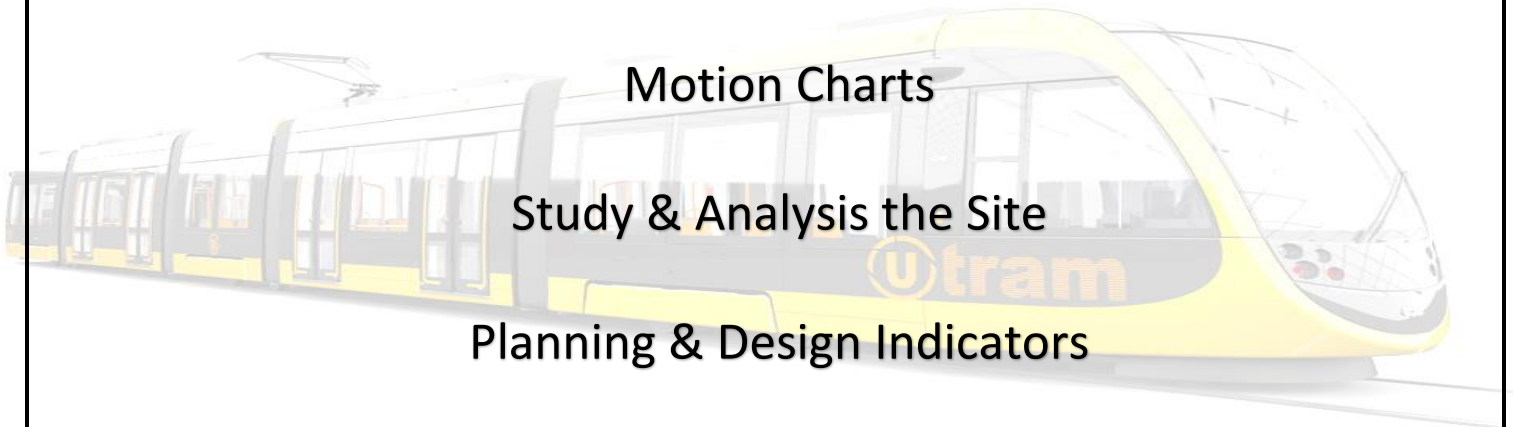# CHAPTER THREE

Project Components

Spaces study

Functional Relationships

Motion Charts

Study & Analysis the Site
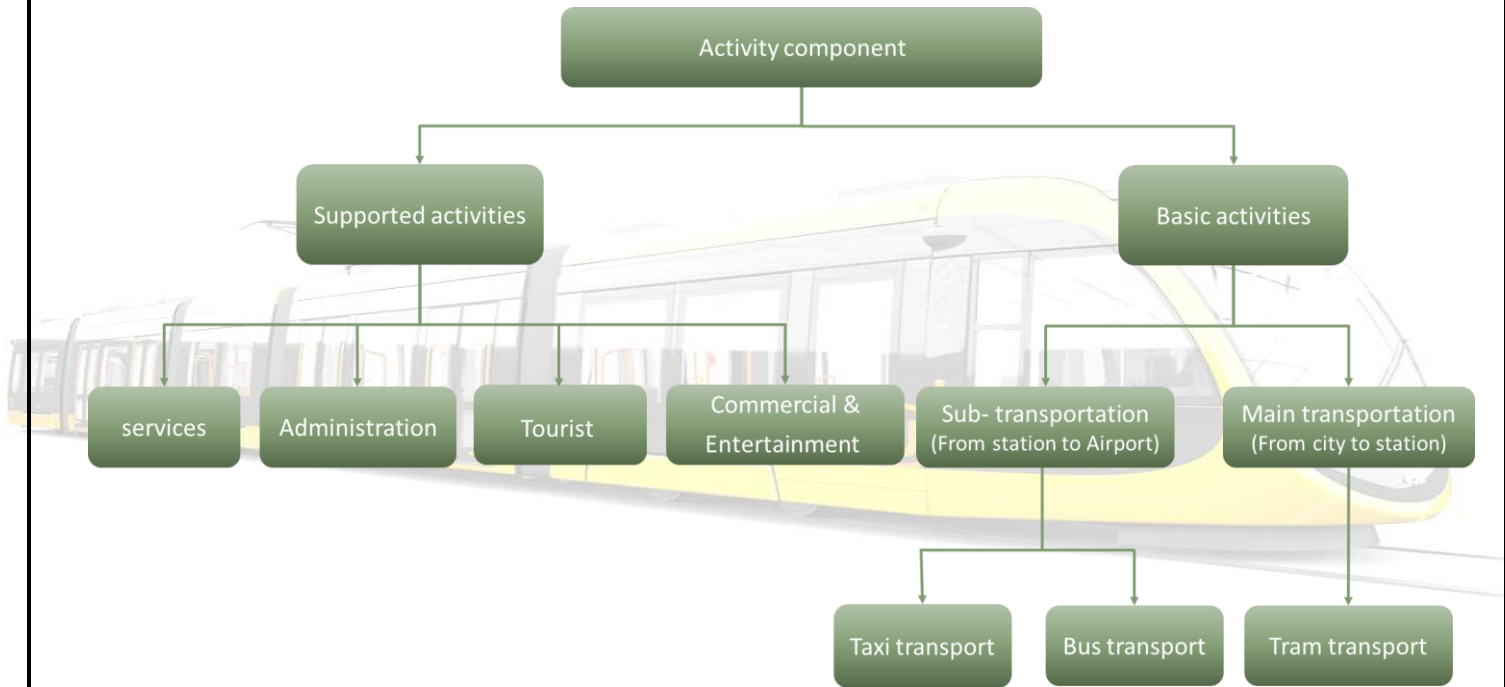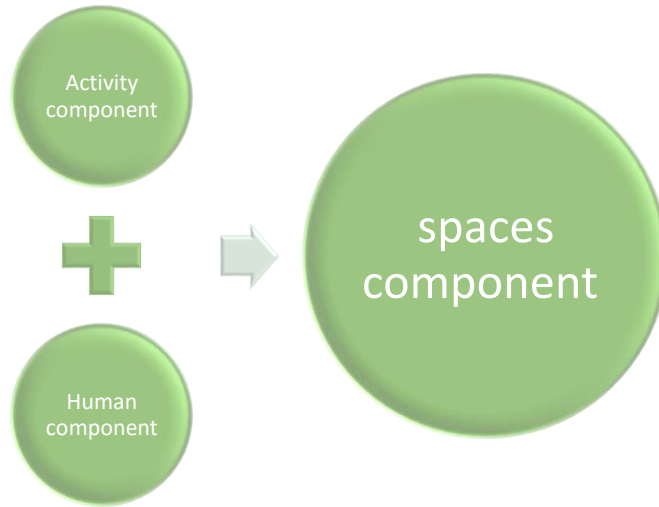
Planning & Design Indicators

Zoning

Project Components

Activity component

+

Human component

➡

spaces component

Activity component

├── Supported activities
│   ├── services
│   ├── Administration
│   ├── Tourist
│   └── Commercial & Entertainment
└── Basic activities
    ├── Sub- transportation (From station to Airport)
    │   ├── Taxi transport
    │   └── Bus transport
    └── Main transportation (From city to station)
        └── Tram transport

Supported activities

↓

Administration

- Public Relations Management
- Sales Management
- Tourism Management
- Personnel Management
- Management of transmission lines
- Engineering Management
- Financial management
- General Administration

Tram Station of New Khartoum Airport

Supported activities

services

- Self-health
- storage
- Adjust security and safety
- Prayer
- parking
- maintenance

- Rest
- therapy
- Control
- Energy supply
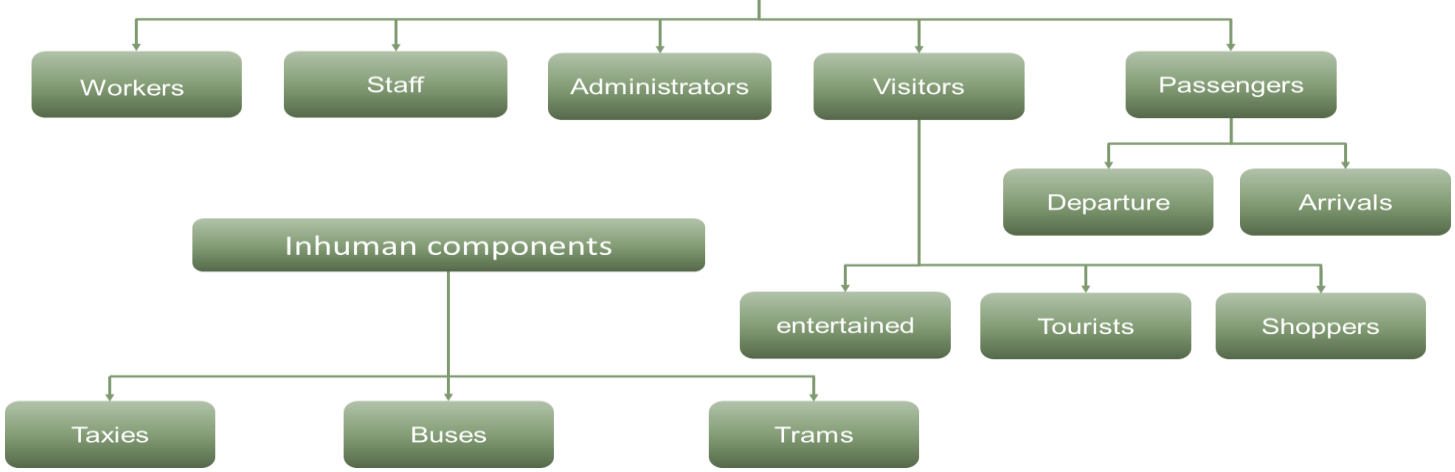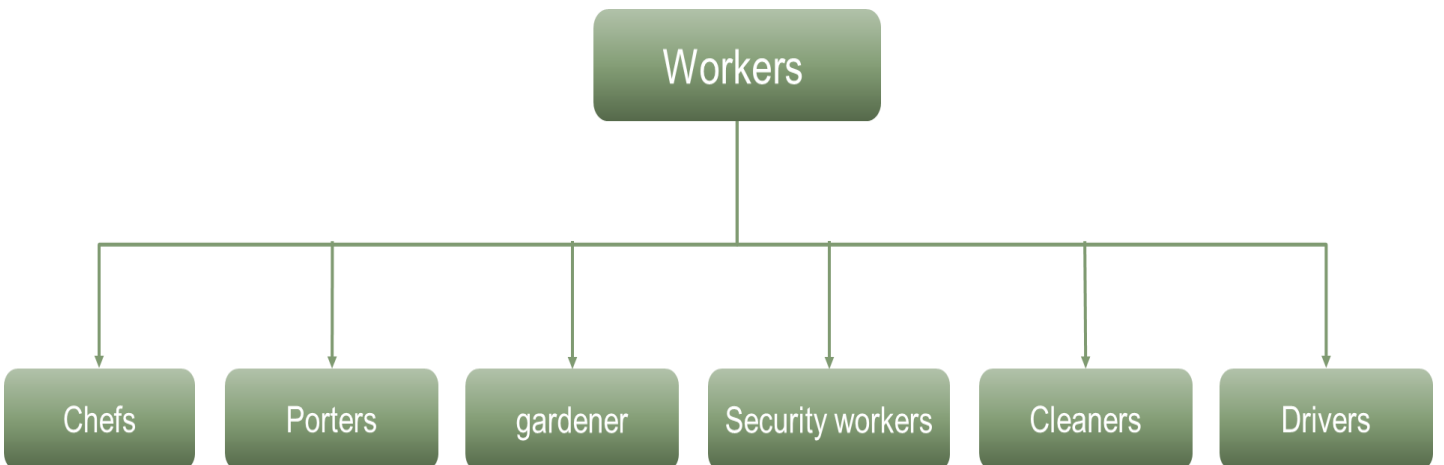- Vertical and horizontal transmission
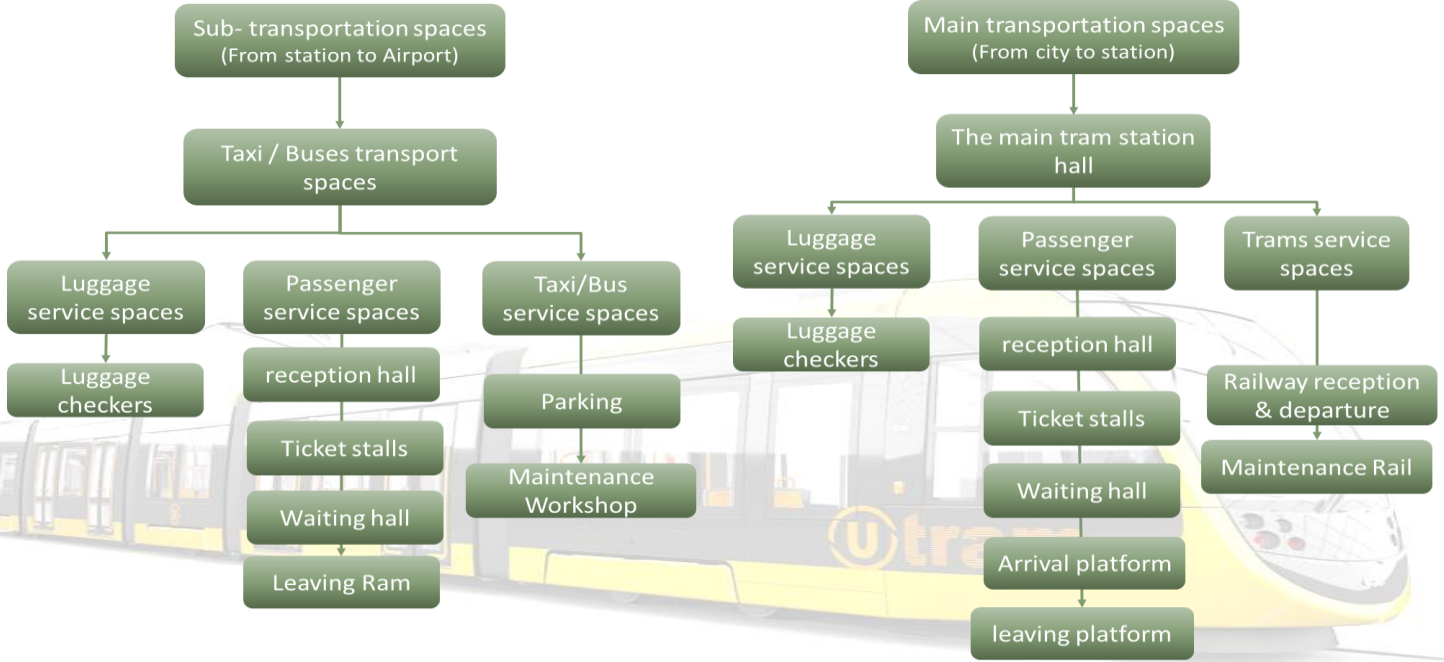- Monitoring and supervision

