InterContinental Hotels Group

Engineering Design Guidelines

November 2015

Revision: 2.1



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INTRODUCTION

These Engineering and Brand Safety Design Standards have been prepared to enable designers and specifiers of the mechanical, electrical and public health (MEP) services to understand the priorities and requirements of the IHG brand. The standards are not intended to provide inflexible prescriptive requirements but rather form a strategic framework of value, good practice, innovation energy efficiency and longevity from which the designers and specifiers can work. In summary the Brand Standards have been prepared in order to:

* Define the design criteria for IHG hotel projects.
* Provide clear indication of responsibilities.
* Provide clear written and illustrative information.
* Provide examples of cost effective simple designs that are proven for use. (This does not preclude the designers from putting forward alternatives that are more cost effective or can provide other benefits).
* Provide a summary of systems that have been proven and are acceptable. (This does not preclude designers from proposing alternatives, particularly as technology advances. Any alternatives proposed however should be submitted with sufficient detail for comparison and in particular the benefits listed, for IHG approval).
  1. **GENERAL**
  2. Design Standards

The standards to be adopted will vary according to the location of the hotels, and consequently there may be conflicting requirements between brand requirements, local codes, international standards and energy saving criteria. In all cases IHG shall be informed in the event of any contradictory requirements as summarized below:

* 1. **Designers Responsibilities**

The following diagram illustrates the designer’s responsibilities in relation to design approvals:-

|  |  |
| --- | --- |
|  |  |
| DESIGN STAGE VERIFICATION SCHEDULES | •Used to verify conformance with IHG Requirements  •Designer to provide submissions as detailed within this manual  •Resolve conflicts with IHG |
|  |  |
| REGULATORY  APPROVALS AND APPLICATIONS | •Designer is responsible for making applications and obtaining all local regulatory approvals  •Documentation may be required to highlight any variances from local standards |
|  |  |
| TECHNICAL SUBMISSIONS | •Designer to provide submissions as detailed within this manual  •Submissions to be made in English and formatted in accordance with this manual  •Any variances from standards to be highlighted otherwise compliance is mandatory |
|  |  |
| DEVIATIONS SCHEDULE | •Designer to maintain a schedule of any agreed deviations from IHG Standards |
|  |  |

* 1. General Design Principles

The following illustrates the general principles to be achieved:-



Hotels are unique developments in that they are operational for 24 hours a day, with guests paying for comfort highest standards of life safety is an expectation.

* 1. Deviations from the InterContinental Hotels Group Standards

Where deviations from InterContinental Hotels Group standards are agreed (must be in writing), the designers must maintain a schedule of the agreed variations including:-

* The item reference and applicable section of the InterContinental Hotels Group standards
* The reason for the variation
* The agreed variation
* Who agreed the variation
* The date
* The cost/ programme benefit to the project
  1. BRAND SAFETY

The objectives of these systems are for the protection of life and property in the event of a fire or incident. This section of the manual must also be read in conjunction with the IHG ‘Brand Safety Standards’.

The objective of this section of the guide is to provide guidance on how to design the systems in accordance with IHG requirements and the relevant standards and codes of practice.

Other relevant documentation is provided below:-

Brand Standard Manual

Property Section 1 Fire and Life Safety.

IHG Brand Safety Standards

Green Engage Recommendations

Not applicable.

* 1. General - Fire Safety

The life safety systems for the hotel include the “passive” as well as “active” design features, which must be designed as a coordinated total fire safety solution.

‘Passive’ meaning fire resisting walls, floors, doors and ‘active’ meaning fire alarm and detection, sprinkler, smoke control systems.

The design of these systems is to ensure they are effective, fit for purpose and will ensure a safe environment for guests and staff whilst simplifying the operation and maintenance of the fire systems as much as practically possible. Section 1.1 of this document identifies acceptable standards to achieve these aims.

The designers (including fire, MEP, architectural, interior) must provide a fire safety strategy for the whole building, which must include all passive and active systems, and clearly show:-

1. The anticipated risk of a fire and its severity.
2. The architectural provisions for resisting the spread of fire and smoke, including provisions for escape

of occupants, identification of fire compartmentation, fire doors and shutters.

1. The adequacy of services designed to detect and prevent the spread of smoke and fire - including

details of the standards/codes to be adopted in the design of these services.

1. A fire detection and alarm system sequence matrix- refer to example at the end of this section.
2. The provision of facilities to assist the fire services in locating and fighting fires.
3. Outline schematic layouts to illustrate the fire strategy
4. Specific requirements for staff training in fire safety routines.
5. Specific requirements for maintenance of the fire systems.

Once this has been approved in principle by InterContinental Hotels Group, the designer must be responsible for obtaining the approval of the local regulatory authority which should follow the process as indicated below:

FLOW CHART OF FIRE SAFETY LEGISLATION

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|  |  |  |
| --- | --- | --- |
| **FIRE SAFETY REGULATIONS**  For relevant Country/State Local Requirement |  | **LOCAL GOVERNMENT DEPARTMENTS** e.g. home office, provide guidance |
| 1 | |
| w | | **FIRE AUTHORITY AND BUILDING CONTROL/CERTIFIER** Implementation, Legislation, Check Assessments |
| **DESIGN FOR APPROVAL**  **IHG / EMPLOYERS**  and their Fire Risk Assessors |  |
| 1 | |
|  | **COMPETENT ENGINEERS& ARCHITECT**  Specialists in fire engineering, fire alarm and emergency lighting design installation provide technical assistance. |
|  | |
|  | **LOCAL STANDARDS INSTITUTE**  Produces standards for equipment that can be used by employers to demonstrate compliance. |
|  | |
| t | | **IHG FIRE AND LIFE SAFETY**  B Standards - minimum requirements |

* 1. Fire Safety

The minimum fire resistance of the structure of a building depends upon its height and whether it is high, medium or low rise.

Building height is measured from the fire brigade access level to finished floor level of the highest floor with guest access. This includes guestrooms, restaurants, meeting rooms and fitness facilities. It does not include mechanical and plant rooms, storerooms and offices.

The structure of the building includes:

* Load bearing walls
* Floors
* Columns
* Beams
* The structural frame of a building

For the purposes of this guidance the structure of a building also includes vertical shafts such as stairs, elevator and service riser shafts and linen chutes.



2.2.1 Structural Fire Resistance

The minimum fire resistance of the structure is detailed in the table below:

|  |  |  |
| --- | --- | --- |
|  | **Europe, Middle & Africa** | **Greater China & Australasia** |
| **Low Rise** | 60 minutes | |
| **Medium Rise** | 90 minutes or 60 minutes + sprinkler protection | |
| **High Rise** | 90 minutes + sprinkler protection | 120 minutes + sprinkler protection |

|  |  |
| --- | --- |
|  | **Americas** |
| **The structure of all hotels** | 60 minutes + sprinkler protection |
| **Elevator shafts, flues & pipe chases in all construction above four stories** | 120 minutes + sprinkler protection |
| **Wood frame construction between all elevated floors and balconies** | 120 minutes + sprinkler protection |

2.2.2 Fire Separation

In addition to structural fire resistance, separation to prevent the spread of fire and smoke must be provided to protect means of escape and to enclose high fire risk areas of the hotel.

A minimum of 60 minutes fire resisting separation must be provided between the following areas:

* Back of house areas and guestrooms and guestroom corridors
* Guestrooms and guestroom corridors
* Guestrooms and adjoining guestrooms
* Mechanical / plant rooms and adjoining rooms or areas (120 minutes)
* Kitchens and adjoining rooms or areas

2.2.3 Protection of Openings in Fire Resisting Construction

Openings have to be made in fire resisting construction for the passage of pipes, cables and ductwork but to prevent the spread of fire via these openings they have to be protected.

**Protection of ventilation ducts and pipe openings.**



2.2.4 Fire Dampers - Requirements

Fire dampers require access and annual maintenance, but are required to maintain the fire integrity of the building.

Fire dampers must be easily accessible for maintenance and resetting.

As an alternative to fire dampers if permitted by local codes, ventilation ducts may either be fire resisting or fully enclosed in fire resisting material of the same standard as the structure throughout their entire length.

An option to fire dampers in a bathroom or rest room exhaust duct, which requires no maintenance, is a sub­duct.

Sub duct (option to Fire Damper)



Combustible pipes of up to 160mm in diameter are permitted where they are provided with a non-combustible sleeve for a minimum of 1000mm each side of the wall / floor.

It is very important that the openings around pipes and ducts are sealed with solid fire resisting material to maintain the fire resistance of the wall or floor. Suitable materials include concrete, gypsum and expanding fire resistant foam.

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**Typical Guest Floor Fire Damper Requirement**

2.2.4 TYPICAL GUEST FLOOR FIRE DAMPER REQUIREMENT

Executive Corridor

FIRE DAMPER FOR ANY DUCT FROM LOBBY OR RISER SHAFT

TYPICAL GUEST ROOM DETAIL.

REFER DETAIL ADJACENT FOR TYPICAL LAYOUT

ALTERNATIVE FIRE DAMPER FOR F/A DUCT FROM CORRIDOR

Lift

Lobby

TYPICAL FIRE DAMPER IN EACH SUPPLY AND- EXHAUST DUCT FROM FIRE SHAFT (UNLESS SHAFT IS SEALED AND FIRE RATED AT FLOOR LEVEL.

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2.2.5 Protection of Voids

Fire resisting walls must extend between floors and must not terminate at false ceilings allowing fire and smoke to spread. Where cross corridor doors are provided to prevent the spread of smoke, smoke separation must continue above any false ceiling to the underside of the structural floor above.

Unoccupied attics or roof spaces must be subdivided into areas no greater than 330m2 by fire and smoke resisting separation. Each area must be provided with smoke detection and in sprinkler protected buildings over four floors in height each area must have sprinklers.

File resisting walls extend to the floor above and do not end at the false ceiling

False ceiling

Fire protected corridor

2.2.6 Fire Resisting Doors

Doors and door frames in fire resisting walls including those to stairs, linen chutes, service riser shafts and elevator landing doors must be fire resisting. The minimum fire resistance is detailed in the table below:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Europe, Middle East & Africa** | **Greater China, Asia & Australasia** | **Americas** |
| **60 Minute fire resisting construction** | 30 | | 45 |
| **90 minute fire resisting construction** | 60 | | |
| **120 Minute fire resisting construction** | 60 | 90 | |
| **Guestroom doors** | 30 | 20 | |

With the exception of doors to service riser shafts, which must be kept locked shut and connecting guestroom doors, all other fire resisting doors must be provided with a hydraulic, overhead self-closing device that is callable of closing the door fully and overcoming the latch. Disabled accessible doors must have delayed action self-closing devices that give sufficient time for guests to enter the room before the door automatically closes. For guestroom pipe/duct riser shafts, which are fire stopped vertically and back filled and sealed horizontally between floors, a fire resisting door is not required.

Hinges must have a melting temperature of not less than 8000C.

To improve their ability to prevent the passage of smoke and heat fire resisting doors must also be fitted with smoke seals along both sides and the top. The gap between the door and threshold must be provided with a flexible edge seal that just contacts the floor without excessive friction and where this is not practical the gap must not be in excess of 3mm.

Locks, including guestroom key-card locks must be certified to have the same fire resistance as the door in which they are fitted.

Where double doors have rebates (overlap) at the join, door selectors must be provided to ensure the doors close in the correct order.

Where vision panels are provided the glazing must have the same fire resistance as the door.

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Where self-closing fire resisting doors are located in areas of heavy use consideration should be given to providing electromagnetic door holders to keep them open during normal operations. The door holders must release allowing the doors to close upon operation of either the main fire alarm system or smoke detectors that are located within 1m of either side of the doors.

2.2.7 Windows

Internal windows and frames in fire resisting construction such as those opening onto internal escape routes must have the same fire resistance as the structure (including insulation) and must be fixed shut.

Windows and frames that open onto external escape routes that are less than 3m wide must have a minimum of 30 minutes fire resistance and the window must be fixed shut.

2.2.8 Elevators

Elevator shafts must have the same fire resistance as the structure of the building.

At all levels elevators must be protected by fire resisting landing doors or lobbies with access via self-closing fire resisting doors.

Fire resisting landing doors

Elevator

Elevator opening directly into, for example, a public area or a guestroom corridoi.

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Elevatoi

Elevatoi s and stall s may be located withill the same til e pi otected shaft

Elevatoi Ä stall lobby with access via self-closing, f¡I e

I esisting tlooi s

Doors do not need to be fire I esisting

2.2.9 Linen and Refuse Chutes

Like other vertical shafts linen chutes must have the same fire resistance as the structure. In addition linen chutes must have:

* Self-closing and locking fire resisting doors at each level, including the terminus of the chute
* The terminus door held open by a fusible link that will release the door in the event of a fire in the linen room
* Sprinklers at alternate floors and the top of the chute in a sprinkler protected building- see illustration.
* Smoke detector at the top of the chute
* A vent at roof level

Linen chutes must be located in housekeeping rooms or service areas on the guestroom floors and should not open directly into guestroom corridors. Smoke detection must be provided in the housekeeping rooms.

Refuse chutes present a fire and health hazard and should not be installed.

**2.2.9 Linen and Refuse Chutes**

GO Miiiirte self-closing. fit e resisting 'tc’Oi held open By • fusible link that releases Blowing the door to tlửSẾ 111 euent of aftie

File resitting chute or ' cunte located In fire

I existing 3hilft

GO Minirte Ing and

locking fire resisting dooi at each floor

Provide sprinklers at top and every alternate or 3rd level -86 0 C

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2.2.10 Car Parking Garages

Car parking garages below hotels should be sprinkler protected and connected to the hotel's fire alarm and detection system. Where sprinklers are provided thermal detectors need not be unless there is a specific local code requirement. Where they are not sprinkler protected they must:

* Be separated from all areas of the hotel by 90 minutes fire resisting construction and two 30 minute, or one 60 minute self-closing, fire resisting doors
* Be provided with mechanical or natural smoke and carbon monoxide ventilation
* Be provided with thermal detection and part of the hotel’s fire alarm and detections system.

Smoke s co extraction

Two 30 minute self-closing fire resisting floors

Car Parking Garage

90 Minutes fire resisting structure

Elevator anti stair lobby

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2.3 Means of Escape

2.3.1 General

All areas of the hotel must be provided with sufficient means of escape to allow guests, visitors and staff to safely leave the building in the event of emergency. Means of escape must comply with the following principles:

* There must be at least two means of escape from all areas so that if one is destructed by fire an alternative

escape route will be available

* People must be able to turn their back and move away from the fire to reach a place of safety
* Means of escape must be designed so that they are safe to use and people can leave the building unaided
* Final exits from the hotel must lead to a place from where people can disperse away from the building and

where they lead to, for example, enclosed areas and terraces there must be unrestricted escape from these areas

2.3.2 Horizontal Means of Escape

Each floor must have a minimum of two emergency exits remote from each other.

The maximum distance to reach an emergency exit on a guestroom floor must be no more than 30m or 60m in a sprinkler protected building.

Guestroom dead-end corridors must not exceed 8m or 15m in a sprinkler protected building

Guestroom corridor width must be no less than:

* Primary corridors 1.3m
* Secondary corridors 1.1m





2.3.3 Vertical Means of Escape

General Requirements

A minimum of two escape stairs must be provided from all above and below ground areas of the hotel.

Escape stairs must be remote from each other as described in the sub section Horizontal Means of Escape above.

Phased evacuation (that is where a limited number of floors are evacuated in phases with guests remaining on other floors) is not permitted and stairs must be of sufficient size to allow the simultaneous evacuation of the occupants of the whole hotel.

The total stair width required is based on:

* The total number of people that will use the stair in an evacuation from the most heavily populated floor
* Allowing a stair width of 7.6mm/person

Escape stairs must lead directly or via fire protected corridors to the outside of the building, however, in sprinkler protected buildings 50% of stairs may lead into a low risk area of the building from where there is direct access to the final exit and where approved by IHG.

It is recommended that exits from the ground floor are not via the escape stair enclosure. Where this is unavoidable the final exit must be of sufficient width for the likely number of people using the stair and those escaping from the ground floor.

Stair construction

The treads and risers of newly constructed stairs should have the following dimensions

* Maximum riser height 180m
* Minimum tread depth 280mm

The surfaces of treads and landings must be:

* Solid and free from holes
* Free from projections that may cause trips
* Non-slip

Any doors opening directly into a stair must not obstruct the stair by more than 50% of its width.

Stairs and means of escape in general must be free from combustible materials and must not be used for storage.

In newly constructed buildings storerooms must not open directly into escape stairs. In existing buildings storerooms that do open directly into escape stairs must be provided with:

* Fire resisting doors that are locked shut
* A self-closing mechanism
* Smoke detection.

Spiral staircases should not be used for means of escape.

Ladders are not permitted for means of escape.

2.3.3 Vertical Means of Escape

Ground Floor - No Sprinklers

Final Exit

Final Exit

Final Exit

Final Exit

Ground Floor-With Sprinkle Protection

Final Exit

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Rooms opening onto the protected corridor must not be high risk such as kitchens or rubbish stores.

2.3.4 Means of Escape from Places of Assembly

Places of assembly such as function rooms, meeting rooms, bars and restaurants must be provided with means of escape based upon the size of the room. Restricting the occupancy of an assembly room because of inadequate means of escape is impractical and unacceptable.

The number of exits must meet the following minimum requirements:

* 50 to 500 people - a minimum of two exits
* 500 to 1000 people - a minimum of three exits
* More than 1000 people - a minimum of four exits but additional exits provided where necessary and approved by IHG

In general the occupancy of an assembly room should be based upon a figure of 1m2 / person unless permanent fixed seating, such as in a restaurant, is provided in which case the occupancy must be based upon the number of seats. In this case great care must be taken when altering the room to ensure that the occupancy does not exceed the capacity of exits.

When determining the width of exits and exit routes a minimum of 5mm should be allowed for each person occupying the room.

Exits must be located remotely from each other to minimize the risk that all are affected by a fire in the room . One method that can be used to ensure that exits are adequately remote from each other is by ensuring that there is an angle of not less than 450 between the exits when measured from the furthest part of the room.

Example of a function room with an area of 400m2:

Occupancy of the function room equals 400 people (1m2 / person)

400 people x 5mm = 2000mm

A minimum of two exits is required each of which should be 1m wide

All exits must not discharge into the same area such as the breakout space so that a fire cannot cut-off all means of escape.

Escape routes must not be via any service corridor or area.

2.3.4 Means of Escape from Places of Assembly

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Exits located remotely from each other so that a fire in the room will not cut-off access to both

Each exit 1m wide

Large function room showing exits remote from each other

2.3.5 External Means of Escape

External escape routes must be easy and safe to use at all times and must where necessary be protected from fire within the building.

Where escape routes are across roofs the following safeguards must be put in place:

* The route must be even and without trip hazards
* The route must be protected by suitable barriers at least 1100mm high and with no gaps greater than 100mm

to prevent falling

* The route must be illuminated by normal and emergency lighting unless there is sufficient borrowed light, for

example, from neighboring street lamps and buildings

* Where the route leads to an escape stair or route within the building this must be fire protected and access

back into the building must only be secured by panic fastenings

* The route must be at least 3m from any opening or vent unless the route is protected from fire within the

building

2.3.5 External Means of Escape

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Where external fire escapes are proposed the following safeguards must be put in place:

* The structure beneath and within 1.8m either side of the stair must be fire resisting
* Doors within this area and those opening onto the stair, other than from guestrooms corridors, must be fire

resisting and self-closing

* Windows and window frames within this area must be fire resisting and must be sealed shut

Fire Protected Area

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Where exits open onto roadways, into service yards and similar areas they must discharge onto pavements protected by barriers to prevent guests spilling onto the road or from being struck by vehicles.

Exits in gates, fences and similar enclosures must only be secured by panic fastenings.

2.3.6 Fastenings on exits doors

Doors on escape routes must never be locked to prevent their use in an emergency and key operated locks must not be installed.

Doors onto escape stairs must be operable in both directions to prevent people being trapped in a stair and to allow guests who do not wish to use lifts to pass between floors. This does not apply to doors onto external escape stairs.

Where doors on escape routes are required to be secured, for example final exit doors to the outside of the building, guests and visitors must be able to easily pass through the doors in an emergency and panic fastenings must be used.

In exceptional circumstances it may be necessary to provide additional security on exit doors and this can be done by providing electromagnetic fastenings. Where electromagnetic fastenings are proposed they must meet the following requirements

* The fastening must release upon operation of the fire alarm system
* In the event of power failure the fastening must release
* An emergency door release must be provided alongside the door - this must be in the form of a break-glass

unit, colored green to distinguish it from a fire alarm call point

* Instructions for the operation of the emergency door release must be provided in clear, plain text alongside

the break-glass unit in the local language and English.

The above requirements apply to exit doors that are also staff entrances and which are secured by fastenings operated by key-cards, key pads and by similar devices.

In back of house areas doors on escape routes that are only used by small numbers of staff may be secured by a simple fastening that can be opened without the use of a key such as a lever handle or thumb turn operated lock.



2.3.7 Escape signage

Escape signage must be used to help people identify exits and exit routes. This is of particular importance for guests and visitors who are unfamiliar with the layout of the building.

Escape signs must meet the following requirements:

• They must be clear and easily understood

* They must include a pictogram ("running man") to overcome language problems (or symbol universally

recognized)

* Text may be used in addition to the pictogram but not on its own
* Signs indicating escape routes must have a directional arrow but arrows must not be used on their own
* They must be fixed above doors and not to them so that they are visible if the door is open
* Signs above doors must be between 2m and 2.5m above the floor
* Signs on walls must be between 1.7m and 2m above the floor
* As far as possible signs must be mounted at the same height throughout an escape route
* In large open spaces such as hotel lobbies signs may be mounted higher than 2.5m but care must be taken

to ensure that they can easily seen



Escape signs must be of sufficient size so that they can be read easily and seen from all areas but they must not be obtrusive. To achieve this balance the following viewing distance size guide should be used:



So that guests and visitors can make themselves familiar with escape routes from the hotel each guestroom and meeting room must be provided with a fire instruction notice including an evacuation plan. The notice must meet the following requirements:

* The notice should be as graphical as possible so that it can be understood by the widest number of people

irrespective of their language

* Where text is provided it must be in the local language and English
* The plan must show the direction to the primary and secondary escape routes
* The plan must be oriented so that it shows the layout of the floor from the guest or meeting room perspective
* The notice must be secured to the inside of the door at a height where it can be easily read

• The notice must be protected to prevent damage



2.3.8 Means of escape for disabled guests

Means of escape for disabled guests must be considered at the design stage when facilities such as refuges and evacuation lifts can be incorporated into the design of the hotel which would be impossible to provide at a later stage.

In general hotel management is responsible for the evacuation of guests including those with disabilities and reliance should not be placed upon assistance from the fire brigade who will be responsible for carrying out rescues and fighting the fire. An evacuation strategy must be developed with hotel operators at the design stage to ensure that unreasonable demands are not placed upon the hotel, particularly with regard to staffing levels, so that they are able to effectively manage the facilities provided.

Issues that must be addressed at the design stage include:

* The number of disabled guestrooms - this must depend upon the number of staff available at all times to

provide the necessary level of assistance to disabled guests.

* The location of disabled guestrooms - evacuation of disabled guests from ground floor guestrooms will be

much quicker and easier than from guestrooms on upper floors. Where there are no ground floor guestrooms those for use by disabled guests should be located close to fire protected stairs and evacuation lifts where they are provided.

* Refuges - these are places of relative safety where disabled people can await assistance from hotel staff to

assist them in escaping. Refuges must:

* Be at least 760 x 1200mm in size
* Provide protection from fire, for example, by being located in a protected stair
* Have direct access to a final exit from the building
* Be located so that they do not obstruct escape routes for other guests
* Have direct two-way communication with a continuously staffed position such as reception with

instructions on how to use the communications

Space occupied by flow of people escaping

Wheelchair space

Communication with continuously staffed position

• Evacuation lifts - these are lifts that are specifically designed for the evacuation of disabled guests and are

provided with additional safety measures to ensure that they are safe to use in a fire. Frequently evacuation lifts are also firefighting lifts. Evacuation lifts must meet the following requirements:

* The lift must be located within a protected enclosure
* Enclosure of the lift should consist of a protected lobby at every level
* The lift should be provided with a switch marked "EVACUATION LIFT" at exit level
* This switch should cause the lift to return to the exit level and then become controllable
* A primary electricity supply must be provided exclusively to the lift from a sub-main circuit
* An alternative power supply must be provided to the lift that must start automatically on loss of the primary supply
* The cables that transmit the alternative power supply must be separate from those of the primary supply

and routed through an area of low fire risk

* Any power switches or isolators must be clearly identified and labels must be provided at the main switchboard and at the alternative power supply indicating the location of the other supply
* Any electrical sub-station, distribution board, generator, hydraulic pump or other apparatus must be fire protected for a period not less than that of the lift shaft. **-**
* The lift should have a minimum load capacity of 400kg
* The lift should have a door(s) that provide a minimum clear opening width of 800mm
* Door to the lift should have a minimum of 2 hours fire resistance.
* All controls for the lift, both inside and at landing level, must be at a height not less than 900mm and not

more that 1200mm at a distance of at least 400 from the front wall

* All controls must also have suitable tactile indication on or adjacent to the buttons
* All lifts should incorporate a signalling system that provides visual notification the lift is answering and if the lift serves more than 3 storeys then a visual and audible system should be provided
* Doors to the lift should stay in the full opening position for 5 seconds before closing. The system may

be overridden and re-opened by an appropriate electronic device but NOT a door edge pressure system

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Communication with continuously staffed position

Evacuation lift

• Ramps may be used for means of escape for wheelchair users providing they meet the following dimensions

and requirements:

* Minimum width 1120mm
* Maximum slope 1:12
* Maximum cross slope 1:48
* Maximum rise of a single ramp 760mm
* The ramp must be permanently fixed
* It must not obstruct escape routes
* The ramp must be made of non-combustible materials
* It must not have perforations

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2.4 Life Safety Systems

2.4.1 Objectives

Provide protection of life and property by providing both automated and manual facilities for preventing the spread of fire.

2.4.2 Design Standards

All in accordance with Section 1.0.

2.4.3 Description

The following systems must be provided as required by the relevant codes, or to enhance the life safety provisions of the entire Hotel:-

* Fire alarm and detection - InterContinental Hotels Group/Code
* Automatic fire suppression - InterContinental Hotels Group/Code (all areas to be covered)
* Hose reels - Code
* Wet/Dry risers - InterContinental Hotels Group/Code
* Hydrants (external) - InterContinental Hotels Group /Code
* Fire dampers between fire zones - Code
* Zone smoke clearance using installed air handling plant and /or dedicated smoke extraction equipment -

InterContinental Hotels Group/Code

* Automatic and manual cut off fuel/power to kitchen equipment and boilers in a fire alarm in that area.
* Gas leak detection
* Carbon Monoxide detection.

2.5 Emergency Lighting

Emergency lighting falls into two categories; escape lighting and standby lighting.

1. Escape Lighting

Escape lighting (minimum 1lux at floor level) is provided to ensure the safe and effective evacuation of the building.

1. Standby Lighting

Standby lighting is provided to enable a prolonged occupation of the building upon failure of the electrical supply. This could be to mitigate against business interruption or to avoid immediate evacuation of the building.

2.5.1 System Types

There are two types of escape lighting, both of which derive their electrical supply from batteries - self-contained luminaries with integral or locally connected battery packs.

1. Self-Contained (minimum 1 hour or 90 minutes for Asia)

The advantages with self-contained emergency luminaries are:

* Relatively low installation cost
* Special fire rated wiring to the luminaire is not required.

Disadvantages are:

* Relatively short battery life (circa 3 years)
* Individually controlled / tested

1. Central Systems

IHG preference is for a central battery system due to its life cycle cost benefits and the following advantages:

* Battery life is circa 10 years
* Slave luminaires can be centrally controlled.
* Slave luminaires can be sited in hotter or colder environments than self-contained systems.
* Relatively low life cycle costs

a) Self-Contained (minimum 1 hour or 90 minutes for Asia)

b) Central Systems

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Line monitoring Charge over unit

Luminaires

Live feed from normal supply

Local emergency distribution board

Sub main cable battery system

Central battery system 1.2.3



2.6 Fire Alarm and Detection

2.6.1 Objectives

Provide protection of life and property by the early detection and automated alarm/annunciation in the event of a fire incident to the whole hotel.

2.6.2 Design standards

All in accordance with Section 1.0

2.6.3 Control requirements

An intelligent analogue addressable, automatic fire alarm and detection system must be installed to cover the whole hotel. The system must also provide signals to other building systems where the hotel is part of a larger complex to alert them in the event of fire system activation.

2.6.4 Definitions

FIP - Fire Indicator Panel (also known as Fire Alarm Panel)

SIP - Sub Indicator Panel (also known as Repeater or Sub Alarm Panel)

MCP - Manual Call Point - (also known as Break Glass Alarm)

Mimic Panel - an engraved panel identifying site buildings and/or building sectional layout with or without a visual (LED) indication of where alarm/s have been activated.

CIE - Control and Indicating Equipment

FFCP - Fire Fan Control Panel

FR - Fire Resistance

VA- Voice Alarm Speaker

2.6.5 Description

The fire alarm and detection system must be installed to cover the whole hotel. The system must comprise the following equipment, to provide life and property protection to all areas:-

* Main fire alarm panel must be located in a constantly staffed position such as reception, which is assumed

to be the primary fire command centre such as the main reception or security office (24 hours manned)

* Repeater fire alarm and detection panel located at security or engineering offices for larger hotel as

appropriate or telephone operator room.

* Addressable point smoke, smoke with audible tone base (guest rooms) and heat detectors (using optical

smoke detectors) with time delay facility at the main panel where allowed, as noted above.

* Manual call points
* Mobile communications device capable of receiving alpha numeric messages and interfaced with FIP to

receive all alarms for larger hotels. It is recommended if not mandatory as per local codes.

* Voice evacuation speakers or voice enhanced fire alarm sounders must be provided in all guest bedrooms

and front and back of house areas.

* Xenon beacons to be provided in the disabled toilets, mechanical plant rooms and any areas with high noise

levels.

* A portable, visible alarm and vibrating fire alarm unit must be provided for guests with impaired hearing.
* BMS link for alarm alert and fault condition
* Fire Interface to the lift installation and security system (where doors in escape paths may be secured)
* Fire rated cables to maintain circuit integrity for 1 hour to a minimum of 830 deg. C whilst undergoing

mechanical shock, in compliance with IEC 60331 - parts 1 & 2 and EN 50200.

* Interface to air handling systems for engineered smoke clearance systems (where required)
* Fire suppression system monitoring with interface to alarm system, as appropriate
* Fire brigade connection and/or monitoring to local fire authority requirements where required by local

regulations

Voice Enhanced Detection & Fire Alarm system

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NOTE

1. ALL DEVICES (DETECTORS. SPRINKLER FLOW SWITCHES. MANUAL CALL POINTS ETC.) SHALL HAVE INDIVIDUAL DEVICE ADDRESSES.



Evacuation system illustration

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TYPICAL FIRE ALARM & DETECTION SYSTEM FOR ENTRY ! LOBBY / PUBLIC AREA LEVELS



TYPICAL FIRE ALARM & DETECTION SYSTEM FOR GUEST ROOM LEVELS

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2.6.6 Type of system

Fire alarm and detection systems may be either single or two-stage as follows:

2.6.6.1 Single Stage

In the event of the operation of any fire detector, MCP or fire suppression system there is an immediate alarm throughout the whole hotel

2.6.6.2 Two stage

Upon operation of a guestroom smoke detector:

* There is an immediate alarm in that guestroom and at the FIP
* A predetermined delay begins for investigation of the alarm that is based upon the time it takes to reach the

furthest guestroom in the hotel - elevators may be used at this time. In general this should be no more than 3 minutes

* If the alarm has not been silenced by the end of the predetermined delay or if a second device operates,

there must a full alarm throughout the whole hotel

At any time that a fire detector operates in any other part of the hotel, a MCP or a fire suppression system operates there must be an immediate alarm throughout the hotel

2.6.7 Sounders and alarm

Fire and voice alarm

Fire alarm sounders must be audible throughout the building (including guest rooms and guest bathrooms) with a minimum requirement of 75dBA at the bed-head in guestrooms and 65dBA elsewhere.

Voice alarms must have both a pre-recorded message in the local language and English and a sonic alarm to raise attention and for guests who may not understand the messages.

The voice alarm must be sequenced as follows:

Attention drawing signal

75dB (A) at the bed-head and 65dB (A) elsewhere lasting 10 seconds

(The signal must be a siren or two-tone)

Brief silence

Lasting 1 to 2 seconds

Recorded evacuation message in the local language

A simple message for example:

*"Attention, attention.*

*There is an emergency*

*Please leave the hotel at once by the nearest exit."*

Silence

Lasting 2 to 5 seconds

Recorded evacuation message in English

Silence

Lasting 2 to 5 seconds

Attention drawing signal

75dB (A) at the bed-head and 65dB (A) elsewhere lasting 10 seconds

The sequence must then be repeated continuously until manually silenced.

A voice evacuation system is compulsory for new and replacement fire alarm systems unless the building is not high rise and has a sprinkler system throughout.

Battery backup must be provided as an integral part of the main fire alarm panel. The batteries must be of sufficient capacity to provide standby operation for 24 hours after which sufficient capacity must remain to operate on full alarm conditions load for a minimum of one hour.

All fire evacuation speakers must be specifically designed for this purpose.

Connections must be protected and a thermal fuse provided to ensure the continuity of the circuit even though the individual speaker may be destroyed by fire.

Fire resistant internal components and cable connections must be provided and to protect the inner core of the cable where the outer fire resistant sheathing has been removed, a fire resistant or metal cover must be provided. Where cables enter the cover, further protection must be provided by fire resistant glands.

Fire Rated Protection for Voice Alarm Speaker



The voice evacuation system must consist of multi-tapped speakers to allow settings to suit mounting height locations.

Where separate public address and background music systems are used they must be isolated via a fire alarm signal through a failsafe, no voltage relay whenever a fire alarm is activated.

Where fire voice evacuation system speakers are also used as public address and background music, the systems must be completely separate with only the speakers and cabling systems being common.

The voice evacuation message must be in the local language, English and any other language required by the local fire department. An example of such a pre-recorded message has been provided earlier.

As an alternative to a conventional public address / voice alarm system a voice-enhanced sounder system that broadcasts a voice alarm message through the detector sounder base may be used and this system is likely to be considerably less expensive. It must be noted, however, that in public areas the system may need to be enhanced by additional sounders to ensure the intelligibility of the message. This is illustrated as follows:-



Xenon Strobe beacons in addition to the audible alarm signal must be provided in disabled toilets/bathrooms within any areas where high ambient noise levels are to be encountered such as mechanical plant rooms, chiller compounds, etc., and meeting rooms where necessary.

2.6.8 System Fire Integrity

The complete system must be wired in fire resistant cables arranged in a loop system for system integrity.

Note: fire retardant cabling is not acceptable for use and the cabling must provide a minimum one (1) hour rating at the temperatures specified earlier in this guide. Certification of compliance with this must be provided.

All fire resistant cables, connections and junction boxes must comply with the following:

* Keep cable joints to a minimum - junction boxes to be marked ‘Fire Alarm’
* To provide ceramic / FR connections within junction boxes and Voice Alarm speakers
* For junction boxes and Voice Alarm speakers to have FR protection
* For cables to be secured with FR ties, cable trays etc.

|  |  |
| --- | --- |
| **Fire Rated Protection for Voice Alarm Speaker** | **Fire Rated Junction Box and Connections** |



The fire alarm must be activated by smoke/heat detectors and manual call points. If a sprinkler system, kitchen o other fire suppression system is installed this should also activate the alarm.

2.6.9 Impaired hearing provisions

Portable visible and vibrating alarm units must be provided for guests with impaired hearing. These units must be operational throughout the hotel and be activated when the fire evacuation alarm is operated. A typical vibrating pad system wireless is illustrated as follows:-



2.6.10 Main Fire Panel

The main fire alarm panel (also known as fire indicator panel) must be located in a constantly staffed position such as the main reception, with both audible and visual alarm on the panel. Specific alarm zone and functioning status of fire detection system must be indicated. If the front desk is not manned at any time the alarm signal must be relayed to a constantly staffed point. A direct interface to the fire authority should only be provided where required by local regulations. This interface must be operated after a predetermined time delay.

The fire alarm panel must incorporate the following features:

* A visual alarm indicator for each zone and detection device
* A visual fault indicator for each zone and detection device
* Warning sounder amplifier controls for all zones, and programmed linking of all zones.
* Visual fault indicators for mains failure, battery under voltage and battery charger failure
* An audible alarm activated by any fault or alarm condition, complete with muting switch
* A general evacuation switch to operate all alarm sounders
* Test facility
* Output to BMS

Addressable hard-wired smoke detectors must be installed in all areas including:

* Guestrooms
* Public Areas
* Corridors
* Storerooms greater than 14m2
* Staircases
* Service risers if not fire isolated at each level

• Technical rooms

Rate of rise heat detectors with a fixed temperature element must be used in kitchens and car parks.

Any ventilation controls for use by firefighters must be adjacent to the fire control panel; however, smoke extraction controls for stairs may be located within the stair at fire brigade access level.

A block plan with the entire installation shown must be installed next to each FIP mimic panel and repeater panel. The plan must be in the form of a permanent diagram, water and fade resistant. The plan must show all zone areas, building layout, FIP, mimics, repeaters, CIE, FFCP, fire suppression controls, pump room etc.

Smoke detection must be provided in roof spaces.

Detector spacing must be in accordance with local standards and manufacturer’s recommendations but must be a minimum of one smoke detector per 85m2 or one heat detector per 50m2 and not more than 15m spacing along corridors.

Smoke detection must be installed in all voids in excess of 800mm height unless there is no combustible material (lighting cables may be disregarded) and all detectors in voids or concealed areas must have a remote indicator in a clearly visible location as close to the detector as possible.

The following sketches illustrate the locations for detectors in a guest room.



Where detectors are installed in concealed zones, risers, floor voids and ceiling voids etc., then a remote visible indicator must be installed. These must be installed in all voids in excess of 800mm height unless there is no combustible material (lighting cables may be disregarded).

Ensure that all detectors are accessible for maintenance purposes.

