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GENERAL

Purpose of Paper

In accordance with the terms of reference set by UNIDO'S Export Industries Section, the purpose of this paper is to serve as a " guideline for those who intend to, or are planning to, create an industrial free zone" . It sets out a comprehensive list of matters to be studied in preparing a physical plan, stressing requirements arising from the export orientation of industrial free zones.

Where general or accepted solutions to planning problems exist, I indicate them. As no two industrial free zones will have the same problems or planning constraints, it is not possible, however, to describe planning solutions in any detail.

While the paper is based primarily on direct experience at Shannon, it draws also on SFADCo staff experience in advisory relationships with other industrial free zone projects and, of course, on reading.

In its preparation, I have been in regular contact with Mr. Brendan O'Regan; knowledge of the contents of his paper on "Possibilities of Co-operation between Export - oriented Industrial Free Zones" has enabled me to reduce or eliminate arguments, which might otherwise be necessary, for some of the provisions to be made in planning; and hence to avoid duplication.

The planning exercise

The physical planning of an IFZ is an engineering and architectural task, but the engineers' brief must be written by people with special competence in promoting industrial investment (sizes and standards of factories, utilities and services required, and so on), by economists and, possibly, sociologists (ultimate size of labour force, rate of growth, housing and other requirements, and so on), and by financial advisors (capital available and when, minimum and maximum rent levels, and so on). The shaping of the brief will involve consultation with several interested bodies, including the Customs Authority, the Port Authority, the public transport authority, the police and fire-fighting services, the local municipality, and the tourism agency.

In particular, close and continuous co-ordination will be needed between the IFZ development agency, the Port Authority, and the national industrial development agency. This could be provided through a joint planning advisory committee.

However wise and experienced planners may be, they cannot anticipate all the trends that may influence the final shape of the IFZ. Flexibility in planning will be the necessary reality, probably expressed in firm plans for the first phase, with plans for each successive phase being modified by experience.

Planning can guide, but never substitute for, action. It would be better to start with an imperfect plan than to wait indefinitely for a perfect one. Action, and the experience it brings of actual, rather than anticipated, conditions will further refine planning. Planning and doing must continuously interact, and therefore they must not be set up in organisationally water-tight compartments. Thus, those who are to build and develop should be involved from the beginning, whether as principals or as partners.

The Industrial free zone - special considerations

An industrial free zone is a special type of industrial estate. It differs from the ordinary estate in that it is surrounded by a customs barrier, so that goods may be brought into it, processed within it, and exported from it without payment of duty. It may also make much greater provision for warehousing, as distinct from manufacturing, than would the ordinary industrial estate.

In planning an IFZ, therefore, we have to take account of all considerations affecting an industrial estate plus some considerations peculiar to the IFZ. These special considerations, which will be emphasised in this paper, are as follows:

a) Customs control points, and a fence, will have to be provided.

b) The need for customs control will limit the number of entrances and exits, and may affect internal road lay-out.

c) It may be necessary to provide for substantial warehousing operations.

Provisions to facilitate the necessary minimum of Customs control, if they are to operate well and smoothly in practice, must be supported by advisory services which will guide industry and enable it to obtain the maximum benefit from the IFZ location.

d) Therefore Customs advisory services must be provided.

A location near a seaport or airport is generally suitable for industrial development, either in an ordinary industrial estate or within a free zone. Where the IFZ is so located:

e) It will be necessary to co-ordinate planning very closely with development planning for the associated seaport or airport.

The IFZ is primarily a tool for promotion. Its purpose is to attract enterprise which, certainly in the early years, will be mainly foreign, to set up factories within it to manufacture goods for export. For success it is essential to cater for the requirements of such enterprises in planning the facilities to be provided.

f) It will be necessary to provide for services designed to assist industry to operate successfully in an unfamiliar environment - advice and assistance in regard to recruitment of personnel, labour law and practices, housing and, possibly, sources of materials and industrial services.

g) Both to meet the needs of such industry, and to facilitate the maximum participation of local people at high levels of authority and responsibility, training facilities should include provision for supervisory and management training.

h) Visual attractiveness will be necessary rather than desirable. This will call for high standards in the buildings and in their surroundings.