---

Supported activities

Commercial & Entertainment

- Shopping
- Tourist shows
- Drinking coffee
- Eat and drink
- External shows
- Green spaces

- Touring Touristic
- checking the Internet
- Sales Marketing
- Buy foodstuffs
- Play area
- Eat a special meal

Human components

- Workers
- Staff
- Administrators
- Visitors
- Passengers
  - Departure
  - Arrivals

Inhuman components

- Taxies
- Buses
- Trams

Visitors:
- entertained
- Tourists
- Shoppers

Tram Station of New Khartoum Airport

Administrators

- Director general
- Deputy Director
- Secretariat

Sales Manager	Director Of Tourism	Director of transmission lines	Director of Personnel	Director of Public Relations	Engineering Manager	Financial Manager
Sales staff	Deputy Director	Deputy Director	Deputy Director	Deputy Director	Deputy Director	Deputy Director
	Secretariat	Secretariat	Secretariat	Secretariat	Secretariat	Secretariat
	Staff	Staff	Staff	Staff Statistics	Engineers	Accountants

Staff

- Nurses
- Technicians
- Sellers
- Supervisors
- Staff Tickets
- Tour Guides
- Reception staff

Workers

- Chefs
- Porters
- gardener
- Security workers
- Cleaners
- Drivers

Tram Station of New Khartoum Airport

```
Spaces components
├── Supported Spaces
│   ├── Services Spaces
│   ├── Administration sector
│   ├── Tourist spaces
│   └── Commercial & Entertainment spaces
└── Basic Spaces
    ├── Sub- transportation spaces (From station to Airport)
    │   ├── Taxi transport spaces
    │   └── Bus transport spaces
    └── Main transportation spaces (From city to station)
        └── Tram transport spaces
```

```
Sub- transportation spaces (From station to Airport)
└── Taxi / Buses transport spaces
    ├── Luggage service spaces
    │   └── Luggage checkers
    ├── Passenger service spaces
    │   ├── reception hall
    │   ├── Ticket stalls
    │   ├── Waiting hall
    │   └── Leaving Ram
    └── Taxi/Bus service spaces
        ├── Parking
        └── Maintenance Workshop
```

```
Main transportation spaces (From city to station)
└── The main tram station hall
    ├── Luggage service spaces
    │   └── Luggage checkers
    ├── Passenger service spaces
    │   ├── reception hall
    │   ├── Ticket stalls
    │   ├── Waiting hall
    │   ├── Arrival platform
    │   └── leaving platform
    └── Trams service spaces
        ├── Railway reception & departure
        └── Maintenance Rail
```

```
Administrators sector
└── general director office
    └── Deputy Director office
        └── Secretariat office
            ├── Sales Manager office
            │   └── Sales staff offices
            ├── Director Of Tourism office
            │   └── Deputy Director office
            │       └── Secretariat office
            │           └── Staff offices
            ├── Director of transmission lines office
            │   └── Deputy Director office
            │       └── Secretariat office
            │           └── Staff offices
            ├── Director of Personnel office
            │   └── Deputy Director office
            │       └── Secretariat office
            │           └── Staff offices
            ├── Director of Public Relations office
            │   └── Deputy Director office
            │       └── Secretariat office
            │           └── Staff Statistics offices
            ├── Engineering Manager office
            │   └── Deputy Director office
            │       └── Secretariat office
            │           └── Engineers offices
            └── Financial Manager office
                └── Deputy Director office
                    └── Secretariat office
                        └── Accountants offices
```

```
                          Supported spaces

                           Services spaces

   Toilets    stores    Security and safety    Prayer spaces    parking    Workshops
                         control offices

  Rest rooms    Clinic    Control room    Energy supply    Means of movement    Monitoring and
                                          room             (stairs-Lifts-rams)  supervision rooms
```

```
                          Supported Spaces

                    Commercial & Entertainment
                              spaces

  Shops & Gallery's    Tourist      Cafes    Restaurants    Outdoor      Green spaces
                       Exhibition                           Exhibition

  Tourist tram    Internet cafe    Marketing Sales    Hypermarket    Playground    Restaurant tram
                                   tram
```

Study of human and non - human components and spaces

<u>Human component:</u>

The airport receives an average number of passengers (3000-3600) passengers per day (departures - Arrivals).

The station receives 60% of passengers (1800-2200) (departures - Arrivals).

70% use buses and 30% use taxis.

The total number of passengers is estimated at peak hour (1200) passengers.

Track Installations

Track Installations

Curved radii (to the centre-line of the track), R:

for direct main line fast track	≥300 m
for sidings in stations	≥180 m
for branch lines with main line rolling stock	≥180 m
without main line rolling stock	≥100 m
for sidings, used by main line engines	≥140 m
for sidings, not used by mainline engines possibly	≥100 m
minimum	≥35 m

Note that if 100 m > R ≥ 35 m carriages should only be pulled. In addition, R >130 m might not be suitable for all rolling stock so the types involved should be checked at an early stage.

Radii for narrow gauge railways

for 1.00 m gauge track	≥50 m
for 0.75 m gauge track	≥40 m
for 0.60 m gauge track	≥25 m

R	l	m	ramp gradient
180–200	40	0.370	1: 320
		0.333	1: 320
250–350	30	0.150	1: 300
		0.107	1: 400
400–2000	20	0.012	1: 310
		0.008	1:1300

③ **Table for branch lines and normal sidings (m)**

④ **Simple set of points**

② **Canted curve and transition curve**
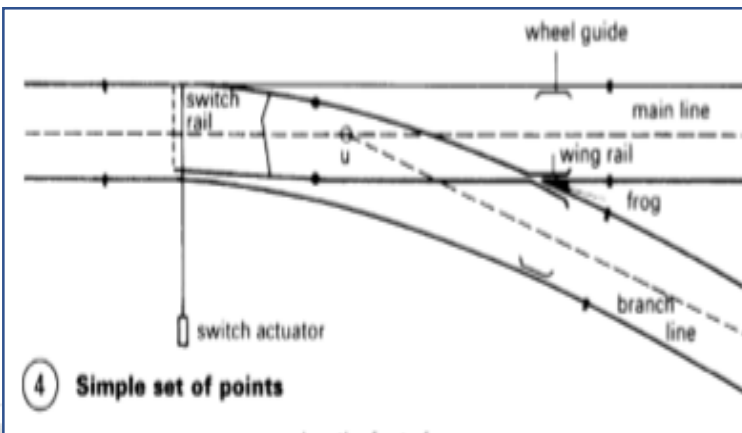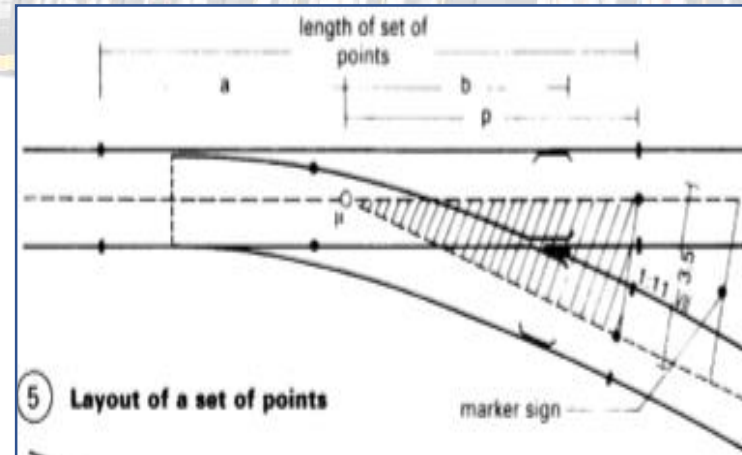
⑤ **Layout of a set of points**
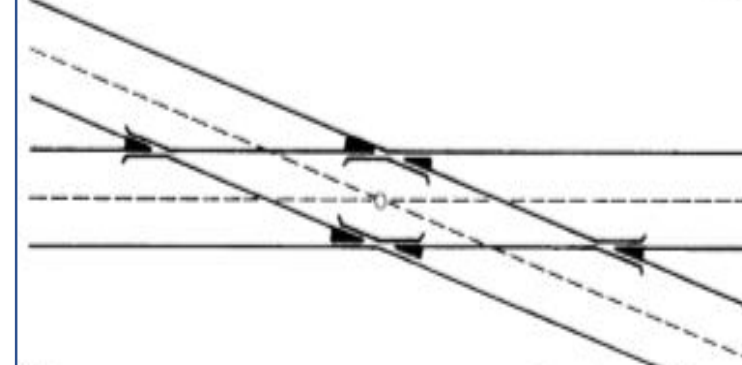
⑥ **Oblique angled crossing (wheel guide as in ④ + ⑤)**

normal track layout for rolling stock with an axle base of 4.5m

normal track layout for rolling stock with an axle base of 4.5m (suitable for virtually all rolling stock)

normal track layout for rolling stock with an axle base under 4.5m (not suitable for all rolling stock)

falling track with R < 100m

falling track for rolling stock with only two axles, 6.5–8.0m axle base

falling track for rolling stock with only two axles, up to 6.5m axle base or wagons with bogies

radii under 100m should be avoided where possible on all new construction work

① **Track radius (for turning round) in sidings**

⑦ **Display symbols**

⑨ **Display symbols**

(a) set of points with outside curve, remotely controlled

(b) double set of point, remotely controlled

(c) double slip points, remotely controlled

(d) simple set of points, hand operated

(e) double slip points, locally operated

(f) crossing
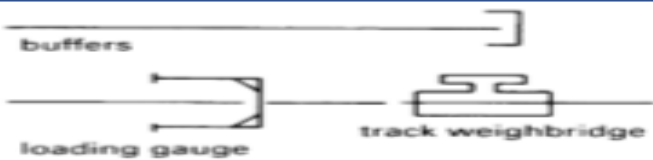
set of points	radius (m)	pitch ratio	overall length (m)
(a) 49	215	1:4.8	22.100
(d) 49	190	1:7.5	30.039
(d) 49	190	1:9	27.138
(c) 49	190	1:9	33.230
(b) 49	190	1:9r/ 1:9l	37.661

⑧ **Dimensions for sets of points → ⑨**
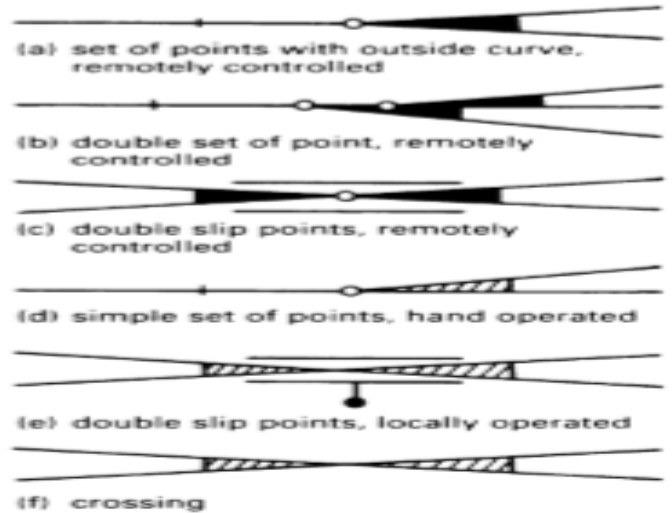
half the radius of the curve (m)	dimensions of half the width a (mm)
up to 250	1445
225	1455
200	1465
180	1475
150	1495
120	1525
100	1555

⑤ **Dimensions for half the width of the upper limit of the clearance**

	h
heavy superstructures up to 15 m wide and in tunnels	5500 mm
heavy superstructures over 15 m wide	6000 mm
light superstructures, such as footbridges, sheds including doors	6000 mm
signal gantries and brackets	6300 mm

⑥ **Minimum clearance under structures**

Other dimensions: European standards (Germany)

For entrance doorways the clear width should be ≥3.35 m and for new structures ≥4.00 m.

For tunnels, the extra clearance needed beyond the trains' kinematic envelope clearance to the wall for a single-track stretch of line is 0.40 m; for a double-track stretch of line it is 30 cm.

There are minimum distances required between buildings and railway tracks for new structures. These vary according to location. Typical examples are: a fire resistant structure with suitable cladding must be separated by ≥7.50 m from railway land; the corresponding distance for soft covered structures that are not fire resistant is ≥15 m. The latter also applies to structures in which combustible materials are stored.

