BUILDING SERVICES SYSTEM IN SMALL HOTELS - A Survey of selected hotels in Kaduna

and

a design guide for water and electrical services for a 45-Bedroom hotel

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DECLARATION

I DECLARE THAT THIS THESIS HAS BEEN WRITTEN BY ME AND THAT IT IS A RECORD OF MY OWN RESEARCH WORK. IT HAS NOT BEEN PRESENTED IN ANY PREVIOUS APPLICATION FOR A HIGHER DEGREE. ALL QUOTATION ARE INDICATED AND THE SOURCES ARE SPECIFICALLY ACKNOWLEDGED BY MEANS OF REFERENCES.

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We certify that we have read this Thesis and in our opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate in scope and quality as a thesis for the degree of Master of Science in Building Services.

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It is my conviction that this has been completed only because the Almighty in His Grace has made it possible.

There are numerous persons through whom, this Grace of the Almighty was extended to me, and in so many ways. Itemizing their names in this work would not substitute for the heart-felt gratitude that I am compelled to experience, consequent to their magnanimous actions that were more or less, but welcome happenstances.

I wish all these people succor in times of need, and the capacity to continue in their admirably good gestures.

DEDICATION

This work is dedicated to that fragment of mankind that is earnestly involved in the search for beautiful humanity.

OBADOFIN, C. W. DISMENTO

ABSTR;

This thesis was motivated by the sensing of inadequcies in all ramifications of building services installations in small hotels around the country.

The traditional role of a hotel in the service of a community seems to be crumbling like a pack of cards under the weight of afflictions brought about by ignorance and incapacity of hotel developers and managers.

In the liqht of the foregoing this work was designed to reestablish the concept on which the hotel industry is built, which is the provision of comfort in all it's relevant ramifications to all categories of hotel users, to measure the status of building services installations in elected small hotels in Kaduna by means of a survey, and bo present a design guide for a small hotel.

The hotel on which the excercise is based is a 45-bedroom hypothetical hotel, in Kaduna.

The building services haven been identified as a very relevant instrument towards the provision of comfort in hotels has not been well considered in many hotel developments as the result of the survey indicated.

The first chapter presents the background to this work the need for it and the scope, while the second chapter deals with historical aspects of hotel development and hotel classification.

The third chapter concerns itself with the survey which has been touched upon above. The methodology of the survey and the analysis of data gathered from this survey along with relevant recommendations are presented here.

Chapter four highlights some useful concepts towards the design of engineering services in buildings.

Subsequent chapters set out the fundamental principles and regulations of statutory bodies along which Lnes the various components of the building services system could be successfully designed. These component; include:

(a) Cold and Hot water services

(b) Electrical Installations and allied serrvices.

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GLOSSARY OF TERMS.

WATER SUPPLY

COLD WATER SUPPLY

Actual capacity - the capacity of a vessel measured up to the water line

Back flow - flow in a direction contrary to the natural or intended direction of flow.

Cistern - A fixed container for water at atmospheric pressure. The water is usually supplied through a ball valve.

Stop Tap - Point of termination of the water authority's installations. It is usually provided by the authority and can only be operated by a turn cock in the possesion of the authority.

Disk Feed - A method of regulating the flow into an automatic flushing cistern by the use of a thin disk, with a calibrated orifice, mounted in a union in the feed pipe.

Diversity Factor - A factor used in the design of pipework to determine the maximum rate of flow to allow for in a pipe-probable rate of flow devided by the possible total rate of flow.

Head (Static) - The pressure head when water is at rest

(Total) - Sum of the position, pressure and velocity heads.

(working) - The head of water at which an installation is designed to work.

Loading unit - A unit so chosen that the relative water

requirements of sanitary appliance can be expressed as multiples of that unit. The Loading unit rating of an appliance depends on the required rate of flow and it's duration at the appliance and the frequency of use.

Distributing pipe - Any pipe (other than an overflow pipe or a flushing pipe) conveying water from a storage cistern under pressure from that cistern.

Overflow pipe - A pipe connected to a vessel, sanitary appliance, sewer or chamber to discharge excess water.

Service pipe - So much of any pipe, for supplying water from a main to any premises, as is subject to water pressure from that main, or would be so subject but for the closing of some stop-valve.

Back Siphonage - Back flow caused by syphonage of liquid from an appliance or storage vessel into the pipe feeding it.

Ball Valve - A valve with a float riding on the surface of the water in an open topped chamber.

Water hammer - A hammering sound caused by violent surges of pressure in water pipes.

Water line - A line marked inside a cistern to indicate the highest water level at which the ball valve should be adjusted to short off.

Hot Water Supply -

Calorifier - A storage vessel not open to the atmosphere, in which supply of water is heated. The vessel con-

tains an element, such as a coil pe, through which is passed a supply of hot water steam in such a way that the two supplies do nc mix, heat being transfered through the walls of t element.

Primary Circuit - A circuit in which water circulat s between a boiler or other water heater and hot water storage vessel.

Second Circui - A circuit in which water circula in distributing pipes from and back to a hot ater storage vessel.

Closed circuit - A system of pipes and fittings i which the same water is circulated and from whi n no water is drawn off for use, as in a hot w ter space heating system.

Feed Cistern - A cistern supplying cold water t a hot water system

Hot water cyl nder- A cylindrical closed vessel for oring hot water under pressure greater than atm heric pressure.

Indirect-cylinder - A cylindrical calorifier with a ating element inside.

Feed Pipe - A distributing pipe conveying co water from a cistern to a hot water apparatus

Direct System - A hot water supply system in whi n the water supplied to the draw-off points is heated y a primary source of heat such as solid fue , gas electricity or oil.

Expansion pipe/
Vent - A pipe, on a hot water appliance for the escape

of air and for the safe discharge of any steam generated.

Lighting

Luminous flux - The light emitted by a source or received by a surface.

Lumen - SI unit of luminous flux, used in describing the quantity of light emitted by a source or recieved by a surface.

Luminous intensity - The quantity which describes the power of a source or illuminated surface to emit light in a given direction.

Candela - SI unit of luminous intensity

Illumination - The process of lighting an object

Illuminance - The luminous flux density at a surface, i.e. luminous flux per unit area. Called planar illuminance when related to a flat surface.

Lux - SI unit of illuminance, equal to one lumen per square meter

Luminance - The physical measure of the stimulus which provides the sensation of luminousity (brightness), in terms of the intensity of the light emitted in a given direction (usually towards the observer) by unit area of a self-luminous or transmitting or reflecting surface.

Candela per square meter - SI unit of luminance. A unit luminance is that of a flat uniform diffuser emitting [illegible] lumens per

square meter.

Visual field - The full extent in space of what could be seen when looking in a given direction.

Visual task - The visual content of the work being done.

Visual task acvity - Capacity to discriminate between details or objects which are close together.

Adaptation - The process which takes place as the eye adjusts to the brightness or the colour of the visual field. The term could also be used to connote the final state of the process.

Adaptation Level - The level to which the eye will become adjusted in the steady state in a given visual environment.

Luminosity - The visual sensation associated with the amount of light emitted from a given area (Brightness).

Colour rendering- A general expression for the colour appearance of an object when illuminated by light from a source compared conciously or unconciously with the appearance under light from some reference source, (usually deaylight)

Incondescent lamp- A lamp in which light is produced by a filament heated to incondescence by the passage of electric current. A tungsten filament is used in most cases hence they are referred to as tungsten lamps.

Discharge lamp - A lamp in which light is produced directly or by excitation of phosphors by an electric discharge through gas, metal vapour or a mixture of

Flourescent lamp - A tubular discharge lamp in which light is emitted by layer of a flourescent material deposited on the surface of the glass tube and excited by ultra-violet radiation from the discharge.

Reflectance - The ratio of the flux reflected from a surface to the flux incident on it.

Luminance - An apparatus which controls the distribution of light given by a lamp, and which includes all the components for fixing and protecting the lamps and for connecting them to a supply circuit.

Working plane - The horizontal, vertical or inclined plane on which the usual task lies.

C H A P T E R I

INTRODUCTION

1.1 Background to the Study

The primary and most historically documented function of a building is largely, that of providing shelter for its occupants, from influences of the environmental elements - sun, wind and rain. It is a fact that over a good part of the earth's surface, the prevailing natural environment does not provide (except momentarily) satisfactory conditions for human comfort. The need for the buildings is therefore justified against this singular, if only background.

The nature and intensity of these influence however, are subject to factors like;

(a) Geographical location of the area under influence.

(b) The time of the day, month and year.

(c) The activities of the inhabitants as it affects the natural balance which existed prior to habitation.

Historically, traditionally, established precedents and traditional experience of local conditions formed the reference or basis for building and environmental planning decisions. Combinations of materials and forms were employed and tested on a trial by error basis to arrive at the most economic and practical solution to environmental comfort. With growing civilization and advancement in technology, more exacting needs had to be satisfied. Experience of historical methods are no more enough to tackle the new situations arising. In some cases electronic equipment or manufacturing processes demand more closely controlled conditions than are necessary for human comfort, which makes the requirements of mankind in respect to his shelter more complex.

All these developments, initiated one of the most marked trends in architecture over the centuries - the systematic replacement of the functions of the building structure by engineering service systems. Maver, T.W. [1] observed this in his discussion on the subject -

> "In the past, the mass of the structure provided security and protection for climatic extremes, and openings in structure provided light and ventillation. The trend is such that the function of security has been taken over by electronic security systems and that of moderating climatic variations has been taken over by heating and cooling plants. Some of the functions of the window - provision of light and ventillation are now performed by engineering systems."

Strictly speaking, it would be observed that man's yearning for a greater control over his environment is in a bid to make himself more comfortable. Human needs in terms of comfort are such that the physiology and psychology of human sensations and perception must be regarded as the basis for forcasting measurements of comfort levels.

One can safely say that discipline of architecture is becoming more of application of special skills to the solution of complex environmental systems. Environmental consideration must be taken into account at the very initial stages of the design of buildings as well as associated variables. The approach to building and environmental design should be an integrated one, rather than a factionalization between the Architects on one hand and Engineers skilled in specific types of energy distribution on the other.

With this kind of trend in the approach to environmental problems, the buildings services designer must be seen as applying himself to finding solutions to ever new and exacting demands of mankind. A systemic and systematic approach which would embrace economic considerations is most realistic.

1.2 Statement of the Problem

For various activities of mankind have been developed different shelter - types, which are referred to as building types by writers, such that buildings serving similar functions are grouped together into a specific building type. These building types include; commercial, residential, industrial, religious, recreational etc. A sub-group of commercial building type consists of the hospitality industries, among which are, Hotels, Restaurants, Clubs etc. The requirements of man in respect of any building will depend on the functions to which the building is intended, which would then affect the building services installations necessary to meet these requirements. In hospitality industries, generally, building services play a very important and decisive role in comfortability determination. Our discussions within the scope of this work shall be centred on only one of the hospitality industries - The Hotel.

The importance of building services to the Hotel cannot be overemphasized. As a matter of fact the success of a Hotel is directly linked to the extent of provision, efficiency and the aesthetic variables of its services installations. Comfortability being a very prime requirement in a Hotel, dictates that the building must be serviced to the satisfaction of the Hotel Clientelle. The components of the building services system as it affects the Hotel shall be discussed in later capters.

At the decision-making level in building services design, there are major areas that must be properly considered;

(a) The Functional Variables: These relate to the functions that the building is expected to perform and the services installations that would be needed along with the functions of each installation.

(b) The Technical Variables: These relate to the technical aspects of the installations. Here the estimated demand level, the load, the size and complexity of plants and distribution media, the choice of material and other similar considerations come to play.

(c) The Aesthetic Variables: These relate to visual comfort. This is affected by decisions in (a) and (b) above and must therefore be jointly considered with them.

(d) The Economic Variables: These relate to the cost of alternative systems and methods. A proper analysis of the possible alternatives with due regard to initial costs and costs-in-use is very helpful. This analysis would be most realistic when (a), (b) and (c) above have been thoroughly investigated, and decisions taken on them.

It is unfortunate that in a good number of Hotel developments in the country, these variables were not given due consideration resulting in problems associated with the installations, usually centred around one or more of the problems enumerated below.

(a) Lack of and under provision of necessary services installations: These problems arise from a number of factors including, non-involvement of qualified consultants in the design of building and of the installations; non-adherence to design recommendations of consultants at installations stage, where Consultants were involved at design stage; improper analysis of the requirements of Hotel users in the appropriate respect; malicious economic manipulations whereby

higher initial investments are traded off for comfort of Hotel users. These factors severally and jointly are most easily identifiable as linked with problems associated with non-existence of, and inadequate provision of some services.

(b) Inefficiency of Provided Installations: When a system is inefficient the causes are not far fetched. In the first place the problems outlined in (a) above may easily be one of such causes. An installation based on errorneous design or on no design at all could least be expected to be efficient.

Secondly, the quality of manpower used in the installations and whether or not they were supervised by competent persons is a very important factor towards efficiency.

Thirdly, maintenance of what has been installed is of utmost importance. Lack of adequate maintenance can singularly run down any system. But then because of the fact that a good number of the Hotel developments were not properly concieved, matters relating to cost-in-use of the building were not considered along with benefits, with the result that management keeps trying to avoid huge maintenance costs to improve profits and consequently inconviniencing hotel users by so doing.

(c) Uncomfortable Internal and External Visual Environment: The degree to which services plants and distribution runs are expressed visually, are very significant towards satisfactory internal and external visual environment. A good number of Hotels have their services runs exposed on the surfaces of internal and external walls forming a very nauseating view. Apart from the fact that such exposure predisposes the affected installions to damage, in the event of such damage the mess that ensues is better imagined. Most people do not seem to recognize the psychological implications of visual presentation. An ugly sight is repelling and if one has to tolerate it due to helplessness, it has a depressing influence on the body. Even in simple matters like that of installation of a wash-basin or even a water closet, psychological effects must be duly considered.

To drive this point home, let us recall our experiences with any two toilete, one in which the fittings and the services runs are beautifully laid out and another in which they are roughly done, and the effect of the individual situations on the body chemistry. In the first we could say that the sight was comfortable but in the other definitely uncomfortable. But again this psychological aspect is quite subjective. For the background of the assessor plays a very important role. The level of aesthetic appreciation of people vary, and what some will call fair others might call good. However it is always possible to prescribe a minimum in all these matters.

1.3 Purpose and Scope of the Work

These problems that affect the Hotel Industry in Nigeria cannot be divorced from the spontaneous increase in demand on hotel services pre-empted by changes in the socio-economic and geo-political policies of the country within the last decade. These changes induced urbanization in a large scale in most Nigerian towns, particularly in those that were directly affected by the changes, and a consequent strain on Hotels located in these arears, with a result that standard droped as the Hotels tried to cope with their more than usual customers.

Although this penomenon affected the entire Hotel Industry the way in which problems generated manifested in individual Hotels varied. It has been observed that in large Hotels, the problems relate to administration and protocol, but in the small Hotels, apart from these two, there is an added problem affecting the building services.

From available statistics, the small Hotels are more in number than the large ones, for example in Kaduna, there are only 2 big Hotels as against not less than 40 of the small ones. This automatically suggests that a greater number of hotel users patronize the small Hotels, though this is not unconnected with the fact that the smaller ones are slightly cheaper.

In the wake of mounting allegations against the building services condition in the small Hotels, there could be no better time for any building service designer to examine the circumstances closely. It is therefore the intention within the limits of this exercise to:

(a) Define the functions of a Hotel traditionally.

(b) Examine the role of building services in the Hotel towards achieving these functions.

(c) To carry out a survey concerning the condition of building services in small Hotels in Kaduna with a view to identifying the extent of problems that are said to afflict these Hotels.

(d) To highlight useful concept in the design of building services and finally, to carry out a design proposal for a small Hotel based on present practices in building services, and incorporating recommendations relating to arears of other than that of building services but which are pertinent to solving some of the physical problems in Hotel development.

(e) To make recommendations, based on findings of the survey towards improving the situation as is presently obtained.

The said survey shall cover only a selected town in the country as the author believes that there is a homogeniety in the development of Hotel business in all parts of the country. Along the lines of the stimulants for growth and responses of enterpreneurs to the problem of hotel accommodation.

C H A P T E R II

BACKGROUND TO HOTEL DEVELOPMENT AND CLASSES OF HOTELS

2.1 Introduction

The idea which today has evolved into the hotel dates as far back as the last century within reliable historical records. Then, travellers stopped at Inns to seek comfort and rest, haven offered some consideration for the care by the Inn keepers.

Today, a Hotel is a commercial institution that provides accommodation, food and entertainment and generally concerns itself with the comfort of travellers or any other persons or group that desire such services. In addition, adequate security is guaranteed for lodgers and their properties within the rooms in which they lodge, although this is usually not strictly adhered to, nonetheless the general well-being of the lodgers and other customers alike is paramount in the list of functions of the management of the Hotel.

Generally, the 'Hotel' simply applied to an institution suggests that the Clentelle is basically transient in nature and only very few lodgers are in that respect permanent. If however, the number of lodgers that are permanent exceed the number of those transient (most of the time) then such an institution would be correctly referred to as a residential hotel. This means that most of the lodgers stay quite long periods of time in the Hotel. The nature of a Hotel is not unconnected with the demands of the locality of its location.

2.2 Background to Hotel Development in Nigeria

Hotel development in Nigeria can be traced back to the pre-Independence days when Catering Rest Houses featured prominently in most parts of the country as resting places for travellers.

These Catering Rest Houses were located in the then district and regional headquarters and were built by the colonial administration primarily to cater for government officials who had no houses and those travelling out of their usual stations. They featured accommodation units consisting of single rooms, and living room with bedroom. Not until recently when some of these establishments introduced unit air-conditioners into the accommodation units, the only building services were that of cold water supply, hot water from individual water heaters and electricity. In some towns, there were Inns with accommodation and one or two public places notably for drinking, although these were quite few. In Lagos however, the situation was a bit different as there were a handful of small Hotels which had more elaborate facilities. At these times travellers relied mostly on friends and relations for accommodation.

After independence and at the advent of the oil boom, economic activities started to take a new turn. There was a marked expansion in the construction industry particularly in the state headquarters. This induced migration of people from the rural arears to urban centres, where the need for accommodation other than that which could be provided by relations and friends became increasingly inevitable. The hotel business had thus found a fertile soil on which to grow. A few government agencies were set up and charged with responsibility of formulating plans for and building international standard Hotels as trade with foreign countries increased in tempo. Organizations with the background of financial institutions also began speculative projects in hotel business first in Lagos and later in other parts of the country.

The last decade has however witnessed an extremely rapid growth in hotel business in the country. From available statistics, an unprecedented number of premises have been registered to carry on hotel business in Nigeria particularly in the state and federal capitals. But within the last decade there have been significant charges in the socio-economic and geo-political policies of the country. These changes have definite effects on the growth of hotel business as would be explained shortly.

2.3 Effects of Socio-Economic and Geo-Political Changes

After independence in 1960 this country had only 3 regions- North, West and East - which later increased to 4 when the Mid-Western region was created. With the advent of military rule in 1966 complications started to arise in the geo-politics of the nation and in 1967 the country was split into 12 states, with the country's capital still in Lagos. This suggests that henceforth government activities which had hitherto been concentrated in only three towns, now had to be expanded to cover 12 town - 12 state capitals (Lagos state and the federal government shared the Lagos area as their capitals). At about this period there was an increased sale in crude oil along with hinking selling prices which facilitated quick development in the new capitals. The trend continued until 1975 when the country had a change of government. By this time there had been a remarkable increase in the tempo of socio-economic activities.

In 1975 the new government made further incisive changes in the socio-economic and geo-political life of the country. These changes brought in their wake a greater participation of individuals in enterprise, migration into the urban centres from the rural areas and a general awareness that is now characteristic of the country.

Creation of states which was one of the geo-political changes was followed by movement of government functionaries and parastatals into the affected loans to set up the seat of government. This led to a general increase in population and a strain on hotel facilities already existing.

A similar fate although at a much lesser scale befell the local government headquarters which were created as a result of the local government reforms which also took effect from 1976.

Also in 1975 Abuja was declared as the new Federal Capital Territory. The nearest town to this territory is Suleja which had before this time been a small town with a population of about 40-50,000 people. Abuja was to be built from a virgin land, which was more or less a forest.

There was continually increasing revenue from oil sales, and a boom in the construction industry as offices, quarters and infrastructural projects were undertaken in areas affected by the changes.

The indigenization decree of 1977 further opened avenues for a still greater participation of Nigerians in business. While all these were going on government was formulating plans for expansions in the industrial, agro-industrial and agricultural, as well as commercial sector of the economy. Later when these plans started to be implimented, certain basic infrastructural requirements had to be fulfilled - good roads linking major towns of the country, increase in number of seaports and airports, water supply schemes, step-up of power generated by NEPA which further involved government investment, employment of manpower and more business opportunities for private enterpreneurs.

It would be unrealistic not to think of what happened to all the people (from within and without the country) who in one way or the other were involved directly or indirectly in the implimentation of these government programmes. These people from all walks of life moved into the affected areas in large numbers, where they were faced with serious accommodation problems. In some cases, staff houses were built to accommodate some of the peronnel but then it would not be possible to build enough houses to meet the requirements of the incoming population, and of course most of them had to resort to hotel accommodation.

It is pertinent to note here that these towns had before the influx of immigrants, had facilities designed or tailored towards the needs of the population. It therefore became impossible for these facilities to sustain the increased population and logically expansion commenced. However due to the pressing situation, the standard of the facilities dropped. This was the background against which the hotel industry grew in Nigeria. Although one could enumerate many more factors that influenced the rapid growth those already mentioned are enough to give a good picture of what is to be expected of hotels in Nigeria today. In the last two years there has been a gradual decline in socio-economic activities in all parts of the country and the hotels that were rushed to completion with very meagre capital investment which in previous years people just had to make do with one now subject of attacks from hotel users.

2.4 Classification of Hotels (Worldwide)

The activities of a Hotel would determine how it is qualified. This qualification is necessary to help prospective customers decide which Hotel to lodge in or to go to for whatever reasons they may have. There are quite a number of alternative applicable in classification of Hotels:

1. Size or costlines
2. Location and seans of operation
3. Social functions

Of the three alternatives mentioned above, the third method of classifying hotels is mostly applied worldwide, a hotel would be best described by its social function - which means how the service it offers fits into the economic and social life of the community it serves. Though this is generally true for countries of the world where the hotel industry is matured in age, the same cannot be said of Nigeria, where this method of classifying Hotels would definitely be misleading. This is unconnected with the fact that the hotel industry in Nigeria has not yet assumed the status where opportunists and shylocks would not have a chance, but only those who are keen on providing good service to supplement that of existing genuine ones. How be it we should still consider the classification that is worldwide and later see how the Nigerian situation compares with this.

2.2.1 Commercial Hotels

It is logical to say that the emphasis and location of a hotel is usually tailored towards the expected requirements of the clientelle anticipated. Thus the expression 'Commercial Hotel' refers to that institution that is principally concerned with travelling businessmen, merchants and the like. The location of such hotels is understandably close to or within reach of business districts or industrial layouts, as this would afford convenience for the users. The emphasis is on the accommodation units and eating places. Hotels located in the centre of town are commercial in nature and rate of checking into and out of rooms is highest in this group. The same applies to a hotel located in an area where a large number of industries are located.

In both cases mentioned, the clientelle is drawn largely from a group of people who come into town to negotiate business and who are very likely to be out of town soon again only to be back in the near or distant future depending on the extent of activities. Such businessmen would invite people to dine with them in the hotel, which suggests a large Restaurant and Kitchen facilities, and a comfortably large loung/bar.

2.2.2 **Resort Hotels**

Hotels in this group operate seasonally in most cases, although there are some whose services are perenial. The clientelle is mainly holiday makers, in all forms. Usually the Hotel is located close to or on the site of an attraction. Thus if the attraction is seasonal then the operations of the Hotel would also have to be seasonal.

However, during the season, there is excellent business for the hotel and indeed, months before the season is on, the hotel management would be at work preparing for the customers and ensuring that no business opportunity is lost. New ideas leading to renovations on the structure of the hotel and its degree of comfortability would have been executed. The motto here is "Fun and Variety", this being what the clientelle would want.

If on the other hand the attraction is perenial (there are not too many of such) then the operations of the hotel would have to be all year round. Even in such cases, the hotel is usually closed down at periods considered to be low for business to allow for a re-appraisal of the hotel and to give the entire environment a face lift. This is particularly important in Resort Hotels. Attractions for Resort Hotels include: Lakes, Rivers, Seas, Mountains, Wildlife, Parts, Traditional area for festivals etc.

In any case there must be an attraction for a hotel to be referred to as "Resort Hotel". Local attractions may have to be expanded to stimulate or promote recreational business. Supplementary facilities like, Swimming Pool, Golf Course, Tennis Courts etc. may have to be provided as appropriate.

2.2.3 Conventions and conferences mean a lot to the income of some hotels. Such hotels rely on and are always on the look-out along this direction. By nature, conventions and conferences attract a large number of people to the venue and by catering to participants hotels generate a lot of income. Some towns have gained reputation for offering good convention hotels, and these hotels may be fully booked all year round as they may be recieving new conventioners as old ones leave, the two groups meeting at the entrance/exit doors. Naturally, emphasis in this type of hotel would be different from the other type already discussed. A convention hotel has to be able to show a very large capacity for lodgers in terms of accommodation units and function rooms like Ball Rooms, Convention Hall have to be of adequate sizes. Convention hotels have to be located in an area where conventioners would be able to enjoy other interesting facilities apart from those provided by the hotel, usually not far from and preferably within easy reach of large town.

2.2.4 The word "Motel" is coined from the expression motor-hotel. Traditionally, a motel served travellers who used highways, driving in their own cars. The location is mostly along highways; at road junctions, petrol stations, toll gates, ferry crossings. The idea of a motel is to afford the traveller a possibility of resting off his journey. There is less rigidity, and the formalities of the normal hotel are saved the traveller.

Since they are out of town locations, land is adequate and there is no need to rise high instead they are spread on the ground, a single storey being maximum. This affords the traveller the possibility of parking right in front of his own door. Security provisions are not as serious as in the case of the hotels in the townships. Restaurants are not popular as provisions are made for self-catering.

2.5 Classification of Hotels (Nigeria)

From the discussions on the background to hotel in Nigeria, if could easily be percieved the type of hotels that are likely to emerge from a situation where demand was much greater than supply. It was the sellers market as economists would like to put it. Businessmen with meagre financial resources and who knew very little or nothing at all about hotel administration and management flocked the hotel business to cash in on the desperate situation of the people who had no alternative than to accept what they were offered. Amidst all the hullaballoo however were some hotel developments that still met international standards, these were not many unfortunately.

A summary look at hotels in the country immediately suggests a classification based on size. Since classification can only result from identifying characteristics common to a particular group and since it appears that most hotels of similar size in terms of a given range of units of accommodation, tend to possess very similar characteristics, the choice of size as a means for classification is considered most logical. In order to avoid sematic problems, it might be necessary to say that the word hotel as applied in the country to some premises is a misnomer. We shall only concern ourselves with those that offer at least a combination of the following three: Accommodation, Restaurant and Bar/Lounge, and who have at least 30 accommodation units.

The hotels that satisfy these requirements can be classified into two major groups - the large hotels and the small hotels.

2.5.1 The Large Hotels

This group of hotel usually have over 100 accommodation units. They have adequate building services installations and a variety of facilities. Apart from accommodation units, Restaurants and the Bar/Lounge, they also have function rooms and an elaborate reception arrangement. Ample parking facilities are provided on the premises. Applying the international classification methods, these hotels perform the functions ascribed to hotels in a multiplicity of classes - commercial, convention and resort. They are mostly managed by experienced hoteliers and are mostly of international standard. Complaints from hotels users about this group of hotels regarding aspects of building services installations are quite minimal.

2.5.2 The Small Hotels

Mostly these have between 30 and 70 accommodation units with a few exceptions. In addition they also have a Restaurant, a Reception Lounge and in some cases this Lounge serves as a Bar Lounge. These are basically all the spaces that are to be expected in any hotel in this group. They are characterized by: location on fully built-up sites with almost no parking facilities; expression of service runs on the external surfaces of building; a usually 4-floor structure. There is a preponderance of complaints about the services installations in these hotels. They like their large counterparts, also serve for a variety of functions. It is therefore not possible to classify them based on their function. They are very many in number and are mostly managed by personnel who are probably just having a debut in hotel business.

