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Lighting and the New City of Milton Keynes

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Introduction

A new city in north Buckinghamshire was first envisaged in 1962 by Buckinghamshire County Council for overspill from the towns to the south of the county, for part of the county's contribution towards the housing of London's overspill, and the future population of South-East England as a whole.

In 1966, the County Council published a study of the possible development of a new city of 250,000 in an area between Bletchley, Stony Stratford and Wolverton. The Minister of Housing and Local Government, in his South East Study published in 1964, reached a similar conclusion. This study recommended a new city in the vicinity of Bletchley which was already being expanded by agreement with London under the Town Development Act of 1952.

In the light of these and other proposals the Minister made a draft designation order for some 25,000 acres and early in 1967 he decided to designate, under the New Towns Act, a new town, and that it should be called Milton Keynes; the name of a small village in the designated area.

Location

The region is set on the southern side of the broad valley of the River Ouse running between the Chilterns and the Northampton uplands. It lies right against the most important transport access in the country from London to the north-west. The historic role of this route is shown by the fact that Watling Street, built by the Romans, the trunk canal of the late 18th century, the London North-West railway of the 19th century, and the 20th century M1 motorway, all pass through the area of Milton Keynes.

Milton Keynes Development Corporation

The Milton Keynes Development Corporation (MKDC) was established in 1967 and drew up a brief specifying its requirements. A team of planning consultants and their co-consultants were selected to work on the preparation of a master plan for the new city.

The purpose of Milton Keynes was to provide houses and jobs for newcomers and the existing population, to reach 250,000 by the early 1990's—the existing, and encompassing towns of Bletchley, Wolverton and Stony Stratford having a population at the designated date of some 45,000 people.

In the preceding twenty years, twenty-five other new towns had been established in the United Kingdom, and many had reached an advanced stage of development. Their planning reflected the general and social economic climate of post-war years, and were generally sized at approximately a third of Milton Keynes.

Since the new city will not reach maturity until close to the turn of the century it has, therefore, to consider the environment which will fit people's wants and needs at that time. As in all advanced countries, technological and scientific knowledge is increasing the gross national product. Predictions as to the rate of the increase vary. It seems that the real purchasing power of the average family could double or even treble by the end of this century and their ways of life change accordingly. One only has to look back to pre-war years to appreciate how significant this difference can be. With this in mind, however, Milton Keynes must be clearly planned to meet the realities of present and more limited incomes and resources, while recognising in the longer term that, due to additional resources, life styles may greatly change.

Development of the Strategic Plan: Goals in Planning Milton Keynes

Many goals and objectives for Milton Keynes were debated during the preparation of its plan and its early implementation, and out of these the Corporation has identified six broad goals which the proposals in the plan are intended to achieve. These goals are:— Opportunity and freedom of choice, easy movement and access and good communications, balance and variety, an attractive city, public awareness and participation, and efficient and imaginative use of resources.

Existing towns and cities have much to offer which a new town cannot provide, but they generally cannot offer full freedom of movement and space. Their pattern of roads, building and public transport cannot meet the needs of the present day without unacceptable destruction of the old fabric, but in a new city, easy access can and must be available for all.

Inherent in these goals was the desire to give maximum opportunities of choice through a dispersed pattern of employment and social opportunities, and the need to accommodate a wide variety of housing types to bring in owner occupation and private housing investment and to meet the demand for space generated by rising incomes. The report favoured net residential densities between fifteen and twenty-five dwellings per hectare (six to ten dwellings per acre). Employment sites are distributed fairly widely, and many are located around the perimeter of the city, which will reduce the journey to work and spread the traffic load evenly.

