions.
The sixth sub-region

The location of the sub-region

This sub-region comprises the western desert, and the southern part of the Kattara depression. Total population to-day is only 10000, but it is expected to reach 100000 in the next ten years. This area had an important strategic situation in the Second World War, but lost it after the independence of Libya (Fig.331).

Society and type of agglomeration

Original nomad society in the oases which blossom wherever natural water springs exist in the desert. This characteristic does not appear in the fifth sub-region. The agglomerations are more or less desert settlements with primitive building efficiency and methods. Dry sandy mud bricks, sand and straw compose the wall constructional materials, while palm logs are used for roof construction which is sometimes made in the form of vaults or domes.

The new immigrants come from the east and north as official technicians and workers.

Type of industry

Mining industries in the south, for coal, iron, and chemical products. Other metals and phosphates in the Kattara depression. In the north and at the oases, preserved food would be successful, dates, coconuts, and vegetables, as well as chemical industries. A fully mechanized agricultural industry of melons and salty fruits will create an active transport and export industry in the area.

Climatic conditions

Dry weather, little or no rain, very hot by day and in summer. Very cold at night and in winter.
Heat insulation is essential, also climatic conditions should be taken into consideration, in the orientation and design of houses, and streets, and in the zoning of the industrial centres either in the working or residential areas settlement.

Proposals

Mechanization of agriculture should be adopted. Better results than those of the Liberty Province can be expected for two reasons:

1. The better quality of the land which stretches from Aswan to the middle oasis, and can easily be prepared for cultivation.

2. The new high Nile water level allowing good irrigation possibilities throughout the year. The stored water also contains very rich fertile loam from the Abyssinian mountains (Fig. 332).

3. The good opportunity for extending an electric power transmission line for the industries, and an electric railway line.

4. The good combination of agricultural industries with the new chemical industries, coal and iron mining industry, and the power stations and irrigation departments. Variety of work and social conditions.

Over-population causes traffic chaos and housing shortage. Besides these lands there lie ready for improvement millions of feddans which it is sought to turn into cultivable land. Black sands, salt, fish and preserved fish industries, as well as co-operative mechanized rice industries are possible.

Fig. 332. The proposal is to connect the sixth sub-region with the second one to benefit from combined power generation and from the mobility of the labour force. The sixth sub-region will turn the direction of the emigration stream flow and attract it more to the south west.

Fig. 333. The concentration of industry can be applied in the Qena region while decentralization of industry can be applied in the Fayum region.
The seventh sub-region

The location of the sub-region

This sub-region comprises the northern coastal part of the Egyptian region. It stretches from the north-western desert to the Gaza region in Palestine, passing through the Alexandria area and the northern part of the delta. It also covers the northern part of the Kattara depression, overlapping with the first, third and fifth and sixth sub-regions (Fig. 334).

Society and type of agglomeration

As this sub-region is the only one which extends laterally through the Egyptian region, it covers a variety of differences, which vary in the two eastern and western wings from the centre. In the extreme west, the original population are nomads and cattle-breeding groups; tents, temporary residences and simple settlements exist. After the Second World War it gained a touristic reputation for the war scenery, and memorials, besides its clear water and sandy beaches. The project of Kattara depression will change the face of this sub-region to a unique multifunctional one. The electric power of the Kattara depression can alone provide the whole third sub-region with the required power, including Cairo, Alexandria, the Delta, and the western part of the seventh sub-region.

In the central part of this sub-region there is water, in shallow pits which are covered with salt sea water but can be treated for cultivation. The characteristic of the population of this part, its non-mobility, in contrast to the wings of the same sub-region or to the fourth sub-region, caused this part to be almost deserted through only 100 km to the south.

In the eastern part of the seventh sub-region, more agricultural industries and fishing industries exist. Towards the Red Sea, petroleum centres begin to appear. Refineries, petroleum wells and research centres are established. Other mining industries also extend along the Suez Red Sea coast on the peninsula side.

No real settlements exist in the southern part of the Sinai peninsula, other than temporary colonies of less than 100 houses each. Big villages, as well the semi-urban centre of Gaza at the northern end of this sub-region, exist on the shores of the Mediterranean Sea.

Fig. 334. The seventh sub-region.

Fig. 335. The different positions of the industry and the worker's colonies and housing projects.

Climatic conditions

The high humidity of this sub-region increases in its northern parts, especially at the top of the Nile delta. It then descends in a quick uniform deceleration till it turns into complete dryness in the southern parts of the two wings of the sub-region.