It would be observed that almost all hotels with upwards of 30 bedrooms generally fall into these two main categories just discussed. In each group however there may be variations in areas like level of efficiency, number of accommodation unit etc.

C H A P T E R III

SURVEY OF BUILDING SERVICES IN SMALL HOTELS IN SELECTED HOTELS IN KADUNA

3.1 Introduction

The frequency of comments decrying the state of building services installations in small hotels in Nigeria, though enough to stimulate an investigation, cannot be used as basis for analysis. Judging from the visits of the author to a number of small hotels in the Kaduna metropolis and Zaria, it is obvious that the disenchantment expressed by people is not unfounded. How-be-it, the level of development of the country makes it possible for people to be able to still tolerate the standard of service that is offered by a number of hotels around the country, though this may be very much below desirable levels, and can definitely not be compared with that obtainable in a more civilized society.

By their nature many Nigerians are fond of exaggerating, and a minor problem might be represented in later discussions in a manner that could be very misleading to the audience. For example, an inconvinience suffered in a hotel might lead the hotel user to flaying all hotels in that category even though it might have been the only hotel visited in the group. In some extreme cases (which are not uncommon) complaints might be based on mere heresay - opinions expressed by friends and associates. A survey of hotels is therefore considered an invaluable vehicle for any serious study of the situation.

So far we have talked so much about building services as an entity. There are quite a number of components that constitute this entity and it would be most logical at this juncture to state what components are relevant to further discussions and on which our survey shall concentrate

3.2 Building Services Component

The building system consits of many sub-systems, one of which is the building services sub-system. This sub-system is that which relates to issue of environmental comfort, personal and environmental hygiene. In all buildings there must be some provisions for one or more of the building services components to take care of various aspects of these human needs - portable water to drink, water for flushing of toilets, lighting at night, cooling of building in hot weathers, heating of buildings in cold weathers, removal of offensive particles and odours from interiors etc. Each component thus has its characteristics form of energy utilized, medium of transportation and mode of transportation.

In a Hotel building there are prescribed requirements which must be satisfied for environmental comfort and hygiene. The building services components that are discussed below are those that are essential to the prescribed requirements.

3.2.1 Hot and Cold Water Services

The supply of water is one of the most important provisions in almost all buildings. This ensures an adequate standard of hygiene, of the occupants of the buildings, of their clothes, of equipment and utensils, and of the building fabric itself, apart from facilitating easy removal of wastes from the building. Although cold water supply is the barest minimum in water supply services, hot water supply affords more comfort and convinience, in bathing during cold climates, washing in laundry, in the kitchen. Besides all these, there is the requirement for a means of containing and extinguishing fires which otherwise could destroy the contents and the fabric of the building. Yet a very important use is that of providing portable water to satisfy physiological needs of organic life within the building.

It is worthy of note that for buildings like breweries and laundries water supply would be considered a very primary requirement.

3.2.2 Electrical Services

There is an increasingly wide range of use for electricity in buildings; lighting, power for movable and immobile equipment, cooking, space heating, transmitting information and for control of other engineering services. The specific use to which it is put would however depend on the activities carried out in the building. In modern buildings, electricity is heavily depended upon a great deal such that a momentary supply cut-off may result in incalculable damage, and grave discomfort, this being consequent to the fact that almost all engineering systems now require electric power to function properly. An uninterupted supply is therefore desirable. Within a given time limit, it could be said that a cut-off of water supply could be better tolerated than that of electricity supply.

3.2.3 Environmental Comfort Services (Heating, Ventillation and Air-Conditioning)

This system is primarily used in conjuction with the building fabric to provide a controlled environment in the building. Although environmental comfort is quite subjective and would depend on the physiological and psychological state of individuals, there are prescribed limits considered to be the comfort zone for an average human being.

Nonetheless, the following factors have been identified to have definite influence on perception of thermal comfort:

(1) Temperature of air sorrounding the human body
(2) Temperature of adjacent surfaces
(3) Relative humidity of the air and

(4) Motion of the air

Heating, Ventillation and Air-Conditioning systems are used in buildings to attain prescribed comfort levels and to remove dust particles, bacteria, gases and other matters of a noxious or unpleasant nature from the air within the building and thereby increasing the level of hygiene therein.

3.2.4 Sanitary Wastes Services

This concerns the removal of wastes from the building and their proper disposal. A very high percentage of water supplied to a building end up as wastes and would have to be removed along with other wastes introduced by the occupants of the building being end products of biological processes in the body in order to ensure a sanitized environment.

3.2.5 Communication Services

This describes all systems used for communication using wired and unwired electronic devices. Most prominent among these is the telephone. By their use it is possible to settle a lot of matters which would otherwise have required at least one of the parties involved to leave his position to the position of the other. Information could be passed on in shorter times and unnecessary expenditure of time avoided.

3.2.6 Audio and Audio-Visual Services

Background music and television systems are the most common in this group, as applied to buildings. In commercial buildings it is popular practise to install a music system the production of which could be heard in all parts of the building. Similarly in hotels and other hospitality industries television sets in various locations within the same building would necessitate a central antenna system which would link all the T.V. sets. Furthermore in modern hotels a central video system is not uncommon, whereby

one of the T.V. channels is connected to video machine which then enables lodgers to look on to programmes played by the hotel management.

3.3 Objectives of the Study

A search for literature related to building services installations in small hotels in Nigeria showed that no work known to any of the university libraries, state libraries and the national library has been published. This search was prompted by the incessant allegations levelled against small hotels in respect of inadequacies relating to building services installations.

In recent times, people have started to emphasize the need for places of relaxation and good lodging places for tourists and businessmen alike. The hotel is an institution which should cater for people outside their localities in terms of providing their comfort requirements apart from serving as relaxation areas for persons in the locality.

In Nigeria however, it is obvious that small hotels are far more in number than the large ones, but unfortunately they are not properly serviced in most cases. There are many reasons why this is so, as discussed in the previous chapter. In order to restore the historic functions of a hotel it is necessary to bring the services installations to a level where these functions would be achievable. However it would be useful to know the existing state of these installations so as to know which areas require attention, the most attention. Unfortunately there is very little written evidence to support the misgivings of hotel users in the area of building services and the only way of really establishing the true picture of the situation is to carry out the survey.

3.4 Research Questions

The Research Questions Investigated Include:

1. Determination of certain characteristics of the Hotel.
   - (a) Period of establishment of hotel
   - (b) Size of hotel (No of Accommodation Units)
   - (c) Types of spaces available in the hotel
2. Determination of the quality of management staff.
3. Determination of the management's perception of importance of various building services in a hotel.
4. Determination of the state of services installations in the hotel.
5. Determination of the extent of provision of services installations in the hotel.
6. Determination of certain characteristics of the services installations -
   - (a) How was the design concieved
   - (b) Who installed
   - (c) What are the sources of supply
7. Determination of hotel users' perception of the importance of building services in hotels.

3.5 Statement of Hypotheses

This study is based on the following hypotheses:

1. There is an under-provision of the necessary services required to provide comfort in most small hotels in Kaduna, in terms of environmental conditions and personal and environmental hygiene.
2. There is gross inefficiency in the operation of those services that have been provided in most small hotels in the country.
3. Aesthetic variables are not considered in most installations of services in most small hotels in the country.

4. That most of the hotels were built during the period marked by incisive changes in the socio-economic and geo-political policies of the country particularly within the last decade 1974 - up to date, and as such a lot of the problems associated with services installations are as a result of non-involvement of qualified persons at the design or implimentation stage or both.

3.6 The survey instruments adopted here are two sets of questionaires supported by a number of oral interviews. This method of gathering information was selected as it has proven to be the most convinient for both the author and the projected sources of information (the hotel management staff and the hotel users). This conclusion was reached after an ealier attempt at an oral interview proved unsuccessful as most of the people met were always not just ready for an interview and did not prove any good at keeping interview appointments. Besides there is not a single date-base that could give any information whatsoever (beyond the registered names of the hotels, and their location) pertinent to the objectives of this study.

3.6.1 Survey Instrument - 1

This is a questionnaire directed to the hotel users and contains a set of questions covering all building services installations within the area of the hotel exposed to the hotel user - accommodation units, restaurant, bar/lounge and function rooms if any. (Appendix).

The primary purpose of the survey instrument - 1 is to determine; the building services provided in the hotel where the hotel user is currently visiting; the efficiency of the installations and the visual impressions that they may have on him.

Besides these, it is also the intention to gather similar information on other hotels which he might have visited. Also it is hoped that the open ended question at the end of the questionnaire would help to expose any other areas not covered by the questionnaire. Since it cannot be guaranteed that all information given by hotel management staff is correct to every detail, the instrument 1 would help as a cross-check to whatever information gathered through the second instrument to be discussed in due course.

3.6.2 Survey Instrument 2

This instrument is directed towards the hotel management staff. A set of questions relating to the building services provisions in the hotel and the condition of such services are contained in this instrument. similar questions to those in instrument 1 have been asked and other questions in areas that are likely to be known only to hotel staff. The contents of the questionnaire is reproduced in the appendix.

3.7 Methods and Procedure

3.7.1 Sampling population:

A study population made up of two categories of respondents was utilized. The first include hotel users in selected hotels in Kaduna metropolis. The second include hotels management staff in the selected hotels. The selection of these groups of people is as a result of the conviction that information relating to services installations in hotels can best be gathered from them. Among the hotel users include users of Restaurants, Bars, and Lodgers. The hotel management staff are those that have basic qualifications that would enable them respond to the questionnaire accurately and logically. This was ensured by first discussing with the staff concerned and later issuing selected staff with the questionnaire.

3.7.2 Sampling Technique and Method of Administration of Questionnaire

In the case of casual hotel users a simple random technique was employed. The questionnaires were issued to persons at the premises of the hotel in a random manner. Selection was based purely on the appearance of the persons. Such persons were implored to respond to the questions within the period in which they use the hotel. Lodgers were however treated differently. The questionnaire we delivered to the reception clerk, who was instructed to issue every other person with one questionnaire until the number of questionnaires was exhausted. Each hotel was given questionnaires to administer in this manner. The questionnaires were then collected the next day, giving about 24 hours period within which to attend to the questionnaire.

In every hotel, 2 questionnaires were administered to hotel management staff which included, the manager, his assistant who were considered to have the basic knowledge required to respond to the questionnaire.

On the whole 50 hotels were so trated and a total of 100 questionnaires were issued to hotel staff and 400 to hotel users - 100 to casual users and 300 to lodgers. Altogether 500 questionnaires were issued. From a pre-test, the time required to respond to the questionnaire apart from that for the open-ended question was estimated at 10 minutes for the hotel users and 15 minutes for the staff.

3.7.3 Data Collection Procedure and Rate of Response

Casual hotel users had to return their questionnaires before leaving the hotel by depositing with the reception clerk. Lodgers were asked to return the questionnaires the next day (24 hours later), to the reception clerk, and the hotel staff also returned theirs through the same medium after 24 hours.

All returned questionnaires were collected the next day of administering. In all 415 questionnaires were returned which interpretes to 66% total response. Table 3.1 represents the breakdown of the responses.

Table 3.1 - Breakdown of relative return of questionnaires

	No of Questionnaires Administered	No of Responses	No. Usable	%Usable Response
a) Hotel Users	400	315	256	64%
b) Hotel Staff	100	100	84	84%
(a+b)	500	415	330	66%

Overall the returns could be considered as good. Thus a data base for the study was established with 330 usable questionnaires returned.

3.8 Assumptions

The following assumptions were made in the process of the study:

(a) The questionnaire is a reliable method for gathering information pertinent to the objectives of the study.

(b) The hotel users and the management staff are the best sources for information on the situation of services installations in selected hotles.

(c) The hotel users and the management staff are able and willing to give factual and accurate information on the questionnaire

(d) The findings from the survey would be similar to that obtainable if survey was conducted in any state capital other than Kaduna.

3.9 ANALYSIS OF DATA

3.9.1 Introduction

The data analysed was derived from 330 usable returns of questionnairs from the staff and hotel users of 50 selected hotels in the Kaduna metropolis. Because two distinct though homogenous group were identified as source of relevant information, two sets of questionnaires referred to as the survey instruments were drawn up. The main objectives of this study are, first, to determine the extent of provision of services, that is, the number of building services components that are utilized in small hotels generally. Also to be determined is the efficiency of the installations in the said group of hotels. Finally the study is also to help in determining the level of consideration given to visual presentation in the layout of services appliances and distribution runs.

The analysis shall be presented in line with the research questions enumerated in chapter III.

3.9.2 Determination of certain characteristics of the hotel

These characteristics which include, period of establishment of hotel, size of hotel and the service spaces in the hotel are related to the fourth hypothesis. It is believed that significant changes in the policies of the country some of which were consequent to unprecedented increases in revenue from oil sales, directly influenced the rate of proliferation of small hotels across the country. This proliferation was in response to identified market in the large numbers of people that immigrated into the state capitals and other towns that were affected by the changes in policies and subsequent involvement in development projects.

Out of the 84 usable responses, only 4 checked the period before 1974 and the remaining 80 checked the period from 1974-1984. This tends to confirm that a very significant number of hotels in the specified group were established in the last decade, which result was anticipated anyway.

The sizes of hotels was in all cases within the prescribed limits for small hotels as set out earlier, between 30 and 80 accommodation units. All the 84 responses indicated the hotel size falls within the 30-80 range. This has to be ascertained to ensure that the survey is being carried out on the desired group of hotels.

3.9.3 Determination of quality of management staff

The quality of management staff highly affects the appreciation they may have for the importance of services installations. First the services components provided may not be adequate, and a good management would normally introduce other components if this anomaly becomes obvious whereas a less capable management may not see anything wrong with non-provision of the other services. Secondly, maintenance of existing services which is very important to ensure their efficient functioning may not be carried out frequently enough. It is suspected that a good number of the hotels are managed by incompetent hands. This was confirmed by the results of the survey. 68 respondents have not attended any instructional courses in hotel management, and 51 have their first assignment in hotel business in the hotel they are presently working in - Table 3.2 and 3.3

Table 3.2

Question	Yes	No
Have you undergone any instructional courses in hotel management?	16	68
Percentage	19	81

Table 3.3

Question	Yes	No
Have you worked in any hotel of a similar size or larger than the one you presently work in?	33	51
Percentage	39.29	60.71

These figures show clearly that a good number of the management staff in small hotels are not qualified to work in their capacities, or at least work hardly appreciate the responsibilities of a hotel towards her customers in some very vital areas which transcend administrative duties, one of which areas is the technical aspects of comfort requirements. Singularly the results from this research question may not be convincing enough since it may as well be possible that such persons, though do not have any training in relevant areas of hotel management may per chance have a reasonable level of understanding of the role of services in a hotel. In order to eliminate this doubtful situation the next research question was investigated.

3.9.4 Determination of the management's perception of the role of various components of building services in a hotel

Unless a provision is considered of importance to the hotel by the management, it is unlikely that such provision would be properly maintained. Thus is why this research question has to be explored.

The perception of management in respect of services requirements is a decisive factor determining the condition of services installations in the hotel.

Table 3.4 represents the result of the research question

Question		No	%
Tick the combination of services below which you consider desirable in a hotel of a size in which you work	Cold water supply	84	100
	Hot water supply	84	100
	Electricity (interrupted)	84	100
	Sewage plumbing	84	100
	Telephone	84	100
	Television/Video	84	100
	Airconditioning	84	100

It would be observed that 100% of respondents believe that all services enumerated are necessary in the hotel but incidentally not many hotels have these services as would be seen from the results of other research questions later. This therefore indicates that there is a general awareness regarding the comfort requirements in a hotel relating to building services installations. It is obvious therefore that other factors must be responsible for non-provision of some services installations.

3.9.5 Determination of hotel users perception of the importance of services installations in hotels

If the hotel users do not know what they want, then they would definitely not know what they are missing. In this regard, if for example hotel users do not appreciate the need for a communication system then they would not be bothered by its non-provision. This research question being discussed sought to find out what the hotel users consider necessary building services in a hotel. Table 3.5 below shows the distribution in this regard, the total number of respondents, the number that preferred all the services listed, the number that feel they could do with less than all the services listed and the corresponding percentages.

Table 3.5

Question		No	%
Please tick which of the services in front do you consider essential to the hotel	Cold water supply	256	100
	Hot water supply	256	100
	Uninterrupted electricity	256	100
	Sanitary plumbing	256	100
	Air-conditioning	256	100
	Telephone	188	73.44
	Television/Video	196	76.56

It can be deduced from the distribution in table 3.5 that the generality of the hotel users would prefer to have all the services listed. Although some respondents did not consider telephone an important installation, while some others did not consider the television important, the percentages of these groups are not enough to tilt the scale in their favour as could be seen from the table 3.5. On the whole it can be said that hotel users have a positive perception of the need for the itemized building services in the hotel.

3.9.6 Determination of the extent of provision of services installations in small hotels

Both instruments were used as tools for investigating this research question. The same question was asked in both instruments - Which of the following services are installed in the hotel? The services referred to were enumerated and the respondent was asked to tick as appropriate. Incidentally the results show that the facts given by the hotel staff were in tune with those given by the hotel users, Table 3.6 shows the distribution in this regard. It would be observed that a large percentage of the hotels only have the barest minimum of installations just enough to keep the hotel going. Whereas 100% was recorded for cold water suppy, sanitary plumbing and electricity supply, the percentages recorded for the other services shows that they are probably considered extras in most hotels. Provision of intercom system

Table 3.6

		Hotel Users		Hotel Staff	
Question	Services	No	%	No	%
Which of the following services installations are provided in the hotel? Please tick	Cold water supply	256	100	84	100
	Hot water supply	188	73.44	63	75
	Air-conditioning	168	65.63	56	66.6
	Electrical installation	256	100	84	100
	Sanitary plumbing	256	100	84	100
	Telephone/(Intercom)	40	15.63	15	17.8
	Television/Video	130	50.78	44	52.4

scored the lowest percentage of 15.63 and 17.8 respectively. This is not unconnected with the fact that until recently, not many people had access to telephones and it was thus considered a priviledge rather than a necessary service. In the hotel however the intercom is enough to cater for the requirements of the hotel users. A possibility of outside calls is however desirable through an exchange at the reception. This way lodgers could be contacted from outside the hotel and he too could make external contact without leaving the premises of his hotel building. This is very economical for both the lodger and the hotel, as the hotel can make small charges against such provisions which thouch insignificant to individual hotel user is definitely on the long run some good source of income for the hotel.

3.9.7 Determination of serviceability of services installations in the hotel

Although certain services installations might have been provided in the hotel, one cannot completely assume that they also function efficiently or are in a serviceable condition. It may well be possible that the installations do not work, or that the installation works only intermittently. The relevant research question was posed to evaluate the level of efficiency of those installations which have been certified as existing in the hotels.

Not completely unexpected are the responses from the two groups of respondents. The hotel users seem to be less confident in the efficiency of the services installations, whereas the hotel staff are more confident in the efficiency of the installations. Unlike in the previous research question there is a marked deviation in the data collected from the hotel users as against that collected from the hotel staff. Really this turn of events is quite natural, as hotel management would not easily succumb to inefficiency, while on the other hand the hotel users are ready to condemn at the least opportunity. In any case it is obvious from these results that services installations in small hotels particularly in those selected for survey are not efficient. There must be underlying reasons for this problem. However the area most relevant to this text is explored in the next research question. Meanwhile table 3.7 enumerates the distribution of responses from the two groups in respect of the research question just discussed.

Table 3.7

Question		V. Good		Good		Fair		Bad		To No Re
		No	%	No	%	No	%	No	%	
How would you rate the efficiency of services installation in the hotel? 1 - Very Good 2 - Good 3 - Fair 4 - Bad	Cold Water Supply	28	10.9	124	48.4	65	25.8	38	14.9	25(
	Hot Water Supply	10	.4	46	18.6	90	35.5	38	14	10(
	Electrical Installations	10	.4	110	43	100	39	36	14	25(
	Sanitary Installation	20	.8	180	70.3	26	10.0	30	11.7	25(
	Air-Conditioning	20	.8	36	14	86	33,6	26	10.2	16(
	Tel./Intercom	1	0.4	3	1.2	24	9.3	16	6.1	14·
	Television	12	4.7	68	26.6	32	12.5	20	1.9	13:
	Space Heating	3	1.2	12	4.7	22	8.6	5	2.	42

Some of the revelations from table 3.7 corroborate with those in table 3.6. The column containing the total number of responses in table 3.7 should be compared with the number of hotel users column in table 3.6. Similarly the column containing the total of responses in table 3.8 should also be compared with the number of hotel staff column in table 3.8

Table 3.8

Question		V/Good No	V/Good %	Good No	Good %	Fair No	Fair %	Bad No	Bad %	Total No of Respo
How would you rate the efficiency of services installation in the hotel? Please tick appropriate box.	Cold Water Supply	3	3.6	36	42.8	45	53.6	-	-	84
	Hot Water Supply	16	19	20	23.8	28	33.3	-	-	64
	Electrical Installations	18	21.4	26	31	40	47.6	-	-	84
	Sanitary Installations	18	21.4	36	42.8	30	35.7	-	-	84
	Air-Conditioning	12	14.3	16	19	26	31	-	-	54
1 - Very Good	Tele./Intercom	10	11.9	5	5.95	1	1.19	-	-	16
2 - Good	Television/Video	20	11.9	22	26.2	10	11.9	-	-	42
3 - Fair	Space Heating	18	21.4	12	14.3	10	11.9	-	-	40
4 - Bad										

It is interesting to note that no hotel staff thinks the services are in a bad state efficiency - wise. In any case they seem to think it is in a fair state, which is next to bad. Appropriate inferences shall be drawn by comparing the tables 3.8 and 3.7. There is no doubt that the degree of efficiency of the services is highly questionable and most obviously below desirable standards.

3.9.8 Determination of the role of some technical variables towards inadequacies in the services installations

There are a number of factors that could be responsible for inadequacies in all forms, however this research question sought to investigate those technical variables related to the installations. Specific questions in the second instrument have been used as a vehicle towards towards achieving this goal.

The technical variables referred to include:

(a) Frequency of maintenance

(b) Involvment of specialists in the design and implimentation of installation.

These questions are designed to test one of the hypotheses as would have been observed.

3.9.8.1 Frequency of Maintenance

All installations require proper maintenance to function efficiently and effectively. Maintenance should be clearly distinguished from repairs, the latter being as a result of damage or malfunction, whereas the former is a periodic tone-up of the system to ensure continued good performance. If a system is not adequately maintained, malfunctioning would set in which may lead to eventual damage of equipment and probably lead to a state of disrepair, in extreme cases.

Table 3.9

Question	Very Often		Often		Not Often		Only Repairs	
	No	%	No	%	No	%	No	%
How often is maintenance (not repairs) carried out on the services installations?	28	33.3	34	40.1	16	19	6	7.6

The distribution suggests that maintenance is carried out often enough on the installations.

3.9.8.2 Involvement of Specialists in Design and Implimentation of Installations

Design of services requirements of a building is a specialist sub-consultant's job - the services consultant. Sometimes a thumb-of-rule approach is adopted and installations are simply carried out by artisans who would then

only draw on their past experiences where such experiences existed. This practise is commonest when the building owner does not in the first instance involve an Architect in the building project. When an Architect is involved in the design of the building, proper advice shall be given to the building owner and all the necessary sub-consultants who have to partake at the design would have been invited. This way the services consultant who would handle all problems relating to services in the building would have properly liased with the other consultants, determined the services requirements of the building based on the functions of the building, the size of probable demand and put into consideration limitations imposed by other sub-consultants work. For instance, services runs would have been checked with structural layout and where necessary ducts may be provided to conduct services vertically through the building or amendments might have to be made to the structural drawings to facilitate the ease of installion. In any case there would be proper co-ordination between the consultants.

The services consultant addresses himself to all the variables involved in the design of services installation - functional, technical, aesthetic, and economic. If the installations are then based on the designs then maintenance would be the only link required to achieve on very effective and efficient installation.

Below in table 3.10 are a breakdown of the responses of about 84 hotel management staff relating to the involvement of Architects and services consultants in physical development of the hotel.

Table 3.10

	Yes	No
Do you have access to or are in possession of the design drawings on which the hotel development was based?	60	24
Is there any indization on the drawings that were designed by an Architect?	34	24
Are there any drawings on the services installations? (Water Supply, Electrical Installatations, Air-conditioning etc.)	8	50

From the figures in the table above, one can say that in most hotels services installations were not based on any designs, as no drawings are available to prove otherwise. Although many of the respondents believe that an Architect was involved in the hotel development, it might have actually been a Draughtsman rather than an Architect, as people still cannot distinguish between the two, besides the fact that some Draughtsmen parade themselves as Architects. If an Architect was involved then there is a likelihood that services drawings would have been made.

3.9.9 The Open Ended Question

On both instruments of survey the last question requested respondents to freely comment on services installations in hotels. Respondents to the first instrument (hotel users) more readily gave comments than respondents to the second instrument. It was gathered from the comments given by the hotel users that:

(a) There is not enough services components in the hotels which means some areas of comfort are neglected. For instance some respondents complained about staying in unheated rooms in very cold weathers (during the harmattan periods). Some of the complaints related to non-provision of Air-conditioners.

(b) Existing services installations are not very efficient. Most of the complaints here related to ceasation in water and electricity supplies. There were also some on the frequency of availability of hot water.

(c) Aesthetic aspects of the installations were feverntly attached. Complaints of eyesaws in the toilets and on the facades of the building was abundant. This is directly traceable to the fact that competent hands were not employed in the hotel developments as far as design is concerned. Although there were many other complaints and comments only those are relevant to the hypotheses of this study have been extracted.

3.10 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

3.10.1 Introduction

Due to the nature of demand on hotel services in the last decade in the country, there was a proliferation of small hotels whose proprietorship were not experienced in hotel business. The circumstances resulted in a very rapid growth in the hotel industry all over the country. The manner of growth was such that hotel buildings had to be completed quickly to meet the demand of a usually existing market, found in newcomers to countries of development projects and places acquiring new status considered to have a likelihood of engendering business opportunities.

The functions of the hotel were reduced basically to providing a place to sleep in and the administrative requirements to support this. Comfort considerations were relegated to the background and this affected the services installations in all ramifications. This happened at a time when the economy of the country was booming and when there was a lot of money to throw around in pursuit of more money. Today the tempo has very seriously decelerated and the hitherto tolerable state of building services installations has become completely unacceptable, with mounting disaffection.

Although this trend was nation-wide, this study is concentrated in Kaduna which is one of the state capitals in the country and which obviously was one of the most affected towns by the malady afflicting small hotels.

The survey was carried out by using two survey instruments the first directed to hotel users and the second to hotel management staff.

Research questions investigated in this study are:

1. Are certain characteristics of the small hotels common to most of them like, period of establishment and type of functional spaces available in the hotel?
2. What is the quality of the management staff in this hotels in relation to hotel management experience and/or professional qualifications?
3. How does management percieve the role of building services in hotels?
4. How do hotel users percieve the role of building services in hotels?
5. What is the state of building services in hotels with respect to:
   (a) extent of provision and
   (b) the efficiency of installations
6. Were there any designs on which installations were based?

The hypotheses that guided the study are:

1. There is an under-provision of necessary building services in most small hotels in Kaduna
2. There is inefficiency in the operation of those services that have been provided in the hotels
3. There is no consideration for aesthetic variables in the layout of installations
4. Most of the small hotels were developed at time of remarkable changes in the scio-economic and geo-political lifestyle of the country during which period dependence on hotels assumed unprecedented proportions.

5. Competent hands were not utilized at design stages of these developments

The survey instruments in the form of questionnaires were administered on two groups of respondents - hotel users and the management staff. Analysis of the responses was carried out against a data base of 84 usable returns from the hotel management staff and 256 returns from the hotel users.