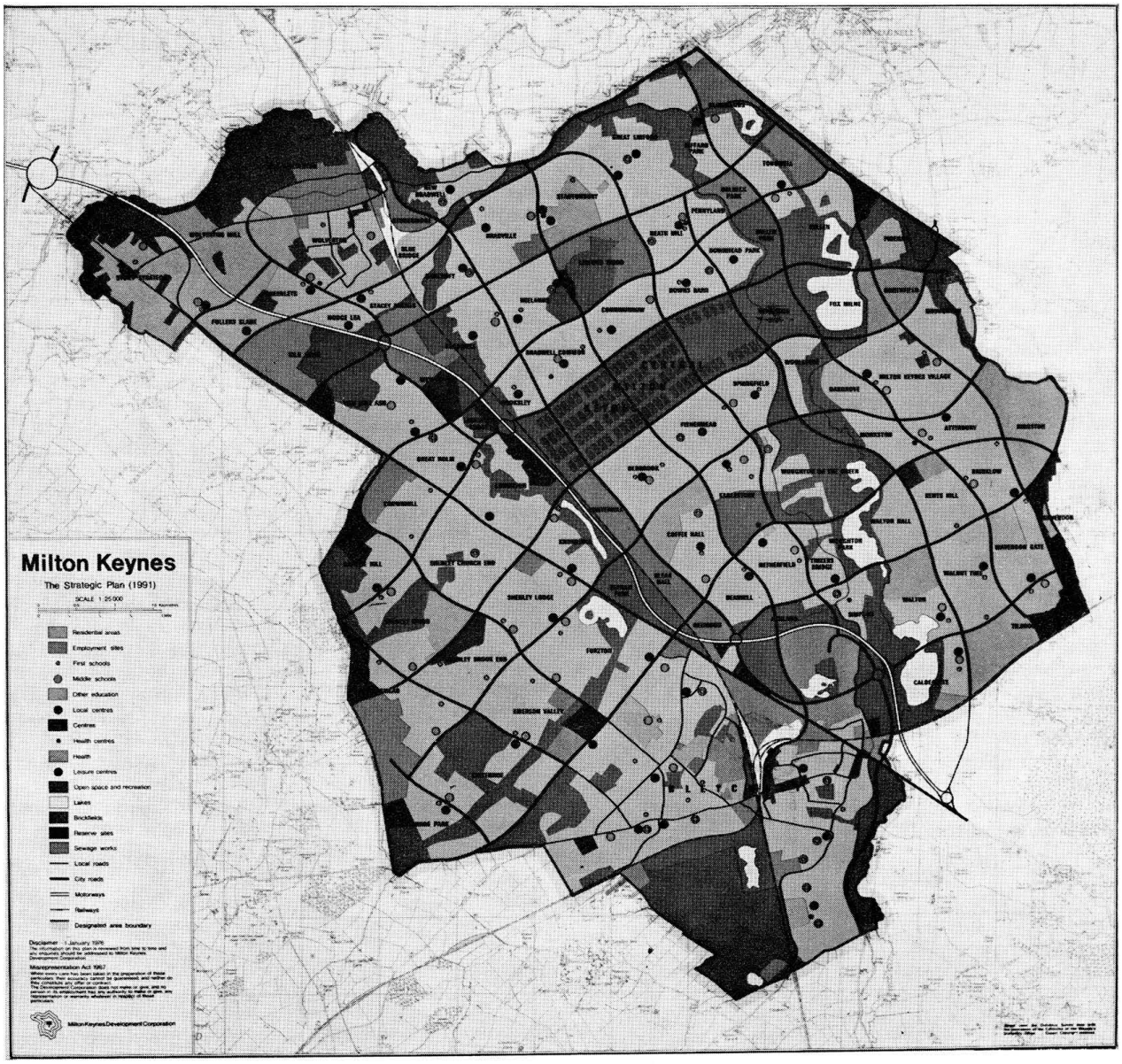


Fig. 1 The designated Area of Milton Keynes.

The economic birth of the new towns dates from the New Towns Act 1947. It is a fact that new towns are good business! The Development Corporation enjoy special advantages related to other governmental bodies and have few statutory responsibilities. There is an undoubted commercial sense in their activities as, within their terms of reference, sufficient return on capital is necessary.

The recent birth of BUDSU (British Urban Development Services Unit) is an interesting spin-off from British new towns, where their special know-how, undoubtedly the best in the world, will be involved in new town building in the Near and Far East.

Organisation

Most new towns have operated a professional hierarchy led by a Chief Officer, e.g. Chief Engineer, Chief Architect, etc., similar to the prevailing local government model. Due to the physical size and implementation programme at Milton Keynes this presented particular problems and some two years ago an executive structure was created with the designated area divided into four primary directorates—Northern Milton Keynes, Central Milton Keynes, Southern Milton Keynes and Infrastructure.

In order to consider the importance attached to lighting and street furniture within the new city it would be of interest to recognise the management structure of the Infrastructure Directorate, which has second tier management directly responsible to the Executive Director. Five departments were set up in

the Directorate: Engineering (Highways and Bridges), Landscaping and Forestry, Public Transport, Divisional Financial Controller, and Street Lighting and Infrastructure Equipment.

Street Lighting and Infrastructure Organisation

In management terms, this Department is divided into three sections—(1) Lighting, (2) Navigational Signing and (3) City Furniture. The basic philosophy for city roads includes an inter-face for all three sections, in an endeavour to co-ordinate all elements in a visual and sometimes contractual form.

Lighting

This section is responsible for all lighting throughout the designated area, for all street lighting works, amenity and environmental lighting, and includes an advisory element to external consulting engineers working within the designated area. These items would include lighting for offices, lighting of Central Milton Keynes shopping building, special lighting for bridges, railway station, etc.