Platform heights vary from country to country, and can be as small as 0.38 m. However, access to platforms must not involve passengers having to cross the track. This requires tunnels or bridges, which should have a width of 2.5–4.0 m. If there is circulation in both directions, 4.00–8.00 m is desirable. Steps on bridges or in tunnels should be the same width as the bridge or tunnel.
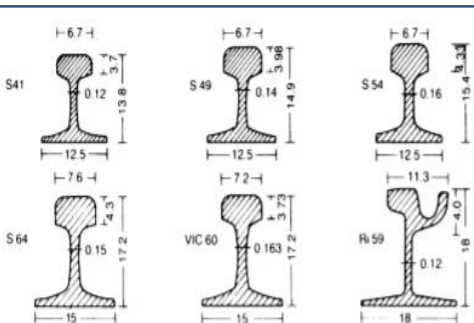
① **The common rail sections**

rail section	G (kg/m run)	A (cm²)	$W_{x\,head}$ (cm³)	$W_{x\,base}$ (cm³)	W_y (cm³)	I_x (cm⁴)	I_y (cm⁴)
S 41	40.95	52.2	196.0	200.5	41.7	1368	260
S 9	49.43	63.0	240.2	248.2	51.0	1819	320
S 54	54.54	69.4	262.4	276.4	57.0	2073	359
S64	64.92	82.4	355.9	403.5	80.5	3253	604
UIC 60	60.34	76.9	335.5	377.4	68.4	3055	513
Ri 59	58.96	75.1	372.6	351.8	81.0*)	3257	781

*) W_{y1} = 118 cm³ because of asymmetry

② **Rail dimensions → ①**
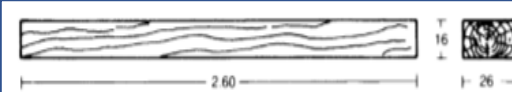
③ **Wooden sleeper**

④ **Steel sleeper**
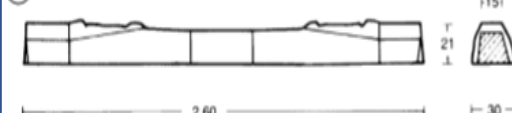
⑤ **Concrete sleeper B70**
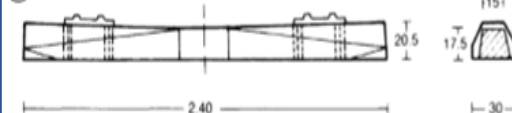
⑥ **Concrete sleeper B58**
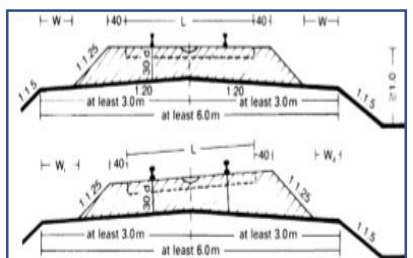
⑦ **Standard cross-section for a single track bed**
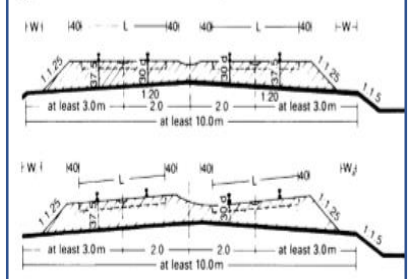
⑧ **Standard cross-section for a twin track bed**

Passenger diminutions

Means of movement

technical details

height of delivery:
4.20 m

conveyor length:
4.20 m

angle of incline:
27–30°

speed of travel:
0.3–0.5 m/s
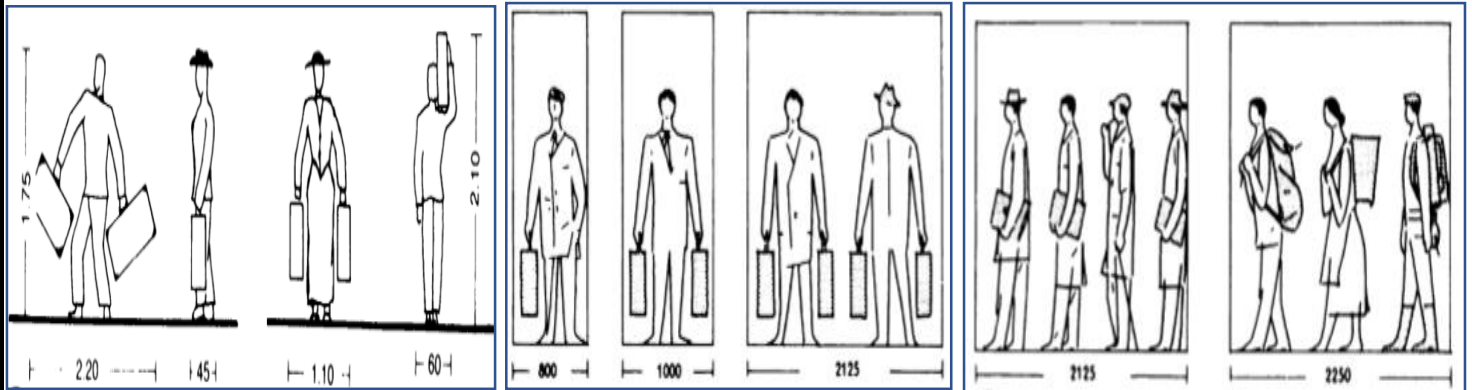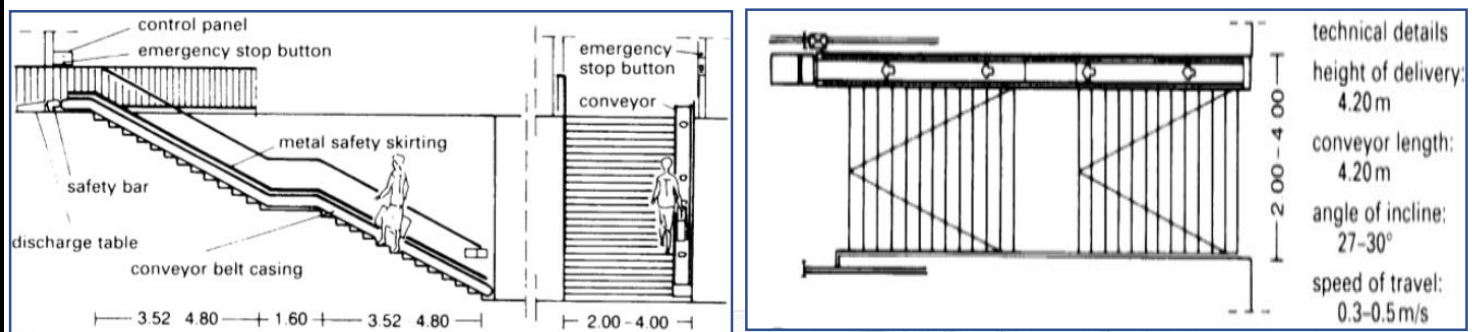
Passenger tram diminutions

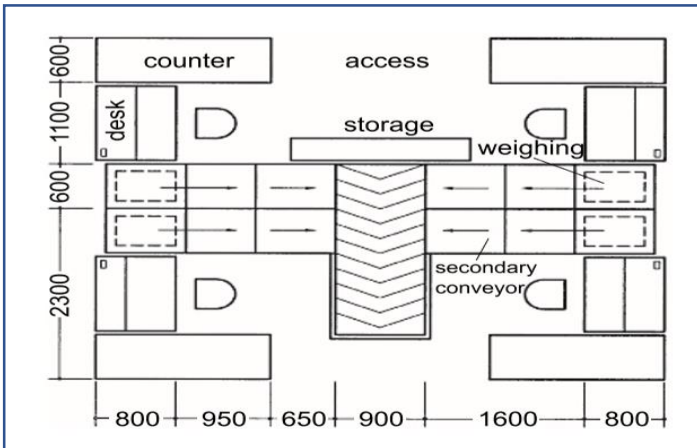old and new rolling stock as an example of minimum space requirements for passenger transport
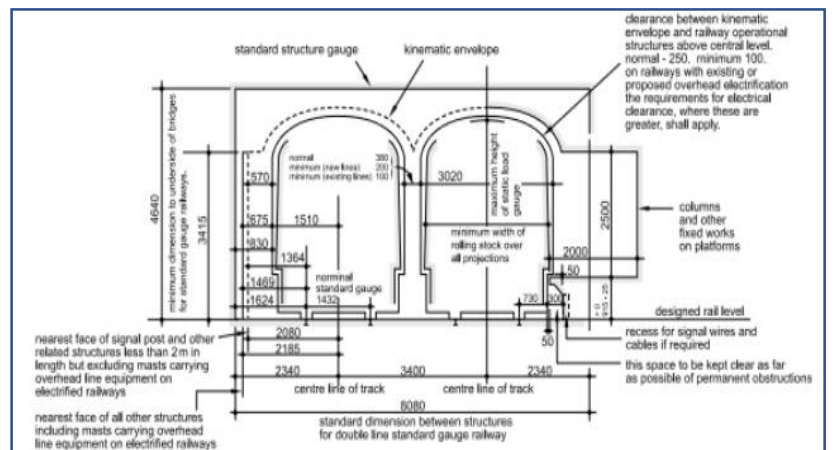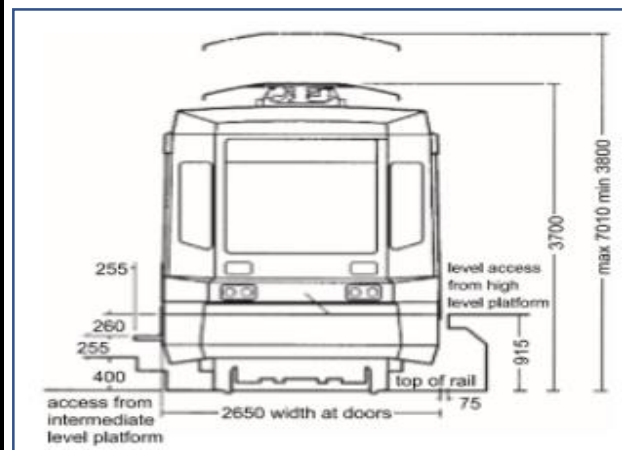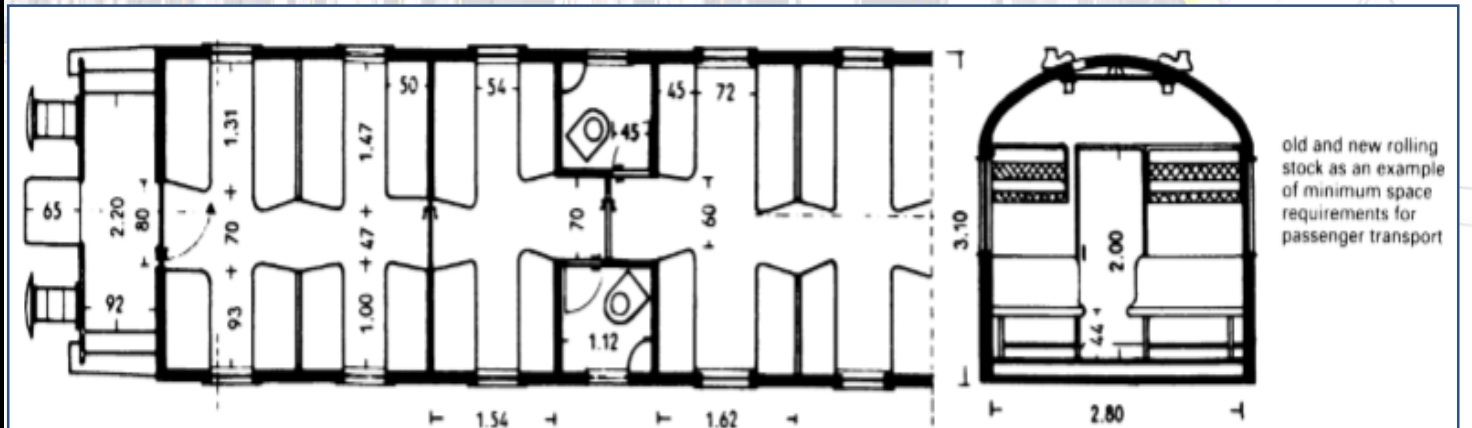
Check – In Installation Type
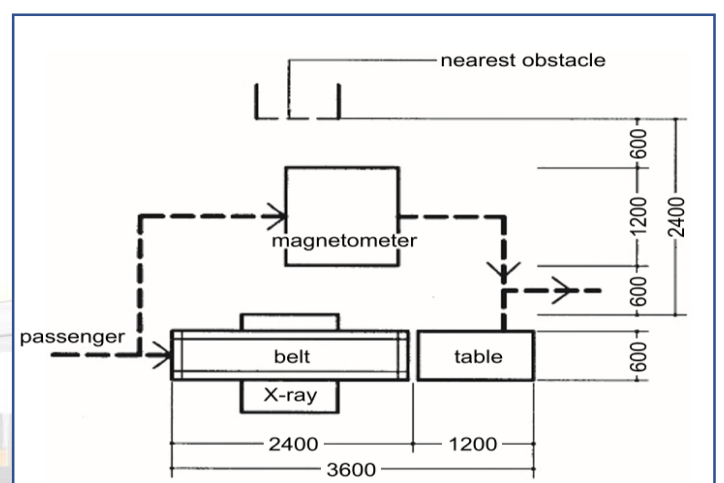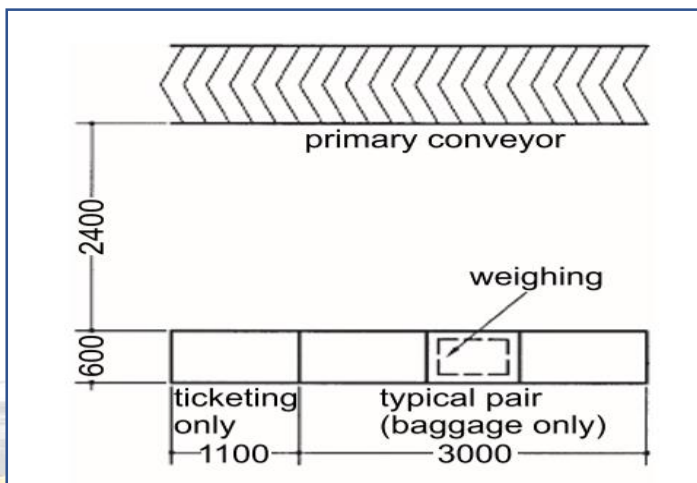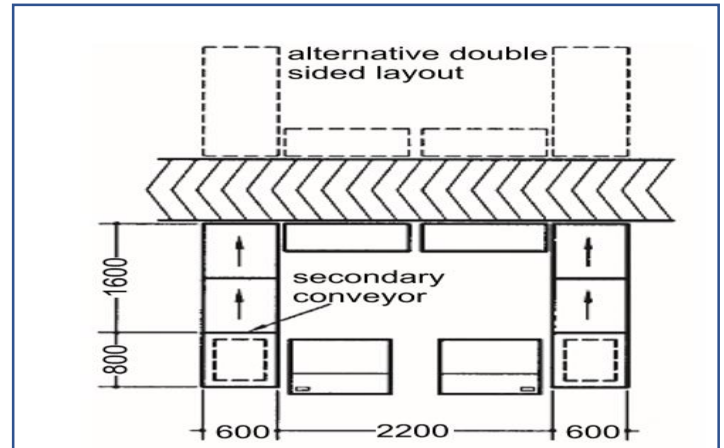
3.13 Typical space calculation

This is based on 2000 originating passengers/hour at a central security check, **30.12**.

Assume two items of baggage or hand baggage per passenger

One set of equipment consisting of a personnel metal detector and two 2 X-ray units can handle 600 passengers per hour.

2000 passengers per hour, excluding transfers, require 4 sets.