3.10.2 Findings from the Analysis of the Data Collected

It was observed that most of the small hotels were established within the last decade, and that they all have similar functional spaces namely accommodation units, bar/reception lounge, restaurant and in very few cases a limited number of parking spaces. Also most of them express their services runs on the facades of the building in a manner repulsive to the eyes. The qualification and experience of the management staff in most of the hotels falls below desirable standards. This observation is made from the percentage of the management staff that have had any instructions or previous experience in hotel management. Irrespective of the lack of professional qualifications and experience as observed in the last paragraph, hotel management staff seem to at least appreciate the need for a wider range and efficiency of services installations.

A similar expression has been observed from hotel users. Regarding the state of the services installations in the hotels, both groups agree up to the components of services installations that are utilized in the hotels, but there is a disagreement on the efficiency of these installations. Whereas the management tend to want to believe that there is a high level of efficiency, the hotel users have a different opinion. They think that there is a lack of efficiency in the operations of the installations.

All the hotels have the following services: Cold Water Supply, Electricity Supply, and Sanitary Plumbing. 74% of respondents say there is hot water supply in their hotels, 65% for air-conditioning, 16% for telephone/intercome and 51% for television/video services.

The open ended question revealed some information which are very illuminating. Management staff mostly left the open ended question unanswered and the few who answered them just briefly did. Almost all of the responses tended to suggest that the services installations in their hotels are satisfactory. None commented outside the quality of the installations.

The responses of the hotel users were however quite lenghty and touched on varying points. Relevant to this study among the comments are:

(a) The hotel services are not properly maintained particularly the fittings in the baths. Some fittings are so noisy, they constitute a nuisance. Some are not tidily fixed while others do not function properly, particularly the water closet astern.

(b) Some customers who are representatives of government agencies and private organizations and who have the priviledge of staying in hotels either when on temporary assignments outside their stations or who have been newly posted to other stations, instead of staying in the hotel, strike a deal with hotel management, and subsequently collect bills to cover the period of their purpoted stay. Claims then made from the sponsoring body are split between such a customer and the hotel management staff. Thus the customer may never know what the services in the hotel are really like.

(c) Almost all the hotels are privately owned and the proprietors are more interested in their profit than anything else not even the comfort of the clientelle.

3.10.3 Conclusions

The conclusions reached here are more or less based on inferences from the analysed and are enumerated below:

1. The variety of components of services installations utilized in small hotels in Kaduna are not enough to cover all aspects of human comfort requirements. Room heating, communication systems and entertainment provisions in the form of a centralized video/television system are lacking in many of the hotels. If these are provided along with the other services there would be more satisfaction among hotel users.

2. The operational efficiency of those services which are provided is not satisfactory. This is principally due to lack of proper maintenance and more fundamental problems relating to the design of the installations. Whereas problems in the operation of appliances are attributable to maintenance, problems relating to the distribution system are definitely as a result of inadequacies resulting from thumb-of-rule approach to decision making.

3. Most of the hotels were established by private enterpreneurs the proprietorship of which have no appreciation for the comfort requirements of hotel users, nor the need to utilize competent consultants in the development of the hotel project. Utilization of plumbers and electricians who have only rudimentary knowledge of installation and methods but who have no knowledge of design requirements seem to be the system adopted in these developments, which approach has definite consequences expressed in (1) and (2) above.

4. There is a growing appreciation by hotel users for a more comprehensive services installations range in hotels. The narrow range provided is increasingly unsatisfactory and hotel users are likely to become very selective in respect of the hotel they lodge in, in a bid to enjoy a wider range of services to satisfy their comfort requirements. It would be necessary for the hotels to start thinking seriously of including those components that have been missing if they want to continue to remain in business.

5. Aesthetics of installations has never been considered seriously in most hotels. Layout of sanitary fittings and teatment of distribution runs are handled with absolutely no regard to the psychological impressions on the clientelle. This cannot be divorced from the level of appreciation of the hotel owner.

6. There is a tendency to trade-off comfort of client to profit making. The level of investments is generally too how to sustain a viable hotel project, thus some subsystems of the building system, particularly the building services subsystem suffer a great deal. Since this practise is predominant among small hotels, it follows that the necessary pre-development studies were lacking. This of course cannot be without problems and these problems are wide-ranged touching on all aspects of the services installations.

3.10.4 Recommendations

It has been observed among small hotels generally that standards in all ramifications are much lower than obtainable in the large hotels. This need not be the case. A hotel is a hotel, whether large or small and good qualities should not be restricted to large hotels only. There are certain fundamental values which are traditional to hotels and these must be observed no matter the size of the hotel. Comfort is the most sacred word in the temple of hotel business, and it should be the goal of every hotel development.

The idea of small hotels in itself is a good one when one considers that large hotels require very complex management which may not be very easy particularly when the age of hotel development in Nigeria is set against the experience required for mastery. It would be better to start from small hotels and gradually acquire experience which could then be applied in future to medium size hotels and eventually large hotels. It is like climbing the ladder from the top, attempting to go into large scale hotel developments, and for this reason it is appreciated, the size of hotels in the country, but then small size does not preclude inefficiency nor ineffectiveness.

The most fundamental problem affecting the building services installations of the small hotels as would have been observed is that of an unplanned development. Hotel development like other developments belonging to the commercial building type require an elaborate initial study. Such a study would naturally embrace a market survey to determine certain characteristics of the clientelle at which the services of the hotel shall be directed, including the size and nature of the clientelle, required investments - both initial and running costs, the estimated time for amortization of invested capital and profitability. The portion of the investment for the building works shall be further apportioned to the various aspects of the construction. The building services would thus consume a percentage of the total costs of construction. This percentage varies with building types and with the size of the building. For this reason, it is best to involve consultants in the planning of such developments. Decisions on the percentage of the total construction costs that would go into building services installations would have been arrived at, at the planning stages of the development and for a hotel development would depend on factors including:

(a) Size of the hotel (Accommodation units and other functional spaces)

(b) The location which would determine sources of supply to the installations and distance between source and building, where existing sources are utilizable.

(c) Government tariffs

(d) The components of building services to be installed.

When decisions have been reached on the components of building services to be installed, which would have come about after due consideration for functional variables - by this is meant the functions to be performed by each building services component towards comfort requirements

of hotel users - the technical and economic implications of these provisions would then have to be considered. The technical implications would include:

(a) Estimation of demand
(b) Distribution system
(c) Storage requirements (where necessary)
(d) Alternative means of supply (where necessary)

As a follow - up to the recommendations expressed above, the next two chapters are devoted to discussions on the requirements of a 45-bedroom hotel in respect of water and electrical services.

C H A P T E R IV

'USEFUL CONCEPTS' IN ENGINEERING SERVICES

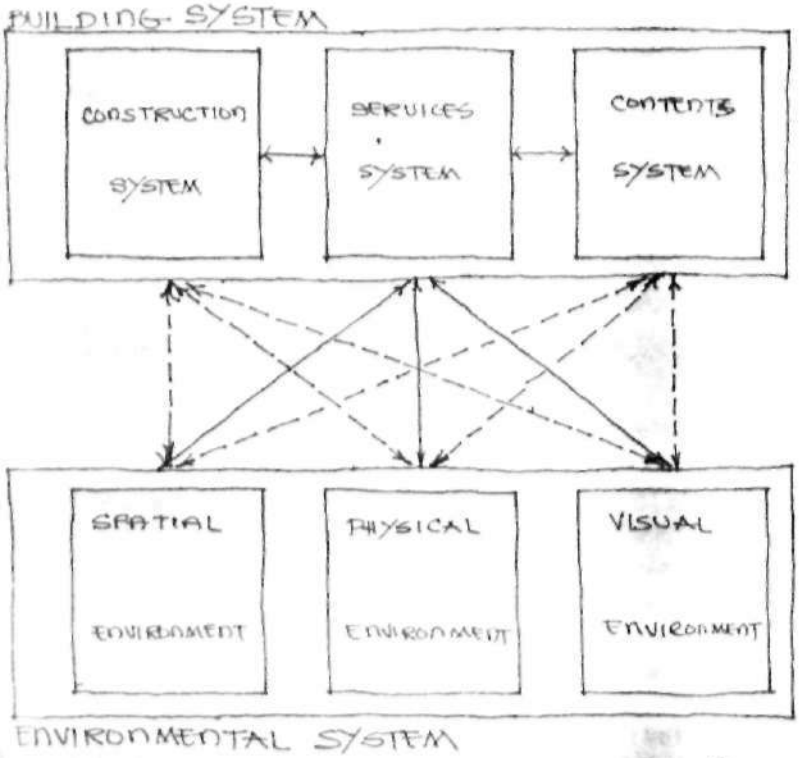
Introduction

One of the most important means of attaining comfort in buildings is through an effective engineering services installations. This fact is even more obvious in the case of hotels where comfortability is the watchword. However, up to date, most services installations have been executed using a thumb-of-rule approach, which has resulted in under-provision, inefficiency and subsequent inability to satisfy comfort requirements. Building services, conform to any reasonable definition of a system, although in the context of a building where the building system is encompassing the services system is only a sub-system.

The idea that shelter itself is a dynamic reactive system having some features of an organic system is not new. In 1857, Cesar Daly, commenting on Bany's London Reform Club noted that ".....the building is not an inert mass of stone, brick and iron, it is almost a living body with its blood circulation and nervous systems. In these walls which appear so immobile, there circulate gases vapours, fluids, liquids, in examining them closely on discovers flues, pipes and wires - the arteries, veins and nerves of a new organized being - through which heat is conducted in winter, fresh air in summer and throughout the year, light, hot water, cold water, bodily nourishment and all the numerous accessories of a high civilization (1).

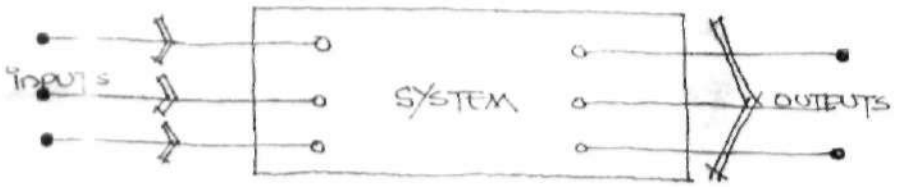
Maver T.W. (2) extended the sense to a biological analogy - the distributive network of engineering services could be likened to be veins, arteries and nerves of a living creature, transporting matter and energy through the structure. He went further "building design has tended to parallel nature's move away from massive and exoskeletal

FIG 1.



SOURCE: BUILDING SERVICES DESIGN - A systematic approach to decision-making
T. W. MAVER

FIG 2 A GENERALIZED SYSTEM DIAGRAM



SOURCE : BUILDINGS, CLIMATE AND ENERGY
T. A. MARKUS AND E. N. MORRIS

structures with rudimentary distributive systems to light structures with complex distributive systems."

As a sub-system of the building system, the services sub-system interacts with other sub-systems, within the building system and also the environmental system. A part of a model developed by the Building Performance Research Unit of the University of Glasgow (fig.1) strives to explain the interaction between the various syb-systems of the building system and the environmental system. The services sub-system should thus be seen as an important integral of a more composite system and its design process should be both systemic and systematic.

4.2 A Systemic Concept

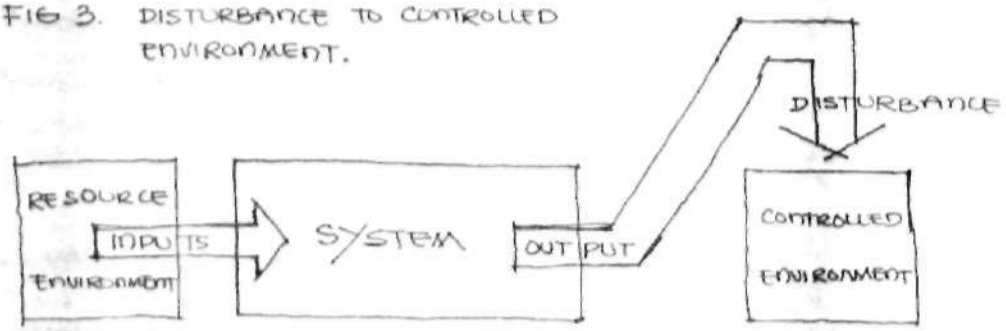
Undoubtedly there is a multiplicity of building services with their different technologies, however a common basis can be established for them. A system can be defined by the relation between its inputs and outputs (fig.2) (3). The function of a system is to transform available inputs to required outputs, where inputs and outputs have their nature described. Such a system can be referred to as a flow system. Indeed all building services with which this text is concerned are flow systems. The system is surrounded by its environment which could be unenclosed i.e. non-systemic. Certain parts of the environment are more intimately associated with the system than the rest. These are the resource environment from which the system draws inputs. When the inputs go into the system a controlled environment is achieved. The controlled environment is maintained within the limits dictated by comfort, by the systems output. Products of the transformation which do not contribute to the output required in the controlled environment are secondary output such as heat emitted from an incandescent lamp.

Such secondary outputs might constitute disturbances to the controlled environment (fig,3). These may result in variation in demand on the flow system. The system therefore requires to be continuously informed about the state of its environment so that there is appropriate regulation of output. (fig.4) The mechanism by which information is generated interpreted and appropriate action taken is the control mechanism of the flow system. Indeed, a sysmetrical relationship may be said to exist between the control mechanism and the flow system with the input and output of one being respectively the output and input of the other (fig.5). If the function of a flow system is described as that of transformation of inputs to outputs, then we can identify 3 kinds of transformation:

1. A transformation in space from point of supply to a demand point (distribution)
2. Transformation in energy (conversion) and
3. Transformation in time between supply and demand levels (storage functions)

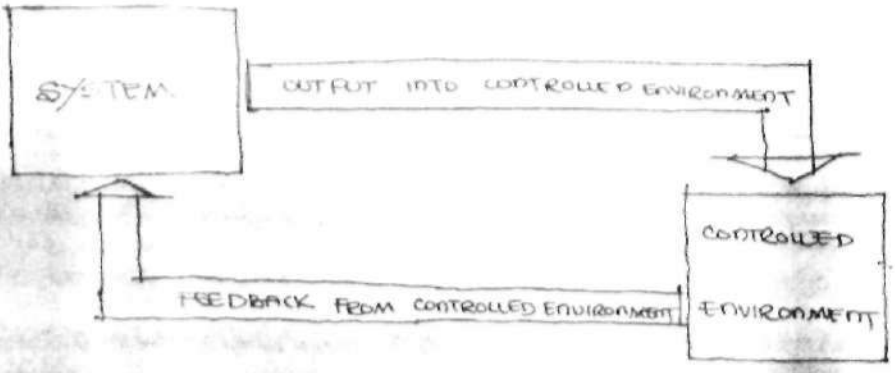
For an efficient and effective system, there has to be a balance between the resource environment and the controlled environment in terms of the requirements of the latter and the capacity of the former to meet these requirements. For there to exist this balance, the characteristics of the controlled environment must be studied carefully and its requirements determine, wherefore the output needed to satisfy these requirements are identified. These requirements are highly subjective and would depend on the physiological and psychological needs of the occupants of the controlled environment. However, these needs could be safely estimated for a known group of people. Next, the system is then provided with a resource environment which would adequately satisfy those requirements, (fig.6). Being a flow system, the transformation process and the vehicle for the necessary transformation would constitute a third area for design by the services engineer.

FIG 3. DISTURBANCE TO CONTROLLED ENVIRONMENT.



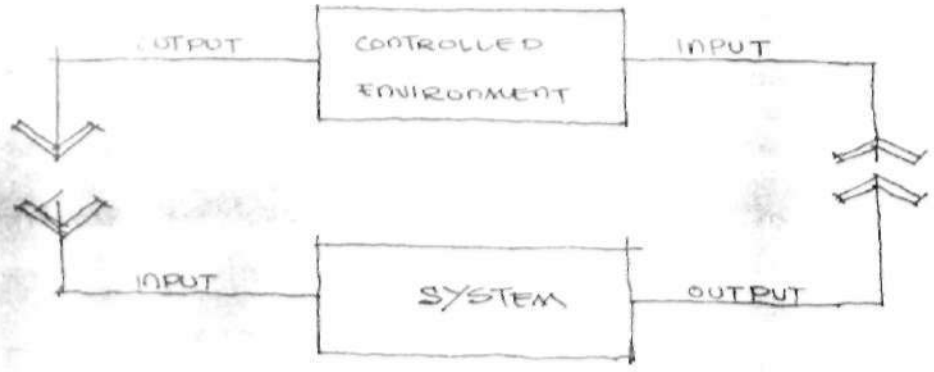
SOURCE : AUTHOR

FIG 4. INFORMATION NETWORK



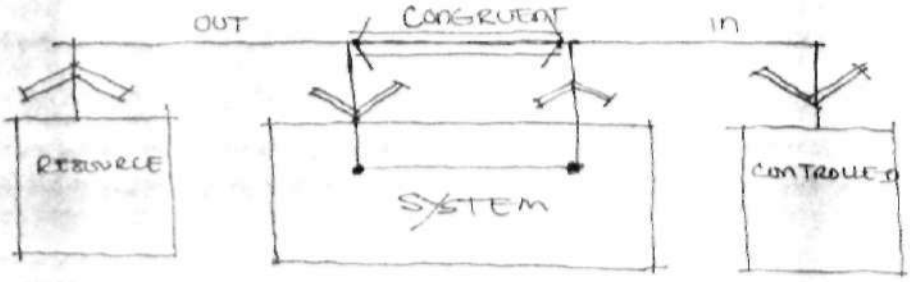
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FIG 5 SYMMETRICAL RELATIONSHIP BETWEEN SYSTEM AND CONTROLLED ENVIRONMENT.



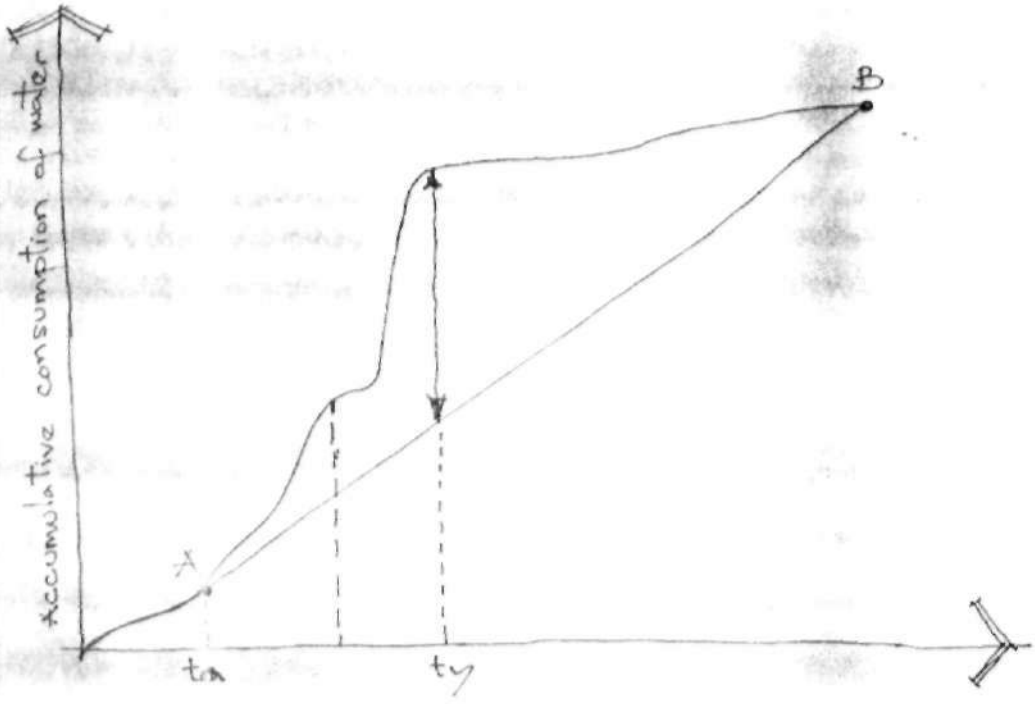
SOURCE: AUTHOR

FIG 6 BALANCE BETWEEN REQUIREMENTS OF CONTROLLED ENVIRONMENT AND OUTPUT CAPACITY OF RESOURSE ENVIRONMENT.



SOURCE: AUTHOR.

FIG. 7 CURVE OF WATER DEMAND/STORAGE



SOURCE: BUILDING SERVICES DESIGN – A systematic approach to decision making
T.W. Maver

With these properly coordinated, there would be harmony between the physiological and psychological requirements of occupants and the characteristics of the controlled environment. Three stages are therefore indentifiable in the design of services installations:

(a) Determination of requirements of the controlled environments

(b) Determination of capacity of resource environment necessary to meet requirements.

(c) Determination of characteristics of the distributive component required to ensure an efficient and effective systems.

4.3 Design Constraints

Even with a very carefully worked out approach to design, few buildings practice have optimized systems.

There are a number of constaints that afflict the design of building services:

1. Very few sub-systems are sufficiently well understood in themselves to allow sub-systems optimization to be carried out.
2. Even when (1) has been overcome there is often a lack of economic and similar crucial data required to allow a cost-benefit analysis to be carried out.
3. The effect of one sub-system on another are often difficult to model and evaluate.
4. The time required to perform modifications/ reappraisal may prove inpractical.

4.4 Functions of System

Let us now return to the functions of the building services system and examine the three modes of transformation earlier mentioned.

4.4.1 Distribution Component

At least one distribution component is contained in any flow system. By means of this component mankind is able to expand his organization beyond the limits imposed

by our physique, and can thus plan buildings free from constraints of providing natural lighting and ventilation of keeping circulation routes within walking or climbing distances. It is also possible to inhabit depths and heights without physical (but perhaps not psychological) strain. Hostile environments, can now be colonized, depending on movement into the environment of all necessities of life, and the removal of its waste products. Thus it is that a flow system operates over distance. Flow is effected through channels and all channels exert a resistance to flow, which is a function of channel size (cross-sectionnal area and lenght). The resistance of a channel may be constant or varied.

Associated with the movement of a fluid through a channel are two variables which measure the energy state of the fluid. At any time 't', one has the same value at each end of the channel and this can be referred to as the Throgh-Variable. T(t) - a rate of flow. The other has different values at the terminals of the channel, and the difference at time 't' is called the Across-Variable, A(t) of the channel. The value of A(t) at any point along its lenght when there is a flow. For example, with water flow through a pipe, T(t) is measured as the rate at which matter enters and leaves the pipe (measured in kilograms/sec). Also, there is a difference in water pressure at each end of a lenght of pipe and this is the across-variable (measured in newtons per square meter). The corresponding variables for an electrical conductor are, electrical current I(t) and voltage difference V(t) and for a thermal conductor they are heat flow and temperature difference.

There is an empirical relationship between the through and across-variables, and the channel resistance. For electrical flow the relationship is linear and expressed

in the Ohm's Law, V(t) = I(t)R where R is the constant value of electrical resistance.

Our main concern is for distribution of water or air as primary commodities or as secondary media for distribution of thermal energy. Resistance to fluid flow is made up of viscious and turbulent effects and varies (but no directly) with flow velocity. The general equation for fluid flow is P=F(Vx/Dy) L where P=Pressure difference F=Configuration factor V=Velocity D=Diameter of (circular) channel, P=Density of fluid L=Lenght of channel, and x and y are constants typical distribution problems, therefore involve for each channel three variables; channel resistance per unit lenght (usually measured as a cross-sectional area), through-flow rate, and across-difference.

Generally the flow rate through a channel is a requirement on the system (e.g. current required at an electrical terminal, mass flow of water at a tap, volume flow-rate of air in a duct). If the value of A(t) is fixed outside system then the only unknown is the resistance of the channel. For systems where this resistance is constant, it could be easily determined by formula; and for a given lenght of conductor the resistance is inversely proportional to the cross sectional area. This way a suitable guage for conductor is determined.

The power of a fluid is the product of its through - and across-variables (p(t)=T(t) A(t) and is measured in watts. Hence, the air power which is expended in overcoming energy losses in the duct is the product; (volume rate in cubic meters/second) x (pressure drop in newtons per square meter). The units being newtons-meters per second, routes per second or watts.

For a 1m duct, the volume flow rate is about $1.0m^3s^1$ therefore the air power is 0.55w. This is the power the fan must deliver, thus a suitable fan may be selected from manufacturers' catalogues.

The discussion up to this point has been limited to a single channel between a point of supply (source) and a point of demand (sink). Now let us consider combinations of channels, between multiple sources and sinks, we need systems laws that govern the distribution of through - and across-variables in a network. These laws are the laws of Continuity and Compatibility respectively (3).

Simply put the law of continuity states that the flow into a node equals the total flow from it. Hence for (fig.7) we have, $S_1=S_2 + S_5$, $S_2 + S_4=S_3$, $S_5 + S_6=S_4 + S_7$. What this law implies is that given a system boundary, then the sum total of T(t) entering the boundary equals the sum total of T(t) leaving it. If this is not true, then the boundary contains more sources or sinks. (fig.7). Here we have $S_{1+}S_6 = S_{3+}S_7$.

The law of compatibility concerns circuits in a network such as that comprising channels, AC, CB, BA. Provided that the circuit is traversed in a consistent direction, the total sum of across-variables differences within the circuit is zero. Hence for the stated network, $A(t)_{AC} + A(t)_{CB} + A(t)_{BA} = 0$ where $A(t)_{AC} = A(t)_{CA}$.

4.4.2 Conversion in Systems

The form of energy in the resource environment is rarely same as is required in buildings, although the solar energy is an interesting exception in this respect. However, we are assuming that our energy has been converted and is in the form immediately usable in our buildings as an excursion into the multiplicity of possibilities in conversion of latent sources would be superflous.

4.4.3 Storage in Systems

Storage is mainly used to ensure some kind of perpetual equilibrium in the supply-demand relationship imposed on a system. A storage component is introduced between two consecutive components of a flow system when the second component is subject to variable demand which may be difficult to match with supply perpetually due to operational reasons.

There is an economic relationship between the size of the storage component and the cost of the distribution channels; the savings in costs of the latter increases with an increased capacity of the storage component, although the cost of storage also thereby increases. The storage function of the building services system relates mostly to water services.

Here the storage cistern performs any or more of the following functions:

(a) It provides a buffer against heavy instantaneous demand on local authority main.

(b) Serves as reservoir in the event of failures in supply by local authorities.

Factors that will then affect efficient sizing of pipework and cistern include:

(a) Rate of demand
(b) Costs associated with cistern and pipework and
(c) The pysical laws of fluid flow.

Knowing that the demand for hot and cold water over time is variable. Let us consider a possible rate of supply of water to the cistern from the local water main represented by the line AB (fig.7).

The rate of demand for water exceeds rate of supply from time t_a up to time t_x thereafter the supply begins to catch up with the demand until at time t_b the cycle is complete. The behaviour of a cistern with the given supply rate, subject to the given demand is represented beneath the graph in (fig. 7) At time t_a, the level in the cistern begins to fall and the ball-valve opens. The level continues to fall until time t_x is reached, after which the level begins to rise until the time t_b when the cistern is once again full and the ball-valve closes. Thus for the given demand pattern and the given supply rate MN, the cistern must have had a capacity of least XY cubic meters in order to cope with the demand. (Fig.7)

Assume a supply point A and given the size of a storage cistern and the required pressure at the ball-valve, the size of the pipework between A and the cistern which will provide water at a rate MN can be calculated using laws of fluid flow. Once the pipe size is known the pipework can be costed. The total cost of system is equal to the costs of the cistern and the pipework. If the supply rate MN is changed, then a different cistern capacity would be arrived at, subsequently a different cistern and pipework costs and a different total cost. It is therefore important to investigate a variety of supply rates for economic advantage.

4.5 STATISTICAL APPROACH TO DECISION-MAKING

In considering the demand which supply must meet, it is important to note that it is not always that the supply is designed to exact demand. The case of a hotel building with say 30 bedrooms is a good example. In estimating the demand, it would be unusual to assume all taps in the rooms running at the same time for many reasons.

Instead, there has to be a reasonable percentage acceptable for use in design, this percentage is a function of the probability of multiple us taps.

The probability of an event occuring is give by the ratio of the number observed occurrences of the event to the total number of possible outcomes of the experiment. So if a die is rolled 100 times, and if a particular spot shows up 10 times then the probability of the spot occurring would be said to be $10/_{100} = 0.1$, this being the number of occurrences of the spot to the total number of rolls of the die.