The Section functions in a similar manner to that of a county lighting department, designing, tendering and implementing, the prime difference being the large design input necessary during the early years of the city's life. It is not, however, a lighting authority in its own right.

Navigational Signing

This section designs, tenders and installs, within highway traffic confines, navigational signing for city roads, basically as in the traffic manual, with professional inputs in traffic design from the Highways Division. Site signing, footpath signing and information signing are also included.

City Furniture

The design of city furniture (infrastructure equipment) includes items such as bus shelters, seats, litter bins, street name plates, statutory enclosures, etc., together with supply and installation.

Design Parameters

In the early 1970's the Corporation invited a firm of industrial design consultants to produce a city furniture philosophy across the whole spectrum of visual aspects. This resulted in a consistent design approach for infrastructure equipment. Infrastructure is the physical anatomy of the city—roads, bridges, underpasses, navigational signs, street equipment, landscaping and footpath systems. The consultants set out a framework of proposals designed to establish a visually coherent system. (See Fig. 2.)

Co-ordinating the various elements of the infrastructure would help to unify the city plan, and provide a design framework capable of responding flexibly to the future growth. It was self-evident the new city offered an opportunity for a rationalised approach, which could contribute positively to the efforts of all those concerned with the city's environment.

Road Lighting Policy

Lighting within the city falls into four major categories: —City roads, Central Milton Keynes, housing estates and other situations.

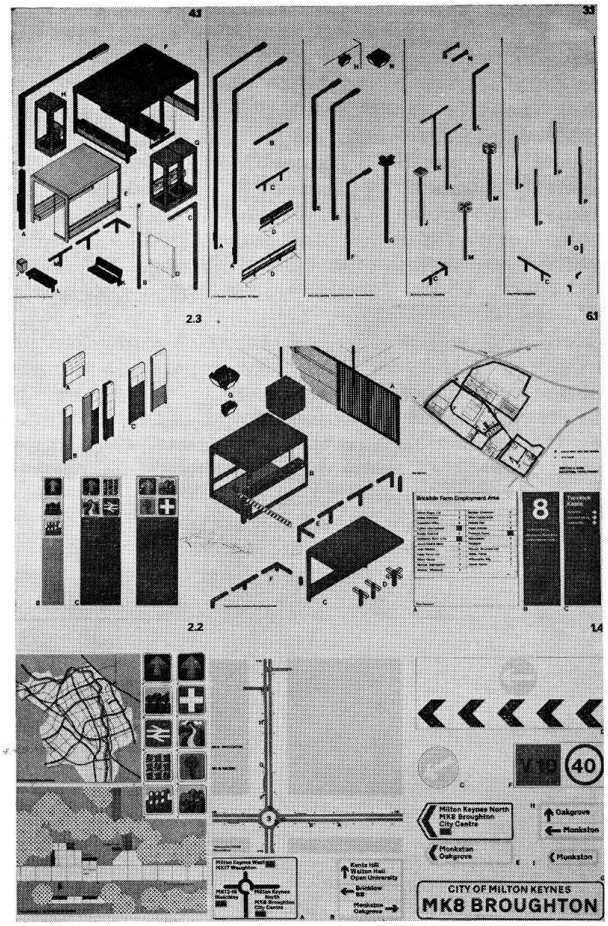


Fig. 2 Infrastructure equipment—a coherent design.

A basic parameter in the lighting concept for the city was for low pressure sodium lighting within the city road system. All lighting within the housing estates would utilise high pressure colour corrected mercury, which is an agreed white light policy with the County Council. An essential principle is that once traffic leaves the major city road network, drivers should be aware of the different traffic speeds and more relaxed ambients. White lighting would emphasise this particular hypothesis at night-time. All lighting in Central Milton Keynes, the commercial heart of the city, would be by high pressure sodium sources.

City Roads

Figure 1 indicates the designated area with the main city road network shown, producing a 1-kilometre grid square system as a complete matrix over the shape of the city. It will be noticed from the diagram that the disposition of primary housing estates and industrial areas is spread fairly evenly throughout the designated area, with a slight emphasis on locating industry at the perimeters away from parks and high density areas.

Lighting throughout the city roads was designed to CP1004 Parts 1 and 2, with semi cut-off luminaires with the lumen packages in the lower hemisphere of

12,000 lumens and 20,000 lumens for the 10-metre single carriageway solution and 12-metre dual carriageway solutions respectively.

In design terms the Corporation were fortunate in that the city road layout will produce over 100 roundabout situations that will be consistently designed, enabling the lighting treatment to be exactly as in the Codes of Practice. Slight deviation from the codes was effected where dual carriageways were involved. The positive landscaping reserve led to the solution of keeping the lighting column located on the outside of the two highways, irrespective of radius or curvatures.

