



HOTEL PURE

SWITT JIENJITLERT

A THESIS SUBMITTED IN PARTIAL
FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

BACHELOR OF ARCHITECTURE

DEPARTMENT OF INTERIOR ARCHITECTURE
SCHOOL OF ARCHITECTURE AND DESIGN
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ID 511-5002

**A Thesis Submitted in Partial
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For the Degree of**

Bachelor of Architecture

**Department of Interior Architecture
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Thesis Approved:

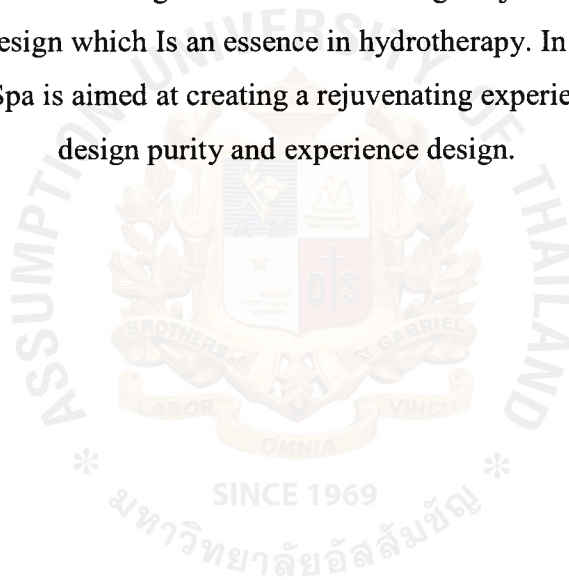
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Abstract

The Pure was designed with the thought of an easy rejuvenating getaway for city dwellers. Using the arts of hydrotherapy, that greatly aids in detoxification of the skin and colon, acne, arthritis, colds, depression, headaches, stomach problems, muscle problems, and stress. By using the specific type of treatment, the project aims at providing guests with the sensation experience offered by hydrotherapy through design and facilities. The project is located on an old building project located on the Petchaburi road, which formerly houses the Sharp company office. The design approach takes the flow of water and created a concept based on each segments of the movement, aiming at creating movement within the static model. The design also aims at creating a rejuvenating experience and creating a purity of design which is an essence in hydrotherapy. In conclusion, The Pure Boutique Hotel and Spa is aimed at creating a rejuvenating experience for guest through design purity and experience design.



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First and foremost, I would like to thank my family for all their love and support. Without them, I would not be able to, or even have the opportunity, to embark on this quest in the pursuit of my passion and desire. They were there to support me through thick and thin, believing in me when I am lost, and giving unconditional love to me when I needed it most. It was them in the first place that convinced me to stay on course when I lost hope and too tired to go on.

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Chapter 1 : Thesis Introduction

1.1 Thesis Background

The daily city life is always in a state of hurry. The society of those willing to achieve a better living for themselves would rarely find time for the mind and body to relax. What should have been a balance between work and life have been overpowered by the ever increasing pace of competitions, where everyone is seizing every chance they can get. It is this society we all accept to live and thrive in, but does our physical and mental health agree with this?

The daily routines of city dwellers are always challenging physically and mentally, no matter what social class and occupational field you are in. The endless exposure to pollutions and chemicals emitted from the machineries that runs our society is inevitable. Also as a country where the climate is considerably hot, it damages our skins and decreases the chances of our proper bodily function. The daily tasks that we face each day increase the mental stress that we bring back with us each day and never be free of it.

These factors are the causes of the physical pain and mental stress that have been collecting in our minds and bodies for a long time that finally lead to the emergence of many spas and gyms in Bangkok, for those who are interested in their well being. In recent years, there is a trend that has been set by the society in order to encourage city dwellers to pay more attention to their well being. Not only does taking care of the body and soul benefit your well being, it also makes you a more productive and optimistic person as well.

Hydrotherapical spas are a good way to relieve both physical and mental stress. It is most suited for the city dwellers that it, among of its many benefits, purifies the body from the toxins and chemicals that have been accumulated in our body. The concentration of these toxic negativities on the skin of people in the city is considerably higher than to people living in rural area with clean environment.

For my thesis project, I would like to present a Health minded hotel, located in the city which will serve as a healthy destination for locals and tourists offering a rejuvenating experience to the hotel's customers. Each the course would take place for several days, and daily visitors can access the spa for a minor course.

The research conduct would aim to create useful data to determine the specifications that are needed to efficiently design the hotel and the spa, which would be the main programs in the project. Other researches would assist the design such as the hotel, the mental experience, and other supporting facilities.

1.2 Study Defined

The physical fatigue and mental stress of the city dwellers can and should be more properly addressed. In support of this statement, it is evident that the competitiveness in the spa and gym market have been increasing in an alarming pace, and each of them tends to offer a unique experience in one way or another. The factor that seems to be affecting city dwellers more than any other people is the high exposure to pollution and chemicals in the city that are caused by the concentration of toxic emitting machineries.

For my thesis project, I propose a boutique hotel with the focus on health rejuvenation treatments of hydrotherapy. Hydrotherapy treatment offers many benefits that would address the problems of the dwellers better than other types of spa treatments. The other facilities would indulge the wellness experience for the visitors. The hotel would be an attraction for both locals and foreigners with healthy mind. The program will provide many courses ranging from an hour up to days.

1.3 Thesis Statement

A boutique hotel that would focus on health rejuvenating experience through hydrotherapy. The goal of the hotel is to create a rejuvenating experience for the visitors through design, program, and ambience. It will serve the needs of the city dwellers both local and foreign customers.

1.4 Research Scope

- Research on the systems and benefits of hydrotherapy, and how to efficiently create a spa that can maximize its functions.
- Research aimed on the behavioral mentalities of the customers to create programs that suit the needs.
- Research on the competitive market to ensure the hotel design edges those that are already available.
- Research and case studies on existing hotels that are similar in terms of design and facilities to strengthen my hotel design to offer a more suitable and healthy experience.
- Research aimed at the functions of supporting facilities to make adjustments that would serve and empowers the overall experience of the hotel.

1.5 Design Scope

- The Hotel Lobby
- The Hotel Rooms
 - o Standard Room
 - o Deluxe Room
 - o Suite Room
- The Hotel Facilities
 - o Health Restaurant
 - o Hydrotherapy Spa
 - Reception
 - Changing rooms + WC
 - Main pool
 - Hydrotherapy treatment rooms
 - Massages
 - o Fitness Facilities
 - Standard gym
 - Yoga room
- Staff facilities
 - o Finance Office
 - o Staff lounge
 - o Staff lavatory

Chapter 2: Project Type Research

2.1 Literature Research

Literature researching collects the information needed to implement the design and program of the hotel. In this part, I have divided parts of the literature research into topics that are related to the research scope specified in Chapter 1.4.

2.1.1 Definition of a Hotel

There are many different types of hotels. They cater for - or serve - different types of customers which in this case are called 'hotel guests'.

All hotels, however, have one common function, which is:

“To provide accommodation.”

In the hotel context, the word 'accommodation' means a place to stay, and especially a place in which to sleep, that is, a "lodging place". In addition to a room in which to sleep, furniture – and particularly a bed - will be provided, as will wash/bathing facilities and toilet facilities. Some hotels provide accommodation for long-staying guests, sometimes called "permanent residents". But the majority of hotels provide accommodation for relatively short-staying and temporary residents, and a very large proportion of such people are 'travelers'.

By "travelers" we mean those who are away from their "homes" - the places where they normally reside. With the exception of commercial travelers and others whose occupations require them to be constantly "on the move", most people live the greater part of the year at home. In the course of their daily lives most people leave their homes quite often for one reason or another: to go shopping, to go to work, to attend educational and/or training classes, to visit friends and relations, to engage in sporting activities or for recreation, and so on; the reasons can be many and varied. But, in general, they return to their homes at night.

However, more and more people are spending part of the year “away from home” - on business, on holidays/vacations, or for other reasons - and many of them stay in hotels whilst they are away from home. Many travelers require more from hotels than accommodation alone; they have other needs or wants to be provided for. We therefore see that the primary function of hotels is:

*“To provide accommodation for those away from home,
and to supply such people with at least their basic needs.”¹*

*Source: Cambridge International’s College guide to Hotel Operations & Management
p.8*

2.1.2 Categorizing the Program: Boutique hotels & Lifestyle hotels

A boutique is defined by the Webster’s dictionary as “a small fashionable specialty shop or business”. While the term is used liberally, there has been no commonly agreed definition of “boutique hotel.”

To provide greater clarity for the current meaning of the terms “boutique hotel” and “lifestyle hotel”, the research points out to perceived differences between the boutique and lifestyle hotels, indicating that the aesthetics of a lifestyle hotel, as opposed to that of a boutique hotel, are more contemporary, with unique design and architecture, and a high technology touch. A lifestyle hotel offers more ancillary services and is focused on wellness and life-enrichment. More specifically, a lifestyle hotel would not be a small, historic property, which would be categorized more appropriately as a boutique hotel.

Researching further the difference between the Lifestyle Hotels and Boutique hotels, the research formulated a list of Emerging Definitions, as well as Emotions and Experiences that define the boutique and lifestyle hotel experience. Among them are Discovery, Curiosity, Intrigue, Amazement; Social, Joyful, Sensual, and Romantic.

Among the characteristics that define a Lifestyle Hotel are: innovative, personal (vs “branded”), contemporary and modern.

¹ Hilary, G. (2006). *Cambridge’s International Guide to Hotel and Operations*. Cambridge University. Jersey, Britain.

Boutique hotels are described as personalized, customized, unique, and individual. The most important defining features of boutique hotels are cultural, historical, authenticity; the boutique hotel is not part of a chain and that it provides interesting, unique services. Other important defining descriptors of boutique hotels include, “social spaces such as living rooms, libraries with social rooms” and “many, high-quality in-room features”.²

In support to the extracted piece written by Dr. Jonathan Day of Purdue University, my thesis project should be categorized as a “Lifestyle Hotel” due to the facts that the hotel project aims to set a wellness program, enriched by a course aimed to create a wellness experience for the user. By defining the type, it allows the program to be more specific and the design to have a more direct approach.

2.1.3 Hotel Functions

Lobby

A lobby is a room in a building which is used for entry from the outside. Sometimes referred to as a foyer or an entrance hall. Many office buildings, hotels and skyscrapers go to great lengths to decorate their lobbies to create the right impression and convey an image, or "power lobby". Since the mid-1980s there has been a growing trend to think of lobbies as more than just ways to get from the door to the elevator, but instead as social spaces and places of commerce.

The hotel lobby is no longer a transient waiting room between the front door and the guestroom. Formerly a pit stop on the way to the guestroom, the lobby has changed in function, aesthetic, and program. It has become the epicenter of a hotel, where you can hold a quick meeting, grab a drink and a bite to eat, or gather in a casual social setting. To accommodate this trend, hotel chains across the industry are incorporating the concept of multi-functional schemes into their lobby designs.

This new direction of multi-function and flexibility is derived directly from the needs and wants of guests and the community. People today are savvier in their hotel

² Day, J. (2012). *What is a Boutique Hotel?*. Purdue University. Indiana, United States.

selection, and they're no longer looking for the cheapest rooms. They are looking for the "experience." As part of this experience, people want the lobby to be a place to socialize, work, and relax - all in a warm and inviting atmosphere.

Major hotel brands are already implementing these changes in their properties, and owners are reaping the rewards. Sheraton has introduced the "Link @ Sheraton" into its properties, which is a place for people to stay connected, but in a setting that is closer to a lounge than an enclosed business center. Hampton Inn by Hilton has created its "Perfect Mix Lobby," which features fresh, contemporary finishes; communal tables; and the ability to close off the buffet area in order to transform the space into a casual gathering area after breakfast hours.

Marriott is reinventing its full-service lobbies by creating multiple zones - such as Relaxing, Individual, and Business - all within the same lobby space. Courtyard by Marriott has also unveiled its new lobby scheme, which creates a welcoming space with flexible seating, private media centers, an intimate lounge area, and communal spaces. In addition to promoting social interaction, it has replaced the traditional front desk with welcome podiums that encourage guests to establish personal connections while interacting with their host.

As hotels continue to focus on the "experience," drawing the guests out of their rooms and into a social community, it's even more important to understand the impact of the lobby. A successful property is no longer the one that simply provides good service and clean rooms. The lobby area is now the place to bring a client, the place to see and be seen. It's the neighborhood lounge and favorite hotspot - the place that people feel proud to call part of their community.³

According to the article, today's trend of hotel lobby are evolving into a multi-purpose area that would serve as a meeting and resting place for both residences and non-residences. Although the examples in the article may refer to functions of the lobby are more business-based such as the Marriot and the Sheraton group, we can still bring the

³ Wheeler, H. (2009). *Transforming the idea of the Hotel Lobby*.

Retrieved from <http://www.buildings.com/article-details/articleid/8140/title/transforming-the-idea-of-the-hotel-lobby.aspx>

idea into Lifestyle hotels. The lifestyle hotel can still encourage residence to come out of the room and interact with other people if we can offer an experience or a specialty function in the lobby such as a small health bar and creating a zoning structure that provides for the public and private needs.

Standards of a Lobby

Will provide a general heating and air-conditioning system (for closed hotels).

A separate counter will be located near the main entrance which will control bellboys, left luggage and car-park attendants.

Front Desk- Concierge will have a joint counter (or a counter for each section), with computers fitted into the back.

A Sol 5 star corporate bell will be placed on top of the Front Desk counter

A Public Relations table must be placed in the lobby area, near the Front Desk- Concierge counter, with a telephone and computer connection.

A display cabinet/unit will be located in the lobby for individual brochures pertaining to Sol 5 star hotels for cross selling actions.

The hotel must have a sufficient number of public telephones according to the amount of beds they have available. They should provide a notebook and a pen, and will be separated by a wall or booth.

Telephones for internal calls should be installed on the front-desk while telephones for external calls should be installed in phone booths. Public coin-operated telephones can be installed in those hotels where local regulations allow.

At least one public telephone must be adapted for use by handicapped guests.

Guestroom

Standard rooms: will be comprised of an entrance hall, bedroom, cupboard, bathroom and terrace (Optional for City hotels)

Surface area: 22 m² excluding entrance hall, terrace and bathroom

Height: 2.7 m

Terrace: 8 m²

Bathroom surface: 6 m²

Superior rooms are standard rooms that are larger or better located

Junior Suite model A: Will have a lounge area in the same room. This area may provide a sofa (or sofa bed) with two armchairs and a TV if the one in the bedroom isn't visible

Surface area: 28 m² excluding entrance hall, terrace and bathroom

Junior Suite model B: Rooms comprised of two separate areas with entrance hall, bedroom, cupboard, bathroom and a lounge

Surface area: 40 m² excluding entrance hall, terrace and bathroom

Suites: comprised of three areas. The bedroom and lounge areas must be two separate rooms (the division must be a built wall). They will have an entrance hall, bedroom, cupboard, two bathrooms and one or two lounges

Surface area: 70 m² excluding entrance hall, terrace and bathroom

Presidential Suites (or equivalent): unique rooms comprised of separate areas: entrance hall, bedroom, two bathrooms, two lounges (meeting room and lounge-dining room), kitchen with scullery and service room

Surface area: 96 m² excluding entrance hall, terrace and bathroom

Rooms for handicapped guests: all hotels should comply with existing legislations in each region or country concerning facilities for handicapped guests.

In those locations that the legislation does not specify a minimum number of rooms that should be equipped for the handicapped, the hotel will assign a certain number (minimum 1).

The assigned room will be double, free of obstacles, with wide hallways and bathrooms, doors with a width of 90 cm and connected to another room.

They will try to be located on lower floors, near a lift or an emergency exit.

Access to rooms and common areas should not be hampered by architectural barriers. If necessary a chair lift or constructed or portable anti skid ramps will be provided.⁴

In my thesis project, I plan to offer 3 types of rooms. It would include the Standard room, the Superior room, and the Suite and also include rooms for disabled guests. The 3 room types should be sufficient to implement the levels of experience offered and enough variation in price range. The rooms will be supplied with a hydrotherapical shower or bath to support the overall experience of the hotel.

Hydrotherapy Baths and Showers

Hydrotherapical baths and showers are fitted with specialized water jets aimed at various parts of the body, while baths have been designed for better circulation of water in the bath and extra climate control implemented. Both baths and showers are available in the form of a complete package ready for installation, or individual nozzle and jet sprays installed in a space designed for each function.

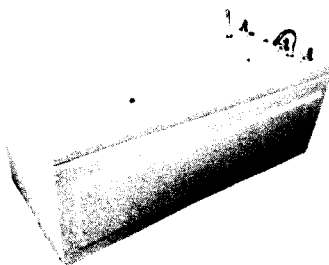


Figure 2.1.1 – Complete Bath w/ jet sprays



Figure 2.1.2 – Jet spray modules

⁴ Mai-Bs. *Master Standards for 5 Star Hotel in Thailand*.
Retrieved from <http://www.mai-bs.com>

Restaurant

Over the past ten years, boutique hotels have evolved their food and beverage offering to match the level of creativity/design witnessed within their guest rooms and public areas. In fact, restaurateurs have seized the reins of the 'food and beverage' operations whilst hoteliers continue to treat the 'food and beverage department' as exactly that, provision of food and beverage for their customers. Guests call these spaces 'restaurants and bars'. Restaurateurs and everyone else in the food and beverage industry view these outlets as concepts, operations and businesses in their own right, as opposed to accessories to the hotel. The involvement of restaurateurs in the idea of the 'hotel restaurant' has completely transformed the notion of what a hotel's dining room and lobby bar could (and should) be. Landmark restaurants, signature bars, often several within one hotel, are now necessary.

It is clear that boutique market has helped develop and evolve the food and beverage offering within hotels, with consumers now expecting a high level of design and creativity to be consistent throughout the hotel. Hotels are no longer able to get away with passable restaurant offerings. Looking forward, we expect further partnerships to evolve between the chef and the hotel in creating truly stand alone offerings drawing in outside custom. The branded chains are also introducing high design into their public areas and in some cases recruiting third party creative consultancies to assist in establishing successful independent outlets. Hoteliers, whether independent or chain affiliated, have had fundamentally to rethink their approaches to hotel food and beverage to compete with the creativity of independent restaurateurs.

By becoming more independent and distinct destinations within boutique hotels, restaurants and bars in hotels have started to become exclusive places for guests and specific clientele that would fit into that environment. This, in turn, has been attracting a more sophisticated 'crowd' who like to enjoy elegant facilities within a fairly exclusive environment, without the daunting fees and complicated initiation processes required in many private members' clubs and bars.⁵

⁵ Balekjian, C. (2011). *Boutique hotel: The Challenge of Standing out from the crowd*. HVS. London, UK

A hotel restaurant now more than ever, particularly in city hotels, has become a main part of the hotel. Its ability to attract and draw customers, both residences and non-residences, to participate in its function is a great source of revenue for the hotel. Restaurant in hotels are now considered more than just a 'hotel restaurant' but rather a unique and exclusive experience for the visitors and community.

As this is a hotel solely focusing on the wellness experience of the visitors, the restaurant can be able to design a program that supports the experience too.

Standards of a hotel restaurant

Aprox. Room capacity: Resort hotels 0.75 m² x seat available plus 100 m² for buffet and scullery; City hotels 1 m² x room available plus space for the buffet and scullery.

The main restaurant should have the largest capacity, as it is where the main meals will be served with a buffet service and show cooking.

Decoration can vary depending on the atmosphere we wish to create. The decorations must be fireproof. Furniture should be positioned depending on the layout of the premises.

Should provide service sideboards, trolleys for presenting desserts, cheese and special dishes. The buffet should be made of high quality materials.

Should provide air-conditioning. If it's an open restaurant it should have fans.

Piped music (optional) and a public address system will be available and controlled from the outlet itself.⁶

⁶ Mai-Bs. *Master Standards for 5 Star Hotel in Thailand*.
Retrieved from <http://www.mai-bs.com>

2.1.4 Building materials

Volatile Organic Compound (VOC)

Volatile organic compounds (VOCs) and other hazardous chemicals are contained in many construction materials and furnishings, posing a risk to public health. Today a number of low and no VOC building materials are available, including less polluting paints, adhesives, solvents, cleaning agents, caulks, wood products, carpets and sealants.

Using low-VOC building products for new construction and remodeling projects can significantly reduce the emission of smog-forming compounds. New homes and commercial buildings generally have VOC concentrations that are two to ten times higher than comparable older structures. These elevated levels have been linked to eye and respiratory irritation, headaches, fatigue and other symptoms associated with “sick building” syndrome.

In general, manmade materials such as paints, adhesive, and sealants generate a high amount of VOC content than those of natural sources. In a wellness space, it is important that the space itself does not harm the users carrying out the program. In my thesis project, the building material choice is will be based on these factors in order to create space that supports the program.

2.1.5 Spa Research

Hydrotherapy pool

A hydrotherapy pool is ideally below ground, to allow ease of entrance and exit. It must also be large enough for users to carry out activity inside the pool. The pool should be no smaller than 9.25m by 4.57m for approximately 8 people to carry out their activity. The depth of the pool is ideally between 0.84m – 1.42m, or around a person's lower end of sternum to shoulder height. The pool should be installed with water jets and designed seating position within the pool for hydrotherapeutic massage.



Figure 2.1.1 - Hydrotherapy pool

Aromatherapy

Aromatherapy is commonly used in hydrotherapy by scenting the water with natural extract of flowers and oils. The most common scents and oils are;

Chamomile

The flowers of the chamomile plant look like tiny daisies but smell like apples instead. Grown for many years now because of its various healing properties, chamomile is best known for its calming effects, thus helping one to achieve a very restful sleep. It is also effective for relieving the symptoms of PMS, menopause and hyperactivity among kids. The oil from chamomile flowers can help ease muscle aches and tensions, headaches and joint pains. Drinking tea made from the petals helps stimulate appetite and calm upset stomach. Unlike other essential oils, chamomile is mild enough to help ease your baby's colic, thus helping him or her achieve sleep.

Eucalyptus

With about 300 varieties, eucalyptus has long been a vital ingredient in cough medications because its scent, which helps open up and clear nasal passages. Eucalyptus oil is also used to scent mouthwashes, aftershaves, colognes and other household cleansers. The effects of eucalyptus on the mind and body include: relief from mental fatigue, improves mental alertness, lessen muscle tension and help boost the immune system. It is also a widely-used disinfectant and insect repellent. However, if used in large amounts, eucalyptus essential oil can be toxic. Also, while it is great for relieving the symptoms of sinusitis and lung congestion, it is not intended for use during an asthma attack.

Lavender

Lavender has long been associated with cleanliness ever since the Romans first used it as an additive to their bathwater. Today, it is still a favorite for scenting perfumes, soaps, air fresheners, fabric softeners, disinfectants and many others. Lavender is one of the safest and most widely-used essential oils, known to have an uplifting and relaxing effect. If used in large amounts, lavender can be stimulating. It also helps improve

digestion, reduce swelling, ease muscle tension and is proven effective for treating minor skin injuries such as burns, cuts, scrapes, and rashes.

Peppermint

Peppermint is popular because of its powerful, mint and distinctive fragrance. It is a common ingredient in all sort of products like ice cream, liqueurs, mouthwashes, toothpastes, desserts, cosmetics, household cleansers and many more. Peppermint essential oil is used in liniments to increase blood flow to a body part, thus relieving muscle spasms and arthritis. It is also known to uplift the mood, relieve mental fatigue, improve alertness and enhance memory. Known to be able to kill many bacteria and viruses, peppermint is used for treating ringworm, scabies, herpes simplex and poison oak.

Rosemary

With its herbaceous, woody and camphorous odor, it is not surprising that rosemary has a wide variety of uses, from the ancient times until today. It became a staple during weddings and funerals in the ancient times. It was used as an ingredient in cosmetics as early as the 14th century. Today it is a popular ingredient in liniments, massage oils and bath products. Rosemary is excellent in improving blood circulation, relieving sore throat and lung congestion, and helpful in improving digestion.

It also helps relieve mental fatigue, uplift the mood and enhance mental alertness and memory when used as an aromatherapy scent.

Essential Oils

Essential oils are distilled, usually by steam or water, from various parts of the source plant such as leaves, stems, petals, roots and other parts. They are highly concentrated and contain no artificial fragrances. When applied to the skin or inhaled, the composition and scent of these oils can provide many physical and psychological benefits.

They are often sold in small bottles and can greatly vary in price, depending on the rarity of the plant, the amount of oil produced by the plant and other standards. Because they are in pure form, essential oils are often diluted with carrier oils prior to usage.

Carrier Oils

Since essential oils are very much concentrated and may cause severe irritations and other reactions in some people, carrier oils are used to dilute them. Carrier oils are derived from the fatty portions of the plant, such as the seeds, nuts and kernels. Sometimes called vegetable oils, each one of them carries different therapeutic benefits, depending on what is being sought.

Carrier oils got scents of their own, although they may not be as strong as those from essential oils. Some of the natural lotions, body creams, massage oils, bath oils and other skin care products are made from carrier or vegetable oils. The choice of carrier oils where essential oils are added to can make a difference in the properties, effects, color, scent and shelf life of the final product.

Fragrance Oils

While essential oils are natural because they are made of the distilled essences of the plants where they came from, fragrance oils, on the other hand, are artificial scents – they contain artificial substances and are diluted with carrier oils. You might have also encountered items like perfume oils or potpourri oils, but they are basically just the same as fragrance oils, considering how they were made.

Unfortunately, fragrance oils do not carry the same therapeutic benefits offered by essential oils. Many scented cosmetics, candles, skin-care products like lotions and soaps, and others only contain fragrance oils or other synthetically-made fragrances. You have to read the labels carefully if you intend to use only natural ingredients in achieving relaxation and holistic caring.

Infused Oils

Infused oils are simply carrier oils infused with herbs. They are especially intended for certain plants that simply do not have much essential oils in them, or when it is virtually impossible to find essential oils extracted from those plants.

The good thing about using infused oils in aromatherapy than just plain carrier oils is that the combined therapeutic benefits of the carrier oils and the herbs infused into them are achieved. Infused oils are generally oily to the touch, depending on the consistency of the carrier oils used. Unlike essential oils, infused oils can go rancid over time, just like carrier oils.

Hydrotherapy showers

Hydrotherapy showers are usually the same size as normal showers but fitted with water jet nozzles for applying hydro massage. It takes less space than a hydrotherapy pools, and offers a good result in muscle pain relief as the water intensity is higher and the water is constantly changing. It is not commonly used with aromatherapy.



Figure 2.1.2 - Hydrotherapy showers

Hydrotherapy massage bed

A hydrotherapy massage bed is a solid bed with jet spray nozzles placed above the bed for hydro massage use. It has similar advantages as a normal vertical hydrotherapy shower but it can be used with massaging therapy with the help of a masseur.



Figure 2.1.3 - Hydrotherapy massage bed

Steam room

Steam rooms are specially designed enclosed space to control the temperature through water steam. It is commonly operated at 45°C – 48°C . The steam room is the best way to detoxify the skin through sweating. Steam rooms also help the user relax, lower your blood pressure, and remove salt from the skin resulting in weight loss. Steam rooms can be used with aroma therapy to use the moist as a device to let skin extract useful minerals from them.

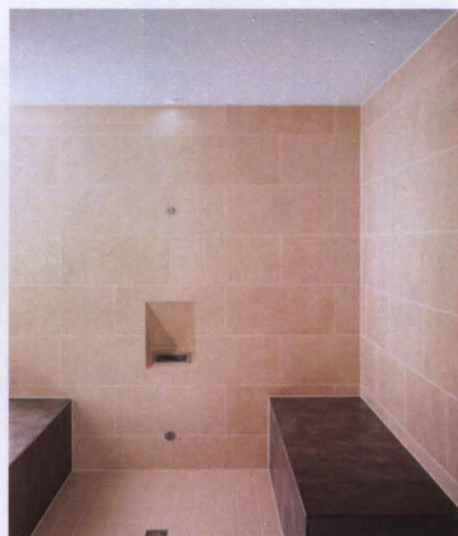


Figure 2.1.4 - Steam room

2.1.6 Site Study

The Petchaburi Road

The Petchaburi road is a considerably important road in the Bangkok city. It links to many major roads and parts of the city such as Thonglor, Ekamai, Sukhumvit, Asok, Rachada, and Rachatejvi. The road has a considerably high amount of traffic congestion, as expected in the city of Bangkok, which is more severe during the morning and evening rush hours. The buildings along the Petchaburi road are mostly office buildings, with the occasional local store popping up here and there.

The Site and nearby Point of Interests

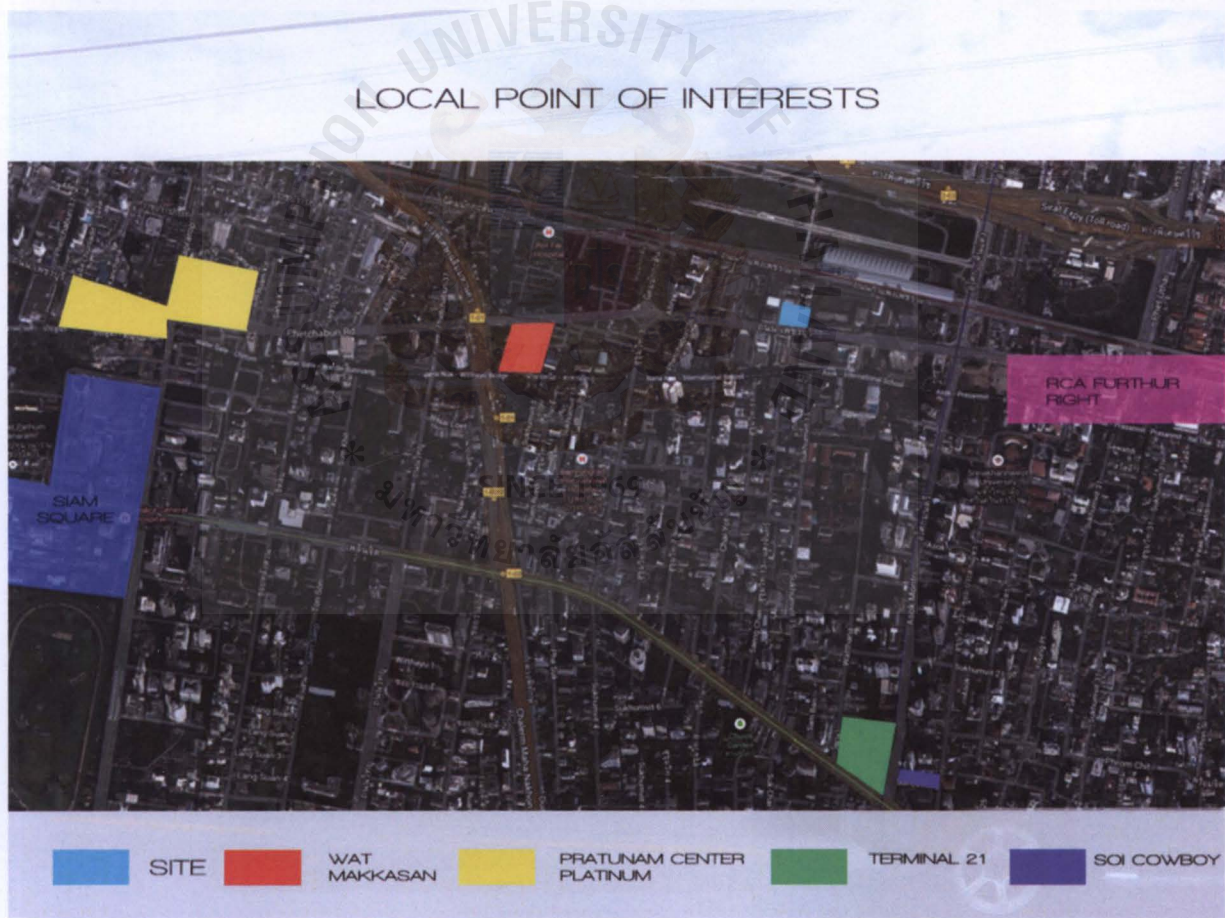


Figure 2.1.5- Local Point of Interests

The site has a fairly high amount of attraction for visitors, mostly shopping districts and night life, but none of them are within walking distance. It would not be difficult to take a cab or bus ride to these points as they are not very far (3-5km).



Figure 2.1.6 - View of site approached from Petchaburi Road

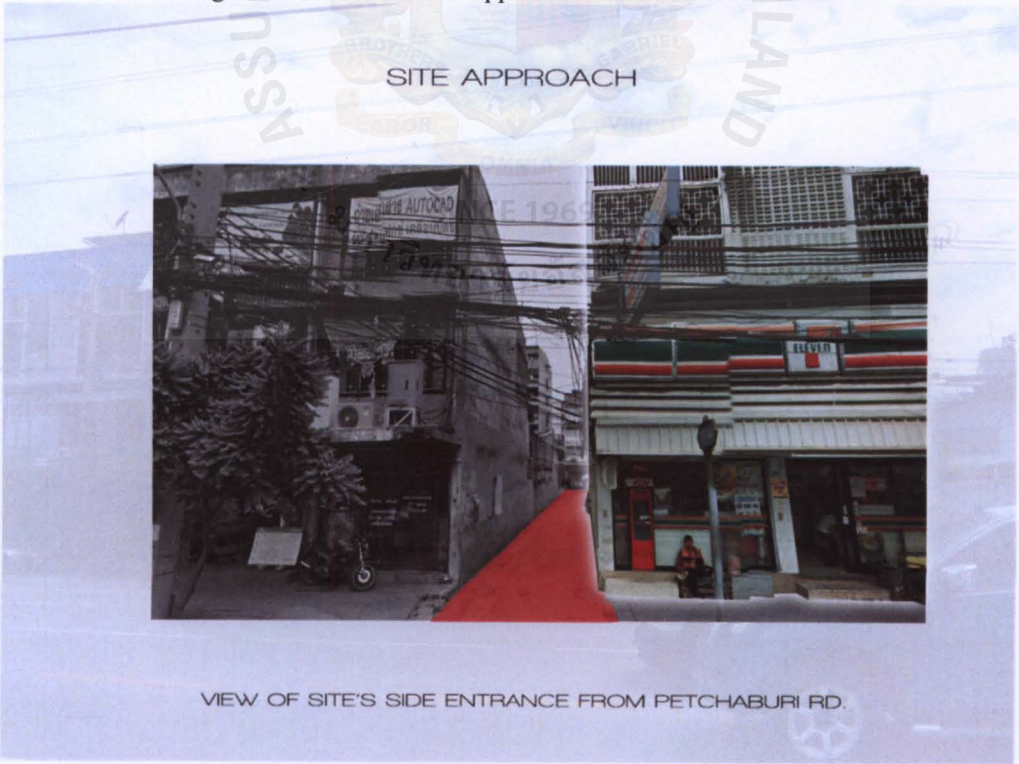


Figure 2.1.7 - View of site's side entrance from Petchaburi Road

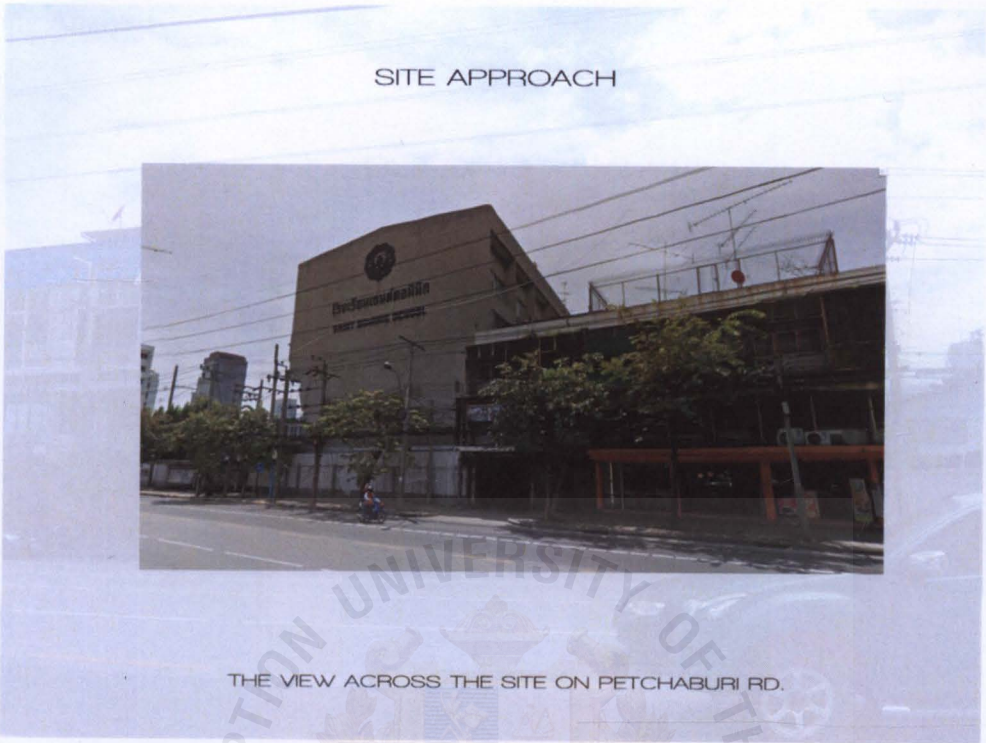
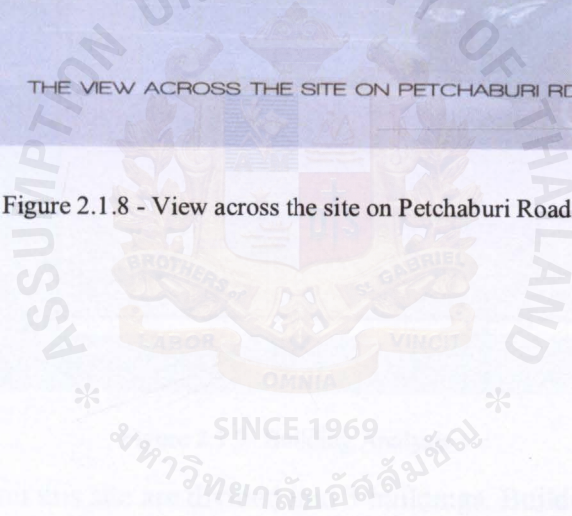


Figure 2.1.8 - View across the site on Petchaburi Road



Building Analysis

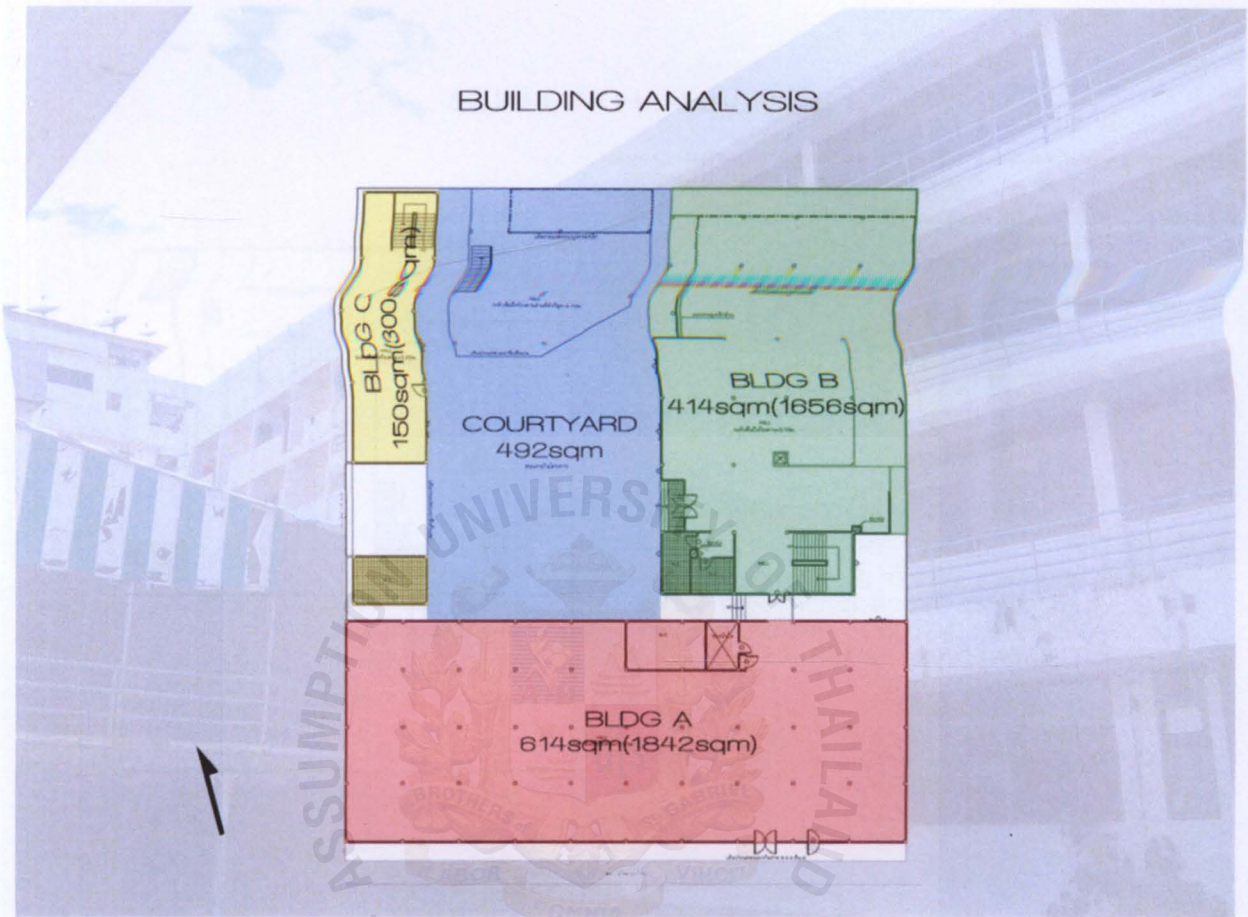


Figure 2.1.9- Building Analysis

The buildings on this site are divided into 3 buildings. Building A is the largest building, with 3 614sqm floors. It also has a large façade facing the main road which is ideal for creating a presence in the neighborhood. Building B is consisted of 4 414sqm floors, while the west building is a small 150sqm 2 storey building. In the middle of the plot sits a 492sqm courtyard, currently housing a metal structure that connects building B to C.