Where atriums are present, optical beam detectors must be provided for detection of smoke in the atrium and operation of the atrium smoke clearance system.

Smoke detectors must be provided in the supply duct for shut down of associated AHU and annunciation at the Fire Panel.

Manual call points must be installed as a minimum at all final exits plus emergency exits of each floor or zone of the building, in major public areas/plant rooms and back of house areas as well as the front desk located so that the maximum travel distance must not exceed 30m to the call point.

Isolation modules must be provided at the entry and/or exit from each separate area of a designated fire zone. As a minimum, isolation modules must be provided, to ensure that no more than 2000m2 of covered area becomes unprotected in the event of any single cable fault. Designated loop isolators must also be provided for monitoring the zone states.

**2.6.11 Cause and effect matrix**

A specific cause and effect matrix and flow chart shall be produced for each hotel to be relevant for the actual systems installed.

Table 1 - Two Stage Fire Alarm and Detection System –Sample Cause and Effect Matrix – for information only

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Annunciation** | | | | | | **Smoke Control** | | | **Elevators** | | |
| **Annunciation &indication- main fire indicator panel** | **Annunciation on repeater mimic panels** | **Notify fire brigade if appropriate** | **Sound sonic alarm and voice alarm throughout whole hotel** | **Alarm operates in guest room where fire is detected only** | **Send signal to mobile communication system if provided** | **Start appropriate smoke extract fans, smoke vents& stair pressurisation** | **Stop all supply and extract vent plant** | **Release all fire doors, release controlled access doors** | **Elevator recall to ground floor** | **Elevator recall to first floor or other floor if alarm at ground floor** | **Firefighting lift returned to ground floor ready for fire brigade** |
| **Manual call point operates anywhere in hotel** | **X** | **X** | **X** | **X** |  | **X** | **X** | **X** | **X** | **X** | **X** | **X** |
| **Smoke detector operates in guest room** | **X** | **X** |  |  | **X** | **X** |  |  |  |  |  |  |
| **No response after predetermined time delay** | **X** | **X** | **X** | **X** |  |  | **X** | **X** | **X** | **X** | **X** | **X** |
| **Second detector operates or manual call point triggered** | **X** | **X** | **X** | **X** |  | **X** | **X** | **X** | **X** | **X** | **X** | **X** |
| **Fire detector operates other than in a guestroom** | **X** | **X** | **X** | **X** |  | **X** | **X** | **X** | **X** | **X** | **X** | **X** |
| **Kitchen hood fire suppression system operates** | **X** | **X** | **X** | **X** |  | **X** | **X** | **X** | **X** | **X** | **X** | **X** |
| **Sprinkler flow switch activated** | **X** | **X** | **X** | **X** |  | **X** | **X** | **X** | **X** | **X** | **X** | **X** |
| **Supply air duct smoke detector** | **X** | **X** |  |  |  | **X** |  | **X** |  |  |  |  |
| **Supply air duct smoke detector no response after time delay** |  |  | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** |
| **Sprinkler valve tamper switch** | **X** | **X** |  |  |  | **X** |  |  |  |  |  |  |
| **Fire pump common fault** | **X** | **X** |  |  |  | **X** |  |  |  |  |  |  |
| **Sprinkler tank water level low** | **X** | **X** |  |  |  | **X** |  |  |  |  |  |  |
| **Generator running/fault (only during alarm)** | **X** | **X** |  |  |  | **X** |  |  |  |  |  |  |
| **System/wiring fault** | **X** | **X** |  |  |  | **X** |  |  |  |  |  |  |

Note:

* A two stage fire alarm and detection system is one where there is a predetermined delay (180 sec max) to

investigate the operation of a fire detector to see if there is evidence of fire before there is a general alarm throughout the whole hotel.

* The period of the delay (180 sec maximum) should be based upon the time it takes to reach the furthest part

of the hotel (elevators may be used at this time) or compliance with local standards whichever is less.

* At the end of the delay period and if the alarm has not been silenced because there is no evidence of a fire,

the alarm must automatically sound throughout the whole hotel.

* If a second device of any kind operates at any time during the delay period the alarm must sound

automatically throughout the whole hotel.

* There must only be a delay upon operation of a smoke detector in a guest room. Should a manual call point,

sprinkler flow switch or other fire suppression system operate there must be an immediate alarm throughout the whole hotel.



2.7 Fire Suppression

Fire Suppression systems shall be strictly in accordance with this brief and the local authorities / fire officer’s specific requirements.

All “New Construction” and “Conversion” high rise hotel properties must have automatic sprinklers fitted to the entire building in accordance with the IHG Brand Safety Standards.

For other properties, a risk assessment will be conducted by IHG to determine if automatic sprinklers may be exempted; however, the table below indicates in red those countries where sprinklers would normally be required

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Western Europe** | **Eastern Europe** | **South-East Europe** | **Russia, CIS, Balkans** | **Middle East** | **North Africa** | **Africa** |
| [Austria](http://web.amnesty.org/report2005/aut-summary-eng) [Belgium](http://web.amnesty.org/report2005/bel-summary-eng) [Finland](http://web.amnesty.org/report2005/fin-summary-eng) [France](http://web.amnesty.org/report2005/fra-summary-eng) [Germany](http://web.amnesty.org/report2005/deu-summary-eng) [Ireland](http://web.amnesty.org/report2005/irl-summary-eng) [Italy](http://web.amnesty.org/report2005/ita-summary-eng) [Portugal](http://web.amnesty.org/report2005/prt-summary-eng) [Spain](http://web.amnesty.org/report2005/esp-summary-eng) [Sweden](http://web.amnesty.org/report2005/swe-summary-eng) [Switzerland](http://web.amnesty.org/report2005/che-summary-eng) [UK](http://web.amnesty.org/report2005/gbr-summary-eng) | [Czech-](http://web.amnesty.org/report2005/cze-summary-eng) [Republic](http://web.amnesty.org/report2005/cze-summary-eng) Slovakia [Hungary](http://web.amnesty.org/report2005/hun-summary-eng) [Poland](http://web.amnesty.org/report2005/pol-summary-eng) | [Cyprus](http://web.amnesty.org/report2005/cyp-summary-eng) [Greece](http://web.amnesty.org/report2005/grc-summary-eng) [Malta](http://web.amnesty.org/report2005/mlt-summary-eng) | Russia [Armenia](http://www.aneki.com/Armenia.html) [Azerbaijan](http://www.aneki.com/Azerbaijan.html) [Belarus](http://www.aneki.com/Belarus.html) Estonia [Georgia](http://www.aneki.com/Georgia.html) [Kazakhstan](http://www.aneki.com/Kazakhstan.html) [Kyrgyzstan](http://www.aneki.com/Kyrgyzstan.html) Latvia Lithuania [Moldova](http://www.aneki.com/Moldova.html) [Tajikistan](http://www.aneki.com/Tajikistan.html) [Turkmenistan](http://www.aneki.com/Turkmenistan.html) [Ukraine](http://www.aneki.com/Ukraine.html) [Uzbekistan](http://www.aneki.com/Uzbekistan.html) [Albania](http://web.amnesty.org/report2005/alb-summary-eng) [Bosnia-](http://web.amnesty.org/report2005/bih-summary-eng) [Herzegovina](http://web.amnesty.org/report2005/bih-summary-eng) [Bulgaria](http://web.amnesty.org/report2005/bgr-summary-eng) [Croatia](http://web.amnesty.org/report2005/hrv-summary-eng)  [Macedonia](http://web.amnesty.org/report2005/mkd-summary-eng) [Serbia and](http://web.amnesty.org/report2005/yug-summary-eng) [Montenegro](http://web.amnesty.org/report2005/yug-summary-eng) [Slovenia](http://web.amnesty.org/report2005/svn-summary-eng) [Turkey](http://web.amnesty.org/report2005/tur-summary-eng) Romania | [Bahrain](http://web.amnesty.org/report2005/bhr-summary-eng) [Iran](http://web.amnesty.org/report2005/irn-summary-eng) [Iraq](http://web.amnesty.org/report2005/irq-summary-eng) [Israel /](http://web.amnesty.org/report2005/isr-summary-eng) [Occupied](http://web.amnesty.org/report2005/isr-summary-eng) [Territories](http://web.amnesty.org/report2005/isr-summary-eng) [Jordan](http://web.amnesty.org/report2005/jor-summary-eng) [Kuwait](http://web.amnesty.org/report2005/kwt-summary-eng) [Lebanon](http://web.amnesty.org/report2005/lbn-summary-eng) [Palestinian](http://web.amnesty.org/report2005/pse-summary-eng) [Authority](http://web.amnesty.org/report2005/pse-summary-eng) [Saudi Arabia](http://web.amnesty.org/report2005/sau-summary-eng) [Syria](http://web.amnesty.org/report2005/syr-summary-eng) [uAe](http://web.amnesty.org/report2005/are-summary-eng) [Yemen](http://web.amnesty.org/report2005/yem-summary-eng) | [Algeria](http://web.amnesty.org/report2005/dza-summary-eng) [Egypt](http://web.amnesty.org/report2005/egy-summary-eng) [Libya](http://web.amnesty.org/report2005/lby-summary-eng) [Morocco /](http://web.amnesty.org/report2005/mar-summary-eng) [Western](http://web.amnesty.org/report2005/mar-summary-eng) [Sahara](http://web.amnesty.org/report2005/mar-summary-eng) [Tunisia](http://web.amnesty.org/report2005/tun-summary-eng) | **Central Africa**  [Burundi](http://web.amnesty.org/report2005/bdi-summary-eng) [Cameroon](http://web.amnesty.org/report2005/cmr-summary-eng) [Central African Republic](http://web.amnesty.org/report2005/caf-summary-eng) [Chad](http://web.amnesty.org/report2005/tcd-summary-eng) [Congo](http://web.amnesty.org/report2005/cog-summary-eng)  [Democratic Republic of](http://web.amnesty.org/report2005/cod-summary-eng) [Congo](http://web.amnesty.org/report2005/cod-summary-eng) [Equatorial Guinea](http://web.amnesty.org/report2005/gnq-summary-eng) [Rwanda](http://web.amnesty.org/report2005/rwa-summary-eng)  **Southern Africa**  [Angola](http://web.amnesty.org/report2005/ago-summary-eng) [Malawi](http://web.amnesty.org/report2005/mwi-summary-eng) [Mozambique](http://web.amnesty.org/report2005/moz-summary-eng) [Namibia](http://web.amnesty.org/report2005/nam-summary-eng) [South Africa](http://web.amnesty.org/report2005/zaf-summary-eng) [Swaziland](http://web.amnesty.org/report2005/swz-summary-eng) [Zambia](http://web.amnesty.org/report2005/zmb-summary-eng) [Zimbabwe](http://web.amnesty.org/report2005/zwe-summary-eng) **East Africa** [Eritrea](http://web.amnesty.org/report2005/eri-summary-eng) [Ethiopia](http://web.amnesty.org/report2005/eth-summary-eng) [Kenya](http://web.amnesty.org/report2005/ken-summary-eng) [Somalia](http://web.amnesty.org/report2005/som-summary-eng) [Sudan](http://web.amnesty.org/report2005/sdn-summary-eng) [Tanzania](http://web.amnesty.org/report2005/tza-summary-eng) [Uganda](http://web.amnesty.org/report2005/uga-summary-eng) **West Africa** [Burkina Faso](http://web.amnesty.org/report2005/bfa-summary-eng) [Cote D'Ivoire](http://web.amnesty.org/report2005/civ-summary-eng) [Ghana](http://web.amnesty.org/report2005/gha-summary-eng) [Guinea](http://web.amnesty.org/report2005/gin-summary-eng) [Guinea-Bissau](http://web.amnesty.org/report2005/gnb-summary-eng) [Liberia](http://web.amnesty.org/report2005/lbr-summary-eng) [Mauritania](http://web.amnesty.org/report2005/mrt-summary-eng) [Niger](http://web.amnesty.org/report2005/ner-summary-eng) [Nigeria](http://web.amnesty.org/report2005/nga-summary-eng) [Senegal](http://web.amnesty.org/report2005/sen-summary-eng) [Sierra Leone](http://web.amnesty.org/report2005/sle-summary-eng) [Togo](http://web.amnesty.org/report2005/tgo-summary-eng) Madagascar |

For clarification, the following table highlights some of the common areas where sprinklers are required but often overlooked :

|  |  |
| --- | --- |
| **SPRINKLERS ARE REQUIRED IN THE FOLLOWING LOCATIONS:** | |
| Small enclosures | Inside saunas, steam rooms, walk-in cold rooms and rooms containing flammable materials. |
| Linen and rubbish chutes | Above the highest opening, above the lowest opening and at alternate floor levels for buildings > 2 stories. |
| Non-combustible stairs | At the top and under the first landing above the lowest level. If doors from two fire separate fire divisions access the same stair sprinklers are required. |
| Ceiling voids | Over 800mm shall require upturned sprinklers (combustible ceiling). |
| Loading docks, covered platforms, exterior canopies >1.2 width | Dry-pendant sprinklers extending through the wall from wet sprinkler piping in an adjacent heated area. If subject to freezing conditions use a dry system. |
| Under cover internal pools | 100% |
| Kitchen exhaust ductwork  horizontal runs | Required along the horizontal section of ductwork and top of risers. |
| Mechanical rooms & plant rooms | Sprinklers are required in all plant rooms, air handling rooms and plenums and chiller, pump and boiler rooms. |
| Computer and PABX rooms | Inside computer and PABX rooms. 100%. unless another approved fire suppression system is installed. |

|  |  |
| --- | --- |
| **SPRINKLERS ARE NOT REQUIRED IN THE FOLLOWING LOCATIONS:** | |
| Guestroom closets | < 2.2 sqm. if walls and ceilings are non-combustible. length of closet must not exceed 0.9m. |
| Guest bathrooms | < 5.0 sqm. if walls and ceilings are non-combustible. |
| Electrical equipment rooms | If 2 hour enclosure is provided, only dry type electrical equipment is installed and dedicated room w/o storage. |
| Open air parking | None |

The benefits provided by Fire Sprinklers are:-

* Larger Fire Compartment size allowed
* Lower construction fire ratings allowed.
* Lower insurance premiums may be possible
* Guest “comfort” factor and attraction to corporate companies.

The following table provides a summary of applications of different fire suppression systems:-

Applications for Fire Suppression Systems

The fire suppression systems must be designed in accordance with recognised international standards and in compliance with local regulations.

|  |  |  |
| --- | --- | --- |
| **System Type** | **Area of Application** | **Comments** |
| Combined wet system | * Guest rooms * Public spaces * Toilets * Corridors * Retail * Restaurants * Services - hair   dressers, bake  shop, etc.   * Back of house areas * Emergency exit stairs * Freezers | * Sprinkler heads to be quick response type. * Atria that are more than 10m high shall be treated as special   spaces and advice from the fire consultant shall be obtained.   * For freezers the following shall be applicable: * either utilise freeze proof heads as sold by Viking or equal   or utilise a glycol system.   * If a glycol system is used, then the glycol shall be food   grade propylene glycol (down frost or equivalent). |
| Wet chemical systems | • All grease kitchen extract  canopies | * Kiddee Ansul system or equivalent. * The design and sizing of this system shall be done in conjunction   with the manufacturer. |
| Foam system | • Fuel oil storage rooms | • Depending on the authority having jurisdiction, this may involve  the installation of the complete system or just a connection point for the local fire brigade. Advice from the local fire department shall be obtained. |
| Water deluge system | • Gas tank installations |  |
| Dry deluge or glycol system | • Gas tank Installations in  areas that are exposed to freezing conditions |  |
| Dry system | • Parking garages liable to  freezing |  |
| Pre-action water based  systems | * Elevator machine rooms * IT rooms * PABX rooms | • Purpose made pre-action valve assemblies shall be  utilised.  Stage one-normal operation-monitoring/sensing   * Sprinkler water valve shut * Sprinkler pipework in room empty of water * Smoke detectors in operation   Stage Two-One smoke detector activated   * Activation of smoke detectors sounds an alarm   in the room & alerts remote annunciator panel.  Stage Three-Additional smoke detectors activated   * Activation of second smoke detector opens the   sprinkler water flow control valve to fill up the sprinkler pipe work with water.  Stage four-Activation of sprinklers under fire conditions   * Fusible link in each sprinkler head will melt under   fire condition to permit water to be discharged from each sprinkler head. |

**2.7.1 Fire Sprinkler Plant**



**2.7.2 Fire Sprinkler and Hose Reels Low Rise**



2.7.3 Fire Sprinkler High Rise

SPRINKLER DRAIN RISER (NOTE - CAN BE DELETED WTH PUMPED ZONE FLOW SWTCH AS ILLUSTRATED PREVIOUSLY)

TAMPER SWITCH PRESSURE GAUGE SPRINKLER DRAIN RISER SPRINKLER RISER

► TO SPRINKLERS

SIGHT GLASS'

ORIFICE

DETAIL A

SPRINKLER ZONE VALVE ARRANGEMENT IMTH PRESSURE REDUCTION



ff®WATER FLOW ALARM SW1TC

*-e*



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**2.7.4 Sprinkler Alarm Valve**

Each pressure zone in the building will be fed by the fire pump with the installation being controlled by a wet sprinkler alarm valve located in an accessible location for the fire brigade to isolate the water supply when necessary.

**2.7.5 Pre-action Dry Sprinkler System**

For use where:-

• Leaks in the system could cause problems

STAGE ONE - NORMAL OPERATION - MDNITORING/SENSING

* SPRINKLER 'WATER VALVE SHUT
* SPRINKLER PIPEWORK IN ROOM EMPTY OF WATER
* SMOKE DETECTORS IN OPERATION

STAGE TWO - ONE SMOKE DETECTOR ACTIVATED

A - ACTIVATION OF SMOKE DETECTORS SOUNDS AN ALARM IN THE ROOM & ALERTS REMOTE ANNUNCIATOR PANEL

STAGE THREE - ADDITIONAL SMOKE DETECTORS ACTIVATED-

B - ACTIVATION OF SECOND SMOKE DETECTOR OPENS THE SPRINKLER WATER FLOW CONTROL VALVE TO FILL UP THE SPRINKLER PIPEWORK WITH WATER

STAGE FOUR - ACTIVATION OF SPRINKLERS UNDER FIRE CONDITIONS

c - FUSIBLE LINK IN EACH SPRINKLER HEAD WILL MELT

UNDER FIRE CONDITIONS TO PERMIT WATER TO BE DISCHARGED FROM EACH SPRINKLER HEAD

2.7.6 Typical Guest floor Fire Protection System

FLUSH MOUNTED SPRINKLER HEAD WHERE PERMITTED

PENDANT SPRINKLER HEAD SPRINKLER VALVE ARRANGEMENT - REFER TO DETAIL OPPOSITE *it* 2.7.4

HOSEREEL / HOSE RACK (MAY BE OMITTED IN SOME

LOCATIONS)

- ALL AREAS TO BE REACHED WTH 30m HOSE,

ALLOWING 3m SPRAY

WET RISER LANDING VAL'Æ

WALL MOUNTED SIDEWALL SPRINKLER HEAD

FIRE EXTINGUISHER

SPRINKLER SPACING NOT TO EXCEED 11.1m’PER

SPRINKLER HEAD

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2.7.7 Kitchen Hood Suppression

The kitchen cooking range and hood shall be protected with a proprietary wet chemical (not foam, dry powder or gas) suppression system such as Ansul or equivalent.



2.7.8 Fog / Water Misting Systems

These are an alternative to conventional sprinkler systems, and offer the following benefits:-

* Reduced pipe sizes
* Reduced water storage
* Less water discharge
* Less damage and downtime of room

Water supply

Pump or accumulator

Tubes

Section valves

Sprinkler *I* spray heads

2.7.9 Other Fire Suppression Systems (e.g. Integrin, FM200)

Fire suppression systems are constantly developing and alternative systems may be considered for use where benefits and approvals can be demonstrated.

Typically these systems will be operated via smoke detectors in the area to be protected which:-

* Sound an alarm
* Shut down the air handlers
* Disconnect the power
* Release the agent into the protected areas

The area must be sealed on activation, and it may be necessary to carry out a pressure test to ensure this has been achieved.

2.8 Smoke Control Systems

Smoke control systems must be provided where these form part of the building life safety strategy and where required by the appropriate codes and standards. In particular the requirements indicated below must be compiled with.

2.8.1 Stair Pressurisation Systems

In high rise buildings to protect against the ingress of smoke and as an alternative to access to escape stairs by fire resisting lobbies or open vestibules / balconies, escape stairs may be protected by a stair pressurization system

This works by maintaining the pressure within the escape routes at a higher pressure than the adjacent spaces

A pressurisation system comprises two main components:-

* Supply air (outside air) injected into the area to be protected
* Air release to allow smoke to be relieved from the adjoining fire area

The system cannot work without these 2 areas working together.

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Diagrammatic Layout of Stair and Lift Pressurization Systems



Diagrammatic Layout of stair and Lift Pressurization Systems



2.9 Atriums

This document provides basic guidance on the areas to be considered when an atrium is proposed in a hotel or when an existing hotel has an atrium.

It must be emphasized that the actual fire protection measures provided must be determined by a suitably qualified fire engineer taking into account local codes and regulations, IHG standards and the individual design of the building. Full details of these measures including calculations and modeling must be provided to IHG for approval prior to installation and IHG reserves the right to have these reviewed by a third party fire engineer at the applicants expense.

An atrium is a large vertical opening that spans two or more floors. As a general rule an atrium has a relatively large plan area and to be considered an atrium the opening must have a minimum horizontal dimension of 6.1 m and a minimum area of 95 sqm. A monumental stair may or may not be considered as an atrium space.

In order for an atrium to be permitted in a hotel, the following must be achieved:

* Where there are no suitable local codes of practice, standards or regulations governing smoke and heat

control in atria the system must comply with NFPA 92B.

* In general HVAC systems do not have the capacity for use as a smoke management system for an atrium,

nor are the supply and exhaust air grilles located for their proper use in such a system, therefore, a dedicated smoke management system must be provided.

* The use of combustible furnishings and decorations on the floor of the atrium must be limited and sparsely

distributed.

* Smoke detectors must be provided on the underside of each floor protruding into the atrium, at the atrium

roof and adjacent to each return air intake from the atrium. Beam type smoke detectors must be provided within the atrium.

* The atrium must be separated from adjacent spaces by at least 60 minute fire resisting construction with

self-closing, fire resisting doors.

* The entire building is to be protected throughout by an approved, supervised automatic sprinkler system and

in particular the fire load in the base of the atrium must be controlled by the sprinkler system.

* The entire hotel must be provided with a fully addressable fire alarm and detection system including a

broadcast voice evacuation message to ensure a speedy response to any alarm.

* In general atria may be either enclosed by fire resisting glazing or may be provided with a smoke and heat

control system that will keep escape routes clear for sufficient time to allow the occupants to escape.

2.9.1 Fire resisting enclosure

Where escape routes do not pass through the atrium at upper levels the atrium may be enclosed by fire resisting construction or glazing. The atrium must be provided with a simple smoke clearance system that may be used by the fire brigade to remove any smoke that enters the atrium.

Non-fire resisting glass may be used where:

* Fast response automatic sprinklers are spaced 1800mm apart or less along both sides of the glass and not

more than 300mm from the glass

* The automatic sprinklers are located so that the entire surface of the glass is wet upon their operation
* The glass is wired, laminated or tempered
* The glass is supported in a steel frame held in place by a gasket system which permits the glass framing

system to deflect without loading the glass before the sprinklers operate

Automatic sprinklers are not required on the atrium side of the glass wall when there is no walkway or other floor area on the atrium side above the main floor level.

An example of an atrium that is not fully enclosed and which has escape routes through the atrium. A smoke and heat control system is therefore required to keep the atrium clear for sufficient time to allow the occupants to safely escape.

2.9.2 Smoke and heat control system

Where escape routes pass through the atrium at upper levels a smoke and heat control system must be provided that will keep escape routes clear for sufficient time to allow the occupants to escape.

The design of these systems is very complex and this must be carried out by specialist fire engineers with experience in this area. This is of particular importance where CFD (computational fluid dynamic) modeling is used.

Calculations and / or smoke modeling of the system must be provided to IHG for approval.

These are provided in Hotels to give a lively atmosphere to the Hotel, but the interconnection of floors must be addressed to allow for safe escape in the event of a fire.

As well as limiting the use and combustible materials at the base of the atrium, a smoke control system must be provided, where the escape routes are open to the atrium. Where they are not, only a smoke clearance system needs to be provided.

The illustrations are shown below:

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An example of an atrium with a fire protected enclosure and without escape routes through the atrium.



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2.9.3 Carbon Monoxide Detection

Single- or multiple-station (interconnected) carbon monoxide detectors and alarms must be installed in each of the following locations

* In each room/area containing fossil fuel burning equipment (within 4.5m/15ft of the equipment unless

the manufacturer’s instructions specify otherwise)

* In each guestroom, corridor or common area adjacent to the fossil fuel-burning equipment area or its flue

ventilation path (within 4.5m/15 feet of the flue ventilation path unless the manufacturer’s instructions specify otherwise)

* In each corridor or common area adjacent to the fossil fuel-burning equipment room/area (within 4.5m/15

feet of the each entrance to the area unless the manufacturer’s instructions specify otherwise)

The device may be battery powered a plug-in device with battery backup, or a device that is either wired into the power line with a secondary battery backup or connected to a system via a panel.

All carbon monoxide detectors and alarms should be manufactured and installed in accordance with local code and the manufacturer’s instructions.

If installing an electrically operated device, the AC power source should be supplied from either a dedicated branch circuit or the un-switched portion of the branch circuit also used for power and lighting. Operation of a switch (other than a circuit breaker) or a ground fault circuit interrupter should not cause loss of power to the alarm.

The carbon monoxide detectors and alarms may be located on the wall, ceiling or other location as specified in the manufacturer’s installation instructions.

For alarms installed within corridors/common areas, the alarm should be clearly audible in all bedrooms over background noise levels and with all intervening doors closed with a minimum rating of 85dBA at 3m/10 ft. If the alarm is intended to notify sleeping occupants in the same room, the sound pressure level is permitted to be 75dBA at 3m/10 ft.

The hotel must prepare a written emergency and evacuation plan in response to an alarm sounding. The plan must contain details of a named person(s) who is/are trained and qualified to respond to the activation of one or more alarms. A programme must be in place to monitor the carbon monoxide detectors and alarms and replace batteries in battery powered carbon monoxide detectors and alarms

In rooms or areas with fossil-fuel burning equipment, a carbon monoxide detector/alarm with an automatic shut down device may be connected to the equipment. Such a component can be wired to the fossil-fuel burning equipment and shut it down automatically. In such circumstances signage and restarting restrictions may also apply. Automatic shutdown is not required for power generator.

A carbon monoxide detector/alarm is not required in a kitchen. Where the only potential source of CO is gas kitchen equipment, there should be written certification from a professional engineer that it has been installed and complies with local codes and the manufacturers installation instructions

Fossil fuel is defined as including coal, natural gas, kerosene, oil, propane and wood.

* 1. Security

REFER TO IHG

* 1. Leisure Activity

REFER TO IHG

* 1. Food Safety

REFER TO IHG

* 1. Health & Safety

REFER TO IHG

* 1. Data Protection

REFER TO IHG

3.0 UTILITY SERVICES

The utility services must be subject to a reliability study to demonstrate the typical available hours per annum, but general principles are outlined below:

COMMUNICATIONS

-REFER TO IHG GLOBAL TECHNOLOGY

-TO ALLOW FOR MULTIPLE PROVIDERS

24 HOUR ACCESS BY AUTHORITY

DOMESTIC WATER

DEDICATED FIRE MAIN DUAL INCOMING SUPPLIES FROM MAINS WHERE PRESSURE PERMITS

DISTRICT COOLING OR HEATING

TO HEAT EXCHANGER ROOM

TELECOM

GAS

REAR OF BUILDING

FRONT OF BUILDING

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* 1. Gas

Gas must be provided to the site from the local service provider, and must enter the property in a position that allows unobstructed 24-hour clear access by the utility company. The gas meter and governor assembly together with any gas booster entry point must be at the rear of the building, not accessible by the public, and a dedicated meter room located on an external wall with facility for isolation must be provided to comply with the local regulatory requirements. The gas supply must have an automatic solenoid shut off valve to isolate the gas supply in the event of a fire alarm. If natural gas is to be used without back up it should be available for 95% of the time.

If natural gas is not available, then an analysis must be carried out to determine the preference between oil and LPG. A gas leak detection system shall be provided covering storage and pipe network up to final termination points.

* Bulk storage of LPF, Butane or Propane may be used, based on 6 weeks supply at maximum use.
* Refer to LPGA Code of Practice No. 1 Part 4: 1999 or NFPA 58.
* Provide separate metering for each area served.
* Provide automatic gas solenoid shut off valves connected to the fire detection and alarm system for each area served, with a manual knock off button provided adjacent to the exit, all of which shall be connected to the fire panel and BMS.
* Gas detections shall be provided in all rooms having gas supply, to sound on alarm and shut off the gas in the event of leakage being detected.

The gas system should be designed to conform to NFPA standards as a minimum for all gas installations including, ventilated risers, combustion gas emissions combustion air and safety precautions must be observed in the design.

For kitchen areas gas is generally cheaper than electricity and cooking intensity can be better controlled. For boilers gas is preferable due to its lower cost and environmental impact.

* 1. Water

A dedicated domestic water supply must be provided to serve all of the hotels ‘non-fire’ requirements from the Water Company’s mains. The Water Supply Company’s mains must be fitted with a water meter at the site boundary, as well as a stop valve either side of the water meter. This should also include a low flow meter.

A dedicated fire water supply must be provided to serve all of the hotel’s ‘fire’ supplies, which may include:

* Fire hose reels
* External fire hydrants
* Internal wet rising/falling mains/sprinkler systems - Combined or individual
* Fire water supply to sprinkler/hydrant storage tanks

The fire supply must comprise of dual incoming supply. Where the facility exists within the local water reticulation, the dual incoming supply must be derived from separate external water mains. Where not available a separate tank supply must be provided, with compartmentation for maintenance.

If local codes do not specify storage requirements of fire water, refer to NFPA requirements

The requirements for storage will depend upon the reliability of the water supply, which should be confirmed before deciding upon the storage requirements indicated in section 6. It is preferable to reduce storage due to the potential health risk, but the final storage requirements should be based on the reliability, and maximum water flow available.

3.3 Electricity

The utility company will supply either an HV or LV electrical supply dependent on the nature of the local network availability.

All incoming electrical supply transformers and switch rooms must be located at the back of house areas of the hotel.

If the Utility Company is able to provide dual feed power supplies to the site from separate independent generating sources, or separate external mains, then consideration may be given to deletion of the standby generator set. This will be subject to receipt in writing from the Utility Company of verification of the supplies and their reliability. (refer to electrical section for further details).

Design of the substation must be strictly in accordance with the local supply authority requirements. Provide signed approval from Local Supply Authority for substation design.

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4.0 Mechanical Services

4.1 Design Criteria

|  |  |
| --- | --- |
|  |  |
| INTERNAL DESIGN CONDITIONS | • In accordance with Table 3.2  •To be achieved at external conditions determined from historical weather data for the project's location - refer to tables for daily maximum and minimum temperatures in following pages |
| *J* |  |
| ' K |  |
| LIFE EXPECTANCY | * In accordance with CIBSE, ASHRAE, BS7543 or other recognised international standard * Expected life in the order of 25 to 30 years |
|  |  |
|  |  |
| LIFE CYCLE AND OPERATING COSTS | •To be minimised through passive building design such as orientation, prevailing winds, insulation levels etc.  • Designer to provide efficient plant and systems, appropriate zoning, effective control systems, selection of the most cost effective fuels and heat recovery |
|  |  |
| ' -X |  |
| SPACE UTILISATION | •To be minised for plant, equipment and distribution, by planning appropriate plant locations, coordination with the structure and providing efficient distribution systems |
|  |  |
| \ |  |
| ACOUSTICS | • Designer to demonstrate and provide the acoustic values for all systems to confirm compliance with IHG standards |
|  |  |
| ENERGY CONSUMPTION | • The design of the building and associated systems shall not exceed the targets stated within |
|  |  |
| CO2 EMISSIONS | * Targets to be as required by National Standards * Where standards do not exist 160kg/m2 must not be exceeded * The designer shall provide calculations to demonstrate compliance |
|  |  |

The design, installation and maintenance provisions shall be in full compliance with all relevant International, European, National and Local standards and regulations, and in particular any health, fire, safety and environmental legislation.

These systems shall be designed and operated to achieve:

* Internal design conditions indicated for each area, as indicated in Table 4.3.2
* Internal design conditions should be achieved at external conditions determined from historical weather data for

the project’s location.

The design recommendations that follow reflect the differences in design in the hotel comparison sheet provided earlier.

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**4.1.1 Green Engage Design Standards**

|  |  |
| --- | --- |
| E-02 | Energy Metering and Sub-Metering |
| E-03 | Energy Performance Benchmarking |
| E-04 | Building Energy System Commissioning |
| E-05 | Building Management System (BMS) |
| E-12 | Low Energy Systems |
| B-02 | Optimize façade design |
| B-04 | Air Infiltration Reduction Methods |
| B-05 | Acoustic Isolation |
| M-01 | Fresh Air Delivery |
| M-02 | Natural Ventilation |
| M-03 | Guest Room HVAC Equipment Selection |
| M-04 | Water Cooled Chillers |
| M-05 | Additional Cooling Systems |
| M-06 | Refrigerant Management |
| M-07 | Economizer Modes |
| M-08 | Heat Recovery |
| M-09 | 4 Degree Dead band |
| M-10 | Enhanced HVAC Guest Room Controls and CO**2** Monitoring |
| M-11 | Motor Energy Efficiency |
| Appendix Recommended construction for different climatic regions | |

4.1.2 InterContinental Brand Standard Manual

Section 2 Property Standards - then reference each individual area Appendix - T echnical Specifications - then reference each individual area.

4.1.3 Mechanical Services, Systems Included

The main mechanical services that are included within the designer’s responsibility:-

4.2 Aims and Objectives

The aims and the objectives of the HVAC systems are to:

* Provide a comfortable odour free temperature controlled environment for occupants up to 24 hours a day.
* Provide individual temperature control in guest rooms, with adjacent rooms having heating/cooling simultaneously

available.

* To provide fresh air to all areas for the dilution of odours and for occupancy needs. This must be pre-conditioned

by dedicated AHU’s.

* To remove vitiated air from the areas.
* To provide sufficient continuous heating for the domestic hot water supply

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CENTRAL CHILLED WATER AND —

HOT WATER PLANT-

PREFERABLY LOCATED ADJACENT TO SUBSTATION

SUPPLY AND EXHAUST VENTILATION SYSTEMS

GUEST ROOM A/C OPTIONS:

-DEPARTMENT ON CLIMATE ZONE

-REFER TO OPTIONS LISTED

ZONED SUPPLY AND EXTRACT

FOR PUBLIC AREAS

BMS MONITORING & CONTROL

GROUND SOURCE (SUBJECT TO IHG APPROVAL)

CARPARK

VANTILATION



4.3 Design Criteria

4.3.1 Selection of maximum and minimum external design temperatures

Select the design maximum & minimum external design temperatures based on weather data for the area and the following:-

Intsrnal coaling design conditions should be achieved at external conditions which are not exceeded by the maximum historical weather data for the location for more than 2% of theyear

98% of the annual external temperature occurrences must be designed for

Historical Maximum Temperature Data Occurrence Chart of Design Location

Daily Maximum Temperatures

Temperature occurs lessthan 2% of the vear

Historical Minimum Temperature Data Occurrence Chart of Design Location

98% of the annual external

temperature occurrences must be

designed for

Internal heating design conditions should be achieved at external conditions which are exceeded by the minimum historical weather data for the location for more than 2% of the year

Daily Minimum Temperatures

Note:-

* Base external heat rejection equipment selections on external ambient design temperature for the location +5°C
* Minimizing life cycle cost by utilizing natural energies (light/solar) and building form, simplifying the services design

and designs appropriate to the building location.