Because of its emphasis on export manufacture, two other considerations will be of greater importance for the IFZ than for the ordinary estate.

i) The necessary ease of importing materials, components and equipment, and of exporting products, will place special emphasis on its location in relation to transport services.

j) The need for regular communications with overseas markets will place special emphasis on the provision of high standards in postal, telephone and telex services.

Because most enterprises in the IFZ, at least initially, will be foreign-owned, a policy which is good on any estate will be particularly desirable.

k) It will be very desirable to follow a promotional policy, to be reflected in physical planning, which will avoid domination of the IFZ by any one industry.

It will be seen that all the above considerations lead to differences in emphasis, rather than special provisions, in the physical planning of an IFZ as distinct from an ordinary industrial estate. The customs boundary is the only major special provision.

LOCATION

Relationship to regional plans

The IFZ should, wherever possible, be located and planned in the context of a plan for the overall social and economic development of its region. Such a plan will embrace population growth and urban development; economic development, including manufacturing, agriculture, tourism, mining, fishing, and services; the location and development of energy and other (including water) resources; education and training; the transportation network; and communications.

All of these factors may effect the location, size and nature of the IFZ. For example, it would be highly desirable for any major industrial development to be near to University - level education. Such considerations will determine, also, the extent to which the development of the IFZ will beneficially affect the area around it through the spread of industrial skills, through the development of local service industry and suppliers, and so on.

Where there is no comprehensive regional plan (or even where there is, in order to verify vital data and to spell out outlines in more detail) it will be necessary to assemble certain key information prior to a location decision. In particular, we will need information on transport facilities; on labour availability ; on essential services (power, water, sewerage) ; and on site suitability. And we will have to relate all this to the planned size of the IFZ.

Planned size of the IFZ

The larger the IFZ, the lower will tend to be total development cost per acre, as some costs will not increase in direct ratio to size - for example, water supply, sewerage, the provision of advisory services, and property management. And the larger the IFZ, the quicker will be the growth of commercial services to industry and the better will be the range and quality of these services. The larger the IFZ, the greater will be the number of individual enterprises and hence the less will be the dislocation and hardship caused by the failure of any single enterprise, if only because alternative employment will be more readily available.

However, a very large IFZ could impose excessive strains on housing, commuting, and traffic movement generally. The right size, between these extremes, can only be determined in relation to a particular location.

As a general rule, it could be taken that a minimum size for first-phase development would be about twenty-five acres (ten hectares), assuming the possibility of later development to at least double that size. A normal optimum size for correlation with housing estates, port facilities, and external service industry would be about one hundred and fifty acres (sixty hectares). Much larger estates might be justified by strong location advantages, but they would involve increasing planning difficulties.

How much of this area should be built over will be a compromise between opposing considerations. On the one hand, ample open space will give the best appearance and the best working conditions; on the other hand, concentrated building will give maximum economy in infrastructure and minimum distances between factories and common service points.

For preliminary planning - the detailed figure will follow on decisions regarding road-layout, sizes of lots, building set-backs, car-parking and trucking areas, recreational areas, common service buildings, and areas for non-specified expansion - it could be assumed that the built-over area will not exceed one-half of the total IFZ area. Space and finance permitting, a figure of one-third would be better; but space is likely to be restricted in the ideal IFZ location near to a port.

Room for expansion should be included (acquired or protected by strong planning controls) from the beginning, together with a buffer area to prevent undesirable development immediately around the zone and on its highway approaches. Where the IFZ adjoins a port, areas may be designated for the expansion of one or the other, or both, depending on the needs as they arise. This could be the most sensible and practical approach, but the provision of a high degree of future flexibility could add to initial costs, for example in road standards and lay-out.