Building Analysis

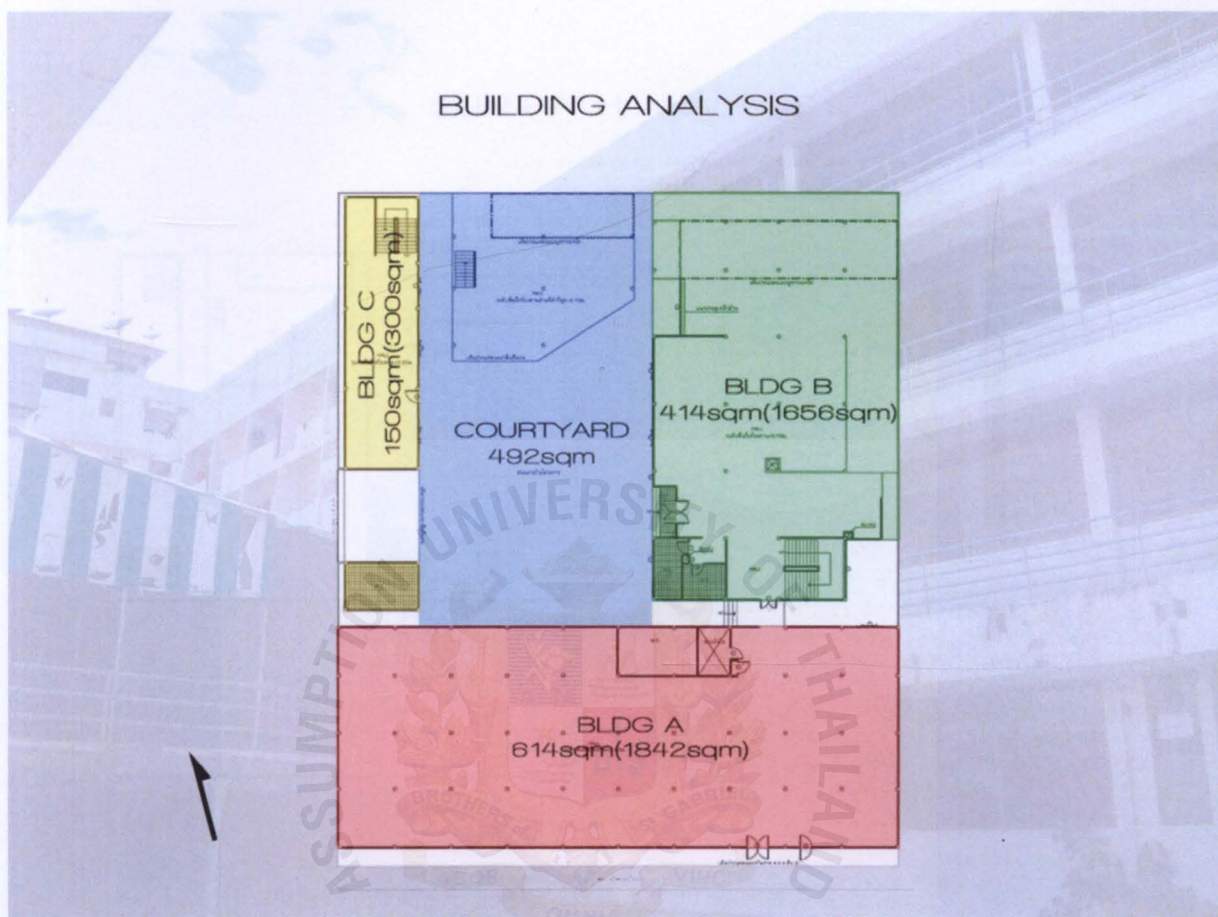


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Sun path Study

SUN PATH ANALYSIS

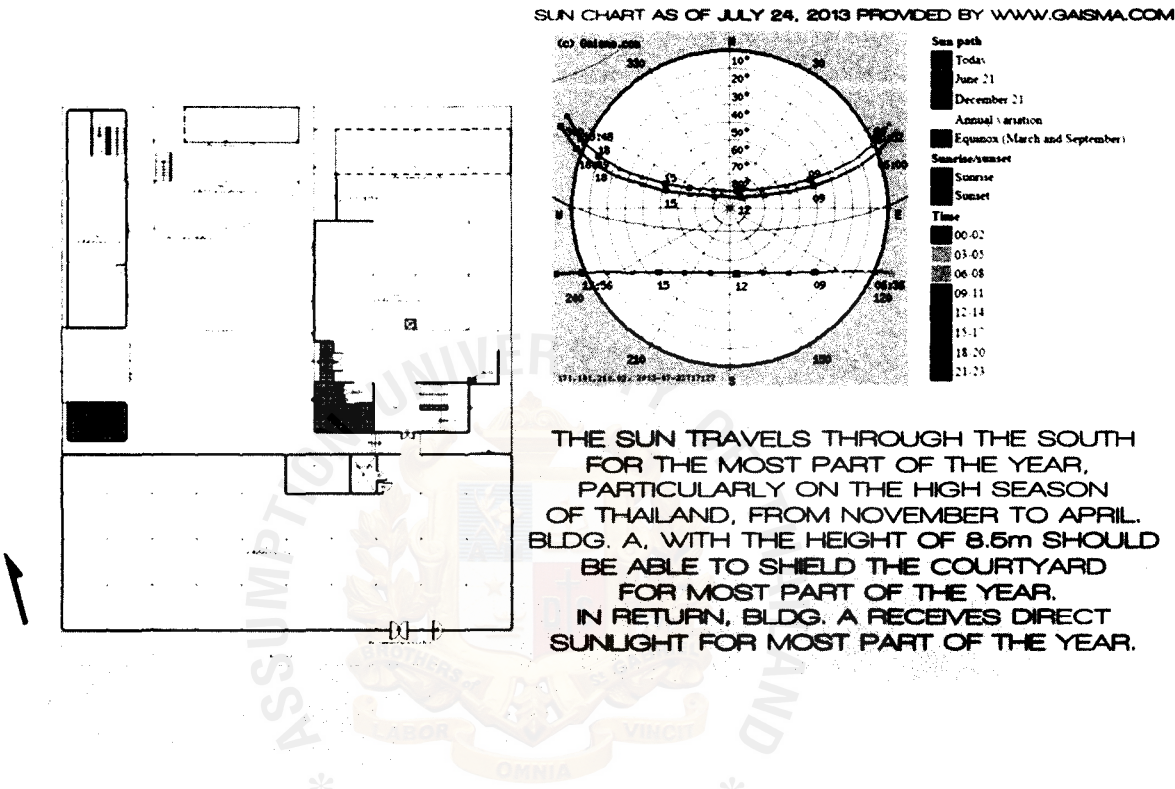


Figure 2.1.10 – Sunpath source: www.gaisma.com

The sun travels through the South for the most part of the year, particularly on the high season of Thailand which starts from the New Year towards the end of the Songkran holiday, and low during the rainy season. Building A can shield the other buildings from the sun for most part of the year, but during midday when the sun’s altitude reaches around 80-85 degrees, it may not be tall enough to provide shading for the courtyard. In turn, building A also receives direct sunlight for most part of the year.

2.2 Case Study

I have studied three hotels for my thesis, one is located in Bangkok while the other two in other countries. The hotel selection for study is selected by its' similarity in the building, the site (city hotel), and its program.



2.2.1 Case Study : Dream Hotel, Bangkok



CASE STUDY
DREAM HOTEL



| | | | |
|-------------|------------------------|------------|--------------|
| DESIGNED BY | ASC INTERIORS CO., LTD | FACILITIES | *RESTAURANT |
| PLOT | 715sqm | | +BAR |
| FLOORS | 10 (7150sqm) | | *GYMNASIUM |
| ROOMS | 96 STANDARDS | | +POOL |
| | 9 SUITES | | *CONFERENCE |
| | | | *ROOFTOP BAR |

Figure 2.2.1 – Case Study Dream Hotel, Introduction

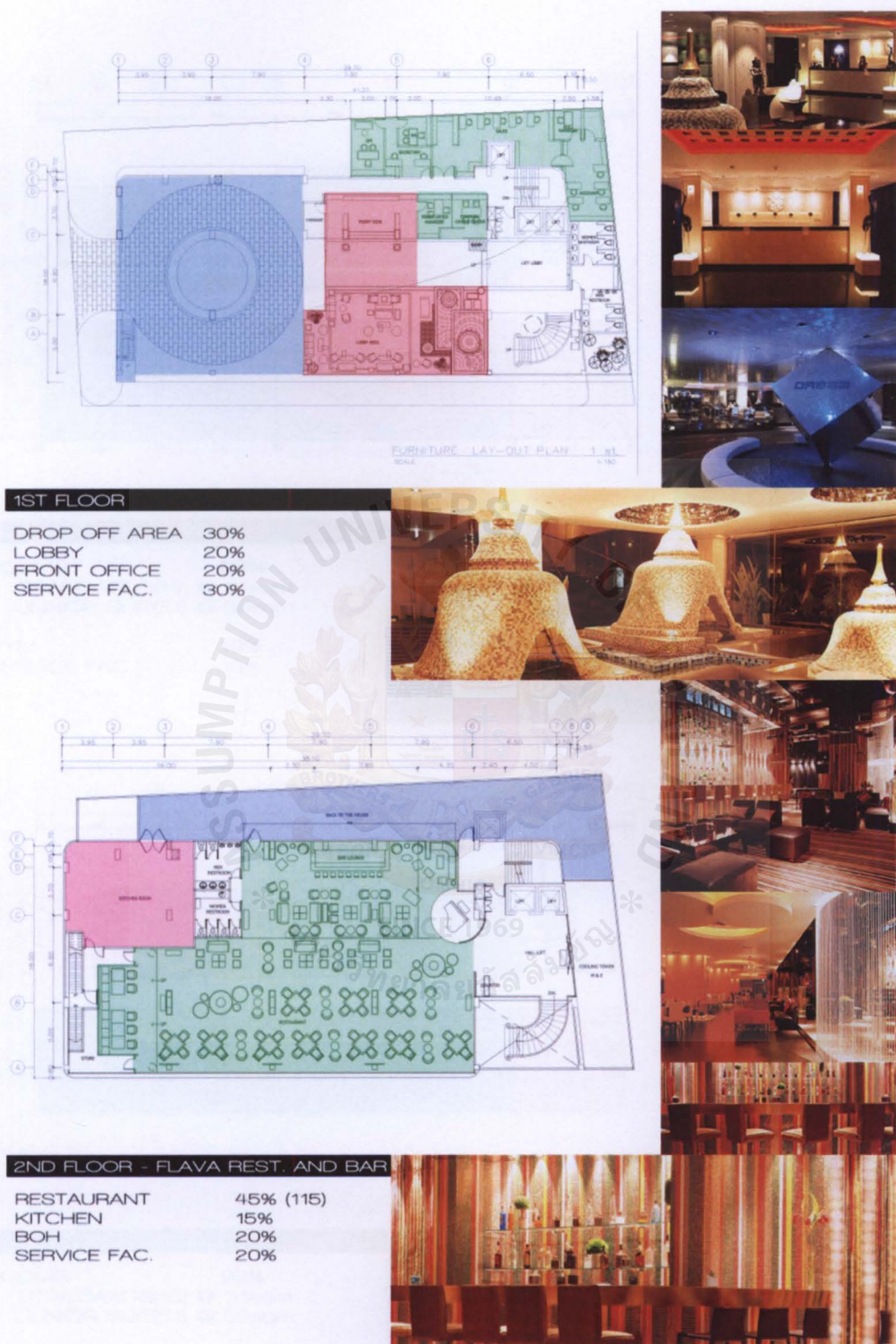


Figure 2.2.2 – Case Study Dream Hotel, 1st and 2nd Floor Plan



Figure 2.2.3 – Case Study Dream Hotel, 3rd-7th Floor Plan



Figure 2.2.4 – Case Study Dream Hotel, 8th and 9th Floor Plan



ROOFTOP FLOOR - POOL, EVENT ROOM, LOUNGE BAR

THE ROOFTOP LEVEL OF THE DREAM HOTEL HOUSES THE POOL, EVENT ROOM, AND LOUNGE BAR. THE EVENT ROOM IS AVAILABLE FOR RENT ALONG WITH THE POOL TO HOST A COCKTAIL PARTY OR MEETING. THE POOL IS LIT UP WITH VIVID COLORS ALONG WITH THE ADJACENT WALL TO CREATE A DREAMY AMBIENCE.



PERCENTAGE OF FACILITIES

| | | | | | |
|-----------|------------|------------|--------------|--------------|---------------|
| DROP-OFF | 3%(215sqm) | RESTAURANT | 6%(430sqm) | SUITES | 13% (930sqm) |
| LOBBY | 2%(143sqm) | BOH | 2%(143sqm) | SERVICE FAC. | 15% (1073sqm) |
| F. OFFICE | 2%(143sqm) | STANDARDS | 50%(3575sqm) | POOL+GYM | 7% (500sqm) |

Figure 2.2.5 – Case Study Dream Hotel, Rooftop Floor Plan and Summary

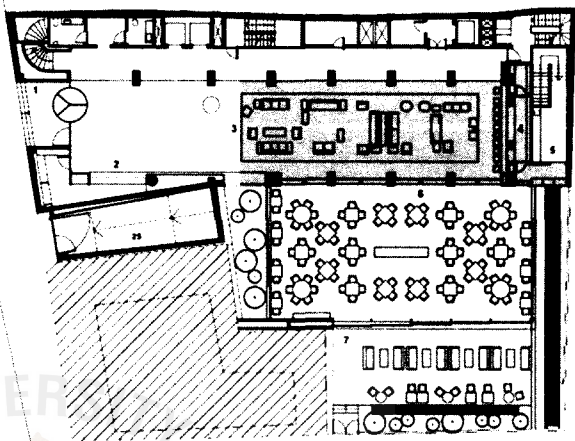
Case Study: Hotel Square Nine, Belgrade



Figure 2.2.6 – Case Study Hotel Square Nine, Introduction

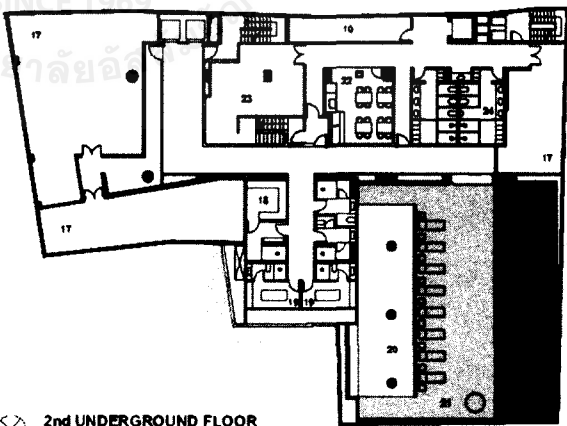
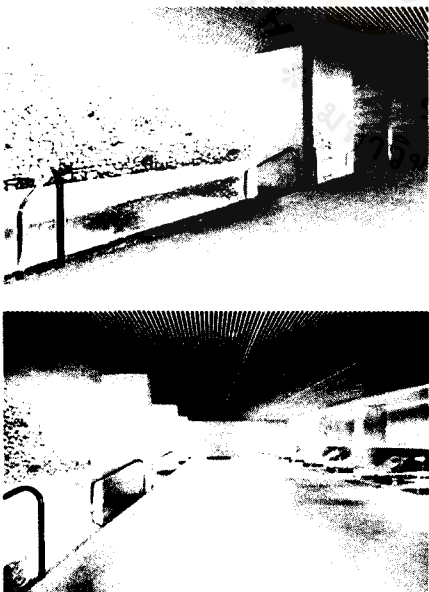


| | | |
|--------------|-----|--------------|
| LOBBY LOUNGE | 15% | SERVICE FAC. |
| RESTAURANT | 45% | 40% |



⊗ GROUND FLOOR PLAN
0 5 10m

| | | |
|------|-----|-----|
| POOL | 20% | BOH |
| GYM | 10% | 55% |
| SPA | 15% | |



⊗ 2nd UNDERGROUND FLOOR
0 5 10m

Figure 2.2.7 – Case Study Hotel Square Nine, UG and Ground Floor Plan

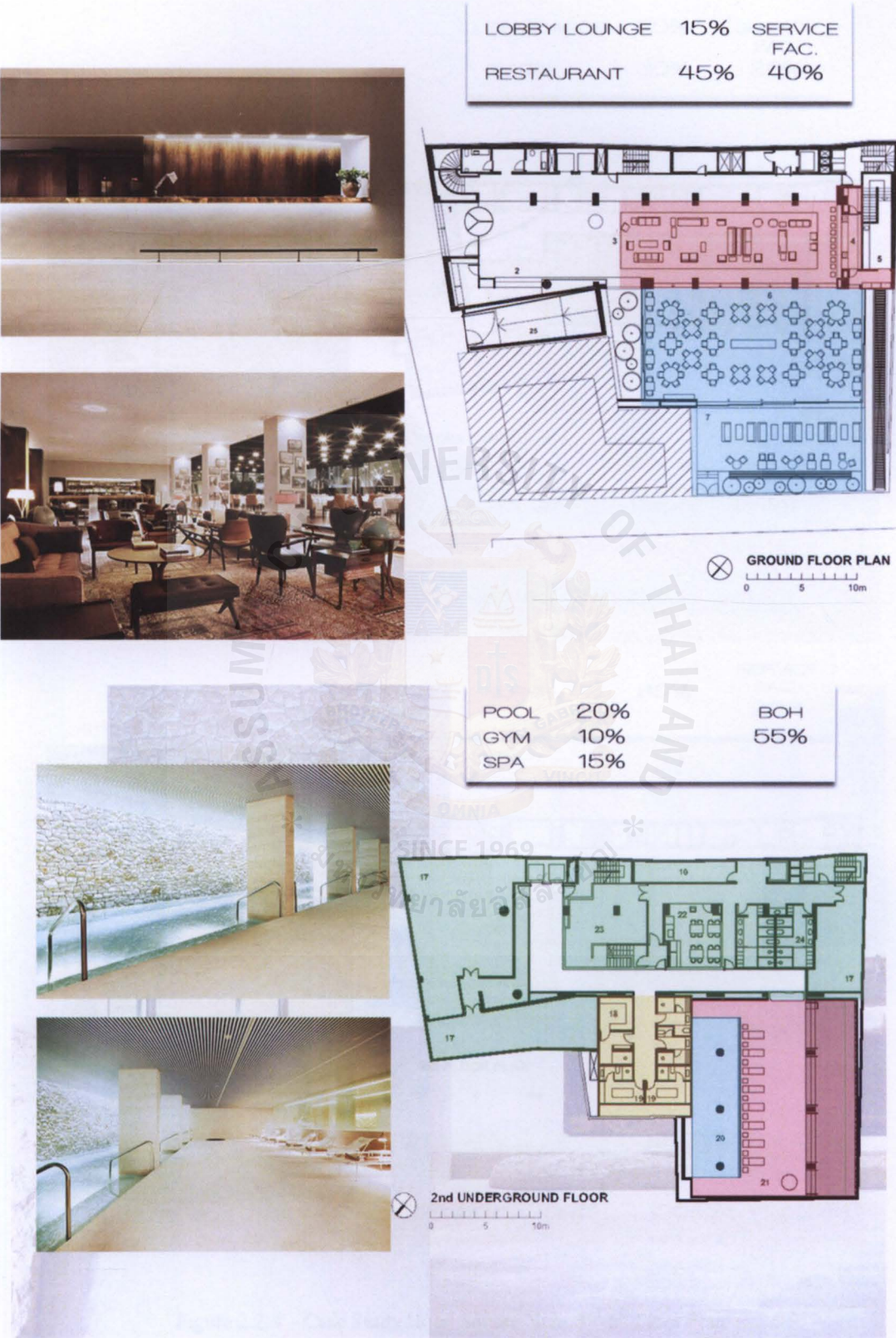


Figure 2.2.7 – Case Study Hotel Square Nine, UG and Ground Floor Plan



Figure 2.2.8 – Case Study Hotel Square Nine, 3rd-6th Floor Plan



SUPERIOR KING 32sqm

Overlooking the interior courtyard and dining room terrace, Square Nine's superior guest rooms offer limestone bathrooms with rain shower and separate tub, king size beds, flatscreen Tv, and built in cumaru wood executive work desk.

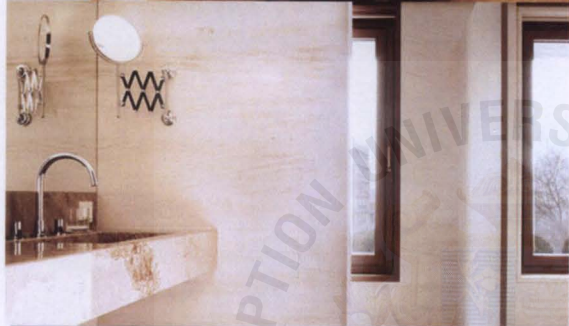


TWIN DELUXE 45sqm

The hotel's corner rooms offer large limestone bathrooms, separate bath and rain shower, twin beds, handwoven turkish throw rugs, a cumaru wood executive work desk, flatscreen Tv, hans wegner chairs, and look over the interior courtyard and dining terrace.



Figure 2.2.9 – Case Study Hotel Square Nine, Guestroom Analysis



JUNIOR SUITE
55sqm

With views over a leafy park square, these airy rooms include king size beds, flatscreen TVs, generous workspace, large bathrooms, and a seating area outfitted with a comfortable de padova sofa and hans wegner club chairs.



EXECUTIVE SUITE
98sqm + 18sqm

These spacious one-bedrooms include a living room with original vintage furnishings by Borge Mogensen, Finnjuhl 45, Hans Wegner and Kaare Klint, as well as, large bathrooms, ample workspace, flatscreen TVs, a separate cloakroom, and a terrace with beautiful views over Kalemegdan fortress and the landmarks of Belgrade's historic district.

Figure 2.2.10 – Case Study Hotel Square Nine, Guestroom Analysis



PRESIDENTIAL SUITE
100sqm + 80sqm

Square Nine's most generous one-bedroom offers a walk in closet, separate cloakroom, a kitchenette, and a large terrace outfitted with a Japanese ofuro tub and panoramic views of the city. This suite's collection of original, mid century furnishings includes a Danish rosewood bar, Borge Mogensen wing chairs, and a Hans Wegner table.

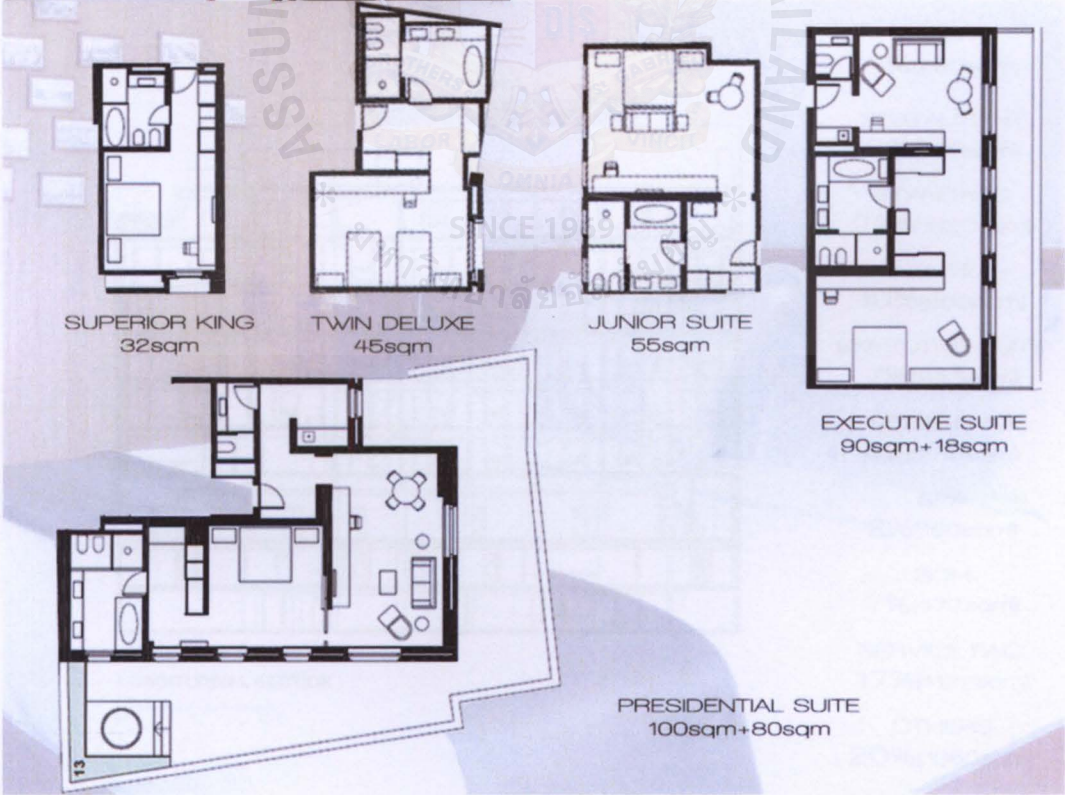


Figure 2.2.11 – Case Study Hotel Square Nine, Guestroom Analysis

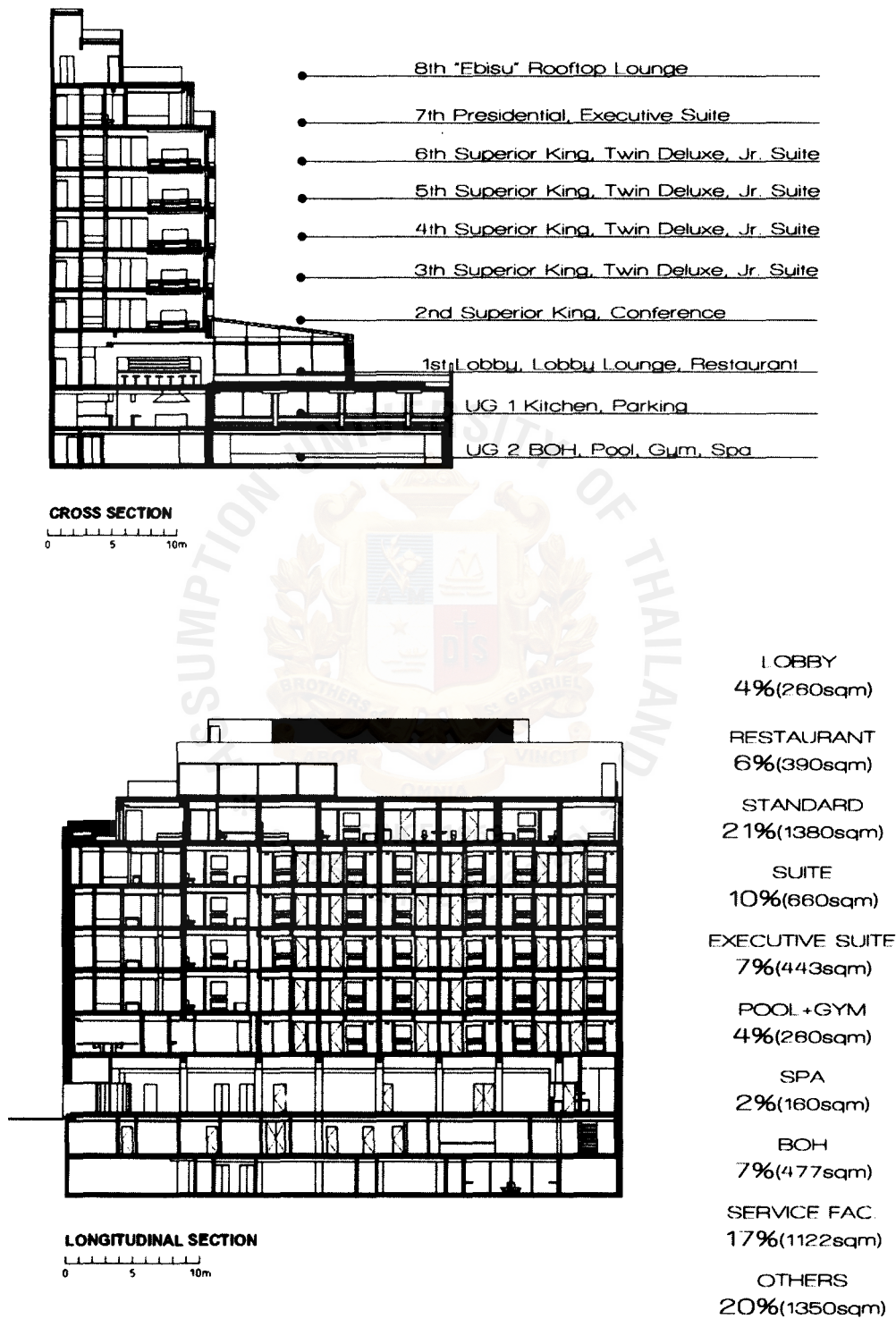


Figure 2.2.12 – Case Study Hotel Square Nine, Cross Sections and Analysis

Case Study: Chrome Hotel, Kolkatta



Figure 2.2.12 – Case Study Chrome Hotel, Introduction

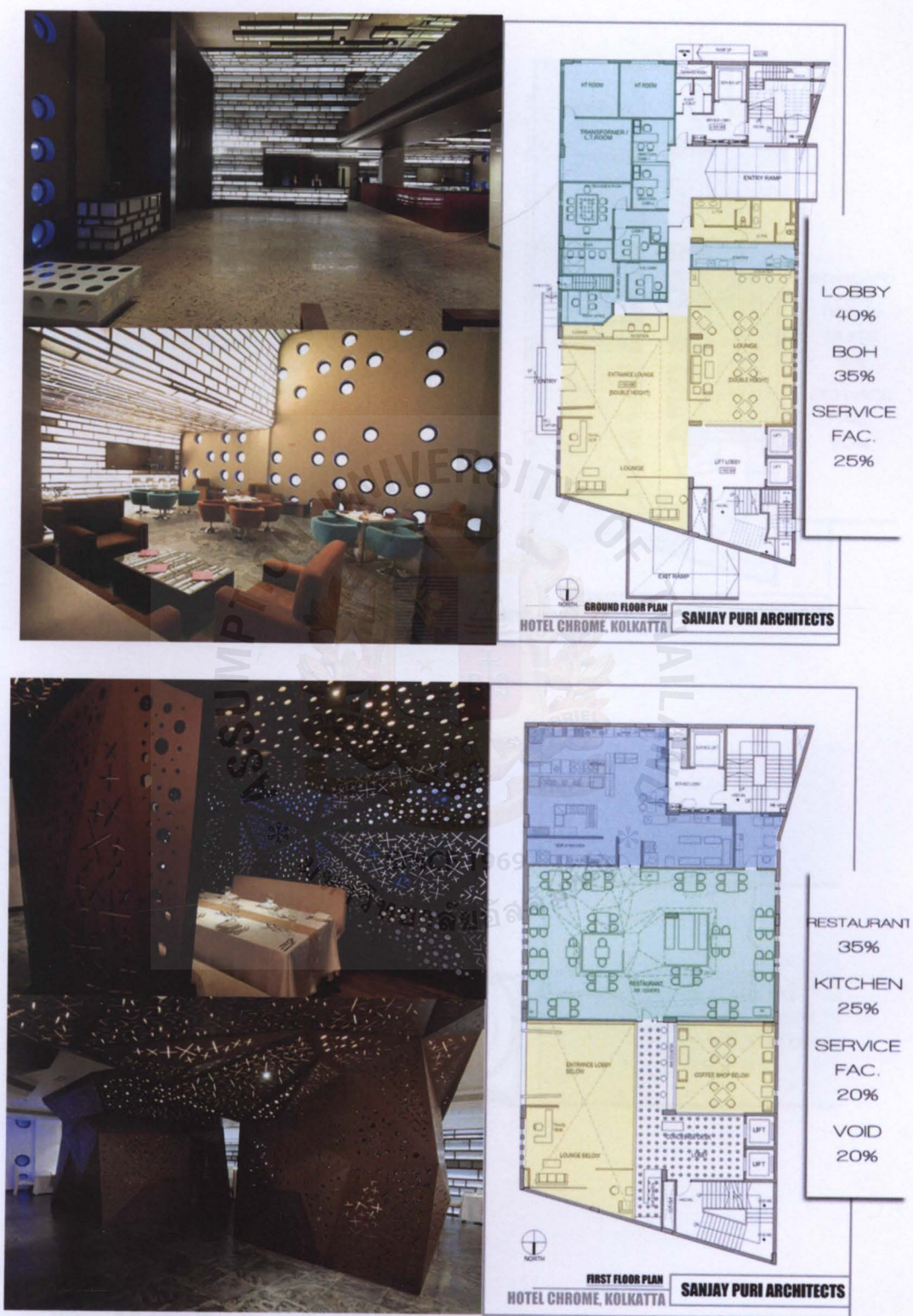


Figure 2.2.13 – Case Study Chrome Hotel, Ground and First Floor Plan

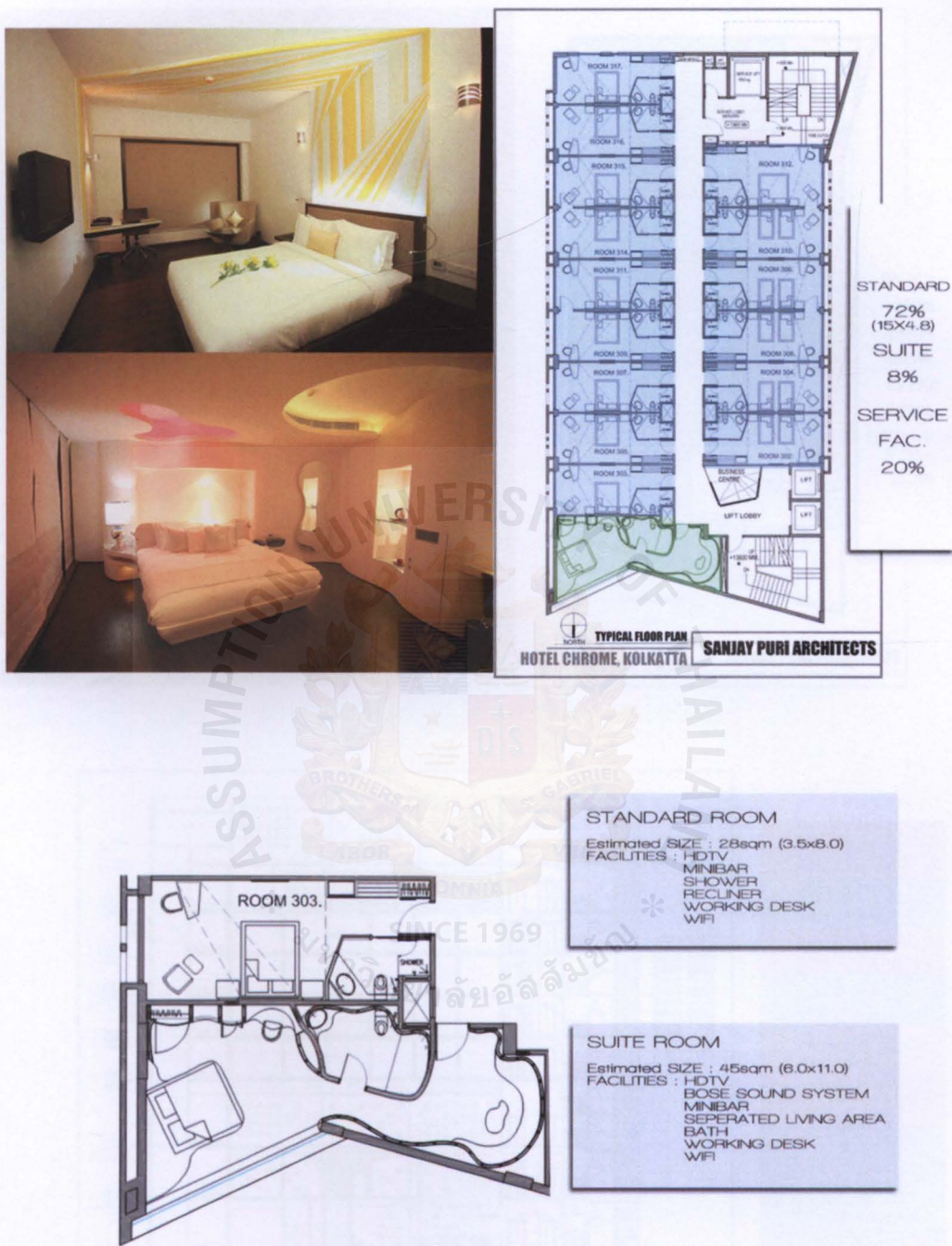


Figure 2.2.14 – Case Study Chrome Hotel, Guestroom Floor Plan and Guestroom Analysis

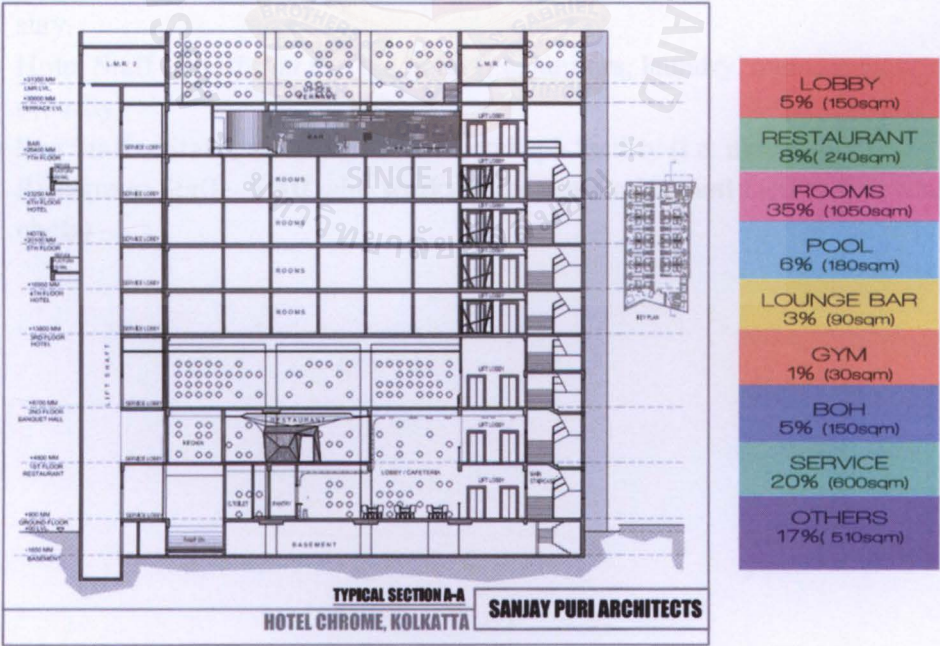
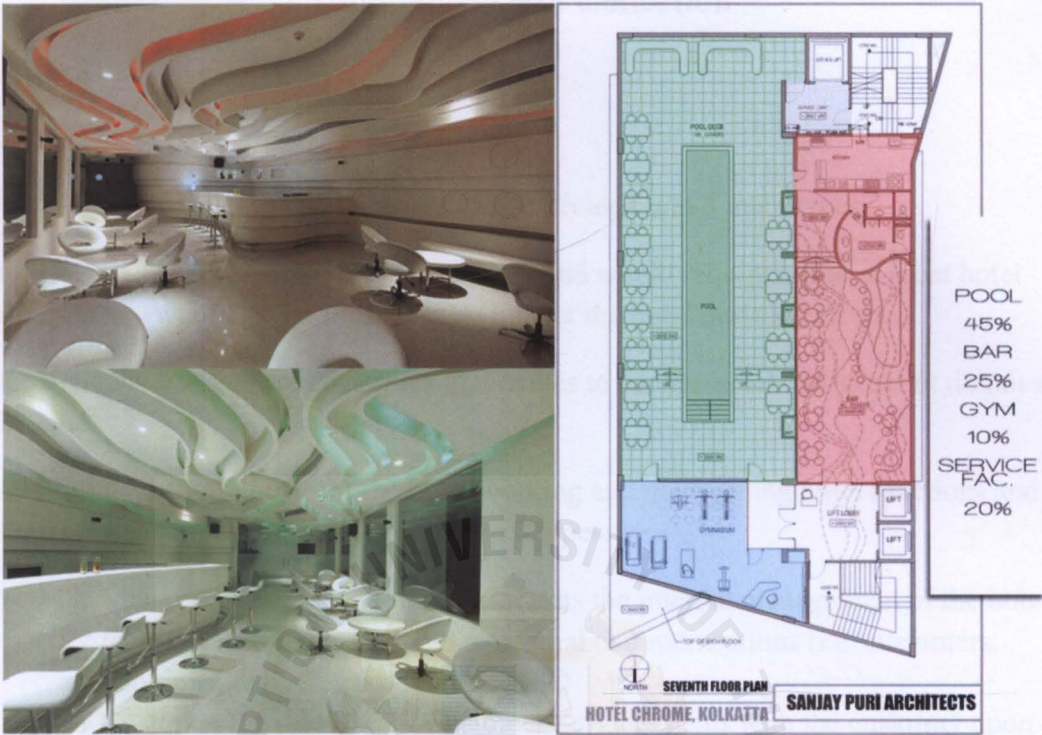


Figure 2.2.15 – Case Study Chrome Hotel, Rooftop Floor Plan and Cross Section

Chapter 3: Data Collection

3.1 User Study

3.1.1 Target User Group

In this project, the users can be divided into 3 main types.

Hotel Guest – Customers that stay at the hotel and would require usage of most hotel facilities. They would spend most of their time at the hotel during their stay.

Hotel Visitor – Visitors are customers that comes to use the hotel facilities but do not stay at the hotel.