The power stations

The author considers the power stations in Egypt as a unique type of industrial centre that exists everywhere all over the Egyptian region. Studies should be carried out to classify the different categories of the Egyptian power stations and the extent of integration of each type with the existing neighbouring agglomerations.

Fig. 337
The typical relation between the big power stations in Egypt and their workers' colonies as shown in the diagram is a tangential contact while both are usually outside the urban borders.

In the case of middle-sized power stations, which are usually located on the borders of cities, the residential complex is either within the neighbouring district or in the form of a small colony in the vicinity of the station. In most cases the colony is combined with the residential colony of the irrigation department which usually dominates the area where it is located.

Proposals

A broadly conceived plan should program the establishment of these colonies with those belonging to the irrigation departments, which usually exist in the vicinity of the power stations.

The planning of the colonies' details and the houses of the workers and engineers should be designed with respect to the specific conditions of the sub-region where they are to be built.

As a conclusion to my new theory of the industrial residence in Egypt, a broad policy should be adopted in this respect to assure the full success of our industrialization schemes. The siting both of factories and of workers' residences in the industrial centre should be given thorough study taking account of all relevant factors before any step is taken on the site.

As a framework upon which architectural and planning efforts can be built, we have introduced the Egyptian seven sub-regions industrial residence theory. This theory depends on realistic facts only. Statistics, natural conditions and human factors compose the design prism that gives each ray of design its colour and tone.

The architectural and planning components which correspond to these colours are the following:

1. The design approach of the industrial centre and the specific relation between its factory and its home.
2. The zoning of the centre, as well as the sub-zoning of the industrial quarters and the residential ones.
3. The architectural composition. Type, size and grouping.
4. The street pattern and design. Type and density of traffic and transport.

Conclusion

From the previous study, and the new theory of the industrial residence sub-regions of Egypt, we conclude that it is of prime importance to pass laws which ensure the correct execution of the industrial centres, factories and workers' housing, from the beginning of the design and planning, to the start of factory production, and the residence of the workers in their houses.

Besides, the low cost house for the industrial worker does not depend so much upon a window saved or a price difference in a sanitary installation, but on rational design of the whole colony and even the whole industrial centre and the relation of the colony with the factory. It depends also to a large extent upon the land use, the architectural composition of the buildings, the street pattern, the installations scheme, and the growth possibilities; all are factors which determine the total sum of costs.

Fig. 336. The proposal for the seventh sub-region.
The Zoning, Street Pattern and Architectural Composition in the Egyptian Industrial Colonies

In the previous analyses, we have differentiated the seven sub-regions with respect to their specific characteristics. In the following pages we will introduce the general factors commonly influencing the design of the industrial centres in the seven sub-regions, namely:

1. The relation between colony and industry.
2. Zoning of the industrial colony.
3. The architectural composition.
4. The street pattern.
5. The design of the workers' houses.

In all the seven sub-regions the zoning, architectural elements and composition, and street patterns are to be considered in terms of the following factors:

1. The site necessities according to the previously introduced design principles of the industrial centres and colonies in general.
2. The factory location, its growth tendencies and the colony's extension and expansion directions, and the duration probability of both.
3. The type, size and needs of industry and its degree of automation and type of energy. Besides, the organization of work and work system.
4. The composition of the factory's staff, its professional and social considerations and the type of services they need.
5. Financial considerations.
6. Environmental conditions.
7. Future technical and social progress.

The design of the industrial centres and the relation between colony and industry

To achieve high-quality design potentialities, the design principles of industry, its workers' residential areas and their accessories should be considered carefully.

The first group of workers will consist of skilful and highly specialized technicians to undertake the control jobs, and the complicated maintenance responsibility for the automatic brains. The lower group of workers will be by no means less skilled than is required today in the average contemporary industry.

Fig. 338. Zoning proposals of the industrial colonies in Egypt.
1. Public buildings and services.
2. Directors.
3. Engineers.
4. Office employees.
5. Supervisors.
7. Single workers or under-age boy or girl workers (mostly in case of textile factories).
8. Playing fields for engineers.

The screen which differentiates the above mentioned different zones will vanish gradually with the development of the society, leaving way to a democratic integrated society, supposed in 20 to 30 years.
The increased qualifications demanded will consequently raise the living standard of the industrial workers and their needs. The elements of the house of the industrial worker will differ from those of today, principally to match the new mode of life, intellectual background, kind of work, working hours, hobbies, family members and the relations between them, kind and function of furniture, and finally, the technical installations with which the house will be equipped.