With building services the approach to the probability theory would be slightly more complicated. If we consider that in a 60-minute duration, a water tap is in use on five occasions, and if each use lasts 2 minutes, then we could say that the number of outcomes in which the event occurred (use of tap) is 5x2 = 10. Thus the probability is given by $10/_{60} = 0.166$. In this example the duration of the demand rather than units of time is the outcome of experiment, and the probability of a demand occurring is therefore the ratio of the duration of the demand to the total study period.

When there is certainty that an event will not occur we say the probability is zero and when there is certainty that an event will occur, we say the probability is one. The probability of any event lies within these extremes.

A pipe supplies two water outlets (taps) A and B, the probability of A being in use is P_A and of B being use P_B. Let us assume $P_A = 1/_3$ and $P_B = 1/_4$. From the laws of probability, we can make two statements safely;

1. The probability of either A or B being in use is given by $(P_A + P_B) = 1/3 * 1/4 = 7/12$.

2. The probability of A and B being in simultaneous use is given by $(P_A \times P_B) = 1/3 \times 1/4 = 1/12$

4.6 APPLICATION

Now let us imagine a building with 20 water taps, each with probability of use of P = 0.5. The probability of all being in simultaneous use would be $PxPxPxP.....P^{20} = (P)n$ where n = 20 and P = 0.5 and $(P)^n = (0.5)^{20}$. For practical design purposes we should assume and logically too, that less than 20 would be in use at a time. Let us say 'r' number are in use out of n taps then the probability of r out of n in use would be:

$P_r = {}_nC_c(P)r\ (1-P)\ n-r$ where $n^Cr = \frac{n'}{r'(n-r)'}$ and n' is given by (n) (n-1)(n-2) --------(1).

Let us now assume n=10 and P=0.3 then we can compute P_r for various value of r from 0 to 10.

NUMBER IN USE	PROBABILITY	CUMULATIVE TOTAL
0	$P_0 = 0.028$	0.028
1	$P_1 = 0.121$	0.149
2	$P_2 = 0.233$	0.382
3	$P_3 = 0.266$	0.649
4	$P_4 = 0.200$	0.849
5	$P_5 = 0.102$	0.952
6	$P_6 = 0.036$	0.989
7	$P_7 = 0.001$	0.990
8	$P_8 = 0.000$	0.990
9	$P_9 = 0.000$	0.990
0	$P_{10} = 0.000$	0.990

One can infer from these computations the following:

(a) Designing for 5 in use simultaneously means probability of satisfying 95% of total demand.

(b) Designing for 7 outlets in use simultaneously has a probability of satisfying 99% of demand.

(c) The probability of 10 in simultaneous use is only 0.000,000,0729.

We can see clearly now, how the probability distribution could help towards an economic design.

Even more accurate predictions could be arrived at if the characteristics of demand are well studied. Under such circumstances, the Binomial Frequency Distribution, normal frequency distribution regression and correllation are some of the statistical techniques that could be employed.

1. DALY C — REVUE DE L' ARCHITECTURE et DES TRAVAUX PUBLICS PARIS, 1857 VOLUME 15, 346-348

2. MAYER T W — BUILDING SERVICES DESIGN, A SYSTEMIC APPROACH TO DECISION-MAKING R.I.B.A PUBLICATIONS LIMITED 1971

3. MARKUS T A & MORRIS E N — BUILDINGS CLIMATE AND ENERGY PITMAN INTERNATIONAL TEXT 1980

CHAPTER V

SERVICES REQUIREMENTS OF 45-BEDROOM HOTEL - COLD AND HOT WATER SERVICES

5.1. INTRODUCTION

This chapter discusses the services requirements of a 45-Bedroom hotel in respect of cold and hot water supply.

Following the sense of the discussions in the previous chapters, the procedure shall be first to identify the functions of the water supply system, and subsequently the technicalities of the provision. In the process of so doing, economic considerations would be given proper attention. The aesthetic variables associated with the provisions, begun to be taken care of as, the building was concieved by the author who is also an architect. Thus, ducts have been provided in the building to cater for the vertical transportation of the services and trunkings and false ceilings shall be used to conceal services running horizontally.

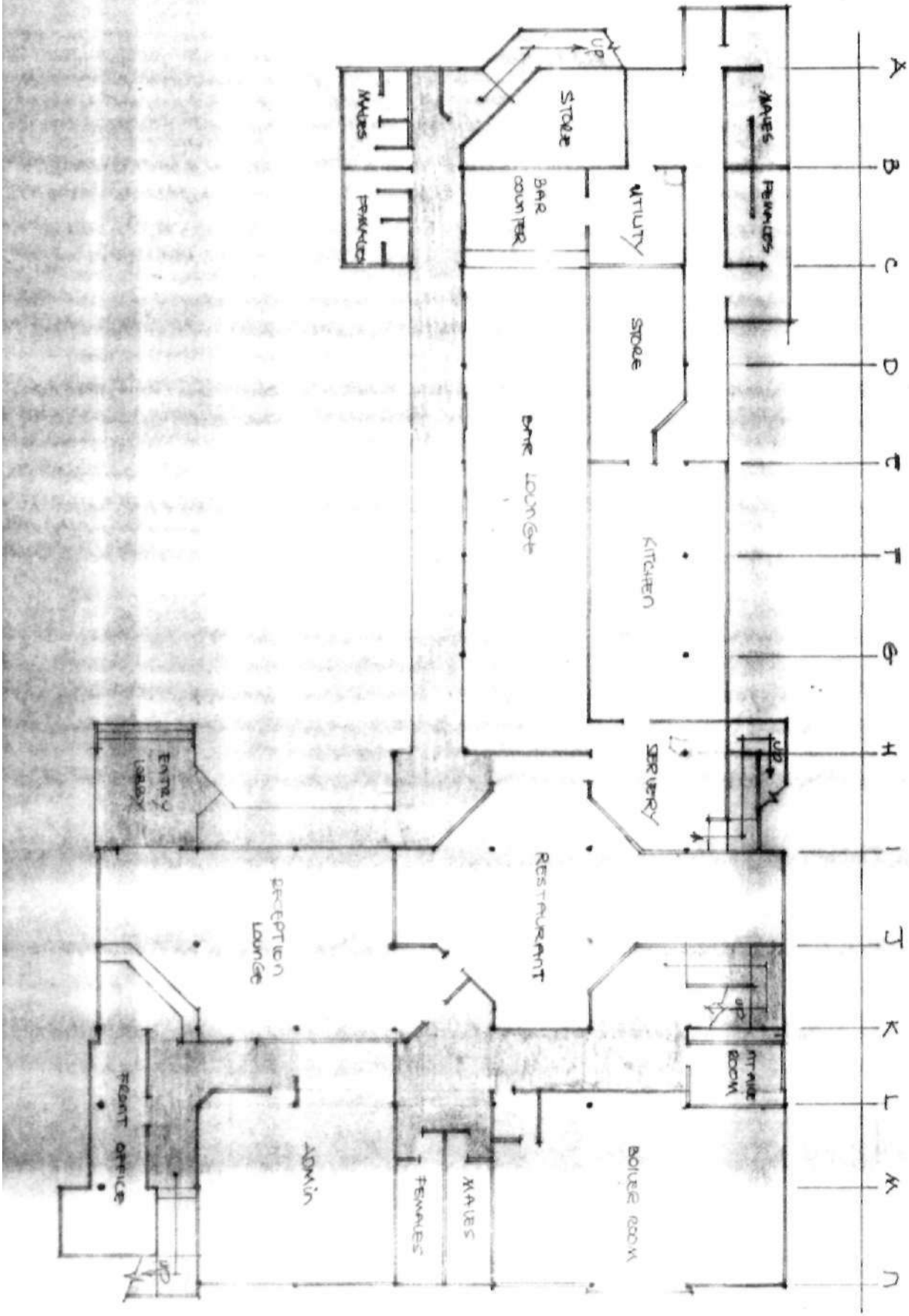
The functions of the water supply system in the hotel include:-

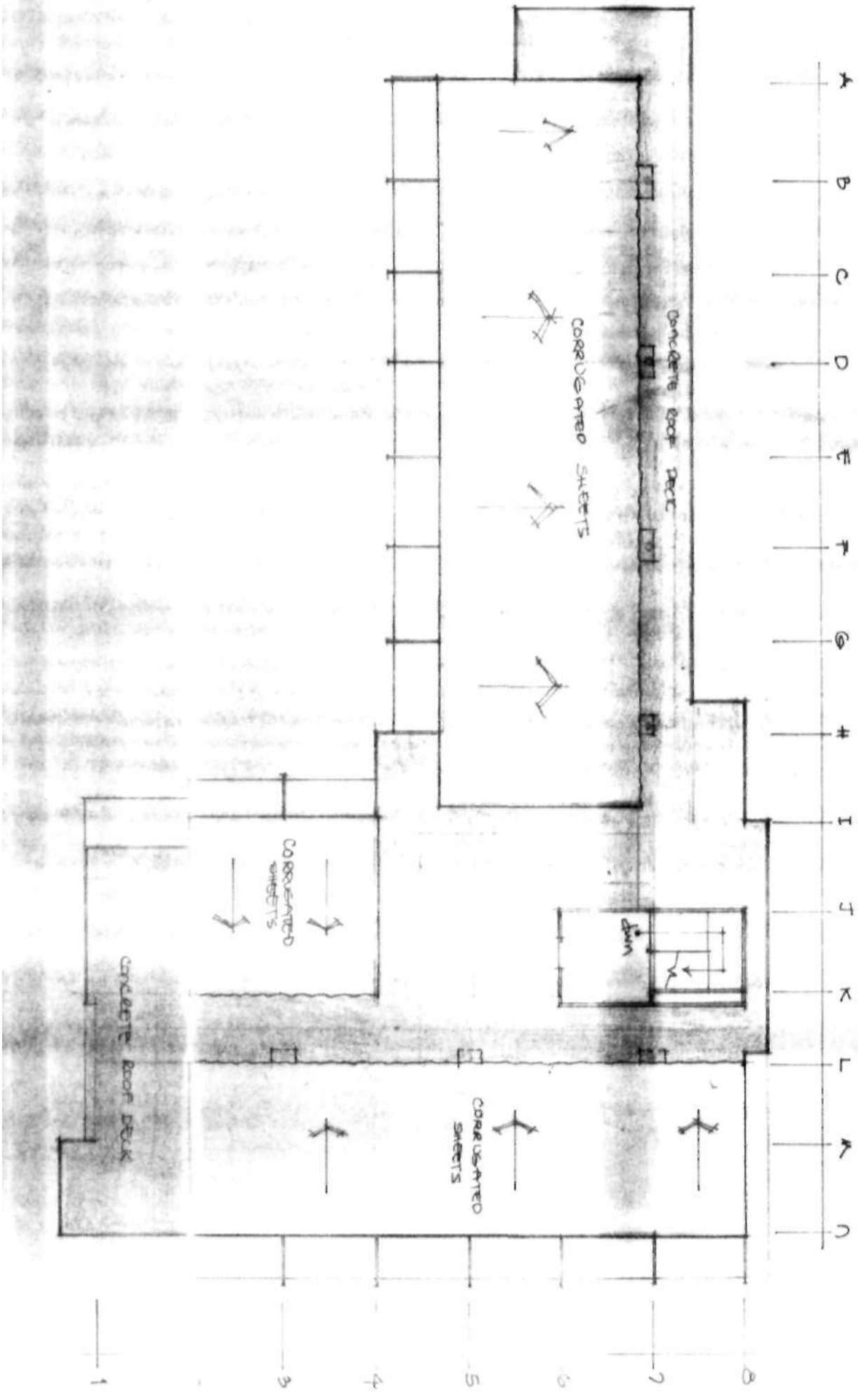
(a) Provision of Potable water for drinking

(b) Provision of water for hygienic requirements which include: washing, Bathing,

(c) Provision of water for use in the Kitchen and associated areas.

(d) Provision of water for use in fire hazards.


UP
STORE
MALES
FEMALES
BAR COUNTER
UTILITY
STORE
BAR LOUNGE
KITCHEN
SERVERY
UP
ENTRY LOBBY
RECEPTION LOUNGE
RESTAURANT
UP
ATTAIN ROOM
FRONT OFFICE
ADMIN
FEMALES
MALES
BOILER ROOM
A
B
C
D
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K
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M
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CONCRETE ROOF DECK
CORRUGATED SHEETS
CORRUGATED SHEETS
CONCRETE ROOF DECK
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5.2 COLD AND HOT WATER SUPPLY

The importance of water supply to a building cannot be over-emphasized and varies with the use to which the building would be put. The need for sustainance of organic life is the most fundamental of all the uses of water, but almost equally important is that of hygienic requirements of the body and the environment.

5.2.1 Mains Distribution

Usually outlets from water service reservoirs are split into a number of trunk mains servicing different areas of a layout. Ideally there should be at least two of such main trunks serving each area to minimize the disruptive effect of any fracture or breakdown in the main.

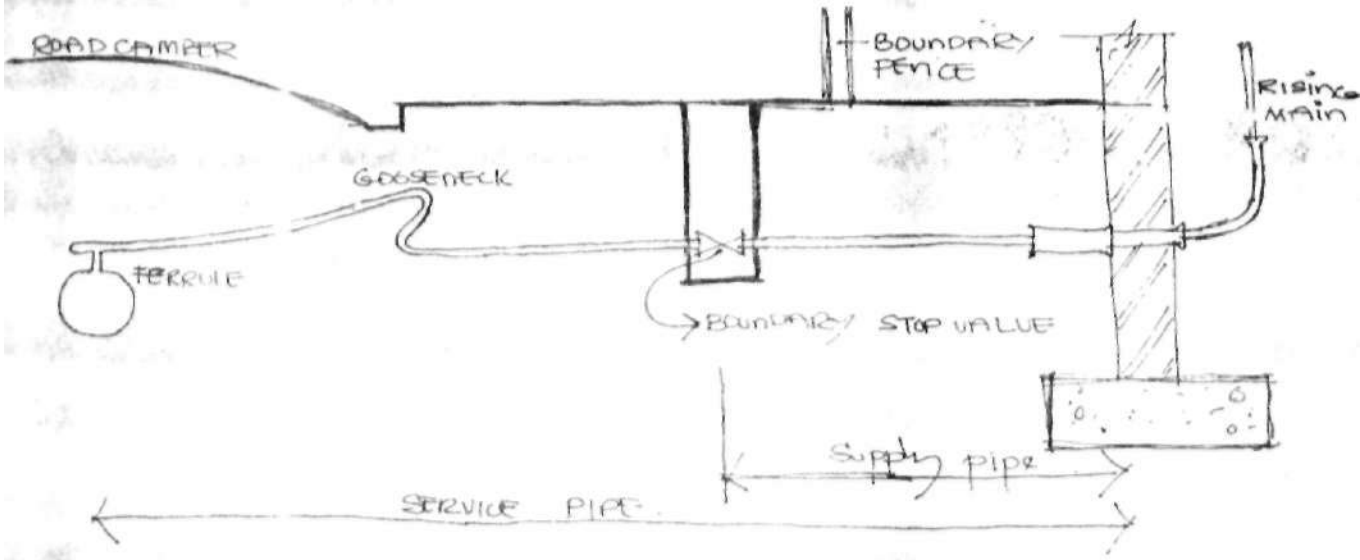
Within each area there is a network of secondary mains ringed to the trunk mains and from which street or branch mains are taken and finally from these, the service pipes to individual premises. The service mains are divided into sections and slvice valves (of the gate type) are used to isolate each section for repair, maintainance or any other purposes.

Service mains must provide sufficient pressure and quantity of water to the premises they service. For the lower floors of the buildings (and for adequate for bungalows or low rise) a pressure of about 30m head of water is considered adequate for fire fighting. Pressure about 70m head of water will lead to waste and excessive noise in the pipework, within the premises. Tall buildings may require additional pumps to boost the mains supply pressure. It is note worthy therefore that the lecation of service reservoirs in respect to areas to be served must be given due consideration in planning a water scheme.

5.2.2 Service pipe

In Nigeria, galvanized mild steel is most often used for the service pipe connecting the water main to the building. The water board would normally make this connection to the main and terminate their connection pipe at a stop valve which is most often placed below the ground just outside the premises - Fig. 5.1. The remainder of the supply pipe, could be fed into a break-tank from which with the aid of a pumping device the water is taken to the storage cistern within (mostly at the top of) the building, or the supply pipe might connect the mains pressure is considered adequate at all times.

FIG 5.1 CONNECTION OF SERVICE PIPE TO MAINS



In small installation, connection can be made to the water main without shutting off mains supply. This is done by clamping a special water tight box to the main, then drilling and tapping the main and introducing a fervle into the hole, the operation being achieved by a special revolving tool box

which sits a top the waterlight box. The connection pipe is then connected to the ferule with a large radius elbow or a 'goose neck' if lead is used. An internal screw plug within the ferrule can now be raised and flow goes through to the building. In large buildings however, where 100mm diameter connection is to be used, say for fire fighting purposes, it is neccessary to shut off the relevant section of the main and introduce a tee into the run of the main, at an appropriate position.

5.2.3 Pipe Sizing

There are quite a number of factors that affect sizing of pipes in an installation, and these shall be individually treated in due course. In any case, there are quite a number of good guidelines already established by different authorities and research bodies on this subject and these shall be heavily depended upon.

5.2.3.1. Assessment of required flow rate

The required flow rate, would be determined by (a) the flow of water at appliances and (b) the probable demand.

The flow of water at appliances varies with almost all types of appliances. There are minimum reccommeded rates of flow for appliances and fittings and are set out in talbe 5.1 These rates have been found to be acceptable to consumers in the developed world.

Appliance or fitting	Rate of flow L/S
W.C. flushing cistern	0.12
Wash Basin	0.15
Wash basin with spray taps	0.04
Bath (private)	0.30
Bath (public)	0.60
Shower (with nozzle)	0.12
sink with 12mm taps	0.20
sink with 18mm taps	0.30
Sink with 25mm taps	0.60
Lab Sink 12mm taps	0.08

Table 5.1

Recommended minimum rates of flow at appliances or fittings.

In designing a hot or cold water supply installation, the probable maximum demand at any particular time must be estimated. In practise it is very rare that all the appliances in a building would be in use simultaneously. For this reason it is logical to design for a fewer number in use simultaneously than the total of all appliances and fittings, if only for economy. This maximum consumption estimated is refered to as the peak usage. However the probable demand would depend on the type of appliance, the type of building in which it is installed and the frequency of use.

In order to assess this peak usage, some desingers find the total consumption and take a percentage of this. One method is derived from a formula deviced by W. Fretwell: $M = 1/\sqrt{N}$ where M = probable number of appliances in use and N= number of appliances installed.

H. A. Howick has devised a method based upon the theory of probability. With this method a unit rating is devised for each type of sanitary appliance, based on its rate of water delivery, times the taps are opened during usage, probable duration of use and the simultaneous demand for each type of appliance.

Table 5.2 contains the 'loading unit' rating for various appliances.

Note that a loading unit has no precise valve in terms of litres per second. By multiplying the total number of each type of appliance by the appropriate loading unit number and adding the resultant totals, the recommended flow rate can be read from Graph 5.1.

Table 5.2 - Loading Units.

Dwellings and flats	loading Units Rating
W.C. Flushing cistern	2
Wash basin	1½
Bath	10
Sink	3 - 5
Shower (with nozzle)	3
Public Bath	22
Offices	
W.C. flushing cistern	2
Wash basin (distributed use)	1½
Wash basin (concentrated use)	3

Schools and Industrial Buildings

W.C. Flushing cistern	2
Wash Basin	3
Wash Basin with spray tap	½
Lab sink	1

For appliances that require continous supply of water while in use like ablution appliances, a loading unit rating cannot be applied, instead a 100% of the flow rate must be allowed for - table 5.1. Other appliances in this category include automatic flushing cisterns used for urinals, shower nozzles and spray taps.

5.2.3.2 Effective length of pipe run and pipe diameter.

For a given flow rate, there is a pipe diameter that is considered adequate, and this diameter of pipe is subject to, the smoothness of the pipe used, the available head and the effective bright of the pipe run. Associated with the smoothness of the pipe used is the loss of head in the pipe. To this loss of head must be added that caused by the pipe fittings such as elbows, tees etc. The loss of head due to these fittings is usually expressed as loss in an equivalent length of a straight run of pipe - Table 5.3.

To determine the diameter of pipe for a given flow rate, the allovable loss of head per meter run of effective length must first be calculated.

Table 5.3

Head losses in pipe fittings expressed in equivalent pipe lengths

Nom Bore	Galvanized mild steel		
mm	elbow meter run	Bend per pipe	Tee
15	0.5	0.4	1.2
20	0.6	0.5	1.4
25	0.7	0.6	1.8
32	1.0	0.7	2.3
40	1.2	1.0	2.7
50	1.4	1.2	3.4
65	1.7	1.3	4.2
75	2.0	1.6	5.3
100	2.7	2.0	6.8

Thus given (a) Flow rate is 2L/S

(b) Available head is 4m

(c) Actual length of pipe is 20m

(d) 8 elbows in the run

to determine a suitable diameter, the following steps shall be taken:-

(1) Assume a diameter of 32mm, the effective lenght shall be 20 + (8x1) = 28m

(2) As available head is 4m, the permissible loss of head per mater would be:- Head/Length =

4/28 = 1/7 = 0.14m/m run.

(3) Read from graph 5.2, a 32mm galvanized steel pipe with a permissible head loss of 0.14m/m run will convey about 1.3L/S and this is too small.

(4) A 40mm pipe should then be chosen.

(5) Cross check on using a 40 mm dia. pipe and this

would convey 2L/S which is the flow rate required.

5.2.3.3 Loss of head at point of delivery the loss of head through the draw off or delivery valve should be taken into account in calculating the diameter of a pipe supplying an individual fitting. Tables for loss of head in this respect are available, and one of such is reproduced as table 5.4 below

Table 5.4 - loss of head through draw-off taps expressed as equivalent pipe lengths.

Now, consider a distributing pipe required to deliver 0.3 L/S through a 20mm bib-tap, the length of pipe is 18m and there are 8 elbows, with an available head of 3m. Assuming a 20mm copper pipe, the effective length would be 18+(8x0.8)+8.5=18+6.4+8.5= 32.9m or 33m Allowable head loss per meter run of effective length would be

$$3/33 = 1/11 = 0.09\text{m/m run.}$$

Refering to graph 5.2, a 20mm copper tube with a head loss of 0.99m/m will convey 0.30L/S. This diameter of pipe will therefore be large enough to give the required rate of discharge at the tap.

5.2.3.4 Loss of head through ball valves and stovalves.

These losses could be very considerable and they vary with rate of flow. It is usual practise to to deduct these losses directly from the available head. The loss of head through ball-valve orifices are given in 5.3 and that through stop valves are given in graph 5.4.

To determine the diameter of a copper cold water supply pipe capable of delivering 1.5L/S through a ball valve having a 16mm diameter orifice given that the pressure at the main is 400kn/m^2 (40.8m head), the ball valve is 15m above the main

and the total run of pipe from main to ball valve is 34m with 6 elbows and one stopvalve:- Assume a a5mm pipe, then the effective length would be 34+(6x1.0) = 40m.

From graph 5.3, at a flow rate of 1.5L/S the loss of head through a ball-valve with a 16mm orifice would be 3.5m and the loss of head through a 25mm stop valve would be 2.7m (graph 5.4). The available head will be 40.8-(15+3.5+2.7)=19.6m. Allowable loss of head per meter run of effective length of pipe would be 19.6/40 = 0.49m/m

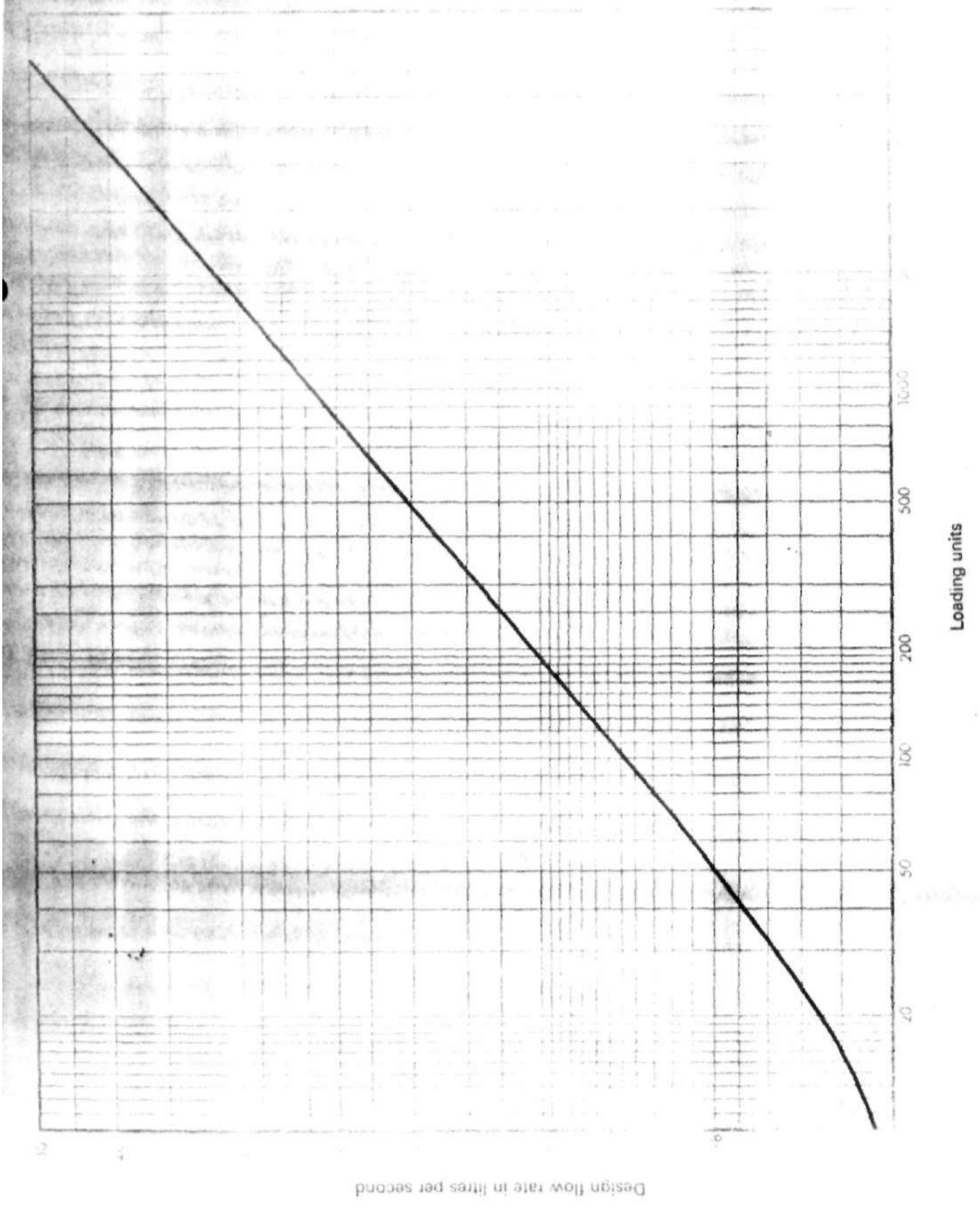
Table 5.4 - loss of head through draw-off taps expressed as equivalent pipe lengths.