The systems proposed should comply with the following recognised International Industry Standards:

* CIBSE
* ASHRAE
* NFPA (Smoke Control Systems)

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**Temperature occurs lessthan 2% of the year**



4.3.2 Internal Design Criteria

The following table provides the internal design criteria to be used

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 4.3.2- Mechanical Services Internal Design Criteria** | | | | | | | | | |
| **Area** | **Location** | **Internal Conditions ± 1**o **C&5%RH** | | | | **Pressurization** | **Fresh Air Quantity *(notes 6 and 13)*** | **NR Rating** | **Minimum Filtration Standard to EN779:2012** |
| **Summer** | | **Winter** | |
| **0C db** | **Max RH** | **0C db** | **Min RH** |
| Public Areas | Entrance Lobby - Seating Areas | 23 | 60 | 21 | 30 | 5% Positive | - | 35 | F6 |
| Reception - General | 23 | 60 | 21 | 30 | 5% Positive | 1.0 l/s/m2 | 35 | F6 |
| Cloakroom | NC | NC | NC | NC | Negative | *Note 7* | 35 | No Filtration |
| Public Toilets | 24 (Note 9) | 60 | 20 | 30 | 10% Negative, max 15 pa | *Note 8* | 35 | G5 |
| Gift Shop | 23 | 60 | 21 | 30 | 5% Positive | 1.6 l/s/m2 | 40 | F6 |
| Corridors | 23 | 60 | 21 | 30 | 5% Positive | 1 AC/hr. | 35 | G5 |
| Restaurant | 23 | 60 | 21 | 30 | 5% positive | 8.5 l/s/m2 | 35 | F6 |
| Coffee Shop | 23 | 60 | 21 | 30 | 5% positive | 8.5 l/s/m2 | 40 | F6 |
| Cocktail Lounge | 23 | 60 | 21 | 30 | 5% Negative (Note 6) | 10.0 l/s/person | 35 | F6 |
| Ballrooms | 23 | 60 | 21 | 30 | 5% Positive | 15 l/s/m2 | 40 | F8 |
| Pre-Function Foyer | 23 | 60 | 21 | 30 | 5% positive | 11.0 l/s/m2 | 40 | F8 |
| Function Room | 23 | 60 | 21 | 30 | 5% Positive | 20 l/s/m2 | 40 | F8 |
| Bar | 23 | 60 | 21 | 30 | 5% Negative | 10.0 l/s/person | 40 | F6 |
| Lounge - General | 23 | 60 | 21 | 30 | 5% positive | 10.0 l/s/person | 35 | F6 |
| Meeting Rooms | 23 | 60 | 22 | 30 | 5% positive | 10.0 l/s/person | 30  *(Note 4)* | F6 |
| Business Centre | 23 | 60 | 21 | 30 | Neutral | 1.6 l/s/m2 | 35 | F6 |
| Lifts | - | - | - | - | - | - | - | - |
| Stairwells | 24 | NC | 18 | NC | - | - | 35 | - |
| Recreation  Areas | Fitness Rooms | 18 | 60 | 18 | 30 | 5% Negative | 4.2 l/s/m2 | 40 | F6 |
| Health Club - Reception | 23 | 60 | 21 | 30 | 5% Positive | 0.8l/s/m2 | 40 | F6 |
| Health Club - Food & Beverage areas | 23 | 60 | 21 | 30 | 5% Negative | 1.6 l/s/m2 | 40 | F6 |
| Health Club - Changing | 24 | NC | 24 | NC | 10% Negative, max 15 Pa | 10 Ac/hr. | 40 | F6 |
| Massage/Solarium/  Sauna/Jacuzzi | 27 | 60 | 27 | 30 | Neutral | 8.0 l/s /person | 35 | F6 |
| Indoor Swimming Pool | 31  *(Note 3)* | 60 | 31  *(Note 3)* | 65 | 5% Negative, max 15 pa | 15 l/s per m2 of wet area | 40 | G3 |
| Private Guest  Areas | Bedrooms - Activity Areas Day/Night | 23 | 60 | 22 | 30 | Positive | 25 l/s *Note 10* | 25 (night)  30 (days) | F6 |
| Bathrooms - Bath Areas | - |  | - |  | Negative | *Note 11* | - | - |
| Club Lounge | 23 | 60 | 22 | 30 | Neutral | 6.5 l/s/m2 | 30 | F6 |
| Corridors | 23 | 60 | 21 | 30 | Neutral | - | 30 | - |
| Laundry | Max 30 | NC | 16 | NC | Negative | *Note 1* | 45 | G3 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Area**  Back of House Areas | **Location** | **Internal Conditions ± 1**o **C&5%RH** | | | | **Pressurization** | **Fresh Air Quantity *(notes 6 and 13)*** | **NR Rating** | **Minimum Filtration Standard to EN779:2012** |
| **Summer** | | **Winter** | |
| **0C db** | **Max RH** | **0C db** | **Min RH** |
| Housekeeping/linen | 25 | NC | 18 | NC | Positive | 1 l/s/m2 | 40 | F6 |
| Kitchen (General) | *27*  *(Note 9)* | NC | 18 | NC | Negative | 1.6l/s/m|2 min *(Note 2)* | 45 | G3 |
| Kitchen (Pastry) | *21*  *(Note 9)* | NC | 18 | NC | Negative | 45 | G3 |
| Kitchen (Prep/Finish) | *20*  *(Note 9)* | NC | 18 | NC | Negative | 45 | G3 |
| Back of House Areas | White Wine and Beer Store | 5 | NC | 5 | NC | - | - | - | - |
| Staff Dining | 25  *(Note 9)* | NC | 21 | NC | Positive | 10 l/s/m2 | 40 | F6 |
| Staff Kitchen | 25  *(Note 9)* | NC | 18 | NC | Negative | 10AC/hr. *(Note 2)* | 45 | G3 |
| Staff Changing | 25  *(Note 9)* | NC | 23 | NC | Negative | 10AC/hr. | 40 | F6 |
| Corridors | 25 | NC | 18 | NC | Neutral | - | 30 | F6 |
| Offices | 24  *(Note 9)* | 60 | 22 | 30 | 5% positive | 1.0 l/s/m2 | 35 | F6 |
| Workshops | 25  *(Note 9)* | NC | 20 | NC | Negative | 1.6 l/s/m2 *(Note 14)* | 45 | G3 |
| Plant Rooms | 30 max | NC | 8 (min) | - | Negative | *(Note 12)* | 65 | - |
| Computer Room/IT Equipment | 23  *(Note 5)* | 60 | 20 | 30 | 5% Positive | 1 Ac/hr. | 45 | F8 |
| Lift Motor Rooms | 28 max | NC | 16 min | NC | Negative | *(Note 12)* | 45 | - |
| Refuse area | 24 max | NC | 18 | NC | Negative | 6AC/HR | 40 | G3 |
| External Areas | Covered /Underground Car Parking | - | **-** | - | - | Negative | 6 AC/Hr (Note 15) | 55 | - |

NC - Not Controlled

|  |  |  |
| --- | --- | --- |
| **Notes to table** | | |
| Note 1 | - | 10 AC/hr. or sized to dissipate heat and moisture from equipment if details are available. |
| Note 2 | - | Air change rate shall depend on kitchen equipment heat output and on extract volume from canopies. A minimum face velocity must be provided to each canopy, refer to the kitchen section of this document. Use of proprietary hoods with UV filtration can reduce this. |
| Note 3 | - | Pool hall internal temperature should be designed 1oC above maximum pool water temperature. |
| Note 4 | - | Cross talk attenuators and any services penetrations to/from meeting rooms and guest bedrooms to provide 50dB sound reduction through the wall, floor or roof. |
| Note 5 | - | Computer and IT/Telephone rooms shall be provided with supplementary “split” under floor ducted air conditioning systems with standby power supply, in the event that the main air conditioning system fails. |
| Note 6 | - | Electrostatic smoke filters and negative pressure are required in the re-circulation system from Lounge and Bar areas when smoking is permitted. Fresh air rates are maximums when smoking is not permitted unless local regulations require higher rates. |
| Note 7 | - | Extract only from cloakroom with makeup from foyer, sized on 1 AC/hr. |
| Note 8 | - | Toilet extract to be sized on 10 AC/hr., with make-up via the toilet lobby, supplied from the nearest supply air system. Extract fans to be dual fans. In “Hot climates” make up air must be cooled and in ‘Cold Climates’ heated if the air is directly from outside e.g. pool toilets. |
| Note 9 | - | Ventilation to these areas to be designed to maintain internal air temperature below 25°C for 95% of the year, if possible without a cooling system. If a cooling system is required the internal design temperature shall be 24°C. |
| Note 10 | - | Ventilation rates to be based on 8-12 l/s per guest, final figure to balance the exhaust rate. The maximum number of guests per room to be utilized hence: |

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|  |  |  |
| --- | --- | --- |
|  |  | Standard rooms, Club room, Queen, King allow 2 persons. Allergy/disabled allow 1 person. Queen Sofa, King Sofa and Double allow 4 persons. Supply of fresh air shall be pre-conditioned. |
| Note 11 | - | Extract volume from guest bathroom shall be minimum of 90% of the supply air volume to the guestroom, and a minimum of 6 Ac/hr., but preferably balanced with the fresh air. |
| Note 12 | - | Ventilation rates to be selected to achieve the maximum summer temperature requirement. Fans to be controlled from a local thermostat. Natural ventilation is an acceptable alternative if suitable control can be demonstrated. |
| Note 13 | - | The fresh air quantities indicated for public spaces are the maximum to be allowed for calculations and equipment selection. The actual fresh air quantity is to be controlled via air quality sensors, to maintain a maximum CO2 level in the occupied space of 600ppm. |
| Note 14 | - | Opening windows are an acceptable alternative to mechanical ventilation in suitable climates. Exhaust systems shall be provided for processes such as welding, carpentry, painting |
| Note 15 | - | Car parks requiring mechanical ventilation shall be extracted to prevent the spread of fumes to adjoining spaces. Systems shall be controlled by air quality sensors (CO and N0x) to reduce energy consumption (with override by Life Safety Controls). Ventilation rate in fire/smoke control mode to meet local regulations. |

4.4 Building Orientation

Careful orientation of the Hotel can have a significant effect on the energy consumption of the Hotel and although it is accepted this is not always possible, there are many occasions when it can be influenced. For example, the guestrooms are most used early in the morning and evening so guestrooms facing E-W are likely to have a larger cooling demand due to difficulties in providing shading on these orientations due to the low sun angle.

Low Cooling Demand

Direction of sun early morning difficult to shade due to low sun angle

Direction of sun late afternoon difficult to shade due to low sun angle

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4.4.1 Solar Shading - Sun Paths

The design of many modern buildings does not consider their form in relation to the sun’s path. This results in considerable additional cooling loads which have to be removed by means of mechanical cooling systems. Excessive energy usage not only increases the operating costs of the building but also increases the resulting pollution produced from generating the power in the first instance. It also requires larger plant, which requires more valuable space to be taken within the building.

With this in mind, careful consideration is required for the building design in terms of orientation and protection from solar penetration. The use of well insulated external walls will help reduce the impact of the sun’s effect. Treatment or shading to reduce solar gains through glazed areas then becomes simpler/easier to achieve. From the earliest stages of the hotel design the building orientation should be assessed to ensure that the general form acts as the primary source of shading, whilst maximising access to natural ‘north light’ (‘south light’ in the southern hemisphere).

For example, the sun’s path in summer rises to a maximum altitude of 64° in the southern sky in the middle of the day for the United Kingdom. The relatively high sun angles make horizontal shading a very effective passive device on the southern façade.

During early mornings/late afternoons the sun angles are much lower. At these times horizontal shading is far less effective, and so, in terms of passive fixed shading, vertical elements can then be employed to help reduce the periods and extent of solar penetration.

For each building design, the solar paths should be plotted to ensure shading or alternative treatment is effective for the orientations to which they are provided.



4.4.2 Wind Path Diagram

Understanding the wind strengths and patterns for the site can help in locating intakes & discharges and benefiting from natural ventilation. The following is an illustration of a typical wind path diagram:



4.5 Cooling Load Estimates

It is important to estimate the building cooling load accurately and not oversize (which will cause inefficiency and poor control) or undersize, (which will cause poor temperature controls).

Hotel guest rooms are conditioned 24 hours a day and the peak load only occurs for 1 hour a day so it is important not to overestimate the load.

Cooling load calculations must be carried out on a proprietary software programme which can simulate based on:-

* Local weather conditions
* Building construction type,
* System types to be provided.

Two large contributors to the overall cooling load in a hotel are:-

* Guest Rooms
* Fresh Air

Some guidelines are provided for these areas to assist in understanding their importance and assessing them correctly.

4.5.1 Guest room load estimation

Refer to an illustration of the expected cooling loads for a hotel guest room - this also provides guidance on wall/window ratios and targets for wall/glass cooling loads

These must be calculated specifically for each hotel project but any major variations from these must be examined and explained.



4.5.2 Fresh Air Load Estimation

As mentioned previously, the air conditioning will make up a large proportion of the power consumption for a hotel building, and the fresh air will form a significant proportion of this, which can be illustrated as follows for different locations:-

|  |  |
| --- | --- |
| Location | Fresh Air Load as a % of Total (Approx.) |
| UK | 15% |
| Middle East/India | 42% |
| Australia / Asia Pacific | 32% |
| Tropical SE Asia | 45% |

It is therefore essential to incorporate heat recovery on fresh air systems

4.6 Main Plant Location

The locations of the main plant rooms (being substation/switch room, chillers, boilers and hot water storage) can have a significant effect on the capital cost and running costs for the Hotel.

The more central they are, and the closer the main load centers are located, the lower the capital cost and energy consumed will be.

Similarly, for air handling plant rooms, these should be located adjacent to the space they serve in order to minimize capital costs and ongoing fan power consumed and duct space for distribution.

Typically the Architect will design the building, then the Engineer will add the plant to areas available which are usually at the extremities of the building (roof and basement) resulting in both increased capital cost for the Developer and increased energy consumption for the owner/operator.

Mechanical Services Plant Remote (**Poor Design**)

* Plant separated - long distribution at maximum size
* Service to one area pass through other areas
* Increased capital and running costs and more space required



Main mechanical plant locations- remote- not recommended (poor practice)

Mechanical Plant Located Correctly (**Good Design**)

* Chiller located central - distribution splits for guest rooms and other areas
* Plant areas minimised
* AHU’s located central to areas served - ducts split for reduced ceiling space, capital cost, installation cost and

running cost

* Simplified maintenance with plant located close together

Main mechanical plant locations­central - recommended (good practice)





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Main electrical load locations - remote- not recommended (poor practice)

Electrical Plant Remote (**Poor Design**)

* Main electrical loads separated
* Distribution cable increased in length and size
* Longer installation/commissioning time
* Increased capital and running costs

Electrical Plant located correctly (**Good Design**)

* Highest electrical demands located close together
* Distribution/cable size minimised
* Installation time reduced
* Capital and running costs reduced



Main electrical load locations­central - recommended (good practice)

4.6.6 Guidelines for Plant space Required

The tables below provide some guidelines of the extent of plant space required for different hotels types and sizes:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| InterContinental/ Crowne Plaza | | | | | | | |
| Number of Guest Bedrooms | 125 | 150 | 200 | 300 | 400 | 500 | 700 |
| Total Gross area public space BOH (m2) | 2700 | 3300 | 4200 | 6000 | 7500 | 9700 | 12400 |
| Boilers, AC Plant, HWS and pumps (m2) | 250 | 300 | 350 | 550 | 630 | 900 | 1100 |
| Air handling Plant (m2) | 50 | 80 | 100 | 120 | 150 | 180 | 200 |
| Electrical transformer and switchgear (m2) | 30 | 20 | 40 | 60 | 75 | 90 | 140 |
| Emergency  Generator (m2) | 20 | 20 | 20 | 20 | 30 | 30 | 50 |
| Telephone  Equipment (m2) | 20 | 20 | 25 | 30 | 40 | 40 | 50 |
| Total Plant  Room area (m2) | 370 | 450 | 535 | 780 | 925 | 1240 | 1540 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Holiday Inn | | | | | | |
| Number of Guest Bedrooms | 75 | 125 | 150 | 200 | 300 | 400 |
| Gross area public / BOH (m2) | 1675 | 2460 | 3025 | 4045 | 5670 | 7445 |
| Gross hotel area  (m2) | 3475 | 5460 | 6625 | 8845 | 12970 | 17045 |
| Total plant space (m2) | 140 | 220 | 265 | 350 | 510 | 680 |
| & of Total area | 4.0% | 4.0% | 4.0% | 4.0% | 4.0% | 4.0% |

These should be used as a guide only for preliminary planning and for checking purposes.

The plant should be located centrally to the areas being served as shown in the following illustration (and not for example all on the roof)

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Plant Locations- should be central to the location being served

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4.7 Energy Targets

The design of the building and associated systems should be such that the energy consumption does not exceed the following targets:

|  |  |  |  |
| --- | --- | --- | --- |
| **Table 3.1 - Energy/Water Consumption Targets** | | | |
| Fuel | Climate | | |
| **Moderate** | **Mediterranean** | **Tropical** |
| Total Energy | 270kWh/m|2/annum | 250kWh/m|2/annum | 260kWh/m|2/annum |
| Water | 0.35m3/guest night maximum | 0.45m3/guest night maximum | 0.70m3/guest night maximum |
| Carbon emissions | 160kg/m2 | 148kg/m2 | 154kg/m2 |
|  |  |  |  |

The target for carbon dioxide emissions should be as required by National Standards, or if they do not exist, then should not exceed 160kg/m2 floor area per annum. In the UK, the energy targets will be set by Building Regulations Part L compliance.

The MEP designer shall provide calculations to illustrate that these targets are being achieved.

Insulate all heating and cooling vessels, equipment and piping to minimise unwanted heat loss or gain.

* Utilise cogeneration plant wherever possible, subject to full feasibility study
* The overall net building pressure (controlled by the BMS) shall be positive to minimise infiltration.

TOTAL FRESH AIR SUPPLY fc TOTAL EXHAUST 10-20%

NOT ro SCALE

OVERALL BUILDING AIR BALANCE TO PREVENT INFILTRATION

HÖT TO SCALE

* Provide VFD’s (speed control) on all central plant air handling systems and pumps delivering variable air volumes

or operating at varying pressures.

* Provide energy efficient systems with international or national ratings.
* Commission all systems using certified equipment before handover.
* Economy cycle operation in all AHU’s to use fresh air for “free” cooling when available.
* CO2 control of fresh air supplies to air supply and extract systems to all public spaces.
* Two speed ventilation systems (or inverter driven fans) serving the kitchens for economy in “low” periods.
* A proprietary kitchen exhaust system with injection nozzles, such as “Halton Capture Jet” Gaylord ELX Hood or

equal and equivalent, to reduce exhaust requirements by approximately 30% from conventional systems, and eliminate grease passing through the system utilising high efficiency cyclone filters and “UV” filtration. For information or Halton& Gaylord equipment

* Use a kitchen exhaust/ Supply air demand control ventilation system such as Intelli-Hood.
* Heat reclaim from chiller condenser for pre-heating or heating of DHWS (See illustration)
* Occupancy sensors are the IHG recommended energy saver for guest rooms.
* Key card control in guestrooms, if provided, shall only reset room temperature set points when unoccupied, and

switch selected circuits (or similar control via guest booking system). Also for use to control fresh air and extract system in conjunction with radiant ceiling option

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* Resetting of chilled water supply temperature from the chiller when external conditions allow to maximise chiller

efficiency and minimize latent cooling

* DDC control systems via a central BMS to optimize system control strategies. Sub meter and data log all air

conditioning and mechanical ventilation energy use for formulating energy efficient strategies.

* Power factor correction equipment will be provided to the main electrical distribution control boards to automatically

correct the power factor to unity such that no tariff penalty is incurred under any load conditions. The equipment will be automatically staged in 50kVAr units.

* Motion sensor control of air conditioning and lights within back of house areas. Sensors should also be considered

for public areas with infrequent use (especially overnight) subject to InterContinental Hotels Group approval.

* 1. Environmental

The design will adopt the following general environmental principles as a minimum:

* All systems shall operate on refrigerants with zero ODP and low GWP (less than 100) such as R123, R410A,

R134a, R407c in accordance with the Kyoto Protocol current North American and European Legislation, and each locations national regulations i.e. No CFC’s and limited use of HCFC’s. The designer shall also investigate and report on the potential use of natural refrigerants such as R744 (CO2) or its blend ECP744.

* The use of HC (hydrocarbon) refrigerants with zero ODP and minimal GWP shall be considered only when

appropriate fire safety procedures are also implemented as they are highly flammable. Any equipment using R290 or similar HC shall be within a fire rated plant room and have leak detection and fire suppression system installed.

* Condensate from central air handling units serving public spaces and fresh air pre-conditioners is to be collected

and used in storage or make up water in cooling towers if using water cooled plant.

Note: The designer shall also incorporate the requirements of any InterContinental Hotel brand standard Green Engage Credit rating level adopted for the project.

* 1. Central Heating and Cooling Plant

4.9.1 Objectives

To provide a central source of generation, with a degree of redundancy, for the building’s heating and chilled water systems, to offset the building’s fabric, casual, operational and machine loads to the thermal criteria as defined elsewhere.

The full cooling loads shall be included for individual spaces.

Diversity:-

To determine the diversified simultaneous cooling load, the grand total calculated cooling load can be reduced by:-

* 20% for guest rooms
* 25% for other areas

The final system selection shall be subject to verification from a technical submission, including a full life cycle cost/benefit analysis, by the designer, and approval by InterContinental Hotels Group.

Provide redundancy (spare capacity). Configuration may vary depending on the location and subject to InterContinental Hotels Group approval.



Typical Chilled Water Schematic

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Efficient Chilled Water Distribution shall be provided to include:

* Primary pumping only with variable speed pumps
* No Secondary circulation - expensive to install & run
* Chillers can be enabled/disabled according to load demand (string piping arrangement)
* Towers can be enabled/disabled with chillers or run to reduce chilled water temperature
* No Standby pumps, spare motor and impellor to be kept on site or one common standby pump
* Bypass valve to maintain minimum chiller flow rate at partial load - to suit chiller requirement
* Varied Condenser and chilled water temperatures according to the load - improved efficiency
* VSD for all chillers

1. IN SOME LOCATIONS AIR COOLED CHILLER OPTION IS PREFERRED - REFER IHG.

2. PROVIDE SPARE PUMP OR MOTOR IMPELLER IN THE PLANT ROOM IN THE EVENT OF A BREATH DOWN.

The systems shall be automatically monitored and controlled via the Building Management System (BMS) and their own proprietary control systems to maximise their efficiency of operation under all conditions.

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4.9.2 Description

The equipment shall be sized to cater for:

* Fabric/solar heat loss and gain - noting diversification with this load for central plant
* Fresh air ventilation heat loss and gain
* Infiltration heat loss and gain
* The primary heating demand associated with the domestic hot water peak demand
* Internal equipment/operational and personnel gains - noting diversification with this load for central plant
* The perimeter zoning

The equipment shall be sized to provide for diversity of use and occupancy, allowing also for energy saving measures included within the design.

4.9.3 Chilled Water Plant Solutions

The selection of the most suitable chiller plants will depend upon the size of chillers required, the Hotel location and serviceability. The following illustrates different chiller types and their respective efficiencies for the conditions indicated.

Air Cooled Chillers versus Water Cooled Chillers

An air cooled chiller plant is one whereby one or more packaged chiller units are utilized to remove the heat from within the building. Each of the chillers within the plant is a standalone package that contains the basic elements, such as compressors, air cooled condensers, evaporators and controls. The chiller transfers the heat absorbed from the building directly to the atmosphere by rejecting the heat to the air, and is typically suitable for smaller projects with a peak cooling load less than 200TR (700kW) This is the preferred option for InterContinental Hotels Group due to the Legionella risk with water cooled. A water cooled chiller plant is one that utilises chillers that reject heat to a water circuit rather than air. The water circuit is passed through a cooling tower where heat is rejected by evaporation. It is a more efficient system due to the fact that more energy can be rejected by evaporating 1kg of water than in raising the temperature of an equivalent amount of air. Water cooled plants are therefore more efficient and require less space and, for larger projects, are the most practical and efficient solution, and should therefore be considered for larger projects.



In general, a water cooled system is more suitable for a larger project due to the following benefits:

Water cooled plant is more efficient than air cooled plant with comparable typical chiller efficiencies at peak load as follows:

* Water cooled LV chillers with VSD - 5.5kWr/we (at 30-70% load)
* Air cooled reciprocating/screw chillers - 1.89kWr/kWe

These efficiencies (COP’s) are illustrated graphically across the range of chiller operation.

Refer to the illustrations.

Water cooled systems are considered to have the following advantages for a larger project:

* Water cooled plant utilizes centrifugal or screw chillers which have greater capacity, less moving parts and lower maintenance requirements than air cooled reciprocating or screw chillers
* The availability of larger capacity plant with the centrifugal chiller options results in far fewer compressors being required
* The area required for water cooled centrifugal plant is less than that required for air cooled
* Water cooled chiller plant is installed internally and is protected from the harsh environment. Air cooled chillers have to be installed externally and corrosion protection may be an ongoing problem to be addressed
* Noise level of water cooled plant is less than that of air cooled plant
* The life expectancy of a water cooled centrifugal chiller is generally 25-30 years, as opposed to that for an air

cooled chiller of only 10-15 years

The main disadvantages of a water cooled system are:

* The system will have a large water use and is dependent on a constant supply of make-up water
* The cooling towers require continuous monitoring and treatment to avoid the potential risk of Legionnaire’s Disease

Notes:

* Air cooled chiller must be rated at 5°C above the design ambient for heat rejection.
* Water cooled chiller selected at 29°C/33°C condenser water temperature, (subject to ambient conditions) 7/14°C

chilled water temperature.

Electrical Infrastructure Requirements for 2,600kW cooling.

As well as the cost of the chiller plant, the electrical infrastructure required for each type can vary significantly, as indicated in the following table, based on a typical 2600kW chiller plant.

|  |  |
| --- | --- |
| Chiller Type | Electrical Power |
| Water cooled centrifugal or screw | 390kW |
| Air cooled screw | 990kW |
| VRF | 830kW\* |
| Packaged water cooled | 910kW |
| Split systems | 1,300kW\* |

* Actual will be approximately 40% higher as there is no or little diversity with plant selection as for these options.

Trapped condensate drains by gravity shall be installed below any cooling coil irrespective of the degree of latent removal or chilled water temperatures.

The configuration of the heating and chilled water circuits should be such that clearly identified zones can be individually served, thus making it possible to close down areas of the hotel for maintenance.

Modulating two port control valves shall be installed on all FCU’s and AHU’s with a pressure operated bypass installed in the plant room between the main flow and return, to maintain the minimum recommended flow rate through the chillers and pumps controlled via a VFD.

Pipe distribution Zones should tie up with domestic water service zones for future phased refurbishments and maintenance.

The distribution system shall be designed for energy efficient operation. Pipework sizing and fitting selection shall ensure that noise is not created within the system.

Where external pipework is not avoidable, it shall be trace heated using a self-regulating trace heating tape, or adequately protected from freezing as necessary. Glycol shall not be added to the system as this will reduce the heat transfer efficacy of the heating and chilled water systems.

An “Enwa Matic” or equivalent water conditioner shall be provided for treatment of the water distribution system for control of water quality and corrosion, to avoid the need for chemical treatment and strainers.



KEY:-

CHILLER TYPE

“““““ Air Cooled Retry Screw

{1053 kW) without VFD

----- Water Cooled centrifugal LV chiller (1053 kW) with VFD ■

----- Wafer Cooled centrifugal LV chiller (1053 kW) without VFD

4.10 Multi-Function Chiller - Total Heat Recovery

Chillers are now available that recover total heat & not just super heat, but these should be sized for the heating requirement - typically for domestic hot water. The remaining chiller capacity should then be determined and chillers selected appropriately. The following illustrates how these works:-

TYPICAL SCHEMATIC MULTI-FUNCTION HEAT RECOVERY CHILLER

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**a) Traditional**

Simple water cooled heat pump (heating mode version) arrangement

Compressor

Recent Cost Benefit Analysis for Delhi Project 2 year payback

Chilled water exchanger

Expansion valve

Hot water recovery exchanger

b) Multi-Function

INDEPENDENT CHILLED WATER PRODUCTION:

As an Air Cooled Chiller:

The unit operates in air cooled chiller mode when there is no demand for hot water

INDEPENDENT HOT WATER PRODUCTION:

As an Air Heat Pump:

The unit operates in air heat pump mode when there is no demand for chilled water

SIMULTANEOUS HOT WATER & CHILLED WATER PRODUCTION;

As a Total Heat Recovery: when there is demand for hot water as well as chilled water, unit operates in total heat recovery mode. When one of the demand is fulfilled, unit changes to chiller or heat pump mode.

4.11 Condenser Water Circuits

Where applicable, condenser water circuits (where selected) shall reject heat to atmosphere by removing-heat directly from the refrigeration cooling process.

All cooling towers should be operated simultaneously with variable speed drives to save energy, whilst still optimizing the condenser water temperature for increased chiller efficiency.

The use of condenser water as a low grade heat source should be investigated.

Air cooled heat rejection equipment shall be selected to operate 5°C above the design external ambient conditions and shall reflect the actual location of plant and the potential for local hot spots.

A satisfactory system of cleaning shall be proposed to prevent the buildup of corrosive elements and bacteriological growths including positive measures to avoid Legionnaires disease bacteria. Adequate provision shall be made for continuous bleeding of the system.

The water treatment system shall be deigned to achieve 7 or better cycles of concentration at acceptable water quality.

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COOLING TOWER WATER TREATMENT AND WATER RECYCLING OPTIONS NOT TO SCALE

4.12 Central Heating Production/Distribution

The central heating distribution plant shall utilise modulating high efficiency / low Nox boilers, with condensing boilers used, having proprietary automatic controls compatible with the BMS system.

A preference shall be given to the use of Biomass boilers, as a ‘carbon-neutral’ fuel, and utilising:

* Automated de-ashing
* Automatic heat exchanger cleaning
* Computer based capacity/combustion control with remote control/ monitoring.
* Fully automatic feed and ignition
* Efficiencies - 90% +
* Carbon Monoxide (Co) detection

Details of suitable boilers are available at [www.woodenergyltd.co.uk](http://www.woodenergyltd.co.uk).

An “EnwaMatic” or equivalent water conditioner shall be provided for treatment of the water distribution system for control of water quality and corrosion, to avoid the need for chemical treatment and strainers.

LTHW shall be circulated at 80/60°C to serve heating and domestic hot water heat exchangers via a primary distribution circuit with variable speed pumping. This may only be varied following substantiation of alternative temperatures proposed.

Care should be taken to match boiler loads as closely as possible to the demand. Modular boiler arrangements allow greater flexibility if controls are flexible enough to responding to the changing demand. Ideally condensing boilers should be used.

For smaller boiler plants electric heat pumps (or electric boilers in freezing climates) may be preferred, subject to IHG approval.

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NOTE:

SEPARATE VARIABLE TEMPERATURE CIRCUIT IS RECURED IF RADIATORS ARE INSTALLED

MOTOR DRIVEN THREE WAY CONTROL VALVE ON FURTHEST AIR HANDLING UNIT TO KEEP PIPE HOT.

TYPICAL MOTOR DRIVEN TWO WAY CONTROL VALVE

TYPICAL PUBLIC SPACE AIR HANDLING UNIT

**LOW TEMPERATURE HEATING WATER SYSTEM WITH DOMESTIC HOT WATER HEAT EXCHANGER**

Where district heating is provided at a higher temperature, it shall be reduced by blending or other means to ensure no exposed pipe or radiator surface temperatures exceed these temperatures for safety.

Where oil is used as the primary heating system fuel, the normal required storage capacity is four weeks at full design duty. This may be increased for remote locations or locations where there are potential delivery difficulties. Storage should preferably be below ground, and must be located away from prominent entries to the hotel.

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4.12.1 Hot water Temperature definitions -

The following definitions will apply for hot water temperature and pressure:

|  |  |  |
| --- | --- | --- |
| • Low temperature/pressure hot water | — | Below 1200 C (2500F)  Below 2 Bar (30 psig) |
| • Medium temperature/pressure hot water | — — | Between 120- 1750 C (250-3500F)  Below 10 bar (150 psig) |
| • High temperature/ pressure hot water | —  — | Above 175 0 C  Below 20 Bar (300 psig) Temperature |

4.12.1 Closed Circuit Water treatment

Chilled water, heating and closed condenser water circuits must be provided with a manual dosing system as follows:



The treatment shall maintain the following water quality:

* Hardness less than 7ppm
* Iron content less than 0.1ppm
* Copper Content less than 0.1ppm
* Dissolved solids less than 4000ppm
* ph 9.0-10.5 (not to exceed 11)
* Microbiological limits
* Total aerobic plate count: Maximum 10,000 organisms /ml
* Total an aerobic plate count: Maximum 100 organisms/ml
* Nitrate reducers: Maximum 100 organisms/ml
* Sulphate reducers: Maximum 0 organism/ml
* Iron Bacteria: Maximum 0 organism/ml

4.13 Distribution options

The effect on plant location on the pipe/duct distribution can also have a significant effect on capital and operating costs.

There are two main ways of distributing services in a Hotel being:

* Horizontal
* Vertical

These options are illustrated in the following pages, but in general vertical distribution is preferred for the following reasons:

IHG Engineering Design Guidelines

* Shorter services runs - generally approximately half the lengths required for horizontal distribution (actual projects have provided reduction in pipe runs alone from 1km-4km)
* Lower capital cost (reduced services and insulation)
* Lower running costs (reduced pumping and heat losses)
* Simpler to commission - pressure differences lower
* Services generally all accessible in vertical services riser

The only main disadvantage of the vertical distribution system is that individual floors cannot be independently isolated from one point.

TYPICAL CHILLED WATER SCHEMATIC

PREFERRED PLANT AND RISER LOCATIONS

OBJECTIVES

1. POSITION LARGE ELECTRICITY CONSUMING PLANT NEAR MAIN SUPPLY SOURCE TO REDUCE VOLTAGE DROP etc 2 ÇËNTRALISE’PLANT ANO RISERS to AID BALANCING, TO REDUCE PIPE HEAT LOSSES / GAINS AND TO REDUii

CAPITAL COSTS etc.

Horizontal distribution - example of pipe distribution (typical section) (**inefficient and uneconomic**)

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* Up to double the pipe length from vertical distribution
* Congested ceiling space and lower ceiling
* Longer installation time
* Increased capital/running costs



Vertical distribution - example of pipe distribution (**efficient and economic**)

* Up to 50% reduction in pipe length from vertical distribution
* Reduced installation programme
* Less space required - higher ceilings in corridor
* Reduced pumping - lower running costs
* Simpler to commission



4.14 Zoning of Air Conditioning

The aims and objectives are to ensure the air conditioning systems are zoned to suit the thermal and occupancy characteristics of the space. If this is not carried out early enough, then finding space to resolve later in the design may not be possible

The following illustration shows typical zoning of a public area with objectives of achieving:-

•

• Thermal comfort

Permeter pubic areas on different facades.'onentaton on different systems (Typcaty 4-6m maximum) depth

Interra zones on separate systems - or common system w th each area *cf* usage capable of being shut down

Penmeter pub c areas on afferent facades'on entat'on or, different systems (Typically 4-6m maximum) depth

Meetng rooms on different facades served from different systems

Ba room system to be capable of contris Ing diffie'er.t areas when divided

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4.14.1 Air Conditioning

The air conditioning system design is critical to achieve the comfort conditions specified in these standards. The air conditioning for a Hotel also represents a significant percentage of the capital (25% - 35%) and running costs (30% - 50%).

If these systems are incorrectly designed, then not only will guests not be provided with comfortable conditions, but the energy costs will be higher than they should be.

The following highlights good zoning for an air conditioning system, with the correct zoning indicated by the different colors.

4.15 HVAC System Selection

The choice of HVAC system to serve the various Hotel areas shall depend on a number of factors including Hotel configuration, ceiling void depths, Plant room space, external space, utility charges and the extent of the work involved. A full evaluation of options shall be undertaken to ensure the optimum system is selected for each particular project, with typical examples for selection criteria provided water in this design guides for:

* Guest rooms
* Public Spaces
* boh

The following systems are considered acceptable:-

4.15.1 All Air Systems (Preferred solution for air quality and energy use)

With central air handling plant and recirculation where possible.

These systems are most appropriate in areas that require high quantities of fresh air for occupants or equipment e.g. Bar, Lounge, Meeting Rooms, Ballroom Restaurant and Kitchens. Re-circulation shall be incorporated where possible and variable fresh air provided, controlled via air quality (CO2) sensors located in each area.

Air systems shall be zoned utilizing VAV or similar (re-heat is not acceptable) according to occupancy pattern and the operations carried out in the area. Physical size of AHU's shall be considered, and the practicality of maintaining large fans, motor and coils.

Air systems shall, where external conditions allow, have suitable controls to enable free cooling to be provided utilizing outside air.

These systems keep the major maintenance away from the occupied space, and hence avoid guest disturbance and allow the use of free cooling when external conditions permit, resulting in reduced life cycle costs.

If plant or ceiling space is limited (e.g. existing buildings), fan coil or VRV (VRF) systems are acceptable to the Restaurant, Lounge and Bar areas, however they are not preferred due to the increased maintenance, inability for free cooling and extent of services requiring maintenance within the public domain areas. The use of these systems **will only be accepted with the prior approval of InterContinental Hotels Group**.

Kitchens shall always utilize all air systems.

4.15.2 Four Pipe Fan Coil Units

These systems are most appropriate for areas that require low fresh air quantities e.g. guest rooms, offices, workshops, retail etc. and where the adjacent areas may require heating and cooling at the same time.

Four pipe vertical or horizontal fan coil units with individual means of isolation, filter, fan and condensate drain (preferably gravity fed) are an acceptable means of providing heating and cooling. Consideration shall be given to providing common control valves serving a number of units in individual thermal zones. Two pipe fan coils may be used in hot arid climates.

In guest bedrooms individual control shall be provided via a flush mounted control panel to InterContinental Hotels Group approval and will be BMS compatible. Units shall operate on water-side control, with fan speed selected to meet the noise criteria in the requirement schedule. Fresh air supply to guestrooms shall be conditioned, to allow the FCU Chilled Water Coils to operate at 100% sensible cooling.

The required cooling and heating capacity of the fan coil unit shall be achieved at medium speed. Setting the fan coil to high speed allows quick cool down or heat up.

4.15.3 Variable Refrigerant Systems (VRV or VRF) Units

These refrigerant based systems are most appropriate for areas that require low fresh air quantities e.g. offices, workshops, retail etc., and can provide both heating and cooling.

They are not particularly suitable for:-

* Areas with high fresh air demand
* Tropical or sub-tropical locations
* Areas with low latent cooling demand

Three pipe (i.e. independent heating and cooling control) VRV units complete with filter, fan and condensate drain (gravity preferred) are an acceptable means of providing heating and cooling, for up to 3 star hotels.

Two pipe VRV units can only provide cooling or heating and not both simultaneously, hence are only suitable for climates requiring cooling only as otherwise independent room temperature control is not achievable.

Guestroom units shall have individual fan and temperature controller and a proprietary central BMS compatible system controller shall be provided behind the reception desk.

VRV systems can be considered in refurbishment projects due to the reduced pipework size, simplicity of installation and non-reliance on a centralized heating or cooling system.

VRV systems do not offer the degree of load diversity that can be applied to central systems, or the provision of ‘free cooling’ with air systems, and this shall be considered in their evaluation.

Refrigerant leakage protection shall be incorporated with each VRV design either by the installation of a gas leak detection system or by demonstration of acceptable peak levels in accordance with BS EN 378-1. All pipework joints must be readily accessible for inspection.

VRV system must not be oversized otherwise poor temperature control and condensation is a high risk and excessive latent cooling will occur unnecessarily.

VRV fan coil units should be selected on the following basis:

* Supply temperature for cooling no less than 8-10 deg. C below room temperature
* Supply temperature for heating no more than 8 deg. C above room temperature
* Latent cooling no more than 5% of the total cooling capacity
* Room air velocity not to exceed 0.15m/s in the occupied space (to 2m from floor level)

Zoning of VRV Systems: IHG Brand standards require that adjacent rooms can be simultaneously cooled or heated hence a “3 pipe” or equivalent system is required in climates which have a heating and cooling demand.