Hotel Staff – The employees of the hotel working and maintaining hotel functions and systems. Hotel staff can be sub divided into 5 types.

- 1.) **Management** – Management staff runs the internal management of the hotel facilities as well as the hotel's external communications (i.e. customers, bookings, delivery, and maintenance)
- 2.) **Customer Service Staff** – Customer Services deals with the customer upon arrival and take care of their needs. It is also important that Customer Service staff is the only type of staff that customers need to interact with during their stay.
- 3.) **Hotel Staff** – Staff that run the hotel (i.e. janitors, laundry, maintenance, security)
- 4.) **Spa Staff** – Staff who works at the hotel spa facility (i.e. masseurs)
- 5.) **Restaurant Staff** – Staff who works at the hotel restaurant facility (i.e. waiters, chefs)

3.1.2 User Behavior

Each type of user in the project attends each facility and approaches them for different purposes. The following user behaviors are 3 main types based on their purposes.

HOTEL GUESTS

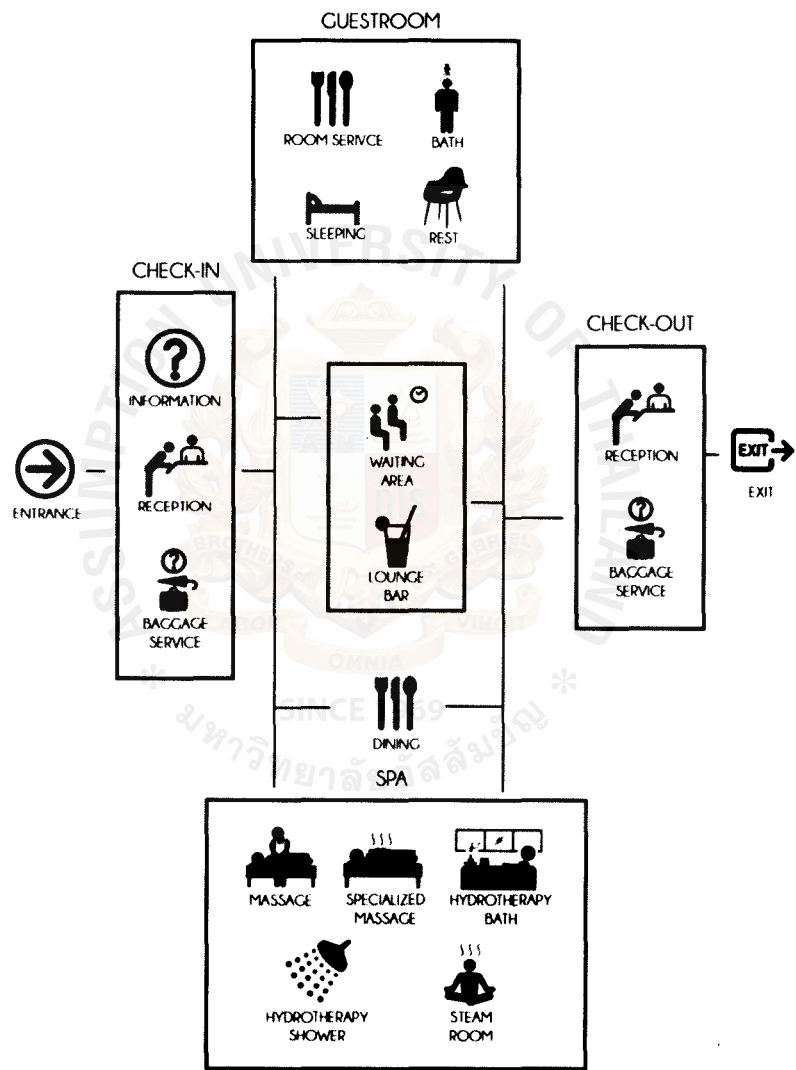


Figure 3.1.1 – Hotel Guests User Behavior

HOTEL VISITORS

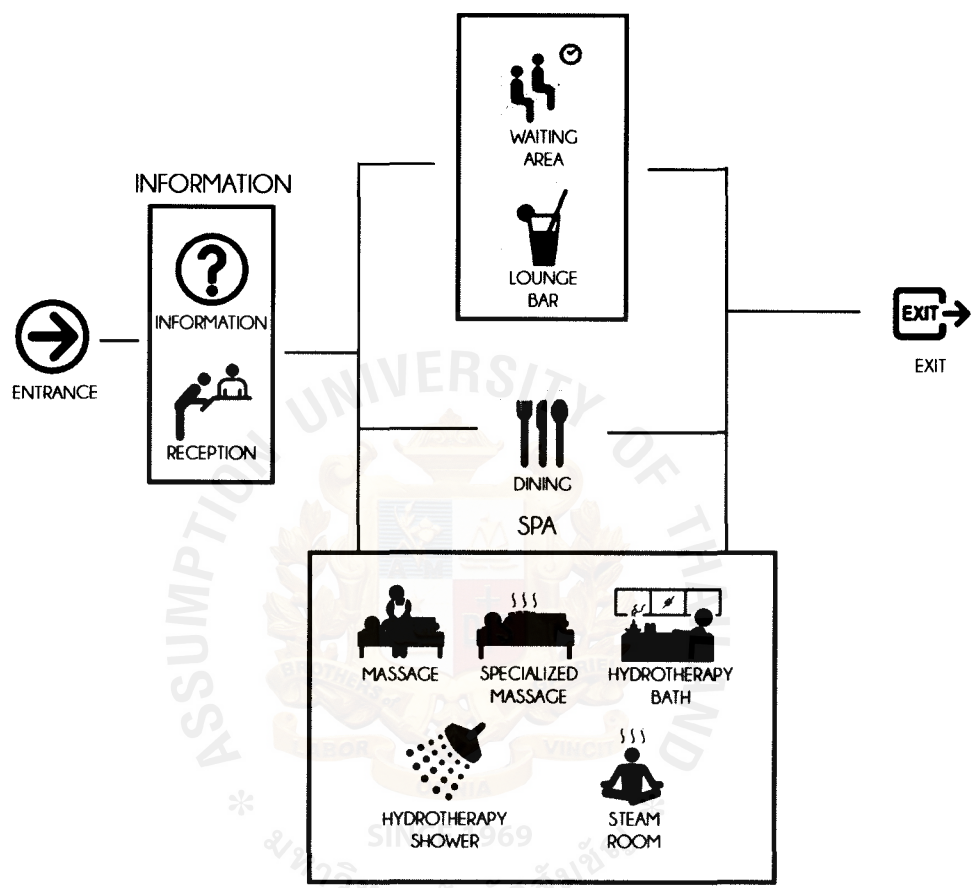


Figure 3.1.2 – Hotel Visitors User Behavior

STAFFS

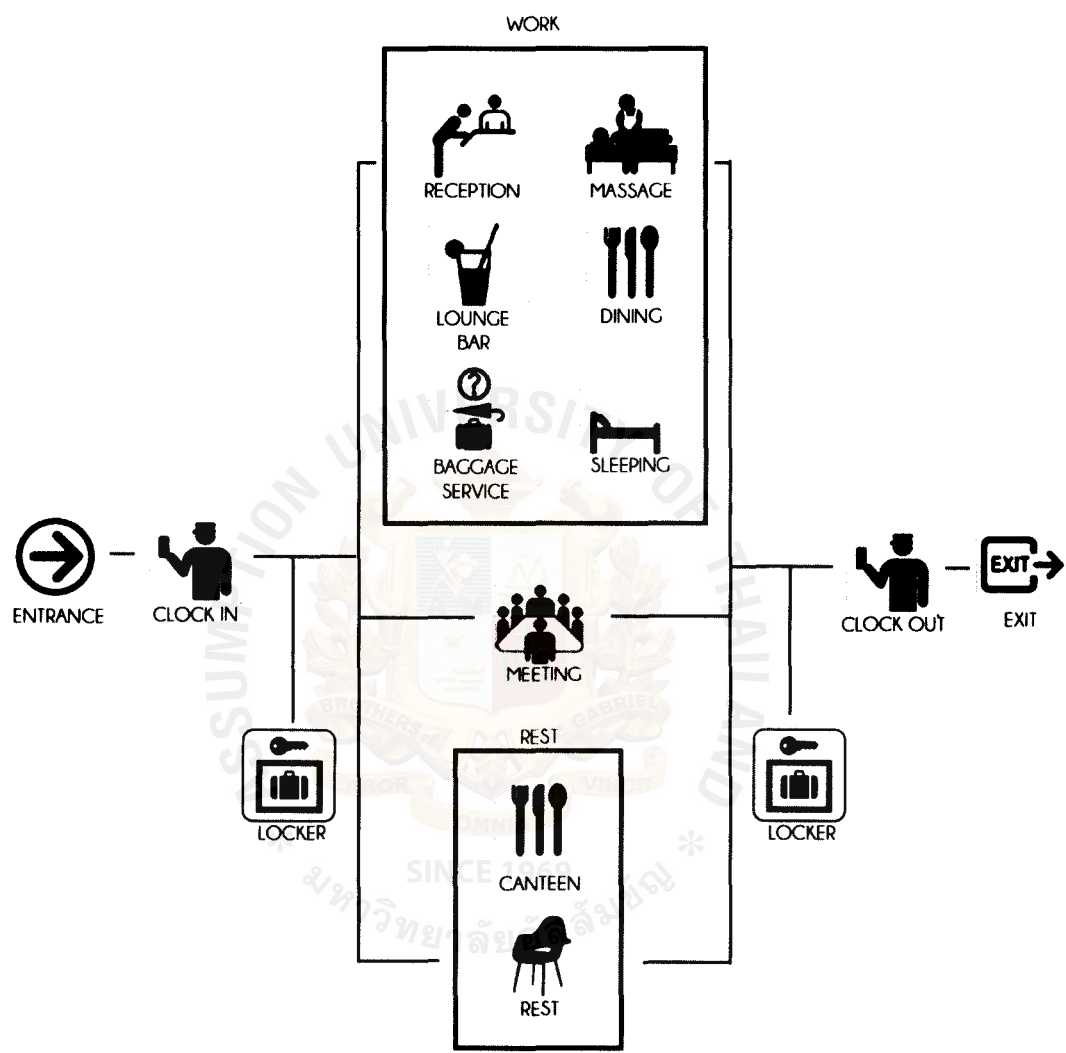
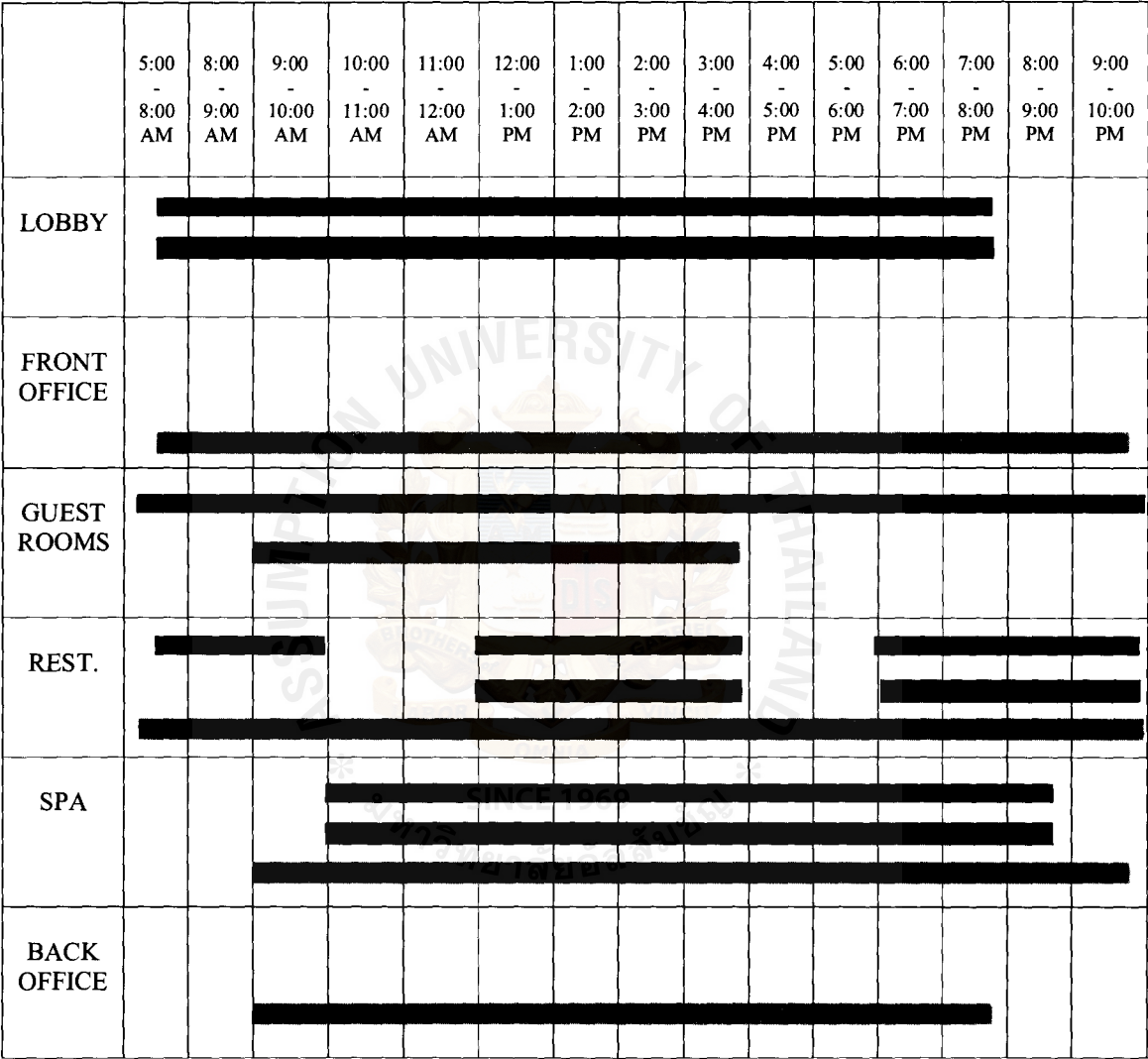


Figure 3.1.3 – Hotel Staffs User Behavior

3.1.3 User Timing

The different types of users occupy a specific facility of the hotel at different times in order for the project to function. The following are a timeline of each type of users and at what time do they occupy a certain hotel facility.



| USERS | COLOR LINE |
|---------|------------|
| GUEST | |
| VISITOR | |
| STAFF | |

3.2 Human Factors

In this project the aimed target group is adults who are healthy minded. It would serve both hotel guests and visitors who would use the hotel facilities other than the guest rooms. The actual physical needs and psychological needs criteria are based on a questionnaire data collected for this project.

| USERS | PERSONAL | PHYSICAL NEEDS | PSYCHOLOGICAL NEEDS |
|-----------------|--------------------|---|--|
| Hotel guests | Adults (20-50) | Spa Services Hotel Facilities Private Space | Relaxation Tension relief Privacy |
| | Children (1-20) | Activity Space | Relaxation Excitement Social fulfillment |
| Visitors | Adults (20-50) | Spa Services Public Hotel Facilities | Relaxation Tension Relief Social Fulfillment |
| Staffs | Adults (20-50) | Safe work space | Respectful environment Physical and Hygiene safety |

3.2.1 Human Dimensions

The following are dimensions collected that are relevant to the project. It includes the human dimensions and dimensions in performing various tasks. They are collected from the book *Human Dimensions & Interior Spaces: A Sourcebook of Design Reference Standards* by Julius Panero and Martin Zelnik.

See Appendix A



General Observations on Spa Design

Interior design should provide a residential not institutional feeling. A simple yet effective zone keying system should be installed. A proper “signage” system should be installed for easy traffic flow. All treatment areas should be as sound proof as possible.

Materials

Non-corrosive materials should be used in all high moisture areas (Vents, ducts, drains, ceiling & wall cover). Easy to clean moisture resistant materials should be used in all high moisture areas.

Consider using local materials and integrating cultural and artistic traditions.

Locker / Changing / Vanity Area

- Provide appropriate number of half size lockers (two per full size locker banks) on each side.
- Provide a separate alcove with third-size lockers (two per full size locker banks) for members on each side.
- Utilize movable benches or Ottomans on casters for seating by lockers.
- Provide wall mounted soap, shampoo & conditioner dispensers in showers.
- Provide make-up lights around vanity mirrors on women’s side.
- Provide wall mounted magnified shaving mirrors at vanity on men’s side.
- Provide wall mounted hair dryer units at vanities on both sides.
- Provide electrical outlets above vanities.
- Flooring in locker and changing area should be carpeted, all other areas tiled.

Locker Room Wet Area

- Accommodate Sauna, Steam, Whirlpool and Cold Pool (if applicable).

- Provide lounge with water proof seating near each wet area.
- Provide clothing hooks throughout area.
- Flooring should be non-slip easily cleanable tile.
- Provide for non-corrosive ventilation ducts in this area.
- Outflow of HVAC should be provided for 25 air changes per hour.
- Provide for ozone water purification system for whirlpools. (no smell).
- Provide a self service beverage service station with sink, counter, storage cabinet, mini-fridge & ice machine.
- Provide clean and soiled linen storage.

Design for Massage/Touch Therapy Room

Design Considerations

- Massage rooms should have a small sink and linen cabinet.
- Rooms need to be sound insulated.
- Use lever-type hardware for door knobs (therapists have oil on their hands).
- Equipment: 72"x30" massage tables: (deep tissue tables should be 39"wide).

Tip: tables should have built-in shelves and an adjustable face cradle attached to the end of table--adding another 12" to the end of table massage table upholstery should be made from Naugahyde with a smooth surface with medium firm padding

Space Requirements:

Generally 120-140 sq. ft., room variations include:

9'x12', 19'x12', 10'x14', 12'x12' therapist requires a min 3' work-space around the massage table.

Location & Access: Located in “dry” therapy area. Tip: should have access to laundry storage and drop off.

Room Set-Up: Sink and cabinet should be in corner at an angle in 9’x12’ rooms. Sinks should have hot and cold water.

Flooring: Vinyl tile, wood, or cushioned recreational surface. Tip: avoid tile, marble, or granite (too hard for the therapist to stand on).

Walls, Ceilings, and Doors: Washable wall paper or paint. Allow doors to open comfortably. Doors need lettering or numbering and an “in use” sign or light.

Lighting: Indirect lighting with dimmer control on walls or overhead (not directly above massage table) windows lighting preferred with vertical, horizontal, or roman blinds.

Electrical: Provide wall outlets at foot and sides of table, and a counter-height outlet for and essential oil diffuser. Tip: In-house phone with intercom in rooms is advised in larger facilities.

Sound System: One centrally located sound system, with speakers in each room that have an individual volume control knob.

Storage: Smaller rooms can have tables with built-in storage space for linens, towels, oils, bolsters etc. If room is too small to provide storage inside, storage directly outside room is necessary.

Designing Spa Treatment Rooms

Treatment Rooms: A wet-area treatment room should feed off of each wet area. Access to these treatment areas should be from both the men’s and women’s locker rooms through a hallway.

The area should include:

- Treatment tables.
- Sink.

- Counter space.
- Clean and soiled linen storage.
- Floor drain.
- Overhead showers or treatment shower.
- Infra-red heat lamps recessed into ceiling over each tables.

Dry Treatment Rooms:

- Keep treatment areas as flexible as possible. Rooms to change when program changes.
- Provide for sinks, lockable storage cabinetry, counter space with mirror above, clothing hooks on back of door, clean & soiled linen storage, electrical outlets on two side walls and above counter, floors of an easily cleanable material (ie. Vinyl tile).
- All lighting should be indirect and on rheostats.
- All treatment rooms should be as sound proof as possible.
- Provide for separate music system with individual controls.
- Provide for clothing hooks.
- Provide for “In Use” signage on all treatment room doors.
- Provide for lockable storage in each room.
- Provide for numbers or letters on doors of each room for identification.
- Balance of nature and man-made elements

3.3 Function and Facility study

A hotel function must separate the guest areas from the staff areas with only exceptions on guest service staffs that interact and provide for the guests. In studying the proposed facilities of the hotel based on existing projects, the conclusion can be explained in two types of diagrams, firstly the user/function diagram which shows the relationship between each area function of the project and its users and secondly the area function which determines how each facility functions.



| AREA | FUNCTION | USERS | | | | | | |
|--------------|------------------|--------|----------|------------|----|-------------|------------|-----------|
| | | GUESTS | | STAFFS | | | | |
| | | Guests | Visitors | Management | Cs | Hotel Staff | Rest Staff | Spa Staff |
| LOBBY | RECEPTION | | | | | | | |
| | LOBBY LOUNGE | | | | | | | |
| | BAGGAGE SERVICE | | | | | | | |
| FRONT OFFICE | FINANCE | | | | | | | |
| | HOTEL MANAGEMENT | | | | | | | |
| GUEST ROOMS | STANDARD | | | | | | | |
| | DELUXE | | | | | | | |
| | SUITE | | | | | | | |
| RESTAURANT | DINING | | | | | | | |
| | CASHIER | | | | | | | |
| | KITCHEN | | | | | | | |
| | STORAGE | | | | | | | |
| SPA | RECEPTION | | | | | | | |
| | WAITING AREA | | | | | | | |
| | RESTROOM+LOCKER | | | | | | | |
| | POOL AREA | | | | | | | |
| | SPA ROOM | | | | | | | |
| | STORAGE | | | | | | | |
| BACK OFFICE | MANAGEMENT | | | | | | | |
| | HUMAN RESOURCE | | | | | | | |
| | FINANCE | | | | | | | |
| | CANTEEN | | | | | | | |

| AREA | FUNCTION | USERS | | | | | | |
|--------------|------------------|--------|----------|------------|------------------|--------------|-----------|-----|
| | | GUESTS | | STAFFS | | | | |
| | | GUESTS | VISITORS | MANAGEMENT | CUSTOMER SERVICE | HOUSEKEEPING | RECEPTION | SPA |
| LOBBY | RECEPTION | | | | | | | |
| | LOBBY LOUNGE | | | | | | | |
| | BAGGAGE SERVICE | | | | | | | |
| FRONT OFFICE | FINANCE | | | | | | | |
| | HOTEL MANAGEMENT | | | | | | | |
| GUEST ROOMS | STANDARD | | | | | | | |
| | DELUXE | | | | | | | |
| | SUITE | | | | | | | |
| RESTAURANT | DINING | | | | | | | |
| | CASHIER | | | | | | | |
| | KITCHEN | | | | | | | |
| | STORAGE | | | | | | | |
| SPA | RECEPTION | | | | | | | |
| | WAITING AREA | | | | | | | |
| | RESTROOM+LOCKER | | | | | | | |
| | POOL AREA | | | | | | | |
| | SPA ROOM | | | | | | | |
| | STORAGE | | | | | | | |
| BACK OFFICE | MANAGEMENT | | | | | | | |
| | HUMAN RESOURCE | | | | | | | |
| | FINANCE | | | | | | | |
| | CANTEEN | | | | | | | |

3.3.1 Area function

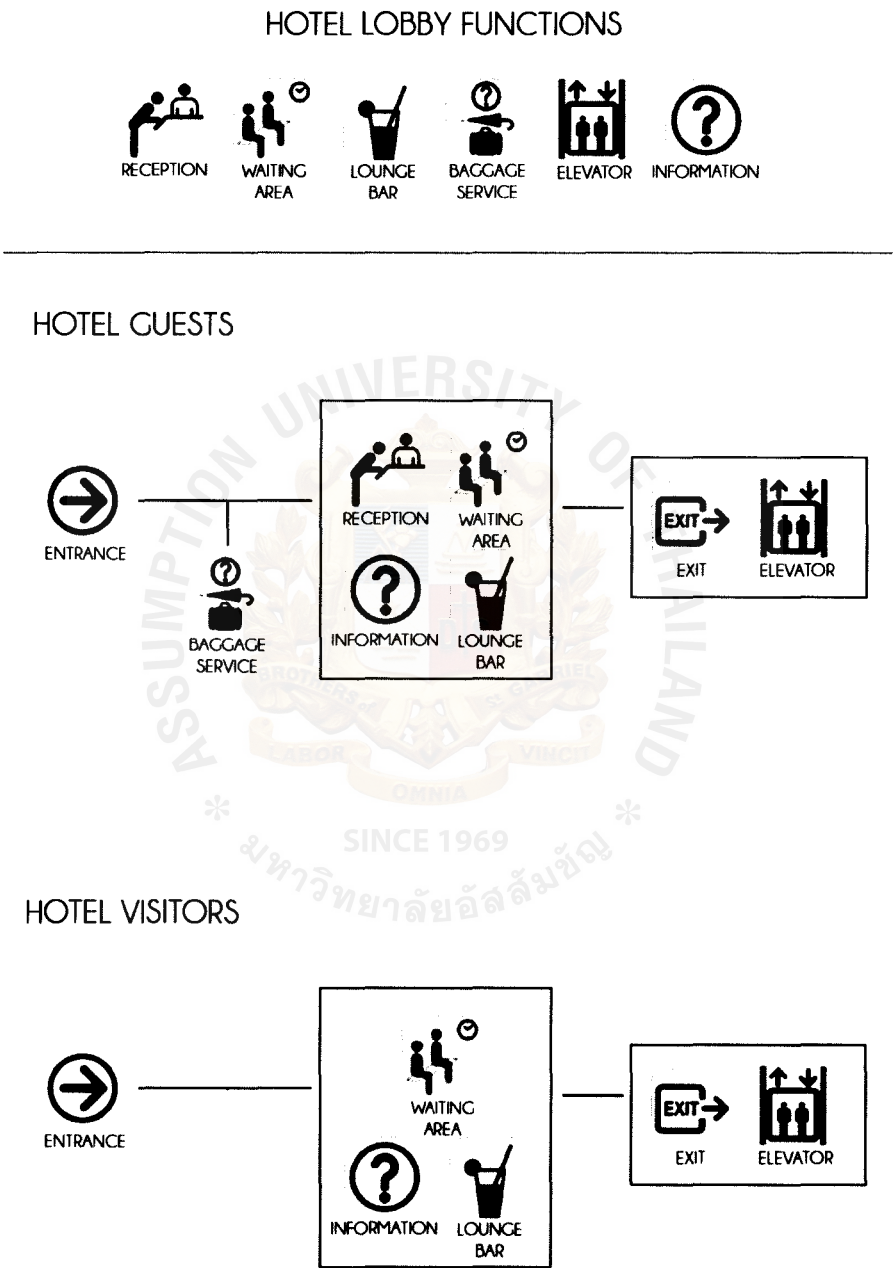


Figure 3.3.1 – Hotel Lobby Area Function

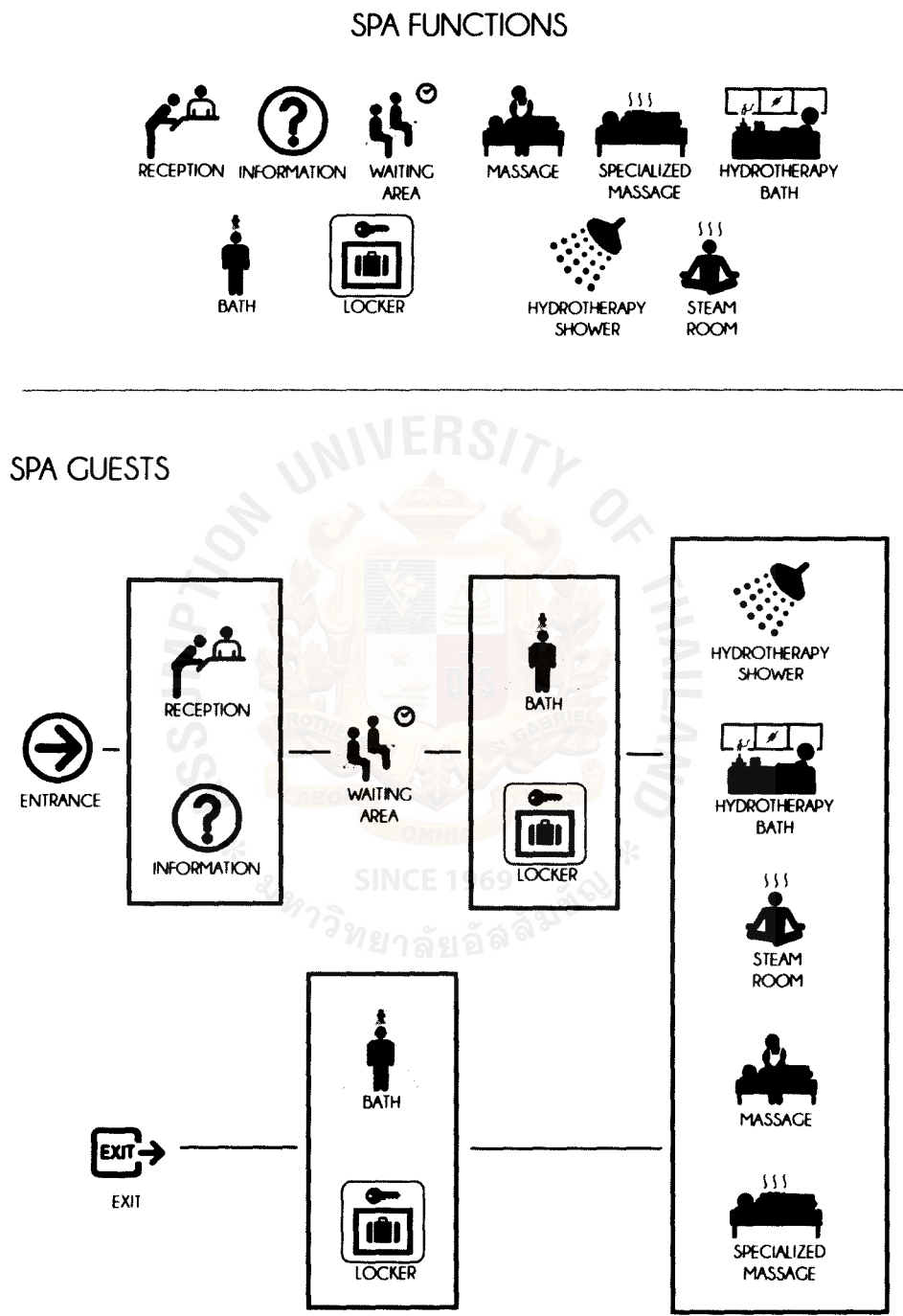


Figure 3.3.2 – Spa Area Function

HOTEL ROOM FUNCTIONS



HOTEL GUESTS

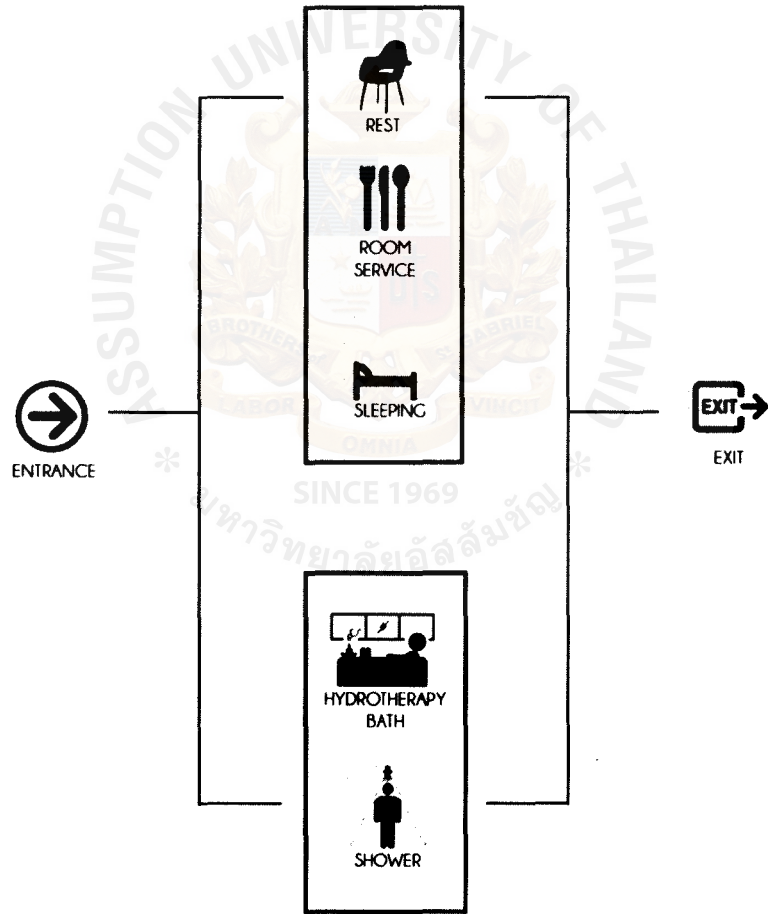


Figure 3.3.3 – Guestroom Area Function

3.4 Aesthetic and Form study

The aesthetic and form study for this project are based on feedbacks from data collected on a set of surveys distributed. The survey example is set in order to generate useful data for the project regarding aesthetic and form studies.

The total number of respondents are 48, divided evenly between males and females with the age range mainly between 20-25 and over 50.

3.4.1 Survey example

Part 1: General Information

Q1 Sex

☐ Male ☐ Female

Q2 Age

☐ Less than 20 ☐ 20-25 ☐ 25-35 ☐ 35-50 ☐ More than 50

Q3 Occupation

☐ Student ☐ Employment ☐ Freelance ☐ Unemployment ☐ Retired

Q4 Have you ever been to a Hydrotherapy Spa?

☐ Yes ☐ No

Q5 How often do you visit a spa?

☐ Very often ☐ Often ☐ Sometimes ☐ Rarely ☐ Very rarely

Q6 Who do you usually go to a spa with?

☐ Alone ☐ Family ☐ Friends ☐ Others

Part 2: Aesthetic and Form

Q1 Which do you prefer as an overall environment of a boutique hotel?

☐ Luxurious



☐ Chic and Trendy



☐ Tropic and Warm



☐ Traditional



Q2 Which do you prefer for a restaurant environment?

() Clean and modern



() Elegant and classy



() Creative and exciting



() Trendy and Chic



SINCE 1969
มหาวิทยาลัยอัสสัมชัญ

Q3 Which do you prefer for a spa environment?

☐ Elegant and classy

☐ Modern and minimalist



☐ Tropic and warm

☐ Organic



Q4 Which do you prefer for a hotel room environment?

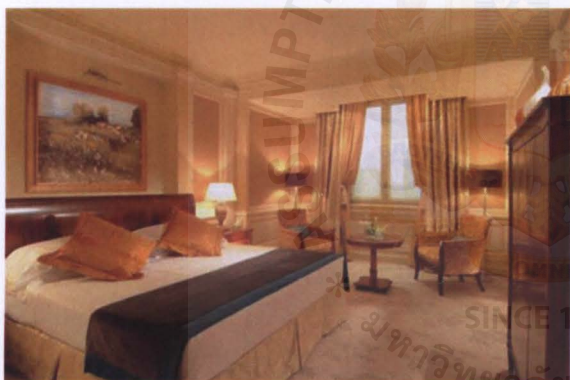
☐ Modern and neutral



☐ Modern and warm



☐ Luxurious and traditional



☐ Chic and trendy



Part 3: Psychological Impact

Q1 What psychological (emotional) impacts would you expect in a hotel?

☐ Welcoming ☐ Sensual

☐ Cozy ☐ Overwhelming

☐ Exciting ☐ Enriching

☐ Relaxing ☐ Others

☐ Formal

Q2 What psychological (emotional) impacts would you expect in a spa?

☐ Welcoming ☐ Sensual

☐ Cozy ☐ Overwhelming

☐ Exciting ☐ Enriching

☐ Relaxing ☐ Others

☐ Formal

Q3 Level of spa privacy

☐ Private

☐ Semi – Private

☐ Public

3.4.2 Aesthetic and Form – Hotel Lobby

Based on the collected data on the survey, the results are as the following

| User | Psychological impact | Solution |
|----------------|--|---|
| Hotel Guests | Welcoming Cozy Relaxing | 1. Clear space planning For easy circulation. 2. Warm, earth tone colors for a cozy and welcoming environment. 3. Lighting should be evenly distributed to ensure a cozy and relaxing environment. |
| Hotel Visitors | Welcoming Relaxing Accessibility | |

Aesthetic environment picture selected:



3.4.3 Aesthetic and Form – Restaurant

Based on the collected data on the survey, the results are as the following

| User | Psychological impact | Solution |
|-------------------|---------------------------------------|---|
| Restaurant Guests | Welcoming Overwhelming Exciting | 1. Ornaments and light play in order to generate and overwhelming and exciting impact. 2. Materials should be selected to ensure a classy look. 3. Seating should be set at a semi-private level. |

Aesthetic environment picture selected:



3.4.4 Aesthetic and Form – Spa

Based on the collected data on the survey, the results are as the following

| User | Psychological impact | Solution |
|------------|----------------------------------|---|
| Spa Guests | Welcoming Relaxing Sensual | 1. Lighting should have major impact on creating relaxing and sensual environment. 2. Warm, earth tone colors for a cozy and welcoming environment. 3. Facilities should be set to mainly private for each guest. |

Aesthetic environment picture selected:



3.4.5 Aesthetic and Form – Guest room

Based on the collected data on the survey, the results are as the following

| User | Psychological impact | Solution |
|--------------|-------------------------------|--|
| Hotel Guests | Welcoming Relaxing Cozy | 1. Modern design to go along with selected aesthetic pictures. 2. Warm, neutral tone colors for a cozy and welcoming environment. 3. Additional functions such as hydrotherapy bath and shower should be added for hotel experience. |

Aesthetic environment pictures selected:



3.5 Project Specific

PROJECT SPECIFIC
SPA FACILITIES AND EQUIPMENT

IN THIS PROJECT, THE SPA PLAYS AN IMPORTANT ROLE
IN THE HOTEL.

THE FOLLOWING ARE SPECIFIC SPA EQUIPMENTS AND
FACILITIES THAT WILL BE USED IN THE SPA.



Figure 3.5.1 – Project Specific Introduction

HYDROTHERAPY POOL

A hydrotherapy pool is a pool fitted with water spray jets that provide water circulation and for hydro massage purposes.

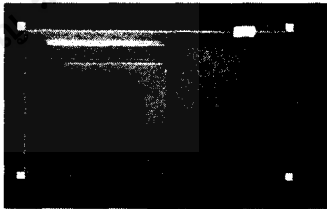
It is preferably installed below ground for ease of entrance and exit.

A hydrotherapy pool should be no smaller than 9.25m x 4.57m for approximately 8 users.

The depth of the pool should be around 0.84 - 1.42m or around the lower sternum of the body to shoulder height.



PROJECT SPECIFIC
HYDROTHERAPY POOL



| Modelo Ancho Alto | Medidas (Cm) Size Measure | Capacidad Total Total Capacity Capacité totale | Asientos Seats Sièges | Tumbonas Deck chairs Transats | Camillas Couch Brancards | Femorales Femoral Femorales | Cascadas Waterfalls Cascades | Cañones Canyons Canons | Volcanes Volcanoes Volcans |
|-------------------------|---------------------------------|--|-----------------------------|-------------------------------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------------------------------|
| Munch | 700 x 400 x 100 / 120 | 12 | 4 | - | 3 | 3 | 1 | 1 | - |

SPECIFICATION OF A
FINISHED HYDROTHERAPY POOL

Figure 3.5.2 – Hydrotherapy Pool Specifics

HYDROTHERAPY POOL

A hydrotherapy pool is a pool fitted with water spray jets that provide water circulation and for hydro massage purposes.

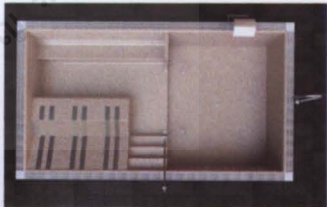
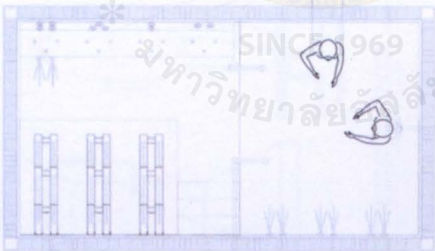
It is preferably installed below ground for ease of entrance and exit.

A hydrotherapy pool should be no smaller than 9.25m x 4.57m for approximately 8 users.

The depth of the pool should be around 0.84 - 1.42m or around the lower sternum of the body to shoulder height.