⑧ **Luggage lockers: four standard compartments**

⑨ **Luggage lockers: three large compartments**
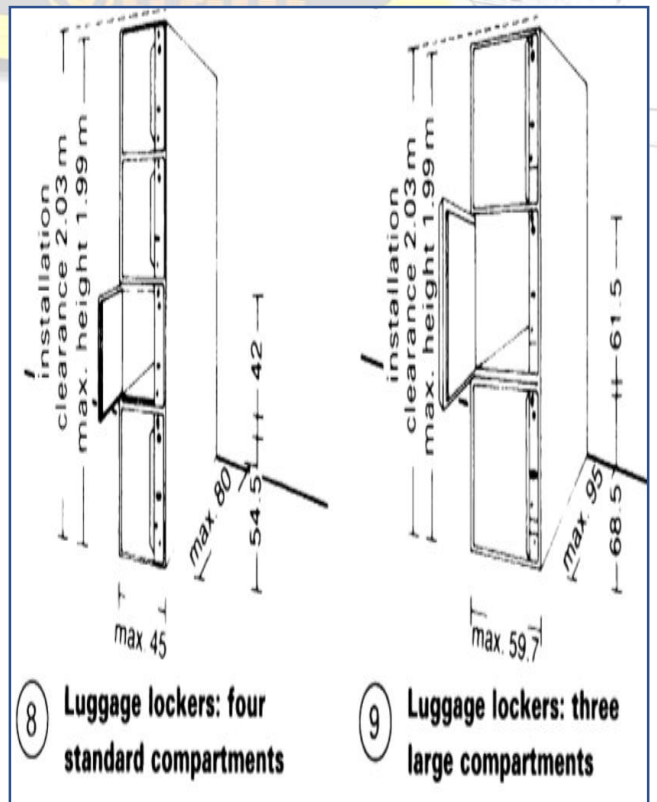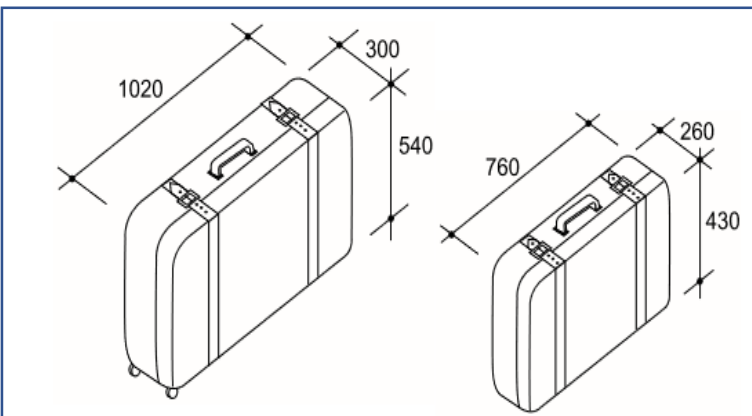
The Main Tram station Hall

The tram serves passengers traveling to and from the city

It is the main hall of the station, and transport procedures by trams are take place there.

The number of passengers using the tram at peak hour = 500.

Single tram capacity = 250 passengers

Number of trams = 2 tram = 250 * 2 = 500 passengers.

Calculate the total area of the main hall:

1/ Reception hall = (Per capita area + area of movement) * Number of individuals = 2200 * 0.7 = 1540 m2.

2/ Waiting area (Per capita area + area of movement) * Number of individuals =2* (250 * 1.2) = 600 M2.

3/ Departure Sidewalk (Per capita area + area of movement) * Number of individuals =2* (250* 0.7) = 350 M2.

4/ Arrival Sidewalk (Per capita area + area of movement) * Number of individuals = (500* 0.7) = 350 M2.

5/ tram track: Single tram area * Number of trams = (2.50 * 50) * 2 = 250 m 2.

6/Ticket counter 1 per 50 people = 10 counters with 1.2 m 2 per unit. The area of the counters = 10 * 1.2 = 12 m 2

7/Cafe with capacity of 50 people (1.2 m 2 per person) = 1.2 * 50 = 75 m 2.

8/Bathrooms: Bath per 50 people = 10 baths per m2 2 = 10 * 2 = 20 m2.

9/Green spaces: 0.05 m 2 per person = (0.05 * 500) = 25 m 2.

10/ Means of movement :1 Ladders and 2 escalators with an area of 40 m 2.
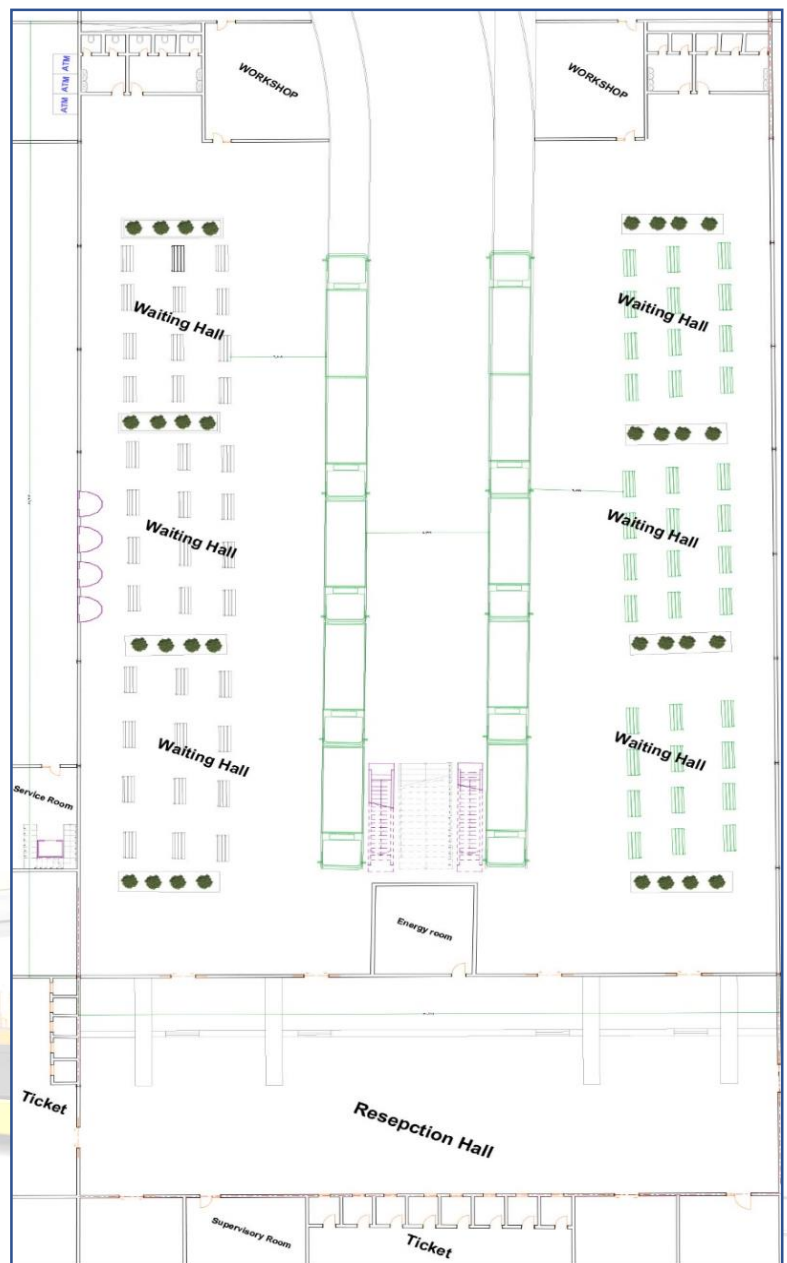
The Buses station

Buses serve passengers heading to the airport

The number of passengers using buses is 70% of the total number at peak hour = 350 passengers.

The bus capacity is 21 people

Total buses = 40 buses.

Calculate the total area of the bus station:

1/ Reception Hall (Per capita area + area of movement) * Number of individuals = 1.2 * 500 = 600 m2.

2/The query counter is one for every 200 people = 4 counters with an area of 5.3 m 2 = 15 m 2

3/Waiting Hall (Per capita area + area of movement) * Number of individuals = 1.2 * 500 = 600 m2

5/Ticket counter 1 per 50 people = 16 counters with 1.2 m 2 per unit. The area of the counters = 16 * 1.2 = 20 m 2

6/Cafe with capacity of 50 people (1.2 m 2 per person) = 1.2 * 50 = 75 m 2.

7/Bathrooms: Bath per 50 people = 10 baths per 2 m2 = 10 * 2 = 20 m2.

8/Green spaces: 0.05 m 2 per person = (0.05 * 500) = 42 m 2.

9/ Means of movement (rams) with an area of 600 m 2.
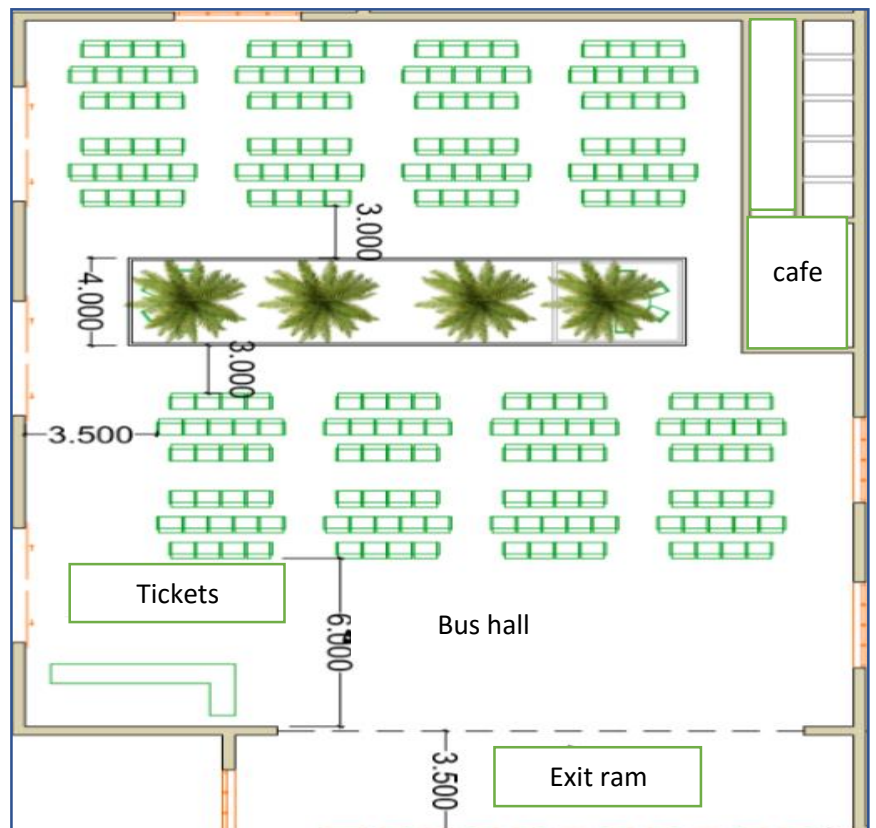
The Taxi station

Taxies serve passengers heading to the airport.

The number of passengers using buses is 30% of the total number at peak hour = 150 passengers.

Average number of Taxies for 150 passengers = 100 taxis.

Calculate the total area of the Taxi station:

1/Reception Hall (Per capita area + area of movement) * Number of individuals = 0.7 * 150 = 105 m2

2/The query counter is one for every 200 people = 2 counters with an area of 5.3 m 2 = 10 m 2.

Cafe

Tickets

Taxi hall

Exit ram

3/Witting Hall (Per capita area + area of movement) * Number of individuals = 1.2 * 150 = 180 m2

4/Ticket counter 1 per 50 people = 3 counters with 1.2 m 2 per unit. The area of the counters = 7 * 1.2 = 8.4 m 2

6/Green spaces: 0.05 m2 per person = (0.05 * 180) = 9 m 2

7/ Means of movement (rams) with an area of 600 m 2.

The outside area study

Single decker bus

Double-decker bus

10.0   12.0   7.2

3500 minimum: 4000 preferred

if kerb provided set back 2000 — allow 1000 to boundary

absolute minimum
16000
minimum 18000
preferred

13000 R

allow 2000 to
boundary

6000
min

3.5   2 m min
centre pavement

Bus/coach parking at 90° (m)