A 3pipe system should be zoned differently to a 2 pipe system as illustrated below:-

1. 2 -“pipe VRV” Heating or Cooling System

* System only has two refrigerant pipes
* Each system provides only heating or cooling
* Only similar zoned rooms on same system
* Low capital cost



1. 3 -“pipe VRV” Simultaneous Heating and Cooling System

* System has three refrigerant pipes
* Same system can provide heating and cooling in adjacent rooms simultaneously
* Heat reclaim and lower running costs
* Higher capital costs
* Lower running costs



4.16 Guest Room A/C and Ventilation

4.16.1 Guest Room A/C and Ventilation

Each guestroom will be provided with its own self-controlled system to enable guests to control their own room temperature within pre-set limits, typically 30C either side of the set point, with a 2.2°C dead band, to prevent cycling of the system.

The following systems are deemed acceptable, dependent on the location, room size and loads:-

* 4 pipe fan coil units located in a bulk head over the entrance
* 4 pipe chilled beam units located in a bulk head over the entrance with variable air flow for boost
* 4 pipe chilled beam units with radiant ceiling panels (Patented - selected climates only)
* 2 pipe fan coil units in hot climates where heating is not required i.e. winter design temperature >10°c DB
* 4 pipe radiant ceiling panels with variable air flow (Patented- selected climates only)
* 3 pipe VRF -particularly for refurbishment projects and small resorts. - Subject to InterContinental Hotels Group

approval.

Note. Where it can be demonstrated that there is no possibility of adjacent or any rooms within the hotel having heating/cooling demands simultaneously, then 2 pipe systems may be considered. This must only be with the prior approval of InterContinental Hotels Group. Fresh air shall be provided to the guest rooms for occupancy needs, and exhaust air via the bathrooms.

* The units shall not be switched by a key card system if provided, and the speed/temperature control shall be to InterContinental Hotels Group approval. Units in tropical locations shall be interlocked with open able

doors/windows, occupancy sensors and door lock interface, to provide unoccupied set back, to an agreed temperature

The following table provides a simple comparison of these systems, which should be carried out for specific projects based on local information:-

TYPICAL GUEST ROOM AC SYSTEM COMPARISON TABLE

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **'~'-\System**  **Item** | **Four pipe fan coil unit** | **Four pipe chilled beams & variable Air flow** | **Four Pipe Radiant panels + variable Air flow** | **Four piped chilled beams & Radiant Panel** | **Three pipe VRF (VRV)** |
| Comments | Suitable for large rooms & larger cooling loads | Lower cost & suitable for medium-large rooms & loads | Suitable for small to medium rooms & loads for large well insulated rooms | Suitable for large rooms & cooling loads | Suitable for large rooms & cooling loads. May be oversize for small  rooms |
| Capital Cost | Base | Base | Base + 10% | Highest | Base |
| Energy cost comparison per year | Medium | Low | Lowest | Low | Highest (Unnecessary latent cooling) |
| Annual maintenance cost | High | Low | Low | Low | Highest |
| Temperature control/comfort | Fair/Good | Good | Best | Good | Fair |
| Heating method | Hot water FCU | Hot water + Air | Hot water radiant + Air | Hot water air + Radiant | Reverse Cycle |
| System Description | Central chiller plant, heat recovery fresh air AHU, boiler & separate heating &chilled water circuits to room FCU’s | Central chiller plant, heat recovery fresh air AHU, boiler, separate heating & chilled water circuits to room chilled beams with variable air flow for boost | Central chiller plant, heat recovery fresh air AHU, boiler separate heating & chilled water circuits to ceiling radiant panels & variable air flow for boost | Central chiller plant, Heat recovery fresh air AHU, boiler separate heating &chilled water circuit to ceiling cost in radiant panels. | Zoned condensing units serving room mounted FCU’s, via 3 pipe heat recovery system |
| External Plant | Cooling tower or air cooled chillers | Cooling tower or air cooled chillers | Cooling tower or air cooled chillers | Cooling tower or air cooled chillers | VRF condensing unit |
| Internal Plant | Water or air cooled chiller + fresh air AHU | Water or air cooled chiller + fresh air AHU | Water or air cooled chiller + fresh air AHU | Water or air cooled chiller + fresh air AHU | Fresh air AHU |
| Redundancy | 100% for compressor | 100% for compressor | 100% for compressor | 100% for compressor | nil for failed compressor |
| Life Expectancy | 25 year plant/ 20 year system | 25 year plant / system | 25 year plant / system | 25 year plant / system | 15 years |
| Legionella Risk | Nil air cooled | Nil air cooled | Nil air cooled | Nil air cooled | Nil |

Notes: Two pipe systems is not shown as this can only be used where simultaneous heating/cooling is not required for room temperature control.

* If water cooled chillers used then legionella risk can be high if correct procedures are not put in place.
* Actual capital cost comparison depends on location.
* Options 1 - 4 provide more opportunity for heat recovery from a central plant.

3.18.2 LOCATION OF EXHAUST IN GUEST BATHROOMS

DOOR TO BE UNDERCUT TO ALLOW MAKE UP AIR WHEN CLOSED IF REQUIRED

locate exhaust over

SHOWER/BATH FOR

CLEARANCE OF STEAM

EXHAUST RISER

FIRE DAMPER WITH ACCESS PANEL

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4.16.2 Guestroom Exhaust Ventilation



4.16.3 Guest room air distribution and heating

It is the supply air distribution that will determine the extent of comfort achieved in the occupied space which is measured in:

* Consistent air temperature
* Air Velocity

GUEST ROOM AIR DISTRIBUTION 8c HEATING

IT IS THE SUPPLY AIR DISTRIBUTION THAT WILL DETERMINE THE EXTENT OF COMFORT ACHIEVED IN THE OCCUPIED SPACE, WHICH IS MEASURED IN:

- CONSISTENT AIR TEMPERATURE

- AIR VELOCITY

CORRECT SELECTION OF THE SUPPLY AIR

DIFFIUSER ENSURES GOOD AIR DISTRIBUTION THROUGHOUT.

FRESH AIR DUCTED TO THE BACK OF THE FAN COIL UNIT AND NOT DIRECT TO THE ROOM

DROPPED CEILING AT ENTRY

The supply diffuser type and size must be selected to achieve the required air flow to distribute throughout the room without causing noise or drafts.

It should discharge the air across the ceiling to use the coanda effect for good distribution.

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**4.16.4 Typical guestroom 4-pipe fan coil unit system**



|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Typical analysis of BLDC motors for FCU’s | | | | | | | | | | | |
| **Type** | **Capacity (TR)** | **Fan Speed** | **Input Power (Watts)** | **Hours of Opera tion** | **Power Cost ($/kWH)** | **Hour s of Oper ation /Yr** | **Diversity** | **Yearly Running Cost ($)** | **Total Yearly running Cost ($)** | **Unit Price**  **($)** | **Payback Period (Years)** |
| FCU with AC Motor | 1 | HIGH | 71 | 6 | 0.14 | 2190 | 0.7 | 14 | 50 | 200 |  |
| MEDIUM | 59 | 12 | 0.14 | 4380 | 0.7 | 23 |
| LOW | 50 | 6 | 0.14 | 2190 | 0.7 | 10 |
| FCU with BLDC Motor | 1 | HIGH | 55 | 6 | 0.14 | 2190 | 0.7 | 11 | 200 | 275 | 3.5 |
| MEDIUM | 25 | 12 | 0.14 | 4380 | 0.7 | 8 |
| LOW | 14 | 6 | 0.14 | 2190 | 0.7 | 3 |

4.16.5 Typical guestroom 4-pipe radiant ceiling option (subject to approval of IHG)

Note: This system not suitable in hot/humid climates with openable windows, or if guest corridor is not air conditioned:

TYPICAL GUESTROOM A-PIPE RADIANT CEILING OPTION

4.16.6 Typical guestroom 4-pipe active chilled beam option

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Issues to address with chilled beams and radiant ceilings.

These systems as illustrated above have benefits in providing reduced energy consumption from conventional systems and increased comfort levels.

They are however not without risk, and must only be used under the following conditions:-

* In suitable climates with sealed windows and doors so infiltration can be controlled
* The fresh air systems must have adequate additional capacity to provide a boost facility to enable a rapid response to a guest’s comfort requirements
* The system must operate 24 hours a day
* The room cooling load must be limited due to the systems restricted capacity

With these considerations, these can provide the following benefits:-

* Energy Consumption can be reduced by up to 20-25%
* Excellent use of low grade water for free cooling if available
* Increased room comfort levels due to radiant effect and low air velocities
* No in room maintenance as there is no fan or filter
* No condensate drain which can be a health hazard if not cleaned regularly
* Quieter system
* No bulkhead or room entry - improved room aesthetics (radiant ceiling option only)

4.17 Air Distribution

The aims and objectives here are to illustrate air distribution philosophies to ensure distribution systems are correctly located and sufficient space is available for services.

4.17.1 Air Distribution - Large Areas

Coverage of the whole of the occupied area must be achieved by careful consideration, in particular of the supply.

It can be seen that with an extract velocity of 2.8m/s, this drops significantly at only 600mm from the intake to 0.05m/s, which will have no affect whatsoever on the overall room air distribution.

The location of return/extract will generally have little impact on the air distribution within a room, which will be dictated by the supply air system.

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4.18 Public Areas A/C and Ventilation

This includes foyers, restaurants, bars, meeting rooms, ballrooms, lounges etc.

To provide good internal air quality, the fresh air shall be monitored by BMS and controlled by CO2 sensors, which shall vary the volume of fresh air supplied to suit the needs.

Economy cycle control shall be provided for all air handling units to maximize the use of free cooling when available.

Humidity override shall be provided in function rooms to override chilled water temperature re-set when necessary, as illustrated.



4.18.1 Radiant Cooling/Heating

Radiant systems can provide cost effective solutions for large open spaces such as convention centers or large lobbies, by providing the base load by radiant means, which can provide improved comfort conditions, and reducing the size of air handling plant and distribution.

The heat exchange is provided by heating or cooling the floor, walls, or ceilings

This absorbs the heat loads in cooling mode, or transfers heat by radiation in heating mode.

In simple terms, flexible tubing is installed to maintain a surface temperature typically between 18°C (cooling mode) to 27°C (heating mode)



4.18.2 Displacement Ventilation

Displacement ventilation is one of the most efficient methods of conditioning high spaces, such as Convention centers, lobbies and atriums.

Thermal displacement ventilation is based on cool air supply at low level and stratification of room air temperature and contaminants as a result of the natural buoyancy forces created by the heat sources. There are two alternative concepts used in a displacement ventilation system:

* horizontal low-velocity supply
* floor mounted diffusers

The extraction point of the exhaust air is located above the occupied zone - preferably close to ceiling level. A displacement system is preferable for the following situations:

* Where the specific airflow rate per unit of floor area is high (as in lobbies, theatres, and conference rooms)
* Where the height of the space is more than 3 metres.
* Where high contaminant loads exist, as in smoking areas.

The temperature gradient in the room space improves the energy-efficiency because only the occupied zone is actively controlled. Also, the relatively high supply temperature improves the utilization ratio of free cooling.

The temperature gradient between extracted and supply air is typically 4 - 10 °C in commercial buildings. Displacement ventilation is typically based on low velocity and low induction supply of cool air at low level. The supply air temperature is only slightly (2 - 6 °C) colder than the ambient room air. The airflow rate of typically horizontal air supply equals the airflow rate of rising convective flows. Both thermal comfort and air quality are maintained at a good level.

For low velocity units a certain wall area will be required and few air terminals will be provided at the centre of the space in the ceiling for proper distribution.

These options also provide reduced spatial requirements, but are subject to development with the architecture.



4.18.1 Fitness Centre

Heat reclaim shall be provided as significant energy benefits can be realised.

4.18.2 Indoor Swimming Pools

An air conditioning system shall be designed to provide a comfortable environment for users, to protect the building interior from the effects of chlorine/condensation and to prevent chlorine smells spilling out to other areas of the hotel.

The system shall be designed to provide sufficient fresh air and exhaust as necessary to achieve this, and maintain the conditions specified in the requirements schedule.

A heat pump - de-humidifier-heat recovery unit, which de-humidifies the supply, and uses the waste heat taken from the exhaust air (due to evaporation from the pool) for re-heating the air, and heating the pool water shall be used. This type of system is expected to provide a pay back within 24 months. Other systems shall only be provided following approval from InterContinental Hotels Group.

The following table provides a simple comparison of systems suitable for FOH spaces. This should be prepared for each project taking into account local conditions to determine the most appropriate:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **FRONT OF HOUSE AC SYSTEM COMPARISON TABLE** | | | | | |
| **''~\System**  **Item** | **Fan coil unit** | **Variable Air Volume (VAV)** | **Four piped chilled beams & variable airflow** | **Three pipe VRF (VRV)** | **Radiant cooling or Displacement ventilation** |
| Comments | Suitable for rooms with small floor areas without high fresh air loads. | Suitable for larger areas with variable occupancy profile. | Suitable for larger areas. | Suitable for smaller rooms without high fresh air loads. | Large high spaces, high occupancies |
| Capital Cost | Base | Base | Medium | Medium | Medium |
| Energy cost comparison per year | Medium | Low | Low | Highest | Lowest |
| Annual maintenance cost | High | Low | Low | High | Low |
| Temperature control/comfort | Fair/Good | Good | Good | Fair | Good |
| Heating method | Hot water FCU | Terminal re-heat using hot water coil. | Hot water coil+ air | Reverse cycle | Hot water |
| System Description | Central chiller plant, heat recovery fresh air AHU, boiler & separate heating & chilled water circuits to FCU’s | Central chiller plant, recirculating AHU with min fresh air, boiler serving AHU and terminal re-heat coil.  Chilled water circuit to AHU. | Central chiller plant, heat recovery fresh air AHU, boiler, separate heating & chilled water circuits to room chilled beams with variable air flow for boost | Zoned condensing units serving room mounted FCU’s, via 3 pipe heat recovery system | Low level supply and/ or radiant floor and/ or ceiling |
| External Plant | Cooling tower or air cooled chillers | Cooling tower or air cooled chillers | Cooling tower or air cooled chillers | VRF condensing unit | Cooling towers or air cooled chiller |
| Internal Plant | Water or air cooled chiller + fresh air AHU | Water or air cooled chiller + fresh air AHU | Water or air cooled chiller + fresh air AHU | Fresh air AHU | Water cooled chiller+ fresh air AHU |
| Redundancy | 100% for chiller compressor | 100% for compressor | 100% for compressor | Nil for failed compressor | 100% for chiller compressor |
| Life Expectancy | 25 year plant/ 15 year system | 25 year plant System | 25 year plant System | 15 years | 25 year plant/ 20 year system |
| Legionella Risk | Nil air cooled | Nil air cooled | Nil air cooled | Nil | Nil air cooled |

* Notes: Cooling only systems are not listed as these can only be used where simultaneous heating/cooling is not required based on annual weather data & actual room loads.
* If water cooled chillers are used then correct procedures must be put in place to minimise legionella risk.
* Actual capital cost depends on location.

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4.19 BOH Area AC and Ventilation

4.19.1 Administration (&BOH) A/C and Ventilation

These areas should preferably be served by variable air volume all air systems from central plant, providing the zoning is similar.

Each area will be provided with local automatic temperature control, monitored by the BMS.

Where a zone requirement prevents all air systems from a central plant, each room/zone may generally be provided with an in ceiling 4 pipe fan coil unit.

4.19.2 Kitchens

A dedicated AHU shall be provided to serve the kitchen area. The unit shall provide 100% fresh air (no re-circulation permitted) with heat recovery. This air shall be tempered to room conditions (cooled/heated) prior to supply to the kitchen.

Mechanical extract ventilation shall be provided to all kitchen areas. Stainless Steel Extract canopies shall be located above cooking ranges to ensure that no spillage occurs.

Refer to the typical kitchen ventilation duct arrangement illustration.

Kitchen Hoods shall be “Halton Capture Jet” or equal to provide a 30% reduction in the exhaust rate from conventional systems, and eliminate grease passing through the system approved system.

Kitchen exhaust ductwork shall be a dedicated system constructed from 16gauge steel with drip proof weld joints, and clean out access doors at all changes in direction, where sprinkler heads are located, and every 6m maximum. Fire dampers are not permitted. The duct shall be fire rated in accordance with the fire strategy and to meet local regulations.

The systems shall be variable speed, or 2 speed minimum to operate at low speed for energy savings at times of low use.

**Example Kitchen Ventilation Drawing**

TYPICAL KITCHEN ARRANGEMENT

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4.19.3 IT Rooms

In addition to the common air conditioning system serving these areas, a separate independent split system shall be provided for each room to guarantee availability of cooling at all times. Failure shall be alarmed at the BMS.

These systems shall also be served from the standby generator supply.

4.19.4 Requirements at Entrances

Low noise type hot water over-door air curtains should be provided above the inner lobby doors at the principle

entrances to the building in cold climates (below 5°C)

Fan coil units to provide de-humidification and cooling shall be provided in hot climates (above 30°C).



4.19.5 Split Refrigerant DC system

These systems are only appropriate for IT rooms (as standby) small stand-alone rooms/ buildings and plant/technical areas requiring cooling. Generally they provide excessive latent cooling which increases running costs.

They must be provided with time/temperature control, and be corrosion resistant to suit the atmosphere which they are installed. Only approved refrigerants may be used.

The following table provides a simple comparison of systems suitable for BOH spaces. This should be prepared for each project taking into account local conditions to determine the most appropriate:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **BACK OF HOUSE AC SYSTEM COMPARISON TABLE** | | | | |
| **" -System**  **Item** | **Fan coil unit** | **Constant Air Volume (CAV)** | **Variable Air Volume (VAV)** | **Three pipe VRF (VRV)** |
| Comments | Suitable for rooms with small floor areas without high fresh air loads. (e.g. corridors) | Suitable for larger areas with high fresh loads (e.g. kitchen, laundry) | Suitable for larger areas with variable loads (e.g. staff kitchen) | Suitable for smaller rooms without high fresh air loads. |
| Capital cost | Base | Base | Base | Medium |
| Energy cost comparison per year | Medium | Medium | Low | Highest |
| Annual maintenance cost | High | Low | Low | High |
| Temperature control/comfort | Fair/good | Good | Good | Fair |
| Heating method | Hot water FCU | From AHU | From AHU or air coil | Reverse cycle |
| System description | Central chiller plant, heat recovery fresh air AHU, boiler & separate heating & chilled water circuits to FCU’s | Central chiller plant, recirculating AHU with min fresh air, boiler serving AHU. Chilled water circuit to AHU. | Central chiller plant, recirculating AHU with variable fresh air, boiler serving AHU and terminal re-heat coil. Chilled water circuit to AHU. | Zoned condensing units serving room mounted FCU’s, via 3 pipe heat recovery system |
| External plant | Cooling tower or air cooled chillers | Cooling tower or air cooled chillers | Cooling tower or air cooled chillers | VRF condensing unit |
| Internal plant | Water or air cooled chiller + fresh air AHU | Water or air cooled chiller + fresh air AHU | Water or air cooled chiller + fresh air AHU | Fresh air AHU |
| Redundancy | 100% for chiller compressor | 100% for compressor | 100% for compressor | Nil for failed compressor |
| Life expectancy | 25 year plant/ 20 year system | 25 year plant / system | 25 year plant / system | 15 years |
| Legionella risk | Nil air cooled | Nil air cooled | Nil air cooled | Nil |

* Notes: Cooling only systems are not listed as these can only be used where simultaneous heating/cooling is not required based on annual weather data & actual room loads.
* If water cooled chillers are used then correct procedures must be put in place to minimise legionella risk.
* Actual capital cost comparison depends on location.
  1. Enclosed Car parks

Where natural ventilation is impractical the design shall incorporate the following:

* Carbon monoxide air quality sensors to control vfd (variable speed) supply and extract fans.
* Ductless plenum supply and exhaust systems providing cross flow ventilation
* Jet fan technology to limit the amount of supply and extract ductwork where ductless plenum systems are not feasible, in conjunction with efficient plant positioning (may require CFD analysis).
* Fan capacities shall be sufficient to meet the requirements of the Life Safety Guidelines.
* Ensure jet fans do not impact on Fire Sprinkler operation
* Jet fans may not be acceptable to some authorities

Note: Jet fans may not be permitted in some countries, such as UAE



* 1. Heating / Cooling Control Options

All hotel projects should utilise 2 port valves in lieu of 3 ports due to the benefits and substantial savings that can be made with these. This is demonstrated in the following example:

a. Two-port Valve Illustration

Use: major heating and cooling systems



For a typical hotel with a 2600 kW Systems, the flow rates are:

* Two port valve system - 88.9 Kg/s
* Three port valve system - 114.5 Kg/s (+29%)

See the following illustration for a typical 2 port valve system with primary pumping only.



4.18.1 Frost Protection - Alternative may be simpler / more economical

1. Typical Frost Protection System (Inefficient)



1. Optional Simpler Efficient Solution (Recommended)

Deletes per AHU:

* 1 Pump (+ wiring/controls)
* 1 Bypass
* 3 Valves
* Reduced maintenance



4.17 Pipe Material Options

Traditional materials suffer from corrosion - Not Acceptable

Alternative - Preferred Option

One plastic pipework system incorporates a three layer composite polypropylene pipe. Typically the three layers are designed with the following criteria:

* Inner layer
* Middle layer
* Outer Layer
* Suitable lining for the fluid flowing
* Strength and rigidity
* Expansion reduction
* Fire resistance
* uv resistance

Polypropylene Water

Services Pipes and Valves

Polypropylene Composite Pipe

Significant savings can be made on:

* Installation cost
* Installation time
* Water treatment
* Reduced insulation

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Corrosion on Steel Pipework

Steel Pipework can be subject to corrosion

12 Month old installation - poor vapour barrier



|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Pipe material comparison for Chilled water pipes | | | | | |
| Type of material | HDPE (High density Polyethylene) | Pre insulated HDPE (High density Polyethylene) | Mild Steel Pipes (Schedule 40,80 ) | Pre insulated Mild Steel Pipes (Schedule 40,80 ) | Polybutlene |
|  |  |  | WZ. w | 'y |  |
| Material specification | HDPE (High density Polyethelene) has outstanding flexibility & high Imapct Resistance. | HDPE (High density Polyethelene) has outstanding flexibility & high Imapct Resistance. | Mild Steel Pipes is most commonly used steel pipe world wide , due to its good mechanical strength and usability. | Mild Steel Pipes is most commonly used steel pipe world wide , due to its good mechanical strength and usability. | Polybutlene is Flexible & High Impact resistance pipe . It is composed of three layers |
| Sizes available | 15mm to 800mm | 15mm to 800mm | Upto 1000mm | Upto 1000mm | 20mm-225mm |
| Joining method | Electro Fusion  Butt Fusion, Compression  Joints | Electro Fusion  Butt Fusion, Compression  Joints | Flanged, grooved, threaded, welding | Flanged, grooved, threaded, welding | Socket Fusion, Electro  Fusion  Butt Fusion, Compression Joints |
| Pressure range | Upto 1600 kPa | Upto 1600 kPa | 4800 kPa to 21000 kPa | 4800 kPa to 21000 kPa | Upto 1600 kPa |
| Temperature range | -4o°C to 60°C (max) | -4o°C to 60°C (max) | -30°C to 340°C | -30°C to 340°C | -10°C to 95°C |
| Resistance to corrosion | GOOD | GOOD | POOR | POOR | GOOD |
| Life expectancy | 50 years | 50 years | 20 years | 20 years | 50 years |
| Insulation requirement for Chilled water pipes | insulation material k=0.25, 25- 50 mm | As provided by the manufacturer | insulation material k=0.04 ,25-60 mm required | As provided by the manufacturer | insulation material k=0.04,10- 15 mm required |
| Thermal expansion mm/m°k | 0.15 to 0.20 | 0.15 to 0.20 | 0.013 | 0.013 | 0.13 |
| Mechanical strength | GOOD | GOOD | EXCELLENT | EXCELLENT | GOOD |
| Thermal conductivity w/mk | 0.43 | 0.43 | 54 | 54 0.19 | |

**4.20** There are many different pipe materials available that have benefits over traditional steel systems

and the following tables provide comparisons for some of these options, which may vary, depending on the country.

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4.20.2 Comparative insulation thickness

Comparison of pipes sizes and insulation requirements for Aquatherm and steel pipes (Reference BS 5422: 2001 conditions)

The following table illustrates the reduction in insulation requirements for alternative pipe materials

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Steel Pipe Size (mm)** | | **Aquatherm (mm)** | | **Insulation Thickness at 5°C** | | | |
| **NB** | **OD** | **NB** | **OD** | **Steel Pipe** | | **Aquatherm Pipe** | |
| **K= 0.04** | **K= 0.03** | **K= 0.04** | **K= 0.03** |
| 15 | 21 | 12 | 16 | 25 | 15 | 15 | 10 |
| 20 | 27 | 14 | 20 | 30 | 15 | 15 | 10 |
| 25 | 34 | 18 | 25 | 30 | 20 | 15 | 10 |
| 32 | 42 | 23 | 32 | 30 | 20 | 15 | 10 |
| 40 | 48 | 29 | 40 | 30 | 20 | 15 | 10 |
| 50 | 60 | 36 | 50 | 40 | 20 | 15 | 10 |
| 65 | 76 | 46 | 63 | 40 | 25 | 15 | 10 |
| 80 | 89 | 54 | 75 | 40 | 25 | 15 | 10 |
| 100 | 114 | 65 | 90 | 40 | 25 | 15 | 10 |
| 150 | 168 | 80 | 110 | 50 | 30 | 15 | 10 |
| 200 | 219 | 91 | 125 | 50 | 30 | 12 | 10 |
| 250 | 273 | 116 | 160 | 50 | 30 | 10 | 10 |
| 300 | 324 |  |  | 60 | 35 |  |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Pipe material comparison for Condenser water pipes | | | | | |
| Type of material | ABS(Acrylonitrile butadiene styrene) | PP-R(Polypropylene) Schedule 40,80 | HDPE (High density Polyethelene) | FRP (fiberglass reinforced plastic) | SS (Stainless steel pipe) (schedule 10 S,4O,8o ) |
|  |  |  |  |  |  |
| Material specification | ABS (Acrylonitrile butadiene styrene) is rigid non flexible, High impact Resistance pipe suitable for Condenser water application. | Polypropylene (PP) is used extensively for HVAC applications. It is a multi­layered pipe mechanically stabilized through a fibre mix integrated in the middle layer & corrosion resistant PP layer in inner and outer part. | HDPE (High density Polyethylene) has outstanding flexibility & high Imapct Resistance. | FRP (fiberglass reinforced plastic) is rigid & non flexible in nature, and has high impact Resistance. | SS (Stainless steel pipe) is used for high pressure systems schedule 40, 80 pipes are suitable for HVAC applications. SS is available in following grades 304, 316. |
| Sizes available | 20mm-225mm | 20-125mm straight lengths 4 m. 160­630mm straight lengths 5,8 m | 15mm to 800mm | 25mm to 600mm | up to 1000mm |
| Joining method | Glue adhesive and thread joints. | Heat fusion weld, | Electro Fusion  Butt Fusion, Compression Joints | Adhesive Bonding | Flanged, grooved, threaded, welding |
| Pressure range | up to 1600 kPa | 828 kPa to 8480 kPa | up to 1600 kPa | up to 1034 kPa | 4800 kPa to 20933 kPa |
| Temperature range | -40°C to 60°C (max) | 0°C to 80°C | -40°C to 60°C (max) | up to 120°C | -30°C to 340°C |
| Resistance to corrosion | GOOD | GOOD | GOOD | GOOD | FAIR |
| Life expectancy | 50 years | 50 years | 50 years | 50 years | 50 years |
| Insulation requirement for Chilled water pipes | NA | NA | NA | NA | NA |
| Thermal expansion mm/m°k | 0.1 | 0.1 to 0.20 | 0.15 to 0.20 | 0.036 | 0.017 |
| Mechanical strength | GOOD | GOOD | GOOD | GOOD | EXCELLENT |

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|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Thermal conductivity w/mk | 0.17 | 0.22 | 0.43 | 0.41 | 16 |

**4.20** Condensate water piping

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**5.0 ELECTRICAL - SERVICES**

5.1 Objectives:

To provide a safe reliable power supply to maintain hotel operations continuously.



GENERAL PRINCIPLES

COST EFFECTIVE

SAFE AND SECU

FLEXIBILITY

ADAPABILITY

.PPROPRIATE FOR

\ DEVELOPMENT OF THIS NATURE

GOOD VISUAL COMFORT

COMPATIBLE WITH ARCHITECTURE AND INTERIOR DESIGN

RELIABLE COMMUNICATIOI

SYSTEMS

RELIABLE POWER SUPPLY

5.1.1 Green Engage Recommendations

E\_01 Adopt Best Management Plan (BMP)

E\_02 Energy Metering and Sub-metering

E\_03 Energy Performance Benchmarking

E\_04 Building Energy System Commissioning

E\_06 Guest Room Master Switching

E\_09 Energy Efficient Lighting

E\_10 Lighting Systems Controls

E\_11 Reduce Light Pollution

E\_12 Low Energy Systems

5.1.2 Brand Standard Manual

Section 2 Property Standards - then reference each individual area

Appendix - Technical Specifications - then reference each individual area

5.1.3 Electrical Services, systems included

To illustrate the main electrical services that are included within the designer’s responsibility.

TELECOMMS

TRANSFORMERS AND LV PANELS -

MATV AND CABLING. AMPLIFIERS AS NECESSARY TO SUIT INTERCON STANDARDS AND LOCAL STATION AVAILABILITY

L UPS (REFER DETAILS)

SECURITY SYSTEM

LIGHTNING PROTECTION SYSTEM IN ACCORDANCE WITH LOCAL STANDARDS

REAR OF BUILDING

AUTOMATIC POWER FACTOR CORRECTION

FRONT OF BUILDING

LV DISTRIBUTION SYSTEM (SEE SCHEMATIC AND DESCRIPTION)



5.2 Power

The electrical services installations must be designed to serve all areas of the Hotel, and provide for future expansion/flexibility. This must comprise spare capacity within containment capacities, switchgear space on all switchboards and individual transformer capacity (based on anticipated maximum demand peak load requirements) to allow for the following power increases:

|  |  |
| --- | --- |
| Kitchens | 25% |
| Conference/Banquet | 25% |
| Health Club | 25% |
| Main Board | 25% |

Where the electrical supply to the development is provided from the electricity supply authority / company at low voltage, the substation arrangement must be selected and installed in accordance with the supply authority’s requirements and shall be provided from dual incoming supplies as detailed in the activity section of this document.

Where the supply will be delivered at high voltage, either two transformers at 50% each or one at 100% each of the maximum peak demand must be provided. The transformers must be dry type either cast resin or sealed silicon filled, with forced air cooling for peak transformer loads. Forced ventilation must be installed within the substation when dry type transformer is installed.

Transformer outputs must be brought with bus ties or cable in case of small rating of transformer (less than 1000kVA) to enable segregation of the switchboard for maintenance purposes.

5.2.1 Typical Electrical Loads

Items of electrical equipment that have a relatively high electrical connected load generally are high consumers of electrical energy (kWh). The following generally come under this category:

* Mechanical Services such as:

o Chillers

o Humidification Plant

o Pumps

o Electrical Heating Systems

o Ventilation system

* Transportation Systems such as:

o Lifts

o Escalators

* Catering Equipment such as:

o Ovens

o Grills

o Dishwashers

o Freezers

* Laundry Equipment such as:

o Washers

o Dryers

* Lighting Systems such as:

o Tungsten Halogen Lamps

o Dichroic Lamps

Following illustrates a “typical” hotel power distribution, but note this may change from region to region:-

Typical Hotel Power Consumption

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5.2.2 Benchmarking Demand/Consumption

The maximum power demand and energy consumption will depend on a number of issues, including location, size, equipment types, availability of gas or other alternative fuels etc.

The following tables provide a range of actual maximum demand and power consumption from 32 Hotels located in sub-tropical climates and includes the chiller plant for air conditioners which can be used for benchmarking:

* Maximum demand for the whole Hotel equated to kW/room
* Annual energy consumption for the whole hotel equated to kWh/room/annum



These tables are provided for guidance only in accessing the installed capacity and potential running costs. The designer should calculate these figures specifically for each individual hotel and use these for checking purpose.

5.2.3 Typical Power Loads for Hotel Areas

An electrical load analysis must be carried out to detail the predicted loads for the hotel, by service and department area, based in VA/m2 floor loadings. This load analysis must include allowances for increase in electrical demand, and typical maximum values are indicated in the table following:

|  |  |  |  |
| --- | --- | --- | --- |
| **Table 5.1 - Schedule of Electrical Loads for Various Hotel Areas Note: Figures exclude heating/air conditioning from central plant** | | | |
| **Area** | **LPD(w/m2) (Ashrae 90.1)** | **Power (w/m2)** | **W/m**2 **(max)** |
| Ballroom | 14 | 46 | 60 |
| Exhibition | 14 | 66 | 80 |
| Assembly | 14 | 36 | 50 |
| Main Entrance Lobby | 11.8 | 28.2 | 40 |
| Lobby | 14 | 16 | 30 |
| Guest Rooms | 11.8 | 23.2 | 35 |
| Restaurants | 14 | 61 | 75 |
| Meeting Rooms | 14 | 26 | 40 |
| Coffee Shop | 15.1 | 34.9 | 50 |
| Lounge | 12.9 | 17.1 | 30 |
| Night Club | 14 | 16 | 30 |
| Cocktail Lounge | 15.1 | 14.9 | 30 |
| Bar | 15.1 | 14.9 | 30 |
| Public Corridors | 11.8 | 8.2 | 20 |
| Guest Corridors | 5.4 | 14.6 | 20 |
| Service Corridors | 5.4 | 4.6 | 10 |
| Foyer | 6.5 | 28.5 | 35 |
| Front Desk | 12.9 | 37.1 | 50 |
| Offices | 11.8 | 28.2 | 40 |
| Kitchen | 12.9 | 107.1 | 120 |
| Laundry Work Area | 6.5 | 123.5 | 130 |
| Valet | 9 | 121 | 130 |
| Housekeeping Area | 8.6 | 16.4 | 25 |
| Work Shop | 20.5 | 4.5 | 25 |
| Service rooms | 16.1 | 8.9 | 25 |
| Machine Rooms | 16.1 | 8.9 | 25 |
| Employees Lockers | 6.5 | 8.5 | 15 |
| Storage | 8.6 | 1.4 | 10 |
| Concessionary Outlets | 18.3 | 141.7 | 160 |
| Telephone switchboard room | 16.1 | 13.9 | 30 |
| Public Toilets | 9.7 | 5.3 | 15 |

Power demand for different area may vary according to case.

Each area of the Hotel must be provided with their own dedicated sub-distribution panels. Distribution sub­panels must be installed to achieve sub-circuit cable route length of not greater than 50 meters.

In general, systems must provide the following:

• A reliable electrical supply:

* The electrical supply must have a reliability of > 99.988%. If a supply of this reliability is not

available, then an additional electrical supply system must also be provided in the form of an independent electrical generating plant, or a totally independent power supply from an alternative generating source. An availability in excess of 99.988% is required (i.e. not more than one hour interruption per year) to obviate the need for the generator.

* The incoming supply, generator supply and electrical distribution must be arranged to prevent a

total loss of power in the event of failure of a single item.

* The tariff for supply must be negotiated to provide the most economic provision of power for the

Hotel, with investigations being made for both HV and LV. Where applicable, the metering system must allow for competitive electricity retailer choice.

• Emergency standby power to dedicated supplies:

* Standby power must be provided after a short break in electrical supply to serve essential, critical

and other designated loads in the event of mains failure, within 10 seconds.

* The generator will be required to operate the loads indicated on the following table 4.3, with

sufficient fuel storage for 48-hours continuous use full load operation.

**Note:** Where power failures are historically extended and fuel supplies are unreliable, storage capacity must be increased up to 7 days continuous full load operation. Where reliability of power is 99.98% +, fuel storage capacity can be reduced to 8 hours subject to IHG approval.

Fuel additives must be used when storing seven (7) day capacity to prevent fuel from going stale.

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**5.2.4 Typical MV Distribution with Primary Loop**

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TYPICAL MV DISTRIBUTION WITH PRIMARY LOOP & PORTABLE GENERATOR FOR COMPLETE POWER BACK-UP



**5.2.5 Typical MV Distribution with Primary Loop**



5.2.6 Typical LV Distribution Schematic

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5.2.6 Emergency Generation or CHP

If CHP is feasible, consider using CHP to support services in emergency operation.

Feasibility: As a rule of thumb, if the cost of 3kWh is at least 30% more than the cost of one litre of

fuel or one cubic meter of gas - payback period should not exceed 5 years.

|  |  |  |
| --- | --- | --- |
| **For Life Safety** |  | **For Operational Reasons** |
| Emergency lighting (if not operated by batteries)  Fire Alarm  Fire Fighting Lift  Fire Fighting Equipment |  | Front of House Lighting Heating System  Air Conditioning System Food & Beverage outlets Kitchen  Point of Sale Outlets |

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5.2.7 Substation Relationships

Electrical Services (Good Practice)

* MV Panel, Transformer & LV panel should be located together.
* It will reduce the cable size.
* Reduce the distribution losses.
* Reduce installation time.
* Capital & running cost reduced.

For a large site only MV cable should feed all substations (MV panel, Transformer & LV panel) instead of LV distribution. This will reduce the running as well as operational cost of distribution system.