PROJECT SPECIFIC
HYDROTHERAPY POOL



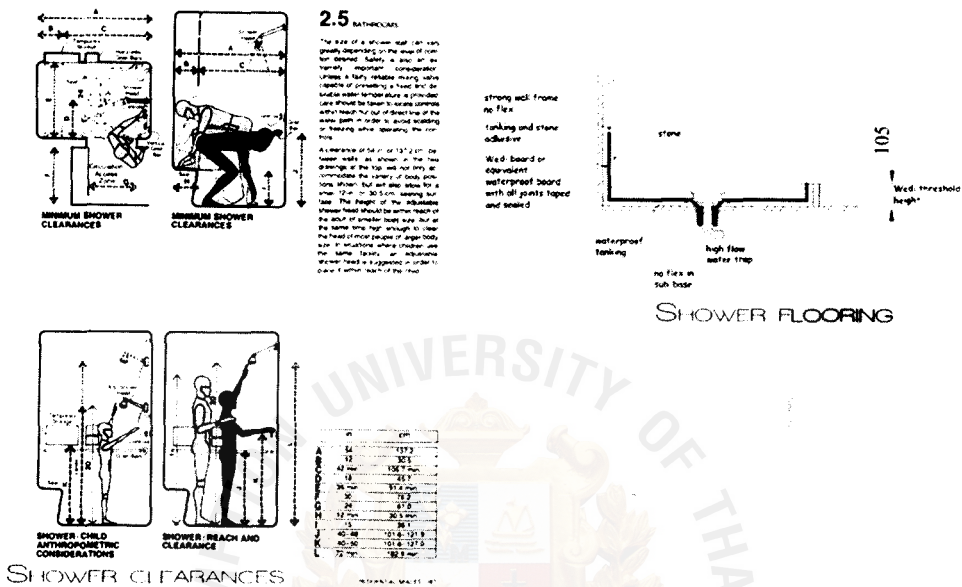
| Modelo Article Modèle | Medidas (Cm) Size Mesures | Capacidad Total Total Capacity Capacité totale | Asientos Seats Sièges | Tumbonas Deck chairs Transats | Camillas Couch Bancards | Femorales Femoral Fémorales | Cascadas Waterfalls Cascades | Cañones Canyons Canyons | Volcanes Volcanoes Volcans |
|-----------------------------|---------------------------------|--|-----------------------------|-------------------------------------|-------------------------------|-----------------------------------|------------------------------------|-------------------------------|----------------------------------|
| Munich | 700 x 400 x 100 / 120 | 12 | 4 | - | 3 | 3 | 1 | 1 | - |

SPECIFICATION OF A
FINISHED HYDROTHERAPY POOL

Figure 3.5.2 – Hydrotherapy Pool Specifics

PROJECT SPECIFIC

HYDROTHERAPY SHOWER



PROJECT SPECIFIC

HYDROTHERAPY MASSAGE TABLE

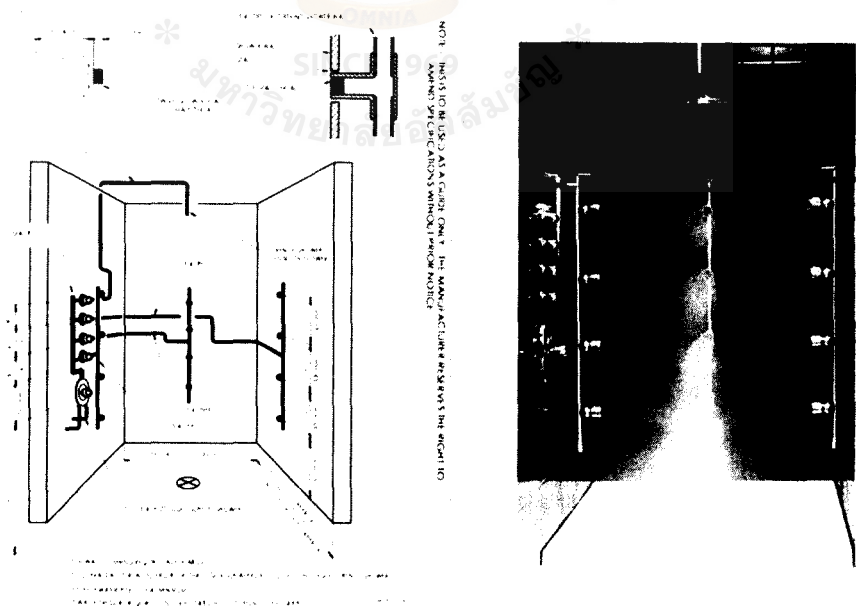


Figure 3.5.3 – Hydrotherapy Massage Shower Specifics

HYDROMASSAGE
BED

A hydrotherapy massage bed is a solid bed with jet spray nozzles placed above the bed for hydro massage use. It has similar advantages as a normal vertical hydrotherapy shower but it can be used with massaging therapy with the help of a masseur.



PROJECT SPECIFIC
HYDROTHERAPY MASSAGE TABLE

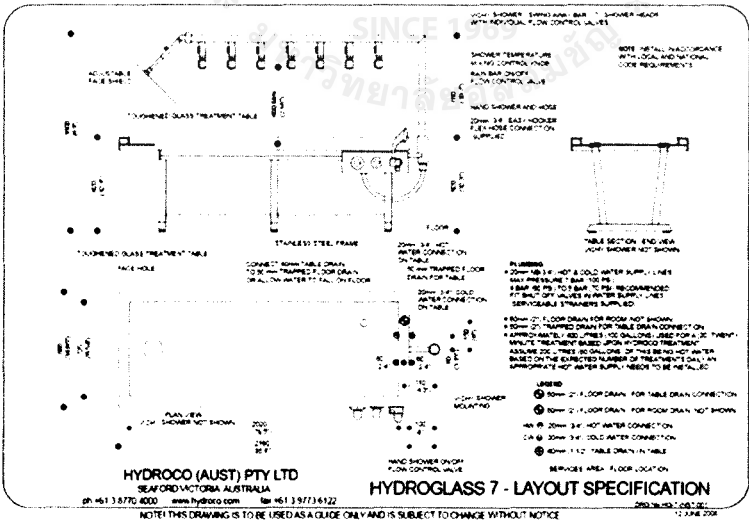


Figure 3.5.4 – Hydrotherapy Shower Specifics

PROJECT SPECIFIC

STEAM ROOM

STEAM ROOMS ARE DESIGNED TO ENCLOSE A ROOM AND PROVIDE IT WITH HIGH TEMPERATURE STEAM.

STEAM ROOMS ARE THE BEST WAY TO DETOXYIFY THE SKIN THROUGH SWEATING.

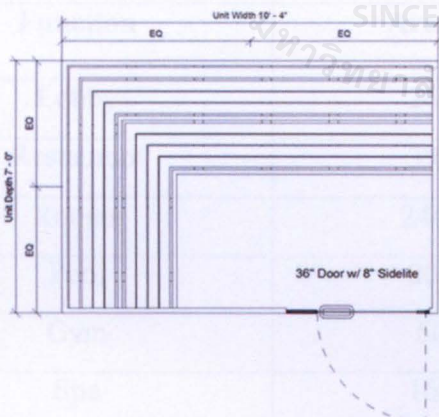
STEAM ROOMS ALSO HELP YOU RELAX, LOWER YOUR BLOOD PRESSURE, AND REMOVES SALT FROM YOUR SYSTEM (WEIGHT LOSS).

STEAM ROOMS CAN BE USED WITH AROMATIC THERAPY TO USE THE MOIST AS A DEVICE TO LET THE SKIN EXTRACT USEFUL MINERALS FROM THEM.

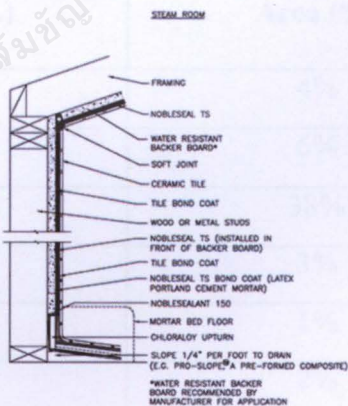


PROJECT SPECIFIC

STEAM ROOM



PLAN OF A TYPICAL 8 PERSON STEAM ROOM INSTALLATION



SECTION OF STEAM ROOM WATER SEALED CONSTRUCTION

Figure 3.5.5 – Steam Room Specifics

Chapter 4: Data Synthesis and Programming

4.1 Area Requirement

4.1.1 Case Study : Chrome hotel, Kolkatta

| Function | Area (sqm.) | Area (%) |
|-------------|-------------|----------|
| Lobby | 150 sqm. | 5% |
| Restaurant | 240 sqm. | 8% |
| Rooms | 1050 sqm. | 35% |
| Pool | 180 sqm. | 6% |
| Lounge Bar | 90 sqm. | 3% |
| Gym | 30 sqm. | 1% |
| Office | 150 sqm. | 5% |
| Circulation | 600 sqm. | 20% |
| Others | 510 sqm. | 17% |
| Total | 3000 sqm. | |

4.1.2 Case Study : Hotel Square Nine, Belgrade

| Function | Area (sqm.) | Area (%) |
|-------------|-------------|----------|
| Lobby | 260 sqm. | 4% |
| Restaurant | 390 sqm. | 6% |
| Rooms | 2483 sqm. | 38% |
| Pool | 200 sqm. | 3% |
| Gym | 60 sqm. | 1% |
| Spa | 160 sqm. | 2% |
| Office | 477 sqm. | 7% |
| Circulation | 1122 sqm. | 17% |
| Others | 1350 sqm. | 20% |
| Total | 5913 sqm. | |

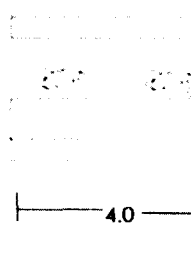

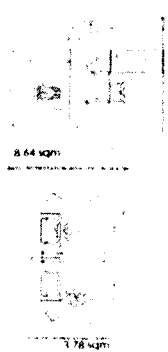
4.1.3 Case Study : Dream Hotel, Bangkok

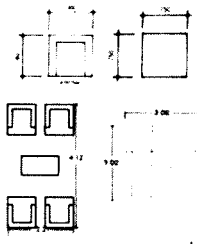
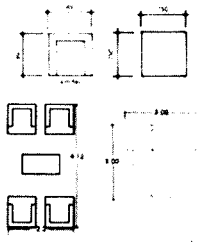
| Function | Area (sqm.) | Area (%) |
|-------------|-------------|----------|
| Lobby | 143 sqm. | 2% |
| Restaurant | 430 sqm. | 6% |
| Rooms | 4505 sqm. | 63% |
| Pool | 380 sqm. | 5% |
| Gym | 120 sqm. | 2% |
| Spa | 160 sqm. | 2% |
| Office | 186 sqm. | 4% |
| Circulation | 1073 sqm. | 15% |
| Others | 215 sqm. | 3% |
| Total | 7150 sqm. | |

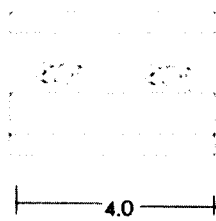
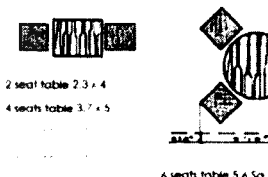
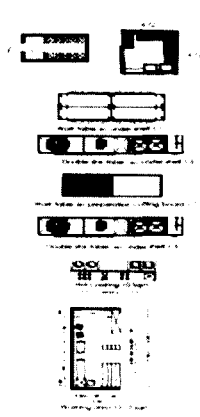
4.2 Overall Area Percentage from Case Studies

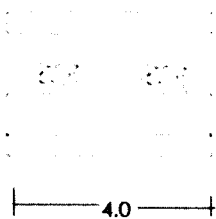

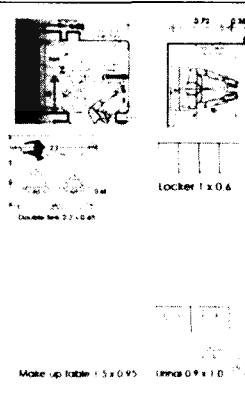
| Function | Chrome Hotel | Square Nine Hotel | Dream Hotel | Average (%) | Project Area (sqm.) |
|-------------|--------------|-------------------|-------------|-------------|---------------------|
| Lobby | 5% | 4% | 2% | 4% | 160 sqm. |
| Restaurant | 8% | 6% | 6% | 7% | 280 sqm. |
| Rooms | 35% | 38% | 63% | 45% | 1800 sqm. |
| Pool | 6% | 3% | 5% | - | |
| Gym | 1% | 1% | 2% | 2% | 80 sqm. |
| Spa | - | 2% | 2% | 20% | 1000 sqm. |
| Office | 5% | 7% | 4% | 5% | 800 sqm. |
| Circulation | 20% | 17% | 15% | 17% | 680 sqm. |
| Total | 4000 sqm. | | | | |

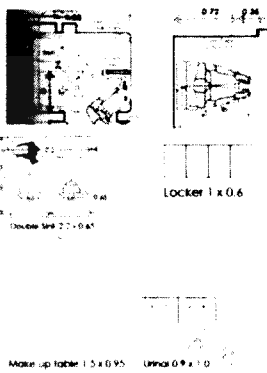
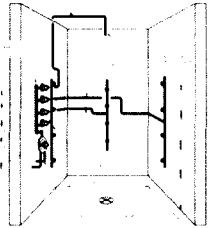
4.3 Estimated Project Area Requirement

| Area | Furniture & equipment | NO. OF | | Area requirement (SQM.) | Typical area furniture layout |
|---------------|---|--------|------|-------------------------|---|
| | | User | Unit | | |
| Lobby - Staff | | | | | |
| Reception | <ul style="list-style-type: none">•Counter•Computer•Telephone | 2 | 1 | 12.5 sqm. |  |
| Bus boy | <ul style="list-style-type: none">•Counter•Storage | 2 | 1 | 1 sqm. 6 sqm. |  |
| Front Office | <ul style="list-style-type: none">•Office desk•Office seating•Computer•Print and Fax | 8 | 1 | 32 sqm. |  |
| | | | | Total furniture | 51.5 sqm. |
| | | | | Circulation 30% | 15.45 sqm. |
| | | | | Total area | 66.95 sqm. |
| | | | | | |

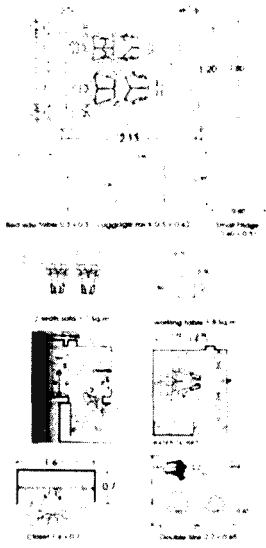
| Area | Furniture & equipment | NO. OF | | Area requirement (SQM.) | Typical area furniture layout |
|------------------|---|--------|------|-------------------------|--|
| | | User | Unit | | |
| Lobby - Guests | | | | | |
| Waiting Area | •5 seater sofa set + coffee table | 5 | 2 | 18 sqm. |  |
| | •2 seater sofa set +coffee table | 2 | 4 | 12 sqm. | |
| Lobby Lounge | •5 seater sofa set + coffee table | 5 | 4 | 32 sqm. |  |
| | •2 seater sofa set +coffee table | 2 | 5 | 15 sqm. | |
| Pantry | •Counter bar •Washing Sink •Refridgerator •Storage | 10 | 1 | 20 sqm. | |
| Internet Service | •Counter •Seating •Computer | 1 | 5 | 7 sqm. | |
| | | | | Total furniture | 104 sqm. |
| | | | | Circulation 30% | 31.2 sqm. |
| | | | | Total area | 135.2 sqm. |

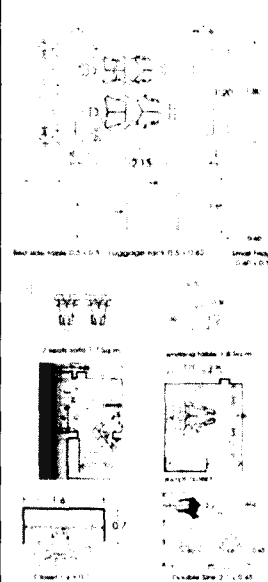
| Area | Furniture & equipment | NO. OF | | Area requirement (SQM.) | Typical area furniture layout |
|----------------|-----------------------|--------|------|-------------------------|---|
| | | User | Unit | | |
| Coffee shop | | | | | |
| Reception | •Counter | 1 | 1 | 4 sqm. |  |
| Dining Seating | •2 seater set | 2 | 10 | 23 sqm. |  |
| | •4 seater set | 4 | 15 | 55.5 sqm. | |
| | •6 seater set | 6 | 5 | 28 sqm. | |
| Kitchen | •Storage | | 1 | 11 sqm. |  |
| | •Cold storage | | 1 | 22.2 sqm. | |
| | •Ingredient area | 4 | 1 | 6.4 sqm | |
| | •Cooking area | 6 | 1 | 10 sqm. | |
| | •Desserts bar | 1 | 1 | 5 sqm. | |
| | •Washing area | 2 | 1 | 10 sqm. | |
| | | | | Total furniture | 175.1 sqm. |
| | | | | Circulation 30% | 52.3 sqm. |
| | | | | Total area | 227.63 sqm. |
| | | | | | |

| Area | Furniture & equipment | NO. OF | | Area requirement (SQM.) | Typical area furniture layout |
|--------------|-----------------------|---------|------|-------------------------|---|
| | | User | Unit | | |
| Spa | | | | | |
| Reception | •Counter | 1 | 1 | 4 sqm. |  |
| Waiting area | •2 seater sofa set | 2 | 2 | 6 sqm. |  |
| | +coffee table | 4 | 2 | 12 sqm. | |
| Men's Locker | •Wash Basin | 1 | 4 | 2.86 sqm. |  |
| | +WC | •Urinal | 1 | 4 | |
| | •Lavatory | 1 | 2 | 2.6 sqm | |
| | •Locker | 8 | 3 | 1.8 sqm. | |
| | •Changing room | 1 | 4 | 5 sqm. | |
| | | 1 | 4 | 5 sqm. | |
| | •Shower | 2 | 2 | 4 sqm. | |
| | •Dressing table | | | | |

| Area | Furniture & equipment | NO. OF | | Area requirement (SQM.) | Typical area furniture layout |
|-----------------------|-----------------------|--------|------|-------------------------|---|
| | | User | Unit | | |
| Spa | | | | | |
| Women's Locker +WC | •Wash Basin | 1 | 4 | 2.86 sqm. |  |
| | •Lavatory | 1 | 6 | 7.8 sqm | |
| | •Locker | 8 | 3 | 1.8 sqm. | |
| | •Changing room | 1 | 4 | 5 sqm. | |
| | | 1 | 4 | 5 sqm. | |
| | •Shower | 2 | 2 | 4 sqm. | |
| | •Dressing table | | | | |
| Steam room | | 8 | 2 | 25.2 sqm | |
| Hydroshower room | | 1 | 12 | 12 sqm. |  |

| Area | Furniture & equipment | NO. OF | | Area requirement (SQM.) | Typical area furniture layout |
|------------|-----------------------|--------|------|-------------------------|-------------------------------|
| | | User | Unit | | |
| Guestrooms | | | | | |
| Standard | •Single/Double bed | 2 | 1/2 | 3.5 sqm. | |
| | •Side table | | 2 | 0.5 sqm. | |
| | •2 seater sofa set | 2 | 1 | 3 sqm. | |
| | +coffee table | | 1 | 2 sqm. | |
| | •Counter | | | | |
| | +Mini fridge | | | | |
| | +TV | | 2 | 2.4 sqm | |
| | •Closet | 1 | 1 | 1 sqm | |
| | •Luggage rack | | 1 | 1.8 sqm | |
| | •Working Table | 1 | | | |
| | +seating | 1 | 1 | 0.8 sqm | |
| | •Wash basin | 1 | 1 | 1.25 sqm | |
| | •Shower | 1 | 1 | 1.53 sqm | |
| | •Bath | | 1 | 1.2 sqm | |
| | •Lavatory | | | | |
| | | | | Total furniture | 19 sqm. |
| | | | | Circulation 30% | 5.7 sqm. |
| | | | | Total area | 24.7 sqm. |

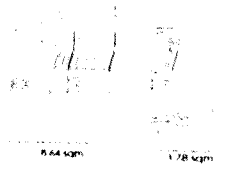
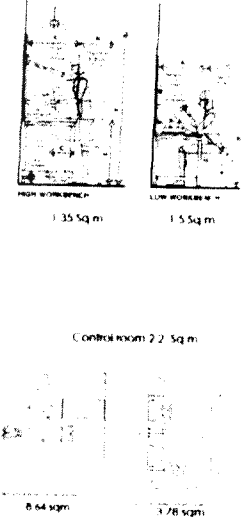
| Area | Furniture & equipment | NO. OF | | Area requirement (SQM.) | Typical area furniture layout |
|------------|-----------------------|--------|------|-------------------------|--|
| | | User | Unit | | |
| Guestrooms | | | | | |
| Deluxe | •Single/Double bed | 2 | 1/2 | 3.5 sqm. |  |
| | •Side table | | 2 | 0.5 sqm. | |
| | •2 seater sofa set | 2 | 1 | 3 sqm. | |
| | +coffee table | 1 | 1 | 1.5 sqm. | |
| | •Lounge Seater | 1 | 1 | 2 sqm. | |
| | •Counter | | | | |
| | +Mini fridge | | | | |
| | +TV | 1 | 2 | 2.4 sqm | |
| | •Closet | | 1 | 1 sqm | |
| | •Luggage rack | 1 | 1 | 2 sqm | |
| | •Working Table | 1 | | | |
| | +seating | 1 | 2 | 1.6 sqm | |
| | •Wash basin | 1 | 1 | 1.25 sqm | |
| | •Shower | | 1 | 1.53 sqm | |
| | •Bath | | 1 | 1.2 sqm | |
| | •Lavatory | | | | |
| | | | | Total furniture | 21.5 sqm. |
| | | | | Circulation 35% | 7.5 sqm. |
| | | | | Total area | 29 sqm. |
| | | | | | |

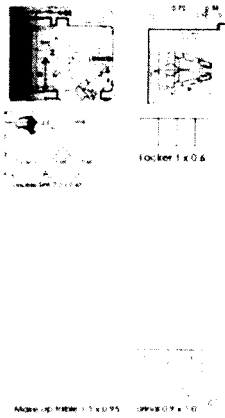
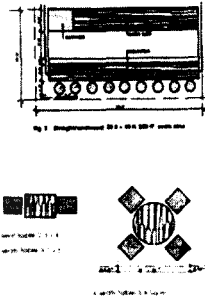
| Area | Furniture & equipment | NO. OF | | Area requirement (SQM.) | Typical area furniture layout |
|------------|-----------------------|--------|------|-------------------------|--|
| | | User | Unit | | |
| Guestrooms | | | | | |
| Suite | •Single bed | 2 | 1 | 4 sqm. |  |
| | •Side table | | 2 | 0.5 sqm. | |
| | •4 seater sofa set | 4 | 1 | 6 sqm. | |
| | +coffee table | 1 | 1 | 1.5 sqm. | |
| | •Lounge Seater | 1 | 1 | 4 sqm. | |
| | •Counter | | | | |
| | +Mini fridge | | | | |
| | +TV | 1 | 2 | 2.4 sqm | |
| | •Closet | | 1 | 2 sqm | |
| | •Luggage rack | 1 | 2 | 4 sqm | |
| | •Working Table | 1 | | | |
| | +seating | 1 | 2 | 1.6 sqm | |
| | •Wash basin | 1 | 1 | 1.25 sqm | |
| | •Shower | | 1 | 1.53 sqm | |
| | •Bath | | 1 | 1.2 sqm | |
| | •Lavatory | 2 | 1 | 5.75 sqm | |
| | •Jacuzzi | | | | |
| | | | | Total furniture | 35.75 sqm. |
| | | | | Circulation 35% | 10.7 sqm. |
| | | | | Total area | 46.4 sqm. |

Guestrooms Grand Total Amount

| Room Type | Area (sqm.) | Room No. | Total Area (sqm.) |
|-----------|-------------|----------|-------------------|
| Standard | 24.7 sqm. | 35 | 864 sqm |
| Deluxe | 29 sqm. | 15 | 435 sqm. |
| Suite | 46.4 sqm. | 8 | 371 sqm. |
| Total | | 58 | 1670 sqm. |



| Area | Furniture & equipment | NO. OF | | Area requirement (SQM.) | Typical area furniture layout |
|-----------------------|-----------------------------|--------|------|-------------------------|---|
| | | User | Unit | | |
| Back of house | | | | | |
| Administration Office | •Manager office | 1 | 2 | 17.28 sqm. |  |
| | | 2 | 4 | 15.12 sqm. | |
| | •Work stations | 1 | 2 | 2 sqm. | |
| | •Fax and printing | | | | |
| Housekeeping | •Linen storage | 2 | 2 | 12 sqm. | |
| | •Equipment | 2 | 2 | 12 sqm. | |
| | Storage | | | | |
| Engineering | •Manager office | 1 | 1 | 8.64 sqm. |  |
| | | 2 | 1 | 3.78 sqm. | |
| | •Work stations | 2 | 2 | 7.56 sqm | |
| | •Work stations (mechanical) | 1 | 1 | 2 sqm. | |
| | •Control room | | | | |
| | | | | | |

| Area | Furniture & equipment | NO. OF | | Area requirement (SQM.) | Typical area furniture layout |
|-------------------------------|-----------------------|--------|------|-------------------------|---|
| | | User | Unit | | |
| Back of house | | | | | |
| Staff Lavatory +Locker | •Wash basin | 1 | 8 | 5.72 sqm. |  |
| | •Lavatory | 1 | 10 | 13 sqm. | |
| | •Urinal | 1 | 6 | 4.26 sqm. | |
| | •Shower | 1 | 6 | 7.5 sqm. | |
| | •Locker | 8 | 6 | 3.6 sqm. | |
| Staff Pantry | •2 seater table | 2 | 6 | 13.8 sqm. |  |
| | +dining chair | | | | |
| | •4 seater table | 4 | 10 | 46.6 sqm. | |
| | +dining chair | | | | |
| | •Pantry | 3 | 1 | 6 sqm. | |
| | | | | Total furniture | 180.86 sqm. |
| | | | | Circulation 30% | 54.2 sqm. |
| | | | | Total area | 235 sqm. |

Back Of House Grand Total Amount

| Function | Area (sqm.) |
|---------------|-------------|
| Lobby | 170.15 sqm. |
| Front Office | 32 sqm. |
| Coffee Shop | 226.63 sqm. |
| Spa | 394 sqm. |
| Guestrooms | 1670 sqm. |
| Back of house | 235 sqm. |
| TOTAL | |



4.4 Bubble Diagram and Adjacency Matrix

4.4.1 Hotel Bubble Diagram and Adjacency matrix

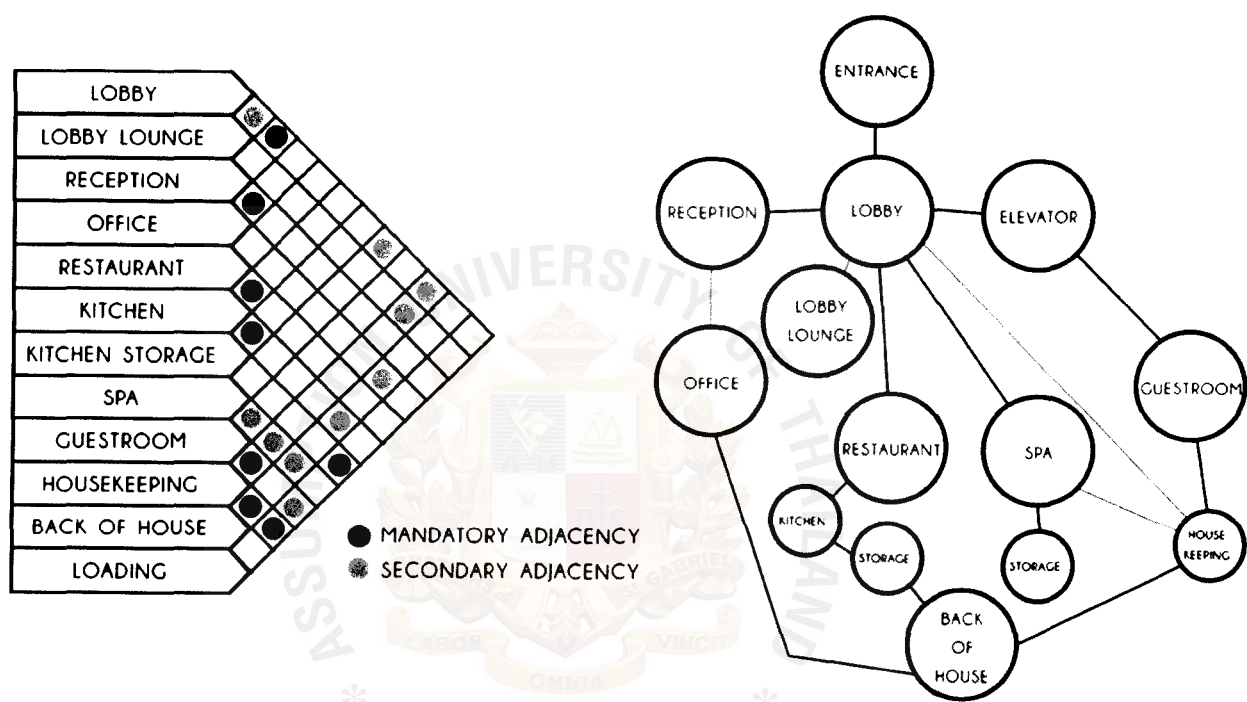


Figure 4.4.1 – Hotel Bubble Diagram and Adjacency Matrix

4.4.2 Spa Bubble Diagram and Adjacency matrix

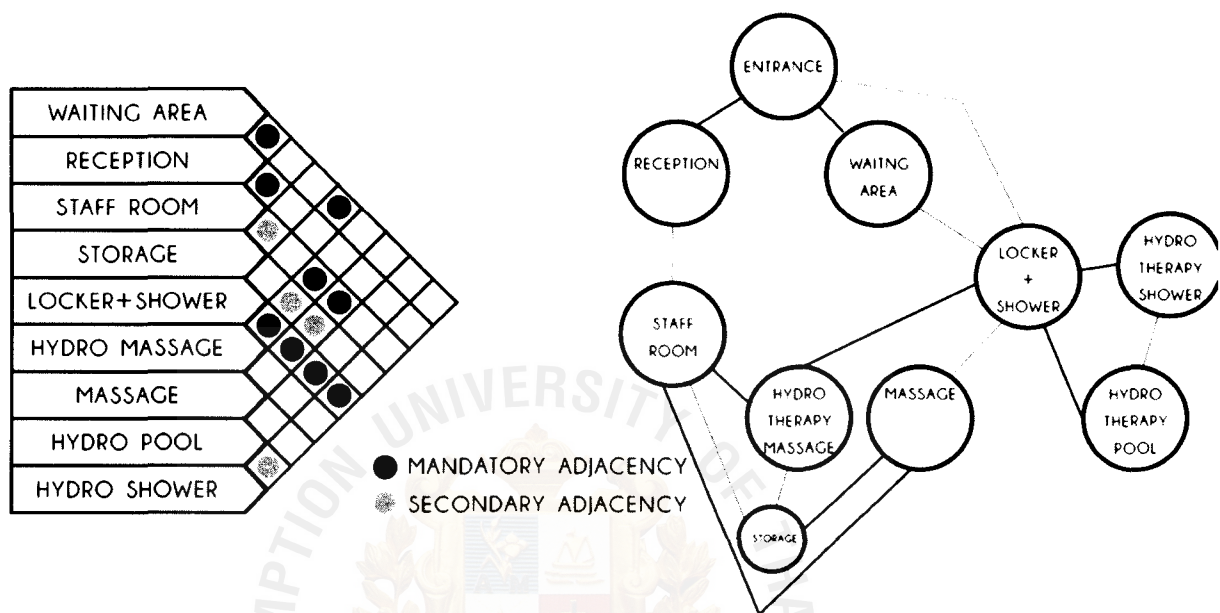


Figure 4.4.2 – Spa Bubble Diagram and Adjacency Matrix

4.4.3 Functional Diagram

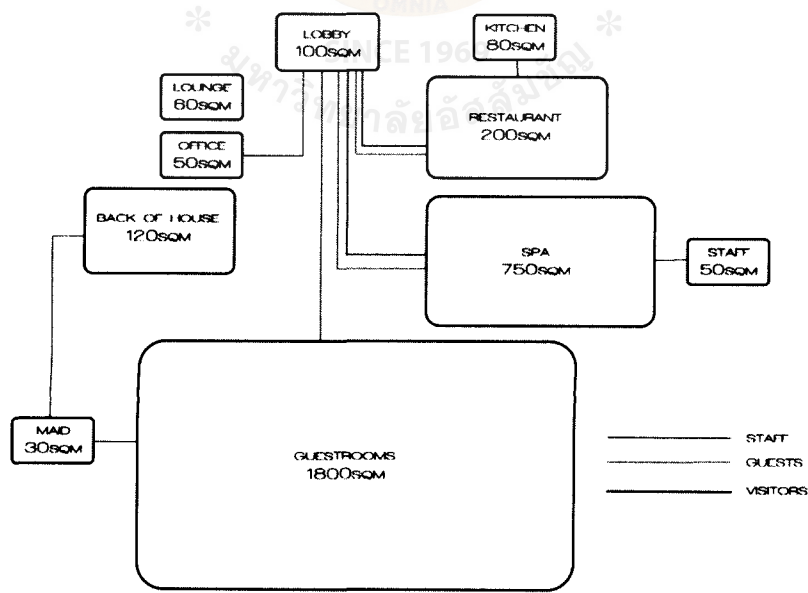


Figure 4.4.3 – Functional Diagram

4.5 Zoning Analysis

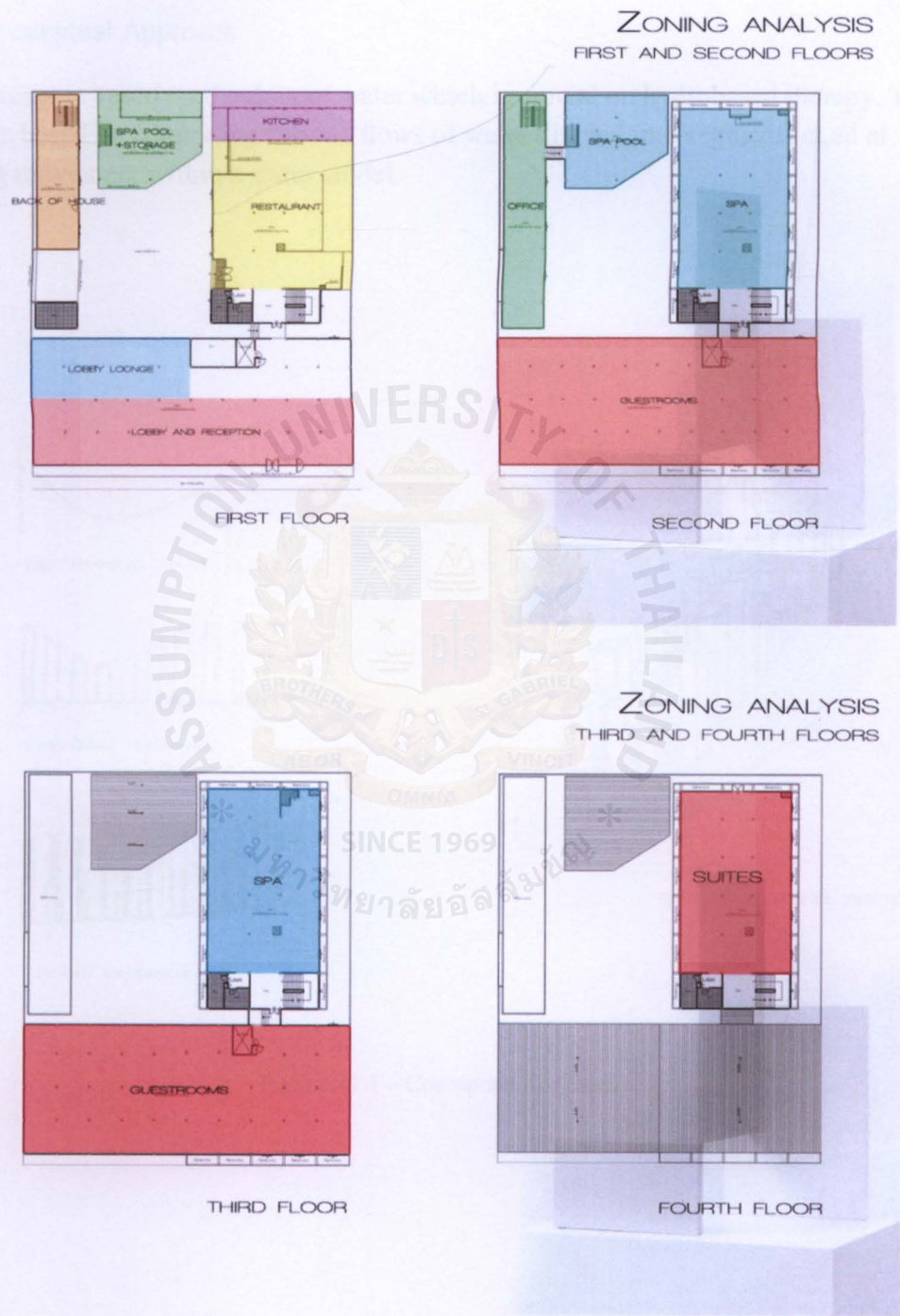


Figure 4.5.1 – Zoning Analysis

Chapter 5: Design Solution

5.1 Design Concept

5.1.1 Conceptual Approach

The concept is based on the flow of water which is crucial on hydrobased therapy. The model is based on combining various flows of water divided into segments aimed at creating movement within a static model.

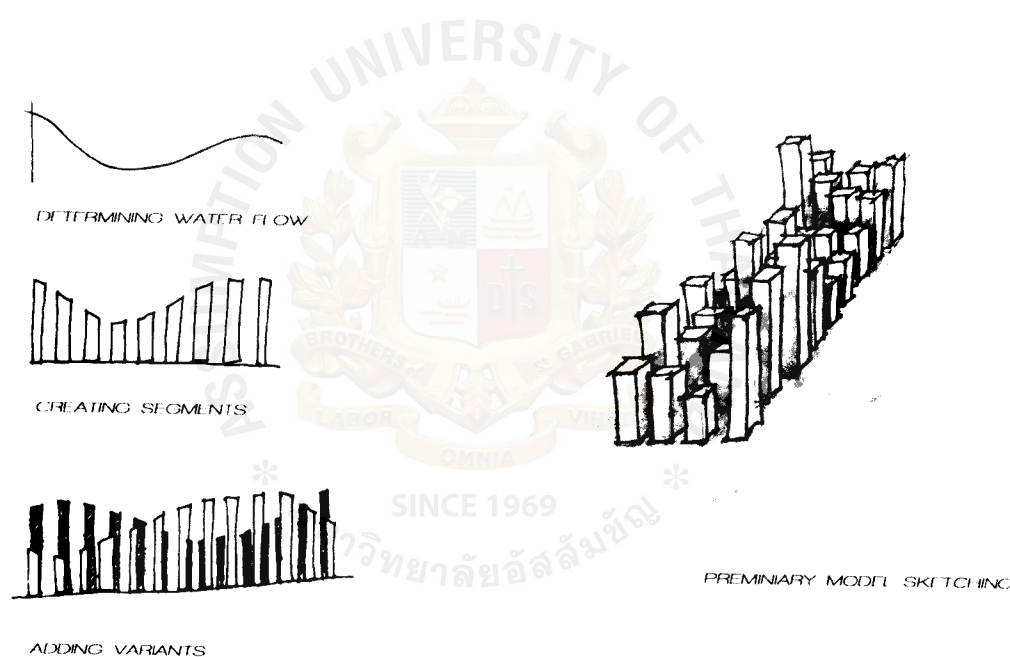


Figure 5.1.1 – Conceptual Approach

5.1.2 Conceptual Model



Figure 5.1.2 – Conceptual Model



Figure 5.1.3 – Conceptual Model

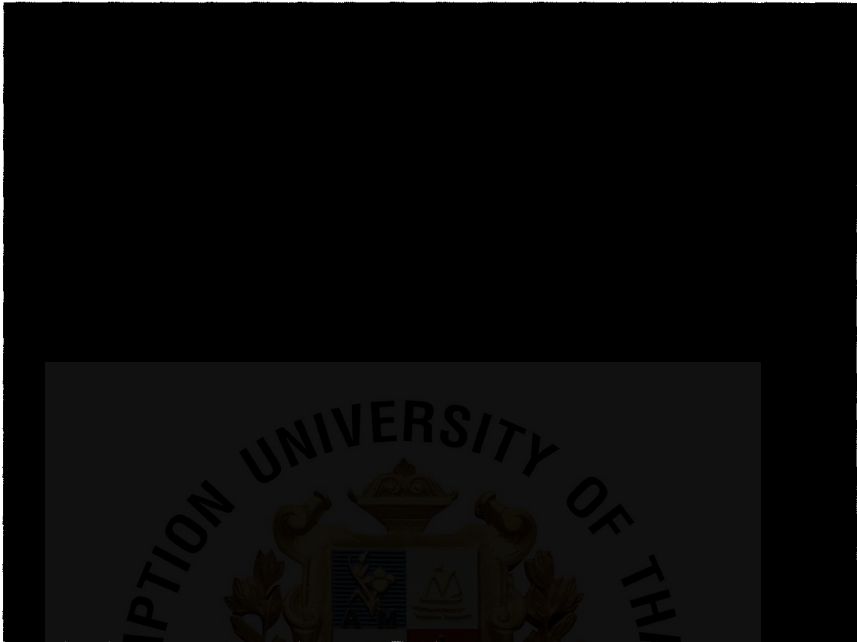


Figure 5.1.4 – Conceptual Model



Figure 5.1.5 – Conceptual Model



Figure 5.1.4 – Conceptual Model



Figure 5.1.5 – Conceptual Model

5.2 Design Development

5.1.3 Conceptual Collage

The collage is composed with the idea of pure and rhythmic design that is related with water and can be implemented on the hotel design.