5.5 6.0 5.5 5.5 6.0 5.5

2.3/4

90° parking for medium sized cars
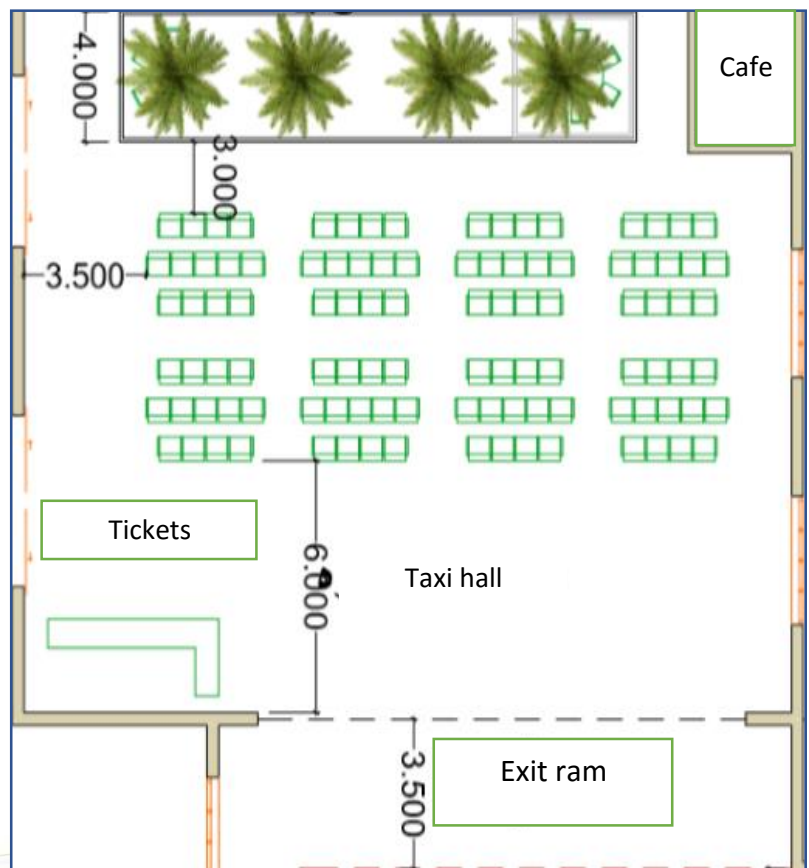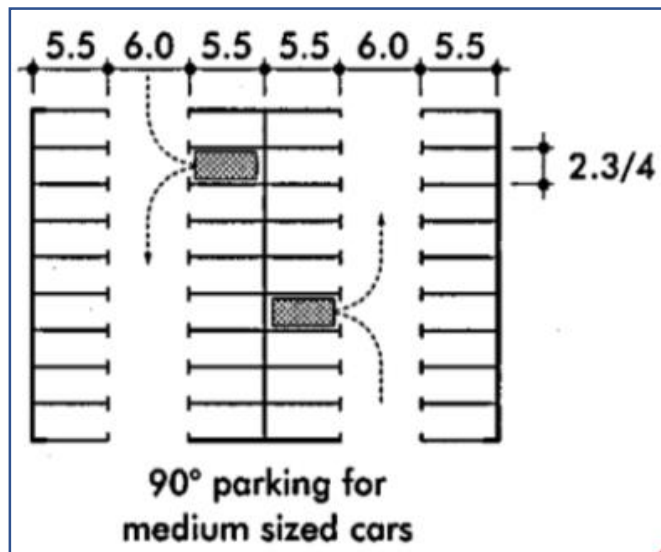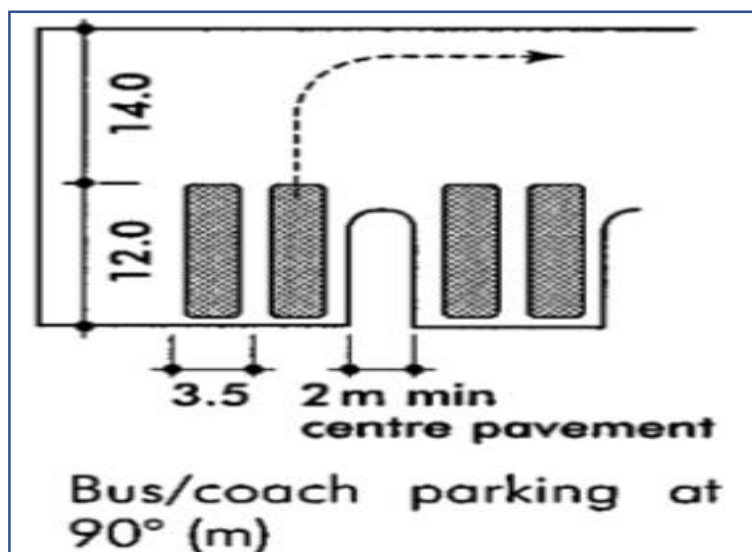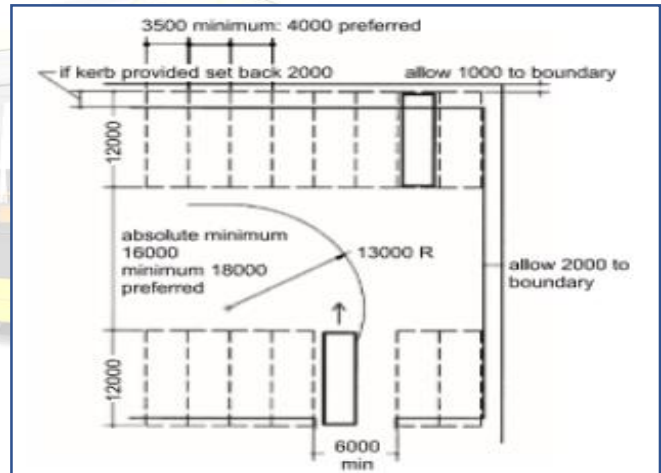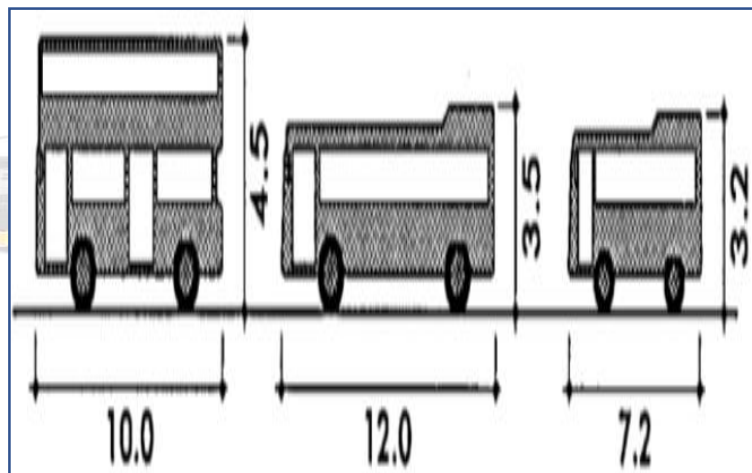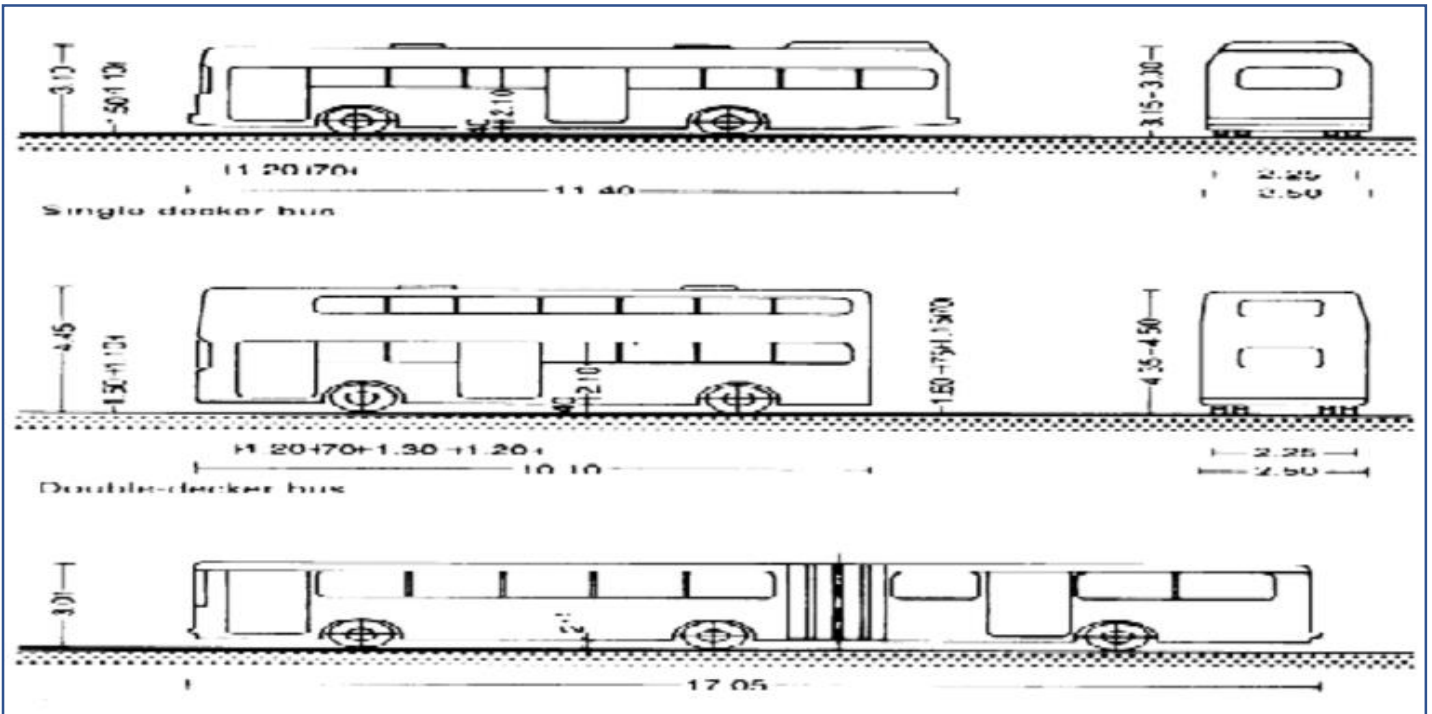
The outside area of the bus station:

1/ Sidewalk (Per bus) * 3 * 7 (bus length * pavement width) Number of buses at rush hour = 40 buses

2/ The pavement area = (3 * 7 * 40) = 600 m 2 (the lowest width of the pavement is 2.6 meters.

3/ Bus parking: Bus dimensions (7 * 3) m * Number of buses total 40 Bus + 20% Area of movement = 1000 m 2

4/ External seats : 20 seat-out seat 4 persons Seat dimensions (0.45 m 2)

Total external seats space = 20 * 0.45 = 20 m2

The outside area of the Taxi station:

1/ Sidewalk (Per bus) * 3 * 5 (bus length * pavement width) Number of Taxi at peak hour = 26 buses

2/ The pavement area = (3 * 5 * 26) = 390 m 2 (the lowest width of the pavement is 2.6 meters

3/ Taxi parking: Taxi dimensions (5 * 3) m * Number of total taxis 26 + 20% Area of movement = 468 m 2.
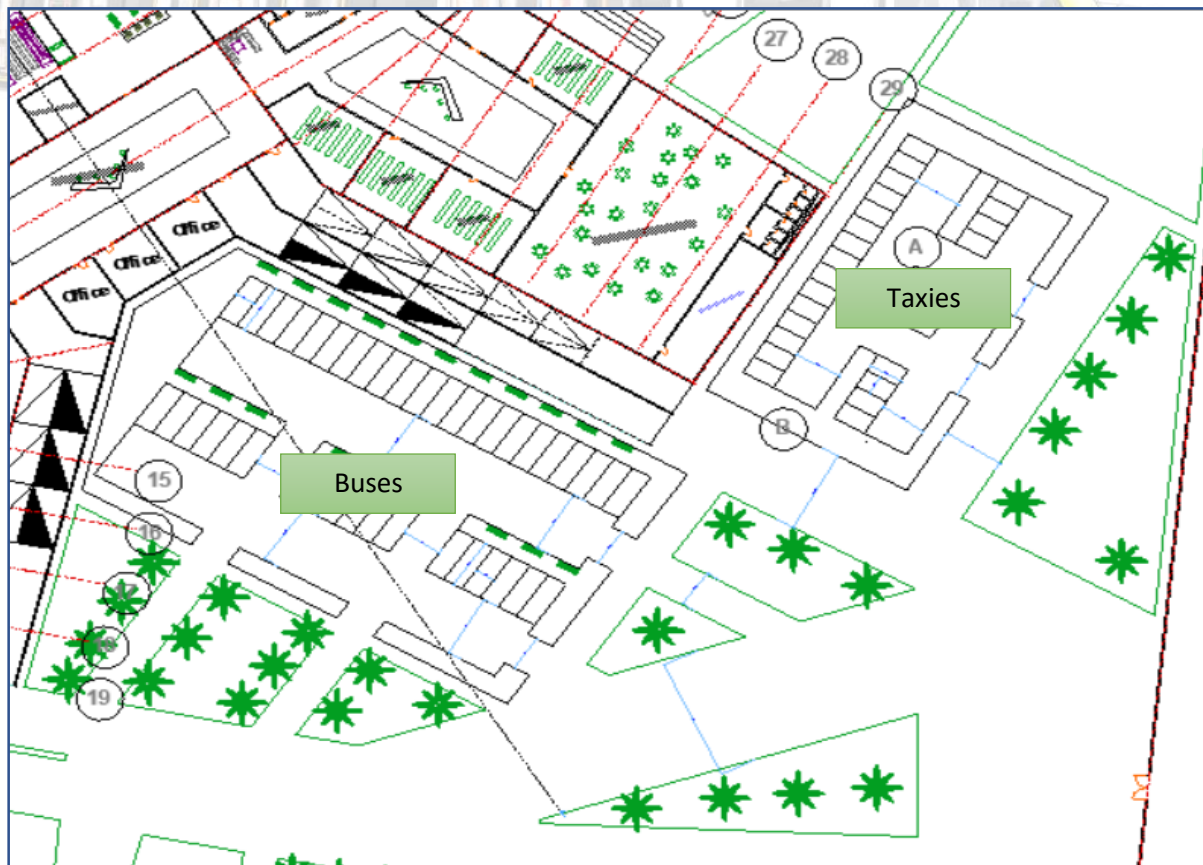
The Main Restaurant

The main restaurant is 400 people

The area of the individual is 1.2 m 2

Total area of the restaurant = 1000 m 2 including the area of movement.

Bathrooms and Laundries

Bathroom area 2 m2 (bath per 75 people = 6 bathrooms)

Total area of the baths = 6 * 2 = 12 m 2

Single wash area 0.8 m 2 (laundry per 75 people = 6 laundries)

Total wash area = 6 * 0.8 = 5 m 2.
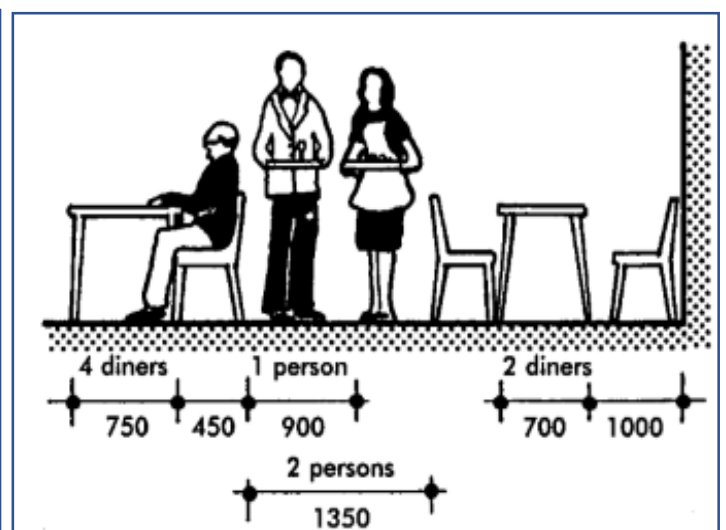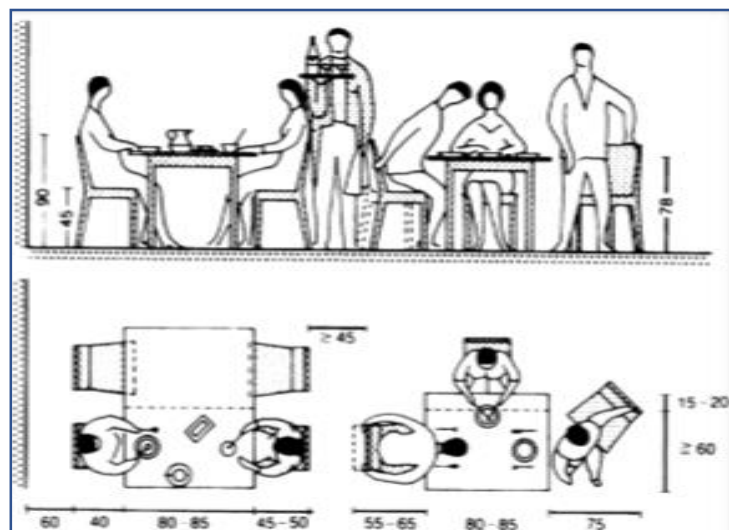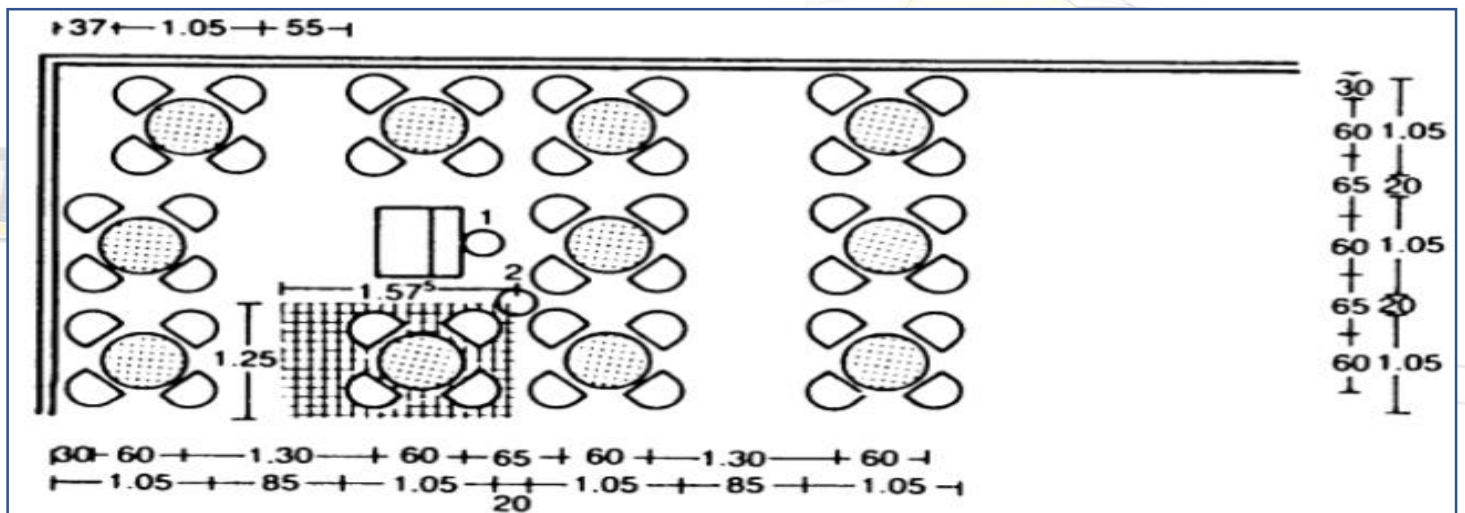
The Open cafe