The classical solution of having lighting on the outside of the bends would have meant the location of the columns continually changing; this was felt to be far less desirable than occasionally having columns on the nearside in a reverse curve situation. (Typical diagram Figure 3a and 3b). Results have more than justified this decision.

Figs. 3a and 3b Lighting on bends.

Following an appraisal of the lighting industry, it was found that the consultants' profile for Group A columns had serious cost problems. The advent of memorandum BE4/72 has further exacerbated the problem and on cost grounds alone an alternative shape was decided on. This was the first serious fragmentation of the MKDC "Infrastructure Package". The revised preferred choice was for a steel hot-dipped galvanised continually tapered design with a square-angled bracket.

Contracts are let in the usual manner by open tender. Most equipment issued is of a standard catalogue type; at the present time MKDC has some 1,600 Group A columns and luminaires installed on city roads.

In engineering programming terms the major difficulty associated with these areas is related County Council/MKDC policy, where roads may only be opened when obstruction lighting is available at roundabouts. In the early years, when highways were constructed in green field situations, the provision of electrical feeds necessary at node points gave considerable forward planning problems in having supplies available at the correct places at the right times. Electrical connections were provided by feeder pillars from the Electricity Board's supply and from then on the system was designed by the Corporation.

Positive steps were taken to utilise street lighting columns for most mandatory lighting units, which reduced the large number of vertical elements that otherwise would have existed.

The city road network totals some 180 kilometres, which will result in some 6,000 units being installed during its growing life for Group 'A' systems.

Central Milton Keynes

Undoubtedly the most challenging lighting problem in the city is the lighting of Central Milton Keynes (CMK) which has an area of about 1-kilometre x 2-kilometres in the heart of the city. This is similar to an area encompassed by Marble Arch to Tottenham Court Road in the North and Hyde Park Corner, Piccadilly and Leicester Square in the South. The highways are basically boulevards approximately 100-metres wide for the highway, landscaping and car parking areas, and comprise a dual carriageway with

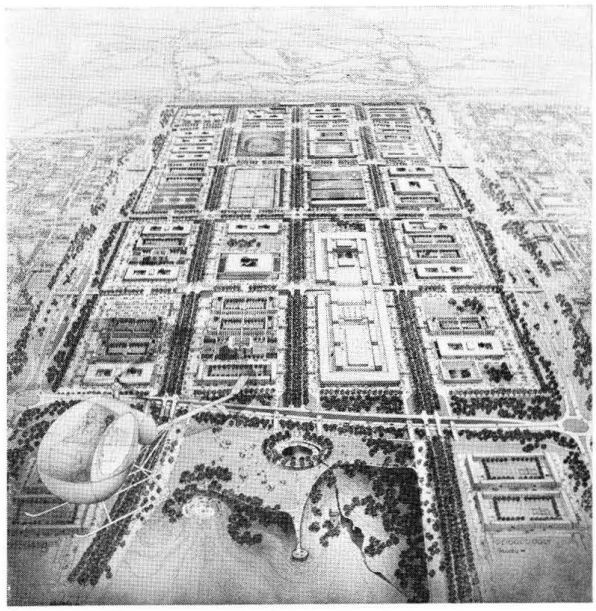


Fig. 4a Central Milton Keynes, 1990—an artist's impression.

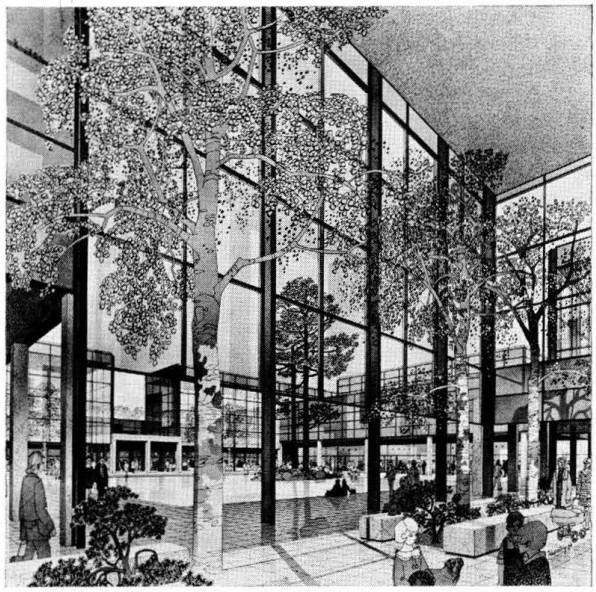


Fig. 4b Shopping Building—an artist's impression.

a rigid discipline of junctions, parking area entrances and bus stops (porte cocheres). An artist's impression of CMK as at 1990 is at Fig. 4a.