Zoning
The zoning of the industrial colonies should in all cases be in terms of professional classification. Engineers', supervisors', office employees' and workers' families sections should be provided, as well as housing for the single persons of each category in the form of barracks for workers and guest-houses for transient professional personnel.
The differentiation of the different building types into separate groups is dependent on the whole conception of the colony.
The zoning of the industrial colonies in Egypt is mostly related to the social structure of its population—the many different classes of people who work in the same factory or industry. The big variety necessitates clever zoning scheme planning.
The classes are then classified by professional strata, separating engineers from technicians, supervisors, skilled workers, workers, and manual workers. Other professional classifications include directors, inspectors, office employees of the administration, and also the heavy duty manual workers or porters.
The classification can also be in terms of wages, married and unmarried, and large and small families.

Although this classification disturbs the ideal integration of the different classes in a democratic Egyptian society, yet it is very important in Egypt for discipline and order in work. Integration can then be slowly tried out parallel to the stages of realization of the industrialization schemes and the development of the country.
It is already possible today to try a semi-integration in the terms mentioned in the first sub-region, as it is ready to accept it now, but it is still too early in the other sub-regions.
In any case, this classification is not strange in an enclosed society like an industrial workers' colony such as we see in Finland (Fig. 276), in India (Fig. 189) and in Olivetti, Ivrea (Fig. 246), although Olivetti tried in another colony to integrate the different classes of workers in one structure of different building types (Fig. 252).

Street pattern
A suitable street pattern should be chosen for each case separately, because traffic and transportation conditions differ much in the different Egyptian industrial centres and colonies. But, in general, provision service roads must be provided in all cases. A main feeding road leading to the colony, encircling it in a kidney form from one side only is suggested. The distance from the furthest building to this road should not exceed 5 minutes on foot. Branches radiate from this road to feed many culs-de-sac, where common public garages can be located. Good extension possibilities should be allowed for the factory, the colony, and the centre of the colony in such a way that they do not disturb each other. The storage area of the factory, and transportation, should be considered, as well as the public services of the centre.

Good lighting installations, water pipes and waste and rain water drainage lines should be provided. Concrete with asphalt spray for the street paving, and cement or limestone slabs for the pavements should replace the green grass footpaths and the present sandy roads both of which are usually a cause of dirt in time of rain or wind, besides being inefficient. Concrete for the roads should to be strongly recommended wherever sand and gravel exist.

Telephone, water, electric, and sewage installations should be considered in the road and street construction, and in the execution program, so that it comes on one side under one of the pavements provided with control openings, instead of under the car-passage way. In case of repairs, additions or any changes the street should by no means be disturbed.

Enough mature trees should be provided for shade. They should be very dense with evergreen leaves. The factors which are to be considered in the design of street and side-walks as regards pattern, size, construction and form, are:

1. Density of traffic, number of cars and the presence or absence of through traffic.
2. The form of the colony, longitudinal or square.
3. Location of garages or car parks.
4. Type of connection between colony and factory, and the crossing system of the street branches, and culs-de-sac.
5. Topography of the site, underpaths or bridges.
6. Type and size of services adopted, their volume and location with respect to the streets.
7. Type and function of the public buildings in the centre.
8. Degree of the isolation or integration of the industry with its colony internally, as well as the external relation of both as a united industrial centre with the surrounding environment.

Street orientation
The orientation of the streets should be totally independent of the form of the street pattern, whether geometric or organic, ring road system or backbone system with feeding branches. The orientation and direction of the streets should be studied as follows:

1. Streets leading to one-family houses with their own private gardens.
The main street should be orientated east-west. Thus the feeding roads are north-south, allowing the longer depth of each parcel's northern facade against the mild northern breeze. The necessary mild sun from the east and west is allowed through the shorter sides of the parcels. Meanwhile, the south is covered by the shadow of the southern neighbour.
2. Streets leading to one-family houses or row houses with public common garden ownership.
Should have north-south main streets and east-west feeding roads.
3. Streets leading to blocks of flats which usually have common open gardens, children's play-grounds, and washing places. Main street should be north-south, and the feeding roads east-west, allowing the blocks of flats free northern facade. The author recommends that the feeding roads should just reach the common garages and that cars should be allowed only in important cases to reach the house entrance.