Labour Availability

The labour supply must be within reasonable commuting distance. What is reasonable will depend on the normal mode of travel - cars, public transport, bicycles, or walking. It is unlikely that an IFZ could be located successfully more than fifteen miles (24 kilometers) from a population centre. The nearer the better. (Much greater distances can be quoted in respect of huge employment centres like London, or in respect of large industrial areas in the USA. But these reflect conditions arising from necessity, rather than deliberate planning, and only made possible by excellent and expensive public transport facilities and by widespread car ownership. In any case, it would be much more difficult to attract industry to a zone at a distance from a population centre.)

In estimating labour availability, we must take account of new service jobs arising from the new manufacturing jobs. As it will take time for services to develop fully, we could use a low planning figure for service employment - say one person in such employment for every person employed in manufacturing. So half the local labour supply could be taken as being available for manufacturing employment.

IFZs are likely to attract light, rather than heavy, industry. (Heavy industry tends to prefer individual sites as they are less restricted, both for expansion and in regard to use restraints - on smoke emission, for example). A modern industrial estate with a mixture of light and medium industry, as at Shannon and elsewhere in Ireland, would have about 50 workers per acre within a range of from 30 to 70 per acre. Using 50 as an advance planning figure , we would see an estate of 100 acres (40 hectares) as appropriate to a locally-available labour force of 10,000, half of whom would obtain non manufacturing jobs .

However, a predominance of labour - intensive light assembly work, which might characterise the first phase of development in a developing country, could well have 100 workers per acre. In a densely-built IFZ the figure would be still higher, and the use of multi - storey buildings would increase it in proportion to the number of storeys. These latter conditions are only likely on a confined site. Taiwan's Kaohsiung Zone has about 300 workers per acre at present.

In relating site size to labour availability (or job - creation targets) the planner will, therefore, have to visualise the likely form of the IFZ and choose an appropriate figure. He will re-check , if necessary, as detailed planning progress.

Transport

An IFZ need not directly adjoin a sea port or airport, as goods can move to and from it under bond. (Any industrial estate designed to attract exporting industry could, with the provision of a customs barrier, be given the additional promotional status of an IFZ. But customs freedom is an advantage only to exporting industry or, in certain cases, to importing industry. The customs barrier could be a positive disadvantage to industry serving home markets). But IFZ industry needs easy access to foreign trade , and the nearer it is to a sea port or airport, the better. The ideal IFZ would be either part of a customs-free seaport, with easy road access to an airport, or vice-versa.

So located, its planning must be closely co-ordinated with that of the port; ideally, its development plan will be an integral part of the port development plan. Co-ordination is particularly necessary in road design to ensure free flowing personnel and freight traffic to and from the IFZ, to and from the port, and between them.

It should not be forgotten that, in bringing greater traffic to the port, the IFZ will help bring about better services for non - IFZ industry and for trade generally. It will improve international communications, and bring greater spending power in its surrounding area. All this will lead to a further increase in traffic.

Apart from the transport of raw materials and manufactured goods, there will be transport of equipment and spares (often urgently needed) and there will be frequent supervisory visits to the IFZ factories. Quick access between port and factory will be needed, calling in turn - where the IFZ is not at the port - for good high - ways and reasonable distances.

Essential services - power and water

The power requirement of the average light to medium industrial development is in the order of 1 KW per 100 to 200 sq. ft. or roughly 1 KW per 10 to 20 sq. metres, of factory space. Thus an IFZ of 100 acres (40 hectares), of which one - half would be built over, could require a total power availability of between 20,000 and 10,000 K.W. This, of course, assumes that no factory will have an exceptionally heavy demand.

Water requirements, apart from that needed for drinking and sanitary purposes (a minimum of about 10 gallons per worker per day) will vary greatly according to the industrial processes in the IFZ, and will have to include provision for fire-fighting and landscape maintenance. A preliminary planning figure , assuming no heavy process requirements (such as for dyeing or paper-making), would be about 60 gallons, within a range of 30 to 80 gallons, per worker per day.

(See also planning notes, Page 18).

Site Selection

Although the choice of site for an IFZ is likely to be more restricted than for an ordinary industrial estate, some selectivity may be possible. The ideal site will be level but well drained, with soil of good bearing quality and an arable top-soil to facilitate landscaping.