The main cafe is 200 people

The area of the individual is 1.2 m 2

Total area of the cafe = 500 m 2 including the area of movement.

Bathrooms and Laundries

Bathroom area 2 m2 (bath per 75 people = 2 bathrooms)

Total area of the baths = 2 * 2 = 4 m 2

Single wash area 0.8 m 2 (laundry per 75 people = 2 laundries)

Total wash area = 2 * 0.8 = 1.6 m 2.
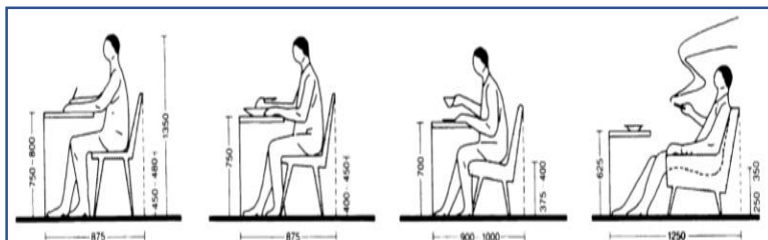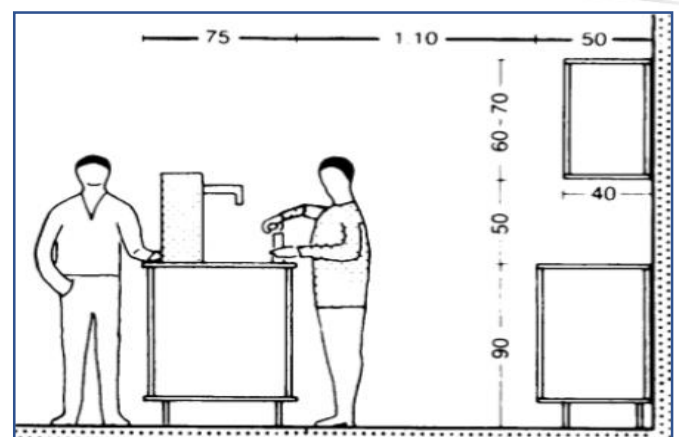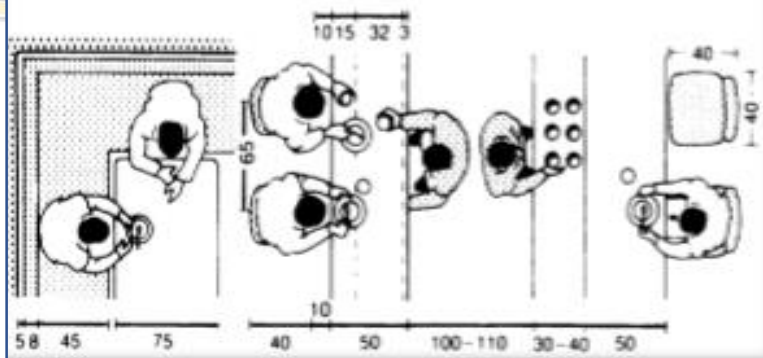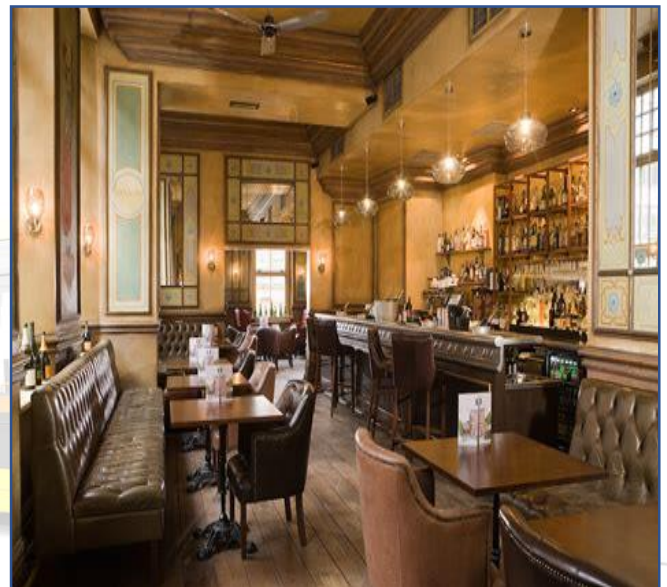
The Restaurant tram

GENERAL INFORMATION

The cost is fully inclusive of all food and beverages from our fully stocked restaurant.

Maximum size is (36 passengers per tram).

Pre-payment is required for all reservations.

Dietary requirements must be advised no later than 24 hours in advance.

Smoking is not permitted

Passengers must arrive no later than 15 minutes prior to the departure time.

	2-seater booth
	4-seater booth
	Rest room
	Kitchen
	Services
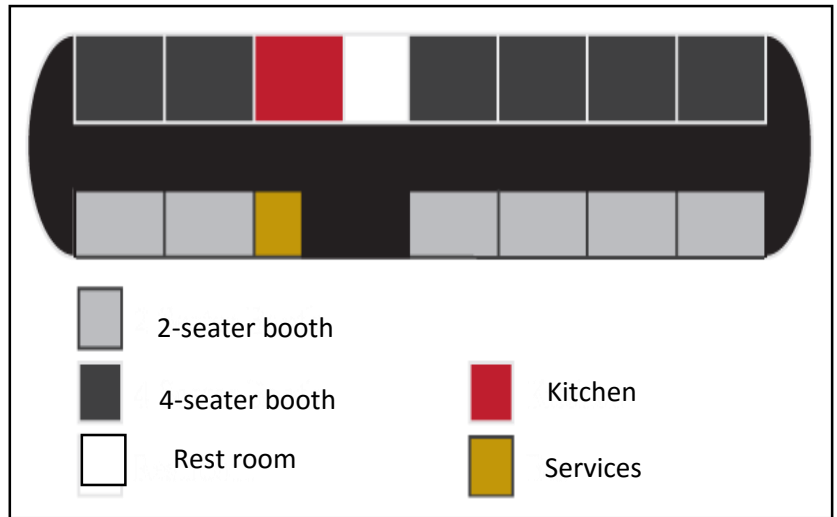
Seating Plan
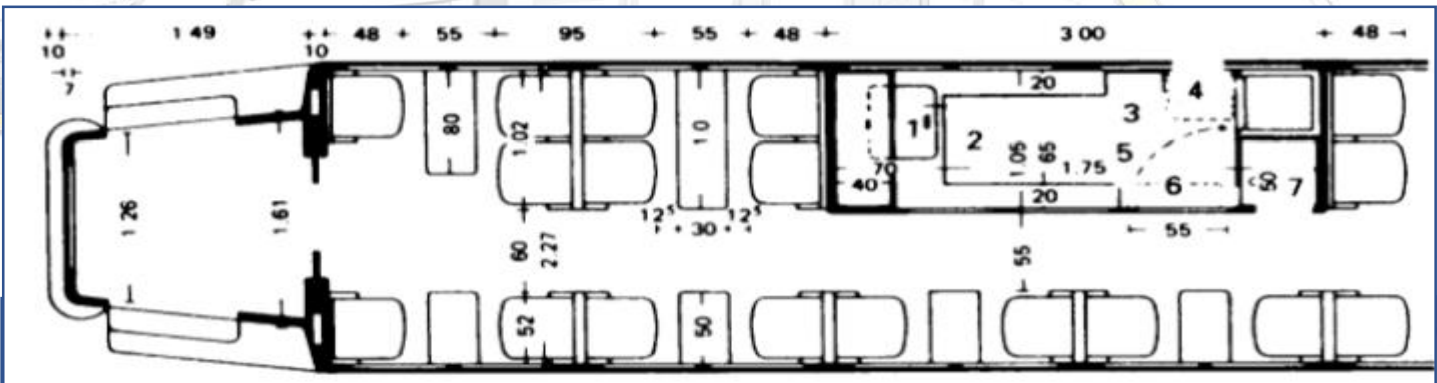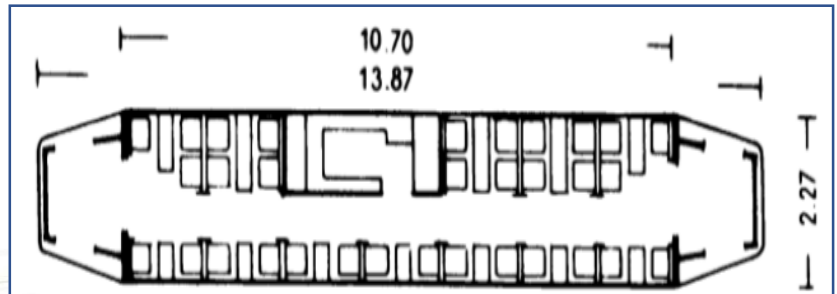
The Mall center

One of the important spaces in the station is a source of attraction for visitors and its size is calculated according to the size of the building and the number of users.

Shops and galleries sell all the needs of arrivals and departures from the station as well as visitors.

The commercial center is also usable by neighborhoods adjacent to the station.

It has shops and galleries linked to the main halls.

There is a small supermarket on the ground floor for daily food need.

<u>Calculate the area of the commercial center</u>

Shops: 40 shops (40m2 per shops).

Total area of shops = 40 * 40 = 1600 m 2.

galleries: 14 galleries (50 m2 per galleries).

Total area of galleries = 14 * 50 = 840 m 2.

Hypermarket: one hypermarket with an

area of 700 m 2.
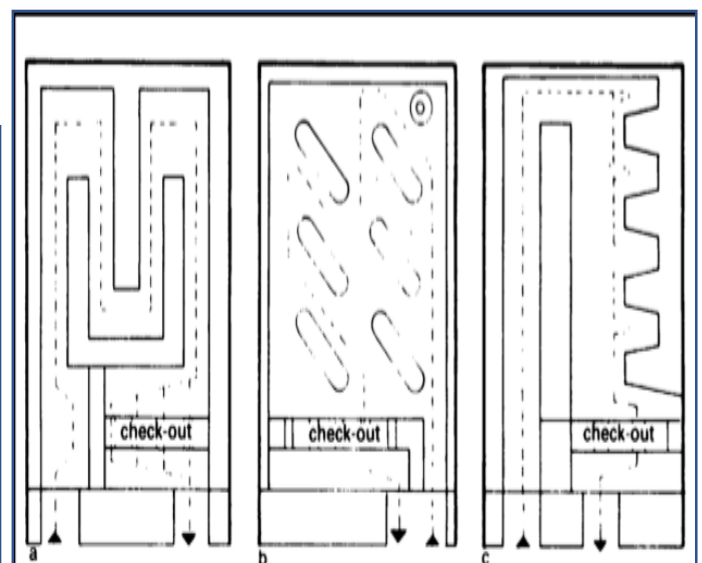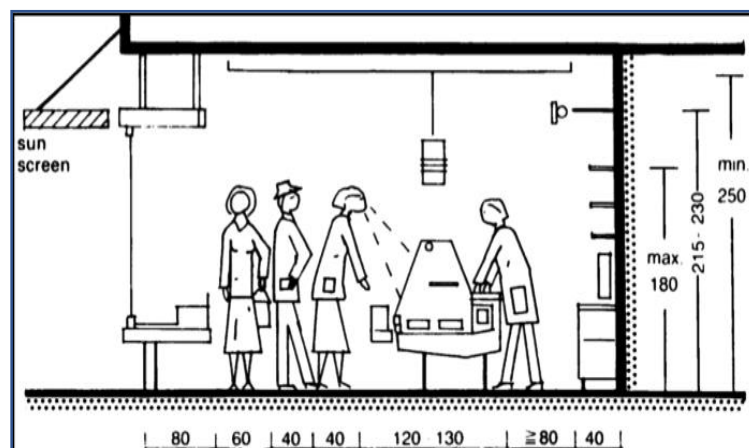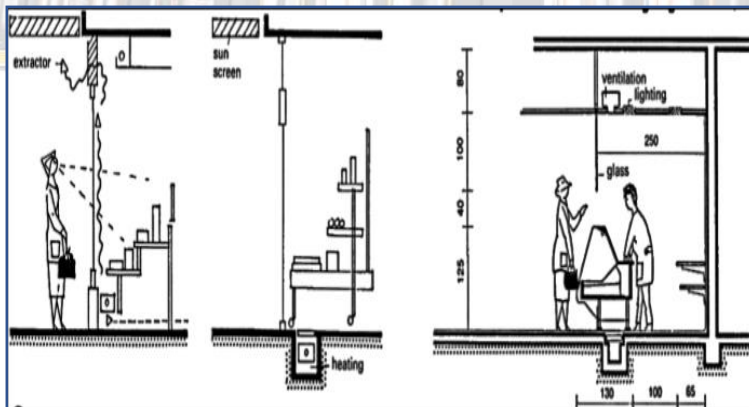
Hypermarket:

There is a small supermarket on the ground floor for daily food need.
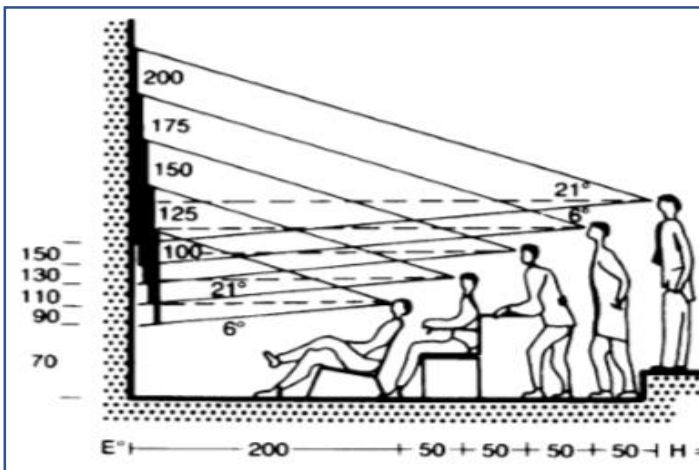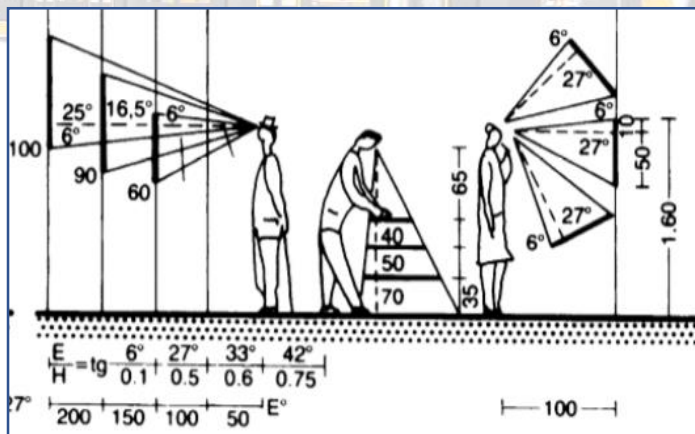
with an area of 700 m 2.
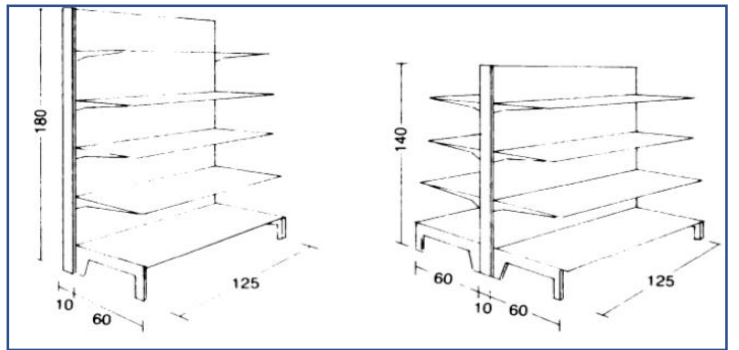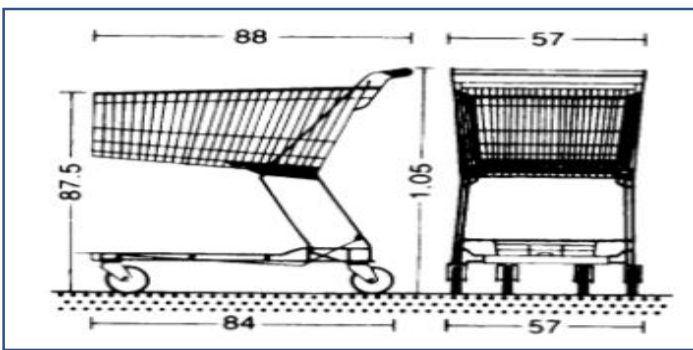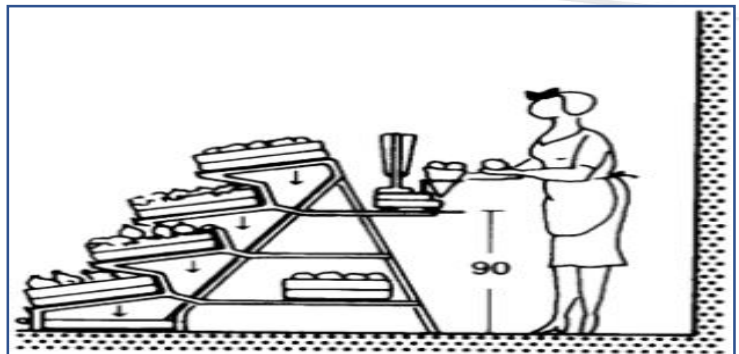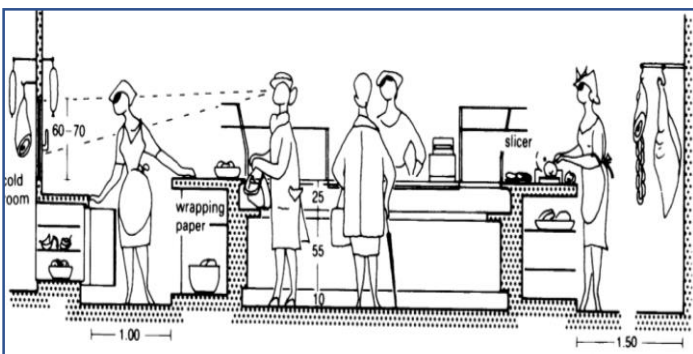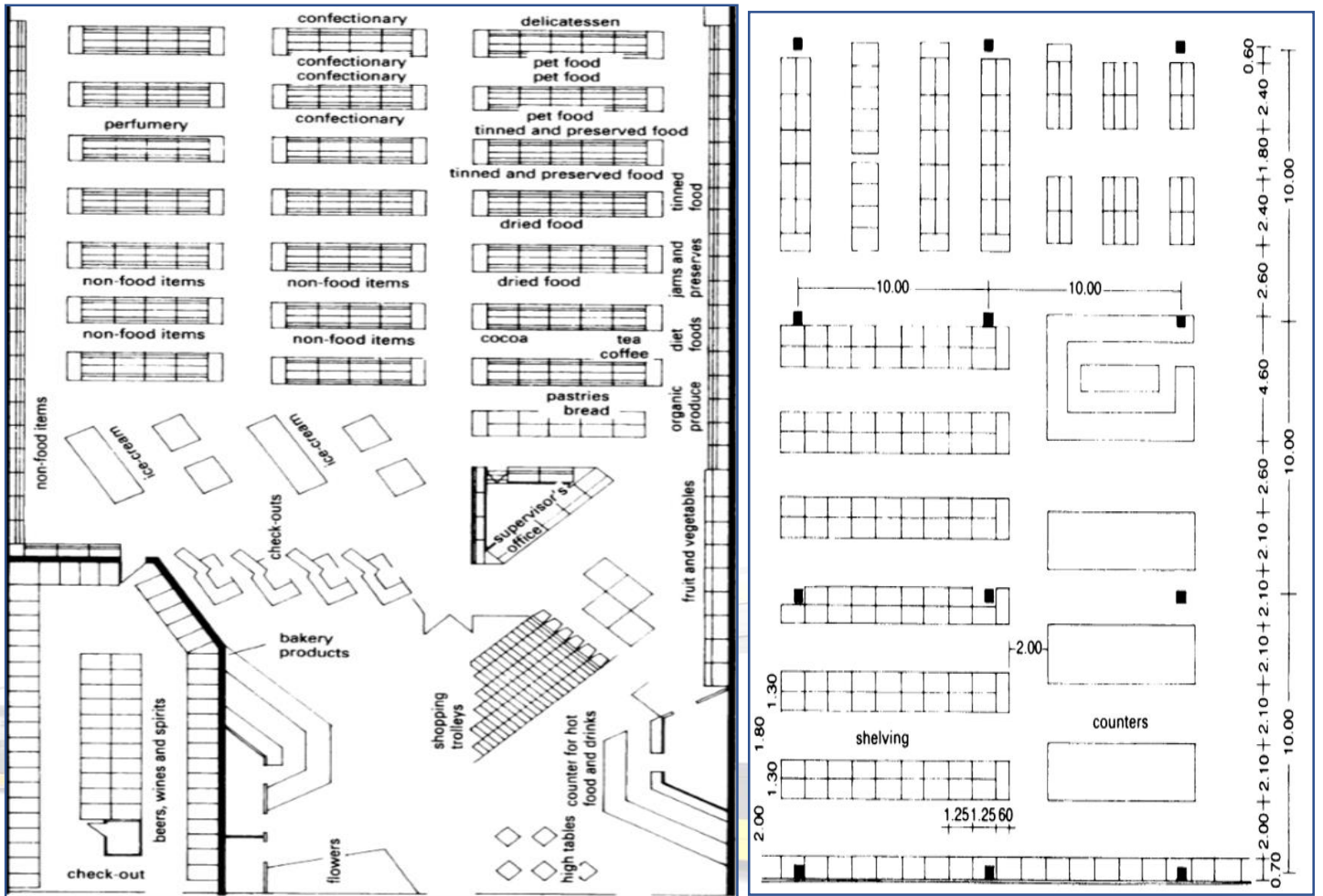
The Tourist Exhibition

Gives a profile of tourists and visitors about Sudan and the important tourist areas in Sudan by presenting three-dimensional images and miniatures of these areas with a brief history of Sudan.

The size of the individual in the exhibition = 1.6 m 2 Number of visitors =1000 visitors

Add the motion area = 2000 m 2
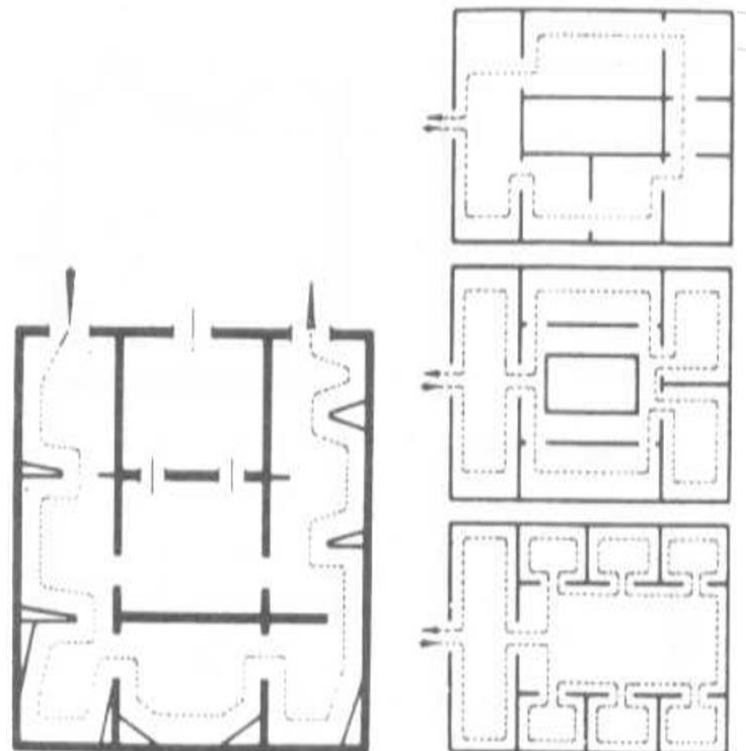
The management department

Administrative spaces are of great importance in all buildings, especially public ones, and the administration of the station is divided into 8 sections:

1/ <u>General Administration</u>: Including the Director-General, his Deputy and the Secretary.

2/ <u>Financial management:</u> Including the Chief Financial Officer, his deputy, secretary and accountants.

3/ <u>Engineering Management:</u> Including the engineering director, his deputy, the secretary and the engineers, Responsible for maintenance and repair of faults

4/ <u>Personnel Management</u>: Including the Director of Public Relations, his Deputy, the Secretary and the staff.

5/ <u>Public Relations Management:</u> Including the Director of Personnel, his deputy, the secretary and the staff responsible for all employees of the station.

6/ <u>Management of transmission lines:</u> Including the director of the movement, his deputy, the secretary and the officials responsible for the tram, bus and taxi lines.

7/ <u>Tourism Management:</u> Including a tourism manager, his deputy, secretary and tour guides.

8/ <u>Sales Management:</u> Includes sales manager and sales staff.

Study of administrative spaces

The departments include the office of a director, deputy director and secretary, as well as staff offices and a meeting room.

1/ <u>General Director Office</u>: It is better to have a closed port because it is characterized by high efficiency and privacy, there are communication devices between it and the staff.