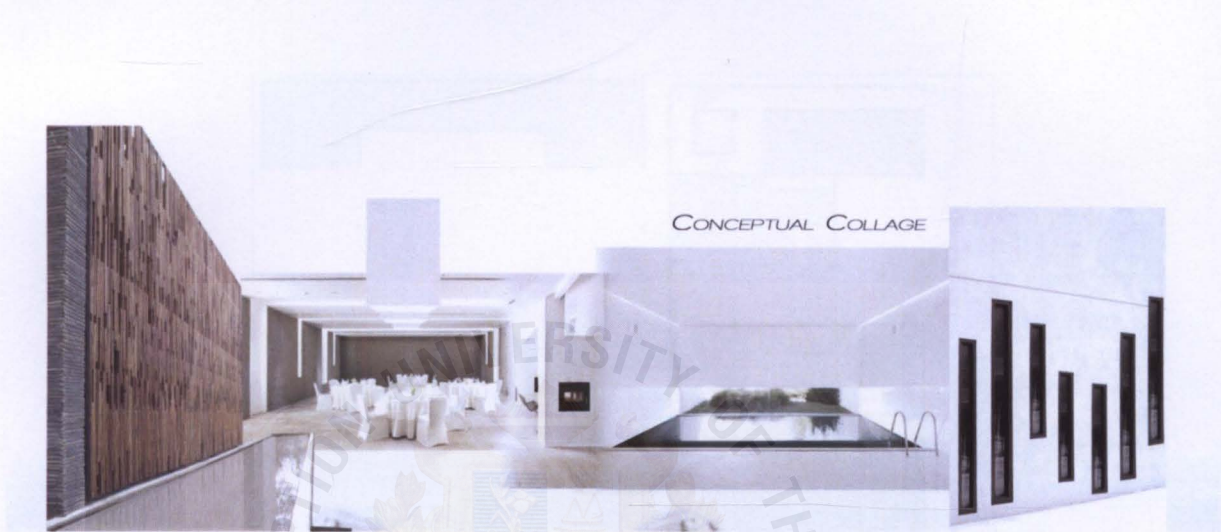


Figure 5.1.6 – Conceptual Collage

ASSUMPTION UNIVERSITY THAILAND
* SINCE 1969 *
มหาวิทยาลัยอัสสัมชัญ

Figure 5.1.1 – Floor Plan: Plot 1

5.2 Design Development

5.2.1 Layout Plans

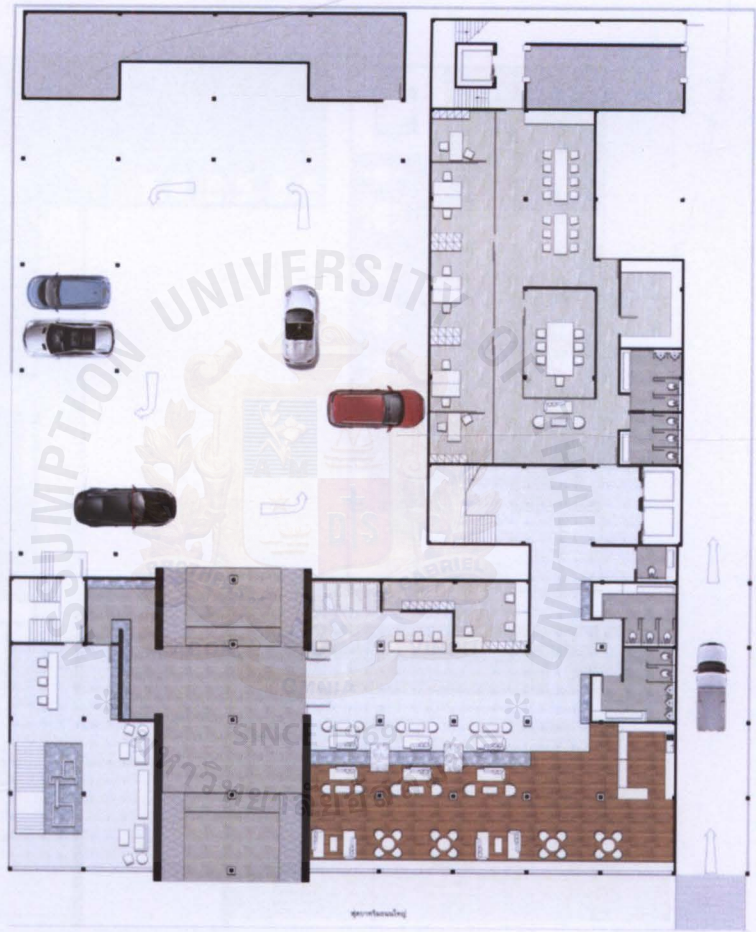


Figure 5.2.1 – First Floor Plan

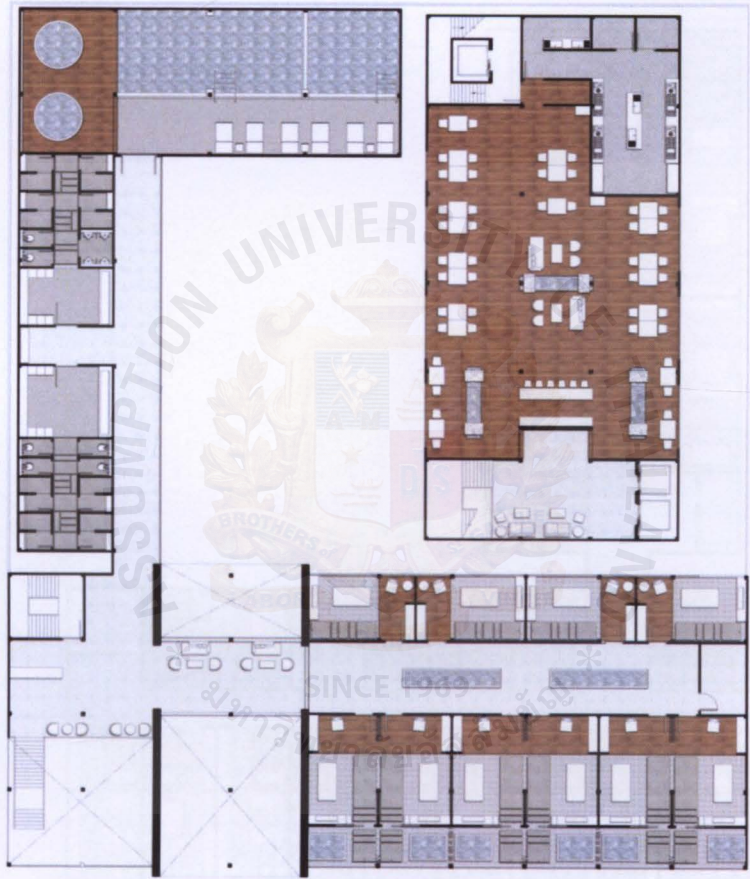


Figure 5.2.2 – Second Floor Plan

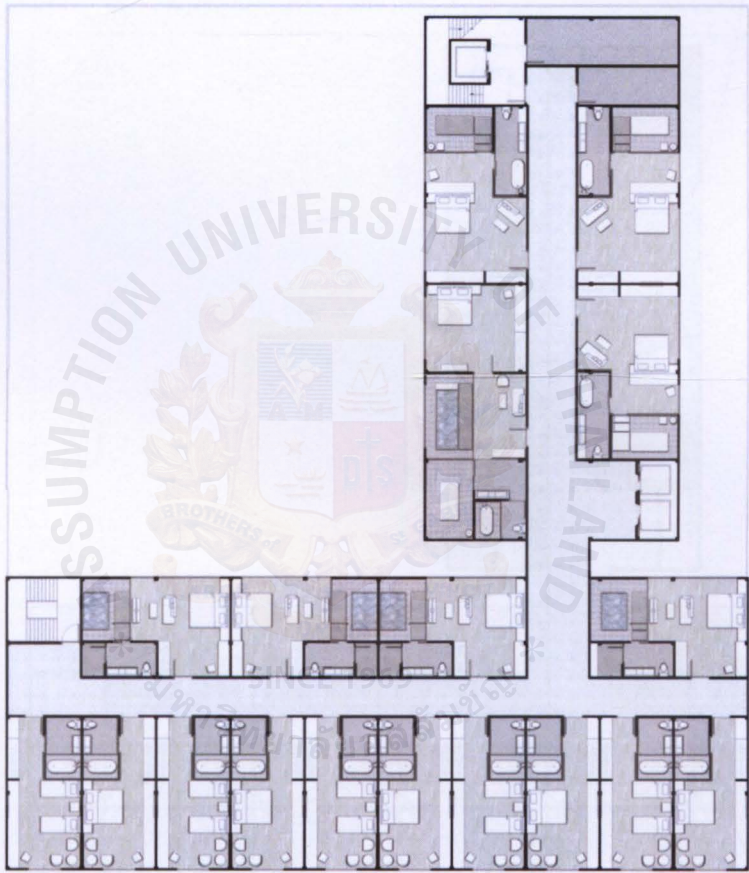


Figure 5.2.3 – Third Floor Plan

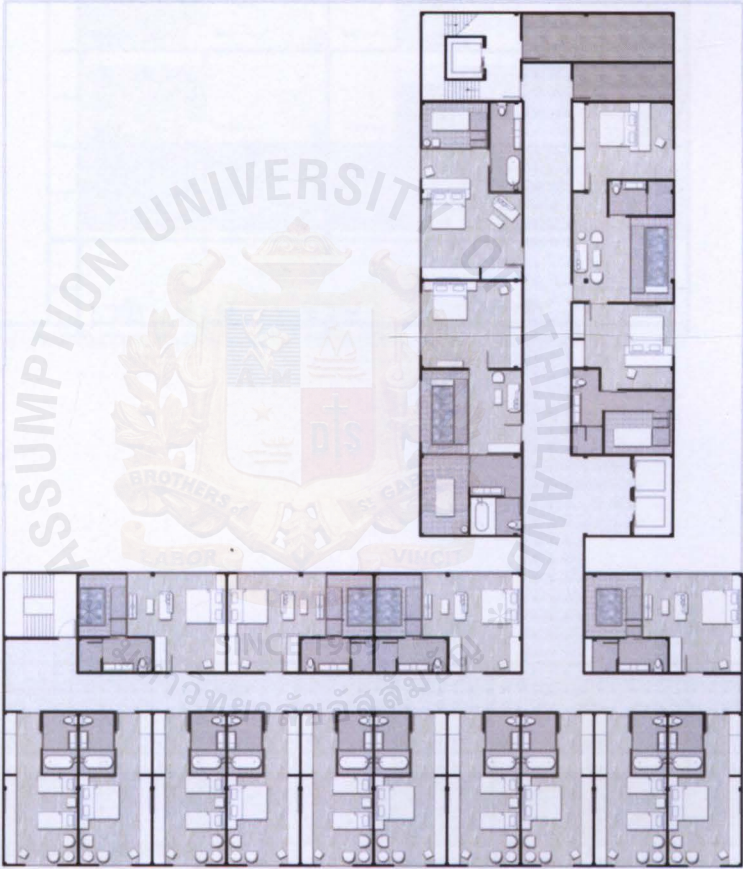


Figure 5.2.4 – Fourth Floor Plan

5.2.2 Cross Sections

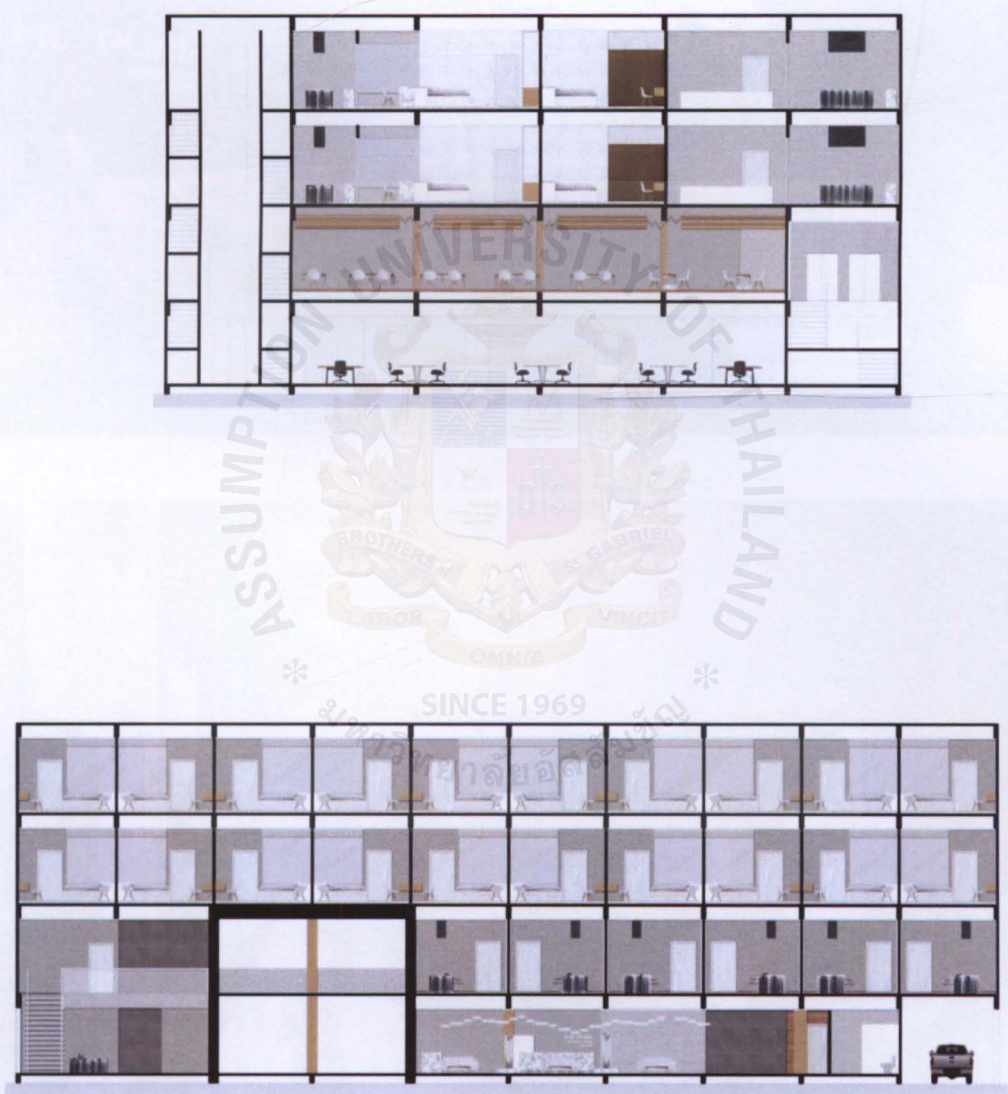


Figure 5.2.5 – Cross Sections

5.2.3 Perspectives



Figure 5.2.6 – Lobby Perspective



Figure 5.2.7 – Lobby Lounge Perspective



Figure 5.2.8 – Restaurant Perspective



Figure 5.2.9 – Jacuzzi Suite Perspective



Figure 5.2.10 - Standard Room Perspective



Figure 5.2.11 - Standard Room Perspective



Figure 5.2.12 - Suite Room Perspective



Figure 5.2.13 - Suite Room Perspective



Figure 5.2.14 - Spa Room Perspective



Figure 5.2.15 - Spa Pool Perspective

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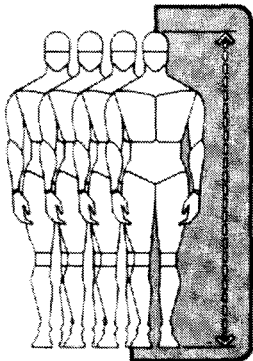
Balekjian, C. (2011). *Boutique hotel: The Challenge of Standing out from the crowd*. HVS. London, UK.



Appendix A

2E

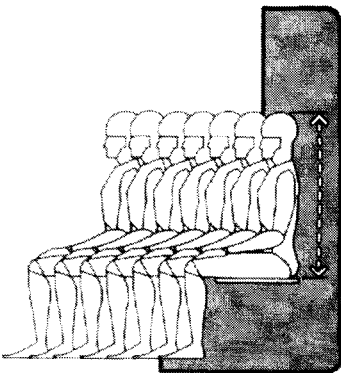
STATURE



| Adult Male and Female Stature in Inches and Centimeters by Age, Sex and Selected Percentiles† | | | | | | | | |
|---|-------|---------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| | | 18 to 79 (Total) | 18 to 24 Years | 25 to 34 Years | 35 to 44 Years | 45 to 54 Years | 55 to 64 Years | 65 to 74 Years |
| | | in cm | in cm | in cm | in cm | in cm | in cm | in cm |
| 99 | MEN | 74.6 189.5 | 74.8 190.0 | 76.0 193.0 | 74.1 188.2 | 74.0 188.0 | 73.5 186.7 | 72.0 182.9 |
| | WOMEN | 68.8 174.8 | 69.3 176.0 | 69.0 175.3 | 69.0 175.3 | 68.7 174.5 | 68.7 174.5 | 67.0 170.2 |
| 95 | MEN | 72.8 184.9 | 73.1 185.7 | 73.8 187.5 | 72.5 184.2 | 72.7 184.7 | 72.2 183.4 | 70.9 180.1 |
| | WOMEN | 67.1 170.4 | 67.9 172.5 | 67.3 170.9 | 67.2 170.7 | 67.2 170.7 | 66.6 169.2 | 65.5 166.4 |
| 90 | MEN | 71.8 182.4 | 72.4 183.9 | 72.7 184.7 | 71.7 182.1 | 71.7 182.1 | 71.0 180.3 | 70.2 178.3 |
| | WOMEN | 66.4 168.7 | 66.8 169.7 | 66.6 169.2 | 66.6 169.2 | 66.1 167.9 | 65.6 166.6 | 64.7 164.3 |
| 80 | MEN | 70.6 179.3 | 70.9 180.1 | 71.4 181.4 | 70.7 179.6 | 70.5 179.1 | 69.8 177.3 | 68.9 175.0 |
| | WOMEN | 65.1 165.4 | 65.9 167.4 | 65.7 166.9 | 65.5 165.4 | 64.8 164.6 | 64.3 163.3 | 63.7 161.8 |
| 70 | MEN | 69.7 177.0 | 70.1 178.1 | 70.5 179.1 | 70.0 177.8 | 69.5 176.5 | 68.8 174.8 | 68.3 173.5 |
| | WOMEN | 64.4 163.6 | 65.0 165.1 | 64.9 164.8 | 64.7 164.3 | 64.1 162.8 | 63.6 161.5 | 62.8 159.5 |
| 60 | MEN | 68.8 174.8 | 69.3 176.0 | 69.8 177.3 | 69.2 175.8 | 68.8 174.8 | 68.3 173.5 | 67.5 171.5 |
| | WOMEN | 63.7 161.8 | 64.5 163.8 | 64.4 163.6 | 64.1 162.8 | 63.4 161.0 | 62.9 159.8 | 62.1 157.7 |
| 50 | MEN | 68.3 173.5 | 68.6 174.2 | 69.0 175.3 | 68.6 174.2 | 68.3 173.5 | 67.6 171.7 | 66.8 169.7 |
| | WOMEN | 62.9 159.8 | 63.9 162.3 | 63.7 161.8 | 63.4 161.0 | 62.8 159.5 | 62.3 158.2 | 61.6 156.5 |
| 40 | MEN | 67.6 171.7 | 67.9 172.5 | 68.4 173.7 | 68.1 173.0 | 67.7 172.0 | 66.8 169.7 | 66.2 168.1 |
| | WOMEN | 62.4 158.5 | 63.0 160.0 | 62.9 159.8 | 62.8 159.5 | 62.3 158.2 | 61.8 157.0 | 61.1 155.2 |
| 30 | MEN | 66.8 169.7 | 67.1 170.4 | 67.7 172.0 | 67.3 170.9 | 66.9 169.9 | 66.0 167.6 | 65.5 166.4 |
| | WOMEN | 61.8 157.0 | 62.3 158.2 | 62.4 158.5 | 62.2 158.0 | 61.7 156.7 | 61.3 155.7 | 60.2 152.9 |
| 20 | MEN | 66.0 167.6 | 66.5 168.9 | 66.8 169.7 | 66.4 168.7 | 66.1 167.9 | 64.7 164.3 | 64.8 164.6 |
| | WOMEN | 61.1 155.2 | 61.6 156.5 | 61.8 157.0 | 61.4 156.0 | 60.9 154.7 | 60.6 153.9 | 59.5 151.1 |
| 10 | MEN | 64.5 163.8 | 65.4 166.1 | 65.5 166.4 | 65.2 165.6 | 64.8 164.6 | 63.7 161.8 | 64.1 162.8 |
| | WOMEN | 59.8 151.9 | 60.7 154.2 | 60.6 153.9 | 60.4 153.4 | 59.8 151.9 | 59.4 150.9 | 58.3 148.1 |
| 5 | MEN | 63.6 161.5 | 64.3 163.3 | 64.4 163.6 | 64.2 163.1 | 64.0 162.6 | 62.9 159.8 | 62.7 159.3 |
| | WOMEN | 59.0 149.9 | 60.0 152.4 | 59.7 151.6 | 59.6 151.4 | 59.1 150.1 | 58.4 148.3 | 57.5 146.1 |
| 1 | MEN | 61.7 156.7 | 62.6 159.0 | 62.6 159.0 | 62.3 158.2 | 62.3 158.2 | 61.2 155.4 | 60.8 154.4 |
| | WOMEN | 57.1 145.0 | 58.4 148.3 | 58.1 147.6 | 57.6 146.3 | 57.3 145.5 | 56.0 142.2 | 55.8 141.7 |

*Height, without shoes. See Table 1A for definition of stature.
†Measurement below which the indicated percent of people in the given age group fall.

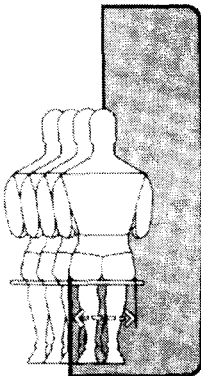
2C
SITTING
HEIGHT
ERECT



| Adult Male and Female Sitting Height Erect* in Inches and Centimeters by Age, Sex, and Selected Percentiles† | | | | | | | | | |
|--|-------|---------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| | | 18 to 79 (Total) | 18 to 24 Years | 25 to 34 Years | 35 to 44 Years | 45 to 54 Years | 55 to 64 Years | 65 to 74 Years | 75 to 79 Years |
| | | in cm | in cm | in cm | in cm | in cm | in cm | in cm | in cm |
| 99 | MEN | 38.9 98.8 | 39.1 99.3 | 39.0 99.1 | 38.9 98.8 | 38.9 98.8 | 38.7 98.3 | 37.7 95.8 | 37.6 95.5 |
| | WOMEN | 36.6 93.0 | 36.7 93.2 | 36.8 93.5 | 36.8 93.5 | 36.4 92.5 | 36.4 92.5 | 35.8 90.9 | 35.7 90.7 |
| 95 | MEN | 38.0 96.5 | 38.3 97.3 | 38.4 97.5 | 38.0 96.5 | 38.0 96.5 | 37.7 95.8 | 36.9 93.7 | 36.7 93.2 |
| | WOMEN | 35.7 90.7 | 35.9 91.2 | 35.5 90.9 | 35.8 90.9 | 35.6 90.4 | 35.4 89.9 | 34.5 87.6 | 34.8 88.4 |
| 90 | MEN | 37.6 95.5 | 37.8 96.0 | 37.3 96.3 | 37.7 95.8 | 37.6 95.5 | 37.1 94.2 | 36.5 92.7 | 36.1 91.7 |
| | WOMEN | 35.2 89.4 | 35.4 89.9 | 34.9 90.2 | 35.4 89.9 | 35.0 88.9 | 34.8 88.4 | 33.9 86.1 | 34.0 86.4 |
| 80 | MEN | 36.9 93.7 | 37.1 95.8 | 36.9 94.7 | 37.1 95.8 | 36.9 93.7 | 36.6 93.0 | 35.9 91.2 | 35.3 89.7 |
| | WOMEN | 34.6 87.9 | 34.8 88.4 | 34.5 88.6 | 34.8 88.4 | 34.6 87.9 | 34.2 86.9 | 33.4 84.8 | 33.3 84.6 |
| 70 | MEN | 36.5 92.7 | 36.7 93.2 | 36.5 93.7 | 36.7 93.2 | 36.5 92.7 | 36.1 91.7 | 35.5 90.2 | 34.9 88.6 |
| | WOMEN | 34.2 86.9 | 34.4 87.4 | 34.1 87.6 | 34.4 87.4 | 34.1 86.6 | 33.8 85.9 | 32.9 83.6 | 32.8 83.3 |
| 60 | MEN | 36.0 91.4 | 36.3 92.2 | 36.1 92.7 | 36.3 92.2 | 36.0 91.4 | 35.7 90.7 | 35.1 89.2 | 34.6 87.9 |
| | WOMEN | 33.8 85.9 | 34.0 86.4 | 33.8 86.6 | 34.1 86.6 | 33.8 85.9 | 33.4 84.8 | 32.6 82.8 | 32.5 82.6 |
| 50 | MEN | 35.7 90.7 | 35.9 91.2 | 36.1 91.7 | 36.0 91.4 | 35.7 90.7 | 35.3 89.7 | 34.8 88.4 | 34.3 87.1 |
| | WOMEN | 33.4 84.8 | 33.7 85.6 | 33.8 85.9 | 33.7 85.6 | 33.5 85.1 | 33.0 83.8 | 32.2 81.8 | 32.1 81.5 |
| 40 | MEN | 35.3 89.7 | 35.4 89.9 | 35.7 90.7 | 35.6 90.4 | 35.3 89.7 | 35.0 88.9 | 34.4 87.4 | 34.1 86.6 |
| | WOMEN | 33.1 84.1 | 33.4 84.8 | 33.4 84.8 | 33.4 84.8 | 33.2 84.3 | 32.7 83.1 | 31.9 81.0 | 31.6 80.3 |
| 30 | MEN | 34.9 88.6 | 35.0 88.9 | 35.3 88.6 | 35.2 89.4 | 35.0 89.4 | 34.5 88.9 | 34.1 87.6 | 33.6 85.3 |
| | WOMEN | 32.6 82.8 | 33.0 83.8 | 33.1 82.8 | 33.1 89.1 | 32.8 83.3 | 32.3 82.0 | 31.5 80.0 | 31.1 79.0 |
| 20 | MEN | 34.4 87.4 | 34.5 87.6 | 34.9 87.1 | 34.8 88.4 | 34.5 87.6 | 34.1 86.6 | 33.7 85.6 | 33.2 84.3 |
| | WOMEN | 32.2 81.8 | 32.6 82.8 | 32.6 81.5 | 32.6 82.8 | 32.3 82.8 | 31.9 81.0 | 31.0 78.7 | 30.4 77.2 |
| 10 | MEN | 33.8 85.9 | 34.0 86.4 | 34.3 86.1 | 34.2 86.9 | 34.1 86.6 | 33.3 84.6 | 33.1 84.1 | 32.4 82.3 |
| | WOMEN | 31.4 79.8 | 32.1 81.5 | 32.1 78.8 | 32.1 81.5 | 31.7 80.5 | 31.2 79.2 | 30.3 77.0 | 29.2 74.2 |
| 5 | MEN | 33.2 84.3 | 33.3 84.6 | 33.9 82.6 | 33.7 85.6 | 33.5 85.1 | 32.9 83.6 | 32.5 82.6 | 31.8 80.8 |
| | WOMEN | 30.9 78.5 | 31.4 79.8 | 31.4 78.8 | 31.5 80.0 | 31.2 79.2 | 30.7 78.0 | 29.7 75.4 | 28.1 71.4 |
| 1 | MEN | 31.9 81.0 | 31.8 80.8 | 32.5 82.6 | 32.2 81.8 | 32.8 83.3 | 31.4 79.8 | 31.3 79.5 | 27.7 70.4 |
| | WOMEN | 29.5 74.9 | 30.4 77.2 | 30.3 77.0 | 30.3 77.0 | 30.1 76.5 | 30.0 76.2 | 28.6 72.6 | 17.8 45.2 |
| * See Table 1D for definition of sitting height erect. † Measurement below which the indicated percent of people in the given age group fall. | | | | | | | | | |

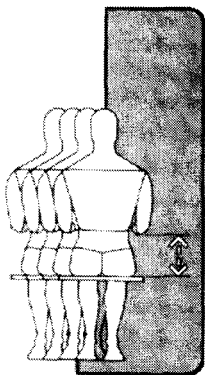
2F

HIP
BREADTH



| Adult Male and Female Hip Breadth* in Inches and Centimeters by Age, Sex, and Selected Percentiles† | | | | | | | | | |
|---|-------|---------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| | | 18 to 79 (Total) | 18 to 24 Years | 25 to 34 Years | 35 to 44 Years | 45 to 54 Years | 55 to 64 Years | 65 to 74 Years | 75 to 79 Years |
| | | in cm | in cm | in cm | in cm | in cm | in cm | in cm | in cm |
| 99 | MEN | 17.0 43.2 | 17.3 43.9 | 17.4 44.2 | 17.1 43.4 | 16.9 42.9 | 16.9 42.9 | 16.6 42.2 | 16.5 41.9 |
| | WOMEN | 18.8 47.8 | 18.4 46.7 | 19.0 48.3 | 19.2 48.8 | 19.0 48.3 | 18.7 47.5 | 18.2 46.2 | 17.1 43.4 |
| 95 | MEN | 15.9 40.4 | 15.8 40.1 | 16.0 40.6 | 15.9 40.4 | 16.0 40.6 | 15.9 40.4 | 15.7 39.9 | 15.5 39.4 |
| | WOMEN | 17.1 43.4 | 15.9 40.4 | 16.8 42.7 | 17.3 43.9 | 17.6 44.7 | 17.4 44.2 | 17.3 43.9 | 16.8 42.7 |
| 90 | MEN | 15.5 39.4 | 15.0 38.1 | 15.6 39.6 | 15.6 39.6 | 15.7 39.9 | 15.6 39.6 | 15.1 38.4 | 14.9 37.8 |
| | WOMEN | 16.4 41.7 | 15.4 39.1 | 16.0 40.6 | 16.5 41.9 | 16.7 42.4 | 16.8 42.7 | 16.7 42.4 | 16.5 41.9 |
| 80 | MEN | 14.9 37.8 | 14.6 37.1 | 14.9 37.8 | 15.0 38.1 | 15.1 38.4 | 15.0 38.1 | 14.7 37.3 | 14.5 36.8 |
| | WOMEN | 15.6 39.6 | 14.8 37.6 | 15.3 38.9 | 15.7 39.9 | 15.8 40.1 | 16.0 40.6 | 15.9 40.4 | 15.8 40.1 |
| 70 | MEN | 14.6 37.1 | 14.1 35.8 | 14.6 37.1 | 14.7 37.3 | 14.8 37.6 | 14.6 37.1 | 14.5 36.8 | 14.2 36.1 |
| | WOMEN | 15.1 38.4 | 14.4 36.6 | 14.8 37.6 | 15.1 38.4 | 15.4 39.1 | 15.6 39.6 | 15.4 39.1 | 15.0 38.1 |
| 60 | MEN | 14.3 36.3 | 13.8 35.1 | 14.3 36.3 | 14.4 36.6 | 14.5 36.8 | 14.3 36.3 | 14.2 36.1 | 13.9 35.3 |
| | WOMEN | 14.7 37.3 | 14.1 35.3 | 14.4 36.6 | 14.8 37.6 | 15.0 38.1 | 15.1 38.4 | 14.9 37.8 | 14.5 36.8 |
| 50 | MEN | 14.0 35.6 | 13.5 34.3 | 14.0 35.6 | 14.1 35.8 | 14.2 36.1 | 14.0 35.6 | 13.9 35.3 | 13.6 34.5 |
| | WOMEN | 14.3 36.3 | 13.8 35.1 | 14.0 35.6 | 14.5 36.8 | 14.6 37.1 | 14.7 37.3 | 14.6 37.1 | 14.0 35.6 |
| 40 | MEN | 13.7 34.8 | 13.3 33.8 | 13.7 34.8 | 13.8 35.1 | 13.9 35.3 | 13.7 34.8 | 13.6 34.5 | 13.4 34.0 |
| | WOMEN | 14.0 35.6 | 13.5 34.3 | 13.7 34.8 | 14.2 36.1 | 14.2 36.1 | 14.3 36.3 | 14.3 36.3 | 13.7 34.8 |
| 30 | MEN | 13.4 34.0 | 13.0 33.0 | 13.4 34.0 | 13.5 34.3 | 13.5 34.3 | 13.4 34.0 | 13.4 34.0 | 13.2 33.5 |
| | WOMEN | 13.6 34.5 | 13.2 33.5 | 13.4 34.0 | 13.8 35.1 | 13.8 35.1 | 13.9 35.3 | 14.0 35.6 | 13.3 33.8 |
| 20 | MEN | 13.1 33.3 | 12.6 32.0 | 13.1 33.3 | 13.3 33.8 | 13.2 33.5 | 13.1 33.3 | 13.1 33.3 | 12.9 32.8 |
| | WOMEN | 13.3 33.8 | 12.8 32.5 | 13.1 33.3 | 13.4 34.0 | 13.4 34.0 | 13.6 34.5 | 13.5 34.3 | 13.0 33.0 |
| 10 | MEN | 12.5 31.8 | 12.5 31.0 | 12.5 31.8 | 12.9 32.8 | 12.6 32.0 | 12.6 32.0 | 12.6 32.0 | 12.4 31.5 |
| | WOMEN | 12.7 32.3 | 12.3 31.2 | 12.6 32.0 | 12.9 32.8 | 13.0 33.0 | 13.2 33.5 | 12.9 32.8 | 12.2 31.0 |
| 5 | MEN | 12.2 31.0 | 12.0 30.5 | 12.2 31.0 | 12.4 31.5 | 12.2 31.0 | 12.2 31.0 | 12.2 31.0 | 12.1 30.7 |
| | WOMEN | 12.3 31.2 | 12.1 30.7 | 12.2 31.0 | 12.4 31.5 | 12.4 31.5 | 12.9 32.8 | 12.4 31.5 | 11.7 29.7 |
| 1 | MEN | 11.5 29.2 | 11.3 28.7 | 11.7 29.7 | 12.0 30.5 | 11.5 29.2 | 11.6 29.5 | 11.4 29.0 | 11.4 29.0 |
| | WOMEN | 11.7 29.7 | 11.3 28.7 | 11.5 29.2 | 12.0 30.5 | 12.0 30.5 | 12.1 30.7 | 12.1 30.7 | 9.8 24.9 |
| * See Table 1J for definition of hip breadth. † Measurement below which the indicated percent of people in the given age group fall. | | | | | | | | | |

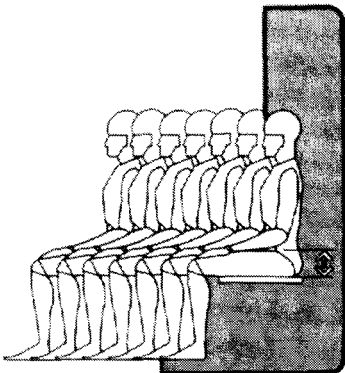
29
ELBOW
REST
HEIGHT



| Adult Male and Female Elbow Rest Height* in Inches and Centimeters by Age, Sex, and Selected Percentiles† | | | | | | | | | |
|---|-------|------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| | | 18 to 79 (Total) | 18 to 24 Years | 25 to 34 Years | 35 to 44 Years | 45 to 54 Years | 55 to 64 Years | 65 to 74 Years | 75 to 79 Years |
| | | in cm | in cm | in cm | in cm | in cm | in cm | in cm | in cm |
| 99 | MEN | 12.5 31.8 | 12.8 32.5 | 12.6 32.0 | 12.6 32.0 | 12.0 24.1 | 12.2 23.6 | 11.9 22.9 | 11.0 21.8 |
| | WOMEN | 11.9 30.2 | 11.8 30.0 | 11.9 30.2 | 12.0 30.5 | 12.1 30.7 | 11.9 30.2 | 11.3 28.7 | 10.7 27.2 |
| 95 | MEN | 11.6 29.5 | 11.9 30.2 | 11.7 29.7 | 11.8 30.0 | 11.5 30.5 | 11.4 30.0 | 10.9 27.7 | 10.6 26.9 |
| | WOMEN | 11.0 27.9 | 10.8 27.4 | 11.1 28.2 | 11.3 28.7 | 11.0 27.9 | 10.9 27.7 | 10.2 25.9 | 10.0 25.4 |
| 90 | MEN | 11.0 27.9 | 11.4 30.0 | 11.1 28.2 | 11.3 28.7 | 11.0 27.9 | 10.9 27.7 | 10.6 26.9 | 10.2 25.9 |
| | WOMEN | 10.7 27.2 | 10.5 26.7 | 10.8 27.4 | 10.8 27.4 | 10.7 27.2 | 10.6 26.9 | 9.8 24.9 | 9.8 24.9 |
| 80 | MEN | 10.6 26.9 | 10.7 27.2 | 10.7 27.2 | 10.7 27.2 | 10.5 26.7 | 10.4 26.4 | 10.0 25.4 | 9.7 24.6 |
| | WOMEN | 10.1 25.7 | 9.9 25.1 | 10.3 26.2 | 10.3 26.2 | 10.3 26.2 | 10.0 25.4 | 9.5 24.1 | 9.4 22.9 |
| 70 | MEN | 10.2 25.9 | 10.3 26.2 | 10.3 26.2 | 10.4 26.4 | 10.1 25.7 | 9.9 25.1 | 9.6 24.4 | 9.3 23.6 |
| | WOMEN | 9.7 24.6 | 9.6 24.4 | 9.9 25.1 | 9.9 25.1 | 9.9 25.1 | 9.6 24.4 | 9.1 23.1 | 9.1 23.1 |
| 60 | MEN | 9.8 24.9 | 9.9 25.1 | 10.0 25.4 | 10.0 25.4 | 9.8 24.9 | 9.6 24.4 | 9.3 23.6 | 8.9 22.6 |
| | WOMEN | 9.5 24.1 | 9.4 23.9 | 9.6 24.4 | 9.7 24.6 | 9.6 24.4 | 9.3 23.6 | 8.8 22.4 | 8.7 22.1 |
| 50 | MEN | 9.5 24.1 | 9.6 24.4 | 9.7 24.6 | 9.7 24.6 | 9.6 24.4 | 9.3 23.6 | 9.0 22.9 | 8.6 21.8 |
| | WOMEN | 9.2 23.4 | 9.1 23.1 | 9.3 23.6 | 9.4 23.9 | 9.3 23.6 | 9.0 22.9 | 8.5 21.6 | 8.4 21.3 |
| 40 | MEN | 9.2 23.4 | 9.4 23.9 | 9.4 23.9 | 9.4 23.9 | 9.3 23.6 | 9.0 22.9 | 8.7 22.1 | 8.2 20.8 |
| | WOMEN | 8.9 22.6 | 8.8 22.4 | 9.1 23.1 | 9.2 23.4 | 9.0 22.9 | 8.6 21.8 | 8.2 20.8 | 8.0 20.3 |
| 30 | MEN | 8.9 22.6 | 9.1 23.1 | 9.1 23.1 | 9.1 23.1 | 9.1 23.1 | 8.6 21.8 | 8.4 21.3 | 7.8 19.8 |
| | WOMEN | 8.5 21.6 | 8.5 21.6 | 8.7 22.1 | 8.9 22.6 | 8.7 21.8 | 8.3 21.1 | 7.8 19.8 | 7.7 19.6 |
| 20 | MEN | 8.5 21.6 | 8.6 21.8 | 8.7 22.1 | 8.7 22.1 | 8.7 22.1 | 8.3 21.1 | 8.0 20.3 | 7.5 19.1 |
| | WOMEN | 8.2 20.8 | 8.2 20.8 | 8.4 21.3 | 8.5 21.6 | 8.3 21.1 | 8.0 20.3 | 7.4 18.8 | 7.4 18.8 |
| 10 | MEN | 8.0 20.3 | 8.1 20.6 | 8.3 21.1 | 8.2 20.8 | 8.2 20.8 | 7.7 19.6 | 7.4 18.8 | 7.1 18.0 |
| | WOMEN | 7.6 19.3 | 7.6 19.3 | 8.0 20.3 | 8.0 20.3 | 7.8 19.8 | 7.4 18.8 | 7.0 17.5 | 7.0 17.5 |
| 5 | MEN | 7.4 18.8 | 7.6 19.3 | 8.0 20.3 | 7.8 19.8 | 7.7 19.6 | 7.2 18.3 | 7.1 18.0 | 6.5 16.5 |
| | WOMEN | 7.1 18.0 | 7.2 18.3 | 7.4 18.8 | 7.5 19.1 | 7.3 19.8 | 7.1 18.0 | 6.4 16.3 | 6.4 16.3 |
| 1 | MEN | 6.3 16.0 | 6.3 16.0 | 7.0 17.8 | 6.5 16.5 | 7.0 17.8 | 6.0 17.8 | 6.1 15.5 | 5.7 14.5 |
| | WOMEN | 6.1 15.5 | 6.2 15.7 | 6.1 15.5 | 6.7 17.0 | 6.4 16.3 | 6.4 16.3 | 5.4 13.7 | 2.8 7.1 |
| * See Table 1K for definition of elbow rest height. † Measurement below which the indicated percent of people in the given age group fall. | | | | | | | | | |

24

THIGH
CLEARANCE



Adult Male and Female Thigh Clearance* in Inches and Centimeters
by Age, Sex, and Selected Percentiles†

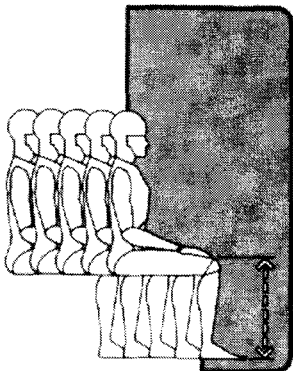
| | | 18 to 79 (Total) | 18 to 24 Years | 25 to 34 Years | 35 to 44 Years | 45 to 54 Years | 55 to 64 Years | 65 to 74 Years | 75 to 79 Years |
|----|-------|---------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| | | in cm | in cm | in cm | in cm | in cm | in cm | in cm | in cm |
| 99 | MEN | 7.7 19.6 | 7.7 19.6 | 7.9 20.1 | 7.8 19.8 | 7.1 18.0 | 7.4 18.8 | 7.0 17.8 | 7.2 18.3 |
| | WOMEN | 7.7 19.6 | 7.0 17.8 | 7.7 19.6 | 7.8 19.8 | 7.7 19.6 | 8.3 21.1 | 7.0 17.8 | 6.9 17.5 |
| 95 | MEN | 6.9 17.5 | 6.9 17.5 | 7.0 17.8 | 7.0 17.8 | 6.9 17.5 | 6.8 17.3 | 6.7 17.0 | 6.6 16.8 |
| | WOMEN | 6.9 17.5 | 6.7 17.0 | 6.9 17.5 | 7.0 17.8 | 6.9 17.5 | 6.9 17.5 | 6.6 16.8 | 6.5 16.5 |
| 90 | MEN | 6.7 17.0 | 6.8 17.3 | 6.9 17.5 | 6.8 17.3 | 6.7 17.0 | 6.6 16.8 | 6.5 16.5 | 6.1 15.5 |
| | WOMEN | 6.6 16.8 | 6.3 16.0 | 6.6 16.8 | 6.7 17.0 | 6.6 16.8 | 6.6 16.8 | 6.2 15.7 | 6.1 15.5 |
| 80 | MEN | 6.4 16.3 | 6.4 16.3 | 6.6 16.8 | 6.5 16.5 | 6.3 16.0 | 6.1 15.5 | 6.0 15.2 | 5.8 14.7 |
| | WOMEN | 6.0 15.2 | 5.9 15.0 | 6.0 15.2 | 6.3 16.0 | 6.1 15.5 | 6.0 15.2 | 5.9 15.0 | 5.8 14.7 |
| 70 | MEN | 6.0 15.2 | 6.1 15.5 | 6.3 16.0 | 6.2 15.7 | 6.0 15.2 | 5.9 15.0 | 5.8 14.7 | 5.6 14.2 |
| | WOMEN | 5.8 14.7 | 5.7 14.5 | 5.8 14.7 | 5.9 15.0 | 5.9 15.0 | 5.8 14.7 | 5.7 14.5 | 5.6 14.2 |
| 60 | MEN | 5.8 14.7 | 5.9 15.0 | 6.0 15.2 | 6.0 15.2 | 5.8 14.7 | 5.7 14.5 | 5.6 14.2 | 5.4 13.7 |
| | WOMEN | 5.6 14.2 | 5.5 14.0 | 5.6 14.2 | 5.7 14.5 | 5.7 14.5 | 5.6 14.2 | 5.5 14.0 | 5.4 13.7 |
| 50 | MEN | 5.7 14.5 | 5.7 14.5 | 5.8 14.7 | 5.8 14.7 | 5.6 14.2 | 5.5 14.0 | 5.4 13.7 | 5.2 13.2 |
| | WOMEN | 5.4 13.7 | 5.4 13.7 | 5.4 13.7 | 5.5 14.0 | 5.5 14.0 | 5.4 13.7 | 5.3 13.5 | 5.2 13.2 |
| 40 | MEN | 5.5 14.0 | 5.5 14.0 | 5.6 14.2 | 5.6 14.2 | 5.5 14.0 | 5.3 13.5 | 5.3 13.5 | 5.0 13.0 |
| | WOMEN | 5.2 13.2 | 5.2 13.2 | 5.2 13.2 | 5.3 13.5 | 5.3 13.5 | 5.2 13.2 | 5.1 13.0 | 4.9 12.4 |
| 30 | MEN | 5.3 13.5 | 5.3 13.5 | 5.4 13.7 | 5.4 13.7 | 5.3 13.5 | 5.2 13.2 | 5.1 13.0 | 4.7 11.9 |
| | WOMEN | 5.1 13.0 | 5.0 13.0 | 5.1 13.0 | 5.1 13.0 | 5.1 13.0 | 5.0 13.0 | 4.9 12.4 | 4.7 11.9 |
| 20 | MEN | 5.1 13.0 | 5.1 13.0 | 5.2 13.2 | 5.2 13.2 | 5.1 13.0 | 4.9 12.4 | 4.8 12.2 | 4.5 11.4 |
| | WOMEN | 4.7 11.9 | 4.7 11.9 | 4.7 11.9 | 4.9 12.4 | 4.8 12.2 | 4.7 11.9 | 4.6 11.7 | 4.4 11.2 |
| 10 | MEN | 4.7 11.9 | 4.7 11.9 | 4.9 12.4 | 5.0 13.0 | 4.9 12.4 | 4.5 11.4 | 4.4 11.2 | 4.2 10.7 |
| | WOMEN | 4.3 10.9 | 4.3 10.9 | 4.9 12.4 | 4.4 11.2 | 4.4 11.2 | 4.3 10.9 | 4.2 10.7 | 4.1 10.4 |
| 5 | MEN | 4.3 10.9 | 4.3 10.9 | 4.5 11.4 | 4.4 11.2 | 4.2 10.7 | 4.2 10.7 | 4.2 10.7 | 4.1 10.4 |
| | WOMEN | 4.1 10.4 | 4.1 10.4 | 4.2 10.7 | 4.2 10.7 | 4.1 10.4 | 4.1 10.4 | 4.1 10.4 | 4.0 10.1 |
| 1 | MEN | 4.1 10.4 | 4.1 10.4 | 4.1 10.4 | 4.1 10.4 | 4.0 10.1 | 4.0 10.1 | 4.0 10.1 | 3.9 9.9 |
| | WOMEN | 3.8 9.7 | 3.6 9.1 | 4.0 10.1 | 4.0 10.1 | 3.5 8.9 | 3.5 8.9 | 3.4 8.6 | 3.2 8.1 |

* See Table 1L for definition of thigh clearance.