Fitting (BS1010)	Discharge Rate Tap fully open L/S	Equivalent length of pipe of same diameter as tap (meters) (Galvanized steel)
15mm(nominal) bibtap or pillar tap	0.2	4.00
20mm(nominal) " " " "	0.3	5.75
25mm(nominal) " " " "	0.6	13.00

Table 5.5 loss of head in meters through draw-off taps

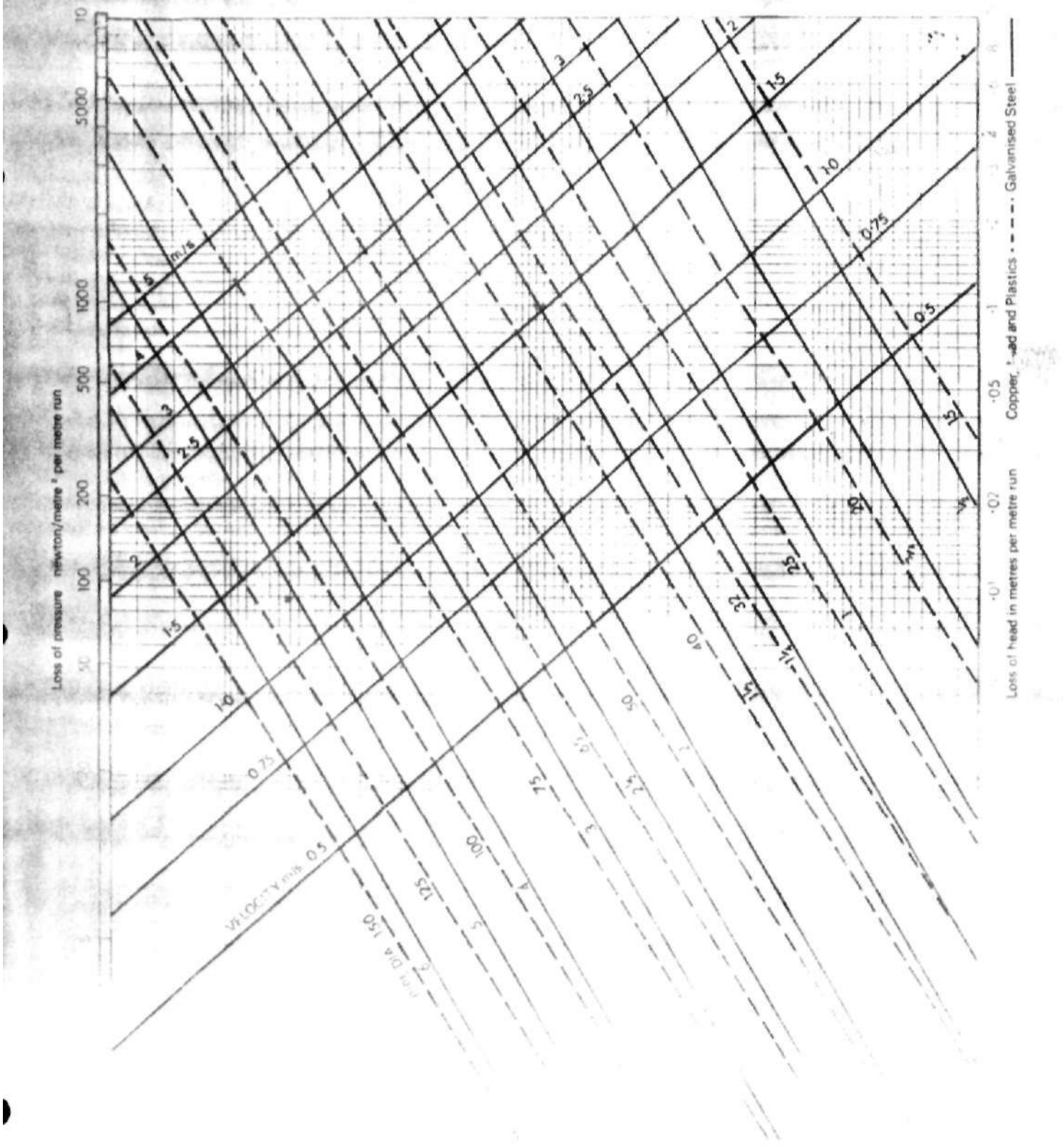
	Discharge rate in L/S									
	.075	0.12	0.15	0.20	0.22	0.30	0.35	0.47	0.55	0.60
15mm bibtap	.185	.365	.52	.75	1.1	1.8				
20mm "			.21	.33	.45	.75	1.1	1.4		
25mm "						.45	.70	.90	1.2	1.5
15mm pillertap	.24	.40	.52	.70	.80	.				
20mm " "			.24	.30	.40	.50	.70			

GRAPH 5.1 Loading units and design flow rates



Pipe sizing

GRAPH 5.2 | Pipe sizing graph



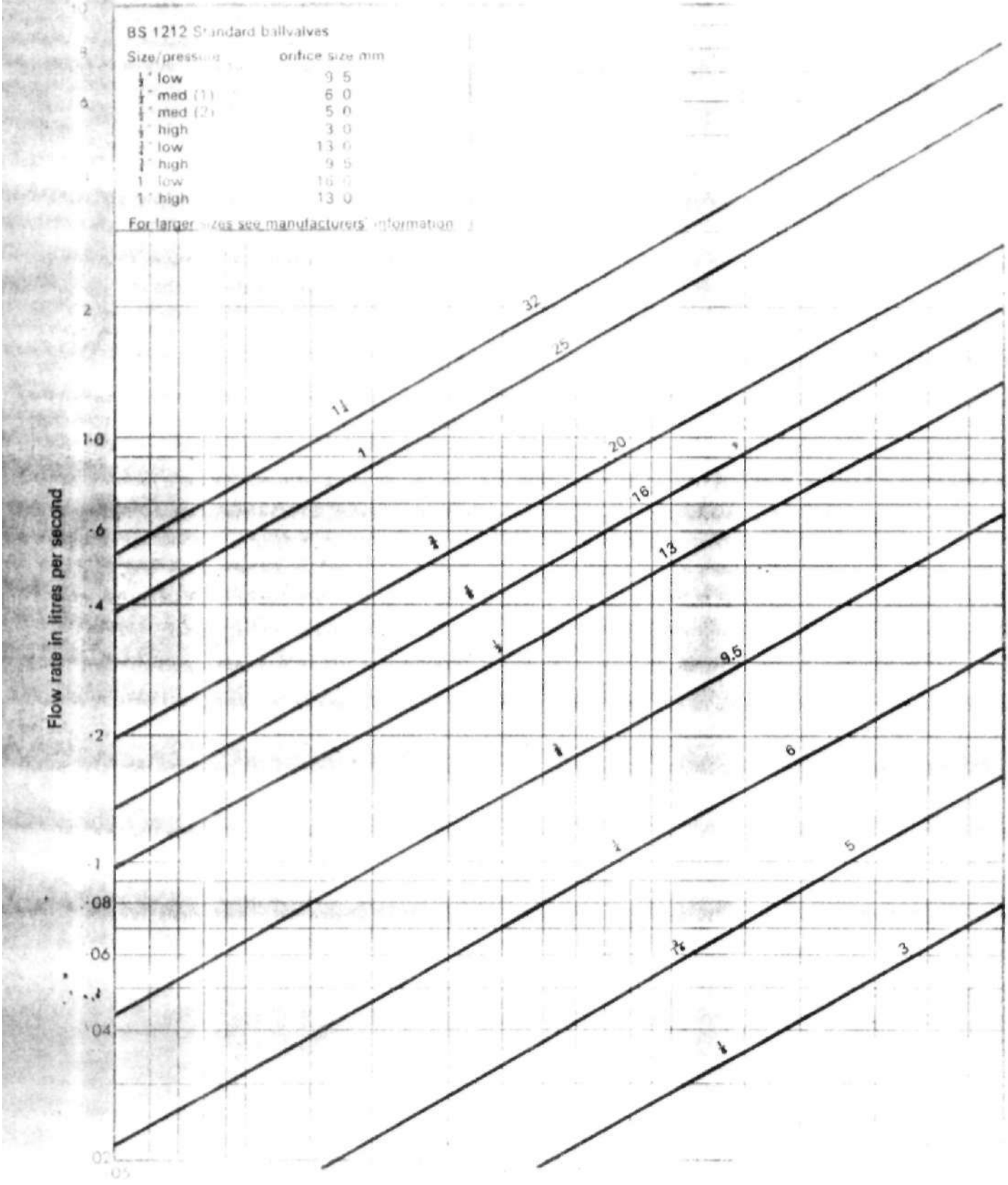
GRAPH 5.3

Head loss through ballvalve orifices

BS 1212 Standard ballvalves

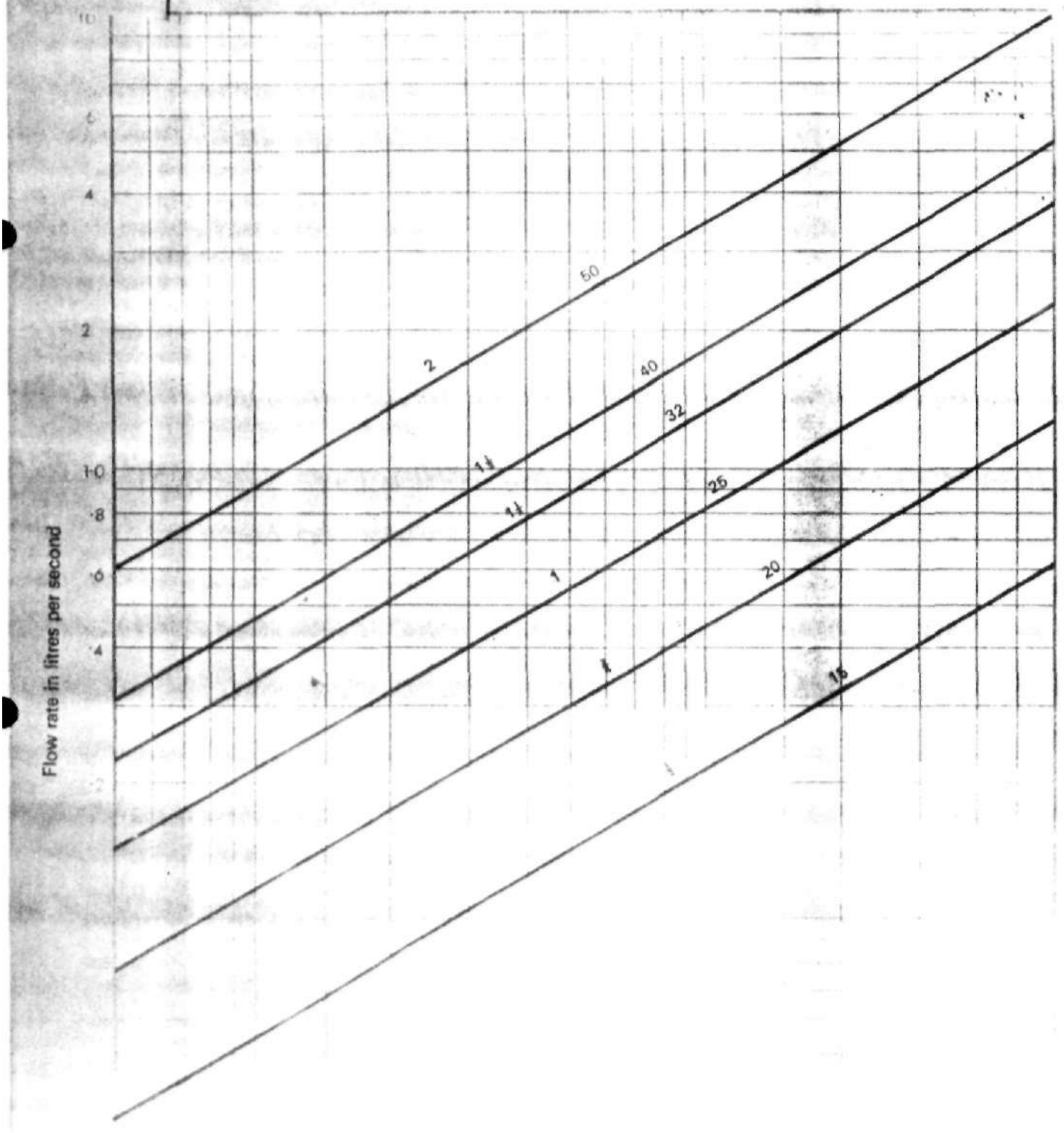
Size/pressure	orifice size mm
½" low	9 5
½" med (1)	6 0
½" med (2)	5 0
½" high	3 0
¾" low	13 0
¾" high	9 5
1" low	16 0
1" high	13 0

For larger sizes see manufacturers' information



Loss of head in metres

GRAPH 5.4 Head loss through stopvalves



5.2.4. Storage

5.2.4.1 Cold Water Storage

There are quite a number of advantages to be derived from water storage in buildings. However these advantages whatever they may be must be measured against economic considerations. Generally factors that would affect the provision of storage cisterns in a building are enumerated below.

1. Reserve for mains failure - This is about the most important consideration in areas subject to gross pressure fluctuations and even the ceasation of flow at times during normal operation. It would be observed that consistency in water supply cannot be guaranteed in most parts of Nigeria. It would therefore be a requirement in commercial buildings, to have storage to forestall commonly low pressures and complete ceasation.

2. Noise in installations - The reduced pressure from storage cisterns as compared with mains pressure will usually give quieter operation, reduce water hammer and particularly ball-valve noise. There is a reduction of waste of water and lighter guages of pipework and components could be employed in installations.

3. Economic considerations - cost of provision of cistern and supports have to be well thought of at design stages to determine the size of cisterns that would be most economical. With storage cisterns, there could be a reduction in size of service pipes, since demand is partially met from storage.

The period during which consumption is to be met by storage should be decided after due consideration to the rate and regularity of supply and the consequences of exhausting the storage. In a hotel building it is adequate to provide storage that would take care of a 24 hour supply interuption. There are recommended valves for water storage in commercial premises, published as bye-laws and codes of practice. For a hotel, it is recommended that 135 letres of cold water storage per resident would cover a 24 hour interruption, plus any additions for Kitchen laundry, public toilets etc., overall, it is reasonable to assume a 250 litre storage per person (residents only) to cover all the uses in a hotel, in Nigeria, having due regard to the sociological factors puculiar to the people of the country.

An alternative method of calculating the water storage requirements is the use of storage for appliances method. By this method estimated storage for every sanitary appliance are added to give the total water storage. See table 5.6

Table 5.6 Provision of cold water storage based on sanitary appliances:-

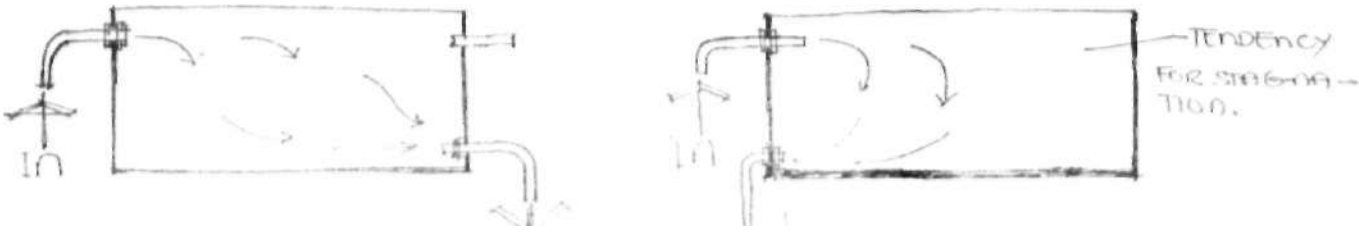
Sanitary appliance	Storage (litres/day)
Water closet	180
Sink	135 - 225
Wash basin	90 - 250
Shower	135 - 225
Urinal	135 - 250

5.2.4.2 Storage cisterns.

Storage cisterns should be constructed of material that will resist any action by the water supplied. Cisterns may be of iron, steel, copper, asbestos cement, plastics or glass-reinforced plastics. In any case it has been observed that the material mostly used for cisterns in Nigeria is steel - galvanized. It is adviced that the internal of the cistern be coated with a non-toxic bitumenous conposition. They must be provided with readily removable covers, well fitting but not air tight, and supplied with water through a float operated valve fixed rigidly to the cistern. An overflow must be fitted on every cistern, and provided with a stop valve at every outlet other than an overflow pipe, so that it will not be necessary to empty the cistern when repairs or maintainance works are to be carried out on distributing pipework. If storage is above 4,500 litres, it is preferable to arrange it as a series of cisterns interconnected by means of a header pipe, such that each cistern is seperately valved to allow for maintainance of any individual cistern, without necessarily interrupting supply. In large storage cisterns the outlet must be provided on the opposite side of the inlet to avoid water stagnation. - See fig.5.1 and fig. 5.2

Drain down valves should be provided to allow complete drain down of cistern for maintainance purposes. Outlets may be above the bottom or the bottom of the tank, though B.S. cisterns (table 5.6) have outlet

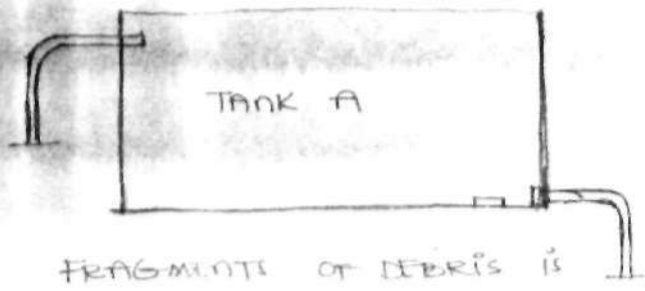
FIG 5.2 LOCATION OF INLET AND OUTLET WITH RESPECT TO CISTERN



holes above the bottom. Fig. 5.3 and 5.4 There is some controversy as to which is better. The outlets above the bottom prevent debris from entering the distribution pipes, but by so doing periodical cleaning would be necessary, else there would be an accumulation of debris which would be washed into pipe line as time goes on. On the other hand, the outlet at the bottom continously allows small fragments of debris to pass through such that at no time is there any serious accumulation with the result that, the cistern may not need to be cleaned very often. Since galvanized steel cisterns have a life span which is usually shorter than the life span of the building, it is advisable that the installation shou ld be consider replacement of the cistern, at a later date.

In recent times plastic cisterns have been developed and are proven to have many advantages over and above the steel cisterns. Apart from the fact that they have indefinite life, they show savings in maintainance costs.

FIG. 5-3 OUTLET AT BOTTOM



FRAGMENTS OF DEBRIS IS CONTINUALLY DISCHARGED. REQUIRES LESS CLEANING

FIG 5.4 OUTLET ABOVE BOTTOM



Table 5.6

Dimensions of cisterns

B.S. Type reference	length L (mm)	Width W (mm)	Depth (mm)	Capacity to Water line (litres)
SCM 45	457	305	305	18
70	457	305	371	36
90	610	406	371	54
110	610	432	432	68
135	610	457	482	86
180	686	508	508	114
230	736	559	559	159
270	762	584	610	191
320	914	610	684	227
360	914	660	610	264
450/1	1219	610	610	327
450/2	965	686	686	336
570	965	762	787	427
680	1092	864	736	491
910	1168	889	889	709
1130	1524	914	813	841
1600	1524	1143	914	1227
2270	1829	1219	1016	1727
2720	1829	1219	1219	2137
4540	2438	1524	1219	3364.

5.3 Hot Water Supply

5.3.1 General

Conventionally hot water is stored at a temperature not more than 65°C, and allowing for some amount of temperature drop in the distributing pipes, the temperture at the draw-off points would be about 60°C. Water at this temperature would have to be croled down by mixing with cold water for some uses, like bathing, while for some other uses there would

be no such requirement. Thus temperature for use would vary with application and individual preference. For instance in washing machines for clothes & dishes, the temperature might have to be further increased. For the purposes of bathing and washing using hands temperatures of 40°C to 43°C are adequate.

The flow rates (table 5.1) established for cold water supplies also apply to hot water supply. The only difference is that WCS will not be included in the appliances to be supplied with hot water. In a hotel building, hot water would be required in the bedroom units principally for bathing and the highest demand for hot water would be in the mornings and in the evenings which are traditional times for having baths, though the demand in the morning is likely to exceed that of the evenings. One can safely say that the highest demand would be in the early morning hours, say from 6am - 9.00am. It is estimated that about 40L/day of hot water would be required per resident in a hotel. The procedure for pipe sizing in hot water supply is the same as in cold water supply, however some aspects perculiar to hot water supply are.

1. Selection of the most appropriate energy source and installation system.

2. Proper balancing of rate of energy input and the storage capacity against the pattern of demand to give an adequate and economic service.

5.3.2 Selection of system and type of energy

There are many systems of hot water supply in use and with varying energy sources, and a possibility of combining systems in a single installation depending on the situation.

A hot water supply system may be central or local. Central systems involve a single energy conversion

plant and storage if needed, and the local system involves installing water heaters at draw off points. In some cases a combination of these two might be the ideal practise whether or not the system has a single central energy conversion plant the decision as to whether a storage cylinder containing a reserve of water be provided, or the use of instantaneous water heaters, would come as a further consideration.

The type of energy employed would be determined by availability and economic considerations. Possible sources of energy include;

(a) Solid fuel, (b) Oil (c) gas, and (d) electricity.

Other factors taking care of practical considerations may also dictate the type of energy source that is utilized, which considerations include,
(a) fuel storage (b) flues, (c) cold water storage,
(d) pressure for showers (e) use of mixed fittings,
(f) space limitations (g) pattern of occupancy and use.

The choice of whether to use a central heating system or a local system, is governed by two main considerations; (a) the availability of the centralized energy source such as a boiler which is also probably being used for the central heating, in which case it might be more economical, than to have individual local heaters and (b) the location of appliances requiring hot water. If the appliances are chosely grouped, then it would be easier to supply them from a central source, but if they are far apart, then

the cost of the services runs terms of the materials and in terms of heat loss may be quite considerable, that it may not be worth it.

There seem to be many advantages derivable from using instantaneous water heaters rather than providing storage with inevitable heat losses. Unfortunately the amount of heat required to raise the temperature of water is very much and the rate of energy input into instantaneous water heaters precludes them from ability to provide the rate of flow which would be required for large sanitary appliances or whole installations. The rapid response required in instantaneous heaters suggest that only gas and electricity are practicable as fuels. It could be imagined that a 3 KW electric instantaneous heater can only raise 0.025L/S from 10 to 42^{o}C. This is highly inaduquate for most uses even in domestic installations.

Where it is possible to arrange a central heating boiler it is better and more economical in most cases, particularly when the demand for hot water at peak periods is quite high. In such installations heat exchangers are used to take away the heat generated by the boiler and circulated to coils in the exchanger in a continous fashion. This is an indirect way of supplying hot water. As the need for hot water is likely to drastically reduce in the hot seasons, provision of immersion heaters practiced by some manufacturers is very good, as it makes it possible to shut down the boilers and convert to the use of immersion heaters.

The use of solar energy to preheat water is also quite practicable, although the costs of installation is usually

prohibitive. A proper cost analysis would have to be carried out before solar energy can be used in heating. Fig. 5.4 and 5.5 show the schematic of some typical examples of solar heating circuits.

Dead legs: In systems where a central boiler plant is used, care must be taken avoid long dead legs. Along dead leg of pipework means that a substantial amount of cold water must be run to waste before hot water arrives at a tap.

In order to avoid this, sometimes, a special flow and return circulation from the hot water storage cylinder can be arranged. See Fig. 5.7. This arrangement however suggest a great loss in heat as the water keeps circulating. It is desirable to avoid secondary circulation for this reason by ensuring from the design stage that appliances are grouped and far lying appliances supplied from instantaneous heaters.

5.4.1 Estimation of cistern and pipe sizes

There is a need for proper sizing of cisterns and distribution pipes in a water supply system to ensure efficiency and effectiveness of supply with respect to adequate rate of flow at draw-off points and recovery time.

Table 5.7 and 5.8 give the cold and hot water storage requirements per person for a 24 hour water supply interruption as recommended by 'CP310' and 'IHVE' guide to current practice respectively.

The characteristics of the hotel are as follows:

Number of bedrooms	-	45
Functional spaces	-	Restaurant, kitchen servery, bar and associated spaces. Reception lounge, administrative offices, public toilets

and function rooms with associated facilities.

Number of persons in bedrooms = (2 x 2) + (1 x 24) = 66

Cold water storage requirements per person = 250 L/Day

Total Cold water storage = 250 x 66 L/Day

= 16,500 L/Day

Assume a tank with dimentions as below:

length = 2000mm = 2m
width = 1500mm = 1.5m
Depth = 1500mm = 1.5m

Volume = 2 x 1.5 x 1.5 = 4.5 cubic meters (m^3)
= 4500 letres

for a storage of 16,500 letres, 4 of the tanks specified above shall be required.

Additional water storage for fire fighting equipment;

Number of hose reels = 9
Rate of flow hose reel - 22 L/min.
Allow a 15 minute fire fighting from a hose reel then we need 22 x 15 = 330 L therefore apply the minimum size allowed = 1150 letres Capacity of storage cistern for fire fighting=1150 letres.

5.4.2 Pipe sizing for hot and cold water supply

Pipes are sized so that the friction loss in pipe and associated bends, tees and orifices balances the head available from cistern or main to achieve desired rate of flow at draw-off points.

Table 5.7 volume of storage to cover 24 hours of supply recommended in CP310; 1965 water supply

Type of Use	Storage Capacity litres/ person
Dwellings	90
Hotels	135
Hostels	90
Offices	37
Boarding Schools	90
Day Schools	27

Table 5.8 Hot water storage capacities and boiler power recommended by Institute of Heating and Ventillating Engineers.

Type of use	Storage Capacity litres/ person	Boiler power Watts/per.
Dwellings	32	750
Hotels	46	1200
Hostels	32	750
Offices	4.6	120
Boarding Schools	23	750
Day Schools	4.6	90

The first step in pipe sizing is to determine all draw off points and their distances from the cisterns and cylinders, and the height between cistern centre and draw off points.

For the excercise of pipe sizing the building would be divided into the following parts.

1. All draw off points between grids A - K and 4A - 7 on all floors excluding the Kitchen area (Kitchen, servery, restaurant and Bar)

2. All draw off points related to the Kitchen, servery and restaurant.

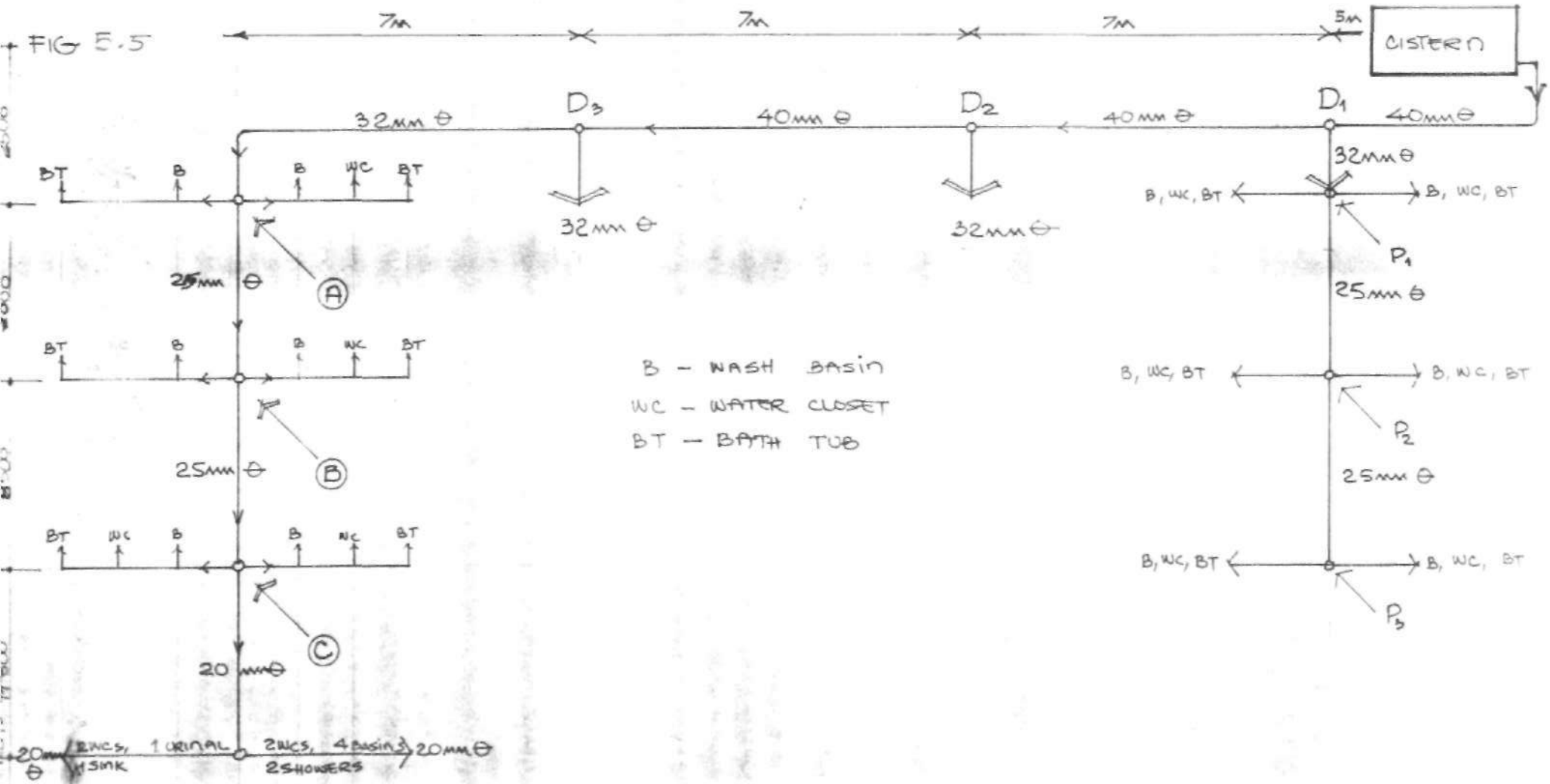
3. All draw off points between grids 1 - 8 and K - L plus draw off points between grids 1 - 3 and I - K.