Slopes of more than 1 in 15 will call for expensive " cut and fill" and for special provision for road access to factories. A bearing capacity of about one ton per square foot would be ample ; piling would not be required for two - storey buildings or for normal industrial floor loadings.

It may be good national policy to site industry on land unsuitable for agriculture. If so , additional costs in levelling or draining must be accepted. The developed site must not merely be sound for building ; in line with the promotional purpose of the IFZ, it must also look good.

Where a site adjoins an airport, some special considerations arise. It will probably be flat, and hence it will be suitable for industrial building but its landscaping will require special attention. If it is an older airport, it may have one or more runways no longer needed by modern aircraft which are less sensitive to wind direction. The de-commissioning of a runway , with the consequent elimination of its flight path, could release a large and valuable building area.

Aircraft noise need be of little concern in the siting of factory buildings. Their office areas should, however, face away from flight-paths and, if necessary, be double-glazed. Office buildings for central services should be sited further from flight - paths, and houses (if associated with the zone) furthest of all. Housing, and any other sensitive buildings, can be given additional protection by the noise-filtering effect of tree belts, and by the noise-diverting effect of even quite low hills.

The Airport Authority should be consulted about any necessary building and use restrictions. These will cover distances of buildings from runways and taxi ways; heights of buildings at various distances from flight paths; lights; and radio and smoke emission. The Shannon IFZ shows that such regulations can be fully adhered to without undue interference with the planning or use of the Zone. In practice, apart from building distances, the main effects are on road layout and lighting, to avoid any confusion with runways from the air; and the prohibition of neon signs and of smoke emission.

Environment

Because of the promotional aim of the IFZ to attract investment and industry from overseas, the amenity value of its surrounding area is of critical importance.

At least one hotel, good by international standards, is a necessity rather than a luxury. Housing acceptable to executives from overseas must be available. Rentable apartments will be needed by executives and key workers who will spend only a few months or a year in the area , starting up factories and training personnel. Schools, shops and recreational amenities are necessary ingredients in the promotional package.

Where any of these do not exist, they must be provided as part of the total task of IFZ development.

PLANNING THE IFZ

The Customs barrier

This will consist of a fence, with Customs check-points at the entrance or entrances. While the Customs Authority will write the specification, the IFZ planner may be able to influence their decision. A very high " unclimbable " fence might be more of a challenge to a smuggler's ingenuity than a deterrent to his initiative , but it could make the IFZ look like a concentration camp, offsetting the best landscaping . In any case , many of the IFZ products are likely to be unsaleable in local markets - for example, electronic components or industrial hardwear. Factories manufacturing easily portable and easily disposable products will, in their own interest , keep a close check on pilferage. Further, the heavy daily traffic of workers will mean that , in practice , Customs examination will be limited to commercial vehicles, with occasional spot-checks on personal transport , and possibly rare personal searches.

The most effective Customs supervision is, therefore, likely to be by way of occasional thorough examinations at check-points (perhaps following an indication of pilferage) and through policing of possible avenues of distribution of smuggled goods.

It is against such considerations - and cost considerations point in the same direction - that the fence should be designed. A wire-mesh fence about 8ft high should be adequate; if the planner can get Customs acceptance for a lower one, so much the better.

An open main surface water drain on the perimeter of the IFZ may substitute for a fence, or the fence could be built along its bottom and thus partically concealed. The reverse slope of a low hill may also be used to conceal the fence, and suitable landscaping can screen it from highways.

The Customs check-point will normally be placed in the middle of the main entrance road, with a large window facing inwards to the IFZ. At least one lay-by will be needed so that vehicles being examined will not obstruct other traffic. The detailed design of this building will have to be worked out in consultation with the Customs Authorities; but it must be on the assumption that a very limited percentage of private cars, and fewer individuals, will actually be examined - otherwise the IFZ will not work.

Power, water and sewerage

When the IFZ is planned in relation to port and community development, utilities will be provided most economically as part of the overall development plan. The IFZ does not have to have an independent system, but it must have a reliable system. For example, while interruptions in power supply may be acceptable in a housing area, they will not be acceptable to IFZ industries. Therefore ring systems are highly desirable for power and water mains.