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**5.2.8 Vertical Power distribution system**

**5.2.8.1 Inefficient and Uneconomical Vertical power distribution system**



**5.2.8.2 Efficient and economical Vertical power distribution system**



|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Table 5.2 - Requirement for a Generator / Back up Power** | | | | | |
|  | **Reliability of**  **Power** | **Generator** | **Quick Connection \*** | **Fuel Provision** | **F&LS** |
| 99.98%+ | No | Yes | N/A | +UPS |
| >80% | Yes | Yes Recommended | 48 hours | +UPS |
| <50% | Yes - continuous run | No | 48 hours | +UPS |
| \* Quick connection - the facility to connect a portable generator without modifications to the installation being required in a suitable location. | | | | | |

5.3 - Schedule of Essential/Critical Services Generator Loads

|  |  |  |  |
| --- | --- | --- | --- |
| **Description of Load** | | **Essential Component (%)** | **Load Classification** |
| Lighting | Stair and exit signs | 50 | E |
| Generator room | 100 | E |
| Guest room vestibule light | 100 | C |
| Switchgear rooms | 100 | C |
| Engineer’s office | 50 | C |
| Telephone switchboard room | 100 | C |
| Service area | 20 | C |
| General Manager’s office | 1 light only | C |
| Department Head’s offices | 1 light only | C |
| Walk-in fridges/freezers and cold rooms including refrigeration plant | 100 | C |
| Main plant rooms | 20 | C |
| Reception | 50 | C |
| Security office | 100 | C |
| Elevator machine rooms | 20 | C |
| Guest room corridors | 20 | C |
| Public areas | 20 | C |
| Elevator car lighting | 100 | C |
| Kitchens | 50 | C |
| IT Rooms | 50 | C |
| Health Club | 50 | C |
| Disabled guest bedrooms | 100 | C |
| Life safety systems | | 100 | E |
| Security system | | 100 | C |
| Sump pumps | | 100 | C |
| Sewage pumps | | 100 | C |
| Kitchen hood extract fans | | 100 | C |
| Computer equipment not connected via UPS | | 100 | C |
| Computer & Telephone Room Air Conditioning | | 100 | C |
| Point of sale terminals not connected via UPS | | 100 | C |
| UPS System | | 100 | C |
| Fire pumps | | 100 | E |
| Smoke control/staircase pressurization fans | | 100 | E |
| Aircraft warning lights | | 100 | E |
| Sewage disposal plant & pumps | | 100 | C |
| Computer and Telephone Room Air Conditioning | | 100 | C |
| Cold Water Pressure Pumps | | 100 | C |
| Air compressors for pneumatic controls (if applicable) | | 100 | C |
| PA System | | 100 | E |
| Selected elevator for Fire Fighting were provided | | 1 only | E |
| Telephone system | | 100 | C |
| Generator fuel pumps | | 100 | E |
| Kitchen Equipment | | 30 | C |

|  |  |  |
| --- | --- | --- |
| **Description of Load** | **Essential**  **Component (%)** | **Load Classification** |
| Refrigeration Cold Rooms | 100 | C |
| Cold Water Pressure Pumps | 100 | C |

Definitions:

* “Essential”- Life safety purposes
* “Critical” -Essential Hotel operations
* An uninterruptible supply system must be provided to ensure no break in electrical supply must occur to the following services:
* Hotel ‘IT’ Systems (30 minutes)
* Telephone System (4 hrs.)
* BMS (24 hrs.)
* Security System (24 hrs.)
* Fire Alarm (24 hrs.)
* Emergency Lighting (3hrs)

The system must be sized to accommodate the electrical load for the equipment supplied plus a minimum of 25% spare capacity. The battery autonomy must be 20 minutes at full load.

• Local Distribution/Protection

* A distribution system must be provided to all items requiring a power supply.
* The distribution system must comprise main and sub-main distribution panels, trucking distribution systems, LV distribution cables, voltage regulators and power factor correction equipment. Panels should not be located in public spaces.
* Sub-main electrical distribution must be arranged to limit the failure of any single item of equipment

or section within the system. This will be accomplished by the correct installation of adequate protection to achieve discrimination, together with segregation of equipment and cables as appropriate.

* The sub-main switchboards must be provided to serve the following specific load distribution centers:

1. FOH lighting and power
2. BOH lighting and power
3. Kitchen (separately metered)
4. Restaurants/cafeteria
5. Banquet facilities
6. Laundry (separately metered)
7. Leisure and fitness (separately metered)
8. Meeting facilities
9. Concessionary outlets
10. Guest rooms lighting and power
11. Service lifts (separately metered)
12. Guest lifts (separately metered)
13. Mechanical services (separately metered)

* All distribution boards serving loads in excess of 50kW must be provided with sub-metering.
* Power factor correction equipment must be included to correct the power factor such that no tariff

penalty is incurred under any load conditions.

* Earthing and Bonding

Earthing and bonding must be provided throughout to ensure safe disconnection of the electrical supplies under earth fault condition. This must be in accordance with British, European or International standards, where there is no conflict with local requirements. A clean earth must be provided to the computer room.

* Lightning Protection

A lightning protection system must be provided for protection of the occupants, structure and its contents in the event of a lightning strike. This must be in accordance with British, European, International or Australian/NZ standards, where there is no conflict with local requirements.

* Surge Protection

Surge protection devices shall be provided in order to protect equipment from voltage spikes.it helps in reducing downtime of equipment. Also helps in reduction of maintenance cost.

* Security System

A security system comprising access controls, intruder alarms, hold up alarms, automatic guard tour, guest room control and CCTV systems must be provided in accordance with InterContinental Hotels Group requirements.

* MATV System

A master antennae television aerial system with appropriate cable distribution network and amplifiers as necessary must be provided throughout the building, to suit InterContinental Hotels Group requirements and local station availability.

* Telecommunications

A structured cabling system and power supplies (only for wireless telephone) must be provided for the hotel telecommunications sections of the Brand Standard. All systems must be provided with a clean earth system.

* Audio /Visual systems

Audio visual systems are required to provide background music, paging and sound reinforcement, and to facilitate presentations for various areas of the Hotel.

Note: The Audio/visual system must be interlinked with fire alarm system to cutoff local/background music convey evacuation message through same backbone in case of fire.

All low voltage distribution systems must be suitably segregated from mains distribution systems.

Electrical systems must be designed in accordance with the appropriate National Electrical standards or InterContinental Hotels Group standards, where they exceed national standards. BS7671 is defined as the minimum acceptable standard for electrical low voltage and extra low voltage systems. The design consultant will be expected to design all electrical systems in conjunction with the architect/interior designer, to assure full functionality of the proposed systems and fully coordinated with all other disciplines.

5.4 Human Safety & Protection

Human safety & protection system shall pertain following:

* Lightning protection
* Surge protection devices
* Human safety protection in distribution board & Panels

5.4.1 Lightning Protection

A lightning protection system is always to be provided to ensure the safe conveyance and dissipation of the lightning energy into the Ground.

A lightning rod or lightning conductor is a metal rod or metallic object mounted on top of a building, electrically bonded using an electrical conductor to interface with ground or "earth" through an electrode, to protect the building in the event of lightning strike. If lightning targets the building it will preferentially strike the rod and be conducted to ground through the wire, instead of passing through the building, where it could start a fire or cause electrocution.

5.4.2 Surge Protection

A surge protector (or surge suppressor) is an appliance designed to protect [electrical devices](http://en.wikipedia.org/wiki/Electricity) from [voltage](http://en.wikipedia.org/wiki/Voltage_spike) [spikes.](http://en.wikipedia.org/wiki/Voltage_spike) A surge protector attempts to limit the [voltage](http://en.wikipedia.org/wiki/Voltage) supplied to an electric device by either blocking or by shorting to [ground](http://en.wikipedia.org/wiki/Ground_(electricity)) any unwanted voltages above a safe threshold. There are following advantages of surge protected system:

* Reduces the loss of equipment due to voltage spikes
* Reduces equipment downtime
* Reduces maintenance costs



5.4.3 Earthing& Earth Leakage Protection

In [electricity s](http://en.wikipedia.org/wiki/Electricity_supply)ystems, an earthing system is the [electrical potential](http://en.wikipedia.org/wiki/Electrical_potential) of the conductors relative to the Earth's conductive surface**.** An Earth Leakage Circuit Breaker (elcb) is a safety device used in electrical installations with high [earth impedance](http://en.wikipedia.org/wiki/Earthing_system) to prevent shock. It detects small stray voltages on the metal enclosures of electrical equipment, and interrupts the circuit if a dangerous voltage is detected. The following advantages due to earthing protection system:

* Earthing provides equipment as well as human safety.
* Good earthing system shall increase the life of electronic equipment.

5.4.4 Efficient power distribution system of Guest room

The guest room power distribution system shall be design in consideration of guest comfort level wit maximum energy saving.

* Each guest room shall have separate distribution board
* Guest room shall have intelligent room control system, which have presence detector (PR) and doo

reed switch to switching on and off Lighting at presence and absence of guest in room.

* Integrated room automation system tells real-time guest status of a room ensure less energ

consumption

* Digital control (DDC) thermostats for precise temperature control in guest room ensure comfort and les

energy consumption.

* Saves up to 20% to 40% of electricity consumption.



Centralized control system of guest room application provides a robust communications solution for hotel with energy management and integrated room automation systems. It gives room monitoring and control capabilities and provides efficient information presentation to staff and management. The central software communicates with room intelligent devices such as digital thermostat and a variety of light switches, controllers and communication devices.

The centralized system has following major features:

* Real-time monitoring of HVAC equipment; reports malfunctioning units.
* Monitor humidity levels in each room and reports rooms exceeding acceptable threshold.
* Monitors guestroom network connection and reports non-communicating rooms.
* Reports rooms that are occupied for extended periods but not rented.
* Reports property-centric events such as domestic hot water and utility company demand events.
* Tracks and reports equipment run-time vs. baseline of rooms running without energy management control.

The centralized system has following advantages:

* Ensures peak performance and operation to avoid catastrophic equipment damage such as frozen

compressors.

* Automatic monitoring and reporting of alarms and events optimizes the investment made in a

room automation system by ensuring peak performance.

* Improve maintenance scheduling, prolonging equipment life and avoiding premature failures.
* Easily displays energy savings month-by-month

Typical Screen from a centralised control system

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Typical Screen from a centralised control system

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Room Electrical Services Requirements

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Location** | **Light Switching \*1** | | | | **Emergency Lighting** | **Power for Equipment & General Cleaning** | **Special Finishes for Switch Plates & Outlets** | **Telephone Outlets** | **Data Outlets** | **TV Power & Aerial** | **CCT V** | **PA, Music & Speech with Local on/off/ auto control** | **Fire Alarm & Detection** | **Panic Alarm/ Disabled Alarm** | **POS** | **Comments** |
| **Local** | **Manual** | **Auto** | **\*2**  **Loose Remote** |
| Public Areas, Lift Lobbies/ Reception |  | *J* | *J*Day/night + 4 Channel Dimming | *J* | *J* | J | J | J + Payphones | J wireless hotspot | J | J | J | J | J | J |  |
| Restaurant |  | *J* | *J*Day/night + Dimming to suit interiors | *J* | *J* | J | J | J | J wireless hotspot |  | J | J | J |  | J |  |
| Bar |  | *J* | *J*Day/night + Dimming to suit interiors | *J* | *J* | J | J | J | J | J | J | J | J |  | J |  |
| Lounge |  | *J* | *J*Day/night + 4 Channel Dimming | *J* | *J* | J |  | J |  |  | J | J | J |  |  |  |
| Meeting rooms  & Foyer | *J* | *J* | Dimming |  | *J* | Inc. flush floor boxes at desks | J | J | J wireless hotspot | J | J | J | J |  |  | Audio Visual including o/head projection, video presentation, video conference, wall mounted projector. |
| Health club reception / dry areas | *J* | *J* | Dimming |  | *J* | Inc. flush floor boxes |  | J | J | J | J | J | J | J | J |  |
| Health club wet/change | *J* | J | Dimming |  | J | IP44 or IP65 as needed |  | J |  |  |  | J | J | J |  | Lighting also in swimming pool |
| Health club activity areas | *J* | J | Dimming |  | J | IP44 or IP65 as needed |  | J | J | J | J | J | J | J |  | RCD’s to power |
| Shops | *J* | J | JDay/night + Dimming |  | J | J |  | J | J |  |  | J | J |  |  | Separate power meter |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Location** | **Light Switching \*1** | | | | **Emergency Lighting** | **Power for Equipment & General Cleaning** | **Special Finishes for Switch Plates & Outlets** | **Telephone Outlets** | **Data Outlets** | **TV Power & Aerial** | **CCT V** | **PA, Music & Speech with Local on/off/ auto control** | **Fire Alarm & Detection** | **Panic Alarm/ Disabled Alarm** | **POS** | **Comments** |
| **Local** | **Manual** | **Auto** | **\*2**  **Loose Remote** |
| Business centre | J | J | Dimming |  | J | J |  | J + fax | J | J | J | J | J |  |  | 3 power outlets + 1 clean earth power outlet per computer |
| Offices | J | J |  |  | J | J |  | J | J |  |  |  | J |  |  |
| Public  Restrooms | *J* |  |  |  | J | J PIR control for urinals | J |  |  |  |  |  | J | J |  |
| BOH General | *J* | J |  |  | J | J |  | J | J |  | J | J | J |  |  |
| Laundry | *J* | *J*IP65 lights |  |  | J | J Flex connections to equipment |  | J |  |  |  |  | J |  |  | Easy clean lights |
| Kitchen/  Food preparation area | *J* | *J* Easy clean |  |  | J | JInsectocut or fixed equipment with IP54 isolators |  | J |  |  |  |  | J | JCookin g |  | Dedicated Fridge Freezer supplied with alarms  Dedicated kitchen equipment supplied from outside the kitchen |
| Staff Dining/  Change room | *J* | J |  |  | J | J |  | J + 1 payphone |  | J |  |  | J |  |  |
| Circulation | *J* | J | J 50% night |  |  | J |  |  |  |  | J |  | J |  |  |
| Linen/  Housekeeping | *J* | J |  |  | J | J |  | J |  |  |  |  | J |  |  |
| Service/  Delivery | *J* | J |  |  | J | J |  | J |  |  | J |  | J |  |  |
| Guest rooms | *J* | J Refer std layout |  | J |  | J Refer std layout | J | J | J  wire or hard | J |  | J | J Flashing light disabled | J  Disabled rooms only | JBar Fridge | Key tags if used restricted as detailed |
| Corridors |  | J | J Day/night |  | J | J |  | J |  |  | J |  | J |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Location** | **Light Switching \*1** | | | | **Emergency Lighting** | **Power for Equipment & General Cleaning** | **Special Finishes for Switch Plates & Outlets** | **Telephone Outlets** | **Data Outlets** | **TV Power & Aerial** | **CCT V** | **PA, Music & Speech with Local on/off/ auto control** | **Fire Alarm & Detection** | **Panic Alarm/ Disabled Alarm** | **POS** | **Comments** |
| **Local** | **Manual** | **Auto** | **\*2**  **Loose Remote** |
| Workshops | *J* | J |  |  | J | J Three phase |  | J | J | J |  |  | J |  |  | Guestroom locks must be illuminated |
| Plant rooms | *J* | J |  |  | J | J Three phase |  | J |  |  |  |  | J |  |  |
| External |  | J | J |  | J Escape/ Access Routes | J Three phase |  |  |  |  | J |  | J |  |  |

* 1 All public area lighting must be designed in co-ordination with the interior designer, and local light switching not to be visible to guests (except meeting rooms)
* 2 Loose remote - loose table/floor lamps and display cabinets to have remotely switched nonstandard outlets
* 3 Refer to typical guest room layouts for preferred layout
* 4 Full WiFi throughout including back of house

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5.5 Lighting

The following design criteria are to be considered as minimum requirements. The design engineer will liaise closely with the Architect, Interior Designer and Specialist Lighting Consultants with regard to the selection and location of decorative luminaries and effects, both within and outside the hotel, together with the location of all outlets required to supply portable decorative lamps.

The use of incandescent or filament luminaires is prohibited. The use of high frequency control gear in fluorescent luminaires is compulsory. Where it is practicable, the use of dimmable high frequency fluorescent control gear, with related dimming equipment is to be encouraged. A comprehensive lighting control system must be provided to front and back of house areas to control energy usage.

The following provides guidance on illuminance levels, surfaces where levels should be measured and types of luminaires.

**Schedule of Lighting Levels and Fitting Types**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Area** | **Location** | **Lighting** | | |
| **Maintained Illuminance (LUX)** | **Working Plane** | **Fitting Type** |
| **Public Areas** | Entrance Lobby - Seating Areas | 100-400 | Floor level | LE/LED/F |
| Reception - General | 300-400 | Floor Level | CF/F/LED\*# |
| Reception - Registration Desk | 400-600 | 1000mm above floor | LE/LED/F |
| Reception - Working Areas | 300-400 | 1000mm above floor | LE/LED/F |
| Cloakroom | 200 | 500mm above floor | F/CF/LED\*# |
| Public Toilets | 200 | 500mm above floor | LE/F |
| Gift Shop | 500 | 500mm above floor | CF/LED/CC\*# |
| Corridors | 150 | Floor level | LE/LED/F |
| Restaurant | 100-500 | Table top | LE/LED/F |
| Coffee Shop | 200 | Table top | CF/LED\*# |
| Cocktail Lounge | 50-400 | Table top | CF/LED/CC\*# |
| Ballrooms | 200-400 | Table top | CF/HID/CC\*# |
| Pre-Function Foyer | 200 | Floor level | CF/LED/CC\*# |
| Function Room | 200-500 | Table top | CF/LED/HID/CC\*# |
| Bar | 200-400 | Table top | LE/LED/F |
| Housekeeping | 150 | Floor level | LE/F |
| Lounge - General | 100-400 | Floor level | F/CF |
| Lounge - Function Areas | 50-400 | Table top - dimmed | LE |
| Meeting Rooms | 500 | Table top - dimmed | LE/LED/F |
| Stairwells-accommodation | Min day 150  Min night 100 | Floor level | DLE/LED |
| Stairwells-escape | 100 | Floor level | LE/F |
| Business Centre | 200/500 | Table top - dimmed | CF/LED/HID/CC |
| Lifts | 100 | Floor level | LE/F |
| Stairwells | 300 | Floor level | F/CF |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Area** | **Location** | **Lighting** | | |
| **Intensity Lux** | **Working Plane** | **Fitting Type** |
| **Recreation Areas** | Health Club - Recreational | 300  300 | 1000mm above floor  Floor level | CF/F  LE/F |
| Fitness Facility - General |
| Health Club - Reception | 200 | Table top | LE/F |
| Health Club - Food & Beverage areas | 200 | Table top | CF/LED\*# |
| **Recreation Areas** | Health Club - Changing | 200 | Floor level | LE/F |
| Fitness Rooms | 300 | Floor level | LE/F |
| Massage/Solarium/Sauna/Jacuzzi | 200 | 100mm above floor | CF/F/LED |
| Indoor Swimming Pool | 300 | Pool Deck | MW/MH |
| **Private Guest Areas** | Bedrooms - General | 150-200 | Floor level | DLE/LED |
| Bedrooms - Sleeping area | 300 | Beside table top | DLE/LED |
| Bedrooms - Desk area | 400 | Table top | DLE/LED |
| Bedrooms - Activity areas | 300 | Table top | DLE/LED |
| Bedrooms - TV/drawer unit | 250 | Table top | DLE/LED |
| Bathrooms - General | 150 | Floor level | Low energy/decorative |
| Bathrooms - bath area | 200 | 1 m above floor | Low energy |
| Bathrooms - vanity areas | 400 | Vanity unit top | Low energy |
| Corridors | Min day 150  Min night 100 | Floor level | DLE/LED |
| **Back of**  **House Areas** | Offices  Laundry | 300-400  200 | 1000m above floor  Floor level | LE/F  F Covered |
| Housekeeping/linen | 300 | Floor level | F Covered |
| Kitchen general | 500 | Work surfaces | F Covered |
| Kitchen pastry | 500 | Work surfaces | F |
| Kitchen prep/finish | 500 | Work surfaces | F |
| White Wine and Beer Store | 200 | Work surfaces | F |
| Staff Dining | 300 | Table top | CF/LED/F |
| Staff Kitchen | 500 | Work surfaces | F Covered |
| Staff Changing Workshops Plant Rooms | 200  500  300 | Floor level  1000m above floor  1000m above floor | CF/F/LED  F  F |
| **External Areas** | Pathways/Parking | 50-200 max at corners/ non­circulation space | Ground Level | HID |
| Covered/Underground Parking | 100 | Ground Level | F |
| Outdoor Pools | 100 | Pool Deck | MH/HID |

|  |  |  |
| --- | --- | --- |
| \* |  | Includes chandeliers, wall brackets, etc, decorative effect lighting. |
| # |  | Subject to special lighting effects/local decorative lighting. |
| F | - | Fluorescent |
| CF | - | Compact Fluorescent |
| HID | - | High Intensity Discharge (High pressure sodium, metal halide, etc.) |
| CC | - | Cold Cathode |
| LED | - | Light Emitting Diode |
| MH | - | Metal Halide |
| LE | - | Low Energy |
| DLE | - | Decorative Low Energy (LED or CF) |
| Please note that all compact fluorescent (CF) and Fluorescent (F) should becolour temperature 3000 K and a color rendition (Ra) of equal to or greater than 85. | | |

Selected lighting circuits to the car park, entrance hall, common area, corridors, staircases, circulation areas and external areas must, in addition to the time clock and/or solar control facility, be provided with a movement sensor which must override the astronomical time clock. Control will revert back to the time clock after a user-adjustable time period, initial set at 10 minutes.

Movement sensors must be provided in sufficient number to achieve adequate control of the lighting circuits to all common areas.

External lighting should be provided for all pedestrian and vehicular access routes to the building, service and car parking areas. Road lighting should be in accordance with relevant standards and local codes of practice. A security risk assessment shall be prepared to identify the external lighting category design criteria. This shall be discussed with InterContinental Hotels Group and agreed prior to progression of external lighting design. Decorative lighting and/or flood lighting should be provided to the major elevations of the building and to landscaped areas and signage. All external lighting should be time switch and photo­cell controlled, with manual override switches being provided in the security office. Separate controls should be provided for the following:

* Road, car parking and delivery area lighting.
* Pedestrian area lighting and building entrances
* Decorative and flood lighting
* Illuminated signs and displays
* Water features/artwork/sculpture
* Roof and external plant areas

The following drawings illustrate the principles for

* Lighting -using wall & ceiling lights
* Power and communications
* Typical guest room wiring diagrams

These must be followed in principle and not changed without approval from IHG.

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Typical Guestroom Power & Communication Layout



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**TYPICAL GUEST ROOM LIGHTING LAYOUT**

NOTES

1. THIS IS AN INDICATIVE LAYOUT TO ILLUSTRATE HOW THE IHG REÛUIRED LIGHTING LEVELS FROM TABLE 4.3 OF THE HEP STANDARDS CAN BE ACHIEVED, IN THIS CASE WITH AN EFFICIENCY OF APPROXIMATELY 70Lm/W. DESIGNERS CAN PROPOSE ALTERNATIVE LAYOUTS PROVIDING THE LIGHTING LEVELS ARE ACHIEVED AT AN AVERAGE EFFICIENCY OF GREATER THAN SQLm/W.

2. ALL WIRING AND EQUIPMENT INSTALLATION STANDARDS MUST BE IN ACCORDANCE WITH THE LOCAL REGULATIONS FOR THE COUNTRY THE HOTEL IS BEING CONSTRUCTED IN.

Typical Guestroom Lighting Layout (Ceiling Light Options)

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Typical Guestroom Lighting Layout (Wall Light Option)

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**TYPICAL GUEST ROOM LIGHTING LAYOUT (WALL LIGHT OPTION)**

NOTES

1. THIS IS AN INDICATIVE LAYOUT TO ILLUSTRATE HOW THE IHŨ REQUIRED LIGHTING LEVELS FROM TABLE 4.3 OF THE MEP STANDARDS CAN BE ACHIEVED USING WALL LIGHTS, IN THIS CASE WITH AN EFFICIENCY OF APPROXIMATELY 70Lm/W. DESIGNERS CAN PROPOSE ALTERNATIVE LAYOUTS PROVIDING THE LIGHTING LEVELS ARE ACHIEVED AT AN AVERAGE EFFICIENCY OF GREATER THAN SOLm/W.

2. ALL WIRING AND EQUIPMENT INSTALLATION STANDARDS MUST BE IN ACCORDANCE WITH THE LOCAL REGULATIONS FOR THE COUNTRY THE HOTEL IS BEING CONSTRUCTED IN.

Typical Guest Room Wiring Diagram

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TYPICAL GUEST ROOM WIRING DIAGRAM



5.5.1 LED Lights

There has been massive growth in LED lighting both internally & externally (façade & landscape). Since being launched into commercial market there has been impressive development into the output and capabilities of LED lighting with significant reduction in cost.

There are following advantages of LED lighting:

* Reliability / Lifespan - LED’s last longer than any other form of artificial lighting. The average lifespan on a 12V halogen lamp is 4000 hours compared with the 50,000 hours of an LED.
* Energy and the environment- reduced power consumption when compared to other lamp sources i.e. a 7 watt LED has the same light output as a 50 watt dichroic down light. LED’s are also easier to control, 60% of the light emitted from a fluorescent tube is wasted.
* Reduced Heat- LED’s produce much less heat than the equivalent lamps making it easy to incorporate them in enclosed spaces.
* Safety- All LED’s operate at low voltages and use direct current. LED’s are solid state devices and have low toxicity by virtue of their construction.

Refer to Volume 3 of this manual for an example of LED light in a hotel.

5.6 IT Systems

The design and specification of the Hotel IT systems will be provided by IHG Global Technology.

Due to the continuing advancement of this technology, this design is often produced late in the construction process, so the purpose of this section is to provide some guidance on what to allow in the provisions for these systems prior to this design being issued.

As for most modern operations, the IT systems are critical to the efficient functioning of the Hotel so reliability and redundancy are essential.

Refer to illustration of this manual for ‘typical requirements which will be confirmed by IHG Global Technology.

Electrical Power

All IT equipment must be powered off a dedicated branch circuit that conforms to the following statements:

* The circuit must have an insulated wire conductor, equal to the size of the phase conductor, for

grounding the equipment.

* The branch circuit grounding wire must be tied to a single insulated ground point at the distribution

panel.

* The distribution panel insulated ground point must have a grounding wire connecting to either a service

ground or a suitable building ground.

* At least 60 Amperes capacity should be provided to the IT Room with a 32 Amp fuse.

Please Note: ‘Ground’ means dedicated ground, not neutral. The conduit or the utility box must not be used as the only grounding means.

The following table indicates the cabling considerations for the number of RJ45 ports that should be provided at various locations in the hotel.

|  |  |
| --- | --- |
| **Location** | **Number of cabled RJ45 ports** |
| Back office workspace   * pC * Telephone * Spare (printer, laptop etc.) | 3 |
| Back office network printer location | 1 |
| Reception workspace (6 recommended)   * PC with PMS access * Printer * Key encoder * Card authorisation terminal | 4 |
| Front of house telephone location | 1 |
| Front of house television location | 1 |
| Front of house printer location | 1 |
| Front of house POS location   * POS terminal * POS printer * Card authorization terminal | 3 |
| Front of house PMS location   * PC with PMS access * Printer * Card authorization terminal | 3 |
| Each kitchen POS printer location | 1 |
| Wireless access point location (WiFi or DECT) | 1 |
| Guest Room   * Telephones (can share 1 connection if analogue or 2   separate if Digital or IP)   * In Room Entertainment * High Speed Internet Access * Minibar (could share with In Room Entertainment) | 4 |
| Meeting Room   * Telephone * Television * High Speed Internet Access * Spare (printer, second telephone etc.) | 4 |
| Refer to your regional IHG Global Technology function for further information. | |

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HOTEL INTEGRATED COMMUNICATIONS SCHEMATIC - TYPICAL PROVISION

Hotel Integrated Schematic - Typical IT Provisions



I.T Room Typical Layout

5.7 Security Systems

5.7.1 General

This section covers the provision of access control, intruder alarms, hold-up alarms, guard tour, guest room control, and closed circuit surveillance television (CCTV) systems.

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Each of the above systems must be supplied installed, tested and commissioned by specialist system suppliers.

5.7.2 System Concept

The security should be based on the Cerberus LMS modular system. The system should be complete with subsystems as described. Interface ports should be available to communicate with other systems as described. It should consist of a three-layer security concept.

Subsystem layer: The subsystem layer should include all the local control units PC’s, sensors and actuators as described. The subsystems should have complete autonomy within the security concept, so that field operations and satisfactory level of security can be guaranteed even in case of failure in the higher levels above.

Communication and integration layer: This layer consists of the communication networks and the communication controllers called gateways. The gateways fulfil three principal tasks:

* Interpret and translate the various communication protocols from the different subsystems.
* Concentrate the data flow between the upper and lower layers.
* Manage the interactions between subsystems. The event-by-control functions, which are initiated in one subsystem and actuated in another, are linked in this layer.

5.7.3 Subsystems

Closed Circuit Television System

A CCTV system will be provided for constant surveillance of the following areas:

* Entry point to the property (vehicular) and final exits
* Parking levels
* Loading dock
* Lobby
* Hotel front desk
* Hotel guest elevator lobby and guest room corridors
* Public areas
* Employee entrance
* Shopping level corridors (where applicable)
* Exit stairs with motion detectors
* Cashiers room
* Alcohol and beverage store

General monitoring locations shall be as follows:

* The main security office of the Hotel will monitor all cameras in the Hotel.

Intruder Detection System (IDS)

The IDS system should allow detection of unauthorized persons. This shall include installing of alarm devices at the following locations:

* Card reader controlled doors
* Exit halls and doors from stairwells
* Hold-up alarm at front desk
* Hold-up alarm at head cashiers desk
* Hold-up alarm at restaurants
* Hold-up alarm at guest safe deposit room

Card access system

The card access system should provide access into the back of the house staff entry. It should also serve as a time and attendance record keeping system for hotel employees. In general, card readers should be located as follows:

* Entry to accounts department
* Safe deposit room
* Computer room
* General cashier
* Employees entrance (to be used for time and attendance)
* Entry to front office
* Alcohol beverage store

Guard Tour system

The automated guard tour system will allow regular rounds by the hotel security guard of the hotel facility. In general, guard tour stations should be located as follows:

* All exit doors
* The two most remote stair cases
* Every other floor level in the stairways
* Guest floor corridors
  1. **Plumbing and Drainage**
  2. **Objectives**

The systems shall provide an appropriate environment for a high quality Hotel and be compatible with architectural/interior designs. In general, this should include the following equipment’s.

GENERAL PRINCIPLES

COST

ECTIVE

APPROPRIATE FOR THE STAR RATING OF THE

HOTEL

DESIGN

SAFE AND RELIABLE

COMPATIBLE WITH ARCHITECTURE AND INTERIOR

DESIGN /

SUITABLE FLOW AND PRESSURES

APPROPRIATE ACOUSTICALLY

ENERGY EFFICIENT MINIMISE

CARBON EMISSIONS

SUITABLE TEMPERATURES FOR HOT AND COLD WITHOUT WAIT

FLEXIBILE AND ADAPTABLE

LEGIONELLA FREE HEALTHY AND ODOUR FREE

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The main services those are included within the designer’s responsibility.



6.1.1 Green Engage Recommendations

E\_02 Energy Metering

E\_04 Building Energy System Commissioning

E\_05 Building Management Systems

E\_07 Energy Efficient Appliances

E\_08 Hot Water Contribution to Energy Reduction

E\_12 Low Energy Systems

W\_01 Drinking Water Quality

W\_02 Water Metering and Sub-metering

W\_03 Water Efficient Fixtures

W\_04 Water Efficient Appliances and Systems

W\_05 Reduce irrigation demand

W\_06 Manage storm water

W\_07 Water Collection Treatment and re-use system

W\_08 Ozone Water Treatment / Chemical Reduction

6.1.2 Summary of Design Requirements

* Intended use of space
* Suitable design temperatures
* Adequate flow/temperatures
* The hot and cold water distribution systems shall be sized using ‘demand units’ based on CIBSE, ASHRAE or the International Building/Plumbing Code.
* The Design Consultant shall indicate, based on the demand unit calculation, the number of fittings that have been designed to operate simultaneously as a percentage of the total number of fittings installed.
* This number of fittings shall be used for commissioning purposes to demonstrate adequate flows/temperatures are available.

Water Quality

* Must comply with the following requirements as a minimum.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table- Physical-chemical limits and maximum permissible concentrations in parts per million**  **(ppm).For drinking water.** | | | | |
|  | **Parameter** | **WHO Standards** | **IHG Desirable Levels** | **EU Standards** |
| Temperature (°C) |  | 10-15 | **<**25 |
| pH | 6.5-9.2 | 7-8 | 6.5-8.5 |
| Conductivity (mS/m|3) |  | 400 | 400 |
| Chlorides | 250 | **<**50 | 250 |
| Sulphates | 200 | **<**250 | 250 |
| Hardness (as CaCO3) |  | **<**100 | 100 |
| Magnesium |  | **<**50 | 50 |
| Sodium | 250 | **<**50 | 175 |
| Potassium |  | **<**12 | 12 |
| Aluminium |  | **<**0.2 | 0.2 |
| Total Dissolved Solids (TDS) | 1,000 | **<**500 | 1,500 |
| Nitrates | 45 | 0 | 50 |
| Nitrites |  | 0 | 0.1 |
| Ammoniu7m |  | **<**0.5 | 0.5 |
| Phenols | 0.001 |  | 0.000,2 |
| Organic Chlorine Compounds |  | 0 | 0.025 |
| Pesticides |  | 0 | 0.000,1 |
| Iron | 0.3 | **<**0.2 | 0.2 |
| Manganese | 0.05 | **<**0.05 | 0.05 |
| Copper | 0.05 | **<**0.05 | 0.1 |
| Zinc | 5.0 | **<**0.1 | 0.1 |
| Lead | 0.5 | 0 | 0.04 |
| Cadmium | 0.01 | 0 | 0.005 |

|  |  |  |  |
| --- | --- | --- | --- |
| Chromium |  | 0 | 0.05 |
| Mercury | 0.001 | 0 | 0.001 |
| Arsenic | 0.01 | 0 | 0.04 |
| Cyanides | 0.01 | 0 | 0.05 |
| Nickel |  | 0 | 0.05 |
| Fluoride | 1.5 | **<**0.07 | 1.5 |
| Silver |  | 0 | 0.01 |

To achieve these requirements, the system must be designed in accordance with:

* WHO recommendations
* National Regulations/ InterContinental Hotels Group Standards
* CIBSE/ASHRAE
* International Plumbing Codes
* Legionella Codes (H&S Executive L8 UK, EWGLC European)

|  |  |  |  |
| --- | --- | --- | --- |
| **Table-B The permitted limit for grey water reuse for Toilet flushing& Cooling Tower.** | | | |
|  | **Parameter** | **WHO Standards** | **EU Standards** |
| BOD5(mg/L) | <10 | **—** |
| Sample Number | Sample/week | **—** |
| TSS(mg/L) | <10 | **—** |
| Sample Number | Sample/week | **—** |
| Thermo tolerant (cfu/100ml) | <1000 | **—** |
| Sample Number | Sample/week | **—** |

|  |  |  |  |
| --- | --- | --- | --- |
| **Table-C The permitted limits for grey water reuse irrigation** | | | |
|  | **Parameter** | **WHO Standards** | **EU Standards** |
| BOD5(mg/L) | <240 | **—** |
| Sample Number | Sample/week | **—** |
| TSS(mg/L) | <140 | **—** |
| Sample Number | Sample/week | **—** |
| Thermo tolerant (cfu/100ml) | <1000 | **—** |
| Sample Number | Two Sample/week | **—** |

* Report on the WHO/AFSED regional consultation to review national priorities and action plans for waste water reuse and management (WHO-EM/CEH/106/E)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table-D Hot and Cold Water Design Criteria.** | | | | |
|  | **Service** | **Storage** | **Shower Flow Rate** | **Pressure Range** |
|  | Cold Water | * 410 liters/guest / day w/o laundry * 560 liters/ Guest /day with laundry * 900 liters/guest /day with all facilities * Restaurant: 35 liters/cover * Maintain below 20°C to prevent Legionella 23°C in   tanks for UAE | 0.15 to 0.22 l/s | 2.5-5.5 Bar \* |

• Pressure requirements typically based on shower requirements. All rooms and all services to have same/balanced pressure.

The maximum fixture pressure shall be limited to 5.5 bars.

**Note:** Water storage and treatment systems must be reviewed and approved by InterContinental Hotels Group Water Management Consultant.

| Hot Water | * 33% of cold water storage (60°C) for guest rooms * Restaurant: 14 liters/cover * Kitchen & Laundry: Base on equipment at higher   temperature (60-70°C) with 2 Hours minimum recovery.   * 2 Hours recovery minimum (Refer to schematic ) * Minimum return temperature 55 °C * Anti-scald fittings on washbasins to limit hot water   supply temperature to 41 °C) | 0.15 to 0.22 l/s | 2.5-5.5 Bar \* |
| --- | --- | --- | --- |

6.1.2.1 Cold water Schematic of water supply to Building

IS AVAILABLE. DUPLICATE TANKS TO BE PROVIDED TO ALLOW FOR MAINTENANCE

6.1.3 Water Treatment

Water treatment shall be installed if any of the following problems exist:

* Hard water - softener only to be applied to hot services, unless levels such that cold services would be affected.
* Alkalinity
* High bacteriological count
* Discoloration
* Excessive organic growths
* Corrosion due to soft water

The water supply shall be neither scale forming nor corrosive.

Particular consideration shall be given to the following systems:

* Heating
* Chilled water
* Condenser water
* Domestic hot and cold water
* Kitchen wash up and laundry equipment

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* Spray coil humidifiers (if used)
* Steam Boiler (Laundry)

Where evaporative condensers or coolers are used, particular attention must be given to the prevention of Legionnaires Disease. Twin biocide dosing and a continued programme of water monitoring must be adopted.

Treatment for Legionnaires Disease in all systems must be in accordance with HSE (UK) Legal Series L8 document - “Legionnaires Disease - The Control of Legionella Bacteria in Water Systems. ACOP and guidance.” or either similar International Standard.

Refer also to IHG ‘Standards and Guidelines for the Operation and Maintenance of Building Water Systems including The Control of Legionellosis’.

Materials that encourage the proliferation of Legionella (e.g. EPDM “rubber” flexible connections) shall not be used.

6.1.3.1 Schematic of Soft Water Plant



6.2 System Selection

The objective as with all new building design is to ensure that all systems inclusive of the Plumbing and Drainage are efficient, effective and safe.

Since the plumbing systems use water, electricity and perhaps gas, it is important that all aspects are carefully considered at the start of the design process. Some of the design considerations that should be carried out prior to the start of the design process are as follows:

* Is Municipal Water available in sufficient quantity and quality to suit the new development?
* If not what will be required to generate sufficient water quantities to support the hotel?
* Is natural gas available to be used as the source of energy for hot water?
* Can grey water be recycled and used for such areas as cooling tower make up water?
* Can laundry water be recycled and reused?
* What type of distribution arrangement best suits the development? Usually vertical distribution is best

as it allows the floor to floor height to be reduced to a minimum, and reduced pipe lengths as illustrated earlier.