Following the positive module design, lighting columns at 22.5 metre centres were decided on. Bearing in mind the limited height of the buildings and the height of the "London plane" trees, a design decision was made to limit the height of the light source to six metres. In essence this was outside the codes of practice, where the road widths would normally have resulted in a ten-metre conventional solution.

An interesting technical exercise was carried out, in which a conventional scheme at ten-metre mounting height was surmised, with illuminance and veiling brightness figures calculated. This was compared to a six-metre solution with a target lumen output, and cut-off distribution, and it was found that the photometric parameters were superior at the lower mounting heights. The disposition of light sources also provided a consistent arrangement at junctions within the area. These figures were then checked by computer and the original calculations were confirmed.

A trial installation was inspected to indicate exactly what the photometric figures meant in visual terms and it was found to be highly successful. Fig. 5 refers.

All these works were done in consultation with the County Council and it was agreed that a six-metre 150W high pressure sodium source should be installed. The semi-cut-off luminaire to produce the data necessary utilised a reflector system. To match column design and height, a special luminaire design was necessary. It was decided not to implement the square column profile within Central Milton Keynes and a continually tapered column with a curved bracket was decided on.

The lighting to the boulevards is being adopted by the County Council, while lighting to the car parking and porte cocheres are private Corporation networks. Switchgear feed points are located at load node points and feeds are taken from the local Electricity Board. The total number of lighting units as described at six-metre height exceeds 1,000, with some 4,000 four-metre "Group B" units in the car parking and ancillary areas.

Housing Estates

A basic aspect of the Development Corporation's design of housing estates is that many young architects from private practices joined the Corporation during its early years, the result being the large number of completely fresh and interesting, although occasionally radical, housing designs.

In lighting terms this programme meant that on occasions some fifty or sixty housing estates, all of different shapes or sizes, could be at one design stage or another concurrently. Systems were designed cognizant with CP1004 Part 3, the mounting height chosen being five metres generally with 80W/125W HPMV colour corrected sources, and all systems being photocell controlled.

Comparison between calculated illuminance/luminance values for 10 metre MH 22,000 lumen system and 6 metre MH 14,000 lumen, single-sided and double-sided systems.

	6.7m highway		14.7m highway	
Mounting Height:	10m	6m	10m	6m
Average illuminance	18.8 lux	36.3 lux	30.6 lux	41.4 lux
G1 = (Emin/Emax)	0.16	0.23	0.41	0.33
G2 = (Emin/Eave)	0.35	0.48	0.65	0.65
Utilization factor (on calculated lanes)	19.1%	40.8%	34.4%	49.9%
Installed flux	687.5 lm/m	622.2 lm/m	1333.3 lm/m	1244 lm/m
Average luminance	1.19 cd/sqm	2.34 cd/sqm	1.94 cd/sqm	2.73 cd/sqm
Veiling brightness	0.04 cd/sqm	0.04 cd/sqm	0.07 cd/sqm	0.05 cd/sqm
Average value	3.4%	1.75%	3.6%	1.8%

Fig. 5 (see also next page).

1. $E = \frac{I}{h^2} \text{Cos}^3\gamma$ Lux

2. $L = qE$ cd/m^2
   or $L \propto q_o \kappa E$

3. $q_o = \frac{1}{\Omega} \iint \Omega^q \, d\gamma \, d\delta$

4. $\kappa = 10^{\text{Log}} \frac{q_o}{q_p}$ (specular factor)

5. Veiling brightness $= H = K \frac{\text{Eye (illuminance)}}{H^2 \text{ (degrees)}}$

Road surface definition Class 2

Kappa " p " = 0.28, by measurement

Q-O = 0.069 cd/sqm/lux

Eyeline = 1.5 metres

(Formula basically as J. B. De boar and Holiday & Styles)

E = Horizontal illuminance

h = Mounting height

I = Luminous intensity towards reference point

γ = Angle of elevation of light source

L = Luminance of reference point from observer

q = Reflection factor

q_o = Average illuminance factor

q_p = Luminance factor for normal incidence

K = Age factor

On aesthetic grounds it was considered that the lighting industry had produced a family of "Group B" luminaires that were not in keeping with the design concepts at Milton Keynes. This criticism, although severe, is really not against the design capabilities, but is a criticism that "utilitarianism is not all" and economic cost is not the only parameter. It is a fairly fundamental issue that a city with a growing life of some twenty to twenty-five years takes on a difficult fashion problem in design.

Any equipment being standardised should have a shape that would withstand these pressures. Following a critical examination of photometric performances of well-tried units, it was felt that the Corporation should produce its own visual and performance specification. The result was the adoption of a post top unit with a non-axial asymmetric glass dome refractor distribution system enclosed in a large sphere. Different sized bowls are used depending on circumstances, the largest proportion being 500mm in diameter and manufactured in polycarbonate.