5.4.2.1 Part 1 (Refer to Figs) 5.5

Step 1: Identify all demand points as shown in Fig. 5. and tabulate the water supply pipes to all the demand points as shown in table 5.8.

Since all appliances are not likely to be in use at all times a demand unit method shall be applied to sizing of pipes. This method allocates a unit to the various appliances haven considered, the rate of the likely frequency of use of appliances as set out in table 5.9. Identify the demand unit valve against all fixtures as in fig. 5. and find total of demand units. Also identify the flow rate in letres per second for each draw of point on the pipe leading to it.

FIG 5.5



COLD WATER SUPPLY SCHEMATIC TO WING (LEFT) OF HOTEL

Table 5.8 Water supply pipes and outlets

Pipe Mark	Area Applied	Appliances					
		WC	BATH	W.HB	URINAL	SHOWER	SINK
D_1	Bedrooms 109,209,309,110,210,310	6	6	6			
D_2	Bedrooms 111,211,311,112,212,312	6	6	6			
D_3	Bedrooms 113,213,313,114,214,314	6	6	6			
D_4	Bedrooms 115,215,315,116,216,316	6	6	6			
D_5	Public toilets on ground floor	2			1		
	Staff changing rooms	2		4		2	
	Bar area						1

Table 5.9 simultaneous demand units

Appliance	Tap Size	Demand Units
WC flushing cistern	12mm	1.5
Wash hand basin	12mm	0.3
Bath	18mm	1
Sink	18mm	2.5

Scale the length of each pipe run between centre of cistern and draw - off points and indicate as in fig. 5 In calculating the effective length of pipe to any draw off point, allow 25% of actual length for tees and elbows, and add to actual length. Also add equivalent length o f pipe for losses in orifices and valves, based on assumed diameter. Equivalent lengths in pipe to allow for fricturial losses in taps and valves are set out in table 5.10. Now refer to nomogram Fig. 5 for water supply and Fig. 5. for calculations below.

The draw-off point with the most critical supply must be identified. To do this using nomogram, link head available and pipe run to each appliance and project the line to cut the rate of loss of head scale. The lowest valve found establishes the critical run of pipework which extends from the supply point - the cistern. Now by inspection of Fig. 5. the run considered to be most critical is that linking centre of cistern to the 2nd water closet in public toilets
Pipe run: Cistern to Water closet in public toilets.
Total length: Actual length + 25% allowance for tees and bend + Equivalent length due to orifice of 12mm diameter

Table length = (5m + 21m + 27m) + 25% (5 + 21 + 27)m + 37
= 53 + 13.25 + 37
= 103.25

Total demand units = Addition of demand units on pipes D_1 - D_4

= (16.8 x 4) + 9.2
= 67.2 + 9.2
= 76.4 demand units

Total head available at the draw off point of the wc is:

3.5 + 3 + 3 + 2 = 11.5m

Now refer to nomogram and draw a line from point on head available where the reading is 11.5 to the point on pipe length where reading

is 103.25m. Project this line onto Rate of loss of head scale.
The rate of loss of head in kilo newtons per square meter per meter run is found to be about 1.9. Draw a line from this point to pass through the scale of flow required to the scale of pipe diameter.

Flow required for all demand units greater than 30 can be read on Fig. 5. In case of demand unit below 30 it would be assumed that all appliances are in simultaneous use.

Total flow required at point D_1 = 1.75
pipe diameter = 40mm
Total flow required at point D_2 = 1.5
pipe diameter = 40mm
Total flow required at point D_3 = 1.2
pipe diameter = 32

Beyond point D_3 demand units are less than 30 therefore for all pipes beyond this point, apply the actual flow required at draw-off points. In any case a diameter 32 between point D_3 and A is considered reasonable. For the remaining portion of the pipes a gradual reduction in pipe size up to the last set of appliances would be carried out,

After point A the diameter becomes 25 up to point C After point C diameter is 20mm up to point E and this is maintained up to point F and G beyond which point it is reduced to 12mm for wash basins, and 18mm for wcs showers and sink.

For pipes supplying appliances directly below points D_1 D_2 and D_3

The pipe diameters are as follows:-

$D_1 - P_1 = 32mm$

$P_1 - P_2 = 25mm$

$P_2 - P_3 = 25mm$

All off takes from P_1 P_2 and P_3 - 20mm and distributed as

18mm to bath tub
12mm to WC
12mm to Wash Basin.

The calculations above shows the procedure for pipe sizing applied all through the building.

5.4.2.2. Determination of total demand units based on total rate of flow

Areas where demand units method shall be applied include;

(a) Bedrooms and (b) public toilets (c) Function rooms and floor service rooms.

Areas where direct rates of flow shall be applied include;

(d) Kitchen, Servery, Restaurant and bar,
(e) Changing Rooms for staff.

(a) Bedroom units:

Number of WCs	-	45
Number of Wash basins	-	45
Number of Bath tubs	-	45

Rate of flows:

WC	-	0.12 x 45	= 5.4 L/S
Wash basin	-	0.15 x 45	= 6.7 L/S
Bath tub	-	0.30 x 45	= 13.5 L/S
Total	-	5.4 + 6.7 + 13.5	= 25.6 L/S

Demand units:

WC	-	1.5 x 45	= 67.5
Wash basin	-	0.3 x 45	= 13.5
Bath tub	-	1 x 45	= 45
Total	-	67.5 + 13.5 + 45	= 126.0

(b) Public toilets

Number of WCs - 5

Number of Wash basins- 8

Rate of flows:

WCs	-	0.12 x 5	= 0.60
Wash basins	-	0.15 x 8	= 1.20
Total	-	0.6 + 1.20	= 1.80

Demand Units:

WCs	-	1.5 x 5	= 7.5
Wash basins	-	0.3 x 8	= 2.4
Total	-	7.5 + 2.4	= 9.9

(c) Kitchen, Servery Restaurant and Bar;

Number of sinks	-	5
flow rate	-	0.6 x 5 = 3.0 L/S

(d) Staff changing Rooms

Number of WCs - 2
Number of showers - 2
Number of wash basins - 4

Total flow rates:

WCs - 0.12 x 2 = 0.24 L/S
Showers - 0.6 x 2 = 1.2 L/S
Wash basins - 0.15 x 4 = 0.6 L/S
Total - 0.24 + 1.2 + 0.6 = 2.04 L/S

(e) Function rooms and floor service room

Number of WCs - 9
Number of wash basins - 15

Rate of flow:

WC - 0.12 x 9 = 1.08
Wash basins - 0.15 x 15 = 2.25

Demand units:

WC - 1.5 x 9 = 13.5
Wash basins - 0.3 x 15 = 4.5

Total demand units for entire building for sanitary appliances

= 126.0 + 9.9 + 4.5
= 140.4 demand units

Rate of flow from graph 5.5

= 2.7 litres per second

Rate of flow for (c) and (d)
= 3.0 L/S + 2.04 L/S
= 5.04 L/S

Total Rate of flow required in entire system

= 5.04 + 2.7 L/S

Total = 7.74 L/S.

Head available draw-off point with most critical run

= 3.5m + 3m + 3m + 2m = 11.5 meters

Total length of pipe from draw-off point to cistern;

= 7m + 21m + 11m + 25% (5 + 21 + 11) + equivalent length due to resistance in valve orifices

= 39 + 9.75 + (e)

e = equivalent length of resistance in valve orifices

WC	-	8x61	= 488 meters
Wash basins	-	5x72	= 360meters
Bath tubs	-	6x45	= 270 meters
Showers	-	6x2	= 12 meters
Urinals	-	8x4	= 24 meters
Sinks	-	6x5	= 30 meters

Total (e) for all appliances = 1184 meters

Total length of pipe = 39 + 9.75 + 1184

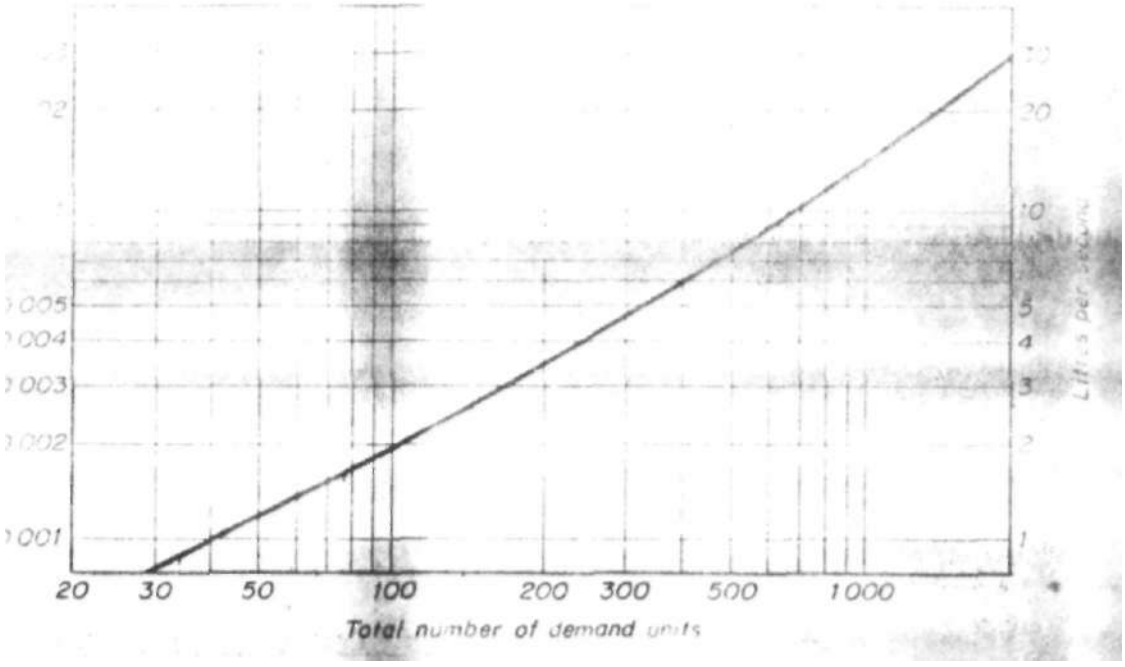
= 1232.75

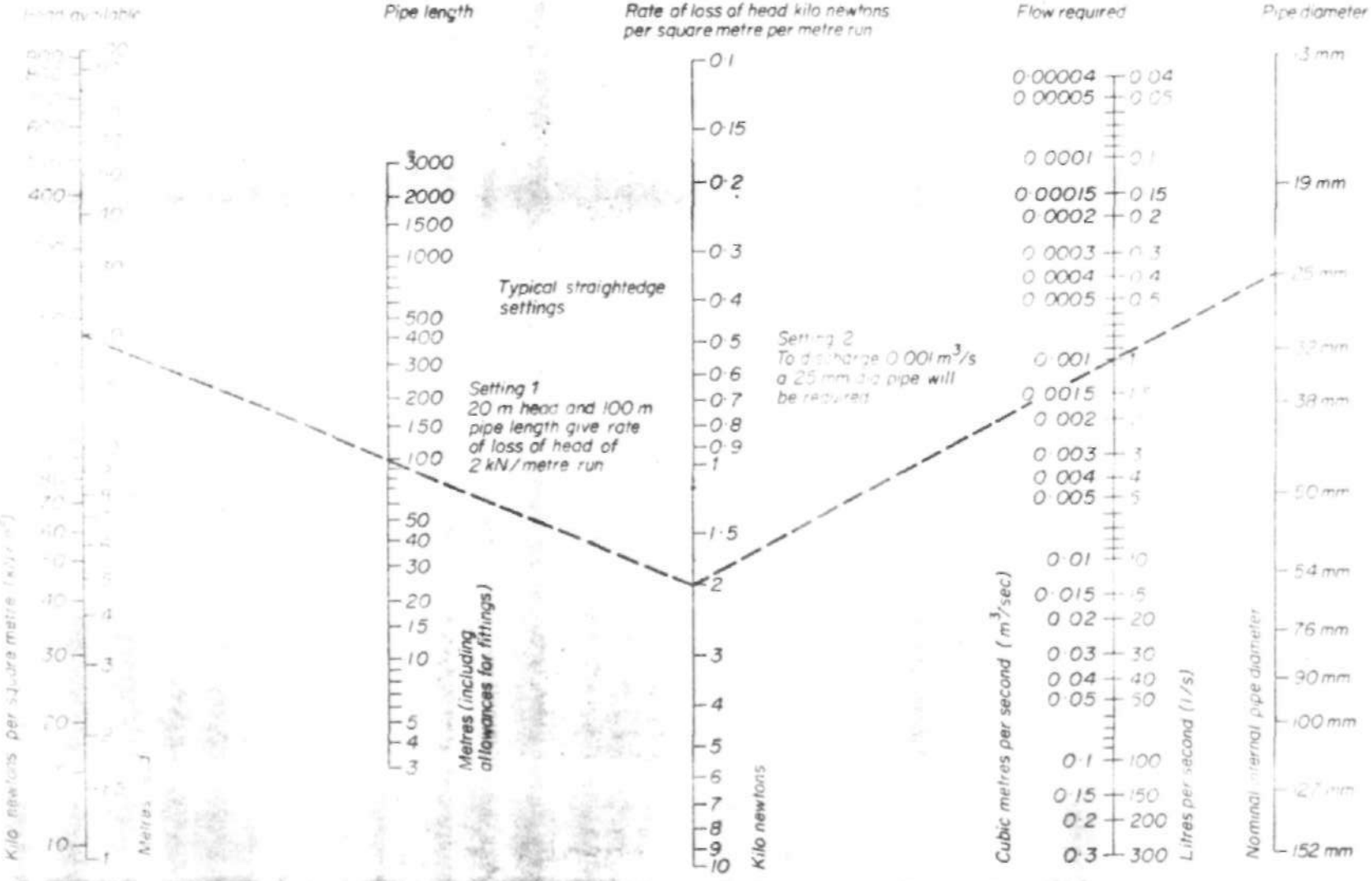
approx. 1300m

consult nomogram and mark off 1300m on the pipe length column. Also mark off head available on the scale. Join the two. Project to the Rate of loss of head scale. Now link from there to pass through the flow required and meet the pipe diameter scale. Read off the corresponding pipe diameter.

For above data pipe diameter = 100mm.

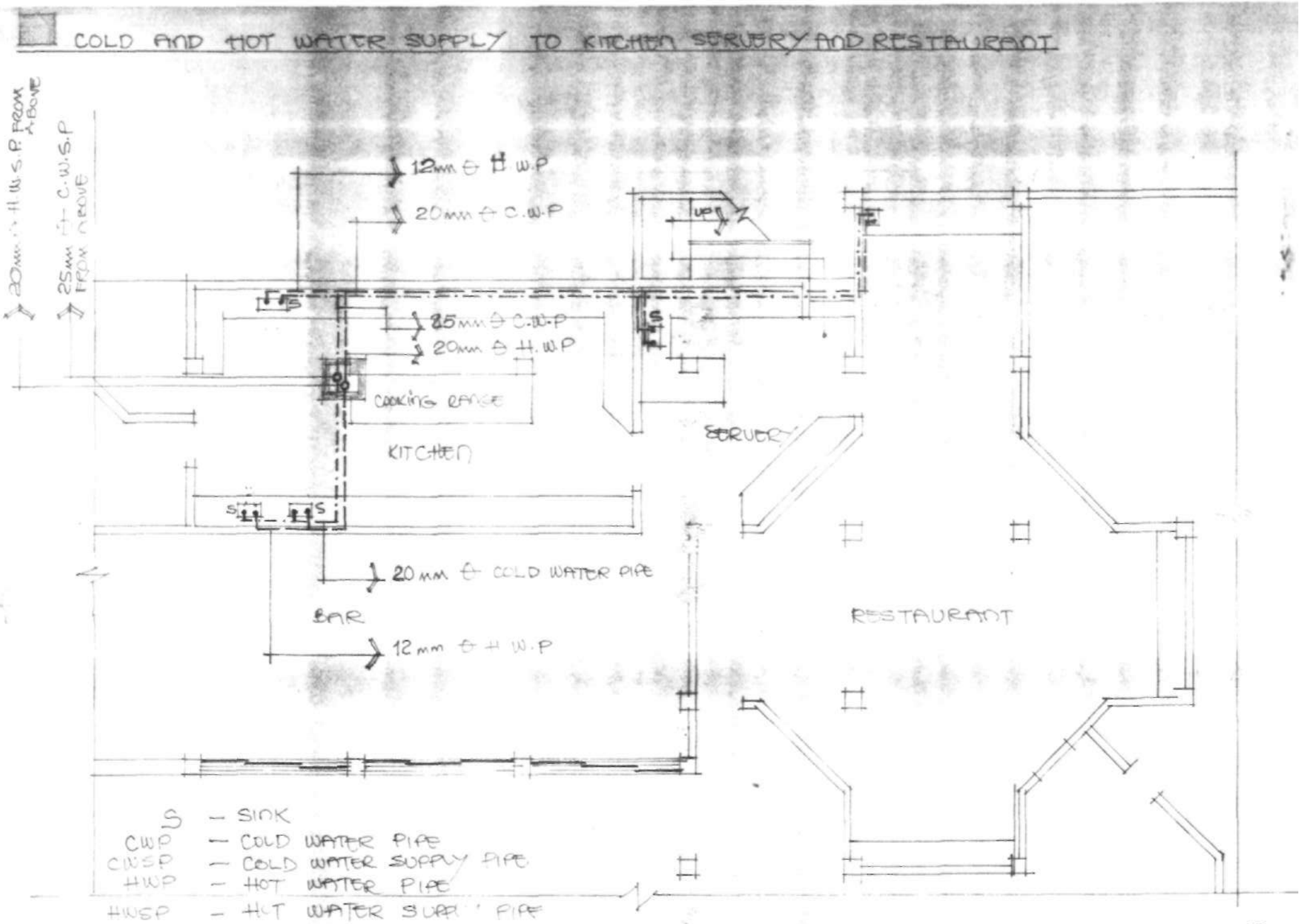
Thus 100mm diameter pipe will run from the water tank to all installations. Since the installations are located in various parts of the building and not in a single direction, the pipe supplying various parts of the building will have differing sizes. For the left wing of the building the pipe sizing is as contained in the next section.

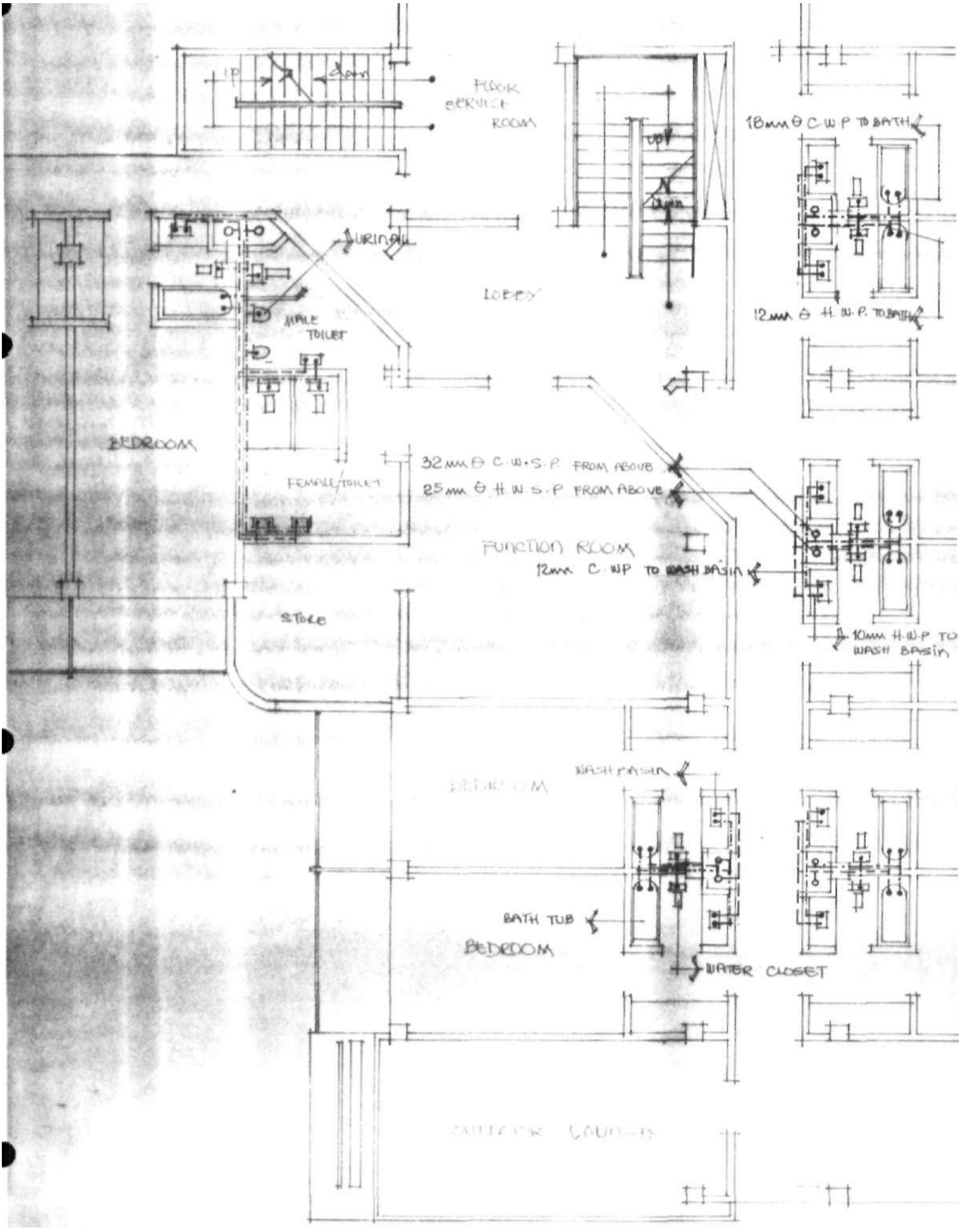

20
30
50
100
200
300
500
1000
Total number of demand units

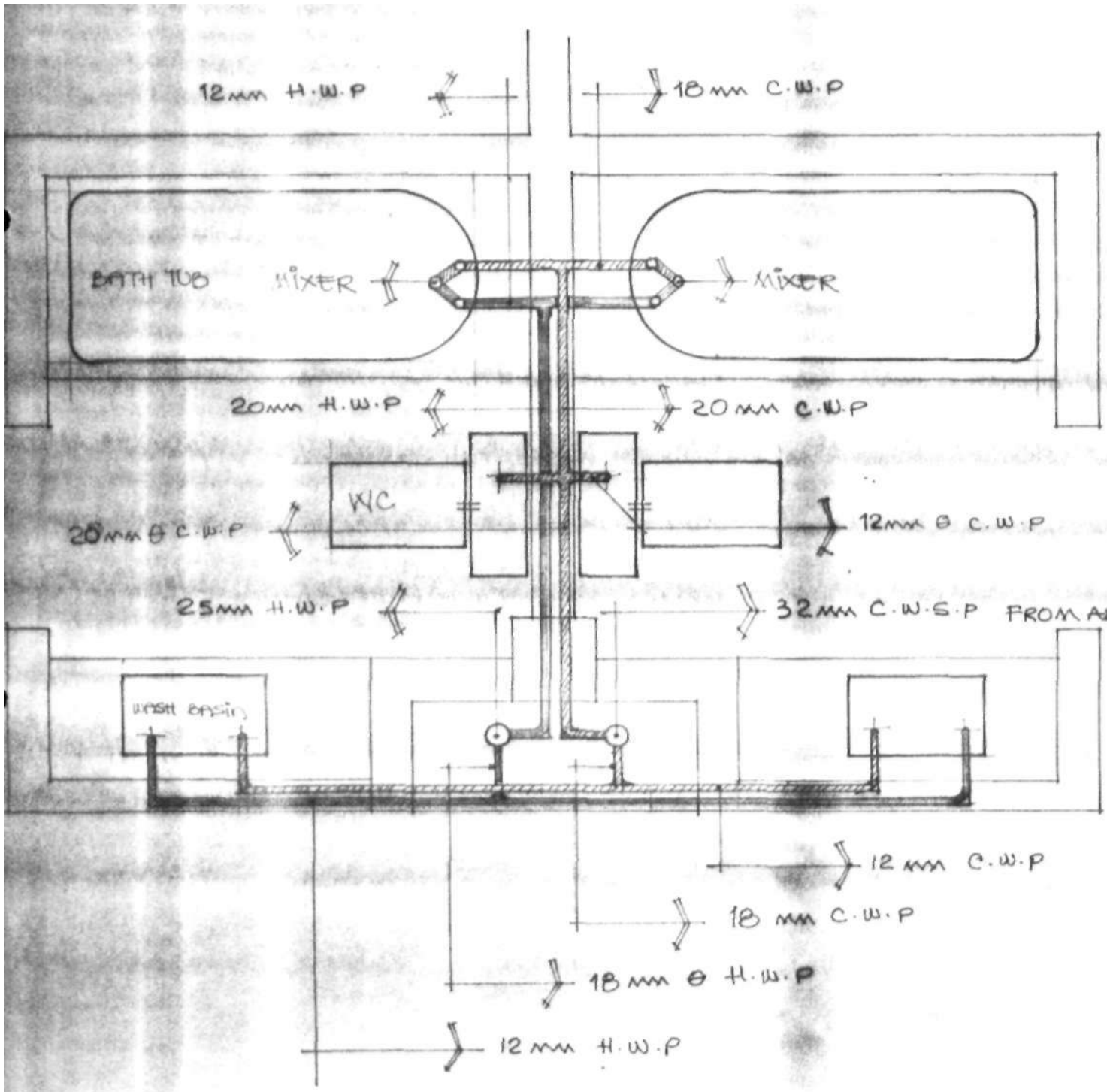


195 Nomogram for water supply pipe sizing

COLD AND HOT WATER SUPPLY TO KITCHEN SERVERY AND RESTAURANT




UP
DOWN
FLOOR SERVICE ROOM
UP
DOWN
18mm Ø C.W.P TO BATH
URINAL
LOBBY
MALE TOILET
12mm Ø H.W.P. TO BATH
BEDROOM
32mm Ø C.W.S.P FROM ABOVE
25mm Ø H.W.S.P FROM ABOVE
FEMALE TOILET
FUNCTION ROOM
12mm C.W.P TO WASH BASIN
STORE
10mm H.W.P TO WASH BASIN
WASH BASIN
BEDROOM
BATH TUB
WATER CLOSET



C.W.P. – COLD WATER PIPE
C.W.S.P – COLD WATER SUPPLY PIPE
H.W.P. – HOT WATER PIPE
H.W.S.P – HOT WATER SUPPLY PIPE

C H A P T E R VI

SERVICES REQUIREMENTS OF A 45-BEDROOM HOTEL - ELECTRICAL INSTALLATIONS, AND ALLIED SERVICES

Lighting

Lighting contributes to safety, operation and pleasantness of building interiors and to the activities that take place within them. Because of the costs associated with lighting, it is important that spaces should be lit in the most economical way possible. This is however not to mean a reduction in lighting standards which have been established over long years of experience and research work and found acceptable by most people.