* VFD pumping versus constant volume pumping?
* Optimise the pumping arrangement with respect to the distribution pressures.
* If a laundry system is to be installed in the hotel, can the steam system be used to generate hot water

and provide heat for makeup air systems?

* Proper selection of sanitary fixtures to ensure minimal water usage, long life, ease of use, ease of

maintenance and occupant comfort.

* Equal pressure on hot & cold water systems.

6.2.1 Preferred System Components

From an operational cost and reliability perspective the following systems should be utilised:

* Gravity water supplies where possible. Roof mounted storage tanks with gravity feeds offer the

greatest reliability.

* Gas fired or heat pump water heating with storage calorifiers - whether directly through a hot water

boiler or indirectly through low pressure steam. This needs constant review as fuel costs vary.

* Heat recovery from chillers. Refer to heat recovery Schematic illustration.
* Hot water recirculation instead of electrical tapes.
* Minimising the number of pressure reducing valves within the system.
* Ensuring that the minimum water pressure at each fixture is 2.5 bars.
* Implement water treatment as necessary. In the first instance utilise ozone or ultraviolet light to control

bacteria and turbidity filters to control suspended solids. This will eliminate the need to costly chemicals.



DOMESTIC HOT WATER SYSTEM ÎDHWSÎ HEAT RECOVERY (Alft ÇODCED EMULER ŨPTIDMÍ

6.2.2 Local Authority Investigation

Prior to the start of the design for the project it is imperative that several key parameters are obtained from the local supply authority. These key parameters include the following items:

* Available water supply flow and pressure - are 2 separate independent supplies available to avoid

storage?

* Available city water quality.
* Location of the available incoming service.
* Reliability of supply - investigate the availability of dual water supplies to consider the deletion of

storage. This option is preferred if reliable in order to reduce the Legionella risk.

6.2.3 Key Design Issues

Based on the information obtained from the local supply authority, the following decision can be made:

* Whether or not a water supply requires boosting and storage within the building or whether it can be

fed directly from the local authority supply.

* In most cases it may not be possible to feed directly from the local authority supply for the following

reasons:

* Instantaneous flow may not be available.
* Depending on the height of the building the municipal pressure may not be sufficient to

distribute the water throughout the building.

• If the building is high rise or if the municipal supplies are not adequate then the Intercontinental daily

allowances must be utilised in order to determine the water storage tank size. The distribution side of the water tank can then be determined by use of the International Plumbing code or other equivalent internationally recognised standards.

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Main electrical load locations- central -Recommended (Good Practice)



6.3 Systems

Plumbing and sanitary systems shall include the following:

**6.3.1 Domestic Cold Water 2 - Zone Distribution Schematic**



**6.3.2 Domestic water schematic, high-rise-Preferred option**



6.**3.3 Domestic water schematic, high-rise-Alternative Options**



6.3.2 Domestic Hot Water

There are a range of different systems available, and the most appropriate solution will be determined from a number of factors including:-

* Cost of various fuel sources
* Availability of fuel sources
* Equipment available
* Technical expertise available in country
* Any sustainable accreditation systems being targeted

**6.3.2.1 Domestic Hot Water Plant Arrangement Including Heat Recovery**



6.3.2.2 Domestic Hot Water Plant Arrangement - Heat Pumps with Solar Thermal



Typical Hotel Hot Water use Pattern



Legionella Prevention - Auto-Flushing Shower (“Hot Start” showers**)**

The single largest source of Legionnaires Disease is Conventional Showers which occurs when they are not in regular use.

Showers in guestrooms unoccupied for more than 3 days are now considered a ‘high’ Legionella risk. The following options are available to address this:-

1. Regular flushing of outlets not used

e.g. Approved code of practice and guidance L8 UK (health and safety commission

* Legal requirements to ensure Legionella risk is minimised
* When outlets are not in regular use (e.g. Hotel Guestroom)
* Weekly flushing required minimising risk (twice weekly with high risk occupants, e.g. elderly).
* Procedures must be documented, etc.

1. Option

* Automatic flushing - “Hot start” - Self flushing shower and basin mixer
* Reduces risk to guests and business
* Reduces whole life costs
* Improve guest comfort (instant correct temperature water)

• Note: Purpose designed shower heads will be considered by the manufacturer on receipt of the

designer’s requirements

Domestic Hot Distribution High Rise- Preferred Option

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**Typical Hotel Domestic Hot Water Distribution High Rise - Alternative Option**



**Typical piping layout within a hotel guest bathroom**



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**Metering of water - indicative requirements**

NOTES:

1. ALL HOTEL COST CENTRES SHALL BE SEPARATELY METERED.

2. RETAIL TENANTS TO BE PROVIDED WITH COLD WATER SUPPLY ONLY IF SPACE IS GREATER THAN 10 m2.

3. THE WATER SUPPLY TO EACH RESTAURANT SHALL BE USED TO FEED ALL AREAS WITHIN THE RESTAURANT SUCH AS LOCAL KITCHENS. WASH



6.3.4 Pressure balancing between Hot and cold Water systems in guest rooms.

Problems can occur within guest bathrooms, if the hot water and cold water pressure are not balanced,

* Incorrect flow rates
* Pressure difference to great between hot & cold uncomfortable Dangerous shower

One means of overcoming this is the ‘**Jemflow ‘**pressure balancing system, which operates as follows.

6.4 Drainage

The foul sewer system must be designed to be self-cleaning, self-venting and fully suitable for the intended purpose:

Key design issues are:

* Grease traps to be provided for all kitchen areas, external to the building, in a location accessible by

vehicles for cleaning.

* Proprietary chemical type grease traps are subject to IHG approval.
* Manholes for maintenance areas shall be external to the building, and provided at every junction and

change in direction.

* Double seal covers shall be provided on all internal sump pits and lifting stations
* Investigate whether PH correction for laundry drainage is necessary
* Investigate storm water harvesting and grey water recovery\

•

Shower Fixture with ‘‘Jemflow’ fittings

Shower Fixture without ‘Jemflow fittings



LJ

ANTI SYPHON PIPE-,

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Md-H

SOIL & WASTE PIPE

TYPICAL BATHROOM

DIAGRAMMATIC

-¿dll

TYPICAL TRADITIONAL SYSTEM

GROUND FLOOR FITTINGS CONNECT TO SUSPENDED DRAINAGE VIA STUB PIPES

LAUNDRY/

KITCHEN

ACCESS ON PIPE FOR CLEANING, CLEARING BLOCKAGES & TESTING

ALL SOIL ỈÍ WASTE SYSTEMS DISCHARGE TO LOCAL SEWER WHERE AVAILABLE. FULLY VENTED SYSTEMS WITH NO PROVISION FOR RECYCLING OF WASTE WATER DISCHARGES.

TRAPPED PLANTROOM- GULLY CONNECTS TO BELOW SLAB DRAINAGE

INTERCEPTOR VENTS TO ATMOSPHERE

LOCAL AUTHORITY SEWER WHERE AVAILABLE

I

CLEANING EYE

VENT PIPE OPEN TO ATMOSPHERE WITH CAGE TYPE COWL TO PREVENT INGRESS NESTING BIRDS TO THE PIPEWORK

MdI I

BATH

GARAGE GULLIES IN CAR PARKS AND SERVICE YARDS

PETROL/GẮSOLINE INTERCEPTOR

KITCHEN GREASE TRAP

■TRAPPED CONNECTION TAKING SURFACE WATER DISCHARGES

■INTERCEPTOR VENT RISES TO DISCHARGE TO ATMOSPHERE

■INTERCEPTOR/DISCONNECTING TRAP PRIOR TO EXIT FROM BUILDING

■DUPLICATE SUMP PUMP DISCHARGES INTO SUSPENDED HL DRAINAGE



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**Schematic of Conventional Soil and Waste Pipe System Single stack Vented**



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IHG Engineering Design Guidelines

Schematic of Soil and Waste Vent Pipe System - High Rise



Schematic Comparision of stack options for high rise



Typical Double Guest bath room drainage system Option - 1 - Floor trap in bath room area



Typical Double Guest bath room drainage system (Option -2 floor trap in shafts area)

53.4.5 TYPICAL DOUBLE GUEST BATHROOM DRAINAGE PLAN

SLAB

SLAB

-CUTOUT 150X150

CUTOUT 150X150

CEILING

CEILING

SECTION AA

COP.

1000

■CUTOUT IN SLAB SIZE(150X150)

4-CUTOUT IN SLAB SIZE(150X150)

32i PIPE FROM WB GRATING

■1500 SOIL <5c WASTE PIPE

■75« VENT PIPE

32# PIPE FROM WB GRATING

SHR t



|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | HDPE | uPVC | CI | Polo- Kal | | |
| ỉâỆ |  |  |  |  | |
|  |  |  |
| **FS^\*=** |  |
| M.  /\ |  |
|  | | |
| Material Specification | High-density polyethylene (HDPE) | Unplasticized polyvinyl chloride (uPvc) | Cast Iron (CI) | Poloplast (Polo- Kal) | | |
| Sizes Available | 40mm - 315mm | 40mm - 160mm | 50mm - 200mm | 32mm - 160mm | | |
| Pressure Range | 2.3 bar - 16.0 bar | 6.0 bar - 12.0 bar | 3.0 bar - 5.0 bar | 6.0 bar - 12.0 bar | | |
| Temperature Range | -40°C to 60°C | 60°C | 95°C | 60°C | | |
| Life expectancy | 50 years | 50 years | 50 years | 50 years | | |
| Weight | Light | Light | Heavy | Light | | |
| Corrosion Resistance | Non-corrosive | Non-corrosive | Corrosion resistant coatings available | Non-corrosive | | |
| UV Resistance | Yes | Yes | Yes | Yes | | |
| Jointing | Butt welding & Ring-Seal socket | Solvent Joint& Ring-Seal socket | Pushfit couplings | Ring-Seal socket/ Solvent Fittings | | |
| Pre-Fabrication | Possible off the site | Not Possible | Not Possible | Not Possible | | |
| Noise reduction | 18-27 db | 30-40 db | 27-34 db | 18-27 db | | |
| Flow | Smoother inner surface | Smoother inner surface | Rough inner surface | Smoother inner surface | | |

Pipe Material Comparision For Drainage Pipes

6.5 Pipework comparison tables for the Plumbing services are provided as follows:

6.5.1 Drainage

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Pipe Material Comparison For Internal Water Supply Pipes | | | | | | | | |
|  | CPVC | PEX | | | Copper | SS | | GI |
| ’ i w |  | **REX "TEE"**  ~~■vfc-J —~~  **TUBING**  **TUBING** |  | **singga**  **1 T 1**  **I Ml tan** |  | **I** |  |
| Material  Specification | Chlorinated polyvinyl chloride (CPVC) | PEX | | | Copper Pipe | Stainless Steel Pipe | | Galvanized Iron Pipe |
| Sizes Available | 15mm - 300mm | 15mm - 50mm | | | 15mm - 108mm | 15mm - 50mm | | 15mm - 150mm |
| Pressure Range | 6.9 bar - 27.6 bar | 2.7 bar - 26.9 bar | | | 50 bar | 150 bar | | 100 bar |
| Temperature Range | 23°C to 82°C | 23°C to 90°C | | | 90**0** C | Upto 300**0** C | | Upto 200**0** C |
| Thermoplastic characteristics | Rigid & Strong | Flexible | | | Rigid & Strong | Rigid & Strong | | Strong |
| Jointing method | solvent cement | heat fusion or with mechanical fittings | | | Solder or Brazed Joints | Grooved, Press fittings joints | | Screw joints |
| Connectors | connectors can be copper, brass, or plastic | connectors can be copper, brass, or plastic | | | connectors can be copper or brass | connectors can be Stainless steel or brass | | connectors can be GI or brass |
| Service Life | 50 years | 50 years | | | 50 years | 50 years | | 15 years |

6.5.2 Water supply pipe

6.5 Sewage Disposal Systems

6.4.1 General

Where municipal sewers are not available, provide a complete sewage treatment plant capable of treating the effluent from the building sanitary system and discharging the treated effluent where dictated by local authorities.

The following table provides a summary comparison of the type of plants available with the final selection being based on a specific in country comparison.

**6.4.2 Comparison of different STP Technologies**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S.N** | **Item** | **MBR** | **Extended Aeration** | **SAFF** | **FAB** | **SBR** |
| **1** | **Type of Process** | **Membrane Bio Reactor** is an extension of the activated sludge process incorporating submerged ultrafiltration  membranes, high MLSS  concentration and excellent effluent quality | **Extended Aeration** is a modification of activated sludge process where the retention time is as high up to 24 hours and high MLSS concentration and high sludge age. | **Submerged Aerated Fixed Film**  **Reactor** is an attached growth process, where the biomass grows on media. | **Floating Aerated Biomedia Reactor** is also an attached growth on a free floating plastic media. | **Sequencing batch reactor**  **(SBR)** utilizes a fill & draw reactor with complete mixing during the batch reaction step. All SBR system has five steps. |
| **2** | **Pre- T reatment** | Absolutely mandatory to  protect the ultra-filtration  membranes. Typically 3mm screening will be used in front of the biological process and grease must be removed via a grease trap or DAF. | No pre-treatment is required. | Absolutely mandatory since if the pre­treatment is not properly designed the media will choke thereby affecting the effluent quality. | Very important as the  floating media is more prone to choke and backwash frequency will largely  depends on the pre­  treatment done. | No pre-treatment is  required. |
| **3** | **Process Involved** | MBR consists of a biological process with relatively low F/M-ratios (typically < 0,1 kg**BOD**/kg**DS**d), dimensioned  with or without denitrification and high MLSS concentration (up to 15 g/l, typically 8 - 12 g/l), followed by submerged ultrafiltration membranes  which physically separate the active biomass from the  cleansed water (instead of secondary clarification via  gravity). | The process involves proper mixing of the sewage or effluent with aeration by diffusers or surface aerators and thus maintaining a high MLSS  concentration and the retention time is very high. The sludge retention time is very high. | This is typically an attached growth process where the biomass is allowed to grow on plastic type media. The process generally consists to two successive aeration tanks where the media is completely submerged in the waste water. Both up flow and down flow processes take place. The raw waste water goes in an up flow pattern in the first aeration tank and  subsequently in a down flow pattern in the next tank.  The organic material present in the waste water is degraded by a  population of microorganisms attached to the media. Organic material from the liquid is adsorbed on to the biological film or slime layer. In the outer portions of the slime layer, the organic material | This system is very identical to the SAFF system, except that the floating media offers surface area for the biomass to get digested and has higher BOD removal per cubic meter. Thus requires lesser footprint for the  aeration reactor. | In SBR Process, during the operation, volume & substrate (raw waste water or primary effluent are added to the reactor .The reactor may be mixed only or mixed and  aerated to promote biological reactions with the effluent  waste water. |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | is degraded by aerobic  microorganisms. As the  microorganisms grow, the thickness of the slime layer increases, and the diffused oxygen is consumed before it can penetrate the full depth of the slime layer. Thus an anaerobic environment is established near the surface of the media. |  |  |
| **4** | **Secondary Settling** | A secondary settling tank is Not required! | A secondary settling tank is required. | A secondary settling tank is required. | A secondary settling tank is required. | There are five steps as follows: fill, react, settle, draw & ideal. |
| **5** | **RAS (Return**  **Activated Sludge) System** | Activated sludge must be returned from filtration step to biological reactor. | The activated sludge is returned for maintaining a high MLSS  concentration. | Sludge is recycled back to the SAFF Reactor from the secondary settling tank. | Although the MLSS is  normally maintained higher due to the attached growth thus doesn’t requires any sludge recycling but normal practice is to give a back-up sludge recycling line so that if there is too low BOD loading, the sludge can be recycled. | The activated sludge is  returned for maintaining a high MLSS concentration |
| **6** | **Nitrification** | Nitrification is always  achieved, de-nitrification if  required! | Nitrification and de-nitrification  generally do not take place. But if the detention time provided in the  secondary settling tank is higher than the normal, then the processes may take place. | Nitrification is achieved. | Nitrification is achieved. | Nitrification is always achieved, de-nitrification if required! |
| **7** | **Space Requirement** | Lowest, due to high MLSS and not needing a secondary  clarification tank (app. 50 % lower than other systems) | High due to larger detention time. | Because of the presence of media, land requirement is low and there is sufficient reduction in the overall volume of the plant. | Since there is a higher surface area exposure, the area required is lesser than SAFF system. | High due to larger detention time. |
| **8** | **Power Requirement** | Quite high, due to additional air scouring for ultra-filtration membranes | Very high due to higher oxygen requirement. | Low power requirement | Low power requirement. | Low power requirement |
| **9** | **Maintenance** | Membranes require cleaning approximately every 4-8  months (required frequency is very site specific). | Optimum | Low, but the system needs to be carefully designed since the media are prone to clog/ choke. | Low, but the system needs to be carefully designed since the media are prone to clog/ choke. | Optimum. |
| **10** | **Skilled Labor** | Required, for cleaning of  membranes and general  systems maintenance | Not required | Required and the tubes need frequent cleaning. | Required as the FAB media needs an expert care and understanding. | Good operator skill required. |
| **11** | **Power Failure** | Power failure interrupts  system-operation. After power supply is re-established,  system-operation starts again without problems. | Power failure disrupts the process and purification may occur. The sludge tends to settle down. | Power failure disrupts the process to some extent but due to the presence of the media the aerobic process  continues. The stabilization of the process takes faster than FAB process. | The power failure disrupts the process and greatly disturbs if there is a  temperature change. | Power failure disrupts the  process and purification may occur. The sludge tends to settle down. |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **12** | **Efficiency** | MBR produces highest quality tertiary quality bacteria-free effluent which safely allows direct recycling without further steps. Highest efficiency at  all; BOD>99%, COD > 95%, no bacteria and viruses in effluent | Very efficient. High BOD loads can be removed up to 98%. | Higher BOD loads cannot be efficiently removed maximum 90% BOD removal. | Higher BOD loads cannot be efficiently removed  maximum 90% BOD  removal. | Higher BOD loads cannot be efficiently removed maximum 90% BOD removal. |
| **13** | **Sludge** | Sludge is totally digested and can be disposed off easily. | Sludge is totally digested and can be disposed off easily. | Sludge is digested and can be disposed off. | Sludge is digested and can be disposed off. | Sludge is totally digested and can be disposed off easily. |
| **14** | **Disadvantages** | 1. Power Requirements  increased in comparison to other systems  (additional operation of membranes)  2. Membranes have a life­  time generally 5-8 years. | High space required and high power requirement. | 1. Pre- treatment is absolutely  necessary, or else the media may get clogged.  2. Not suitable for very higher  flows, above 2-3 MLD. | Pre-treatment is absolutely necessary, or else the  media may get clogged.  2. Not suitable for higher flows. | Process controlled more  complicated. |
| **15.** | **Cost** | System costs higher than conventional technologies  (app. 30 % higher), but allow reduced civil costs and  provide much better effluent quality which is safe for reuse. | The electro-mechanical cost is lesser but civil cost is invariably high, due to high area requirement for aeration tank. | The electro-mechanical cost is higher but Civil cost is reduced due to smaller aeration tank. | The electro-mechanical cost is higher but Civil cost is reduced due to smaller  aeration tank. | The electro-mechanical cost is reduced but Civil cost is  higher. |

6.6.3 Design Criteria

Design of all sewage treatment plants must conform to all local health codes. If local health codes are not available, the sewage treatment plant should be designed on the basis of the following minimum standards.

The system should be complete with the following minimum main components as hereinafter specified:

* Sewage treatment plant
* Chlorination equipment (only if discharged to surface waterways or used for irrigation. Not required for

effluent to seepage pits or the like).

* Pump house
* All piping, fittings, valves, hangers, etc. to complete the mechanical installation

Clarifier surface and weirs should be designed for peak flow rates and not normal daily flow rates.

The plant should be modified to include tertiary treatment if required by the final point of discharge or terminal point use of effluent. Particular emphasis must be addressed to tertiary treatment if effluent is to be used for irrigation.

Disposal of effluent may include leaching fields and or seepage pits where discharge to surface waters is not permitted. For disposal of sludge, drying beds may be considered. However primary consideration should be given to the use of local disposal facilities.

6.6.4 Specification and application

|  |  |  |
| --- | --- | --- |
| **Source** | **Sewage Flow/Person (**5-day B.O.D) | **Organic Loading** |
|  | | |
| Guests | 230 litres/day | 0.060 kilos |
| Resorts and Japan Tropical | 350 litres/day | 0.086 kilos |
| Countries | 300 litres/day | 0.075 kilos |
| Employees | 50 litres/day | 0.010 kilos |
| Restaurant | 35 litres/cover | 0.045 kilos/cover |
| Laundry | 25 litres/kg |  |
| Without recovery | 15 litres/kg | 0.005 kilos/kilo |
| With recovery | Assume 7, 5 kg linen/occupied room |  |

Typical total consumption figures are 400-600 litres/guest in moderate and 600-800 litres/guest in tropical climate zones, which includes all of the above. They differ primarily by hotel type (business v. Resort), facilities (laundry), number of restaurants, and employees etc.

The plant should be based on 5 day B.O.D (Biochemical Oxygen Demand) capacity as scheduled above, with loading of 0.37 kilos per m.3 (23.0 lbs. /1000 cu. Ft.) The preferred system is the extended aeration plant.

Standby Provisions

All compartments should be sectionalised and equipment furnished in duplicate, or two complete plats shall be installed, each size for 50% of the load, to facilitate maintenance and repairs.

6.6.5 Environment and energy conservation

Discharge of treated water to soak-a-ways or water courses should be monitors on a regular basis to ensure out fall content is not hazardous to the local environment. Assess suitability of site with regard to reed-bed filtration for the treatment of grey/waste water for the development.

6.6.6 Space Allocation

The sewage disposal plant should be situated at a lower level than the development, adjacent to roadway or hard standing or at a maximum distance of 30 metres from the nearest road. Access route from roadway to plant area should avoid occupied areas, either internally or externally (e.g., bathing areas tennis courts, etc.).

6.6.7 Commissioning and Testing

The performance of the system should be demonstrated by taking hourly samples of the raw sewage and final effluent over a twelve hour period, freezing each sample as it is taken. The samples should be taken at periods which approximate the flow rates specified by the plant. The samples shall be combined and a 5 day B.O.D run, the results of which must verify the treatment plant’s capacity, prior to acceptance, at less than 20ppm. Plant performance, other than guarantees, must be specified to start one year after start-up, demonstrating plant performance under minimum 50% loading.

* 1. Grease Traps

Grease traps shall be kept as close as possible to the kitchens in temperature controlled spaces but shall **not** be located within the kitchen. Grease traps, where possible, shall be located in temperature controlled and ventilated rooms. Where separate rooms are not available they shall be located in limited use back of house corridors.

Grease traps shall be fitted with siphon storage tanks that will store a minimum of 14 days of grease.

Grease traps shall not be direct buried. If it is necessary to be installed below the ground, purpose made pits shall be constructed to house the grease traps. This will facilitate water proofing, buoyancy and maintenance issues.

Enzyme type grease traps can be used, but only after careful investigation to ensure that enzymes are readily available in the local market and that the local technicians are capable of operating and maintaining these types of traps.

As an option, a proprietary unit such as “Fatstrippa” may be used, which has considerable benefits, refer to Volume 3 of this manual)

* 1. Storm water Drainage System

6.8.1 General

Provide a complete system of storm drainage piping inside the building, collecting water from all roof areas, setback areas, plazas, etc. Connect to headers and, in turn, connect to house drains which will discharge into a storm sewer, combination sewer, ocean, rain water cisterns, or swale, as conditions dictate. All drainage below gravity level should be collected and drained into a sump and then pumped into the storm house drain. Pumps should be in duplicate and be provided with emergency power where available.

In those areas where the water supply is limited, the storm piping may discharge into a cistern for use of non- potable system.

6.8.2 Design Criteria

As a minimum, unless otherwise dictated by code, design storm drainage based on records kept for the area for 10 minute, 25-year interval storm. Coordinate with Architect and IHG to provide balconies with drains piped to the storm drainage system.

Gravity drainage should be used wherever possible to avoid the use of pumps

**Schematic Strom Water Drainage**



6.8.3 Rainwater Harvesting

This shall be provided wherever possible with a typical re-charge pit illustrated as follows:-



* 1. Swimming Pool systems

6.9.1 General

A dedicated water treatment system should be provided to serve pools for wading, swimming or diving. The supply to the pool should be heated to the required temperature or in very hot climates, may be cooled prior to serving pool.

6.9.2 Design Criteria

Water serving pools should be fresh and clean, with the distribution to the pool designed so that the quality and temperature of the water is maintained at acceptable levels. All critical chemical parameters shall be monitored and maintained automatically within the range +/- 10%.

|  |  |  |  |
| --- | --- | --- | --- |
| The preferred water quality is as follows:  Table 6.7.2.1 | | | |
|  |  | **Acceptable Range** | **Ideal** |
| PH | 7.2 to 7.8 | 7.4 to 7.6 |
| Alkalinity | 75 to 250mg/l | 120 to 180 mg/l |
| Calcium Hardness (Calcium Carbonate) | 100 to 500img/l | 150 to 200 mg/l |
| Total Dissolved Solids | less than 3000ppm | Less than 1500ppm |

|  |  |  |
| --- | --- | --- |
| Below are the suggested target temperatures for various types of pool | | |
| Table 6.7.2.2 | | |
|  | **Pool Type** | **Temperature Range** |
| Leisure Pool | 27°C to 29°C |
| Wading/Paddling Pool | 28°C to 30°C |
| Diving/Competition Pool | 26°C to 27°C |
| Plunge Pool - Adjacent Saunas | 16°C to 20°C |
| Jacuzzi | 35°C to 40°C |

Pool plant should be self regulating and include automatic monitoring of pH levels chemical levels and temperatures maintaining acceptable levels.

6.9.3 Swimming Pool System Cycle

1. Distribution System and Pool
2. Filtration and Discharge to Drain
3. Disinfection
4. Top-up With Pre-treated Water
5. pH Level Control
6. Heating



1. Potable/Pre-treated Water Top-up
2. Non-Potable Top-up Prior to Treatment Process
3. Filtered Deposits to Drain/Non Potable systems
4. Distribution System and Pool

A single plant room should serve multiple pools, arranged with run and standby facilities to minimise disruption to pool use during plant maintenance. Pipework distribution should be arranged so that any pool, whatever pool size, will have a minimum of 2 suction/drain connections on the circuit to the pump. Short­circuiting of water should be avoided. Pools with high numbers of infant usage should have a higher circulation rate than those for adult use. Circulation pumps should be run and standby.

|  |  |  |
| --- | --- | --- |
| Suggested turn over rates: | | |
|  | Infant/Shallow section of Pools | Refreshed Every 30 minutes |
| Adult/Deep Section of Pools | Refreshed Every 150minutes |

1. Filtration and Discharge to Drain

Filters within the pool circulation systems should be installed as run and standby.

The filtration selected should achieve a visibility of at least 12m giving clear views of all parts of the pool bottom.

High-pressure sand filters should be rated at 12-13l/s per square meter of filter area. The filters should be protected internally to prevent corrosion. Fiberglass sand filters may be used as an alternative to mild steel.

Rate of flow indicators should be installed to monitor the rate of low from the filters.

A pressure switch should be fitted prior to the filter for backwash/rinse requirements. Pipework should be installed in polybutlene with corrosion resistant fittings.

Where filtration alone will not achieve water clarity required, use flocculates, e.g., aluminium sulphate fed by automatic dosing pumps.

1. Disinfection

The annihilation of bacterial infection of pool waters may be accomplished using several methods. Chemical parameters shall be monitored and maintained automatically via dosing pumps etc.

Chlorine application, via sodium or calcium hypochlorite additives or electrolytically generated in situ. Bromine additives.

Ozone additives in conjunction with low level chlorination.

Ultra violet light application with low dilution of chlorine additive.

Chemical additives all have side effects upon pool users to greater or lesser degrees where not carefully controlled. Chlorine gas is not recommended, as stringent safety precautions must be observed. Ozone is hazardous to health and must be removed from the water after use.

Monitor disinfection level daily to ensure appropriate levels of chemical dilution are present (e.g., 0.6 - 1ppm free available chlorine dependent on application).

Types of Treatment

|  |  |  |  |
| --- | --- | --- | --- |
| **T reatment**  Chlorine | **Benefits**  Tried and trusted  method of pool water treatment  Residual chlorine  content in water  maintains disinfectant properties in pool after treatment | **Problems**  Requires careful control can cause irritation of eyes, discolor hair.  Unpleasant fumes which can be lethal in case of accidental release.  Renders discharged  water useless for  irrigation if it is to be recycled, but can be used for urinal/WC  flushing. Fumes can  damage building  finishes. | **Application**  Larger pools with trained  maintenance staff, used to  handling chlorine.  Where water not used for  irrigation. Where large proportion of infants using pool. |
| Bromine | Residual bromine  content in water  maintains disinfectant properties in pool after treatment. | Can cause skin irritation, sore throats and stinging eyes. Renders  discharged water  useless for irrigation can be used for flushing | Small pools with competent  maintenance staff.  Where large proportion of infant users. |
| Ozone | Powerful disinfectant, oxides impurities  without providing side effects.  No residual chemicals discharged water can be recycled more  readily. | Once added, must be removed again prior to use.  No residue, so water can become contaminated.  It is recommended that a small amount of chlorine is added to maintain pools disinfectant  qualities but this should be balanced with final use. | Where greatest proportion of users are adult, and water to be recycled for irrigating, etc.  Where there is limited space of storing chemicals, or not large enough plant complex to warrant fully trained pool plant engineer. |
| Ultra Violet Light | Once fitted to system is very simple to maintain and manage. No side effects. | No residue, so water can become contaminated.  Small amounts of  chlorine to be added or more frequent pool water changes instituted. | Where greatest proportion of users are adult, and water to be recycled for irrigating, etc.  Where there is limited space of storing chemicals, or not large enough plant complex to warrant fully trained pool plant engineer. |

1. Top-up With Pre-treated Water

Where potable/pre-treated water is available for pool use, introduce the fresh water prior to heating. As a guide, approximately 25 liters of freshwater per bather may be introduced.

Where water is non-potable, it should be introduced to the system prior to filtration and disinfection.

1. pH Level Control

Control of pH levels is particularly important where chlorine is selected as the medium used for disinfection of pool waters.

Sodium bicarbonate is used to reduce the acidity of water treated with chlorine gas.

Where chlorine donors have been introduced such as sodium or calcium hypochlorite, the pH tends towards hardness, therefore treatment to increase acidity should be applied using one of the following:

* Calcium chloride
* Carbon dioxide
* Sodium bisulphate
* Hydrochloric acid

The importance of maintaining balanced pH levels are chiefly relevant to the protection of parts of the pool system susceptible to corrosion from either excessive alkalinity or acidity of pool waters. Additionally, chlorine loses its effectiveness if the level of pH risers too high.

Magnetic Water Conditioners

An alternative method of protecting the system is by application of magnetic water conditioners. The conditioners impose a magnetic charge upon the particles suspended in the systems water. This prevents the particles adhering to internal surfaces susceptible to scale such as pump rotors, heating coils, etc. They have also been found to be beneficial to the disinfecting process. Where magnetic water conditioners are provided, pH monitoring and control are still required to maintain levels in the range of 7.2 - 7.8 mentioned above.

Before selecting magnetic water conditioner refer back to IHG for approval.

1. Heating

When assessing size of plant and method of heating pool water, careful consideration should be taken with regard to expansion of pool structure, concrete shell, tiling, etc. As a guide the rate of heat up from cold to operating temperatures should be no greater than 0.5°C per hour.

The characteristics of heat demand for swimming pools are the most suitable match for slow heat gains from other systems utilising heat exchangers, for example:

1. Solar collectors, transforming solar energy into useable heat.
2. Heat pumps where unwanted heat from refrigeration plant is transferred to the pool water.
3. District heating schemes.
4. Hot springs
5. Heat can also be recovered from within the swimming pool plant from the filtration backwash.

Each of these systems should be supplemented with electric, gas or oil fired boilers via heat the exchangers. These should be designed to compensate for times where the initial source is insufficient.

Where more than one swimming pool is served from a single plant, each pool should have its own dedicated heat exchanger, sized to match the duty required.

1. Pool floor cleaning

Floor cleaning shall be accomplished by automatic floor cleaners, which shall be provided.

* 1. .4 Environment and Energy Conservation

Outdoor pools should be covered with an insulating cover when out of use. This not only conserves energy by reducing heat loss outside hours of sunshine effectively and prevents evaporation but also restricts use to when lifeguards/poolside staff are available for supervision. Where possible, “waste water” from filtration backwash should be recycled for WC or urinal flushing.

Discharge water that is contaminated with chemical additives should be disposed in a manner that will not pollute local water supplies, local water courses, lakes, streams and the like. Any soak ways or leaching pits should be kept remote from wells or boreholes where contaminated water may be withdrawn inadvertently.

Refer to Volume 3 of this manual for an example of an efficient swimming pool water treatment system.

* 1. **BUILDING MANAGEMENT SYSTEM (BMS)**

A building Management system is essential in a Hotel for efficient operation and monitoring of the systems and can help achieve the following goals which otherwise would not be readily achievable:-

* Thermal comfort of staff and guests
* Management of operation and maintenance
* Optimisation of operation with reduction in energy required and running costs.
* Minimising the impact of the Hotel on the Environment
* Assistance with safety and security for Guests and staff
* Pro-active resolution of problems - often before they become an issue for guest complaints
* Increased system efficiency and life cycle due to controlled operation and maintenance
* Publicity to promote the efficiencies and contribution being made to the environment
* Confirmation of whether plant has been sized correctly to meet the loads - this can have substantial benefits on future projects.
* Comparison of system operation year by year can be made to highlights any difference
* Comparison of other Hotels (Globally) can more readily be made to establish “best practice” and

benchmark/ compare hotels and a like for like bais

* 1. **BMS Features**

A central Building Management System (BMS) shall be provided and include a supervisor, comprising central processor unit (CPU), color monitor, keyboard and color printer. The supervisor shall be configured with the latest windows-based operating system and the BMS operational software, including a full graphical user interface.

10% spare outstation capacity shall be provided backed up by the equivalent spare memory within the CPU.

All control panels containing outstations shall have the facility of external connection interface for lap top computer to enable set point adjustment to be carried out locally;

A lap top computer shall be provided with full software package installed complete with password entry; (With Hierarchical Order).

All analogue inputs shall have at least one high and one low alarm settings to provide alarm monitoring. All commands shall have at least one status point;

Full color interactive graphics shall be provided to allow all points to be displayed, together with control set points and real time values.

The system shall have the ability for on/off site networking and for interface with hotel management system and guest room controllers.

An uninterrupted power supply system shall be provided to give 4 hours back up in the event of mains supply failure.

The BMS can be integrated with IT system as illustrated below:

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IHG Engineering Design Guidelines



* 1. Integrated BMS/IT systems
  2. Equipment

All controllers supplied will feature a suite of pre-engineered and pre-tested HVAC applications. No programming is necessary; devices will be configured from a simple user interface. The assignment of inputs and outputs will be automatically configured once the application type has been selected.

All controllers shall have the ability to communicate using a network architecture, which shall support multiple levels of communication using an internationally recognized open standard communication network (EIB/KNX, LON, BACNet, TCP/IP, Modbus or equivalent).

The design of the system shall allow the co-existence and interoperation of primary HVAC controllers, secondary terminal unit (e.g. guest room) controllers and where required, 3rd party devices (e.g. front desk booking system) in the same network, either directly or via the use of gateways or protocol converters. It shall be possible to make available specific data from the HVAC control system to other 3rd party systems if required (such as electrical equipment, lighting, blinds, etc.)

Where required, central user operation for the HVAC plant and building zones shall be available, including central monitoring, management and alarm functions.

* PC-based operator workstation
* SCADA package running on a Web-browser
* Touch screens
* Local hand-held user interfaces

7.2.1 Hardware and Software

All specified control equipment and devices shall be standard proprietary products designed and tested for HVAC control applications, and not custom-designed or adapted specially for each project. Controllers will be pre­configured to suit standard IHG application and functionality. Each device will be fully tested, allowing simple pre­commissioning at the equipment manufacturers works before delivery to each hotel project.

Wherever possible, all systems and components shall have been thoroughly tested and approved to suit the required regional standards where hotels are located, and shall carry the appropriate marking, certification etc. (CE, UL, C-Tick or equivalent). Likewise, devices shall conform to regional and national directives regarding energy saving performance (e.g. EUBAC certification).

7.2.2 Electrical installation

In order to facilitate pre-commissioning of the packaged HVAC equipment supplied to the hotels, all BMS controllers and control equipment shall be installed by the original equipment manufacturer (OEM) prior to delivery to site.

Final commissioning and where applicable, integration of the control equipment into a network shall be performed by the controls supplier; his approved local partners or approved installers. The control system supplier, his approved local partners or approved installers shall be responsible for all low-voltage control wiring for control equipment and devices provided under this project and to ensure a complete and fully operational system. All control wiring (and, where specified, suitable containment systems) shall comply with the latest edition of local and national regulations for electrical installation.

7.2.3 Quality assurance

The complete control system together with all field devices and associated peripherals, shall be designed, installed, commissioned and serviced by qualified personnel. Where required, the supplier shall make available technical engineers, spare parts inventory and necessary test and diagnostic equipment.

The supplier should have proven technical expertise and experience in the manufacture, installation and maintenance of control systems similar in size and complexity to the project. In addition, the supplier should have a competent service organisation and provide a list of (5) projects, similar in size and scope to this project, completed within the last five years.

7.2.4 Hardware compliance

All controllers included shall be fully compliant with latest EMC and low-voltage directives and declarations of conformity shall be provided. Additionally, the equipment shall bear the CE mark (or equivalent) in order to show compliance to the directives.

The specified control system shall be supported for a minimum of 5 years after installation and handover offering the ability of the user or building owner to upgrade installed controllers, software and field devices to current levels of technology and, where required, extend the network with new devices.

* 1. Primary HVAC Controllers

7.3.1 Controller type

The primary controllers shall be dedicated HVAC controllers (stand -alone or communicating) based upon 32-bit technology, with preconfigured and user configurable applications. Each primary controller shall be supplied complete with installation and operating instructions as standard.