The author also recommends that the connection with the colony should be from the east, to free it from the prevailing wind passing over the factory. The factory should thus be situated in the east or the southern east.
Fig. 339a

Fig. 339b. The Kima Colony, Aswan, Egypt.

Layered Plan of the Housing Project for 'Kima' Facitlities Plan Areas.
8. The internal zoning of the industrial colony in terms of the materials from which the factory is built should be considered, as well as the grouping and the materials of the factory blocks, if they are located near the colony.

7. The strong family ties must be considered; the mother and other relatives live with the family, and neighbours visit other houses daily. Also to be considered is the presence of the servants and housemaids who stay in the same house and live with the family. Again, the growth of the family to more than two members faces the problem of the shortage of water and the economic conditions.

6. The internal zoning of the industrial colony in terms of professional classification has the disadvantage of dangerous social splits. This danger can be eliminated by placing the public building and the common services in the middle of the different zones to minimize the sharp contrasts and to create a natural integration of the whole.

9. A fence or hedge should be provided in cases where security is of importance.

The worker's house

Worker's house

It is always sought to provide the house of the industrial worker at the lowest possible price that casts the least burden on the worker's wage and income, and the least financial responsibility on the factory.

Low cost?

The one way to achieve this aim is firstly to keep the area and the volume of the house to a minimum, and secondly to cut out all the elements which can be spared.

Proposals

From our study and visits in the industrial centres in Europe and Egypt, we recommend a contrary principle to the above: to give more amplitude to the house design in area and planning, meanwhile trying to lower costs by the rational planning of the whole industrial colony, and by means of functional architectural composition of the buildings, practical street pattern, and the shortest possible installation lines. Most important is the integration with the factory and the neighbouring agglomerations or colonies to benefit from the combined services.

The house design

The author recommends for Egypt, especially in the sub-regions 1, 2, 4, 5 and 6, the use of atrium houses partially perforated through their elevation on columns to regain the garden and allow cooling cross-ventilation (see figures 208, 340, 343, 344) for the following reasons:

1. It suits Egyptian traditions which call for more family privacy, and separation from the outside.

2. It separates the house from the outside traffic and noise, thus providing the calmness which I consider, from my questioning of many dwellers in different industrial centres, the most important item in the house design for an industrial worker.

3. It suits the climatic conditions of most of the Egyptian sub-regions better.

4. It gives more facades and orientations for almost all the rooms. Also easy possibilities of through ventilation.

5. The enclosed patio replaces the private garden in the case of a colony with common land ownership, also in the case of building in the desert, where small areas can be afforded for the green and plants because of the shortage of water and the economic conditions.

The flats and rows of houses

The blocks of flats have to be built and designed in the Egyptian family requirements, varying from 1 to 6 rooms (Figs. 340, 341). The strong family ties must be considered; the mother and other relatives live with the family, and neighbours visit other houses daily.

Architectural composition

Types

The economical factors, the social life and the proportionally limited technical possibilities, the height of the buildings in the Egyptian industrial centres between one and four storeys. One-family, semi-detached or row houses and blocks of flats are the easily available types. The gallery type 'Laubengang' system can be used for short buildings with a maximum of four dwellings per storey, to avoid disturbing the privacy needed in these colonies. It may succeed if two-storied flats are used where the gallery does not pass by the storey where the bathroom and other rooms are, and can be used in this case as a balcony for the bedrooms upstairs (Figs. 214, 215, 216, 218, 264, 275, 284).

Grouping

The grouping of each of the previous types or any combination of them should fulfill the following requirements: Compare Fig. 339a, b with 339c.

1. Privacy should not be prejudiced by siting the buildings face-to-face.

2. Climate: orientation towards north should be provided for all rooms. Cross-ventilation should be provided at least for the living rooms.

3. Each block should shade the next to a maximum in summer, and minimum in winter.

4. Cool courts should be provided between the different blocks, where children can play in security, and the mothers can sit in protection from the sun and watch over their children, dry their washing or engage in other activities.

5. A landmark should be considered. The water tower or the mosque minaret or some other high element should create with form and colour a focal point of interest for the composition.

6. The grouping of the blocks should give a pleasant silhouette to the colony, considering the surrounding natural or artificial features and the future shape of the colony. The final extension growth of the colony should always be the base of any composition.

7. The materials from which the factory is built should be considered, as well as the grouping and the materials of the factory blocks, if they are located near the colony.