Distribution sub-stations will be located in accordance with the anticipated load pattern. The additional cost of burying electric cables within the IFZ will normally be well justified by greatly-improved appearance and greater safety.

In bringing water to the IFZ, it is best to provide pipe sizes from the beginning which will cater for later expansion, as pipe size has a relatively minor effect on total cost.

Sewer capacities, apart from storm water which is usually best provided for in a separate system, can be taken as equivalent to water supply capacity. It should be a condition of establishment that each industry will, if necessary, so treat its effluent as to make it conform with standards of acceptability for the general system.

Where large quantities of trade effluent are anticipated, or where a limited degree of pollution cannot be accepted at discharge-points, a separate system of sewerage and treat - ment works may be provided for trade effluent, but it will be an expensive additional provision.

Water, sewerage, and underground power mains, together with gas mains if these are provided, should run alongside roads and preferably under grass or unmade ground for easy maintenance access. The only possible exception to this would be in areas where factories have deep set-backs (say 100 feet) from roadways. Such set-backs are unlikely to be planned in IFZs.

Landscaping

Landscaping in and around the IFZ merits special concern, for practical as well as visual reasons. Tree and shrub plant- ing can be used to give shelter from wind, dust, strong sun- shine and, to some extent, noise. It can help in draining and drying out sodden and reclaimed areas. Intensive land- scaping tends to curb the tendency of industries to dump scrap, refuse or other materials on vacant sites. And, of course, landscaping can break the monotony otherwise arising from the most efficient lay-out of roads, blocks and buildings in the zone. The appearance of an IFZ is not only important to its promotion, it effects work satisfaction and attitudes to work.

A few points on tree planting. It must be planned carefully in advance. A nursery area in or near the IFZ can reduce the cost of trees and reduce the risk of failures in transplanting. Avoid any possible danger to underground services and foundations; in shrinkable clay faster growing trees should be kept well away from buildings or roads. Expert advice will be needed in selecting varities of trees and shrubs, and in their location. Before site excavations begin, arrangements should be made for stripping top soil and holding it for future use.

In planning recreational facilities for workers on the IFZ, remember that short lunch breaks mean that employees are unlikely to move from the immediate surroundings of their factory. Large, central playing fields are appropriate to housing areas, not to industrial zones. But small areas, where a ball can be kicked about, where there are shades and seats, will be fully used and will enhance the zone.

Factory and warehouse buildings

As the aim is to attract industrial investment, building design must be attractive by international standards. In any case, the standards expected in factories - as in other buildings - tend to rise, so that standards which are just acceptable today may be unacceptable in a few years' time. So standards must be high; but they must not be extravagant. High building costs reflected in high rents would be a disincentive.

High standards should therefore be reflected, in the first instance, in qualities important to the industrialist - adequate clear working areas, with good ceiling heights and strong, dust - free floors, weather proof and with sufficient insulation to keep down heating (or cooling) costs, and so built as to avoid excessive maintenance costs. High standards relate also to the general appearance of the IFZ, and therefore call for good external finishes.

All buildings should be designed in the knowledge of locally - available materials, building labour and skills, and traditional techniques. A building technique which leads to low costs in one location may be relatively expensive in another. A good architect can design buildings of high international standard using local materials and techniques, and local building experience is also the best indicator of probable building costs for the new factories and warehouses.

IFZ development, even more than the ordinary industrial estate, calls for the provision of standard factories built in advance of demand. The overseas investor will usually wish to avoid involvement in the problems of construction in an unfamiliar environment. However, there are exceptions and it is well to leave some areas in the zone for individually built factories; these are more likely to be sought when the project is well advanced.

Such standard advance units should be offered in a very limited range of sizes, to secure economies in construction and to simplify lay-out. Few industrialists know their specific requirements precisely enough to say " I want 8,500 square feet - a 10,000 square feet building is too big ". Usually they will welcome and be prepared to pay rent for, an undefined amount of extra space over and above their calculated requirements. Remember, too, that with suitable lay-out, a factory can occupy two or more basic units.