7.3.2 Primary controllers

Main plant control of air handling units, chillers, heating plant, etc. Primary controllers shall provide independent control loops and shall contain factory-pre-programmed applications as well as being capable of site engineered applications, either as a modification to factory application or as a new application designed specifically to suit the site requirements.

Primary controllers must be capable of being engineered and commissioned without the need of a PC or tool and shall have sufficient memory to operate autonomously. Any modification or creation of applications shall utilize preconfigured and preloaded function blocks allowing minimal effort in commissioning with the added possibility to define and commission the desired application using only an LCD interface with clear text display in English (or other selected) language.

Technical characteristics

* Freely programmable controller
* I/O-Mix:8 Universal In-/Outputs, 5 Digital Inputs, 2 Analog Outputs, 6 digital Outputs
* Hardware:24 V AC power supply, plug connectors, 2 DIL switches, LED for status indication
* Interfaces: RJ45 serial for HMI, monitoring PC or modem connection; PPS2 for room unit: RS485 for USS or ModBus communication with 3rd party (VFDs)
* Communication: inbuilt, different standards (e.g. KNX/EIB or LON) optional versions without communication

7.3.3 Hotel guest room management system (HRMS)

An alternative “dedicated” Hotel (Guest) Room Management System (HRMS) provides special functions for hotels. The required system shall offer integrated Guest Room Management directly from the hotel’s Front Desk in order to maximise guest and service staff management to assist the hotel manager to cut costs.

* The system shall be directly linked to the hotel’s Property Management System (PMS) / Front Office System

(FOS), ensuring trouble-free operation of guest room access control, indoor climate control, security and energy efficiency from check-in to check-out.

* The system shall be adaptable to any type of hotel, independent of complexity and size.

The Hotel Guest Room Management system shall be designed, commissioned and serviced by manufacturer employed & trained personnel. Manufacturer shall have an in-place support facility within the country of installation with technical staff, space parts inventory and necessary test and diagnostic equipment.

7.3.4 Plug-in operator units

Each primary controller shall have the provision for connection of a backlit LCD plug in operator unit for the display of values and adjustment of settings, showing all menus in plain text for local use operation. These units shall be either mounted directly on the controller or alternatively mounted remotely (typically in the control panel door) with operator keys for navigation and user operation. It shall be possible for the operator unit to be used to make all settings and readouts required for operating the controller and plant.

7.3.5 Device Name

Each controller shall be identified by a unique device name at the planning stage. The device name shall be entered in the controller via the operator units. Each name shall comprise up to 21 alphanumeric characters (maximum 21 characters including blanks). Device names should be agreed in advance with the consulting engineer or plant operator and once saved, these device names shall be visible from services tools or PC management systems

Each controller shall support a suite of language pre-programmed into it, which can be selected at any time via the operator unit. All operating instructions for the end user shall be provided in all languages with which the controllers are supplied.

7.3.6 Access levels

The primary controllers shall have dedicated user levels allowing display of information and adjustment of parameters; no commissioning tools shall be required. Access to the basic controller settings shall be granted only via the password level at the controller.

User level: Lowest access level, without password:

* Typically for the plant operator, to view operational status, measured values, operation mode, main variable set points and time clock. All parameters displayed at this level shall be accessibly by the user.

Service level: Medium access level, via key sequence:

* For service and maintenance, allowing the additional display of inputs and output values, adjustment of operating modes and timer settings.

Password level: Highest access level, via password:

* For commissioning and fine-tuning, full access to operating parameters, controller setting and configuration.

7.3.7 Electrical

The primary controllers shall operate from an AC 24 power supply. This operating voltage must conform to the requirements of SELV/PELV (safety extra low-voltage). The transformers used must be safety isolating transformers featuring double insulation to EN 60 742 or EN 61 558-2-6, and should be suited for 100% duty.

Fuses, switches, wiring and earthing must be in compliance with local regulations. Sensor wires should not be run parallel to mains carrying wires that power fans, actuators, pumps, etc.

7.3.8 Environmental

The controllers shall conform to the following operating environmental conditions:

* Operation to IEC 60 721-3-3
* Climatic conditions Class 3K5
* Temperature (housing and electronics) 0...50 **0**C
* Humidity 5.95 % r.h. (non-condensing)
* Mechanical conditions Class 3M2

7.3.9 Universal inputs

Each primary controller shall accept universal industry standard inputs, which can accept digital signals, passive analog signals, or active analogue signals.

* For each analog input, the type, unit, measuring range and readjustment shall be defined (Ni 1000, -50.+250 0C, -0.5K)
* For each digital input, the normal position shall be defined (normally open/closed)
* Special input identifiers shall be also available for dedicated plant functions (e.g. for set point adjustment,

outside temperature, frost, faults, etc.)

7.3.10 Outputs

Each controller shall provide a combination of fixed analog or digital output signals to suit the required plant.

* Modulating (analog) outputs: DC 0.10V, +/-1mA
* Digital (relay) outputs: Voltage: max. AC 265 V, min. AC 19 V
* Current: Max. 4 A res., 3 A ind
* Etc.
  1. HVAC control algorithms

7.4.1 Dedicated software

The BCS controllers shall comprise pre-programmed and proven software blocks, dedicated to HVAC control applications. It shall be possible when configuring the controller, to select one of the following options:

* Pre-programmed HVAC application
* Adapted HVAC application
* Free configuration

7.4.2 HVAC functions

In order to provide the basic control requirements for heating, ventilation and air conditioning plants, the control system shall provide (but not be limited to) the following control functions as standard:

Control scheme examples

* Cascade control of room/supply air temperature or exhaust/supply air temperature with limits for supply air temperature
* Control of supply air temperature
* Cascade control during summer and supply air control during winter.
* Cascade control with fixed or sliding limits for supply air temperature (differentia! temperature control)
* Min. and max. limits for supply air temperature
* Summer/Winter compensation of temperature set point
* External temperature set point (0-10V or N: 1000)
* Unoccupied mode (night mode) for heating and/or cooling
* Night ventilation function (Night purge)
* Frosting protection for heat recovery unit (HRC)
* Load dependent ventilation
* Frost protection function
* Adjustable P, PI, PD or PID control functions

Pre-Selection of HVAC Equipment

* Electrical or water heater
* Cooling, continuous or one-/two-stage or three-stage (binary) switching (DX cooling)
* HRC, rotary heat exchanger, continuous or on/off, plate heat exchanger, glycol circuit or return air damper
* Cooling recovery
* Pre-heating function for water-heated air heater
* Speed reduction of fans when plant needs heat
* Speed increase of fans when plant needs cooling

Each controller function block shall be a proven and tested HVAC control algorithm specifically for the purposes of HVAC control. In addition, it shall be possible to demonstrate the correct operation of each block via suitable demonstration material or software.

7.4.3 Time switch operation

Each primary controller shall include an internal 365-day clock / calendar with the possibility to operat autonomously or in master / slave configuration. More than one master / slave group may reside on the same bus network.

In addition, the following functionality shall also be provided:

* System time synchronization
* Summertime / wintertime changeover
* Holidays
* Special day / exceptional time functions

Typically, one of the primary controllers shall be defined as the time switch "Master" for designated zone within the building, with all other devices in the group designated as time switch "Slaves". Controllers not involved in the time program shall be set to "Autonomous".

7.4.4 Fault inputs

Each primary controller shall contain a 'fault' function block to collect and evaluate and fault stat messages from the building or plant, and if required, to trigger appropriate actions to prevent damage.

7.4.5 Settings

For every fault status message, the following settings shall be available:

* Fault acknowledgement
* Fault priority (urgent / not urgent)
* Impact of fault (plant stop) depending on whether a plant item shall be switched off
* Fault status signal delay (the period of time before the alarm message is sent)

It shall be possible for alarms of other controllers to be made available on the bus and viewable at any controller having a display connected. In addition to the descriptive clear-text, alarm displays shall include an error code, time and date stamp and the controller address. All alarms shall also be available to the system operator station

7.4.6 Alarms

Each controller shall have an alarm button with LED indication. The alarm button shall flash when new alarms are present and be lit continuously when only acknowledged alarms are present. The LED shall be switched off when all alarm conditions are reset.

Any alarms present at the controller shall be displayed in clear-text on the plug-in operator units. Main alarm message texts (main control loops) shall be factory configured and reflect information important for the HVAC application

Examples

* Deviation alarm: actual value deviates from set point
* I/O alarm: room temperature sensor failure
* Configuration alarm: supply air fan failure
* Etc.

Each controller shall also have the provision for "miscellaneous alarm messages". These alarm inputs shall be user configurable.

7.4.7 Wiring test

To assist commissioning and fault diagnosis, each primary controller shall have a wiring test facility to allow all activated inputs and their connected devices to be checked for correct operation in "real-time":

* Viewing of actual measured values (analog inputs).
* Viewing of status values (digital inputs).

It shall also be possible to drive the controller outputs in real-time for checking the correct connection to, and the correct operation of field devices:

* Drive analog outputs (such as valve or damper actuators)
* Toggle digital outputs (such as fans or pumps)

7.4.8 Data protection

After the initial configuration and setting of the primary controller(s), it shall be possible to store the settings within the controller for later retrieval (restore) in the event of incorrect or unwanted changes being made. Storage date of the last saved parameter set shall be displayed. In the event of power failure, the "currently active" parameter set shall remain in operation when power is returned.

It shall also be possible to save the parameter set to the operator station (PC) for archiving or for downloading to other controllers having similar application

requirements.

* 1. Indoor Air quality Control

In order to reduce energy costs and increase guest comfort building occupancy levels are to be sensed by the implementation of carbon dioxide (C02) -based Indoor Air Quality (IAQ) control and demand control ventilation (DCV).

The technology is simple; sensors monitor levels of exhaled carbon dioxide in selected spaces and ventilation rates are adjusted according to calculated occupancy:

* If lAQ levels are good, ventilation can be reduced to save electrical energy
* If IAQ levels are poor, the percentage or volume of fresh air can be increased to maintain comfort
* The system ensures IHG Hotels conform to ventilation regulations

Measurement of air quality by combined CO2/V0C sensors will allow the following strategies:

* Fan speed/fan stage is adjusted on the basis of the current air renewal demand
* In systems with direct mixing of the recirculated air, the volume of outside air is adapted to the

current air renewal demand

The C02 signal is an indicator of the number of people in a meeting room, while the VOC signal detects sources of odors such as sweat, dirty carpets, dirt from filters, furnishings and fabrics, cleaning agents etc. The sensor automatically provides a maximum value selection so that the air renewal demand is always determined by the higher of the two signals.

Any solution would naturally depend upon the type of plant (fan type, method of heat recovery etc.) and the required control strategy (time schedule, manual control, occupancy sensors etc.

* 1. Benefits

The following benefits can be realised from this:-

Comfort:

* Improved room air quality for guests and staff
* Increased productivity of guests during meetings, conferences, functions etc.
* Increased productivity of employees, fewer sick days
* High C02 contents in a meeting room, reduce a person's capability to concentrate

Guest perception:

* Avoids unpleasant odours in public areas such as restaurants, bars, lounges, shops

Automation:

* Plant automatically controls room air quality levels
* Eliminates human error, forgetting to switch-on and -off of the plant
* VOC measurement provides early warning for poor supply air (dirty filters, problems)

Energy & cost savings:

* Power consumption of fans decrease when the air volume flow is reduced Running
* HVAC plant on demand gives additional savings in heating and cooling
* Studies show energy cost savings of more than 30% possible

Application:

* All rooms with a changing number of occupants and differing occupancy hours
* Meeting rooms, conference rooms, ballrooms etc. (fan stages, enable/disable)
* Restaurants, lounges, swimming pools, fitness areas, shopping areas (fan stages, variable speed fans)
  1. Secondary HVAC controllers

Secondary controllers (also referred to as terminal unit controllers (TECs) or room controllers) shall be provided for the guest rooms and individual zones such as meeting rooms where applicable. These controllers should be available in either standalone form or with the ability to communicate to main plant devices, central hotel controllers, front desk management station etc.

All devices should be capable of accepting industry-standard signals (inputs and outputs) for field devices such as temperature sensors, room units, occupancy detectors, wireless devices, valve actuators, damper actuators, door-switches, card readers etc.

Secondary controllers shall be dedicated controllers based upon 32-bit technology, with preconfigured and user configurable applications contained within the device. Each controller application shall be fully documented and tested for IHG; comprising application number, plant diagram, operating diagrams and all necessary installation and connection diagrams as standard.

7.8 Networked operation

The decision on whether the terminal unit controllers will operate stand-alone or with communications will depend upon the hotel type (size, design, class and star rating). Typically hotels of 4 and 5 stars, and those containing over 150 rooms will benefit from communicating room automation.

Wherever possible, the terminal unit controllers shall offer a choice of communication possibilities, whilst maintaining similar operation, functionality and connections. In this way, standard control functionality for the guest rooms and zones can be assured across the Group.

Recommended range of communication:

* Standalone:
* Proprietary bus:
* Standard bus (LON, BACNet or EIB/KNX)
* Shared networks: TCP/IP or Ethernet (Cat 5)

7.8.1 Network cable

Category 5 cable (pair or multi-pair) is typically used for data transmission within buildings; typically Ethernet networks. Cat 5 cable is often used with a special insulation that has low smoke and low flame

(LSF) characteristics for cables that run through open spaces such as ceilings or plenums

7.8.2 Individual room controllers

The following examples are typical for Hotels:

A scale able room solution should be provided for the zone control of terminal units such as fan coil units, chilled ceilings, variable air volume equipment etc. within the guest room areas. Individual room controllers shall be delivered with a fixed set of factory-tested applications in accordance with IHG requirements. Once selected, the desired application can be activated via a simple hand-held operating and service tool during plant commissioning.

Room controllers shall also have the ability to communicate with additional peripheral devices in the hotel rooms if required (see below) and also to integrate with the hotel management station (or booking system) at the Front Desk. At the time the system is commissioned and configured, all important room parameters shall be stored in nonvolatile memory, autonomously, with no need for having a connection to the network.

A PC-based programming and service tool shall also be available as an option for all HVAC controllers connected to the bus. The solution shall contain several room components specifically designed for managing room functions in hotels. The types of components used and the key functions performed by them shall be described as below:

7.8.3 Optional peripherals

It shall be possible for peripheral devices such as motion sensor unit to be connected to the room controller via bus or via digital inputs and outputs (directly hard-wired). At room level, the room controller shall be able to integrate a combination of room air conditioning, energy management, access control, room management, control of blinds, and control of lighting scenarios. Refer also to details of Incom system.

A guest room unit shall display the room temperature set point and shall show fan speeds 0, 1, 2 and 3. The display shall show the guest's set point adjustments. The guest shall be able to make use of the +/- buttons to adjust the room temperature within predefined limits and to manually select fan speeds.

When connected onto the hotel TCP/IP network or BMS communication bus, all room values (e.g. current room temperature, set point and fan speed) shall be available at management stations or at the Front Desk station.

* Trend logs and graphics showing the progression of the room temperature
* Remote readjustment of temperature set points in the guest rooms.

When the guest leaves the room, sensed by the motion detectorandreed switch the controller shall switch to Automatic mode using the Pre-comfort set point. When the guest returns, the room state selected last shall be adopted again.

7.8.4 Typical Guest room Temperature Controller

The room unit is normally installed in the rooms to be controlled; it is used for the following purposes:

* Guest interface for the room air conditioning (fan-coil unit etc.)
* Room temperature measurement via the built-in sensor
* Controller parameterization by the commissioning staff (restricted access)
* System diagnostics by commissioning and service staff (restricted access)



|  |  |  |
| --- | --- | --- |
| Room Control Functions: | | |
|  | Items | Functions |
| 1 | Indication of:  Room temperature, heating or cooling symbol, parameters and parameter values, absolute and relative set point adjustment |
| 2 | + and - buttons for adjusting the room temperature set point and parameter |
| 3 | Display of the present room operating mode or manually selected fan speed |
| 4 | Left/Right buttons (L/R) for selecting of:   * Room operating mode and fan speed in operator mode * Enter and Esc functions is parameterization mode |

7.9 Communication

7.9.1 Common TCP/IP Backbone

Scalable building management and control equipment proposed for IHG provides a consistent pre­configured solution for the HVAC plant and components, independent of any communications networks. Different options can be provided, however it should be possible to maintain a common operation, look and feel and functionality whichever solution is selected:

* Primary and secondary control devices providing stand-alone control of HVAC plant, with local display of operation and status
* Communications between primary and secondary control devices (demand control, exchange of data, alarms) using proprietary or industry standard bus (EIB/KNX;LON; BACnet). central display of operation and status (e.g. touch screen)
* Communications between primary and secondary control devices (demand control, exchange of data, alarms) using the IT communications infrastructure (Ethernet, TCP/IP, cat 5, twisted or multi-pair) as a backbone. Operation and display via front desk PC or web-browser.
* Communications between all primary and secondary control devices on the network and a dedicated management station (plant overview, alarms, scheduling, adjustment, graphical views).

IHG require an integrated or full BMS solution for 4\* and 5\* hotels; however different regions may demand different specification.

Providing a communications network between BMS devices and management stations in a hotel allows the functional interaction between equipment (heat/cool demand, sharing of data, scheduling, override etc.) and also provides invaluable data on the performance of the building (alarms, trend logs and energy benchmarking). Many communication possibilities exist today for both technical building management and IT Infrastructure, with a strong focus on open communications standards and 'interoperability'.

A standard building communication protocol such as KNX, running on an industry standard TCP/IP backbone offers many benefits to IHG:



7.9.1 Bus devices

There shall be no restrictions on the mix of devices connected to the bus; permissible bus devices include primary HVAC controllers, room units, individual room controllers (terminal units) and devices from third-party manufacturers (EIB / KNX). Each bus shall support a minimum number of 60 devices. All bus devices shall reside on the same network without any intermediate interface

7.9.2 Topology Schematic

Refer to illustration for details of a recommended communications network for a typical IHG hotel. The communications backbone shall be the hotel TCP/IP network, with iProuters provided for selected floor zones and room groups. Final communications between the room controllers will be via a standard 2- wire KNX bus, offering simple set- up and commissioning.

The configuration is very flexible; devices can be grouped by:

* Complete floors up to 60 rooms (160mA power supply required)
* Smaller floor zones up to 20 rooms (640mA powers supply required)

7.9.3 Zone addresses

**It would be highly beneficial for operation that all primary and secondary controllers within the hotel communicate** according to an internationally approved open bus, ideally featuring simplified commissioning procedures. The KNX protocol enables zone addresses for each controller to be set locally viathe plug-in operator unit, without the need of a commissioning tool (also called "Easy Configuration").

Devices having the same zone address shall exchange process data automatically, whereby one zone address permits the exchange of information between several process data points. All primary controllers shall have the option of having a room sensor or room unit connected via the bus; this room unit shall be powered from the bus power supply.

Note: On extended networks, the zone addresses can also be set with a service tool.

7.10 BMS Functions

In Summary the system shall perform the following functions:

* Time of day control of plant
* Duty cycling
* Optimization
* Weather compensation
* Maximum electrical load demand control
* Sequencing of plant
* Set point and reset adjustments
* Automatic change-over of plant;
* Energy audit
* Maintenance cycle and stock position
* Status of part of system
* Temperature measurement
* Pressure measurement
* Flow measurement
* Alarm situation - 2 positions
* Hours run
* Logging of information
* Summaries of measured variables
* Fuel consumption
* Primary control of 3 term variables
* Plant interlocks for safety and fire alarm
* Additional energy profiles or programmes fed by the users
* Lighting time of day
* Lighting sequence switching

7.10.1 Typical Points List

The following Schedule of BMS points is not exclusive but indicative of the requirements.

**7.10.2 Metering**

|  |  |  |
| --- | --- | --- |
| **•** | Water | (Site) |
| **•** | Water | (Kitchens) |
| **•** | Water | (Hot water Make Up) |
| **•** | Water | (Health Club) |
| **•** | Electricity | (Site) |
| **•** | Electricity | (Shop) |
| **•** | Electricity | (Kitchens) |
| **•** | Electricity | (Health Club) |
| **•** | Electricity | (Laundry) |
| **•** | Electricity | (Lifts) |
| **•** | Electricity | (Chillers & Mechanical Plant) |
| **•** | Electricity | (Loads **>**50KW) |
| **•** | Gas | (Site) |
| **•** | Gas | (Kitchen) |
| **•** | Gas | (Boilers) |
| **•** | District heating | (Hotel) |
| **•** | District cooling | (Hotel) |

|  |  |  |
| --- | --- | --- |
| **7.10.3 Digital Input** | | |
|  | a. Mechanical | Pump status |
|  |  | Boiler fail |
|  |  | Hot water fail |
|  |  | Supply fan status |
|  |  | Extract fan status |
|  |  | Filter dirty |
|  |  | Frost condition |
|  |  | Chiller/condenser fail |
|  |  | Plant/motor run |
|  |  | Guest room controller |
|  |  | Inverter alarm |
|  |  | Fire damper status |
|  |  | Plant status |
|  | b. Electrical | Lift fail |
|  |  | Power fail |
|  |  | Generator fail |
|  |  | Fire alarm |
|  |  | Fire alarm fail |
|  |  | Security status |
|  |  | Security alarm |
|  |  | Security fail |
|  |  | Pre fail transformer/switchgear |
|  |  | Gas leak |
|  |  | Gas leak detection fail |
|  |  | Emergency lighting status |
|  |  | Uninterrupted power supply (UPS) status |
|  |  | UPS fail |
|  |  | Public address status |
|  |  | Panic alarm status |
|  |  | Disabled alarm status |
|  |  | CHP status |
| **7.10.4 Analogue Input** | | |
|  | a. Electrical Power factor | |
|  | b. Mechanical | Flow and return temperatures |
|  |  | Water flow rates |
|  |  | Air supply and return temperatures |
|  |  | Air supply and return humidity (where required) |
|  |  | Air supply and return flow rates |
|  |  | External temperature |
|  |  | External humidity |
|  |  | Zone temperatures |
|  |  | Zone humidity (where required) |
|  |  | VAV system pressure |
|  |  | Water system pressures |
| **7.10.5 Analogue Output** | | |
|  | a. Mechanical | Control valves and dampers |
|  |  | Speed control |
| **7.10.6 Digital Output** | | |
|  | a. Electrical Lighting |  |
|  | b. Mechanical | All plant items |
|  |  | Boilers |
|  |  | Pumps |
|  |  | Chiller/condensing equipment |
|  |  | Supply and extract fans |
|  |  | Fresh air dampers where no re-circulation |

* 1. Peripheral devices

7.11.1 Service tool

A service tool shall be available for all controllers connected to the bus network. The service tool shall be MS Windows-based and able to automatically recognize and display all primary controllers, individual room controllers and room units connected to the bus. All devices shall be displayed in a 'tree' structure with all data points updated and displayed when selected.

7.11.2 Functions

Key functions of the service tool shall be:

* Full commissioning of all control parameters, for controllers connected to the bus.
* Uploading, downloading and saving of controller parameters (all parameters or selective).
* Creation of commissioning reports by automatic scanning of the network devices, retrieval and saving of all parameter sets in document form for later viewing/printing.
* On-line trending of selected data values, with automatic creation and real-time display (tabular and graphical). Optional export of values to 3rd party software (M S Excel).

Connection of the service tool to any controller or to the control system bus shall not interrupt nor interfere with normal network operation in any way, prevent alarms from being transmitted.

* 1. PC operator station

A PC based 'operator's station' shall be optionally available for remote monitoring, alarm handling and device configuration purposes. The operator station shall be similar in format and appearance to the service tool with additional functionality for central management, alarming, analysis and display of plant and building data.

7.12.1 Functions

The software shall provide, as a minimum requirement, the following functionality:

* Pre-engineered plant graphics (complete with dynamic points) automatically configured for the standard HVAC applications selected within the controller
* Real-time graphical viewing and control
* Scheduling and manual override of building plant
* Display of historical plant data
* Selection and grouping of data points (Pop cards)
* "Collapsible tree" dynamic architecture
* Online help, including index and search facility
* Identification and upload of all system data from controllers
* Display of dynamic trend data
* Automatic generation of "commissioning" reports with full details of all controller settings
* Modem support with up to four communications port connections for remote or direct access to the

bus (via the communications unit).

* Alarm handling with pop-up windows, sound files and activity log
* Alarm output to screen and/or printer
* Time-based automatic scheduling of plant status and values
* importation of photographic or other images (as bit maps) for the creation of customized user screens with pre-engineered dynamic data points

7.12.2 Hardware Specification

The operator station shall consist of a personal computer (PC) with the following minimum specifications:

* Pentium 1.6 GHz processor
* 512MB RAM (128 MB recommended)
* Hard drive with 300 MB available space
* Video card and monitor capable of supporting SVGA1024 x 768 pixels
* A USB1.1 or higher plus a parallel port.
* Supported operating systems are Windows 98SE, Windows ME, Windows 2000 and Windows XP
* Intel Dialogic Telephony Card
* CD-ROM drive
* Mouse and 101-key enhanced keyboard.
  1. Central Communication unit

A central communication unit (CCU) shall be used to allow direct or remote (modem) connection of the central management software to the plant controllers and devices. If required, the CCU shall provide full alarm and trending activity even when the operator station and central management software are off-line.

The following functionality shall be provided:

* Automatic identification of connected HVAC controllers
* Real-time access to all connected HVAC controllers, either directly or via modem
* Monitoring of all HVAC device parameters
* Freely configurable potential-free inputs for fault status, monitoring, etc.
* Automatic reporting of alarms to a PC
* Automatic reporting of alarms to SMS, fax machines, pagers or e-mail receivers
* Integral system clock with time master function
  1. Property management system

Hotel Room Management Station Software provides IHG personnel with access to main room parameters and data from all guest rooms and zone controllers connected on the network. The software should run on any commercially available PC with Windows XP as a reliable operating system and with Sybase SQL Anywhere as the database software. The design of the Windows based software shall be specially developed to provide a familiar look and feel for ease of use, particularly to existing users of FOS systems.

Additional functionality:

* Definition of different user groups and software access rig hts
* User administration - freely configurable in four stages for user authorization
* User interface with toolbars for frequently used functions and the context menu via

the right mouse button

Room list:

* Tabular overview in the main window showing all guest and room data
* Freely configurable content of columns
* User-related display of room characteristics
* Sorting columns by clicking on the column head
* Filter function by device names, room numbers and alarm types
* Pop-up Room overview for all rooms, showing the exact room state
* Temperature history showing the room temperatures over the last three days
  1. BMS Commissioning and handover

7.15.1 Commissioning

In addition to the pre-configured applications and pre-testing at the equipment manufacturer's works, commissioning and setting to work of the BMS, associated controllers and peripheral equipment must be made on site. The following items shall be considered the minimum requirements:

The final commissioning and handover of the BMS shall be carried out in co-ordination with IHG representation the construction manager and other 3rd party trades as required. Commissioning of the BMS cannot take place until air and water systems are balanced, mains power is available and building services control equipment are proven to be functioning correctly.

The BMS supplier; or approved partners shall complete all testing, calibrating, adjusting and final field tests once the electrical installation of the system is complete. The controllers must be operable in stand­alone mode with operation possible from local operating units. Devices must be proven to failsafe in the specified mode upon panel failure or loss of power.

Primary (main plant) controllers shall contain a dedicated wiring test application. Values shall be displayed at the local operator unit for selected inputs, and aggregates (fans, pumps, etc.) connected to the outputs shall be proven (switched on and off). The wiring test shall be made after all peripheral devices are connected. On completion of the controller configuration and after having made all settings, it is recommended to conduct this test.

During the wiring test, all control applications shall be inactive, with the associated outputs disabled (OFF state) and safety-related functions (frost protection, etc.) temporarily deactivated. All automatic control applications shall be resumed when leaving the wiring test menu.

The control system supplier shall provide recommendations for system modification in writing to IHG, the consulting engineer or building owner. No modifications to the specified control scheme shall be made (including operating parameters and control settings) without prior approval from IHG, the consulting

engineer or building owner.

* 1. Handover and acceptance

Notify operating IHG or hotel personnel in writing of the handover and testing dates so that authorized personnel from IHG, the building owner, consulting engineer and construction manager are present if required.

The controls supplier shall, in the presence of IHG, the building owner, construction manager (or any appointed representative), demonstrate the operation of the system and document the results in writing. Any discrepancies between the specification and the actual performance will be subject to rectification and retest.

The commissioning and handover of the complete control system shall be fully documented in accordance with the requirements of the consulting engineer and shall include commissioning reports, complete controller configuration and settings.

Upon completion and handover of the control system, the approved representatives of the control system supplier, the consulting engineer and/ or the client shall complete and sign a handover certificate, thus signifying formal acceptance of the control system and installation.

* 1. Training

A minimum of (8 hours) training shall be provided for the building owner and designated operating personnel into the use and operation of the control system. Training shall take place at the works unless otherwise stated, and shall be carried out in accordance with the requirements of the specification upon practical completion of the control system.

Training shall include but not be limited to the following:

* Explanation of documentation including plant drawings, controller operating instructions and operating & and maintenance manuals
* Walk-through of the control installation to locate control components and explain functions
* Readout of plant data and values
* Alarm functions plant analysis
* Presentation and functions of the operator workstation(s) and peripherals (where provided)
* Controller functionality, user level operation and fault diagnostics

Should further technical training of the control system, HVAC control theory or applications be required, this shall be made available from the control system supplier in a separate contract.

* 1. LIFTS

The passenger/goods lifts shall be required to provide an excellent quality service, based on the following design criteria.

The type of lift will be dependent upon the size, levels served, speed, etc., however motor room less lifts are preferred, and to be used where the performance can be achieved, for the following benefits:

* Compliance with all the latest Standards and Regulations for highest levels of safety.
* Do not require a motor room either above or adjacent the shaft.
* Makes the most efficient use of available space in the building.
* Highly efficient in operation due to modern motor and VVVF technology, giving reduced electrical supply, cable sizes and full load running current, low heat output from machinery reducing the need for additional cooling or ventilation and lower power factor, without the need for correction devices.
* Environmentally friendly, having gearless machines, with sealed for life bearings, therefore there is little or no oil used throughout the installation and up to be 95% recyclable.
* Superior ride quality and passenger comfort.
* Proven technology, with systems available from all major suppliers to allow competitive tendering for both installation and ongoing maintenance.
* Standard solutions from all suppliers for reduced installation periods and attendance by main contractor.
* Reduced ongoing maintenance costs.
  1. Lift/Elevator Specification
* Minimum interval must be under 35 seconds, handling capacity not less than 17% of the expected guest population over a 5 minute period.
* Minimum capacity to be 13 persons (1,000 kg)
* Minimum door opening to be 1.2m opening.
* Wall-mounted handrails at 800mm, control panel with door open button and facilities clearly marked in accordance with appropriate legislation.
* Telephone and intercom present and functioning.
* House phone connected directly to the switchboard.
* Must be connected to emergency lighting.
* No fluctuations in speed when travelling.
* Free from noise when travelling.
* Promotional material to be framed and of professional design and appearance.
* Decorative lighting should form part of the ceiling design.
* Inspection and compliance certificates should be current and on display.

Refer to the brand standard requirements for details of Fire and Life Safety and controls for Lifts and Elevators. Provide interfaces as necessary to other systems

|  |  |  |
| --- | --- | --- |
| **Preferred Lift Application (subject to traffic analysis for each specific project)** | | |
| **Application** | **Guest Room** | **Room Service** |
| **Capacity** | 1600 kg  3500 lbs. | 1800 kg  4000 lbs. |
| **Speeds:** | | |
| Levels 2-3 served | 30 mpm - 0.5 mps  125 fpm | 30 mpm  125 fpm |
| Levels 4-12 served | 105 mpm - 1,75mps  350 fpm | 105 mpm  350 fpm |
| Levels 13-22 served | 150 mpm - 2,5 mps  500 fpm | 150 mpm  500 fpm |
| Levels 23-32 served | 210 mpm - 3,5 mps  700 fpm | 210 mpm  700 fpm |
| Levels 33 + | 300 mpm - 5mps  1000 fpm | 210 mpm  700 fpm |
| **Platform:** | | |
| Width | 2200 mm 7 ft 2 in. | 2400 mm 8 ft 0 in. |
| Depth | 2000 mm 6 ft 6 in. | 2000 mm 6 ft 2 in. |
| **Entrances:** | | |

|  |  |  |
| --- | --- | --- |
| **Application** | **Guest Room** | **Room Service** |
| Width | 1200 mm 4 ft 0 in. | 1200 mm 4 ft 0 in. |
| Height | 2100 mm 7 ft. 0 in. | 2100 mm 7 ft. 0 in. |
| Type | Centre Open | Centre Open |
| **Cab Height:** | | |
| To Canopy | 2750 mm 9 ft. 0 in. | 3000 mm  10 ft. 0 in. |
| **Compensation:** | | |
| Manufacturer’s Standard | 105 mpm  350 fpm | All duties |
| Whisperflex | 150 mpm  500 fpm | - |
| Rope | 210 mpm  700 fpm | - |
| Lockdown | +800 fpm | - |

The designer may wish to consider the benefits of regenerative lift drives. Refer to Volume 3 of this manual.

* 1. **TESTING AND COMMISSIONING**
  2. Works Testing (Equipment)

Witness testing shall be carried out at works, as required by the appropriate National and International standards. If the performance of the equipment offered is not satisfactorily demonstrated, then further tests shall be carried out until InterContinental Hotels Group are fully satisfied that the equipment offered meets the requirements. These further tests shall be at no extra cost to the contract.

InterContinental Hotels Group shall be entitled, at all reasonable times during the manufacture, to inspect, examine and test on the manufacturer’s premises, the materials and workmanship of all equipment to be supplied under the contract. Such inspection, examination or testing, if made, shall not relieve the designer from any obligation under the contract.

* 1. Testing

A visual inspection shall be made of the installed equipment before any tests are carried out to confirm the following:

* Correct selection and erection of materials and workmanship
* Signs of damage so as to impair safety

During construction of the works, the installer shall undertake all necessary tests to ensure compliance with the regulations and specifications relating to the works.

Upon completion of the works, the whole installation shall be subject to the tests required by the regulations and specifications relating to the works. Test procedures to be submitted for approval 2 weeks prior to schedule testing. These tests shall be witnessed by InterContinental Hotels Group to their full satisfaction.

* 1. Commissioning

Professional commissioning of the systems is essential to ensure:

* The system’s performance in accordance with the design
* Guest comfort is not jeopardised
* Operating and maintenance costs are minimised

It is therefore critical to the ongoing operation of the Hotel that this key task is carried out correctly in a thorough and professional manner.

InterContinental Hotels group reserves the right to bring in an Independent Specialist Commissioning Company at the owners cost if this task is not being carried out correctly.

The installer and designer shall verify the correct operation of the complete systems, including items of plant, to ensure that they are operating in accordance with specified conditions and that the systems achieve the environmental conditions required.

This shall include proving of equipment installed under full load conditions. Where heat or electrical loads are not inherent in the installation, temporary heat loads and electrical loads shall be provided.

Upon completion of all testing and commissioning, the installer and designer shall provide two signed copies of the commissioning certificates and submit to InterContinental Hotels Group within 1 4 days of the results being obtained. Signed copies of the certificates shall be installed within the operating and maintenance manuals.

The installer shall provide, at his own cost, all water, power, fuel, labor, etc., necessary for all testing and commissioning.

* 1. Method Statements

Prior to all testing the installer and designer shall issue detailed Method Statements prior to carrying out the works. These Method Statements shall contain the following information:

* Health and safety issues
* Instruments to be used and their calibration certificates
* Sequence of tests to be carried out
* Documentation which will be provided to record results

Full and detailed Method Statements shall be provided for all pre-commissioning, setting to work, commissioning, testing and handover procedures. These Method Statements shall include the following information:

* Logic diagram of the process
* Outline programme (detail to be added as the document develops)
* Copies of all checklists, record sheets, etc., proposed
* Permit to work systems and documentation
* Details of works by others affecting progress of works detailed
* Proposed off-site testing
* Proposed completion sequence
* Proposals for quality control
* Handover, demonstration and training

InterContinental Hotels Group reserve the right to request additional Method Statements for any aspect of the works, at no additional cost to the contract.

* 1. Programme

A programme must be submitted to detail all key aspects of the commissioning, including but not limited to:

* Submission of Method Statements/procedures
* Utility connection dates
* Individual system commissioning dates
* Witnessing dates for authorities/intercontinental Hotels Group

The simplified programme in Appendix A provides details of the expected timescales but this must be prepared in detailed form, specific for each project.

**10.0 RECORD DOCUMENTATION**

* 1. General

The installer shall prepare full operating and maintenance manuals and As Fitted drawings in both English and the local language, if applicable. Draft copies of these documents shall be issued to InterContinental Hotels Group for comment a minimum of six weeks prior to practical completion. Final copies shall be issued upon practical completion.

All record drawings shall be provided in electronic form (CD ROM and memory stick, Windows), in additional to paper copies. Drawings shall be provided on the CD ROM to the latest AutoCAD Release Standards and shall be prepared using agreed CAD layering convention.

Three (3) paper copies and three (3) CD ROM copies shall be provided, with three (3) additional copies of each in the local language, if applicable.

* 1. Record Drawings

Record drawings shall be produced, which shall include the following minimum information:

* The location of all public service connections, within the contract, whether installed by the contractor or by the appropriate Authority, together with points of origin and termination, size and materials of pipes, line pressure, flow and other relevant information.
* The layout, location and extent of all sub-mains cables and piped services together with all isolation points, valves, test points, etc.
* Location, identity, size and details of all controls equipment.
* The layout, location and extent of all electrical systems, including containment.
* The layout, location and extent of all air ducts, including dampers, silencers, and air flow quantity, etc.
* The location and identity of each room, including spaces housing plant machinery air apparatus.
* Detailed general arrangements of all machinery spaces, air handling plant rooms, tank rooms, electrical

switch rooms, etc., including location, identity, manufacture, size and rating of all equipment.

* All necessary sections, elevations, isometrics and schematics of all plant spaces.
* All controls and wiring diagrams shall be provided.
* Floor layouts shall be provided at a scale of no less than 1:50. Plant areas and equipment rooms shall be at a scale of not less than 1:20.
* Each record drawing shall indicate:
* Name of the contract and the area of the building
* Description of the drawing, unique number and scale
* Name and address of the installer
* All record drawings shall be signed and checked by the installer and designer in accordance with agreed quality control procedures.