6.1.1 Electric light and/or daylight.

There are three approaches to the issue of lighting an interior space, as enumerated below. Each approach has its own justifications and selection would depend purely on the situation.

(a) The first approach is the use of only daylighting during the day and electric light after sunset. This method is feasible if the depth of the spaces from daylight access is not much and if the area open to admit daylight is adequate. Under such circumstances, in the event of slight changes in atmospheric consistency, like cloudy skies, the lights could be turned on as a temporary measure. This cuts down on energy consumption drastically.

(b) To use electric light as a permanent supplement to daylight.

A combination of electric light and daylight is practicable in circumstances where the natural

light admitted is not enough for the activies going on in the interior of the spaces and supplementary electric light would be required to arrive at desirable illumination levels. It has been established that most people prefer rooms that have a view outside, and enjoy subtle and continous changes of daylight, and the distinctive appearance of some buildings that have natural lighting. To be effective however a combined lighting must be carefully planned.

(c) The third approach is to rely on electric light only, with daylight virtually excluded, probably because the area has no windows at all or the windows are very small or glazed with very low transmission levels. This method is most desirable when the functions in the space demand for a fully controlled environment lighting wise.

6.1.2 Lighting Criteria.

In lighting spaces, visibility and a satisfactory visual environment must be seperately considered, as lighting that gives one may not necessarily give the other. Visibility is the ease with which important details of task can be recognized. The lighting of an interior is however, judged by the overall appearance of the space as a whole. There are numerous factors that affect both visibility and appearance.

Visibility would be influenced by sizw, and reflectance of the task details, the contrast between the details and their background, and the amount, derection and colour of the light which illuminates the task.

Appearance of an interior is affected by the general brightness, the patterns of light, shade and colour

throughout the space, the degree of glare experienced and the modelling of people, objects and structural features of the room.

6.1.2.1. Quantity of light

The quantity of light is generally specified by the illuminance on the working plane, which is usually assumed to be horizontal. The working plane could be the immediate area of the task or it could extend throughout the entire interior.

The illuminance which would be required by a specific task would depend on (a) visual difficulty of task, (b) complexity of task, (c) eyesight quality of workers, and (d) expected level of visual performance.

The recommended minimum level of illuminance for all working areas is 200 lux and in areas where no daylight is present, 500 lux. For recommended task illuminances in a hotel building see table 6.1.

The illuminance on an interior is related to the general brightness and the reflectance of surfaces. In spaces with light walls and fittings,

Table 6.1

General schedule for lighting in hotels (IES code 1977)

	Standard service illuminance (lux)	Position of measurement	Limiting Glare Index	colour appearances of lams.	
Entrance Halls					
General	75 scalar	1.2m above floor	19	Intermediate or warm	
Reception, Cashier,	300	Desk	19	"	
Public Rooms:					
Bars	150	Table	--	"	Flexibility of control for variety lighting
Dining Rooms grill rooms restaurants, general	100	Table	--	"	Additional table lighting may be required.
Cash desks	300	Desk	--	"	"
Lounges	100	1.2m above floor	16	"	
Writing rooms	150	Table	19		
cloakrooms	150	floor	--	"	additional mirror lighting
Bedrooms/ general	50	floor	--	"	
bedhead	150	bed	--	"	
Bathrooms	100	floor	--	"	
Service areas					
Kitchens					
food stores	150	floor	--	"	
working areas	500	working surface	22	"	
laundries	300	working plane	--	"	proof luminares required.

and usual lighting system, like diffusing luminaires, the impression of brightness corresponds reasonably well with the illuminance on the horizontal plane.

6.1.2.2. Daylight factors.

The quantity of natural light required in an interior is usually specified by a daylight factor, rather than by illuminance, as the quantity varies continously. Recommended factors for daylight (minimum and average) for selected interiors are given in I.E.S. codes. It is important to note too that room surface reflectances affect the quantity of daylight available in a room.

6.1.2.3. Reflectance of room surfaces.

The reflectance of major room surfaces has a vital influence on both electric lighting and daylighting, so also the interior fittings and decorations have their own effects. The kind of effects that these world have however depends on the nature of the lighting and the size of the interior.

In a room with a white ceiling, reasonably light walls, and surface-mounted diffusing luminaires, up to 50% of the illuminance on the working plane is contributed by light interreflected from walls and ceilings.

(a) Ceilings: In a room which is small compared to its height the ceiling is not conspicous and the proportion of light contributed on the working plane by reflectance is also small. In a large room this is not so. The ceiling becomes conspicous visually and the proportion of illuminance contributed at the working plane becomes much more.

Similarly painting the ceiling and upper walss of a small room in a colour of relatively low reflectance, may be of some advantage architecturally, and there

would be little effect on the lighting, However if the room is large and the same treatment is applied, the outcome would be intolerable. Under such circumstances a white or near-white ceiling is most desirable.

(b) Walls: The impact of wall surfaces is also affected by room size. In a small room the walls constitute a large proportion of the visual field and affect to a considerable extent the amount of light reflected to the working plane. Thus the colour and illuminance of small rooms have a decisive effect on the 'atmosphere' of the room and the energy required to achieve a given illuminance. In a larger room with a relatively low ceiling, the visual and reflective significance of the walls is less, thus there can be much greater freedom in colour treatment.

The building materials used in finishing the wall surfaces are also of grave importance. For instance timber panelling is after visually pleasant in small rooms where as if plain walls are painted the same colour it might lead to a depressing effect. This is similar the effect of book shelves. Though the reflectance of the bookshelf may be low, it may not be bad to look at, and at least may be better than a wall painted in the same colour.

(c) Floors and floor cavities: The floor cavity is regarded as the part of the room below the horizontal working plane, or below about 1m where there is no suitable reference plane. The floor cavity forms a substantial part of the field of view in most interiors and the choice of colours and texture would affect the appearance of the room. Light floor increases the utilization factor and reflect more light to the ceiling, though extremely light

floors have their own complications. Striking the right balance between the various factors is the most logical approach to lighting problems.

The area of glazing needed to achieve a given daylight factor is less when the room surfaces are light coloured than when they are dark.

6.1.2.4. Colour

The colour appearance of a lamp refers to the apparent colour of the light it emits. The colour of the light illuminating a room, and the appearance of surface colours within it, are important considerations in the design of lighting schemes. Lamp colour appearance can be categorized as "cool", 'intermediate' or 'warm'. At illuminances less than 300 lux, the last two types of lamps are prefered.

The colour of flourescent lights changes with ambient temperature unlike other lamps and to some extent also with loading. The temperature effects may be quite apparent, for instance, in an installation in which some lamps are housed in luminaires of a normal type and others in air-handling luminaires. The passage of air throught the latter cools the lamps and a change in colour occurs. It not practise to combine lamps of apparently different colours.

Good colour rendering is desirable, but the cost of providing it must be weighed against the advantages. For instance, the better the colour rendering of a flourescent lamp the lower in general is its luminous efficacy and therefore the greater the energy required for a prescribed illuminance.

6.1.2.5 Glare (I.ES code)

Glare occurs when luminaires, windows or other sources, of light, seen directly or by reflection, are too bright compared to the general brighness of the interior.

Glare can impair vision (disability glare) and could also cause visual discomfort (discomfort glare). The two effects may be experienced seperately or simultaneously.

Disability glare may be due to a very bright source or its image lying close to the line of sight when attention is focussed on a task. Screening such a source would immediately eliminate such glare. It is therefore recommended that visual tasks should preferably be so located that no bright source or its image has close to the line of sight. Where this is not practicable, the glare source should be screened from view, or its luminance reduced, or the relative positions of task, observer and source changed appropriately. In very difficult cases, the task illuminance may have to be increased.

Glare from general lighting systems in working interiors is more likely to produce discomfort than disability. The effect may however not be immediately apparent but is cummulative and can result in people feeling excessively tired towards the end of the day, especially if their work is visually exacting. For this reasons restrictions on discomfort glare are neccessary, but if too severe may result in the interior appearing to lack 'life' and interest.

The degree of discomfort glare would depend on the room size and the pattern of decoration as well as on the lighting system, and may be expressed by a glare index that can be calculated for a particular interior and lighting system. The calculated index can then be compared to the limiting glare indices for various interiors in a hotel building are given in table 6.1.

It is suggested that calculated glare index for any interior should not exceed that set out in the limiting

values table.

In an interior where more than one type of activity goes on the glare index should not be greater than the lowest of the limiting values recommended for the individual occupations.

In the event that it is not convienient to calculate a glare index or, where applicable, to restrict luminaire luminance, an empirical method should be used to ensure that glare in the interior is not excessive. For example, the lamp may be shielded from direct sight at usual angles of view by reflectors, louvres or structural features of the interior (fig.-6.1.); the lamps may be enclosed in diffusing covers whose average luminance at usual angles of view is not greater than 500 cd/m^2 ; and in corridors and passages lit by unscreened flourescent lamps, the lamps should be mounted in line with the corridor, not across it. Unscreened incandescent or high pressure lamps should not be used for lighting these spaces.

6.1.3. Equipment for lighting.

There are three types of lamps that are commonly used for lighting interiors;

(a) incandescent (tungsten general lighting service, tungsten halogen)

(b) tubular flourescent; and

(c) high pressure discharge (mercury flourescent, mercury halide, sodium)

The characteristics of various lamps can be found in the IES code 1977, tables 4.

Incandescent and tubular flourescent lamps give virtually full light output immediately they are switched on. On the other hand most high pressure discharge lamps may take several minutes to reach full light output and from 1 - 20 to restrike after an interruption in supply.

Starting devices used in discharge lamp circuits are generally refered to as control gears. They include ballasts, capacitors etc. Where as ballasts and/or supress radio interference, and other starting devices provide high voltage pulses to initiate the discharge through the vapour or gas.

Provided they are properly maintained and the installation requirements are met most luminaires will give satisfactory service for at least 10 years.
The control gear used with flourescent and high pressure discharge lamps usually generate some noise which may be amplified by luminaire and its mountings. Such noise is seldom noticed in offices and factories where the noise level of other sources is fairly high, but it may be a nuisance in quiet rooms.

6.1.4 Maintainance of fittings

It is recommended that lighting systems should be properly maintained to reduce deterioration of equipment, promote safety, keep lighting performance within design limits and to minimize electrical load and costs. Renewal of failed or faulty lamps and control gear, replacement of cracked glazing, repair of any intervals are all steps to ensuring good maintainance.

The most suitable replacement cycle for a given type of lamp is usually recommended by the manufacturer. The cycle is determined by records of the failure rate and the fall in light output with time to an uneconomical level.

Dirt and dust on lamp and luminaire surfaces absorb light and reduce illuminance by 20% or more. Since the rate at which dirt is deposited is dependent on air pollution it is adviced that economic cleaning interval should be determined based on the particular situation.

6.1.5 Lighting design

In this section the lighting for the bedrooms Kitchen, and Reception shall be designed and specified. The lumen method which is still the most widely used method shall be adopted and the format for design shall be that employed in the I.E.S Code 1977.

6.1.5.1 Bedroom type 1

1.	Type of interior	Bedroom (4.5x3.35x2.80)m
2.	Service illuminance En	50lx
3.	Limiting glare index	-
4.	Lamp reference letter	-
5.	Special Requirements	-
6.	Room dimensions	h_m = 2.3 , h_s = 0.5 length (l) = 4.65, width (w) =3.35
7.	Room Index (RI)	$\epsilon i = \frac{l \times w}{h_m(l+w)} = \frac{4.56 \times 3.35}{2.3(4.55+3.35)}$
8.	Room reflectances: Ceiling, walls, floor surface effective wall reflectance	= 0.847 $\rho c, \rho w, \rho f$ = 0.8, 0.4, 0.1 ρwe = 0.1
9.	Average Surface reflectance of gross areas above luminaires	$\rho u = \frac{2\rho w(l+w)hs + \rho c(lxw)}{2(l+w)hs + (l+w)}$

	$= \frac{(2x0.4 \times 8x0.5)+(0.8 \times 15.6)}{(2x8x0.5) + (15.6)}$
	$= \frac{15.68}{23.6} = 0.66$
10. Ceiling Cavity Index	$Kc = \frac{lxw}{hs(l+w)} = \frac{15.6}{0.5(8)} = 3.9$
11. Ceiling cavity reflectance	$Pcc = \frac{Pu\ Kc}{Kc+2(1 - Pu)} = \frac{0.66x3.9}{3.9+2(1-0.66)}$
	$=0.562$
12. Select luminaire and note utilization factor corresponding to ceiling floor and wall reflectances given in manufaturer's catalogue.	Thorn NM 100 Surface mounted B46 diffuser UF (assume 0.35)
13. Spacing of luminaires	S = 4.65 meters
14. Number of lamps	$n_1 = 2$
15. Lamp Luminous flux	$\phi_1 = 700$
16. Luminaire Luminous flux	$n_1 \times \phi_1 = 2x1400 = 2800$
17. Maintainance factor	MF = 0.9
18. Number of Luminaires	$N = \frac{E(h)xWxL}{n_1 \times \phi_1 \times UF \times MF}$
	$= 2$
19. Final actual illuminance	$E(h) = \frac{N \times n_1 x \phi_1 \times UF \times MF}{W \times L}$
	$= \frac{2x2x700x0.35x0.9}{15.56}$
	$= 56.61$

6.1.5.2 Bedroom type 2

The parameters are the same with bedroom type 1 up to item 18 and in item 1 bedroom dimensions are L = 5.3, w = 3.35 and h = 2.80 (all dimensions in meters)

18. Number of luminaires

$$N = \frac{E(h) \times W \times L}{n_1 \times \phi 1 \times UF \times MF}$$

$$= 2$$

19. Final actual illuminance

$$E(h) = \frac{N \times n_1 \times \phi 1 \times UF \times MF}{W \times L}$$

$$= \frac{2 \times 2 \times 700 \times 0.35 \times 0.9}{17.75}$$

$$= 49.6$$

6.1.5.3 Kitchen

1. type of interior — Kitchen (L=9.5, w=4.5, h=3.2)
2. Visual Task — Cooking and associated functions.
3. Service illuminance — E(h) = 500 Lux
4. Limiting glare index — 22
5. Lamp reference — Thorn Luminaire twin tube trouffer with flat opal panel PTRA2675
6. Special requirements — Position luminaires relative to working areas, proof luminaires may be required.
7. Room dimensions — hm = 2.2m, hs = 0.65m, L=9.5 w = 3.2
8. Room index

$$RI = \frac{Lx_w}{hm(L+w)} = \frac{9.5 \times 4.5}{2.2(9.5+4.5)}$$

$$= 1.39$$

9.	Room reflectances; ceiling, walls, floor surfaces	$\rho c = \rho w = 0.25$, $\rho = 0.3$
10.	Select luminaire and note utilization factor corresponding to ceiling floor and wall reflectances given in manufacturers catalogue	Thorn FTRA 2675 twin tube troffer with opal panel BZ 4 diffuser. ULOR 0.00 DLOR 0.38 U.F. 0.3
11.	Recommended spacing mounting height ratio	S/hm = 1.62
12.	Spacing of luminaires	S =
13.	Number of lamps per luminaire	N_1 = 2
14.	Lamp luminous flux	ϕ_1 = 5650 lumen
15.	Luminaire luminous flux	$n_1 \times \phi_1$ = 2x2700 = 5400 lumen
16.	Maintainance factor	0.8
17.	Number of Luminaires	$N = \frac{E(h) \times W \times L}{n_1 \times \phi_1 \times UF \times MF}$ $= \frac{500 \times 9.5 \times 4.5}{2 \times 5650 \times 0.3 \times 0.8}$ = 7.88 = 8 luminaires.
18.	Decide practical layout taking into account position of beams etc.	See electrical drawings
19.	Find actual illuminance	$E(h) = \frac{N \times n_1 \times \phi_1 \times UF \times MF}{W \times L}$ $= \frac{8 \times 2 \times 5650 \times 0.3 \times 0.8}{9.5 \times 4.5}$ = 507.50 Lux

It is possible to design the method of design of lighting fittings illustrated above has been applied in all the other spaces in the hotel. It would be superflous to state the procedure for all spaces, instead the electrical drawings will take care of all the spaces in the hotel.

The sources of data for the calculations include:

(a) The IES code 1977
(b) .. EE Regulations for the electrical equipment of buildings.
(c) Thorn EMI catalogue 1980
(d) Thorn EMI photometric data 1984
(e) Thorn EMI Technical handbook 1984.

6.2 POWER SUPPLY AND WIRING

6.2.1 Power supply

The regulations guiding the power supply to premises are quite explicit in respect of the type of supply for various building loads. For domestic premises supply is normally at 240/415 volts from the power authority overhead cables. However where the total power consumption is expected to exceed about 100Kw it is advised that such consumers should provide a space on their properties for the installation of a stepdown transformer, as the supply from the power authority is preferably at 11KV. with the transformer, the power can then be stepped down to a 240/415 volts three phase, four-wire supply.

The power consumption in the hotel in question is oovviously in the excess of 100Kw and it is therefore recommended that a stepdown transformer shall be installed on the site to step down the line transmission of 11KV to 240/415 volts. (See

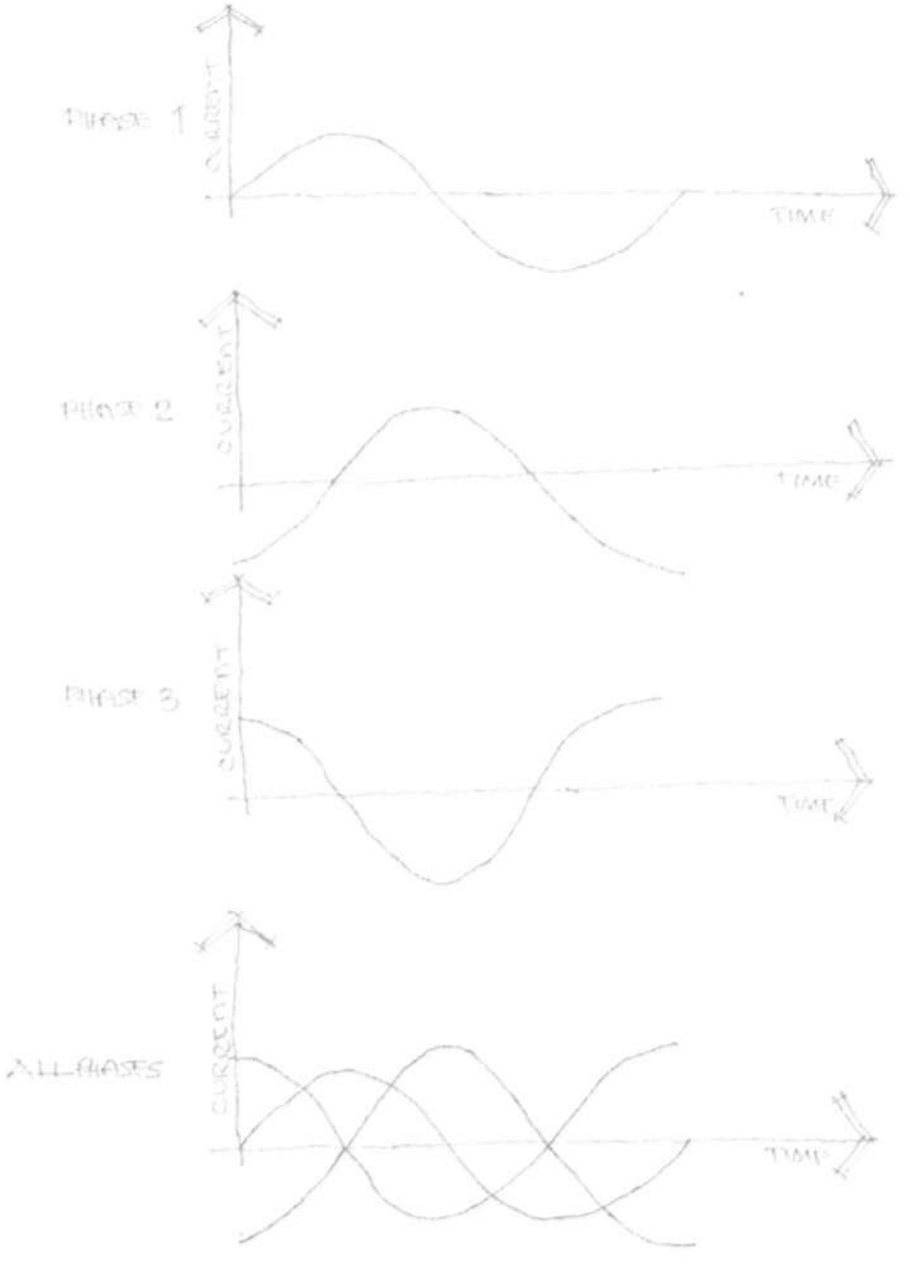
attached drawings for the transformer arrangement schematic.).

6.2.1.1

Three-phase supplies.

A three - phase supply implies that there are three seperate supplies, each of which are out of step with the others by equal amount. Fig. 6.1 Taking any one of these supplies as the reference, the other two are respectively one-third and two-thirds of a cycle out of step.

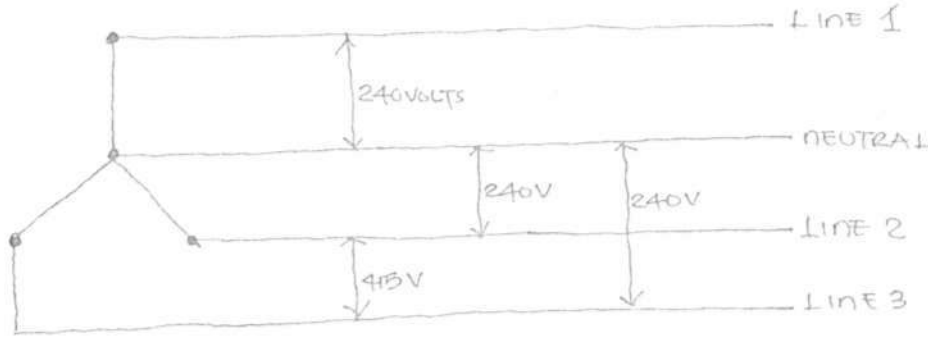
Fig 6.1



Power supply consistency in the country is highly below desirable levels and it is important that alternative sources of power supply be arranged to supplement would have to be installed. Because of the level of power consumption in a hotel of the prescribed size, it would be a very large investment to provide a generating set that would meet the entire power consumption of the hotel and it is possible and probably the most practicable thing to do to provide a generating set capable of taking care of the essential power points and lighting such points would include, supply to Kitchen area and bar and all equipment apart from air-conditioners in the entire building such a system described above is refered to as a stand-by power supply system.

In a three phase supply, a common return wire refered to as the neutral wire is used, such that each of the line cables (corresponding to the three phases) is 240V alternating voltage, with the neutral wire. (Fig 6.2) The voltage

FIG 6.2



between any two of the lines is 1.732 times that between any line and neutral and is 415 volts, where the line to neutral volt is 240volts.

Loads may be connected between any of the line cables and the neutral and if these loads are equal it would be discovered that there is no current in the neutral at all, the three return currents, having cancelled each other out. How be it even if the leads are not equal, the current in the neutral can never exceed the greatest current in any of the line cables.

It is advisable that the load on the three phases should be balanced in any installation, so that the current in the neutral may be kept to a minimum, however, lighting points or socket outlets that are close together, should be served from the same phase so as to avoid, the risk of a 415 volts shock. There are certain appliances that are designed to be connected to a 3-phase Supply, and in most cases would not require a neutral connection - notably motors.

The method of installing such a supplementary power supply arangement (see schematics) involves a change over switch in a switching room preferably adjacent to the generator house. It is adviceable that the switching arrangement should be automatic. Beyond the switching point the rest of the system would be arranged as if there is no standby.

6.2.2. Phenomena associated with power supply

6.2.2.1 Excess current (Heating effect)

Anything which carries an electric current gets heated up with time to some extent, determined by the amount of current, the length of time and the size of the conductor.

Usually this heat is put to use, like in the filament of a lamp or the element of a heater. However some of the heat thus generated is wasted, for example, in the cables that supply appliances

and fixtures. The object of design should be to keep such wasted heat to a minimum, because if the cables get too hot they might melt, which could result in short - circuit and may be fire.

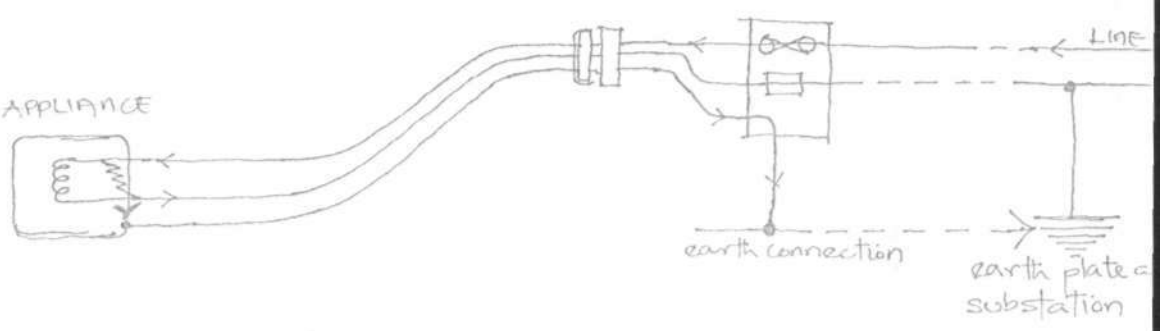
Every circuit should be provided with a fuse or circuit breaker to guide against excess current described above. These devices are safety devices whose function is to prevent too great a current from flowing through the system beyond it in the event of an accident.

A fuse is a circuit breaking device consisting of a fine length of wire connected between two terminals each on the demand and the supply side of the circuit. The size of the wire used is such that, they will just carry the current for which the circuit was designed, but will melt if the current rises significantly above the designed figure. In modern times the use of circuit breakers that are automatic in operation is most common. The circuit breaker automatically switches off once too much current passes through. They would simply be switches on again after the fault has been rectified, which makes them more convienient than fuses, where the wire that melted would hape to be replaced.

There are two types of fuses which are usually employed in installations; rewireable fuses and cartridge fuses. (Fig. 6. 3). If the fault in an installation occurs after the installation has been switched on for sometime, (whereby the wire of the rewireable fuse has warmed up a bit) then there is a likelihood that it would reach its melting temperature faster in the event of excess current passage. If however the installation has been switched off over a long period and shortly after switching on there is an incidence of excess current flow, it might take some time for the wire to bread down. Also if the fuse is not well fixed into place, convection currents may occur round the wire and alter the characteristics.

other cable called the neutral is connected to earth through an electrode at the transformer or substation. Fig. 6.4 shows an electric appliance connected to a three - pin plug and socket being connected to earth by means of the sheath of the service cable.

Fig 6.4



If there is a fault in the appliance, such that the line cable comes into contact with the metal case, which in effect means the line cable is connected through this path. If the resistance of the earth leakage path is low enough, a heavy current will flow which will be sufficient to blow to fuse. If however the resistance of the earth leakage path cannot be guaranteed to be low, then a 'Protective Multiple Earthing' could be provided. This involves earthing the neutral at each of the consumer's premises by means of a simple earth rod.

6.2.2.3 Earth leakage circuit breakers.

These are simply refered to as ELCBs. There are two types, one of which is voltage operated and the other current operated. The voltage operated one requires an earth connection, but this can be a simple rod driven into the earth. The circuit breaker measures the voltage between the metalwork. Enclosing the apparatus and the voltage at the earth rod. If this rises above 40 volts, which is considered to be the lower limit for dangerous shocks, it turns the system off. In the IEE regulations they are refered to as fault-voltage operated protective devices.

The current balance circuit breaker is now generally used. In the IEE regulation it is called the residual current device. This device continually compares the current in the line with that in the neutral and if these are exactly equal the circuit is maintained. However if for any reason, there is a difference, by more than a certain amount the circuit breaker turn the supply off.