While experience will indicate the unit sizes most suitable for a particular IFZ, initial planning will not be far wrong if it is on the basis of two units - a "standard" unit of from 15,000 to 20,000 square feet (say 1,500 to 2,000 sq. metres), and a " small " unit of from 3,000 to 5,000 square feet (say 300 to 500 sq. metres).

Expansion can be provided for in terraced factories by using non-load-bearing side walls (the roof supported on columns) which can be removed to link adjoining units ; or by providing space for expansion beside a factory or a lot allocated to an individual company. The common practice is to allow space for at least 100% expansion.

Roof-supporting columns hinder work lay-out and work flows - each column utilises about 30 sq. ft. (2.8. sq. metres) of space around it, and therefore involves a cost of 30 times the building cost per sq. ft. But long spans are expensive, and the best cost will be a compromise between these considerations . The economic span for larger buildings, and hence the width of the unit, is likely to be between 50 and 100 ft. (say between 17 and 35 metres).

Heights to roof-trusses, to allow adequate ventilation and the use of fork-lift trucks, should not be less than 12' 6" (3.8 metres). A better height, now used as standard at Shannon, would be 16' 0" (4.9 m). Floor design will depend on soil conditions . With reasonable sub-soil a 6-inch layer of dry-fill, and a 6 to 8 inch (15 to 20 c m) layer of concrete, smooth-finished and dust-proofed, should meet most industrial requirements.

It is usual, and sound practice, to complete advance factories to " shell" stage only, leaving partitioning and internal finishes to be decided upon by the tenant.

Warehouse buildings save more expensive factory space, and are particularly required on the IFZ for the assembly of economic loads for shipment. Those for occupation by commercial warehousemen and freight forwarders might best be built by the firms concerned on suitable space provided within the IFZ ; at least they should be designed in consultation with such firms.

Good commercial warehousemen, with their special knowledge of shipping, consolidation and freight rates are a major asset in an IFZ , and should be attracted and well provided for . Preferably, they will erect their ow buildings on suitable sites, or buildings for renting will be designed in consultation with them. Additional warehouse buildings, for renting to industries or to non-manufacturing firms which can take advantage of IFZ conditions and thus contribute to traffic development at the associated port, will also be valuable. These latter can be built as standard units for letting.

A suitable standard warehouse unit would be about 3000 sq. ft. (say 300 sq. metres), with a simple internal partitioned office, built as part of a terrace with non load-bearing internal walls.

Buildings for common services

There will need to be provision for three general categories of services : a) those specific to an IFZ ; b) those related to attracting industrial development ; and c) those commonly provided on industrial estates. All , with the probable exception of worker training) can be provided in one administrative building. There might appear to be some advantage in having the general enquiry office outside the IFZ , in that this would reduce public traffic through the Customs boundary.

However, there will in any case be considerable daily traffic to each of the factories, including customers, salesmen, sub-contractors, service agencies, and job applicants. Unless there are rigid boundary controls, which (see 8 above) would be inappropriate to an IFZ, it would be most convenient to locate the public enquiry office, and all other services, in an administrative building within the zone.

a) Services specific to the IFZ

Local Customs administration can be provided for by incorporating necessary office space in the boundary post building, and it is probably desirable to separate this preventative function from the Customs advisory function. The latter function should be the responsibility of a senior Customs official, located in an office in the administrative building. His task will be to assist industries to make full use, within the law, of the advantages of the IFZ, helping them to understand and operate necessary procedures, and advising them on problems as they arise. (Helpfulness in the operation of Customs law is at least as important as having a good law).

b) Services related to attracting industrial investment

Telex facilities for firms not installing their own, or awaiting their own, should be available. Post office premises, if not located near the zone, should also be provided in the administrative building. High standards will be called for in communications generally.

One or two offices, with telephones, should be provided for the use of executives awaiting the completion of their factories. Office space will be needed for at least one bank, and other offices can usefully be provided for letting to commercial service firms - notably insurance agents, and possibly accounting and legal firms.