8. The internal zoning of the industrial colony in terms of professional classification has the disadvantage of dangerous social splits. This danger can be eliminated by placing the public building and the common

Fig. 339d. The mosque as an architectural element in the workers' colony of the Northern Cairo Power Station, Egypt.

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Houses of the natives, Aswan.

Fig. 340. Blocks of flats in the Kima Colony, Aswan, Egypt.
than 7 persons (more than 5 children) and the difficulty of preventing or limiting births in face of traditional and religious opposition must be remembered, although this year (1962) much response to the tendency of birth restriction has been felt to a reasonable extent.

But most of these theories were created on principles rooted deep in the architectural and planning conceptions of unindustrialized societies. Aiming at achieving beauty and the greatest separation of industry and residence, for fear of smoke and other disturbances. One excuse is that the problem was not ripe for an estimate of all the planning and design considerations of today. The real problems of the growth of industry and its influence upon the economy and structure of its surroundings were scarcely touched upon as the fast accelerating progress in means of transport and the new social and economical composition were in too early a stage.

To lay down principles for the design of the industrial centres, the influence of industry upon regional and, city planning, architecture, social and economical structure is to be tested and analysed.

Conclusion of the research

In the first chapter of this research we have introduced a review of the past relations between human agglomeration and the work, activities or crafts mankind practiced. We throw light on the beginning of the revolutionary changes in the means of energy, and in the machines and means of production, and explained the results of the industrial revolution.

In the second chapter, we dealt with the design analysis of the different types of industrial centres, their planning principles and the design conceptions of their internal factors, from the point of view of their composing elements, architectural composition, street pattern, zoning and landscaping. Special consideration has been given to the worker's house and the colony where he lives. Besides, the specific technical considerations have been extracted from the analyses of some distinguished existing examples, some of which I have visited personally and officially. These examples gave a picture of the practical application of the planning and design theories and the experience which can be gained from their analysis. Moreover, a study of the international as well as the different national points of view on the problem, its programs and its finance has been introduced.

In the third chapter, the special case of Egypt has been taken into consideration with respect to the specific special characteristics of a developing land which possesses its own local circumstances and need not pass through the same problems which the industrialized countries had to tackle before. We concluded that it should also avoid the difficulties which usually accompany technical changes in a developing land and society, as far as modern solutions can facilitate them.

The birth of the United Arab Republic including Egypt, Iraq and Syria today, and more Arab states in the future will mean the growth of our 'Theory of Industrial Topology of the Egyptian Region' to the 'Theory of Industrial Topology of the United Arab Republic'. Our theory will be then modified in its breadth to widen the ranges of its types, in length to cover all the Arab regions and its depth to include more types and closer study of their environment. The proposed organization will spread its authority to the new borders and will gain many new skills and potentialities as well as carry heavier responsibilities.

From the three chapters mentioned, we conclude that a broad policy should be laid down for the industrial centres design and planning and the constructional developments and the urbanization accompanying it. A special organization should be established to carry this responsibility, and should include planners, architects, specialized engineers, technicians, scientists and psychologists.

The aim of such a highly qualified authority is to carry on research studies, and lay down principles for industrial and urban development. This should be an integrated product springing from the pure Egyptian local life conditions but within the framework of modern town-planning and architectural principles according to our three points of broad design policy mentioned before.

The responsibility of this organization extends, not only to the control of the executed projects but also to the execution and the control of new ones.

How can such a huge program be carried out? And how can rationalization procedures and progressive technical means take command? And how shall we get the maximum product from our human energy as well as from our fuel energy? And how can high standards of brains, hands and machines be achieved through far-
sighted and broad-minded preservation of all this precious human and material property? To answer these questions, this work should then be read again, our new industrial topology of Egypt should be restudied and our proposed organization should be brought to life. Until this organization is established, we have introduced our new theory of the industrial-residence topology of the Egyptian region as a structural basis for this big framework. When all these aspects are realized, then only serious efforts and hard work are needed to link the glory of the past with a tremendous shining creation of the future.

Fig. 344

Fig. 345, An engineer's house in Henkel Colony, Düsseldorf, Germany.

Fig. 346, Engineers' houses, Aswan, Egypt.
Leer - Vide - Empty
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Die Aufgabe der führenden Kräfte von heute ist, eine neue Welt aufzubauen. Die Entwicklung der Technik und der Erdbevölkerung ist so schnell vor sich gegangen, dass die Lösung der Probleme von heute morgen bereits ungenügend ist.