† Measurement below which the indicated percent of people in the given age group fall.

21

KNEE
HEIGHT



Adult Male and Female Knee Height* in Inches and Centimeters
by Age, Sex, and Selected Percentiles†

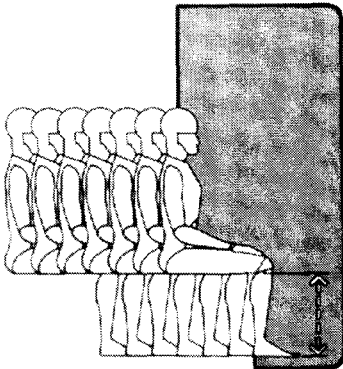
| | | 18 to 79 (Total) | 18 to 24 Years | 25 to 34 Years | 35 to 44 Years | 45 to 54 Years | 55 to 64 Years | 65 to 74 Years | 75 to 79 Years |
|----|-------|---------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| | | in cm | in cm | in cm | in cm | in cm | in cm | in cm | in cm |
| 99 | MEN | 24.1 61.2 | 23.9 60.7 | 24.6 62.5 | 24.4 70.0 | 23.9 60.7 | 24.0 61.0 | 23.7 61.0 | 23.3 59.9 |
| | WOMEN | 22.4 56.9 | 22.7 57.7 | 22.5 57.2 | 22.4 56.9 | 22.5 57.2 | 21.9 55.6 | 22.0 55.9 | 21.5 54.6 |
| 95 | MEN | 23.4 59.4 | 23.4 59.4 | 23.7 61.0 | 23.4 59.4 | 23.3 59.9 | 23.1 58.7 | 22.9 58.7 | 22.7 57.7 |
| | WOMEN | 21.5 54.6 | 21.6 54.9 | 21.6 54.9 | 21.5 54.6 | 21.6 54.9 | 21.4 54.4 | 21.0 53.3 | 20.9 53.1 |
| 90 | MEN | 22.9 58.7 | 22.9 58.7 | 23.3 59.9 | 22.9 58.7 | 22.8 57.9 | 22.8 57.9 | 22.5 57.2 | 22.2 56.4 |
| | WOMEN | 21.0 53.3 | 21.0 53.3 | 21.0 53.3 | 21.0 53.3 | 21.0 53.3 | 20.9 53.1 | 20.7 52.6 | 20.7 52.6 |
| 80 | MEN | 22.4 57.0 | 22.5 57.2 | 22.7 57.7 | 22.5 57.2 | 22.4 57.0 | 22.2 56.4 | 21.9 55.6 | 21.7 55.1 |
| | WOMEN | 20.5 52.1 | 20.6 52.3 | 20.6 52.3 | 20.6 52.3 | 20.5 52.1 | 20.4 51.8 | 20.1 51.1 | 20.2 51.3 |
| 70 | MEN | 22.0 55.9 | 22.1 56.1 | 22.2 56.4 | 22.1 56.1 | 22.0 55.9 | 21.8 55.4 | 21.6 54.9 | 21.4 54.4 |
| | WOMEN | 20.1 51.1 | 20.3 51.6 | 20.3 51.6 | 20.2 51.3 | 20.1 51.1 | 20.0 50.8 | 19.8 50.3 | 19.9 50.5 |
| 60 | MEN | 21.7 55.1 | 21.8 55.4 | 21.9 55.6 | 21.8 55.4 | 21.7 55.1 | 21.4 54.4 | 21.3 54.1 | 21.0 53.3 |
| | WOMEN | 19.8 50.3 | 20.0 50.8 | 20.0 50.8 | 19.9 50.5 | 19.8 50.3 | 19.7 50.0 | 19.5 49.5 | 19.6 49.8 |
| 50 | MEN | 21.4 54.4 | 21.5 54.6 | 21.6 54.9 | 21.5 54.6 | 21.4 54.4 | 21.1 53.6 | 21.0 53.3 | 20.7 52.6 |
| | WOMEN | 19.6 49.8 | 19.7 50.0 | 19.7 50.0 | 19.6 49.8 | 19.5 49.5 | 19.5 49.5 | 19.2 48.8 | 19.4 49.3 |
| 40 | MEN | 21.1 53.6 | 21.2 53.8 | 21.3 54.1 | 21.2 53.5 | 21.1 53.6 | 20.8 52.8 | 20.7 52.6 | 20.4 51.8 |
| | WOMEN | 19.3 49.0 | 19.5 49.5 | 19.4 49.3 | 19.4 49.3 | 19.2 48.8 | 19.2 48.8 | 19.0 48.3 | 19.2 48.6 |
| 30 | MEN | 20.7 52.6 | 20.8 52.8 | 21.1 53.6 | 20.8 52.8 | 20.7 52.6 | 20.5 52.1 | 20.5 52.1 | 20.0 50.8 |
| | WOMEN | 19.1 48.5 | 19.2 48.8 | 19.2 48.6 | 19.1 48.5 | 19.0 48.3 | 19.0 48.3 | 18.7 47.5 | 18.9 48.0 |
| 20 | MEN | 20.4 51.8 | 20.5 52.1 | 20.6 52.3 | 20.4 51.8 | 20.3 51.6 | 20.2 51.3 | 20.2 51.3 | 19.6 49.8 |
| | WOMEN | 18.6 47.2 | 18.9 48.0 | 18.8 47.8 | 18.8 47.8 | 18.5 47.0 | 18.6 47.2 | 18.4 46.7 | 18.4 46.7 |
| 10 | MEN | 20.0 50.8 | 20.1 51.1 | 20.2 51.3 | 20.0 50.8 | 19.9 50.5 | 19.6 49.8 | 19.9 50.5 | 19.2 48.6 |
| | WOMEN | 18.2 46.2 | 18.4 46.7 | 18.3 46.5 | 18.3 46.5 | 18.1 46.0 | 18.2 46.2 | 18.1 46.0 | 18.0 45.7 |
| 5 | MEN | 19.3 49.0 | 19.4 49.3 | 19.8 50.3 | 19.4 49.3 | 19.3 49.0 | 19.1 48.5 | 19.2 48.8 | 19.0 48.3 |
| | WOMEN | 17.9 45.5 | 18.1 46.0 | 18.0 45.7 | 18.0 45.7 | 17.6 44.7 | 17.8 45.2 | 17.8 45.2 | 17.3 43.9 |
| 1 | MEN | 18.3 46.5 | 18.3 46.5 | 19.0 48.3 | 18.4 46.7 | 18.2 46.2 | 18.1 46.0 | 18.2 46.2 | 18.0 45.7 |
| | WOMEN | 17.1 43.4 | 17.3 43.9 | 17.2 43.7 | 17.2 43.7 | 17.1 43.4 | 16.6 42.2 | 17.1 43.4 | 16.3 41.4 |

*See Table 1M for definition of knee height.

†Measurement below which the indicated percent of people in the given age group fall.

2.

POPLITEAL
HEIGHT



Adult Male and Female Popliteal Height* in Inches and Centimeters
by Age, Sex, and Selected Percentiles†

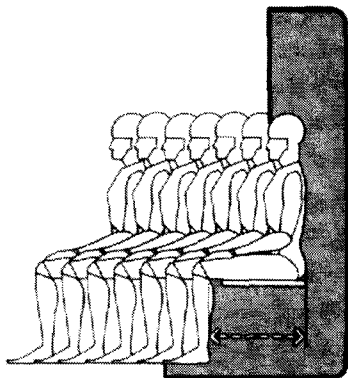
| | | 18 to 79 (Total) | 18 to 24 Years | 25 to 34 Years | 35 to 44 Years | 45 to 54 Years | 55 to 64 Years | 65 to 74 Years | 75 to 79 Years |
|----|-------|---------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| | | in cm | in cm | in cm | in cm | in cm | in cm | in cm | in cm |
| 99 | MEN | 20.0 50.8 | 20.4 51.8 | 20.6 52.3 | 19.9 50.5 | 19.9 50.5 | 19.8 50.3 | 19.8 50.3 | 19.3 49.0 |
| | WOMEN | 18.0 45.7 | 18.5 47.0 | 18.2 46.2 | 17.9 45.5 | 18.3 46.5 | 17.9 45.5 | 17.9 45.5 | 17.8 45.2 |
| 95 | MEN | 19.3 49.0 | 19.6 49.8 | 19.7 50.0 | 19.1 48.5 | 19.1 48.5 | 19.0 48.3 | 18.9 48.0 | 18.4 46.7 |
| | WOMEN | 17.5 44.5 | 17.8 45.2 | 17.5 44.5 | 17.5 44.5 | 17.5 44.5 | 17.1 43.4 | 17.0 43.2 | 17.2 43.7 |
| 90 | MEN | 18.8 47.8 | 19.0 48.3 | 19.2 48.8 | 18.8 47.8 | 18.6 47.2 | 18.6 47.2 | 18.4 46.7 | 17.9 45.5 |
| | WOMEN | 17.0 43.2 | 17.4 44.2 | 17.0 43.2 | 17.0 43.2 | 17.0 43.2 | 16.8 42.7 | 16.8 42.7 | 16.9 42.9 |
| 80 | MEN | 18.2 46.2 | 18.5 47.0 | 18.6 47.2 | 18.2 46.2 | 17.9 45.5 | 18.0 45.7 | 17.8 45.2 | 17.4 44.2 |
| | WOMEN | 16.6 42.2 | 16.9 42.9 | 16.7 42.4 | 16.6 42.2 | 16.6 42.2 | 16.4 41.7 | 16.3 41.4 | 16.6 42.2 |
| 70 | MEN | 17.8 45.2 | 18.0 45.7 | 18.1 46.0 | 17.8 45.2 | 17.7 45.0 | 17.7 45.0 | 17.6 44.7 | 17.0 43.2 |
| | WOMEN | 16.3 41.4 | 16.6 42.2 | 16.4 41.7 | 16.3 41.4 | 16.2 41.1 | 16.1 40.9 | 15.9 40.4 | 16.2 41.1 |
| 60 | MEN | 17.6 44.7 | 17.7 45.0 | 17.8 45.2 | 17.6 44.7 | 17.5 44.5 | 17.4 44.2 | 17.3 43.9 | 16.8 42.7 |
| | WOMEN | 16.0 40.6 | 16.4 41.7 | 16.1 40.9 | 16.0 40.6 | 15.9 40.4 | 15.7 39.9 | 15.6 39.6 | 15.9 40.4 |
| 50 | MEN | 17.3 43.9 | 17.5 44.5 | 17.5 44.5 | 17.3 43.9 | 17.2 43.7 | 17.1 43.4 | 17.1 43.4 | 16.6 42.2 |
| | WOMEN | 15.7 39.9 | 16.1 40.9 | 15.8 40.1 | 15.7 39.9 | 15.5 39.4 | 15.4 39.1 | 15.3 38.9 | 15.6 39.6 |
| 40 | MEN | 17.0 43.2 | 17.2 43.7 | 17.3 43.9 | 17.0 43.2 | 17.0 43.2 | 16.9 42.9 | 16.8 42.7 | 16.4 41.7 |
| | WOMEN | 15.4 39.1 | 15.8 40.1 | 15.6 39.6 | 15.4 39.1 | 15.2 38.6 | 15.0 38.1 | 15.0 38.1 | 15.4 39.1 |
| 30 | MEN | 16.7 42.4 | 17.0 43.2 | 17.0 43.2 | 16.7 42.4 | 16.7 42.4 | 16.5 41.9 | 16.5 41.9 | 16.2 41.1 |
| | WOMEN | 15.1 38.4 | 15.5 39.4 | 15.3 38.9 | 15.1 38.4 | 14.9 37.8 | 14.7 37.3 | 14.7 37.3 | 15.1 38.4 |
| 20 | MEN | 16.4 41.7 | 16.6 42.2 | 16.6 42.2 | 16.4 41.7 | 16.3 41.4 | 16.2 41.1 | 16.2 41.1 | 15.9 40.4 |
| | WOMEN | 14.7 37.3 | 15.2 38.6 | 15.0 38.1 | 14.7 37.3 | 14.5 36.8 | 14.4 36.6 | 14.4 36.6 | 14.6 37.1 |
| 10 | MEN | 16.0 40.6 | 16.2 41.1 | 16.2 41.1 | 16.1 40.9 | 16.0 40.6 | 15.8 40.1 | 15.6 39.6 | 15.4 39.1 |
| | WOMEN | 14.2 36.1 | 14.6 37.1 | 14.4 36.6 | 14.2 36.1 | 14.2 36.1 | 14.1 35.8 | 14.1 35.8 | 14.1 35.8 |
| 5 | MEN | 15.5 39.3 | 16.0 40.6 | 16.0 40.6 | 15.6 39.6 | 15.5 39.4 | 15.3 38.9 | 15.2 38.6 | 15.2 38.6 |
| | WOMEN | 14.0 35.6 | 14.2 36.1 | 14.1 35.8 | 14.0 35.6 | 13.8 35.1 | 13.6 34.5 | 13.9 35.3 | 13.5 34.3 |
| 1 | MEN | 14.9 37.8 | 15.2 38.6 | 15.1 38.4 | 15.0 38.1 | 14.7 37.3 | 14.9 37.8 | 14.2 36.1 | 15.0 38.1 |
| | WOMEN | 13.1 33.3 | 13.5 34.3 | 13.2 33.5 | 13.1 33.3 | 13.1 33.3 | 13.1 33.3 | 13.0 33.0 | 9.5 24.4 |

*See Table 1N for definition of popliteal height.

†Measurement below which the indicated percent of people in the given age group fall.

2K

BUTTOCK-
POPLITEAL
LENGTH



Adult Male and Female Buttock-Popliteal Length* in Inches and Centimeters by Age, Sex, and Selected Percentiles†

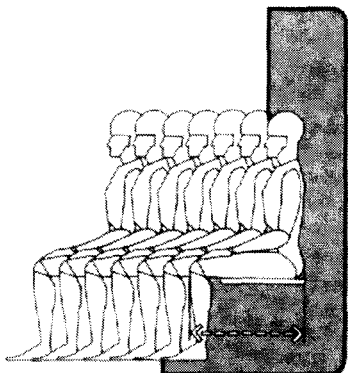
| | | 18 to 79 (Total) | 18 to 24 Years | 25 to 34 Years | 35 to 44 Years | 45 to 54 Years | 55 to 64 Years | 65 to 74 Years | 75 to 79 Years |
|----|-------|---------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| | | in cm | in cm | in cm | in cm | in cm | in cm | in cm | in cm |
| 99 | MEN | 22.7 57.7 | 22.9 58.2 | 23.1 58.7 | 22.7 57.7 | 22.0 55.9 | 22.2 56.4 | 21.9 55.6 | 22.1 56.1 |
| | WOMEN | 22.0 55.9 | 21.9 55.6 | 21.9 55.6 | 22.4 56.9 | 22.0 55.9 | 22.0 55.9 | 21.9 55.6 | 20.8 52.8 |
| 95 | MEN | 21.6 54.9 | 21.6 54.9 | 21.9 55.6 | 21.8 55.4 | 21.5 54.6 | 21.5 54.6 | 20.9 53.1 | 21.2 53.8 |
| | WOMEN | 21.0 53.3 | 21.1 53.6 | 21.0 53.3 | 21.1 53.6 | 20.9 53.1 | 21.0 53.3 | 20.9 53.1 | 20.0 50.8 |
| 90 | MEN | 21.0 53.3 | 21.0 53.3 | 21.4 54.4 | 21.1 53.6 | 20.9 53.1 | 20.9 53.1 | 20.7 52.6 | 20.8 52.6 |
| | WOMEN | 20.6 52.3 | 20.6 52.3 | 20.5 52.1 | 20.7 52.6 | 20.6 52.3 | 20.5 52.1 | 20.4 51.8 | 19.9 50.5 |
| 80 | MEN | 20.5 52.1 | 20.5 52.1 | 20.8 52.8 | 20.6 52.3 | 20.5 52.1 | 20.4 51.8 | 20.3 51.6 | 20.2 51.3 |
| | WOMEN | 19.9 50.5 | 19.8 50.3 | 19.9 50.5 | 20.0 50.8 | 20.0 50.8 | 19.9 50.5 | 19.8 50.3 | 19.6 49.8 |
| 70 | MEN | 20.1 51.1 | 20.0 50.8 | 20.4 51.8 | 20.1 51.1 | 20.1 51.1 | 20.0 50.8 | 19.9 50.5 | 19.7 50.0 |
| | WOMEN | 19.5 49.5 | 19.5 49.5 | 19.5 49.5 | 19.6 49.8 | 19.6 49.8 | 19.5 49.5 | 19.4 49.3 | 19.3 49.0 |
| 60 | MEN | 19.8 50.3 | 19.7 50.0 | 20.0 50.8 | 19.8 50.3 | 19.7 50.0 | 19.7 50.0 | 19.6 49.8 | 19.2 48.8 |
| | WOMEN | 19.2 48.8 | 19.1 48.5 | 19.2 48.8 | 19.3 49.0 | 19.3 49.0 | 19.2 48.8 | 19.1 48.5 | 19.0 48.3 |
| 50 | MEN | 19.5 49.0 | 19.5 49.0 | 19.6 49.8 | 19.5 49.0 | 19.5 49.0 | 19.4 49.3 | 19.3 49.0 | 18.9 48.0 |
| | WOMEN | 18.9 48.0 | 18.8 47.8 | 18.9 48.0 | 18.9 48.0 | 18.9 48.0 | 18.9 48.0 | 18.8 47.8 | 18.7 47.5 |
| 40 | MEN | 19.2 48.8 | 19.2 48.8 | 19.3 49.0 | 19.2 48.8 | 19.2 48.8 | 19.0 48.3 | 19.0 48.3 | 18.6 47.2 |
| | WOMEN | 18.6 47.2 | 18.5 47.0 | 18.6 47.2 | 18.6 47.2 | 18.6 47.2 | 18.6 47.2 | 18.5 47.0 | 18.3 46.5 |
| 30 | MEN | 18.8 47.8 | 19.0 48.3 | 19.0 48.3 | 18.9 48.0 | 18.8 47.8 | 18.6 47.2 | 18.6 47.2 | 18.3 46.5 |
| | WOMEN | 18.2 46.2 | 18.1 46.0 | 18.3 46.5 | 18.3 46.5 | 18.2 46.2 | 18.3 46.5 | 18.2 46.2 | 18.0 45.7 |
| 20 | MEN | 18.4 46.7 | 18.5 47.0 | 18.5 47.0 | 18.5 47.0 | 18.3 46.5 | 18.2 46.2 | 18.3 46.5 | 17.9 45.5 |
| | WOMEN | 17.9 45.5 | 17.7 45.0 | 18.0 45.7 | 18.0 45.7 | 17.8 45.2 | 18.0 47.2 | 17.8 45.2 | 17.6 44.7 |
| 10 | MEN | 17.9 45.5 | 18.0 45.7 | 18.1 46.0 | 18.0 45.7 | 17.8 45.2 | 17.6 44.7 | 17.8 45.2 | 17.3 43.9 |
| | WOMEN | 17.3 43.9 | 17.2 43.7 | 17.3 43.9 | 17.4 44.2 | 17.3 43.9 | 17.4 44.2 | 17.3 43.9 | 17.2 43.7 |
| 5 | MEN | 17.3 43.9 | 17.4 44.2 | 17.6 44.7 | 17.4 44.2 | 17.4 44.2 | 17.2 43.7 | 17.3 43.9 | 17.0 43.2 |
| | WOMEN | 17.0 43.2 | 16.9 42.9 | 17.0 43.2 | 17.1 43.4 | 17.0 43.2 | 17.1 43.4 | 16.9 42.9 | 17.0 43.2 |
| 1 | MEN | 16.5 41.9 | 16.5 41.9 | 16.6 42.1 | 16.5 41.9 | 17.0 43.2 | 16.4 41.7 | 16.3 41.4 | 16.2 41.1 |
| | WOMEN | 16.1 40.9 | 16.1 40.9 | 16.1 40.9 | 16.2 41.1 | 15.8 40.1 | 16.1 40.9 | 16.1 40.9 | 14.7 37.3 |

* See Table 10 for definition of buttock-popliteal length.

† Measurement below which the indicated percent of people in the given age group fall.

21

BUTTOCK-KNEE LENGTH

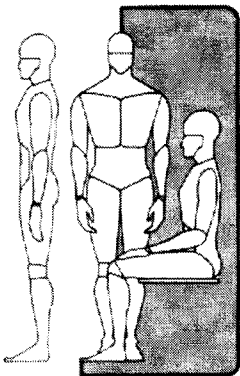


Adult Male and Female Buttock-Knee Length* in Inches and Centimeters by Age, Sex, and Selected Percentiles†

| | | 18 to 79 (Total) | 18 to 24 Years | 25 to 34 Years | 35 to 44 Years | 45 to 54 Years | 55 to 64 Years | 65 to 74 Years | 75 to 79 Years |
|----|-------|---------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| | | in cm | in cm | in cm | in cm | in cm | in cm | in cm | in cm |
| 99 | MEN | 26.3 66.8 | 26.5 67.3 | 26.8 68.1 | 26.2 66.5 | 26.1 66.3 | 25.8 65.5 | 25.9 65.8 | 24.9 63.2 |
| | WOMEN | 25.7 65.3 | 25.6 65.0 | 25.6 65.0 | 25.9 65.8 | 25.5 64.8 | 25.7 65.3 | 25.9 65.8 | 24.7 62.7 |
| 95 | MEN | 25.2 64.0 | 25.4 64.5 | 25.7 65.3 | 25.1 63.8 | 25.2 64.0 | 24.9 63.2 | 24.8 63.0 | 24.7 62.7 |
| | WOMEN | 24.6 62.5 | 24.6 62.5 | 24.6 62.5 | 24.7 62.7 | 24.6 62.5 | 24.7 62.7 | 24.6 62.5 | 23.9 60.7 |
| 90 | MEN | 24.8 63.0 | 24.9 63.2 | 25.0 64.0 | 24.8 63.0 | 24.8 63.0 | 24.6 62.5 | 24.4 62.0 | 24.4 62.0 |
| | WOMEN | 24.0 61.0 | 23.9 60.7 | 24.0 61.0 | 24.0 61.0 | 24.1 61.2 | 24.0 61.0 | 23.9 60.7 | 23.5 59.7 |
| 80 | MEN | 24.4 62.0 | 24.4 62.0 | 24.6 62.5 | 24.4 62.0 | 24.4 62.0 | 24.1 61.2 | 23.9 60.7 | 23.9 60.7 |
| | WOMEN | 23.4 59.4 | 23.3 59.2 | 23.5 59.7 | 23.5 59.7 | 23.5 59.7 | 23.4 59.4 | 23.4 59.4 | 22.9 58.2 |
| 70 | MEN | 23.9 60.7 | 23.9 60.7 | 24.2 61.5 | 24.0 61.0 | 24.0 61.0 | 23.7 60.2 | 23.6 59.9 | 23.3 59.2 |
| | WOMEN | 22.9 58.2 | 22.9 58.2 | 23.0 58.4 | 23.0 58.4 | 22.9 58.2 | 22.9 58.2 | 22.9 58.2 | 22.6 57.4 |
| 60 | MEN | 23.6 59.9 | 23.6 59.9 | 23.9 60.7 | 23.7 60.2 | 23.7 60.2 | 23.4 59.4 | 23.3 59.2 | 22.9 58.2 |
| | WOMEN | 22.6 57.4 | 22.5 57.2 | 22.7 57.7 | 22.7 56.7 | 22.6 57.4 | 22.6 57.4 | 22.6 57.4 | 22.4 56.9 |
| 50 | MEN | 23.3 59.2 | 23.3 59.2 | 23.6 59.9 | 23.4 59.4 | 23.4 59.4 | 23.1 58.7 | 23.0 58.4 | 22.6 57.4 |
| | WOMEN | 22.4 56.9 | 22.2 56.4 | 22.4 56.9 | 22.5 57.2 | 22.4 56.9 | 22.3 56.6 | 22.2 56.4 | 22.2 56.4 |
| 40 | MEN | 23.0 58.4 | 23.0 58.4 | 23.3 59.2 | 23.1 58.7 | 23.1 58.7 | 22.8 57.9 | 22.7 57.7 | 22.3 56.6 |
| | WOMEN | 22.1 56.1 | 21.9 55.6 | 22.1 56.1 | 22.2 56.4 | 22.1 56.1 | 22.0 55.9 | 21.9 55.6 | 21.9 55.6 |
| 30 | MEN | 22.7 57.7 | 22.7 57.7 | 22.9 58.2 | 22.7 57.7 | 22.7 57.7 | 22.4 56.9 | 22.4 56.9 | 22.0 55.9 |
| | WOMEN | 21.7 55.1 | 21.6 54.9 | 21.8 55.4 | 21.9 55.6 | 21.7 55.1 | 21.7 55.1 | 21.5 54.6 | 21.4 54.4 |
| 20 | MEN | 22.3 56.6 | 22.3 56.6 | 22.5 57.2 | 22.4 56.9 | 22.4 56.9 | 22.1 56.1 | 22.2 56.4 | 21.6 54.9 |
| | WOMEN | 21.3 54.1 | 21.3 54.1 | 21.4 54.4 | 21.5 54.6 | 21.3 54.1 | 21.3 54.1 | 21.2 53.8 | 21.0 53.3 |
| 10 | MEN | 21.8 55.4 | 21.9 55.6 | 22.1 56.1 | 21.9 55.6 | 21.9 55.6 | 21.5 54.6 | 21.5 54.6 | 21.2 53.8 |
| | WOMEN | 20.9 53.1 | 20.8 52.8 | 21.0 53.3 | 21.1 53.6 | 20.9 53.1 | 20.9 53.1 | 20.6 52.3 | 20.3 51.6 |
| 5 | MEN | 21.3 54.1 | 21.3 54.1 | 21.6 54.9 | 21.3 54.1 | 21.3 54.1 | 21.2 53.8 | 21.0 53.3 | 21.0 53.3 |
| | WOMEN | 20.4 51.8 | 20.3 51.6 | 20.5 52.1 | 20.5 52.1 | 20.3 51.6 | 20.3 51.6 | 20.2 51.3 | 19.9 50.5 |
| 1 | MEN | 20.3 51.6 | 20.4 51.8 | 20.8 52.8 | 20.3 51.6 | 20.4 51.8 | 19.6 49.8 | 20.1 51.1 | 20.2 51.3 |
| | WOMEN | 19.5 49.5 | 19.3 49.0 | 20.0 51.0 | 20.0 51.0 | 19.4 49.3 | 19.4 49.3 | 19.4 49.3 | 18.5 47.0 |

* See Table 1P for definition of buttock-knee length.

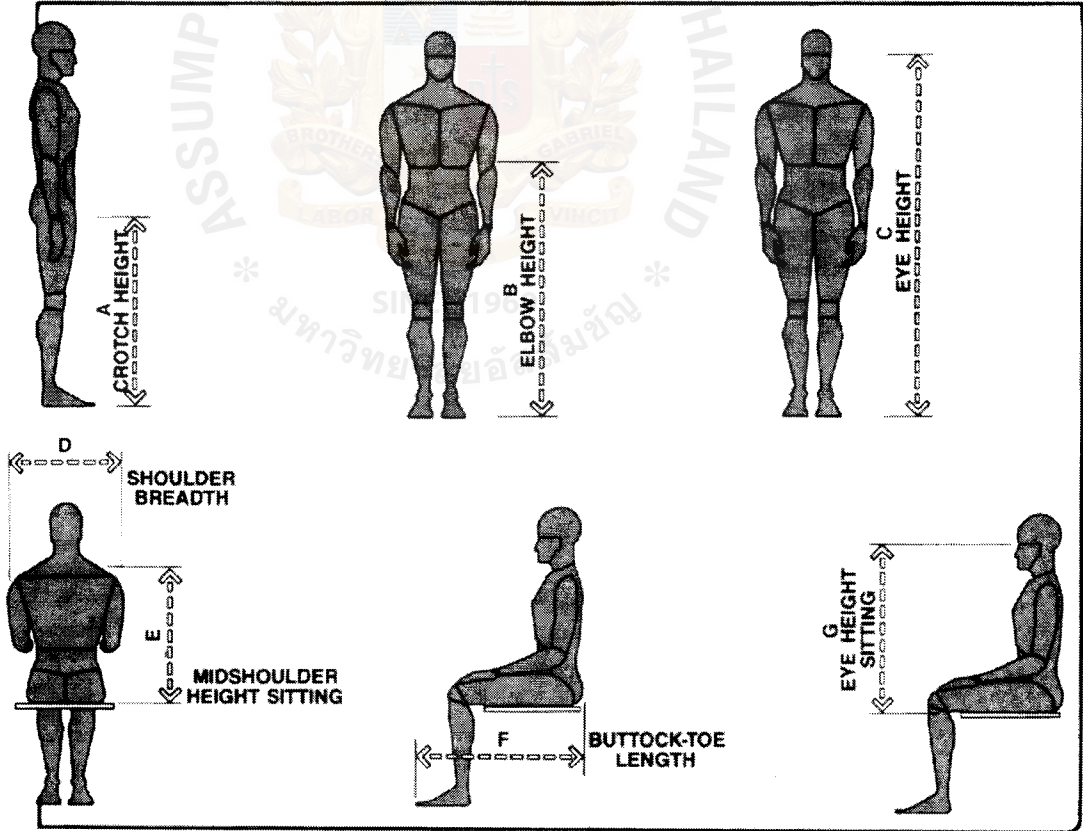
† Measurement below which the indicated percent of people in the given age group fall.



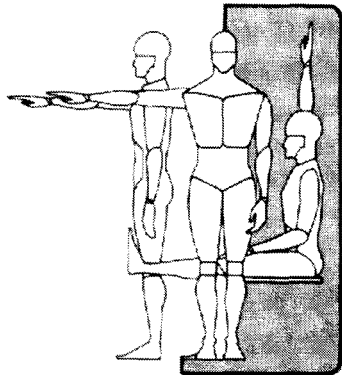
3
MISCELLANEOUS
STRUCTURAL BODY
DIMENSIONS

Adult Male and Female Miscellaneous Structural Body Dimensions in Inches and Centimeters by Age and Selected Percentiles

| | | A | | B | | C | | D | | E | | F | | G | |
|----|-------|------|------|------|-------|------|-------|------|------|------|------|------|------|------|------|
| | | in | | cm | | in | | cm | | in | | cm | | in | |
| 95 | MEN | 36.2 | 91.9 | 47.3 | 120.1 | 68.6 | 174.2 | 20.7 | 52.6 | 27.3 | 69.3 | 37.0 | 94.0 | 33.9 | 86.1 |
| | WOMEN | 32.0 | 81.3 | 43.6 | 110.7 | 64.1 | 162.8 | 17.0 | 43.2 | 24.6 | 62.5 | 37.0 | 94.0 | 31.7 | 80.5 |
| | MEN | 30.8 | 78.2 | 41.3 | 104.9 | 60.8 | 154.4 | 17.4 | 44.2 | 23.7 | 60.2 | 32.0 | 81.3 | 30.0 | 76.2 |
| | WOMEN | 26.8 | 68.1 | 38.6 | 98.0 | 56.3 | 143.0 | 14.9 | 37.8 | 21.2 | 53.8 | 27.0 | 68.6 | 28.1 | 71.4 |

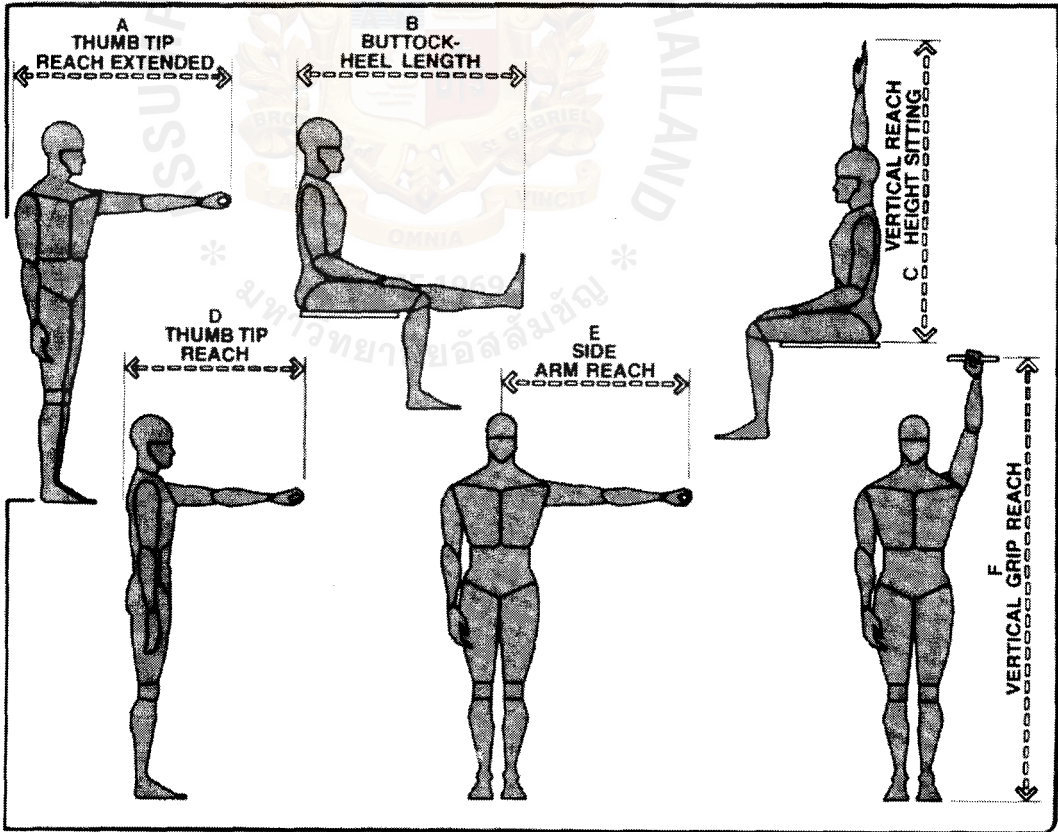


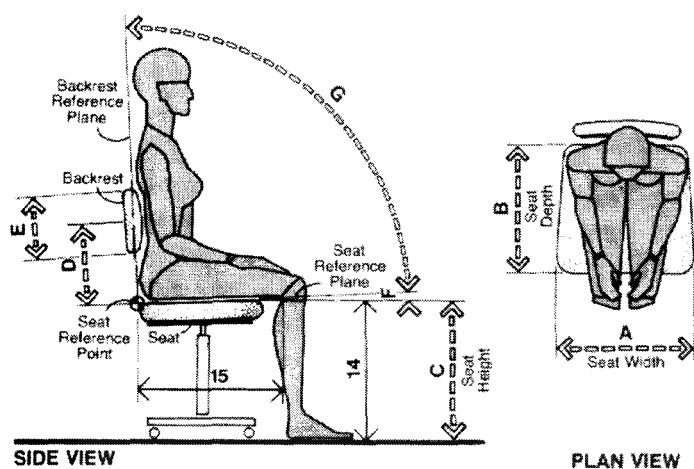
4
FUNCTIONAL
BODY
DIMENSIONS



Adult Male and Female Functional Body Dimensions in Inches and Centimeters by Age, Sex, and Selected Percentiles

| | | A | | B | | C | | D | | E | | F | |
|----|-------|-------|------|-------|-------|-------|-------|-------|------|-------|------|-------|-------|
| | | in cm | | in cm | | in cm | | in cm | | in cm | | in cm | |
| 95 | MEN | 38.3 | 97.3 | 46.1 | 117.1 | 51.6 | 131.1 | 35.0 | 88.9 | 39.0 | 99.1 | 88.5 | 224.8 |
| | WOMEN | 36.3 | 92.2 | 49.0 | 124.5 | 49.1 | 124.7 | 31.7 | 80.5 | 38.0 | 96.5 | 84.0 | 213.4 |
| | MEN | 32.4 | 82.3 | 39.4 | 100.1 | 59.0 | 149.9 | 29.7 | 75.4 | 29.0 | 73.7 | 76.8 | 195.1 |
| | WOMEN | 29.9 | 75.9 | 34.0 | 86.4 | 55.2 | 140.2 | 26.6 | 67.6 | 27.0 | 68.6 | 72.9 | 185.2 |





WORK OR SECRETARIAL CHAIR

CRITICAL WORK CHAIR MEASUREMENTS

| SOURCE | A | | B | | C | | D | | E | | F | | G | |
|--------------------|------------|------------|------------|------------|-------------|-------------|---|-----------------------|-----------------|-----------------|-------------------------------|-------------------------------|-------------------|-------------------|
| | SEAT WIDTH | SEAT DEPTH | SEAT WIDTH | SEAT DEPTH | SEAT HEIGHT | SEAT HEIGHT | CL OF BACKREST HEIGHT FROM SEAT SURFACE | CL OF BACKREST HEIGHT | BACKREST HEIGHT | BACKREST HEIGHT | ANGLE OF TILT OF SEAT SURFACE | ANGLE OF TILT OF SEAT SURFACE | ANGLE OF BACKREST | ANGLE OF BACKREST |
| | in | cm | in | cm | in | cm | in | cm | in | cm | degrees | degrees | degrees | degrees |
| 1. CRANEY | 17 | 43.2 | 13.5-33.6 | 14-38.1 | 14-25.6 | 5-7.5 | 12.7 | 4-8 | 10.2-20.3 | 0-5° or 3-5° | 95°-115° | | | |
| 2. DIFFRENT | 15 min | 40.6 | 15-16 | 38.1-40.6 | 13.6-20.6 | 34.5-52.3 | 8-10 | 22.9-25.4 | 6-9 | 15.2-22.9 | 0-5° | 95° | | |
| 3. DREYFUSS | 15 | 38.1 | 12-15 | 30.5-38.1 | 15-18 | 38.1-45.7 | 7-11 | 17.8-27.9 | 6-8 | 15.2-20.3 | 0-5° | 95°-105° | | |
| 4. GRANDJEAN | 15.75 | 40.0 | 15.75 | 40.0 | 14.9-20.8 | 37.8-52.8 | | 7.9-11.8 | 20-30 | 3-5° | Adjustable | | | |
| 5. PANERO-ZELNIK | 17-19 | 43.2-48.3 | 15.5-16 | 39.4-40.6 | 14-20 | 35.6-50.8 | 8-10 | 19.2-25.4 | 6-9 | 15.2-22.9 | 0-5° | 95°-105° | | |
| 6. WOODSON-COROVER | 15 | 38.1 | 12-15 | 30.5-38.1 | 15-18 | 38.1-45.7 | 7-10 | 17.8-25.4 | 6-8 | 15.24-20.32 | 3°-5° | 20° | | |

[1] John Crane Anthropometrics for Designers, p. 147; [2] Niels Diffrient et al., Humanescape, Guide 28; [3] Henry Dreyfus, The Measure of Man, Sheet C, Dwg. 2; [4] Etienne Grandjean, Ergonomics of the Home, pp. 126, 127; [5] Authors; [6] W.E. Woodson and Donald Corover, Human Engineering Guide for Equipment Designers, p. 2-142 (see Selected Bibliography for additional information)

1 SEATING

The top diagram shows the more critical measurements to be considered in the design of the typical work or secretarial chair. To function properly, its design must be responsive to human dimension. Anthropometrically, the two most important measurements are buttock-popliteal length and popliteal height. Provision for support of the lumbar region by proper location of a backrest is essential for a successful design.