Employment advisory services will be needed to assist firms to recruit suitable labour (waiting rooms, interview rooms, records office) and to advise them on labour law, trade union relationships and labour practices generally (advisor's office).

Services commonly provided on industrial estates

Training, other than limited classroom facilities in the administrative building for supervisory and executive training, is best provided in one or more standard factory units. As well as giving a realistic industrial setting for training, it is easy to adjust to changing space requirements. Should training needs reduce, the building can be used for industry.

Where public transport will be used to a substantial extent, close liaison will be necessary between the transport authority, individual industries, and the development authority. This calls for the provision of office space for at least one representative of the transport authority.

If not otherwise available nearby, one good restaurant including a lower-price self-service area will be highly desirable and is best provided by a commercial concessionaire in space in, or near, the main administrative building. This need not include a central canteen for workers ; because of short lunch breaks , most firms prefer to provide some form of canteen facilities within their own buildings or, where the climate permits, as simple outdoor facilities for eating linked with modest recreational facilities.

Other services to be provided for in the administrative building are: general information office ; estate management ; building maintenance ; and central office services including translating, duplicating and printing.

Services also needed, but which may be provided for in separate buildings, are : police station ; fire protection ; medical centre ; garage for vehicle maintenance and repair ; and removal, disposal and salvage of industrial waste.

It would be almost impossible to plan accurately from the outset the space requirements for the various services as their needs will develop over time, so a high degree of flexibility should be incorporated in the plans for the administrative building. It may be easier to do this in terms of a block of related buildings, suitably sited - probably near to the IFZ entrance.

Roads, blocks and lots

Roads should be adequate for estimated traffic flow and provide against congestion between the main highway and any point in the IFZ where goods or personnel will be loaded or unloaded . At the same time, economic design indicates that roads should occupy only about 15% of the total area, and certainly not more than 25%.

They should not contain traffic hazards such as acute angled , multiple, or concealed junctions; mixtures of vehicular,bicycle, and pedestrian traffic; or steep hills. They should not be congested by car-parking or by vehicle loading or unloading. These should be either completely separated from the roadway or in clearly-defined docks with limited access to the road.

It is desirable not to have intersections with the main road system at more frequent intervals than about 600 feet (say 180 m), and this may call for additional subsidiary service roads. The desirable will have to be related to what is possible to finance.

These considerations generally indicate a rectangular road-pattern in so far as the shape of the site (including natural drainage runs) allows.

During the first phase of development some roadways may be paved only on part of their ultimate widths; but it is necessary to allow sufficient right - of - way from the beginning, and to site utilities so that they will not be covered by road-widening.

Where roadside car - parking docks, separated by " fingers", are used they should be at least 15 feet (4.6 m), and preferably 18 feet (5.5 m) deep.

While road widths will depend on anticipated traffic densities, it is good policy to choose widths which, because they are in general use in the area, drivers are accustomed to. Also building, maintenance and repair methods and costs will be well known. Probable minimum widths; main roads , 24 feet (7. 3 m) ; secondary roads, 16 feet (4. 9 m); service roads , 10 feet (3. 0 m). Other design dimensions : minimum curb radius for trucks, 25 feet (7. 5 m) ; for tractor - trailer vehicles , 40 feet (12 . 2 m) ; minimum lane for moving traffic , 12 feet (3. 7 m).

Roads in an IFZ will need to be well - lighted, because of shift work and for protection.

(see page 15 in connection with Airport locations).

Where bicycles are widely used, separate cycle paths must be provided. Footpaths must be on the shortest route between points - while this seems obvious, one often sees paths ignored by people cutting across open or grassed areas. Bus stops should be near footpaths and should be at lay-bys to avoid interrupting traffic flows.

Sizes of blocks (i.e. the area to be sub-divided into factory lots to which all utilities will be connected, or on which a terrace of factory bays will be built) will determine the road plan. The main considerations in choosing their size will be economy of road and utility lengths and ease of access to lots. Generally, depths most favoured give a 2: 1 rectangle to individual lots, with the short side along the frontage.