In addition to Record Drawings, the following wall-mounted, glass covered schedules and schematic layouts shall be provided. These shall be located in plant rooms and any other appropriate locations:

* Schematic drawings of all systems and circuit layouts showing identification and duties of equipment, numbers and locations, controls and circuits
* Control schematics
* All items required under statutory/other regulations
* Emergency operating procedures and telephone numbers for emergency call out services

All of the above is to be submitted for approval prior to erection.

10.3 Operating and Maintenance Manuals

The operating and maintenance manuals shall incorporate the following minimum information:

* A section containing an introduction, abbreviations, health and safety and working notices, etc.
* A section containing a full description of each system, together with main plant components, locations, mode

of operation of automatic control systems, etc.

* A section containing plant technical data for all items of equipment
* A section describing, in detail, operating procedures necessary for startup, running and shut down of equipment and systems
* A section describing maintenance operations on a daily, weekly and monthly basis for each item of equipment and any system
* A section describing the emergency procedures to be adopted by personnel engaged on the operation and maintenance of the systems with respect to fire, first aid, failure, etc.
* A section describing recommended action on plant malfunction
* A section listing recommended spares and lubricants
* A section containing all the record drawings
* A section containing all test certificates and commissioning reports
* A section comprising a list of manufacturers, including addresses, telephone numbers and equipment supplied

Generic Programmes

1. Design Programme
2. Construction Programme
3. Commissioning Programme

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Intercontinental Hotel Group** | | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | **ADG>**  **ALLIANCE DESIGN GROUP CONSULTING ENGINEERS** | | | | | | | |
| **Preliminary Draft Generic Design Programme for a 200 bed Hotel** | | | | | | | | | | | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| NOTE: This programme is based on a traditional fully detailed design and tender | | | | | | | | | | | | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | |  | | | | | | | | | | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | | WEEK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ID NO. | TASK | BRIEF | | | CONCEPT | | | | | | | | SCHEMATIC | | | | | | | | DETAIL DESIGN/TENDER | | | | | | | | | | CONSTRUCTION DOCUMENTATION | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
| 1 | Pre-design |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Review information |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Complete Compliance Checklists 1-11 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Issue report for brief/scope |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |
| 2 | Design |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Design Team Meetings | V | |  | |  | |  | |  | | V | | w | | ▼ | | V | | V | | ▼ | | ▼ | | ▼ | | ▼ | |  |  |  |  |  |  |  |  |
| 3 | Concept |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Develop Design Brief |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Pre-Concept Designs |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |
|  | Prepare Pre-Concept Report |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Client Approval |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Complete Concept Design |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |
|  | Workshops |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |
|  | Complete Concept Report |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |
|  | Client Approval |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4 | Local Authority Approvals (subject to project location) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Preliminary Applications |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |
|  | Final Applications |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |
| 5 | Scheme Design |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | VE meetings |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Develop Scheme Design |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  | Confirm Spatial Requirements |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |
|  | Confirm utility Demands |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |
|  | Client Approval |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 6 | Detail Design |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Develop Detail Design |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |
|  | Equipment  Deli n i ti on/Spec if! c at I on |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  | Samples |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 ■ | 1 ■ 1 | ■ 1 | ■ ■ | ■ ■ | ■ ■ | ■ ■ | ■ ■ | 1 ■ | 1 ■ 1 |  |  |  |  |  |  |  |
|  | Detail Design Report |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |
|  | Client Approval |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Complete Tender  Documentation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |
|  | Peer Review |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |
|  | Tender Period |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |
|  | Tender Review, Negotiation and Appointment |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |
|  | Contractor Appointment |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 7 | IHG Reviews |  | Brief ’ | | F 1 |  | Concept Design Report | | | | | F 1 |  | M&E confirmed load schedules and 1 energy conservation analysis | | | | | | |  | Detail Design Report | | | | F V | |  |  |  |  |  |  |  |  |  |  |
|  | | | | | | | | | |  | | |  | | |  |  | |  |  | | |  | |  |  | | | | | | | | | | | |
| NOTE: Refer to MEP Design Standards for detailed schedules of information to be submitted. | | | | | | | | | | | | |  | | |  |  | |  |  | | |  | |  |  | | | | | | | | | | | |

IHG Engineering Design Guidelines

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Intercontinental Hotel Group** | | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | **ADG>**  ALLIANCE DESIGN GROUP CONSULTING ENGINEERS | | | | | |
| **Preliminary Draft Generic Construction Programme for a 200 bed Hotel** | | | | | | | | | | | |  |  |  |  |  |  |  |  |
| **NOTE: This programme is based on a traditional fully detailed design and tender** | | | | | | | | | | |  |  |  |  |  |  |  |  |  |
|  | | |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ID NO. | TASK | MONTH | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 1 | Building structure to waterproofing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |
| 2 | Shop drawings and equipment submissions |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |
| 3 | First fix MEP |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |
| 4 | Major equipment in place |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |
| 5 | Second fix MEP |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |
| 6 | Equipment and outlet connections |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |
| 7 | Defects inspections |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| 8 | Preliminary as built drawings, O&M Manuals |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 9 | Final as built drawings and O&M Manuals |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | n |
| 10 | Testing and commissioning method statements and procedures |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 11 | Testing and commissioning |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |
| 12 | Building fine tuning during occupancy |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 |
|  |  |  |  |  |  |  | J All construction shop drawings and equipment submissions finalised | | | | | | | | | |  |  |  |  |  |  |  |  |  |
|  | | | | | | | |  |  |  |  | |  |  |  |  | | | | |  |  | | | |
| NOTE: | | | | | | | |  |  |  |  | |  |  |  |  | | | | |  |  | | | |
| a) | The intention of this programme is to illustrate the general services requirements during the hotel construction phase. | | | | | | | | | | | |  |  |  |  | | | | |  |  | | | |
| b) | This programme should be read in conjunction with the design and commissioning programmes. | | | | | | | | | | | |  |  |  |  | | | | |  |  | | | |
| c) | A project specific construction programme should be issued for each project incorporating all the points illustrated here. | | | | | | | | | | | |  |  |  |  | | | | |  |  | | | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Intercontinental Hotel Group** | |  | |  |  |  |  |  |  |  | **ADG>**  ALLIANCE DESIGN GROUP CONSULTING ENGINEERS | | | |  |  |
| **Generic Commissioning programme - MEPF Services** | | | | |  |  |  |  |  |  |  |  |
| **Draft for 200 bed Hotel** | |  | |  |  |  |  |  |  |  |  |  |
|  |  | WEEK | | | | | | | | | | | | 12 MONTHS |  |  |
| **TASK** |  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | s | 9 | 10 | 11 | 12 | **OCCUPATION** |  |  |
| Appraisal of Method  Statement-Procedures |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Utility Services Connected |  | F Permanent power | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Mechanical Systems** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Check/Clean/Flush |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Electrical Checks/Run |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Balance Water  Balance Air  Chillers/Pumps | — |  |  |  |  |  |  |  |  |  |  |  | — |  |  |  |
| Boilers/Pumps |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Controls/BMS  **Electrial Systems** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Transformers/SS/Main LV Panel  LV Panels |  |  |  |  |  |  |  |  |  | — |  |  |  |  |  |  |
| Power |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Lighting and Controls  PA/CCTV/Secu rity/Co mms |  |  | — |  |  |  |  |  |  |  |  |  |  | — |  |  |
| **Fire System** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Fire Alarm and Detection |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Smoke Control |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Fire Sprinklers |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Fire Extinguishing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Plumbing and Drainage** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Flush/Disinfect HWS |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Flush/Disinfect cws |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Water Treatment |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Booster Pumps |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| H&cws Balance |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Grease Traps.-'Clean Drains |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Lifts (60 days)** |  |  | (construction use) | |  |  |  |  |  |  |  |  |  |  |  |  |
| Intercontinental-Authority Witnessing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| As bu lit draw in gs/OÃM M a n u a Is |  | F Drafts submitted | |  |  |  |  |  |  |  | Final As Eluilts and Manuals " | | |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | End of defects |
| Note: any works testing/inspections to be listed separately on the construction programme. | | | | | | | | | | | | | | Building tuning |  |  |

IHG Engineering Design Guidelines

Appendix B Design Compliance Checklists

This section includes the following Design Compliance Checklists which must be completed by the Designers and submitted to InterContinental Hotels Group as indicated.

1. Summary Schedule of Information and Stage to be submitted
2. Checklist 1 - Design Stage Compliance Verification
3. Checklist 2 - Site Location/Summary Details
4. Checklist 3 - Climatological Data
5. Checklist 4 - Electricity
6. Checklist 5 - Gas Service
7. Checklist 6 - Potable Water
8. Checklist 7 - Sewage Disposal
9. Checklist 8 - Fire Protection
10. Checklist 9 - District steam/heating
11. Checklist 10 - Boiler Fuel Options
12. Checklist 11 - Telephone & tv
13. Checklist 12 - Sample Mechanical Load Schedules
14. Checklist 13 - Sample Electrical Load Schedules
15. Checklist 14 - Building Air Balance

SUMMARY SCHEDULE OF INFORMATION AND STAGE TO BE SUBMITTED

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SCHEDULE OF INFORMATION** | | | | |
| **REQUIRED INFORMATION** | **DESIGN PERIOD** | | **PRE-CONTRACT WORKS** | **HANDOVER** |
| **Preliminary Drawings** | **Final Scheme** | **Detailed Construction** | **As Built Record Drawings/Manuals** |
| Mechanical & Electrical Services Schematics & Load Schedules | Outline | Detail | Detail | Detail |
| Mechanical & Electrical Services Drawings & Specifications & Site Plan | Outline | Detail | Detail |  |
| Energy Conservation | Calculation/ Appraisal | Detail | - | - |
| Drainage Plans & Details | Preliminary | Outline | Detail | Detail |
| Fire Safety Systems and Specifications | Outline | Outline | Detail | Detail |
| Fire Safety Strategy Proposal | Preliminary | Detail | Final | - |
| Calculations | Outline | Detail | - | - |
| Technical Submission for Plant & Equipment | Preliminary | Detail | Final | - |
| Schedule of Deviations | Outline | Detail | - | - |
| Checklist 1 - Design Stage Compliance  Verification | *J* | J | - | - |
| Checklist 2 - Site Location/Summary Details | *J* | - | - | - |
| Checklist 3 - Climatological Data | *J* | - | - | - |
| Checklist 4 - Electricity | *J* | J | - | - |
| Checklist 5 - Gas Service | *J* | J | - | - |
| Checklist 6 - Potable Water | *J* | J | - | - |
| Checklist 7 - Sewage Disposal | *J* | J | - | - |
| Checklist 8 - Fire Protection | *J* | J | - | J |
| Checklist 9 - District Steam/Heating | *J* | J | - | - |
| Checklist 10 - Boiler Fuel Options | *J* | J | - | - |
| Checklist 11 - Telephone & TV | *J* | J | - | - |
| Checklist 12 - Sample Mechanical Load Schedules | *J* | J | - | - |
| Checklist 13 - Sample Electrical Load Schedules | *J* | J | - | - |
| Checklist 14 - Building Air Balance | *J* | J | - | J |
| **Note:**  Outline: All the information needs to be indicated but not fully described Detail: Complete information to fully describe the works. | | | | |

CHECKLIST 1: DESIGN STAGE COMPLIANCE VERIFICATION

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Item** |  | **Compliant** | **Non-Compliant** | **Comments - if Non-Compliant** |
| **1.0** | **Aims & Objectives Section 1** |  |  |  |
|  | Not Yet Issued |  |  |  |
| **2.0** | **Fire Safety** |  |  |  |
|  | **-** Detection and alarm |  |  |  |
|  | **-** Suppression |  |  |  |
|  | **-** Emergency Lighting |  |  |  |
|  | **-** Gas detection |  |  |  |
|  | **-** Cause & Effect |  |  |  |
| **3.0** | **Mechanical/HVAC** |  |  |  |
|  | **-** Design Criteria |  |  |  |
|  | **-** System Selection |  |  |  |
|  | **-** Energy Conservation |  |  |  |
|  | **-** Load Schedule Completed |  |  |  |
| **4.0** | **Electrical** |  |  |  |
|  | **-** Power supply |  |  |  |
|  | **-** Emergency Power |  |  |  |
|  | **-** Lighting |  |  |  |
|  | **-** LV System |  |  |  |
|  | **-** Load Schedule Completed |  |  |  |
| **5.0** | **Plumbing/Sanitary** |  |  |  |
|  | **-** Water Quality/Treatment System |  |  |  |
|  | **-** Cold Water Reliability |  |  |  |
|  | **-** Hot Water Storage/Circulation |  |  |  |
|  | **-** Drainage |  |  |  |
| **6.0** | **BMS** |  |  |  |
|  | - System & Points Schedule |  |  |  |
| **7.0** | **Lifts/Elevator** |  |  |  |
|  |  | | | |

|  |
| --- |
| **Checked by:** |
| **Date:** |
| **Signed:** |

CHECKLIST 2: SITE LOCATION & SUMMARY DETAILS

|  |  |
| --- | --- |
| **Item** |  |
| **Country:** |  |
|  | |
| **Site Address:** |  |
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| **Location (Country/City/ Combined Development)** |  |
|  | |
| **Latitude/Longitude:** |  |
|  | |
| **Proposed No. of Rooms:** |  |
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|  | |
| **Proposed Facilities:** |  |
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| **Total Area - Occupied Spaces/Storage:** |  |
|  | |
| **Total Area - Plant:** |  |
|  | |
| **Total Area - Car Parking:** |  |

CHECKLIST 3: CLIMATOLOGICAL DATA

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|  |  |  |
| --- | --- | --- |
| **1.0** | Annual Rainfall: |  |
| Maximum Rate: | |  |
| **2.0** | Annual Snowfall: |  |
| Maximum Rate: | |  |
| **3.0** | Number of annual heating degree days: |  |
| **4.0** | Number of annual cooling degree days: |  |
| **5.0** | Winter Design Temperatures - DB: |  |
| **6.0** | Summer Design Temperatures (1%, 2%% - DB/WB): |  |
| **7.0** | Average Wind Speed and Direction for each season: |  |
|  | | West: |
|  | | South: |
|  | | North: |
|  | | East: |
| **8.0** | Number of Annual Sunshine Hours;: |  |
| **9.0** | Identify Prevalent Natural Phenomenon: |  |
| **a.** | Typhoon Season: |  |
| **b.** | Hurricane Season: |  |
| **c.** | Tornado Season: |  |
| **d.** | Monsoon Season: |  |
| **e.** | Flooding Season: |  |
| **f.** | Seismic Index: |  |
| **Remarks:** | |  |
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CHECKLIST 4: ELECTRICITY

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| --- | --- | --- | --- | --- |
| 1.0 | Obtain full network characteristics, including transformer type and site, fault current, rate schedule, rules and regulations, national and local codes, etc. and attach. | | | |
| 2.0 | Voltage Stability: ± |  | % |  |
| 3.0 | Frequency Stability: ± |  | % |  |
| 4.0 | Number of Brownout Hours: |  |  |  |
| 5.0 | Number of Blackout Hours: |  |  |  |
| 6.0 | Identify Major Causes of Service Disruption: |  |  |  |
| 7.0 | Are two services possible? | YES |  | NO |
| 8.0 | Adequacy of system over next 5 years: |  |  |  |
| 9.0 | Application lead time: |  |  |  |
| 10.0 | Available tariffs: |  |  |  |
| 11.0 | Separate light and power tariffs or fate rate: |  |  |  |
| 12.0 | Unit costs, night/day charges, season variations: |  |  |  |
| 13.0 | Demand charges and when applied: |  |  |  |
| 14.0 | Power factor requirements: |  |  |  |
| 15.0 | Controlling agency: |  |  |  |
| 16.0 | Is frequency change contemplated? | YES |  | NO |
| **Remarks:** | |  |  |  |
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CHECKLIST 5: GAS SERVICE

|  |  |  |  |
| --- | --- | --- | --- |
| **1.0** | Is utility, piped-in gas available: | YES | NO |
| **2.0** | Alternative Gas Sources: |  |  |
|  | | | |
| **3.0** | Type of Gas and CV: |  |  |
| **4.0** | Distance to Main (meters): |  |  |
| Main Size (mm): | | | |
| Pressure and Fluctuations (mbar ±): | | | |
| **5.0** | Largest Tap Permitted: |  |  |
| Limits on quantity: | | | |
| **6.0** | Are interruptible rates available? | YES | NO |
| **7.0** | Annual Service Interruption Hours: |  |  |
| **8.0** | Major Cause of Interruption: |  |  |
| **9.0** | Rules & Regulations attached: | YES | NO |
| **10.0** | Rate schedule attached: | YES | NO |
| **11.0** | Application Lead Time: |  |  |
| **12.0** | Controlling Agency: |  |  |
| **13.0** | If LPG, is bulk delivery available: | YES | NO |
| **14.0** | Cylinder size: |  |  |
| **15.0** | CV, if known: |  |  |
| **16.0** | Cost: |  |  |
| **17.0** | Is supply adequate? | YES | NO |
| **18.0** | Are LPG installations subject to local codes/practice? | YES | NO |
| **19.0** | Is copy of code/regulations attached? | YES | NO |
| Note | if utility gas is not available, furnish the following data: |  |  |
| **20.0** | Is LPG imported? | YES | NO |
| **21.0** | Provide heating value of LPG: |  |  |
| **22.0** | Is LPG delivered by tank truck: |  |  |
| **23.0** | Indicate size of cylinders: |  |  |
| **24.0** | Indicate cost of LPG: |  |  |
| **25.0** | Name applicable codes: |  |  |
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| **Remarks:** | | | |
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CHECKLIST 6: POTABLE WATER SERVICE

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| --- | --- | --- | --- |
| **1.0** | Primary Supply by: |  |  |
| **2.0** | Alternate Sources: |  |  |
| **3.0** | Distance to Mains: |  |  |
| Size: | | | |
| Press: | | | |
| Elevation | | | |
| **4.0** | Age and Condition of Mains if known: |  |  |
| **5.0** | Largest tap permitted: |  |  |
| **6.0** | Are Dual Services available: | YES | NO |
| **7.0** | Limits on peak demand: |  |  |
| Limits on peak consumption: | | | |
| **8.0** | Rate(s) applicable: |  |  |
| **9.0** | Overall water quality: |  |  |
| **10.0** | Turbidity: |  |  |
| **11.0** | Odor and taste: |  |  |
| **12.0** | Total hardness for each season: |  |  |
| **13.0** | pH for each season: |  |  |
| **14.0** | Bacterial count: |  |  |
| **15.0** | Chlorine residual: |  |  |
| **16.0** | Corrosive or scaling tendency of water. Reference is made to Langelier & Ryznar Indices. | |  |
| **17.0** | Reliability: total hours shut down annually: |  |  |
| **18.0** | Identify major cause(s) of service disruption: |  |  |
| **19.0** | Laboratory Report attached: | YES | NO |
| If no, when is this expected: | | | |
| **20.0** | Application Lead Time Agency: |  |  |
| **21.0** | Adequacy of System over next 5 years: |  |  |
| **22.0** | Adequacy of System over next 15 years: |  |  |
| **23.0** | Copy of rules and regulations attached: | YES | NO |
| **24.0** | Summaries treatment proposed to achieve InterContinental Hotels Group water quality requirement as detailed on the next page. | | |
| **Remarks:** | | | |

CHECKLIST 7: SEWAGE DISPOSAL

|  |  |  |  |
| --- | --- | --- | --- |
| **1.0** | Proposed Disposal method: |  |  |
| **a.** | Municipal System: |  |  |
| **b.** | On-site treatment/distance: |  |  |
| **c.** | Off-site disposal/distance: |  |  |
| **d.** | Sludge off-site/distance: |  |  |
| **e.** | Filter Bed/Percolation/distance: |  |  |
| **e1.** | Size of filter bed/distance: |  |  |
| **e2.** | Is percolation data available: | YES | NO |
| **2.0** | Proposed effluent discharge into: |  |  |
| **a.** | Ocean/Sea: |  |  |
| **b.** | Lake: |  |  |
| **c.** | River: |  |  |
| **d.** | Retention Size/Distance: |  |  |
| **e.** | Other: |  |  |
| **3.0** | Size of municipal main: |  |  |
| **4.0** | Distance of municipal: |  |  |
| **5.0** | Elevation of municipal: |  |  |
| **6.0** | Present capacity factor: |  |  |
| **7.0** | Adequacy over next 5 years: |  |  |
| **8.0** | Adequacy over next 15 years: |  |  |
| **9.0** | Reliability of system: |  |  |
| **10.0** | Annual fee/rent: |  |  |
| **11.0** | Are effluent standards establish: | YES | NO |
| **12.0** | Is copy of standard attached: | YES | NO |
| **13.0** | Name approving agency: |  |  |
| **Remarks:** | | | |
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CHECKLIST 8: FIRE PROTECTION

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| --- | --- | --- | --- |
| The following are services normally provided by municipal authorities. Please identify each service available and furnish as much data on each as possible: | | | |
| **1.0** | Is hotel within jurisdiction of a fire district: |  |  |
|  | Professional: | | |
|  | Private: | | |
|  | Volunteer: | | |
| **2.0** | Estimated response time: |  |  |
| **3.0** | How is alarm transmitted: |  |  |
|  |  | | |
| **4.0** | Type of firefighting equipment: |  |  |
| **5.0** | Describe rescue equipment: |  |  |
|  |  | | |
| **6.0** | Type of water connection(s) into building: |  |  |
| **7.0** | Volume of required water reserve: |  |  |
| **8.0** | Does fire code exist: | YES | NO |
|  | If yes, what standards are acceptable (NFPA/BS, etc.): | | |
| **9.0** | Is copy attached: | YES | NO |
| **10.0** | Inspection services during construction: | YES | NO |
|  | Final Inspection: | YES | NO |
| **11.0** | Approvals during construction: | YES | NO |
|  | Final Inspection: | YES | NO |
| **12.0** | Does controlling agency issue certificate of compliance: | YES | NO |
| **Remarks:** | | | |
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CHECKLIST 9: DISTRICT STEAM/HEATING HOT WATER

|  |  |  |  |
| --- | --- | --- | --- |
| **1.0** | Is district heating or steam available: | YES | NO |
| **2.0** | Size of Main: |  |  |
| Press: | | | |
| Distance: | | | |
| **3.0** | Quality of Steam or temperature/pressure of hot water: |  |  |
| **4.0** | Is condensate wasted: | YES | NO |
| **5.0** | Reliability: Total hours of service distribution annually: |  |  |
| **6.0** | Rate(s) - Summer/Winter: |  |  |
| Minimum Billing: | | | |
| Demand Charges: | | | |
| **7.0** | Are interruptible rate(s) available: | YES | NO |
| If yes, provide details: | | | |
| **8.0** | Is district hot water available: | YES | NO |
| If yes, provide details: | | | |
| **9.0** | Rate(s) - Summer/Winter: |  |  |
| Minimum Billing: | | | |
| Demand Charges: | | | |
| **10.0** | Are interruptible rate(s) available: | YES | NO |
| **11.0** | Incoming Temperature: |  |  |
| **12.0** | Incoming Pressure: |  |  |
| **13.0** | Leaving Temperature: |  |  |
| Maximum permitted, i.e. spread: | | | |
| **14.0** | Controlling Agency: |  |  |
| **15.0** | Lead Time: |  |  |
| **16.0** | Distance to main(s): |  |  |
| **17.0** | Adequacy of System over next 15 years: |  |  |
| **Remarks:** | | | |
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CHECKLIST 10: BOILER FUEL OPTIONS

|  |  |  |  |
| --- | --- | --- | --- |
| **1.0** | Identify each fuel - type available and cost: | | |
| **a.** | Gas | $ | |
| **b.** | Fuel Oil | $ |  |
| **c.** | Bio Mass | $ |  |
| **d.** |  | $ |  |
| **2.0** | Delivery time for each type: |  |  |
| **a.** | | | |
| **b.** | | | |
| **c.** | | | |
| **d.** | | | |
| **3.0** | Are roads accessible year round: | YES | NO |
| **4.0** | Limits of quality: |  |  |
| **5.0** | Largest on-site storage permitted: |  |  |
| **6.0** | Do emissions standards exist (attach): | YES | NO |
| **7.0** | Identify applicable codes: |  |  |
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| **Remarks:** | | | |
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CHECKLIST 11: TELEPHONE & TV

|  |  |  |  |
| --- | --- | --- | --- |
| **1.0** | Distance to nearest telephone exchange: | | |
| **2.0** | Quality of service: | YES | NO |
|  | Local: |  |  |
|  | Long Distance: |  |  |
|  | International: |  |  |
| **3.0** | Is direct dial available for: |  |  |
|  | Local: | YES | NO |
|  | Long Distance: | YES | NO |
|  | International: | YES | NO |
| **4.0** | Number of exchange lines allowable for the hotel: |  |  |
| **5.0** | Service interruption hours annually: |  |  |
| **6.0** | Is telex line available: | YES | NO |
| **7.0** | Does central office provide meter pulse: | YES | NO |
| **8.0** | Overall quality and reliability of telephone service: |  |  |
| **9.0** | Is TV available: |  |  |
|  | Standard Broadcast: | YES | NO |
|  | Satellite: | YES | NO |
|  | Cable: | YES | NO |
| **10.0** | TV Format: |  |  |
|  | NTSC | YES | NO |
|  | PAL | YES | NO |
|  | SECOM | YES | NO |
| **11.0** | Are TV broadcasts in color: | YES | NO |
|  | Black/White: | YES | NO |
| **12.0** | Indicate number of FM stations serving the area: |  |  |
| **13.0** | Are TV/FM Programmes listed in Newspapers: | YES | NO |
| **14.0** | Is copy attached: | YES | NO |
| **15.0** | If answer to 13 and 14 is no, please last type of programmes available, for example Music (classical, popular, rock, indigenous). | | |
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|  |  |  |  |
| **16.0** | Furnish similar data on AM stations only in the absence of FM stations. | |  |
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| **17.0** | Is there censorship for in-house movies: | YES | NO |
| **Remarks:** | | | |
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CHECKLIST 12: SAMPLE MECHANICAL LOAD SCHEDULE

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Description** | **Gross Floor Area (m2)** | **Cooling Load (W/ m2)** | | **Cooling Load (W)** | | **Heating Load (W/ m2)** | **Heating Load (W)** | **Fresh Air (l/s)** | **Supply Air** | |
| **Sensible** | **Latent** | **Sensible** | **Latent** | **l/s/lm2** | **l/s** |
| **Guest Room Areas** |  |  |  |  |  |  |  |  |  |  |
| Guest Rooms |  |  |  |  |  |  |  |  |  |  |
| Circulation, Stairs, etc. |  |  |  |  |  |  |  |  |  |  |
| **Public Areas** |  |  |  |  |  |  |  |  |  |  |
| Lobby/Reception |  |  |  |  |  |  |  |  |  |  |
| Restaurant |  |  |  |  |  |  |  |  |  |  |
| Branded Restaurant |  |  |  |  |  |  |  |  |  |  |
| Bar |  |  |  |  |  |  |  |  |  |  |
| Public WC |  |  |  |  |  |  |  |  |  |  |
| Cloakroom |  |  |  |  |  |  |  |  |  |  |
| Pre-Function Area |  |  |  |  |  |  |  |  |  |  |
| Function Rooms |  |  |  |  |  |  |  |  |  |  |
| Meeting Rooms |  |  |  |  |  |  |  |  |  |  |
| Board Room |  |  |  |  |  |  |  |  |  |  |
| Business Centre |  |  |  |  |  |  |  |  |  |  |
| Function Room WC |  |  |  |  |  |  |  |  |  |  |
| Function Cloaks |  |  |  |  |  |  |  |  |  |  |
| Shop |  |  |  |  |  |  |  |  |  |  |
| Leisure Centre (MD, Changing Facility) |  |  |  |  |  |  |  |  |  |  |
| **Administration** |  |  |  |  |  |  |  |  |  |  |
| General Manager |  |  |  |  |  |  |  |  |  |  |
| Secretary |  |  |  |  |  |  |  |  |  |  |
| Assistant Manager |  |  |  |  |  |  |  |  |  |  |
| Sales Office |  |  |  |  |  |  |  |  |  |  |
| Banqueting Manager |  |  |  |  |  |  |  |  |  |  |
| F&B Manager |  |  |  |  |  |  |  |  |  |  |
| PR Manager |  |  |  |  |  |  |  |  |  |  |
| Reception & Secretaries |  |  |  |  |  |  |  |  |  |  |
| Director of Accounts |  |  |  |  |  |  |  |  |  |  |
| Accounts Office |  |  |  |  |  |  |  |  |  |  |
| Front Office |  |  |  |  |  |  |  |  |  |  |
| Telephone & Switchboard |  |  |  |  |  |  |  |  |  |  |
| Front Office Manager |  |  |  |  |  |  |  |  |  |  |
| **Back of House** |  |  |  |  |  |  |  |  |  |  |
| Kitchen Cooking Area |  |  |  |  |  |  |  |  |  |  |
| Preparation Area |  |  |  |  |  |  |  |  |  |  |
| Pastry/Bakery |  |  |  |  |  |  |  |  |  |  |
| Dish wash |  |  |  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Description** | **Gross Floor Area (m2)** | **Cooling Load (W/ m2)** | | **Cooling Load (W)** | | **Heating Load (W/ m2)** | **Heating Load (W)** | **Fresh Air (l/s)** | **Supply Air** | |
| **Sensible** | **Latent** | **Sensible** | **Latent** | **l/s/lm2** | **l/s** |
| Bulk Store |  |  |  |  |  |  |  |  |  |  |
| Dry store |  |  |  |  |  |  |  |  |  |  |
| Refrigerated Stores |  |  |  |  |  |  |  |  |  |  |
| Banquet Kitchenette |  |  |  |  |  |  |  |  |  |  |
| Crockery & Linen Store |  |  |  |  |  |  |  |  |  |  |
| Beverage Store |  |  |  |  |  |  |  |  |  |  |
| Function Room store |  |  |  |  |  |  |  |  |  |  |
| General Stores |  |  |  |  |  |  |  |  |  |  |
| Staff Dining |  |  |  |  |  |  |  |  |  |  |
| Staff Changing |  |  |  |  |  |  |  |  |  |  |
| Maintenance Office |  |  |  |  |  |  |  |  |  |  |
| Maintenance Workshops |  |  |  |  |  |  |  |  |  |  |
| Maintenance Stores |  |  |  |  |  |  |  |  |  |  |
| Truck Deck/Loading Bay |  |  |  |  |  |  |  |  |  |  |
| Receiving Area |  |  |  |  |  |  |  |  |  |  |
| Control Room/Time Keeper |  |  |  |  |  |  |  |  |  |  |
| Garbage Store |  |  |  |  |  |  |  |  |  |  |
| Refrigerated Garbage |  |  |  |  |  |  |  |  |  |  |
| Empty Bottle Store |  |  |  |  |  |  |  |  |  |  |
| **Plant Rooms** |  |  |  |  |  |  |  |  |  |  |
| Boiler Room & Mechanical |  |  |  |  |  |  |  |  |  |  |
| Transformer Room & Electrical |  |  |  |  |  |  |  |  |  |  |
| Generator |  |  |  |  |  |  |  |  |  |  |
| Telecom Equipment |  |  |  |  |  |  |  |  |  |  |

CHECKLIST 13: SAMPLE ELECTRICAL LOAD SCHEDULE

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Description** | **Gross Floor Area (m2)** | **Mechanical Load (incl. A/C Plant)** | | **Lighting & Power** | | **Total Load (kVA)** | **% Essential Load** | | **Essential Load** | **Non­Essential Load** |
| **VA/m2** | **Total (kVA)** | **VA/im2** | **Total (kVA)** | **Mech. Services** | **Lighting & Power** |
| **Guest Room Areas** |  |  |  |  |  |  |  |  |  |  |
| Guest Rooms |  |  |  |  |  |  |  |  |  |  |
| Circulation, Stairs, etc. |  |  |  |  |  |  |  |  |  |  |
| **Public Areas** |  |  |  |  |  |  |  |  |  |  |
| Lobby/Reception |  |  |  |  |  |  |  |  |  |  |
| Restaurant |  |  |  |  |  |  |  |  |  |  |
| Branded Restaurant |  |  |  |  |  |  |  |  |  |  |
| Bar |  |  |  |  |  |  |  |  |  |  |
| Public WC |  |  |  |  |  |  |  |  |  |  |
| Cloakroom |  |  |  |  |  |  |  |  |  |  |
| Pre-Function Area |  |  |  |  |  |  |  |  |  |  |
| Function Rooms |  |  |  |  |  |  |  |  |  |  |
| Meeting Rooms |  |  |  |  |  |  |  |  |  |  |
| Board Room |  |  |  |  |  |  |  |  |  |  |
| Business Centre |  |  |  |  |  |  |  |  |  |  |
| Function Room WC |  |  |  |  |  |  |  |  |  |  |
| Function Cloaks |  |  |  |  |  |  |  |  |  |  |
| Shop |  |  |  |  |  |  |  |  |  |  |
| Leisure Centre (MD, Changing Facility) |  |  |  |  |  |  |  |  |  |  |
| **Administration** |  |  |  |  |  |  |  |  |  |  |
| General Manager |  |  |  |  |  |  |  |  |  |  |
| Secretary |  |  |  |  |  |  |  |  |  |  |
| Assistant Manager |  |  |  |  |  |  |  |  |  |  |
| Sales Office |  |  |  |  |  |  |  |  |  |  |
| Banqueting Manager |  |  |  |  |  |  |  |  |  |  |
| F&B Manager |  |  |  |  |  |  |  |  |  |  |
| PR Manager |  |  |  |  |  |  |  |  |  |  |
| Reception & Secretaries |  |  |  |  |  |  |  |  |  |  |
| Director of Accounts |  |  |  |  |  |  |  |  |  |  |
| Accounts Office |  |  |  |  |  |  |  |  |  |  |
| Front Office |  |  |  |  |  |  |  |  |  |  |
| Telephone & Switchboard |  |  |  |  |  |  |  |  |  |  |
| Front Office Manager |  |  |  |  |  |  |  |  |  |  |
| **Back of House** |  |  |  |  |  |  |  |  |  |  |
| Kitchen Cooking Area |  |  |  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Description** | **Gross Floor Area (m2)** | **Mechanical Load (incl. A/C Plant)** | | **Lighting & Power** | | **Total Load (kVA)** | **% Essential Load** | | **Essential Load** | **Non­Essential Load** |
| **VA/im2** | **Total (kVA)** | **VA/im2** | **Total (kVA)** | **Mech. Services** | **Lighting & Power** |
| Preparation Area |  |  |  |  |  |  |  |  |  |  |
| Pastry/Bakery |  |  |  |  |  |  |  |  |  |  |
| Dish wash |  |  |  |  |  |  |  |  |  |  |
| Bulk Store |  |  |  |  |  |  |  |  |  |  |
| Dry store |  |  |  |  |  |  |  |  |  |  |
| Refrigerated Stores |  |  |  |  |  |  |  |  |  |  |
| Banquet Kitchenette |  |  |  |  |  |  |  |  |  |  |
| Crockery & Linen Store |  |  |  |  |  |  |  |  |  |  |
| Beverage Store |  |  |  |  |  |  |  |  |  |  |
| Function Room store |  |  |  |  |  |  |  |  |  |  |
| General Stores |  |  |  |  |  |  |  |  |  |  |
| Staff Dining |  |  |  |  |  |  |  |  |  |  |
| Staff Changing |  |  |  |  |  |  |  |  |  |  |
| Maintenance Office |  |  |  |  |  |  |  |  |  |  |
| Maintenance Workshops |  |  |  |  |  |  |  |  |  |  |
| Maintenance Stores |  |  |  |  |  |  |  |  |  |  |
| Truck Deck/Loading Bay |  |  |  |  |  |  |  |  |  |  |
| Receiving Area |  |  |  |  |  |  |  |  |  |  |
| Control Room/Time Keeper |  |  |  |  |  |  |  |  |  |  |
| Garbage Store |  |  |  |  |  |  |  |  |  |  |
| Refrigerated Garbage |  |  |  |  |  |  |  |  |  |  |
| Empty Bottle Store |  |  |  |  |  |  |  |  |  |  |
| **Plant Rooms** |  |  |  |  |  |  |  |  |  |  |
| Boiler Room & Mechanical |  |  |  |  |  |  |  |  |  |  |
| Transformer Room & Electrical |  |  |  |  |  |  |  |  |  |  |
| Generator |  |  |  |  |  |  |  |  |  |  |
| Telecom Equipment |  |  |  |  |  |  |  |  |  |  |

CHECKLIST 14: BUILDING AIR BALANCE SUMMARY FORM (SAMPLE)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Location** | | **Fresh Air Supply (l/s)** | **Exhaust (l/s)** | **Balance (+/- l/s)** |
| **1.0** | **Guest Floors (Floor by Floor)** |  |  |  |
|  | Guest/Bathrooms |  |  |  |
|  | Corridors/Services |  |  |  |
|  | **TOTAL** |  |  |  |
| **2.0** | **Public Areas (Floor by Floor)** |  |  |  |
|  | Lobby/Restaurant/Restrooms |  |  |  |
|  | Kitchen |  |  |  |
|  | Ballroom/Meeting/Function Rooms |  |  |  |
|  | Retail |  |  |  |
|  | Health Club |  |  |  |
|  | **TOTAL** |  |  |  |
| **3.0** | **Back of House** |  |  |  |
|  | Offices |  |  |  |
|  | Service Corridors |  |  |  |
|  | Laundry |  |  |  |
|  | Staff Areas |  |  |  |
|  | Maintenance |  |  |  |
|  | Storage |  |  |  |
|  | Car Park |  |  |  |
|  | **TOTAL** |  |  |  |
|  | **OVERALL TOTAL** |  |  |  |

SMOKE DETECTOR - 1 PER 80m2 .

MINIMUM 2No DETECTORS PER AREA COVERED

1 FROM SPRINKLER SYSTEM (HEAT TRACE IF EXTERNAL)

2 ISOLATING VALVE

3 SPRINKLER WATER CONTROL VALVE

4 LOCAL ALARM - BELL OR SOUNDER

• PENDANT HEAD - CHROME PLATED FINISH [No. OF HEADS DEPENDS ON ROOM SIZE OR 1 HEAD PER 12 M MAX)

MAINTENANCE & TESTING TO NFPA 25 REQUIREMENTS