Fundamental in this decision were two particular requirements—that "Group B" street lighting should first provide illumination on the highway and, second, provide security and general amenity lighting.

Whilst recognising the photometric requirements of CP1004 Part 3 and BS 1788, the writer appreciated during his research laboratory days that glare in this context is not too serious a problem. The use of the fishbowl unit produced certain intensities between the 70° and 90° vertical angles which are important in luminous output terms. A Rousseau diagram or Russell angles appraisal soon showed the sense of this attitude. It was felt that any reduction in intensities in the important azimuth angles was compensated for by this useful light. The "Fishbowl", as such, took both these philosophies on board and in principle satisfied BS 1788.

The design of the "Group B" lighting column followed the requisites of the original square philosophy and a 4 in. x 4 in. (100mm x 100mm) cross section was decided upon. This dimension enabled all standard equipment, and any envisaged new control equipment, to be enclosed within the lighting column.

Tests are still being carried out related to the choice of materials for this column, and during the last two years' implementation, RHS (rolled steel), fabricated steel and aluminium, extruded aluminium and GRP (glass reinforced plastic) have been considered. Because of the cost of RHS the Corporation are now testing fabricated steel and GRP.

The total number of "Group B" lighting points should be of the order of 25,000 by the time the city has reached full maturity.

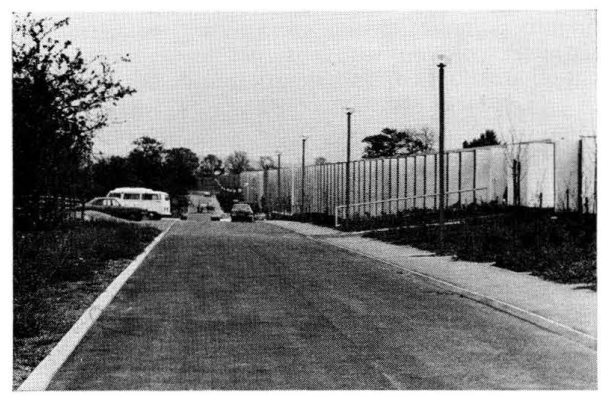


Fig. 6. Typical housing areas, with 'Fishbowl' lanterns surmounting 5m. square GRP columns (above) and steel columns (below)

As previously described, the city road system utilises feeds from the Electricity Board's pillars, but within housing estates a common trench system is being used wherever possible, with electricity, gas, water and GPO services included in one contract. The system is being managed by the Development Corporation, but is funded primarily by the statutory authorities.

Use is made of the fact that, within the common trench, multi-service joints are provided for feeding

houses, and provision is made for the connection of street lighting cables. This is felt to be the most economical way of providing feeds, both in capital terms and having regard to future maintenance.

Other Lighting Systems

Footpaths

In a city with a basic philosophy of a major road matrix, pedestrian traffic between housing, industry and commercial centres, requires a positive pedestrian system. Lighting is to be included on the majority of footpaths, with signing and seating, etc. Because the footpaths are often far away from the common trench, this cabling is usually done on private networks. Five-metre lighting standards are used, usually at approximately 50/60-metre centres. Use is made of low level lighting bollards in certain circumstances.

Underpasses

The decision to keep pedestrian traffic away from city roads necessitates a large number of underpasses for pedestrians, and a definite cost decision is made to keep these underpasses as wide and as well designed as possible. A dark tunnel effect would obviously produce all the anti-social connotations at night-time and therefore a great deal of consideration is given to the width, height, footpath finish and entrance detail of the underpass.

The finally agreed lighting scheme, after tests, was for a single-sided fluorescent tubular lighting system to be installed in the corner between the ceiling and abutment; vandal-proof, with photo-electric controls, the units are angled at 60° with 65W tubes and polycarbonate diffusers, and are spaced nominally at 2.5 metre centres.

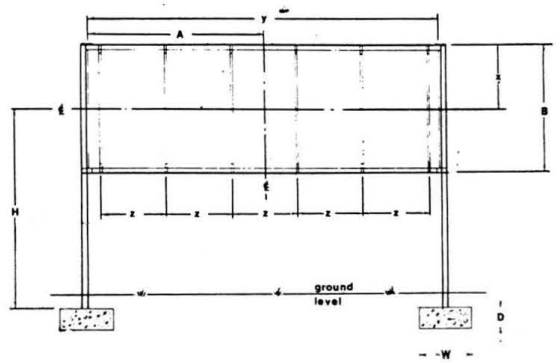
The target illumination agreed with the County Council was of the order of 50 lux average. It was found that the diversities in illuminance resulting from single side fixings was quite acceptable. By not providing too much illumination from the underpass itself, there is no sense of deprivation when emerging onto conventionally lit footpaths.