In den letzten 200 Jahren hat sich die Technik so gewaltig entwickelt, wie es die Weltgeschichte vorher noch nicht erlebt hat. Dazu hat die Erdbevölkerung in den letzten fünf Jahren so zugenommen wie im ganzen 18. Jahrhundert.


Das Ziel ist vermehrte Produktion, bessere Qualität, niedrigere Preise, höhere Löhne, weniger Arbeitsstunden und mehr Freizeit.

Daraus ergibt sich die Notwendigkeit höher qualifizierter Techniker und zuverlässiger Arbeiter mit bedeutend mehr Erfahrung und Training. Immer neue automatische Kontroll- und Korrektursysteme stellen sich.


Um dieses Ziel zu verwirklichen, wurden verschiedene industrielle und andere Zentren besucht, mit den Behörden diskutiert, mit den Menschen, die darin leben, den Männern, Frauen und sogar Kindern gesprochen, um zu studieren, was notwendig ist.
Kapitel II

Die internationale Beteiligung an der Lösung der Probleme der industriellen Zentren und der Arbeiterbehausungsfrage sowie die Rolle der Regierungen, der Architekten, Planer, Industriellen, Fabriken, Arbeitgeber und Arbeitnehmer werden untersucht, um in der Zusammenfassung eine gemeinsame Richtung für einen rationellen Aufbau und eine Gestaltung der industriellen Zentren ausarbeiten zu können.

Kapitel III

Dieses Kapitel befasst sich mit dem Entwurf der industriellen Zentren, ihrer Lage und Größe und ihren Wachstumsmöglichkeiten. Es behandelt die Beziehungen zwischen den Fabriken und Arbeiterwohnsiedlungen, die Details der Industriearbeiterkolonien, insbesondere die Zonen- und Umgebungsprobleme, die architektonische Gestaltung und Gruppierung sowie die Strassennetze. Das Haus der Industriearbeiter wird im Rahmen seiner Lebensinteressen gebaut.

Kapitel IV

Hier werden einige bezeichnende Beispiele der industriellen Zentren in verschiedenen Ländern gezeigt; sie werden analysiert und kritisch betrachtet, um durch ihre Vorteile und Nachteile für den Entwurf der neuen industriellen Zentren Orientierungsprinzipien festzusetzen.

3. Abschnitt: Ägypten

Im nachstehenden Abschnitt stellen wir eine neue Planungstheorie für die Entwicklung der industriellen Zentren vor.

Curriculum Vitae

Mohamed Zaki Hawas was born in Cairo, Egypt, on May 16th, 1929. His father is Chief Engineer Mohamed Saad Hawas. From 1934 to 1941 he lived in the industrial settlements of the power stations and the Irrigation Department in the Sudan, where he attended primary and partially secondary school. Here he gained the first deep impressions that were the seeds of future interest in industrial settlements. From 1941 to 1948 he attended secondary school in Cairo, Tanta, Shebin El-Kom, and Delta Barrages. In 1945 he received the first prize in the annual National Egyptian Drawing Competition for students. From 1945 he was a student in the Faculty of Engineering at the Architectural Department of Cairo University, where he gained the degree of B. Sc. (Architecture) with distinction. From 1951 to 1958 he worked as an Assistant in the Architectural Department of Cairo University, alongside his private professional practice. During this period he worked with Professor Ali Labib Gabr. In 1954 he obtained the Diploma for Regional and Town Planning of the University of Cairo. In 1954 he undertook an architectural study trip to Italy and Greece. In 1956 he attended two courses at the American University of Cairo: 'Industrial Management for Engineers' and 'Industrial Public Relations for Engineers'. In 1957 he published his book entitled 'The Art of Building Construction' which deals with contemporary building construction and executional organization in the Middle East.

In May 1958 he joined the Swiss Federal Institute of Technology in Zurich, and studied for the 6th and 7th semesters under Professor Dr. W. M. Moser. From 1958 to 1959 he attended the New York School of Interior Design. In 1959 he passed the admission examination for research leading to a doctor's degree under the guidance of Professor Dr. W. M. Moser. In the same year he began his doctor's thesis on 'The Industrial Centres'. This thesis has been accepted on the recommendation of both Professor Dr. W. M. Moser and Professor W. Custer and he passed the Doctorate Degree Examination on 18 July 1962. During his stay in Switzerland he practised the profession and visited industrial centres in England, Holland, Germany, Denmark, France, Italy, and Austria.