6.2.2.4 Protection against electric shock

The 15th edition fo the IEE regulations requires that a fuse or circuit breaker be rated such that it will disconnect circuit within five seconds of an earth fault occuring for fixed appliances but within 0.4 seconds of an earth fault occuring for socket outlets. This is because items usually connected to socket outlets are more likely to be gripped very tightly, than fixed appliances.

Not only metal cases of electrical apparatus present a shock risk. Al metalwork which may at any time come into contact with the electrical system offers some risk. The IEE regulations require that main water pipes and other service pipes and ductwork, rising mains of central heating and air conditioning systems and any exposed metallic parts of the building structure, be bonded (firmly connected) to the main earth terminal by conductors of

6.2.3 Wiring

6.2.3.1 General

Wiring is carried out by means of cables, which consist of conductors sorrounded by insulation. In most cases the conductors are made if copper, which has a very low electrical resistance, though aluminium and other metals are now increasingly used. The insulation must be of high electrical resistance, usually rubber, paper or plastic. Cable sizes are metric and are based on the cross - sectional area of the

conductor; 1.0mm^2, 2.5mm^2 etc.

A single strand conductor with a diameter of 1.13mm is usually represented as; (1/1.13), like a 1mm^2 conductor. Similarly a stranded conductor of 4mm^2 cross sectional area having 7 strands each of 0.85mm diameter is represented as; (7/0.85).

The 'rating' of a cable is the largest current which it may carry without becoming too hot, the temperature limit being such as to prevent damage to insulation.

The voltage drop in a conductor between the supply point and the apparatus is the voltage required to drive the current carried in the conductor against the resistance of the conductor. For a given current the voltage drop is reduced with increased size of conductor. Cable sizing should therefore take into consideration voltage drop. The maximum drop permitted is 2.5 percent, which interpretes to 6 volts on a 240 volts supply, (IEE regulations).

6.2.3.2 Methods of wiring

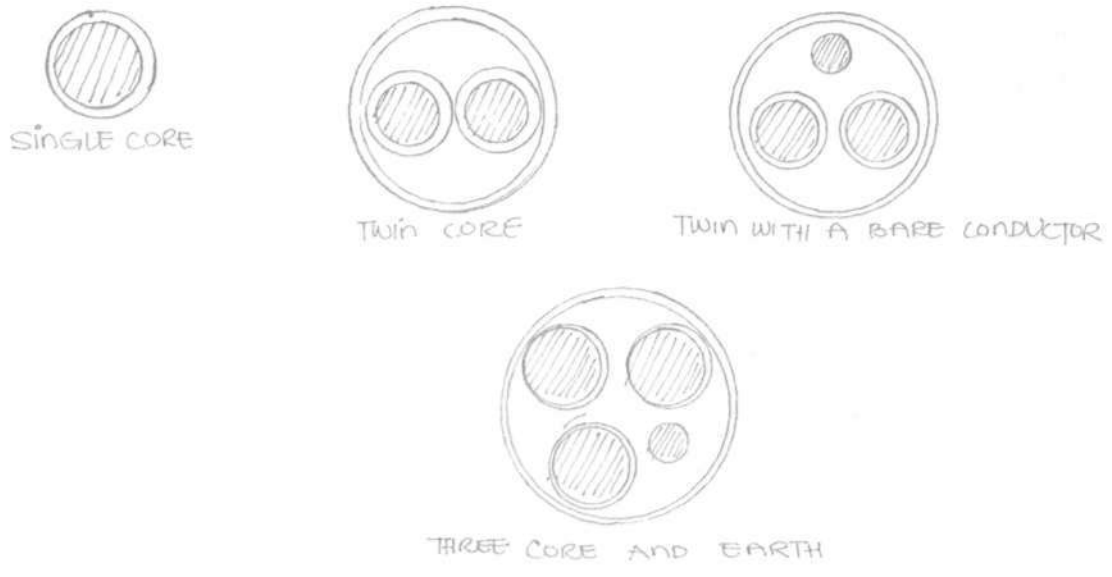
There are three basic methods of wiring now in common use.

(a) Sheathed wiring

This consists of one or more conductors each insulated, and all enclosed in an outer sheath of the same material of insulation or other insulting material. Sheathed wiring can be obtained single - care, that is with one conductor only; twin core, with two conductors; twin with earth, that is two insulated conductors and one bare circuit protective conductor all enclosed in an

outer sheath; and finally three-core and earth with three seperately insulated conductors and a CFC all enclosed in one outer sheath. See Fig. 6.5

Fig 6.5



(b) Conduit installations.

The screwed steel conduit is still the reference standard by which most other systems of wiring are judged. The function of the conduit is to give mechanical protection to the cables and also itself to form the earth leakage path.

Conduits are available in light steel, copper and plastic. Where plastic conduits are used an additional circuit protective (earth) conductor has to drawn through them as they cannot for a path for earth leakage themselves.

(c) Mineral insulated copper covered cables.

The cables contain conductors consisting of single strands of copper all enclosed in a thin copper sheath. They may be obtained with from one to seven cores.

The tube is packed with highly compressed magnesium oxide which holds the conductors in place and insulates them from the sheath and from each other.

6.2.4 Distribution arrangement

The type of distribution arrangement usually depends on the size of the building and the loading characteristics. For the hotel under consideration the loading pathern can be broken down as follows:-

(a) Lighting points on ground floor

i - Kitchen, servery bar and related areas

ii - Entrance area, reception, offices, restaurant and Boiler room

(b) Lighting point on first Second and third floors.

i - Left wing bedrooms and toilets and associated corridor.

ii - Right wing bedrooms and toilets and associated corridors and spaces.

(c) Power points in spaces associated with (a) and (b) above including

i - Socket out lets
ii - Air conditioning equipment
iii - Heating equipment
iv - Kitchen equipment

The mode of supply to each category of demand points and the control of such supplies shall be discussed shortly.

An intake room should be provided which should be large enough to accomodate all the controls and meters that are to be associated with the installations at this stage of supply. The size of this space shall be determined only after the complete distribution arrangement has been arrived at. The most suitable kind of intake panel for buildings of a size similar to that with which we are concerned is the cubicle switchboard. They are factory-built and are better looking than made up types consisting of individual components singly mounted.

It is adviceable that if the total power consumption of the building is above 100 KW the supply to the premise should be from an 11-KV line. This line voltage would then be stepped down at a transformer on the premises. The current rating of the transformer would be determined from the total power consumption on the premise using the

formula;

$P_o = VI$ where P = Total power consumption
V = Voltage
I = Current

To the power consumption of some appliances and fitings would be applied some power factor for capacitance, inductance and other resistances, that also consume some power seperate from the ratings of the appliance. The transformer would normally have an in-built switch gear.

The supply from the transformer would be taken to the intake room and terminated at the change over switch between the authority's supply and a stand - by (generator). Se electrical drawings for details of arrangement. From here power is fed into a main bus-bar which subsequently feeds distribution boards controlling various parts of the building, and which consist of miniature circuit breakers which control the final subcircuits. For heavy loads individual Isolators shall be used to control supply.

6.2.5 Sub-circuit wiring

6.2.5.1 Socket outlets

For general purpose work the 13 amp socket outlet is the most useful. The method of wiring to these outlets is called a ring circuit and is illustrated in Fig. 6.

Twin with earth 2.5mm^2 cable is taken from a 30amp MCB on the distribution board to the first socket outlet. From here it runs to the second and subsequent outlets and from the last it returns to the circuit breaker. Each ring can serve an area of about 100m^2 or a maximum of

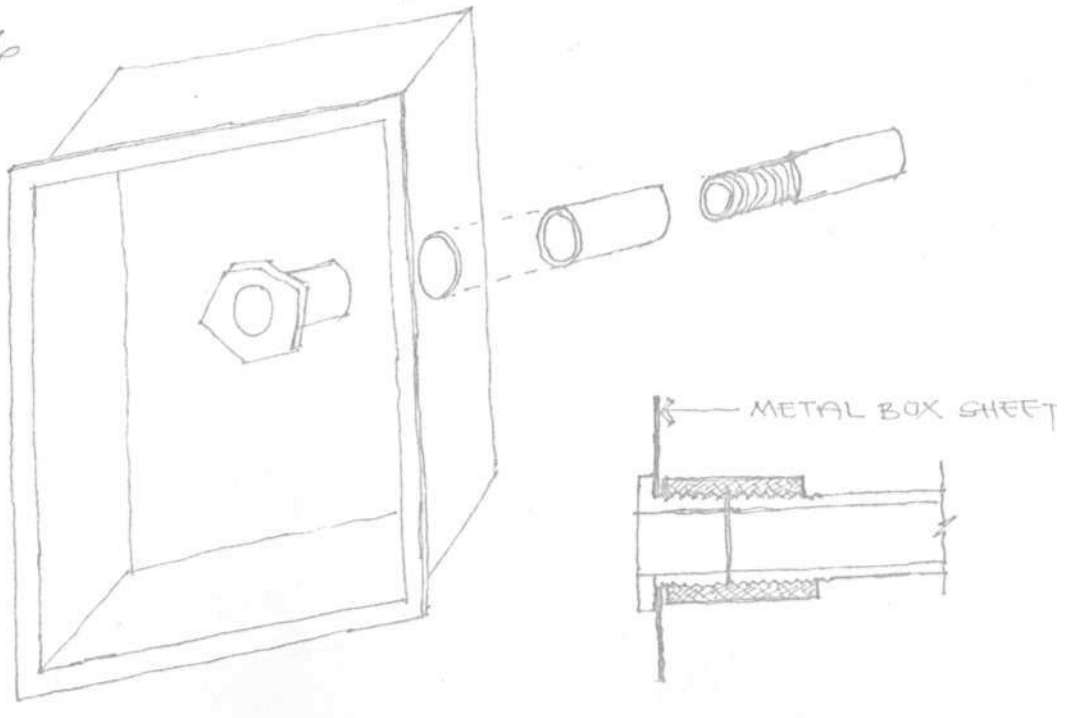
6 outlets and 3 spurs in accordance with IEE regulations.

The spur wiring consists of a single run of 2.5mm^2 cable only joined to the ring at one socket. There cannot be more than a single or twin socket outlet from a spur, and not more than half the number of sockets on the ring. Although the ring circuit is protected by a 30amp MCB, this is too large to protect the appliances that may be connected to the individual socket outlets and such appliances must have their own protection arrangements.

6.2.5.2 Conduit wiring

Steel conduits are used for most medium and some large scale installations. They are manufactured in metric sizes. Two sections of conduit are connected by means of a coupler or boxes.

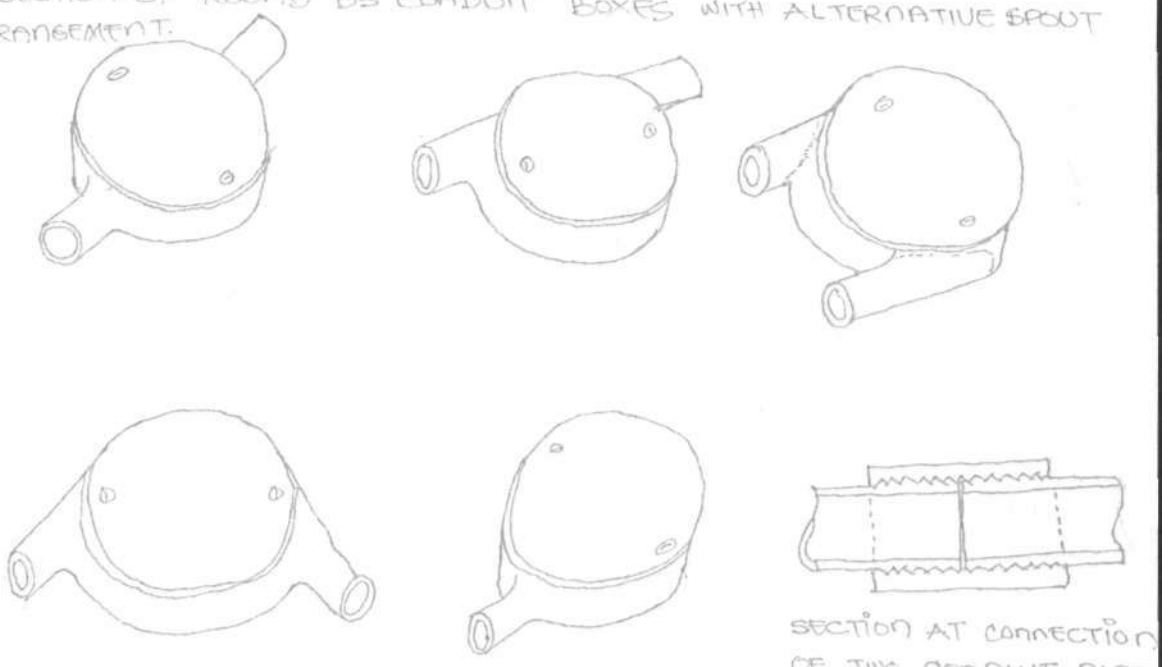
FIG. 6.6



METHOD OF CONNECTING CONDUIT TO SHEET STEEL BOX

Circular boxes are provided with spouts which are threaded internally to accept the threaded end of the conduit. Pressed steel boxes are also available which do not have spouts and the conduit is connected to these boxes by means of a coupler and male bush.

FIG. 6.7 SELECTION OF ROUND BS CONDUIT BOXES WITH ALTERNATIVE SPOUT ARRANGEMENT.



Joints between lengths of conduit and between conduit and junction boxes must be securely made as the conduit acts as the earth leakage pipe in steel conduits.

6.2.5.3 Trunking

Where a large number of cables have to follow the same route it is often better to use trunking in place of many conduits. This consists of a metal trough with detachable lids and conduit or MICC cables may be connected to it. In large installations it is good practice to ensure that trunking runs are used between intake position and each area or floor in the building. The advantage of trunking is that the wiring to auxilliary services may be run in the same trunking as the wiring to lighting and power outlets.

6.3 Allied Services

Auxiliary services in a hotel building consists of

(a) telephone and intercom system
(b) Alarm systems
(c) Television antenna system/Video system
(d) Background music/Public address system

(a) Telephone and intercom system.

The provision of telephones and/or intercom in a hotel is a very essential service which has already been discussed in earlier chapters. For a hotel of the prescribed size at least three lines would be needed. One for the Manager, another for the Management and the third for the hotel users. Various manufacturers of equipment have differing specifications for installations and the important thing is the provision of the path in the building to the expected positions for telephones and the operator desk. The telephone cables carry very low currents and should be seperated from electrical cables.

They can however be run in the same conduits with other low current - carrying cables like that of Television and video. (see telephone and television antenna system drawings).

(b) Alarm systems

Alarm is very useful in the case of emergency. Fire alarms are the most popular form of alarm systems. There are many types with different methods of operation, Fire alarms may be fed from the supply mains or preferably from batteries. Some alarms operate by

detection of combustion through smoke detection, or increased temperature.

Wiring to fire alarms should be in MICC cable or be enclosed in seperate conduits, which should be kept clear of all other services.

The basic difficulty with all alarm systems is that the more delicate and sensitive they are, the greater the likelihood that they will be set off accidentally.

(c) Television antenna/Video System.

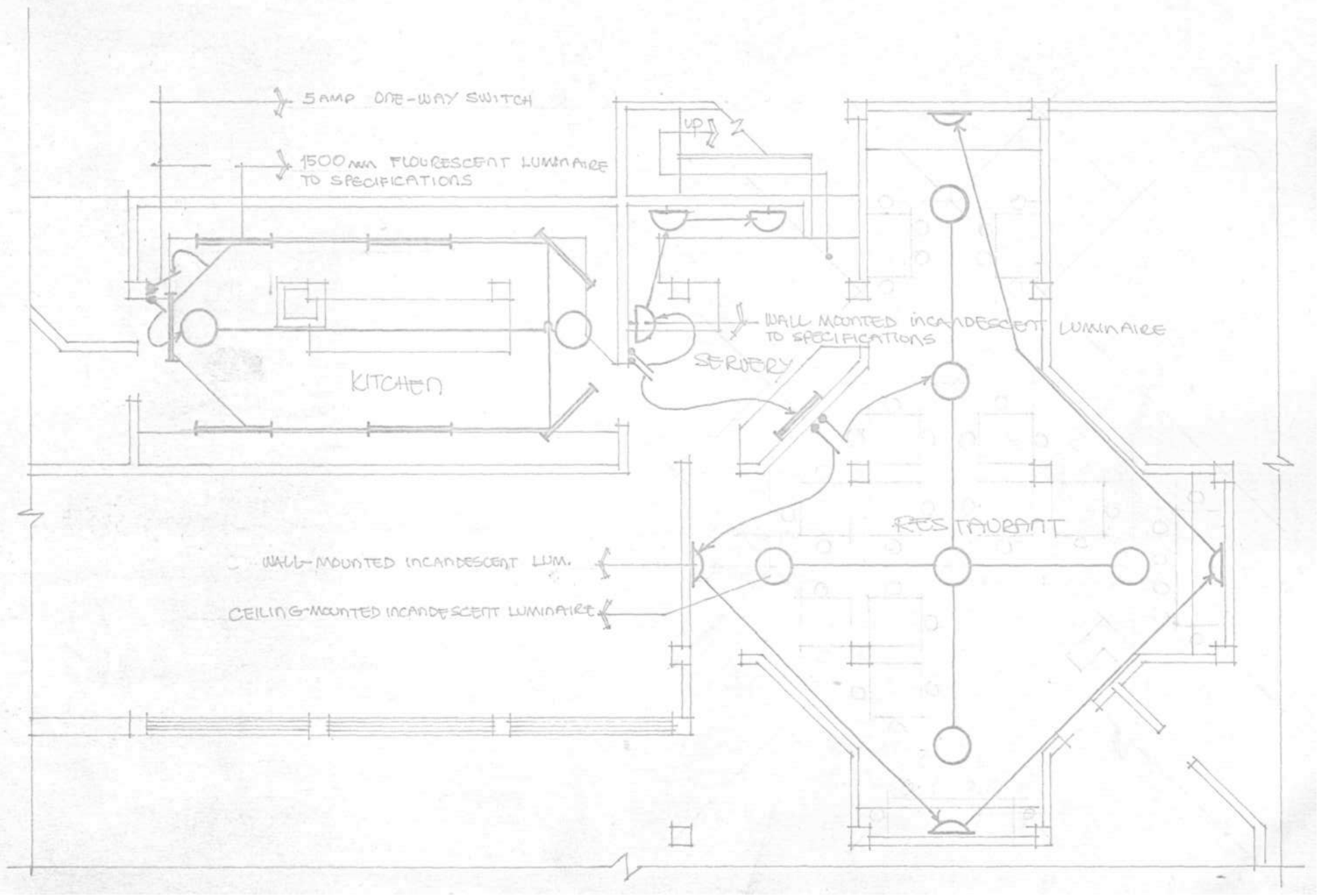
The television antenna system is used to feed UHF and VHF signals recieved by a single antenna located at the top of the building to a number of recievers in the building, like the bedrooms of a hotel. Provision is made for a boosting of the recieved signals and for its distribution by means of equipments, the specification of which would have to be established with manufacturers. However cables from the central signal source for both Television, and video programmes originated within the building can be distributed by means of cables in conduits throughout the building. These cables can be run in the same conduit as the Telephone cable and the background music system.

(d) Background music and public address system

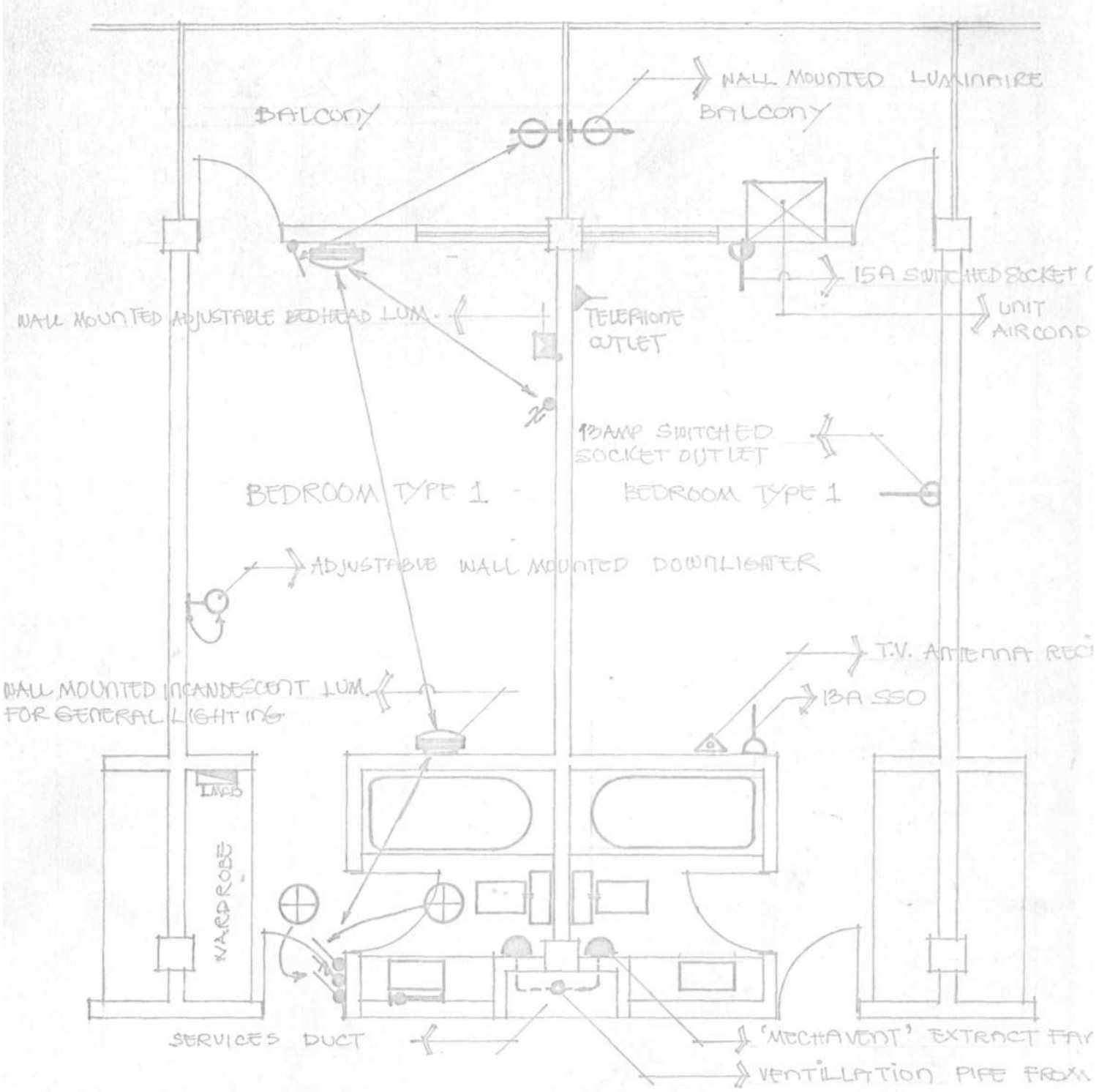
Systems of this kind are used for playing recorded music or radio programmes throughout a building by means of loudspeakers. If a microphone is fitted at the control position it is also possible to pass general messages. Fire alarm and other signals could be passed on, on such systems. A control position having all the audio equipment is installed and from here after amplification and through flexible wires, distributed to various locations in the building.

Examples of terminals of such distribution, are loud-speakers on the ceilings of reception areas, restaurants and bars, and the bed heads in the bedrooms. Other places may be included in the list depending on Management.

LIGHTING OF KITCHEN SERVERY AND RESTAURANT



ELECTRICAL SERVICES (LIGHTING AND POWER/T.V ANTENNA AND TELEPHON



LEGEND

SYMBOL		SYMBOL	
⊕	CEILING MOUNTED INCANDESCENT LUM.	⊢●	LUMINAIRE WITH ASSOCIATED SHAVER SOC.
●	1-WAY, 5A SWITCH		
●²	2-WAY, 5A SWITCH		
LCMB	LOCAL MINIATURE CIRCUIT BREAKERS		

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SURVEY INSTRUMENT - 1 APPENDIX I

QUESTIONNAIRE FOR HOTEL USERS.

Q1 HOW MANY TIMES HAVE YOU VISITED OR LODGED IN THIS HOTEL?

a) First time only ☐
b) Les than 5 times ☐
c) More than 5 times ☐

Q2 HOW LONG HAVE YOU STAYED IN THIS HOTEL DURING A SINGLE VISIT?

a) One night only ☐
b) Less than five nights ☐
c) More than five nights ☐
d) Others (please specify) ☐

Q3 WHICH OF THE FOLLOWING SERVICES INSTALLATIONS DO YOU CONSIDER ESSENTIAL TO THE HOTEL. (Pease tick as you feel)

a) Air-conditioning ☐
b) Cold water supply ☐
c) Hot water supply ☐
d) Electrical services ☐
e) Sewage/Plumbing ☐
f) Telephone/Intercome
g) Television/Video ☐

Q4 HOW WOULD YOU RATE THE EFFICIENCY OF THE FOLLOWING SERVICES PROVIDED IN THE HOTEL. (Please tick against only those provided).

1 - Very Good 2 - Good 3 - Fair 4 Bad

	1	2	3	4
a) Air conditioning				
b) Cold water supply				
c) Hot Water supply				
d) Electrical services				
e) Sewage/Plumbing				
f) Telephone/Intercome				
g) Television/Video				

Q5 COMMENT GENERALLY ON THE SERVICES INSTALLATIONS IN HOTELS OF SMILIAR SIZE TO THIS ONE.

.....

.....

.....

QUESTIONNAIRE FOR HOTEL MANAGEMENT STAFF

Q1 WHEN WAS THIS HOTEL ESTABLISHED?

a) Before 1975 ☐
b) After 1975 ☐

Q2 HOW MANY BEDROOMS ARE THERE IN THE HOTEL?

a) Below 30 ☐
b) 30 - 80 ☐
c) Above 80 ☐

Q3 HAVE YOU UNDERTAKEN ANY INSTRUCTIONAL COURSE(s) in HOTEL MANAGEMENT?

a) Yes ☐ b) No ☐

Q4 HAVE YOU WORKED IN ANY HOTEL OF SIMILAR CAPACITY OR LARGER THAN THE ONE YOU WORK IN AT PRESENT?

a) Yes ☐ b) No ☐

Q5 WHICH OF THE FOLLWOING SERVICES DO YOU CONSIDER OF IMPORTANCE TO A HOTEL OR THE SIZE SIMILAR TO THE ONE YOU WORK IN.

a) Cold water supply ☐
b) Hot water supply ☐
c) Electrical services ☐
d) Good Sewage plumbing ☐
e) Telephone/Intersome ☐
f) Television/Video ☐
g) Air-conditioning ☐

Q6 HOW WOULD YOU RATE THE EFFICIENCY OF THE FOLLOWING SERVICES INSTALLATIONS PROVIDED IN YOUR HOTEL? (Please tick against only these provided)

1 - very good 2 - Good 3 - Fair 4 Bad

	1	2	3	4
a) Air conditioning	☐	☐	☐	☐
b) Cold water supply	☐	☐	☐	☐
c) Hot water supply	☐	☐	☐	☐
d) Electrical services	☐	☐	☐	☐
e) Good Sewage/Plumbing	☐	☐	☐	☐
f) Telephone/Intercom	☐	☐	☐	☐
g) Television/Video	☐	☐	☐	☐

Q7 HOW OFTEN IS MAINTAINANCE WORK CARRIED OUT ON THE INSTALLATIONS?

a) Very often ☐
b) Often ☐
c) Not often ☐
d) Only repairs ☐

Q8 DO YOU HAVE ACCESS TO OR ARE IN POSSESSION OF THE DESIGN DRAWINGS ON WHICH THE HOTEL DEVELOPMENT WAS BASED?

a) Yes /__/ b) No /__/

Q9 IS THERE ANY INDICATION THAT THE DRAWINGS WERE DONE BY COMPETENT PERSONS (ARCHITECTS)

a) Yes /__/ b) No /__/

Q10 ARE THERE ANY DRAWINGS ON THE SERVICES INSTALLATIONS?

a) Yes /__/ b) /__/

Q11 COMMENT GENERALLY ON THE SERVICES INSTALLATIONS IN HOTELS OF SIMILAR SIZE TO THIS ONE.

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