Villages

Scattered through the designated area of the new city are eleven charming and unspoiled villages. The utmost care is being taken to see that none of them loses its identity as the city expands. Any new housing is carefully designed to relate to scale and density. Lighting schemes are treated as one-off situations and full use is made of wall brackets, low level lighting bollards and all the lighting tools available to produce layouts that are as delicately designed as possible.

Navigational Signing

In designing the navigational system hardware, it was found that, to be consistent with the square design philosophy, the first problem to be solved was that the nomograms in the traffic manual showed support details such as strength, size and gauge of metal for only tubular and rectangular supports. This necessitated the production of our own nomograms for the "square" design, as shown on figure 7a.



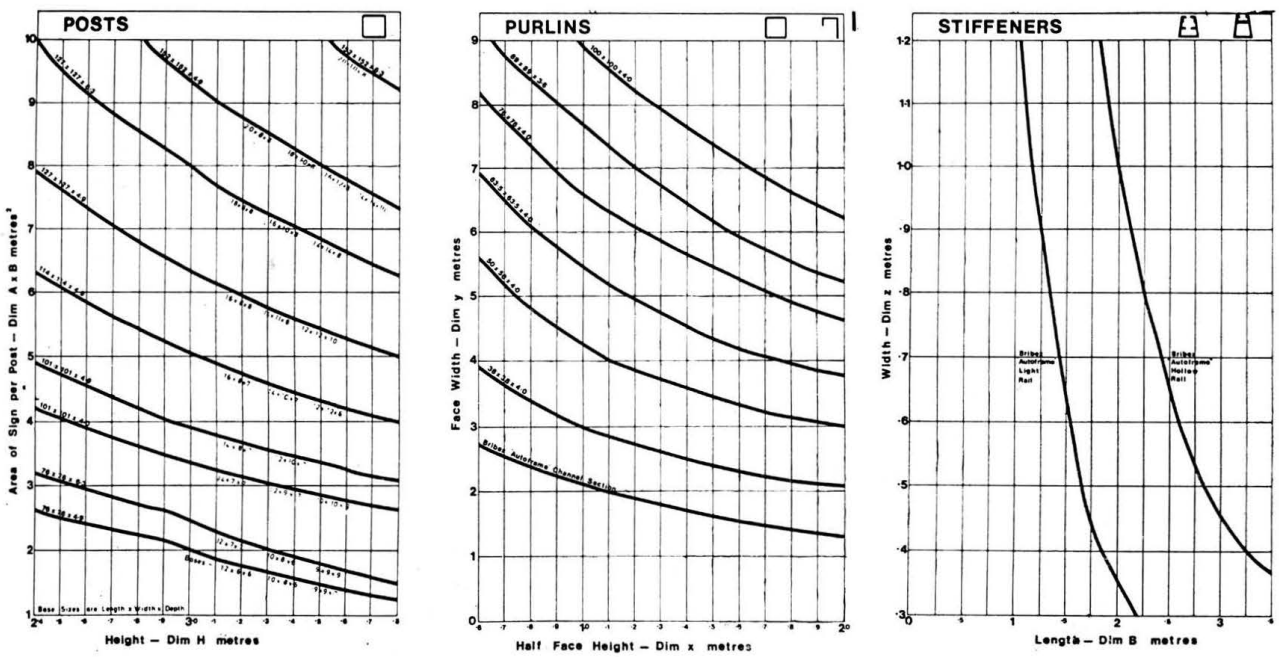


Fig. 7a Nomograms for "square" design.

Fig. 7b Milton Keynes sign.

The design not only had an obvious requirement to match other square support elements but provided a definite rigid relationship between the sign face and support which was very often lacking with conventional tubular equipment when badly installed.

Other difficulties when working from first principles concerned the method of design of brackets and supports, bearing in mind that they should not only be able to be installed simply but, probably more important, should be able to be reassembled by unskilled labour in the event of knockdowns.

Inherent in the design are a number of special brackets, purlins and clips, which obviated the need for the square support steel to be welded or jigged for holes, etc. To assist signing manufacturers these items were supplied direct by the Corporation, so that in essence the manufacturer merely supplied the sign face to the given specification.

To keep the visual line of the sign uncluttered, low level floodlighting to BS873 was the chosen method. A hard standing was provided for the floodlight so that grass-cutting on the verges would not cause knockdowns. A GRC (glass reinforced concrete) baffle was also provided as an "L" shape which in addition to providing an enclosure, assisted in screening direct light against traffic coming in the opposite direction.