An approach to the size of block, other than for terraced factories, in the IFZ would be to take the size of factory to be provided; add for expansion space to at least double that size; add for parking and trucking areas; add for outside storage space, if this is to be provided; add for clear areas to be left around factories. Then establish the 2: 1 rectangle to give this area. The longer side of the rectangle would then be the lot depth which will be the same as the block depth where factories have front and rear access ; or half the block depth where there is front access only. The grid established by this approach will then be modified to suit the particular site.

It is usual to lay down a minimum distance between buildings and roads, for fire - fighting as well as for appearance - for example, 75 feet (22. 9 m) on major roads and 10 feet (3.0m) on side roads.

In the ordinary industrial estate it is common practice to designate one or two large areas for occupation by major industries. In the IFZ, there is some danger that this would facilitate domination of the zone by a single foreign firm. Policy opposed to this can be given effect in the lay-out of the IFZ.

Car Parking

Any error in planning should be towards providing too much, rather than too little, space for car - parking. If car ownership does not increase to the extent anticipated, unused space can be put to other uses; but insufficient space will call for very expensive solutions , such as multi-storey car - parking or relocation of factories. As guides: in Puerto Rico, one parking space was provided for each 12 employees; in the U.S. many estates provide one space for each 500 or 1000 sq. ft. of factory space, or for every $1\frac{1}{2}$ or 3 employees. Allowing for manoeuvering space, each vehicle parked will require about 300 sq. ft. (28 sq. metres). The planner can obtain guidance by observing existing factories, but should anticipate increasing car ownership.

Factories normally each have access to a large convenient employee car-park, as well as a small visitors' park in front of or beside the factory.

Where bicycles are widely used, a bicycle shed should be provided - possibly as a simple lean-to roof over bicycle racks - at each factory.

A central bus parking area and shed may also be required.

Phasing IFZ development

Because of the high cost of developing land, development will normally be carried out in stages related to the rate of growth.

For the attraction of investment to an IFZ, it is highly desirable to be able to show successful industry already established in a pleasant environment and supplied with all necessary utilities and services. Therefore the aim should be to have the first phase reasonably complete in itself at the earliest possible date and, towards this, to finish infrastructural works as quickly as possible so that buildings can be created in an area free of heavy builders' plant and excavations. Grassing and tree planting should, wherever possible, precede simultaneously with site development, protected by fencing from building operations.

This first phase area should be near the highway and the IFZ entrance, and must include the administrative building or, at least, the first phase of the administrative building. It should be possible to route constructional traffic for further areas around rather than through the first area.

The first phase area should not be larger than can be completely developed within two, or at most three, years.

Successive phases should be planned so as to continue, as far as possible, the separation of building traffic from completed areas.

Some works may have to be carried out, or may be most economically carried out, for the full development right at the start. For example, main drainage, flood embankments, water mains and main sewers.

Phasing in another sense is no less important - the timely completion of buildings not part of the IFZ but necessary for its successful operation. These will depend on the existing environment of the IFZ, and may include hotel, housing and community development. If such buildings are not part of the responsibility of the IFZ development agency, responsibility for co-ordination must be clearly carried at the first level concerned with all areas of associated development - if necessary at Government level. An otherwise excellently planned IFZ could well fail through lack of active and timely attention to this.

CONCLUSION

Looking back over my paper, I can see that many of the considerations I listed, in attempting a comprehensive view of IFZ planning, are either obvious or arguable. But the planner will need to take account of all of them, even if he decides to dispute or discount some of them. How deeply he will need to examine any matter will depend on the particular circumstances of his study.

The need to consider all these matters may make the IFZ seem a more complex thing than in fact it is. If the planning and development of an IFZ is in the hands of people with the necessary authority and with the Government support necessary for co-ordination, they will find that it contains no difficulties that they cannot overcome with application and common-sense. That is how the Shannon prototype came into existence. Today's developer has the advantage of being able to make use of experience gained at Shannon and elsewhere and will, I hope, use it towards the continuing improvement of the concept of the IFZ.