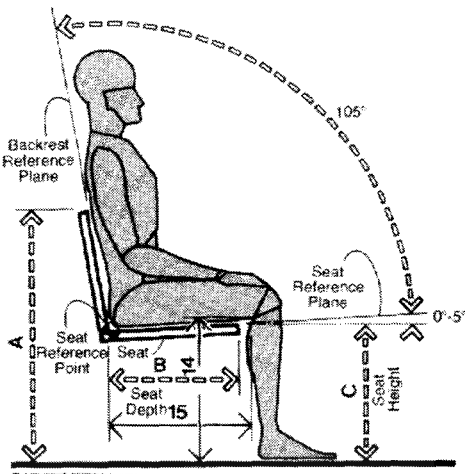
The element of sitter comfort, however, is an elusive quality that defies translation into simple dimensions. This factor alone, in addition to the considerable variation in human body size, demands the exercise of a great deal of personal judgment in establishing proper chair dimensions. Currently used recommendations may vary, but they all work and are generally responsive to anthropometric requirements. For the most part, they are also within reasonable range of each other. The authors felt it would be interesting, therefore, in addition to stating their own dimensional suggestions, to present in the form of a chart recommendations from a variety of respected sources. It should be recognized, however, that the primary intent of the data presented is to provide the designer with a basis for initial preliminary design assumptions and mockups—not a final design solution.

It is also suggested that the reader refer to Part A, Section 4, and the following pages of this section for additional information related to the theoretical aspects of chair design. A good deal of that is applicable to all chair types.

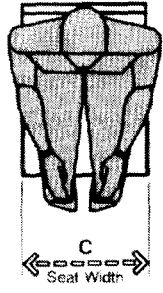
1 SEATING

The top diagram shows dimensions for a general purpose chair intended for brief periods of use. A 17-in., or 43.2-cm, seat height will accommodate most adults, except very small females, who may require a 16-in., or 40.6-cm, and in extreme cases, even a 14-in., or 35.6-cm, seat height. A smaller user, however, can function with a greater seat height by using a footrest.

The bottom diagram shows the dimensions for an executive chair, a type intended for a longer duration of use. The buttock-popliteal length governs the seat depth. This length, for 95 percent of both men and women, is 17-in., or 43.2-cm, or more. A seat depth not exceeding that should, therefore, accommodate a large majority of users. The very large person, however, would find that such a depth might leave a substantial portion of his thigh unsupported, while a very small person would find that the edge of the seat might dig into the tissue behind his or her knee.

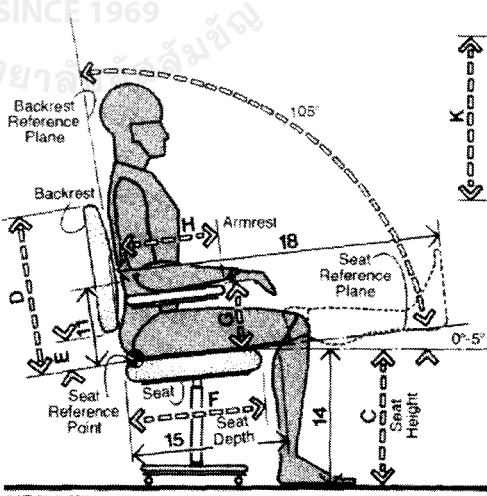


SIDE VIEW
GENERAL PURPOSE CHAIR

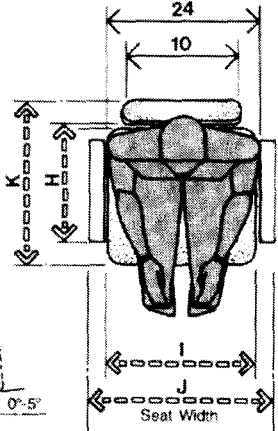


PLAN VIEW

| | in | cm |
|---|---------|-----------|
| A | 31-33 | 78.7-83.8 |
| B | 15.5-16 | 39.4-40.6 |
| C | 16-17 | 40.6-43.2 |
| D | 17-24 | 43.2-61.0 |
| E | 0-6 | 0.0-15.2 |
| F | 15.5-18 | 39.4-45.7 |
| G | 8-10 | 20.3-25.4 |
| H | 12 | 30.5 |
| I | 18-20 | 45.7-50.8 |
| J | 24-28 | 61.0-71.1 |
| K | 23-29 | 58.4-73.7 |



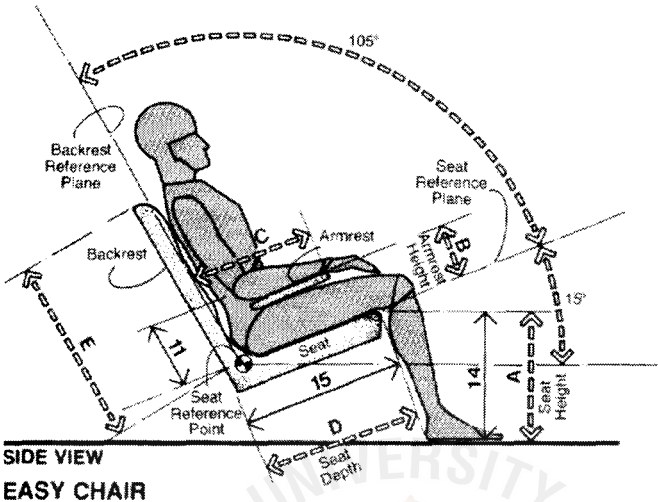
SIDE VIEW
EXECUTIVE CHAIR



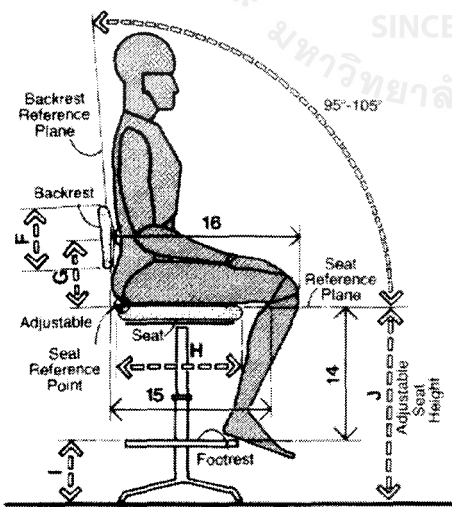
PLAN VIEW

1 SEATING

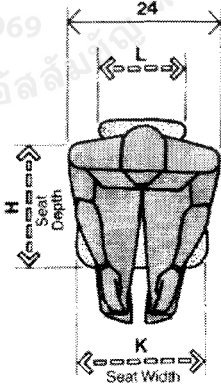
The easy chair, shown in the drawing at the top, is a difficult chair type to design, or establish guidelines for, since it is primarily intended for relaxation and comfort—qualities which are highly personal. Nevertheless, the drawing offers some basic dimensions for use in making preliminary design assumptions. The following suggestions should also prove helpful: (1) The angle formed by thighs and trunk should not be less than 105°. Angles significantly less than this will cause discomfort. (2) Design should allow the user to change body posture. (3) The front edge of the seat should be rounded to prevent irritation. (4) The backrest should provide lumbar support by following the spinal contour in the lumbar region. (5) The seat surface should tilt backwards. Too severe an angle, however, may cause a person difficulty in getting up from the chair, particularly for elderly people. A seat angle of about 15° should be adequate. (6) If the angle formed by the backrest with the vertical exceeds 30°, provisions for a headrest will be required in the form of a separate design element or extension of the backrest itself. (7) Armrests should be padded and designed horizontally or at the same angle as the seat surface. The drawing at the bottom provides basic dimensional information for the design of a drafting stool, which is similar in many respects to the secretarial chair.



SIDE VIEW
EASY CHAIR



SIDE VIEW
DRAFTING CHAIR / STOOL



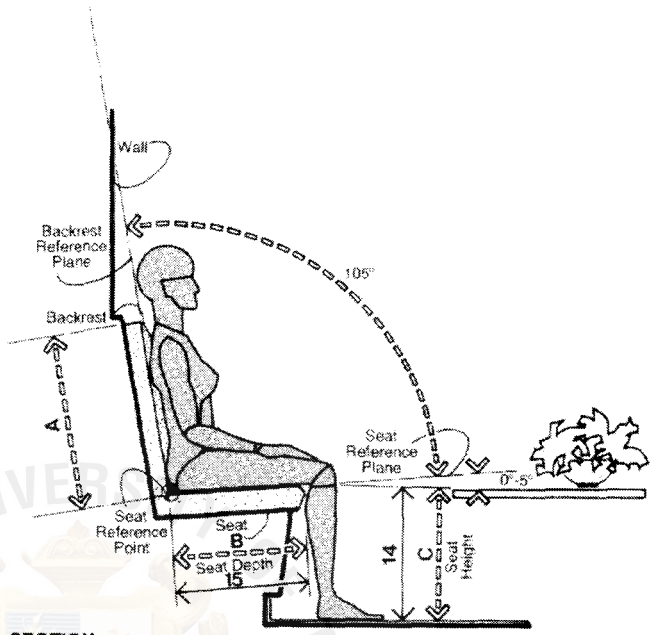
PLAN VIEW

| | in | cm |
|---|------------|--------------|
| A | 16-17 | 40.6-43.2 |
| B | 8.5-9 | 21.6-22.9 |
| C | 10-12 | 25.4-30.5 |
| D | 16.5-17.5 | 41.9-44.5 |
| E | 18-24 | 45.7-61.0 |
| F | 6-9 | 15.2-22.9 |
| G | 10 adjust. | 25.4 adjust. |
| H | 15.5-16 | 39.4-40.6 |
| I | 12 max. | 30.5 max. |
| J | 30 adjust. | 76.2 adjust. |
| K | 15 | 38.1 |
| L | 12-14 | 30.5-35.6 |

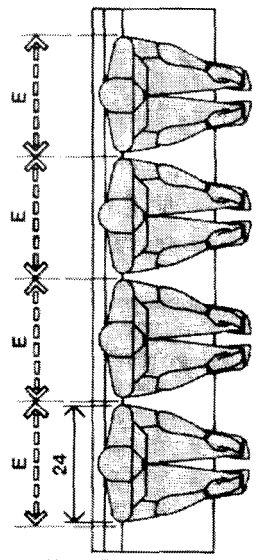
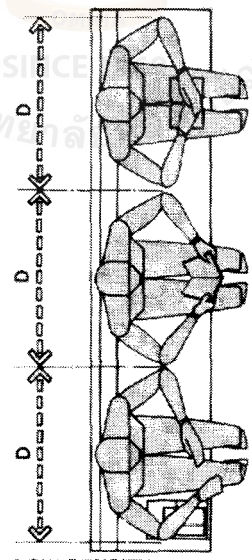
1 SEATING

The drawings at the bottom show the basic dimensions for the design of banquette seating. The lack of armrests makes it difficult to define seat boundaries. The user, therefore, tends to establish his own territory by assuming a desired sitting posture and placing personal articles next to him, such as a briefcase, purse, or package. Since the nature of this type of seating can permit some form of body contact, hidden dimensions and personal space also play an important part in how close the users sharing the banquette will sit.

Because of the many hidden psychological factors involved, the actual efficiency of this seating type in terms of capacity is questionable. The diagrams indicate two possible seating situations, each dictated by the anthropometrics involved. One arrangement is based on the premise that the user's elbows will be extended, possibly in conjunction with some activity, such as reading, or simply as an attempt to stake out additional territory, as would be the case in the strategic positioning of some personal article on the seat. In this situation it would be reasonable to assume that each user would take up about 30 in. or 76.2 cm. of space. The other diagram shows a more compact seating arrangement. The diagram at the top shows a section through a typical banquette.



SECTION
BANQUETTE SEATING



LOW DENSITY
BANQUETTE SEATING

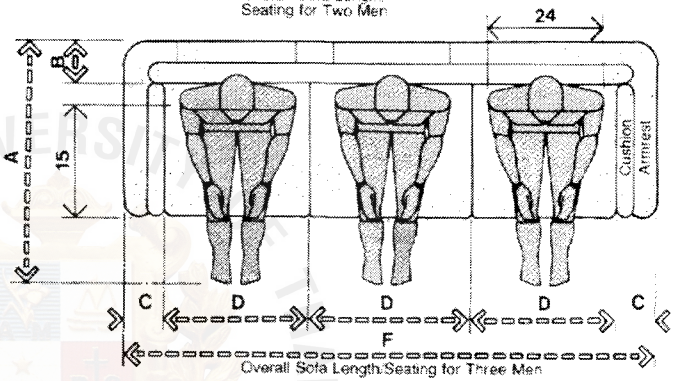
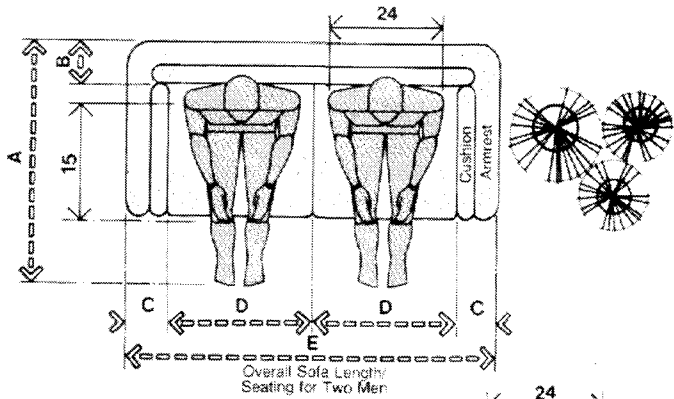
| | in | cm |
|---|---------|-----------|
| A | 18-24 | 45.7-61.0 |
| B | 15.5-16 | 39.4-40.6 |
| C | 16-17 | 40.6-43.2 |
| D | 30 | 76.2 |
| E | 24 | 61.0 |

2.1 LIVING SPACES

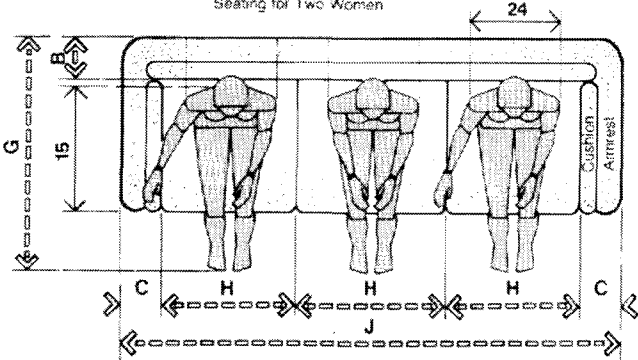
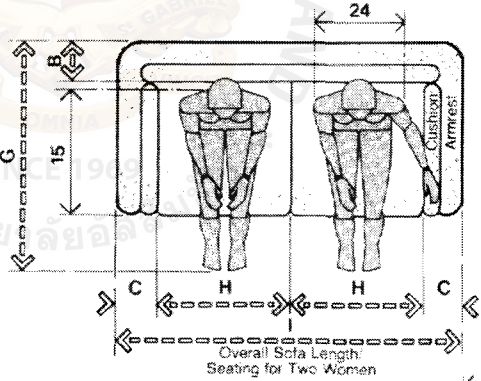
The drawings here examine the relationship of female and male body dimensions to sofa seating, in order to determine how much space the seated body requires. The anthropometric measurements of major interest here are maximum body breadth and buttock-popliteal length.

The top drawing deals with male dimensions; based on 95th percentile data, the maximum body breadth dimension is 22.8 in., or 57.9 cm, with a nude subject. Allowing for clothing and some body movement as well as change in posture and position, a minimum dimension of 28 in., or 71.1 cm, is suggested as a width allowance for a seated person. The overall dimension, therefore, includes the individual width allowances and the width of a sofa arm construction, which obviously can vary depending on personal design preference. A range of 3 to 6 in., or 7.6 to 15.2 cm, is suggested. Using the buttock-popliteal length of the smaller person and adding a similar allowance of 6 to 9 in., or 15.2 to 22.9 cm, for backrest construction as well as a minimum zone in front of the sofa for foot movement, an overall depth dimension of 42 to 48 in., or 106.7 to 121.9 cm, is suggested. The rationale for the drawing at the bottom dealing with female data is the same. The information should prove not only useful in providing a keener insight into the general relationship between body size and furniture but of specific value in establishing preliminary design assumptions for institutional seating in spaces designed exclusively for the use of males or of females. In spaces where seating is to be used by both sexes, the larger dimensions should apply.

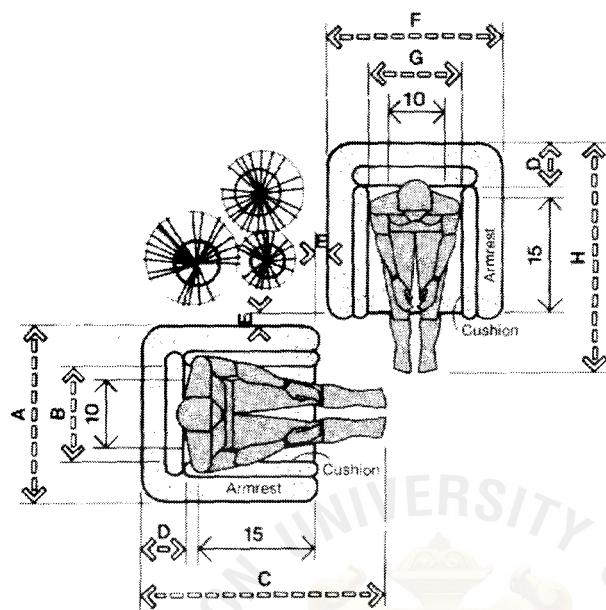
| | in | cm |
|---|-------|-------------|
| A | 42-48 | 106.7-121.9 |
| B | 6-9 | 15.2-22.9 |
| C | 3-6 | 7.6-15.2 |
| D | 28 | 71.1 |
| E | 62-68 | 157.5-172.7 |
| F | 90-96 | 228.6-243.8 |
| G | 40-46 | 101.6-116.8 |
| H | 26 | 66.0 |
| I | 58-64 | 147.3-162.6 |
| J | 84-90 | 213.4-228.6 |



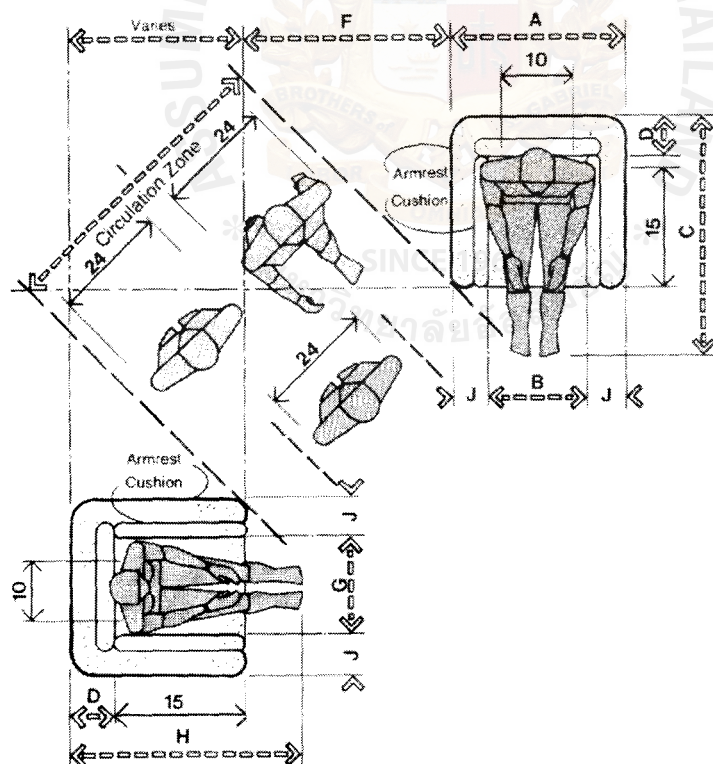
SOFA SEATING / MALES



SOFA SEATING / FEMALE



CORNER LOUNGE CHAIR SEATING/
MALE AND FEMALE



CORNER LOUNGE SEATING WITH CIRCULATION

2.1 LIVING SPACES

The top drawing examines the relationship of the female and male body dimensions to arm chair seating in order to determine the amount of space the seated body requires. The rationale is similar to that in dealing with sofa seating, outlined on the preceding page.

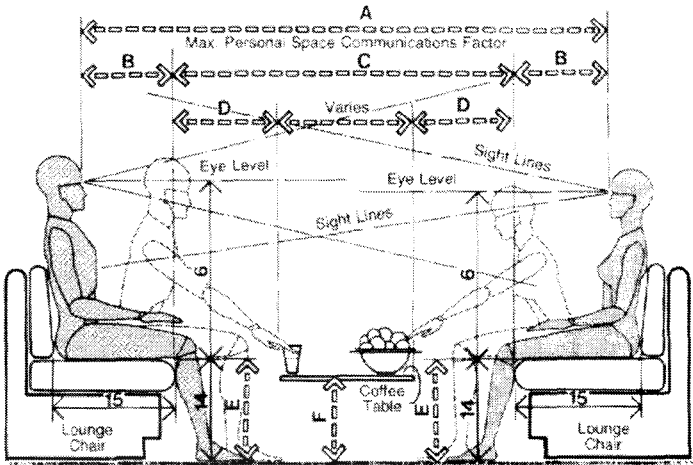
The bottom drawing is not intended to suggest a specific layout for a conversational grouping, and therefore should not be taken literally. Nor is it suggested that special female and male seating be provided in the same living space. The drawing is essentially informative and its purpose is to suggest allowances for comfortable circulation relative to corner lounge seating situations. The key consideration anthropometrically is maximum body breadth data. Since clearance is involved, the data related to the larger person rather than the smaller should be used.

| | in | cm |
|---|-------|-------------|
| A | 34-40 | 86.4-101.6 |
| B | 28 | 71.1 |
| C | 42-48 | 106.7-121.9 |
| D | 6-9 | 15.2-22.9 |
| E | 3 | 7.6 |
| F | 32-38 | 81.3-96.5 |
| G | 26 | 66.0 |
| H | 40-46 | 101.6-116.8 |
| I | 48-60 | 121.9-152.4 |
| J | 3-6 | 7.6-15.2 |

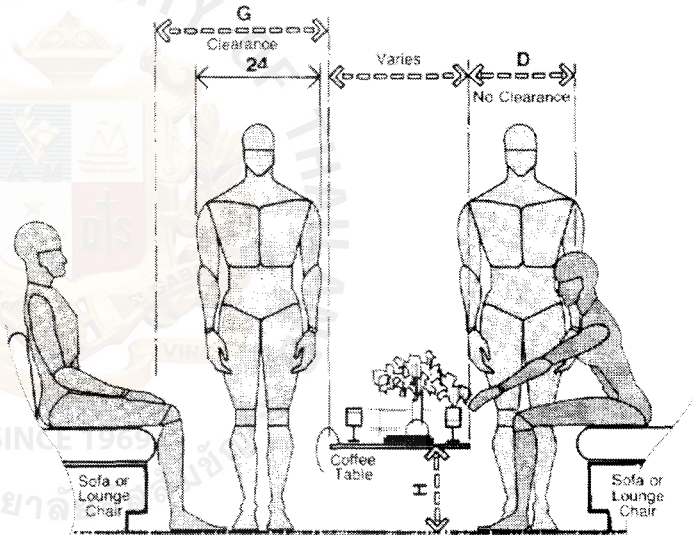
2.1 LIVING SPACES

The drawings at the top and center deal with the major clearances involved in lounge or conversational seating. The top drawing is based on a conversational grouping in which the clearance between the front of the seat and the edge of the table is limited between 16 and 18 in., or 40.6 and 45.7 cm. This clearance may require some degree of body contact or side-stepping for circulation and access. Anthropometrically, however, it does accommodate human reach, permitting the seated person access to the coffee table without rising. The drawing also suggests a dimensional range for verbal conversation. The center drawing illustrates a similar furniture arrangement that would permit circulation with full head-on access. The clearance indicated, however, to permit such access would make it impossible for most people to reach the coffee table from a seated position. This could be extremely undesirable in terms of food, beverages, and cigarettes. Given the choice between full head-on access and the accommodation of reach, the authors opt for reach and recommend the smaller clearance.

The bottom drawing suggests an overall allowance for easy chair or reclining chair seating, including footrest. The buttock-leg length of the larger person is the most significant anthropometric measurement in establishing this clearance. It should also be noted that the height of the footrest is also a function of seat height. The footrest should be a few inches below the height of the seat.

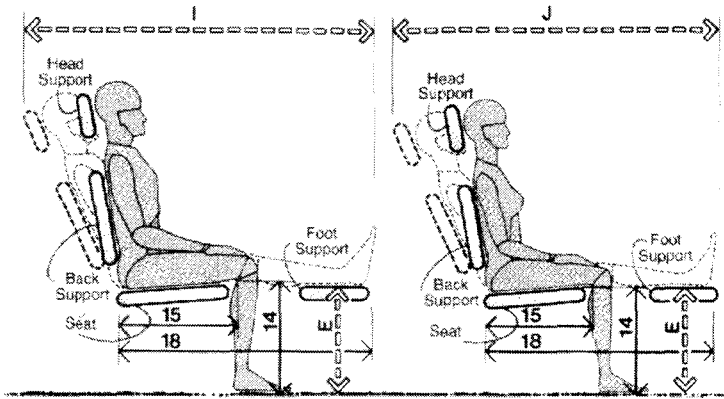


LOUNGE SEATING / CLEARANCES



LOUNGE SEATING / CLEARANCE RELATIONSHIPS

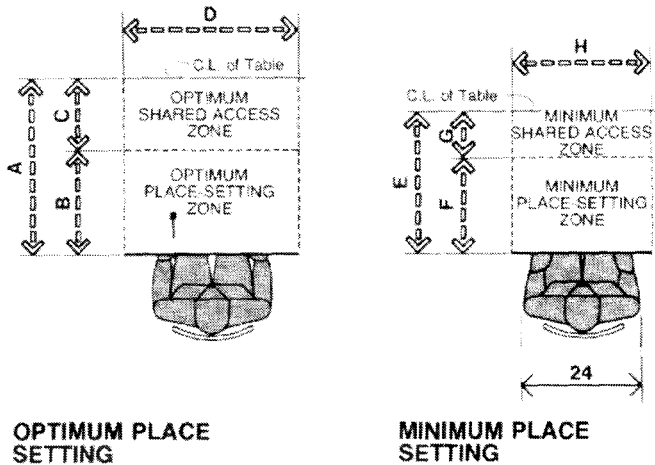
| | in | cm |
|---|--------|-------------|
| A | 84-112 | 213.4-284.5 |
| B | 13-16 | 33.0-40.6 |
| C | 58-80 | 147.3-203.2 |
| D | 16-18 | 40.6-45.7 |
| E | 14-17 | 35.6-43.2 |
| F | 12-18 | 30.5-45.7 |
| G | 30-36 | 76.2-91.4 |
| H | 12-16 | 30.5-40.6 |
| I | 60-68 | 152.4-172.7 |
| J | 54-62 | 137.2-157.5 |



RECLINING CHAIR WITH FOOTREST / MALE AND FEMALE

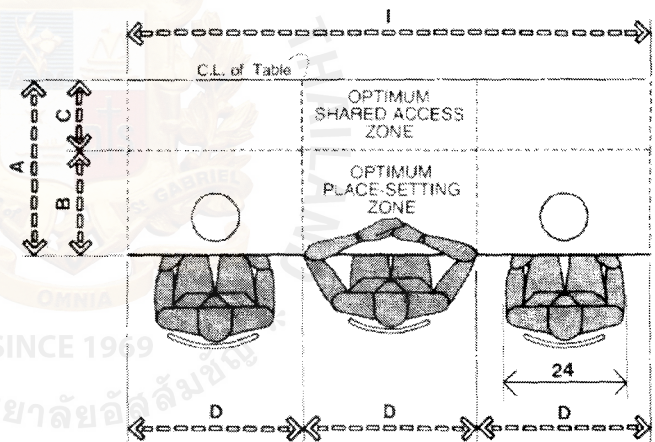
2.2 DINING SPACES

To determine table size it is helpful to view the table as consisting of two zones. The place setting zone represents the personal activity space directly in front of the individual diner. Ideally, it should be of adequate size to accommodate the necessary dinnerware, silverware, glassware, etc., both in its original structured form and in its eventual state of disarray during the course of its use. The width of this zone should also accommodate the human dimension and body positions assumed during the eating process. Etiquette aside, it should be generous enough to allow for the inevitable projection of the elbows. Anthropometrically, the maximum body breadth measurement of the larger person should be considered. Accordingly, the optimal width suggested for this zone, allowing for elbow projection, is about 30 in, or 76.2 cm, and the minimal width about 24 in, or 61 cm. To allow for the elements of the setting itself, the optimal and minimal depths suggested for this zone are 18 and 16 in, or 45.7 and 40.6 cm, respectively. The optimal place setting zone can be viewed as a rectangle, 30 by 18 in, or 76.2 by 45.7 cm, and the minimal zone, 24 by 16 in, or 61 by 40.6 cm. The shared access zone represents the table space opposite the place setting zones necessary to accommodate serving dishes and platter, related silverware, glasses, decorative centerpieces, candelabras, etc. The size of this zone varies greatly and is a

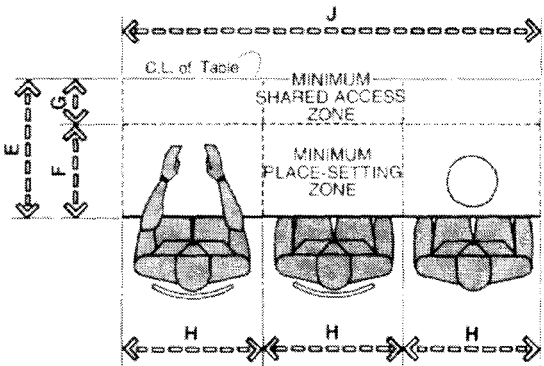


OPTIMUM PLACE SETTING

MINIMUM PLACE SETTING

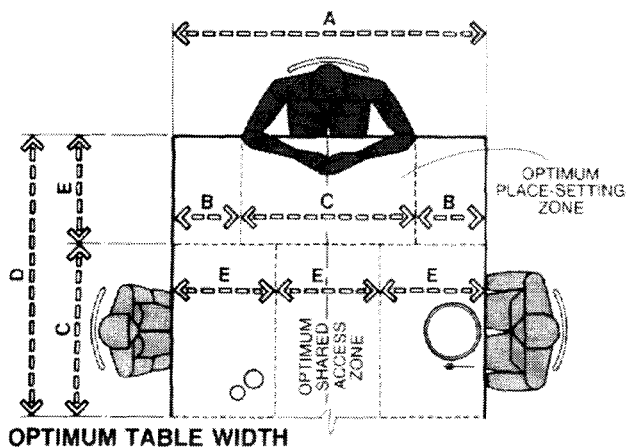


OPTIMUM PLACE SETTING FOR THREE

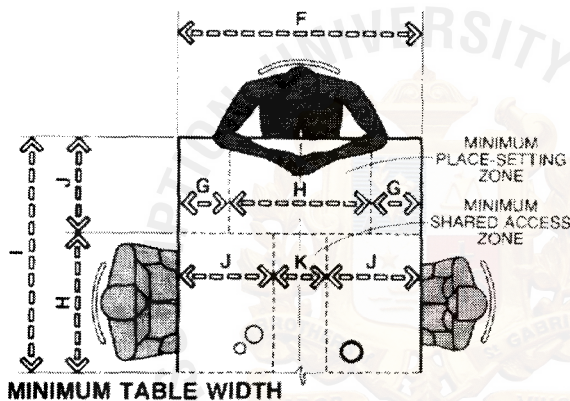


MINIMUM PLACE SETTING FOR THREE

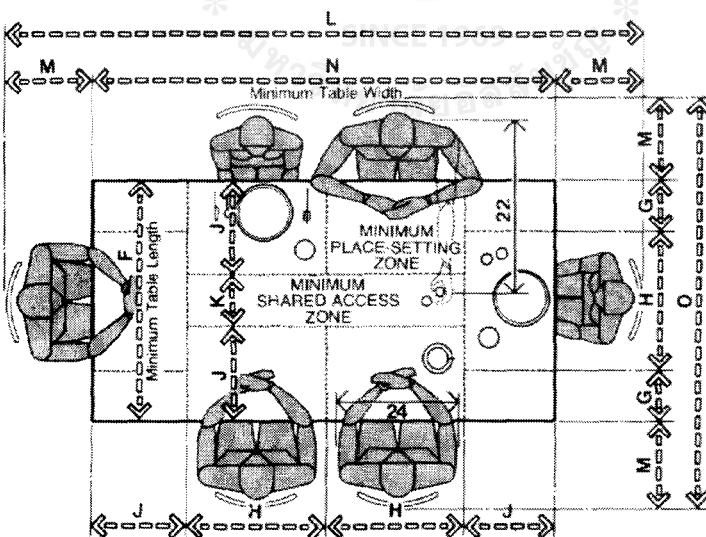
| | in | cm |
|---|----|-------|
| A | 27 | 68.6 |
| B | 18 | 45.7 |
| C | 9 | 22.9 |
| D | 30 | 76.2 |
| E | 21 | 53.3 |
| F | 16 | 40.6 |
| G | 5 | 12.7 |
| H | 24 | 61.0 |
| I | 90 | 228.6 |
| J | 72 | 182.9 |



OPTIMUM TABLE WIDTH



MINIMUM TABLE WIDTH



RECTANGULAR TABLE / MINIMUM LENGTH AND WIDTH / DINING FOR SIX

function of lifestyle, type of meal, level of formality and sophistication, serving help available, nature of serving operation, occasion, and number of people. The optimal depth suggested if relatively formal and frequent dinner parties are involved is 18 in, or 45.7 cm. The minimal depth is about 10 in, or 25.4 cm. If half of the depth of this zone is allocated to the individual place setting zone, it is possible to arrive at an optimal and minimal incremental unit of area per diner that can be applied in determining table size to serve any given number of diners. The optimal unit so calculated becomes 30 by 27 in, or 76.2 by 68.6 cm, and the minimal unit 24 by 21 in, or 61 by 53.3 cm, respectively. The drawings on these two pages examine table sizes in terms of their optimal and minimal incremental units. The drawing at the top of the facing page illustrates the basic optimal and minimal units.

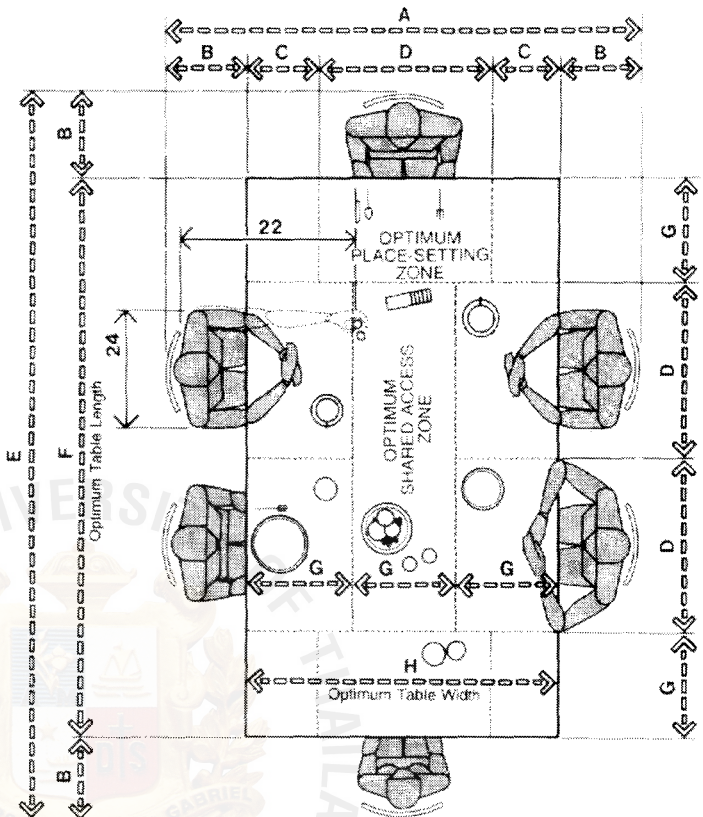
The bottom drawing illustrates each of the units arranged three in a row. The drawings at the top of this page illustrate the units arranged around the end of the table, while the bottom drawing illustrates a table for six based on a minimal increment. It should be noted that room size also dictates the size of the table. It is also possible to function with tables of less or certainly greater width. Dining tables of 36 in, or 91.4 cm, for example, are quite common. Much depends, however, on the level of comfort and convenience desired, which, within limits, becomes a matter of personal decision.

| | in | cm |
|---|---------|-------------|
| A | 54 | 137.2 |
| B | 12 | 30.5 |
| C | 30 | 76.2 |
| D | 48 | 121.9 |
| E | 18 | 45.7 |
| F | 42 | 106.7 |
| G | 9 | 22.9 |
| H | 24 | 61.0 |
| I | 40 | 101.6 |
| J | 16 | 40.6 |
| K | 10 | 25.4 |
| L | 116-128 | 294.6-325.1 |
| M | 18-24 | 45.7-61.0 |
| N | 80 | 203.2 |
| O | 78-90 | 198.1-228.6 |

2.2 DINING SPACES

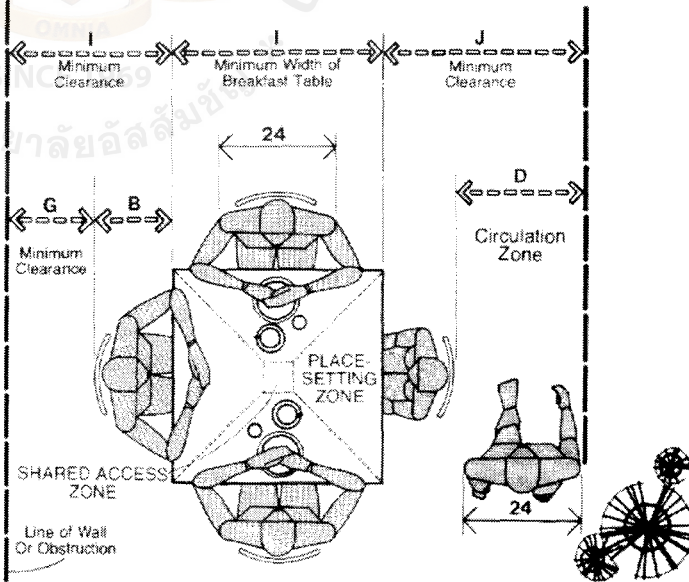
The top drawing applies the optimal incremental unit discussed on the preceding page to a rectangular table for formal dining for six. The table size shown is 54 by 96 in, or 137.2 by 243.8 cm. This size will provide each person with an individual place-setting zone of 18 by 30 in, or 45.7 by 76.2 cm, and will allow a shared access zone at the center of the table with a depth of 18 in. The 30-in width provided for each person allows for elbow room.

The bottom drawing, in contrast, shows a minimal, square general purpose table for informal dining. Although the width and depth of the place-setting zones are the same as in the larger rectangular tables, their angular configuration reduces the area significantly as well as the area of the shared access zone. To allow clearance for the chair and head-on circulation behind the chair, a minimum distance of 48 in, or 121.9 cm, must be maintained between the edge of the table and the wall or nearest physical obstruction. A clearance of 36 to 42 in, or 91.4 to 106.7 cm, can be provided to allow restricted circulation. This will require a person to sidestep or the seated person to adjust the chair to allow passage.