Of comparable cost to conventional tubular systems this square support system has plastic-coated steel supports, and is now being implemented with the local authorities' blessing.

Sign-posting is particularly important in an area the size of Milton Keynes. In addition the verges will be tree-lined and often contoured so that the traditional landmarks of church and pub will not easily be seen. To assist in this situation local areas have been given postal districts which form part of the address. There are some seventeen designated postal areas in the city. To assist vehicular traffic these Milton Keynes postal numbers are shown on advance directional map signs, for which dispensation has been granted by the Department of the Environment. The routeing policy is that local advance directional signs indicate grid squares up to two squares away, with the advanced map signs indicating the primary areas and destinations beyond the city boundary.

An important part of the group's task is to provide consistent location for all navigational signing and mandatory signs, so that junctions have the minimum amount of "clutter".

Information Signing

Informatory signing seems a highly emotive subject, apart from the logistical connotations. Within the new city, several sub-headings come under this umbrella as follows: —

1. *Information Signing*

Information points at the port ways to the city are provided so that visitors, business people and contractors' traffic can stop and at their leisure peruse a major map of the area and decide on their final route. Seats and litter bins are provided at these points together with miscellaneous local information for visitors.

2. *Street and City Road Name Plates*

Each city grid road, whilst still having its vertical (V) and horizontal (H) co-ordinates from the master plan, has been designated a street or way depending upon orientation, with the name having some local or historical significance. For example, H9 is known as Groveway, from a name known to have existed in the 18th century; V7, known as Saxon Street, which passes through the reputed folk moot site of the ancient Saxon hundred of Secklow; V8, Marlborough Street, is named after the Duchess of Marlborough (Sarah Jennings) who was the 18th owner of the Manor of Stantonbury, and so on. Each city road has a name plate giving its name and H or V number. Conventional street name signs are provided for more local information for housing estates.

Coupled with the street name signs, an estate street name map is provided at the entrance to each grid square giving car users/visitors further information as to the estate layout and disposition of each road and local centres.

3. *Industrial Areas*

Without adequate information, particular difficulties would be faced by visitors at the entrance of each industrial area, so companies situated in a particular estate were shown, together with their location.

Further localised signing giving car parking and entrance information was also necessary.

4. *Footpaths*

As previously indicated, the use of footpaths with adequate wearing surfaces, seating, landscaping and lighting is paramount in a city with a positive road matrix splitting the grid squares and amenity centres. In addition to the preferred local authority "footpath" sign, therefore, precise information as to the

name of the adjacent area was included together with a small picture giving further information, to assist pedestrians as much as possible.

Contractors' Site Signs

To alleviate the number of contractors' signs which proliferate in an area in which at any given time some fifty to seventy building contractors may be working, a consistent sign system was evolved providing site name, contractor's name and professional team information. With positive control over ad hoc contractors' signs at roundabouts and junctions, this system has helped a great deal to reduce unsightly clutter over the highway.

All the signing systems mentioned follow the unified design approach of square profile or square supports.

City Furniture

Infrastructure, being the physical anatomy of the city, should manifest itself primarily in its highways, bridges and landscaping. However well-designed and built, and the planting of some ten million plants of all types are an obvious manifestation, this effort can be too easily undermined by poor design and location of infrastructure equipment items.

The "Infrastructure Package" includes designs for bus shelters, litter bins, seats, miscellaneous signs, enclosures for statutory services such as gas and water supply, bollards, lights, etc., the philosophy being that a unified design for city furniture, correctly and consistently located, should not be a visual abrasion and will allow the major infrastructure elements to provide an environmental ambience that is up to the standards that the Corporation is striving for in the new city. The Corporation stockhold quantities of city furniture for supply to contracts as required.

Conclusions

The Lighting Engineer produces the largest single element in the visual scene, both in size and in quantity, and therefore it is right, in the author's view, that his technical and aesthetic ability should be coupled with the other visual elements, such as signing and furniture, in providing his contribution to the design of Milton Keynes.

The conclusion to a paper on lighting in the new city of Milton Keynes should in simple terms reiterate its aims; the inhabitants will decide its success.

The author has remembered a statement through his years in lighting and it is a major criticism that can be levelled at many lighting engineers: "His efforts are all light but no lighting". In Milton Keynes a positive effort is made to provide lighting that does not clash with this philosophy. He believes that the corporate management juxtaposition of having the complete street scene as his battleground, in providing the correct lighting levels, and the visual scene in all its aspects, are coherent to specific aims. This is what the battle is all about.

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Source of Reference: Plan for Milton Keynes, Volumes 1 & 2, Main Consultants: Llewelyn-Davies Weeks Forestier-Walker & Bor.