RECTANGULAR TABLE/OPTIMUM LENGTH AND WIDTH/ DINING FOR SIX

| | in | cm |
|---|---------|-------------|
| A | 96-102 | 243.8-259.1 |
| B | 18-24 | 45.7-61.0 |
| C | 12 | 30.5 |
| D | 30 | 76.2 |
| E | 132-144 | 335.3-365.8 |
| F | 96 | 243.8 |
| G | 18 | 45.7 |
| H | 54 | 137.2 |
| I | 36-42 | 91.4-106.7 |
| J | 48 min. | 121.9 min. |
| K | 18 min. | 45.7 min. |

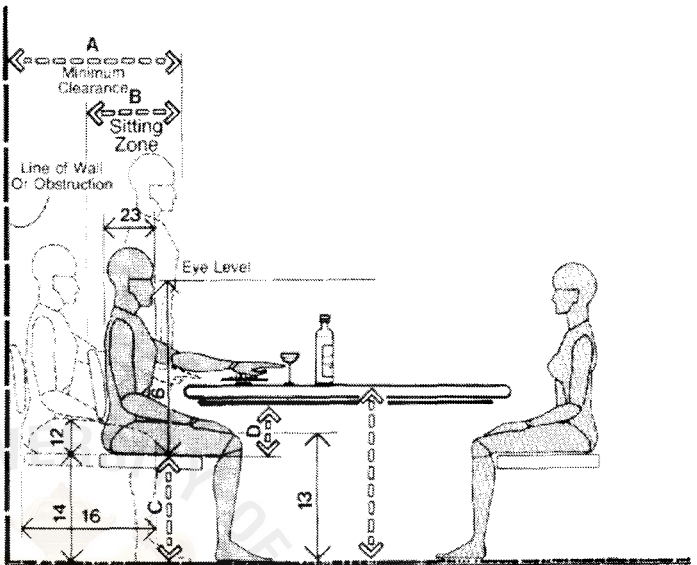


BREAKFAST / KITCHEN TABLE FOR FOUR

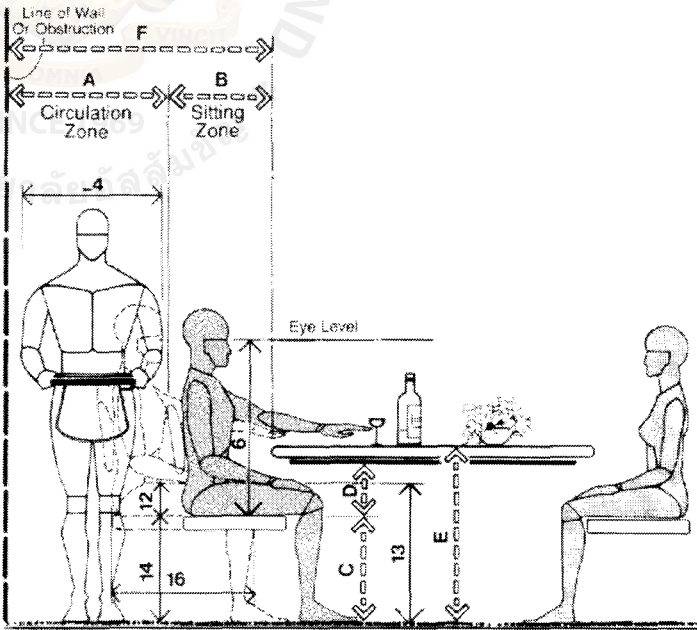
2.2 DINING SPACES

The relationship of the chair to the dining table is an important consideration. The top drawing explores two basic aspects of this relationship. The first is the various locations of the chair in relation to the table during the course of the meal and the clearances involved; the chair may be relocated as many as four times during the dining process. At the beginning, it is much closer to the table. Near the end of the meal, perhaps while the person is sipping coffee and attempting to relax by changing body position, the chair may be moved away from the table about 24 in. of 61 cm. Intimate conversation may cause the chair to be brought closer to the table than at the beginning. Finally, as the person rises from the chair at the conclusion of the meal, its final location may be as much as 36 in., or 91.4 cm away. The drawing indicates that the edge of the table should be at least 36 in., or 91.4 cm, away from the wall or nearest obstruction to accommodate all these movements. The height of the seat above the floor should allow the foot to rest firmly on the ground. If the seat height is too great, the foot will dangle and the area of the thigh just behind the knee will become pinched and irritated. A seat height of 16 to 17 in., or 40.6 to 41.3 cm, should be adequate to accommodate most people. Adequate clearance for the thigh should also be provided between the top of the seat and the underside of the table. As indicated on the drawing, 7.5 in., or 19.1 cm, is the minimum required. The backrest of the chair should be properly located to give support to the lumbar region of the back. The height of the table top from the floor should be between 29 and 30 in., or 73.7 to 76.2 cm. The bottom drawing indicates that to allow sufficient clearance for someone to pass or serve, the table should be located between 48 and 60 in., or 121.9 to 152.4 cm, from the wall.

| | in | cm |
|---|----------|-------------|
| A | 30-36 | 76.2-91.4 |
| B | 18-24 | 45.7-61.0 |
| C | 16-17 | 40.6-43.2 |
| D | 7.5 min. | 19.1 min. |
| E | 29-30 | 73.7-76.2 |
| F | 48-60 | 121.9-152.4 |



MINIMUM CHAIR CLEARANCE / NO CIRCULATION

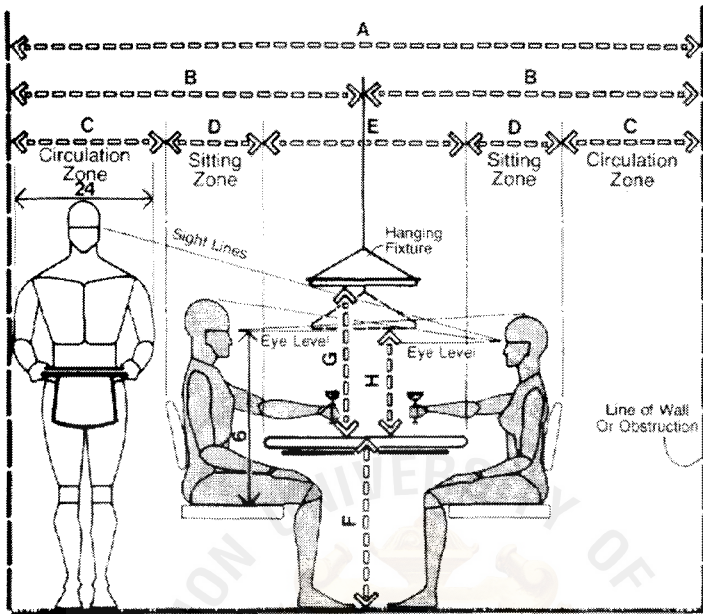


MINIMUM CLEARANCE BEHIND CHAIR IN PLACE

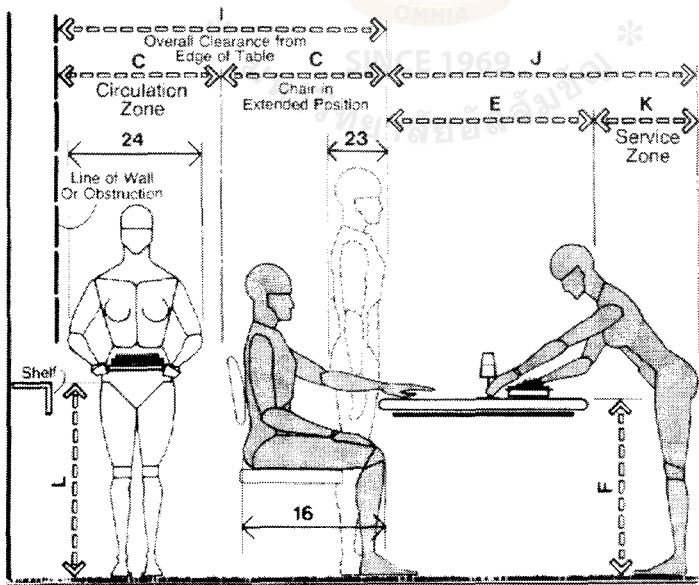
2.2 DINING SPACES

The proper height of a chandelier or other type of pendant lighting fixture above a dining table should be based on human dimension to ensure that it does not obstruct vision. The top drawing shows the relationship of fixture height above the table surface to a small and a large person. Eye height sitting is the body measurement to consider anthropometrically. The ideal solution is an adjustable arrangement so that the height of the fixture can be regulated to respond to personal preferences. The information on the drawing is useful in establishing initial height parameters as a basis for preliminary design assumptions. The drawing also indicates a minimal clearance between the table and the wall 48 in, or 121.9 cm, with the chair minimally extended from the table to permit one-lane service circulation behind the seated person.

The bottom drawing provides additional clearance information and suggests a minimum distance of 60 in, or 152.4 cm, between table and wall to accommodate one-lane head-on circulation with the chair extended a maximum distance from the table.



MINIMUM DINING AREA WIDTH

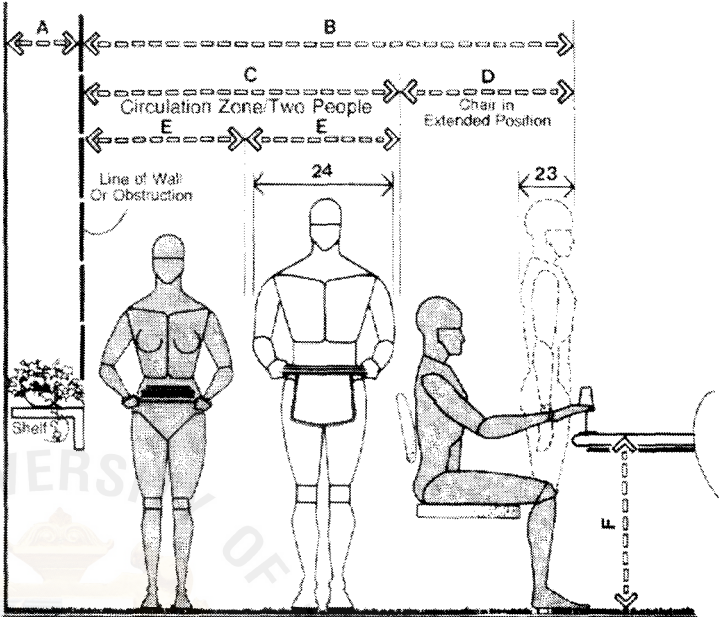


MINIMUM CLEARANCE BEHIND EXTENDED CHAIR

| | in | cm |
|---|---------|-------------|
| A | 132-162 | 335.3-411.5 |
| B | 66-81 | 167.6-205.7 |
| C | 30-36 | 76.2-91.4 |
| D | 18-24 | 45.7-61.0 |
| E | 36-42 | 91.4-106.7 |
| F | 29-30 | 73.7-76.2 |
| G | 27 | 68.6 |
| H | 19 | 48.3 |
| I | 60-72 | 152.4-182.9 |
| J | 54-60 | 137.2-152.4 |
| K | 18 | 45.7 |
| L | 29-36 | 73.7-91.4 |

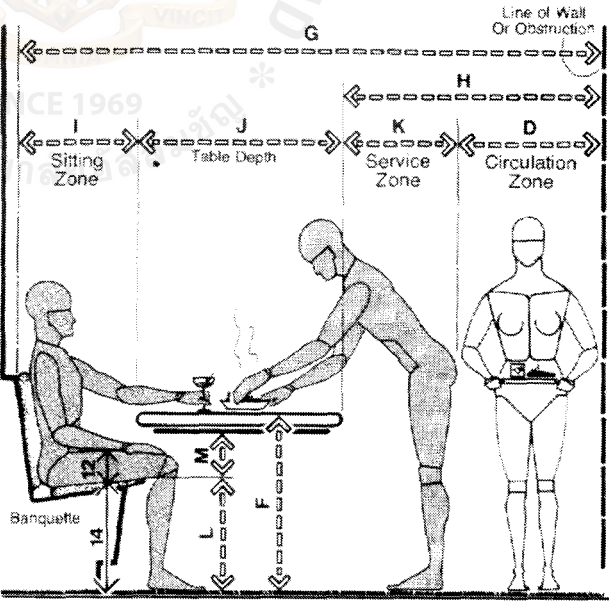
2.2 DINING SPACES

The top drawing shows clearances between the edge of the table and the wall or nearest physical obstruction to allow two-lane service circulation behind the chair, with the chair away from the table. The individual clearances shown require the table to be located 90 to 96 in. or 228.6 to 243.8 cm, from the wall. This clearance is generous for the average residential situation, given minimal room sizes available. It should be noted that in other arrangements illustrated on the preceding pages, a compressed minimal clearance permitting head-on one-lane circulation behind the seated person, with the chair minimally extended from the table, was established at 48 in. or 121.9 cm. The bottom drawing illustrates clearances required in a banquette arrangement where seating is located at one side only. The key body measurements to consider anthropometrically in most clearance situations is the maximum body breadth and maximum body depth of the larger person.



MINIMUM CLEARANCE FOR TWO BEHIND EXTENDED CHAIR

| | in | cm |
|---|-----------|-------------|
| A | 12-18 | 30.5-45.7 |
| B | 90-96 | 228.6-243.8 |
| C | 60 | 152.4 |
| D | 30-36 | 76.2-91.4 |
| E | 30 | 76.2 |
| F | 29-30 | 73.7-76.2 |
| G | 101.5-110 | 257.8-279.4 |
| H | 48-54 | 121.9-137.2 |
| I | 17.5-20 | 44.5-50.8 |
| J | 36 | 91.4 |
| K | 18 | 45.7 |
| L | 16-17 | 40.6-43.2 |
| M | 7.5 min. | 19.1 min. |

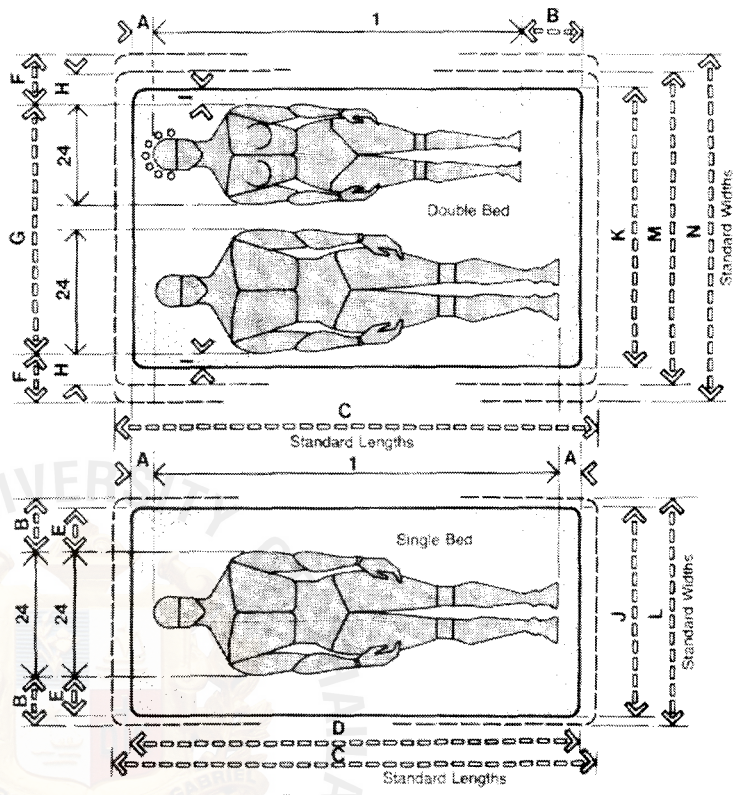


BANQUETTE SEATING/ SERVICE AND PASSAGE CLEARANCE REQUIREMENTS

2.3 SLEEPING SPACES

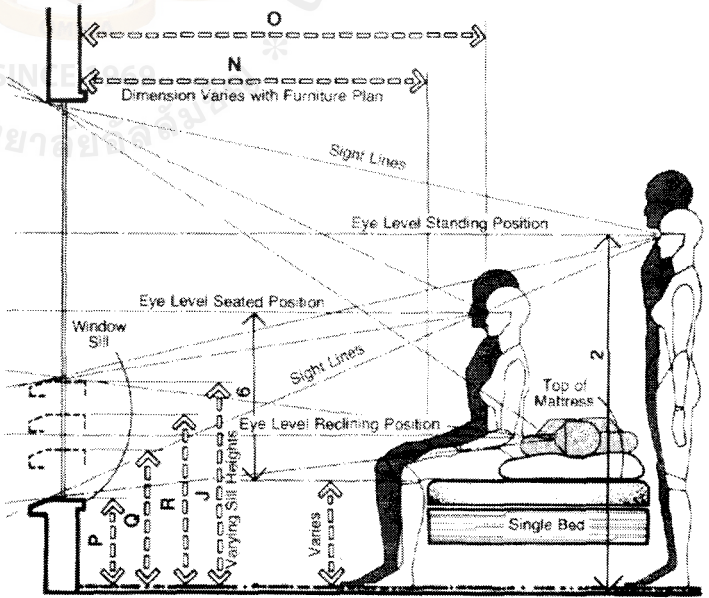
The top drawings illustrate standard variations of the typical single and double bed. The figures are shown simply to provide some approximation of the space required by the human body in relationship to the bed area. The drawings should not be taken too literally. The body positions assumed while sleeping may, in fact, take up far more space than shown. The clearances indicated to the edges of the bed are also quite academic and are intended only to provide a better sense of the bed sizes available and the general relationship of body size to bed size.

The relationship between sight lines and the sill or head of a window is critical if a view to the outside is a design consideration. The drawing at the bottom of the page shows the relationships of eye height in sitting, standing, and reclining positions to varying sill heights.

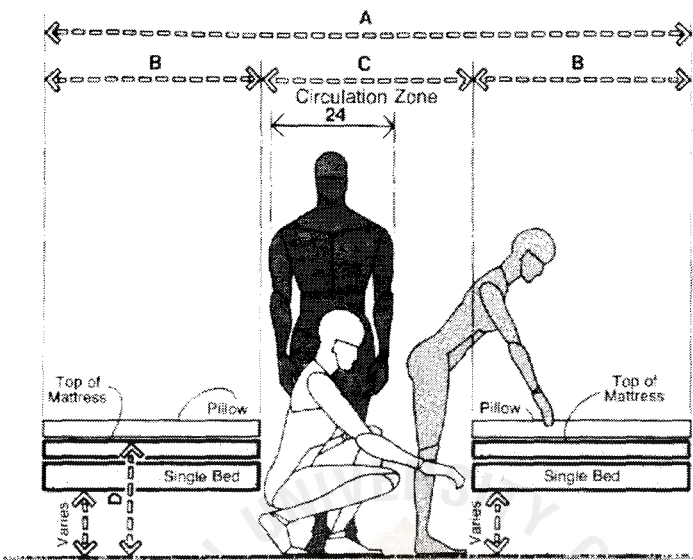


SINGLE AND DOUBLE BEDS

| | in | cm |
|---|-------|-------------|
| A | 2.5 | 6.4 |
| B | 7.5 | 19.1 |
| C | 84 | 213.4 |
| D | 78 | 198.1 |
| E | 6 | 15.2 |
| F | 7-8 | 17.8-20.3 |
| G | 44-48 | 111.8-116.8 |
| H | 4-5 | 10.2-12.7 |
| I | 1-2 | 2.5-5.1 |
| J | 36 | 91.4 |
| K | 48 | 121.9 |
| L | 39 | 99.1 |
| M | 54 | 137.2 |
| N | 60 | 152.4 |
| O | 70 | 177.8 |
| P | 16 | 40.6 |
| Q | 22 | 55.9 |
| R | 30 | 76.2 |



BEDROOM / VISION AND SIGHT LINES



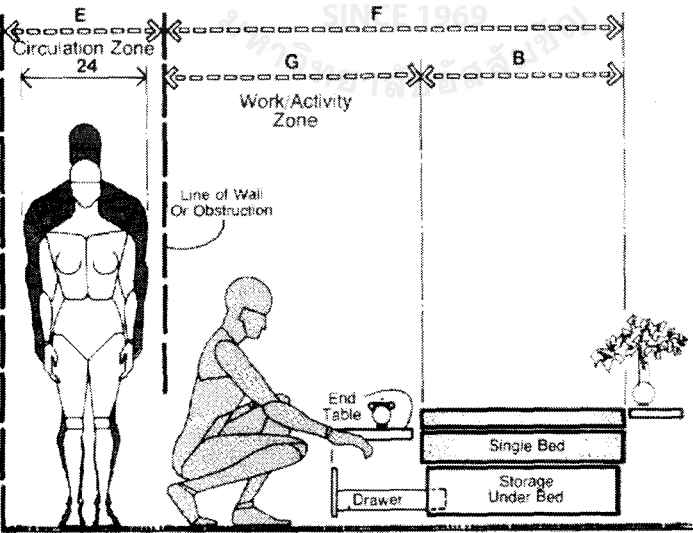
TWIN BED / CLEARANCES AND DIMENSIONS

2.3 SLEEPING SPACES

The top drawing illustrates the clearances suggested between single beds to allow for circulation, access, and making up the beds. A minimum of 36 in. or 91.4 cm, is recommended.

To conserve space, underbed storage may be used in many instances. In such situations, it is essential that adequate clearance be provided between the bed and the wall or the nearest physical obstruction to ensure comfortable access.

As indicated in the bottom drawing, a clearance of 46 to 62 in. or 116.8 to 157.5 cm, should be adequate to accommodate the human body in a kneeling position as well as the projection of a partially extended drawer. If it is necessary to provide for circulation that must by-pass the work/activity zone shown, an additional 30 in. or 76.2 cm, should be added.



SINGLE BED / CLEARANCES AND DIMENSIONS

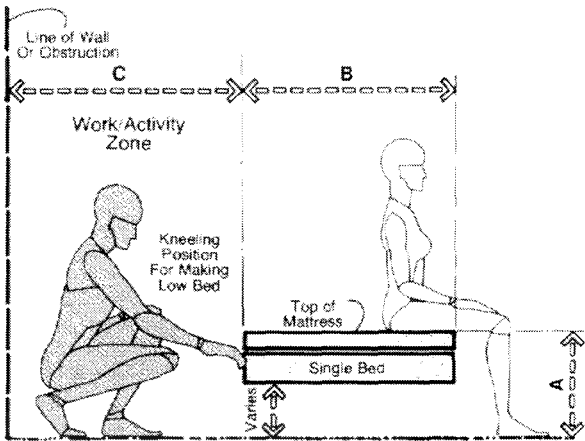
| | in | cm |
|---|---------|-------------|
| A | 108-114 | 274.3-289.6 |
| B | 36-39 | 91.4-99.1 |
| C | 36 | 91.4 |
| D | 18-22 | 45.7-55.9 |
| E | 30 | 76.2 |
| F | 82-131 | 208.3-332.7 |
| G | 46-62 | 116.8-157.5 |

2.3 SLEEPING SPACES

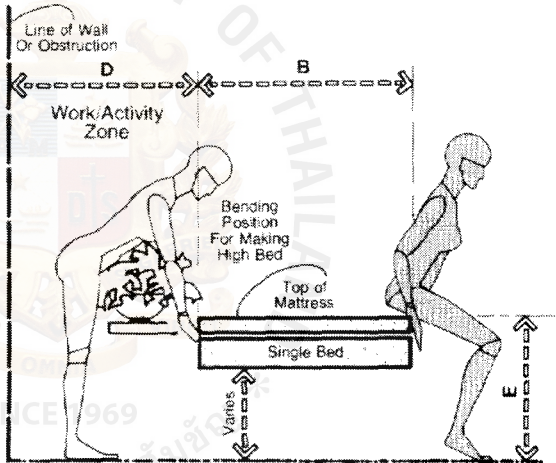
The three drawings on the page show the clearances involved in various bed-related work activities. The drawing at the top of the page illustrates a kneeling activity which would require a clearance of 37 to 39 in., or 93 to 99 cm, where a bed of low height is involved. Bed making usually results in backache because of the body position required to reach the bed surface. If the height of the bed were located about 24 in., or 61 cm, above the floor, as shown in the center drawing, the strain on the back would be greatly reduced. Such a height, however, does not accommodate the seated user comfortably, as suggested by the rather awkward body position of the seated figure.

In any event, a clearance of 26 to 30 in., or 66 to 76.2 cm, related to the higher bed height, is recommended to accommodate the bed-making activity.

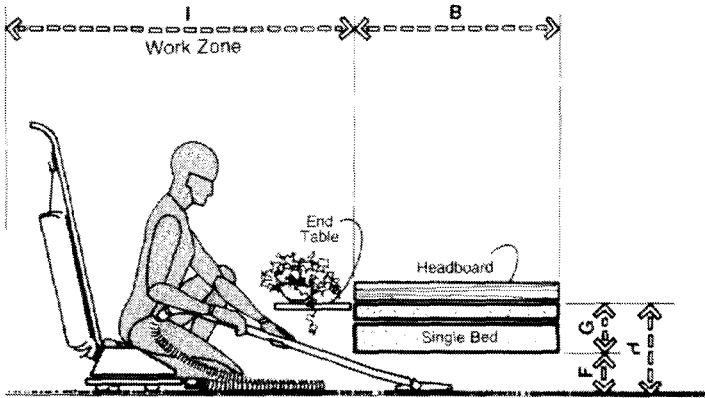
The lower drawing illustrates the clearances involved for vacuuming under the bed. A workzone of 48 to 54 in., or 121.9 to 137.2 cm, is suggested to accommodate this activity. It should be noted that the vacuum cleaner is intentionally shown located outside the workzone merely to stress that the clearance is not overly generous. The cleaner can be located at the side of the user or even a considerable distance away. The configuration of the room and length, type, and flexibility of the cleaning device will all impact on the clearances required.



SINGLE BED / CLEARANCES AND DIMENSIONS



SINGLE BED / CLEARANCES AND DIMENSIONS

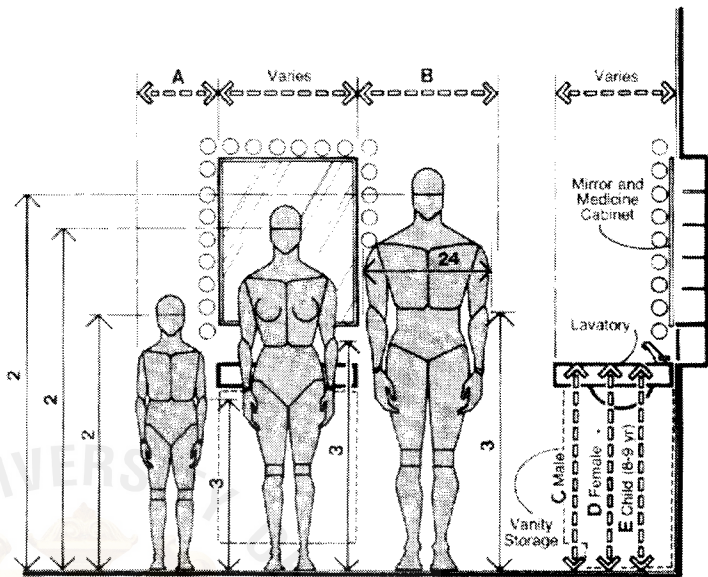


CLEANING REQUIREMENTS

| | in | cm |
|---|-------|-------------|
| A | 16 | 40.6 |
| B | 36-39 | 91.4-99.1 |
| C | 37-39 | 94.0-99.1 |
| D | 26-30 | 66.0-76.2 |
| E | 24 | 61.0 |
| F | 6-8 | 15.2-20.3 |
| G | 12-16 | 30.5-40.6 |
| H | 18-24 | 45.7-61.0 |
| I | 48-54 | 121.9-137.2 |

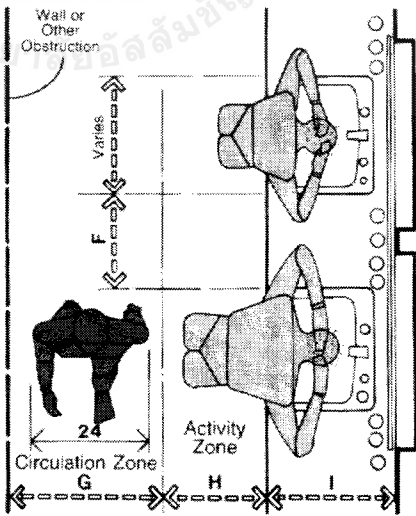
2.5 BATHROOMS

The drawing at the top of the page illustrates some of the basic anthropometric considerations related to the lavatory area. Perhaps the most obvious problem concerns the height of the lavatory above the floor. For too long this dimension has been established in the field on so-called trade practice at 31 to 34 in., or 78.7 to 86.3 cm, and has little relationship to the anthropometric requirements involved. Optimum work height for the hands on a counter or work bench situation is established at about 2 to 3 in., or 5 to 7.6 cm, below elbow height. Published data show that only 5 percent of a male sampling measured had an elbow height of 41.3 in., or 104.9 cm, or less, while 5 percent of a female sampling had an elbow height of 38.6 in., or 98 cm. Subtracting 3 in from the female measurement would place a comfortable height for the lavatory at 35.6 in., or 90.4 cm. That is greater than the height at which lavatories are normally installed, presumably to accommodate the majority of the population. Stated another way, more than 95 percent of users are not properly accommodated by the heights at which most lavatories are presently installed. The drawing indicates ranges for adult males, females, and children of lavatory heights suitable to accommodate a greater portion of the respective populations. The bottom drawing indicates horizontal clearances recommended in the lavatory area.

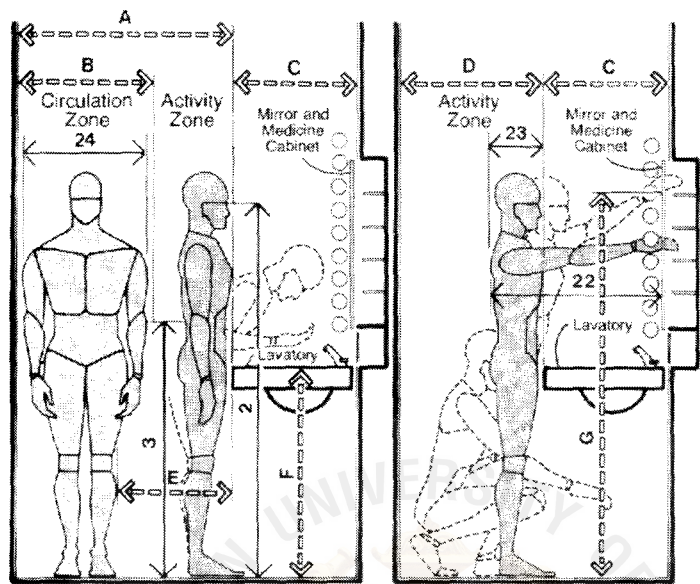


LAVATORY / GENERAL ANTHROPOMETRIC CONSIDERATIONS

| | in | cm |
|---|-------|------------|
| A | 15-18 | 38.1-45.7 |
| B | 28-30 | 71.1-76.2 |
| C | 37-43 | 94.0-109.2 |
| D | 32-36 | 81.3-91.4 |
| E | 26-32 | 66.0-81.3 |
| F | 14-16 | 35.6-40.6 |
| G | 30 | 76.2 |
| H | 18 | 45.7 |
| I | 21-26 | 53.3-66.0 |



DOUBLE LAVATORY CLEARANCES

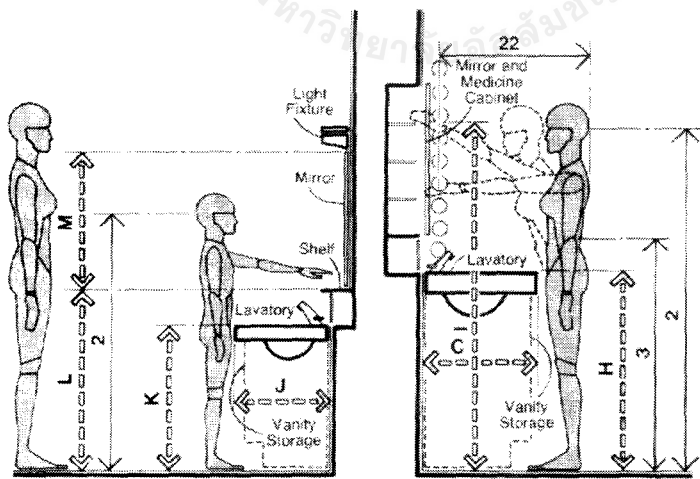


LAVATORY / MALE ANTHROPOMETRIC CONSIDERATIONS

2.5 BATHROOMS

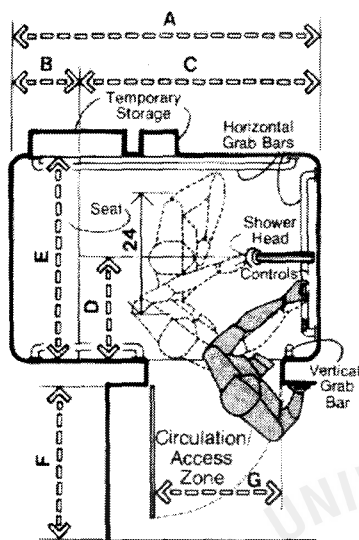
The drawing at the top deals primarily with some of the more critical male anthropometric considerations developed on the preceding page. A lavatory height above the floor of 37 to 43 in, or 94 to 109.2 cm, is suggested to accommodate the majority of users. In order to establish the location of mirrors above the lavatory, eye height should be taken into consideration.

The two drawings at the bottom of the page explore, in much the same manner, the anthropometric considerations related to women and children, respectively. Given the great variability in body sizes to be accommodated within a single family, a strong case can be presented for the development of a height adjustment capability for the lavatory. Until that is developed, there is no reason, on custom installations, why the architect or interior designer cannot take anthropometric measurements of the client to ensure proper interface between the user and the lavatory.

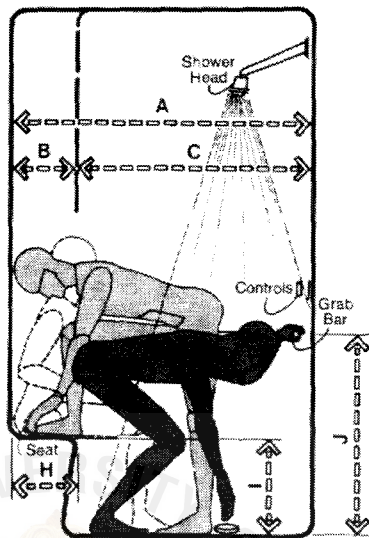


LAVATORY / FEMALE AND CHILD ANTHROPOMETRIC CONSIDERATIONS

| | in | cm |
|---|---------|------------|
| A | 48 | 121.9 |
| B | 30 | 76.2 |
| C | 19-24 | 48.3-61.0 |
| D | 27 min. | 68.6 min. |
| E | 18 | 45.7 |
| F | 37-43 | 94.0-109.2 |
| G | 72 max. | 182.9 max. |
| H | 32-36 | 81.3-91.4 |
| I | 69 max. | 175.3 max. |
| J | 16-18 | 40.6-45.7 |
| K | 26-32 | 66.0-81.3 |
| L | 32 | 81.3 |
| M | 20-24 | 50.8-61.0 |



MINIMUM SHOWER CLEARANCES

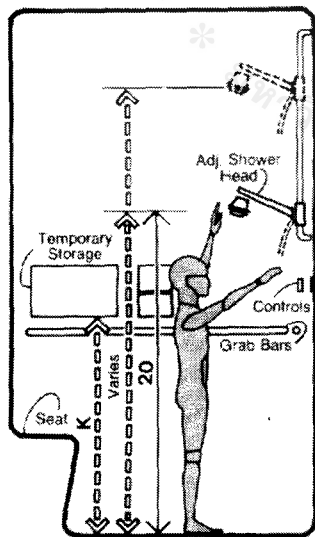


MINIMUM SHOWER CLEARANCES

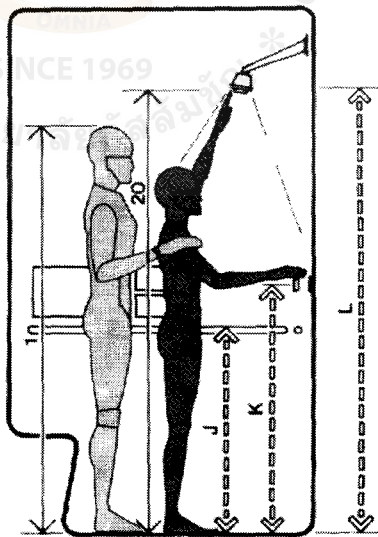
2.5 BATHROOMS

The size of a shower stall can vary greatly depending on the level of comfort desired. Safety is also an extremely important consideration. Unless a fairly reliable mixing valve capable of presetting a fixed and desirable water temperature is provided, care should be taken to locate controls within reach but out of direct line of the water path in order to avoid scalding or freezing while operating the controls.

A clearance of 54 in., or 137.2 cm, between walls, as shown in the two drawings at the top, will not only accommodate the variety of body positions shown, but will also allow for a small 12-in., or 30.5-cm, seating surface. The height of the adjustable shower head should be within reach of the adult of smaller body size, but at the same time high enough to clear the head of most people of larger body size. In situations where children use the same facility, an adjustable shower head is suggested in order to place it within reach of the child.



SHOWER / CHILD ANTHROPOMETRIC CONSIDERATIONS



SHOWER / REACH AND CLEARANCE

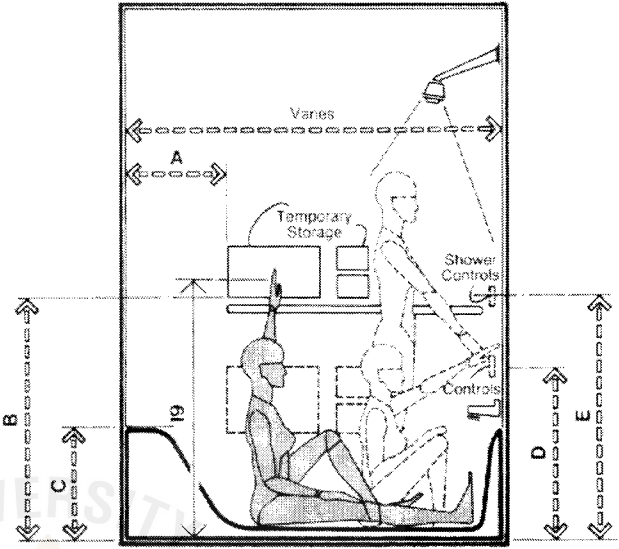
| | in | cm |
|---|---------|-------------|
| A | 54 | 137.2 |
| B | 12 | 30.5 |
| C | 42 min. | 106.7 min. |
| D | 18 | 45.7 |
| E | 36 min. | 91.4 min. |
| F | 30 | 76.2 |
| G | 24 | 61.0 |
| H | 12 min. | 30.5 min. |
| I | 15 | 38.1 |
| J | 40-48 | 101.6-121.9 |
| K | 40-50 | 101.6-127.0 |
| L | 72 min. | 182.9 min. |

2.5 BATHROOMS

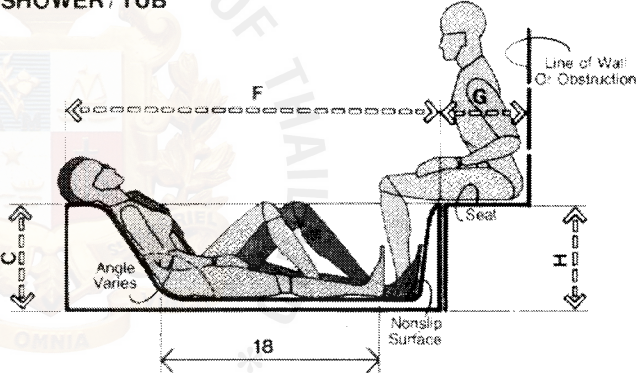
The drawing at the top of the page illustrates some of the basic clearances required for a combination shower and tub. Dimensions concerning the shower head are similar to those indicated on the preceding page. The location of the tub controls should be placed within reach of the smaller seated user.

Unless a tub is custom designed, the choice of dimensions is limited to standard available tub models. A knowledge of the anthropometric considerations involved, however, will prove helpful in making the appropriate selection. If the user enjoys reclining and soaking for extended periods, a large-size tub may not necessarily be the wisest selection. The length of the tub at the bottom surface should approximate the buttock-heel length of the smaller user. This will allow the feet to bear against the end of the tub and act as a brace to prevent the body from sliding too far under the water.

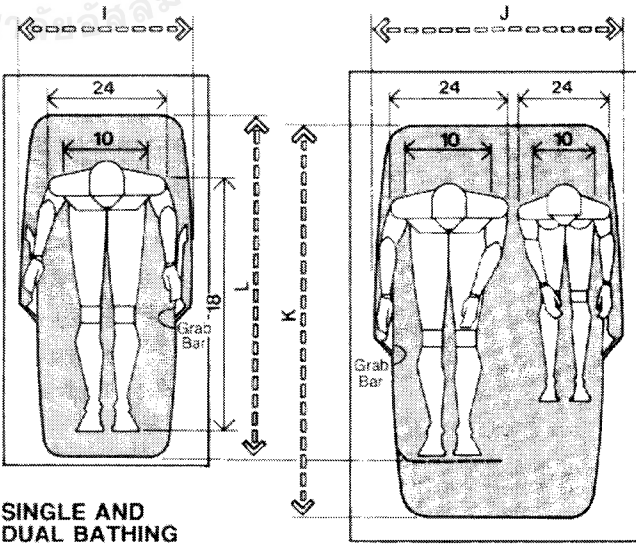
The center drawing illustrates that condition. The bottom drawing indicates that a tub width of 40 to 44 in, or 101.6 to 111.8 cm, is necessary to accommodate two people in the tub at the same time.



SHOWER / TUB



TUB / RECLINING AND RELAXING



SINGLE AND DUAL BATHING

| | in | cm |
|---|---------|-------------|
| A | 18-21 | 45.7-53.3 |
| B | 40 | 101.6 |
| C | 15-22 | 38.1-55.9 |
| D | 30-34 | 76.2-86.4 |
| E | 40-50 | 101.6-127.0 |
| F | 66 | 167.6 |
| G | 12 min. | 30.5 min. |
| H | 18 max. | 45.7 max. |
| I | 26-27 | 66.0-68.6 |
| J | 40-44 | 101.6-111.8 |
| K | 66-70 | 167.6-177.8 |
| L | 56-60 | 142.2-152.4 |