A single space and separators are created separating the office, the sitting set, the bathroom and your private buffet with an area of 100m2.
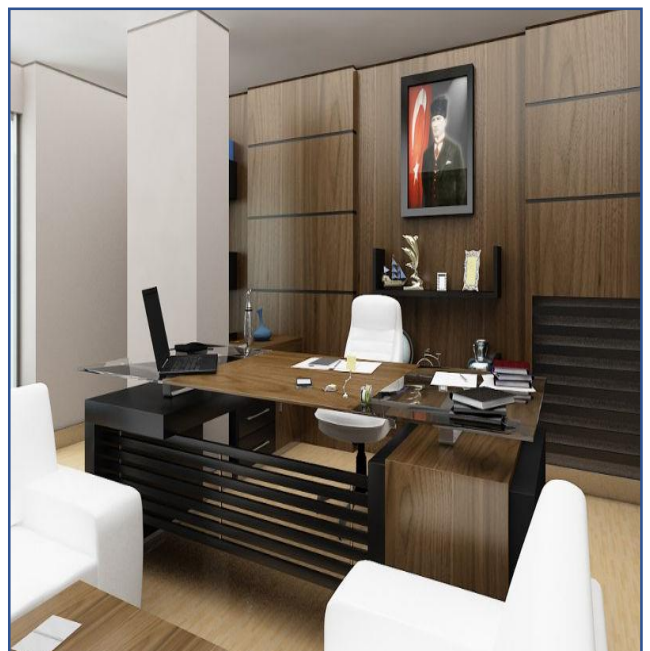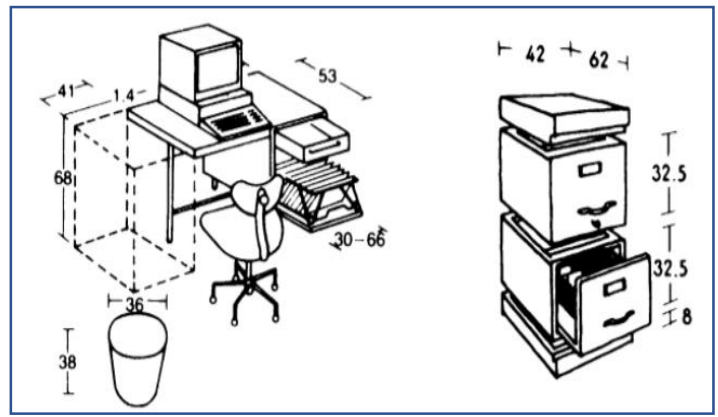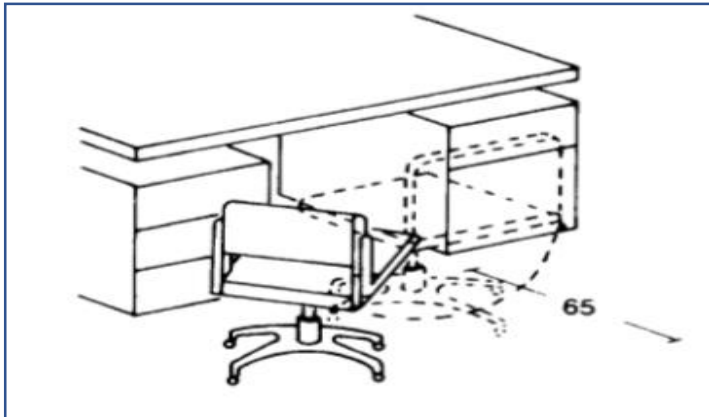
2/ Staff Office: It is best to be open-minded because it is characterized by high efficiency and ease of communication between staff, and the open project is highly flexible construction where a vacuum is created without breaks.
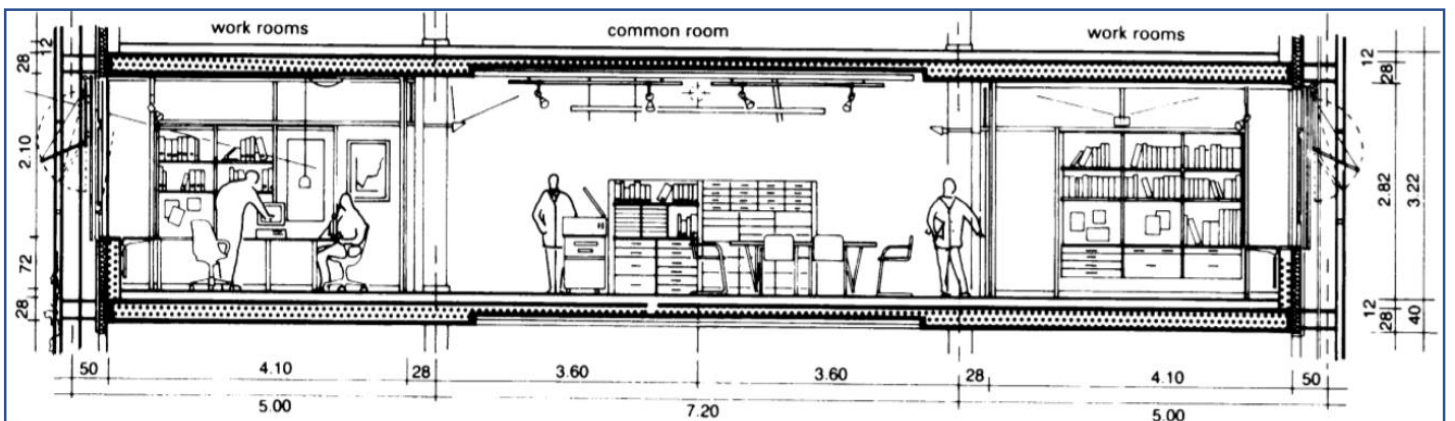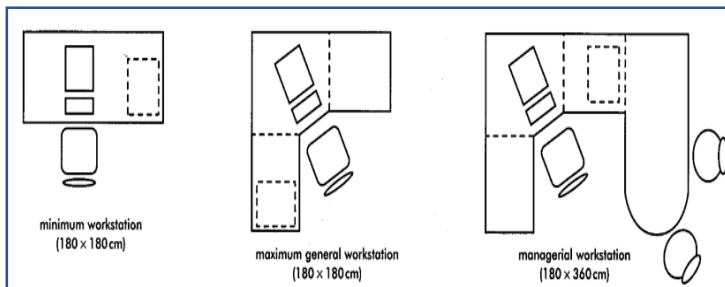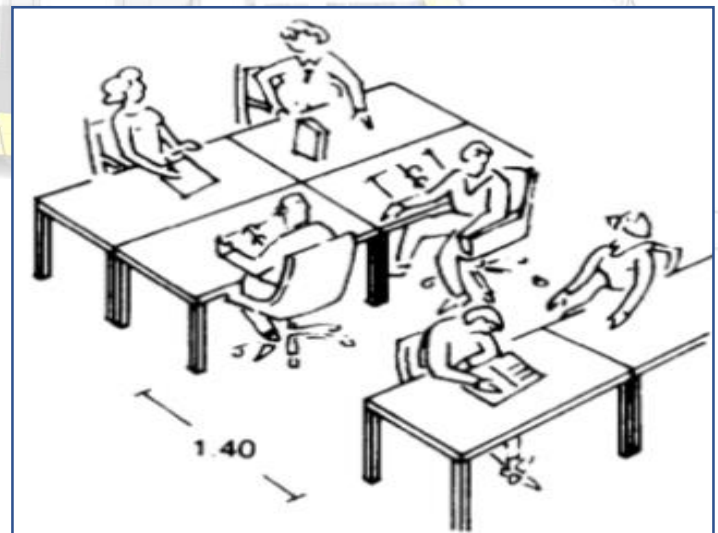
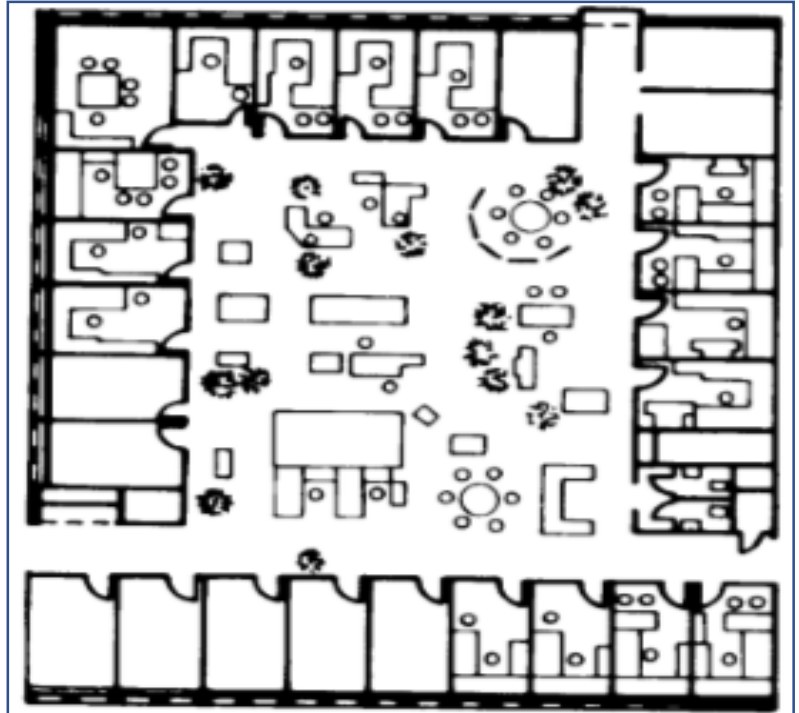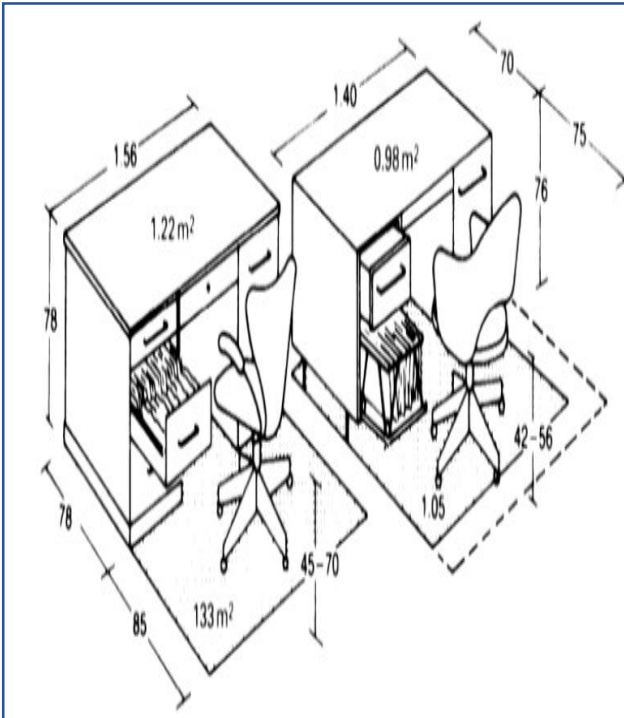Office Personnel Area in Management = 2.25 * 15 = 33.75 m 2

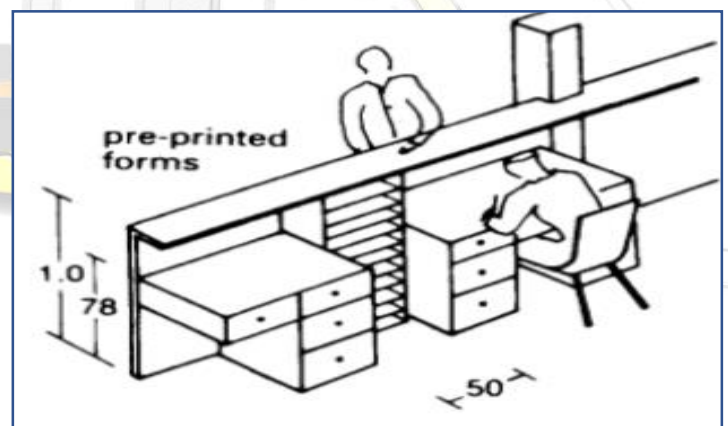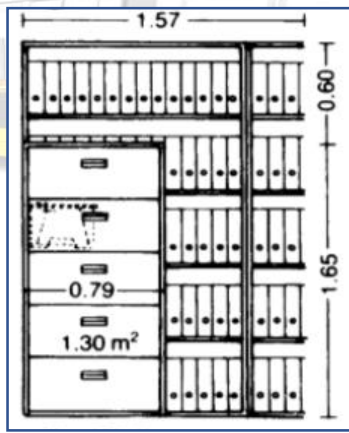In addition to the area of movement of 40% of the space = 13.5 m 2

Staff Area = 47.25 m 2.

Management has 8 staff offices

Total office space = 8 * 47.25 = 378m2

minimum workstation
(180 × 180 cm)

maximum general workstation
(180 × 180 cm)

managerial workstation
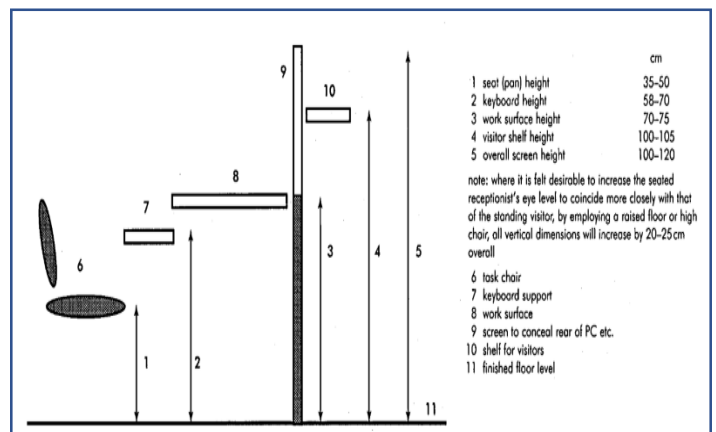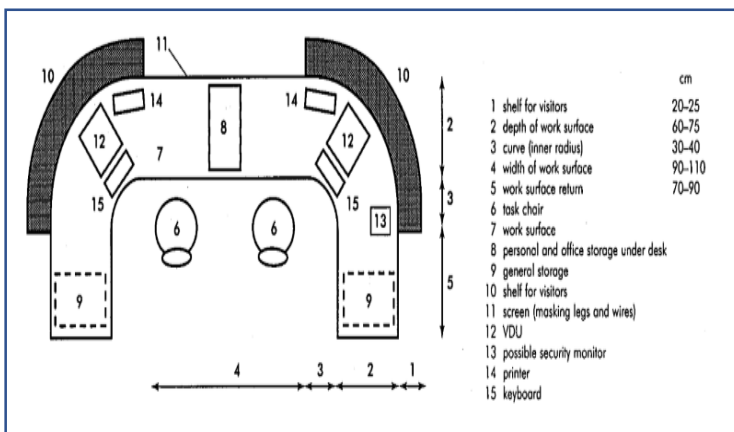(180 × 360 cm)

1.40

work rooms — common room — work rooms

3/ Archive room: The archive room is used to store important and confidential files and documents for buildings with an area of 30 m².


pre-printed forms
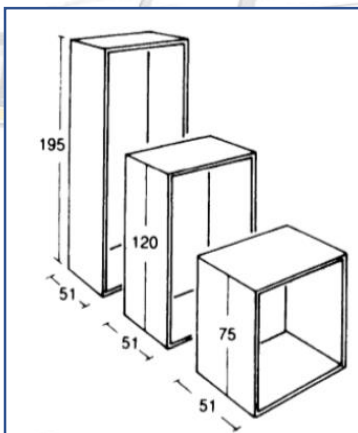
4/ Counter queries: The query counter is one for every 200 people with an area of 5.3 m 2.

	cm
1 shelf for visitors	20–25
2 depth of work surface	60–75
3 curve (inner radius)	30–40
4 width of work surface	90–110
5 work surface return	70–90
6 task chair	
7 work surface	
8 personal and office storage under desk	
9 general storage	
10 shelf for visitors	
11 screen (masking legs and wires)	
12 VDU	
13 possible security monitor	
14 printer	
15 keyboard	

	cm
1 seat (pan) height	35–50
2 keyboard height	58–70
3 work surface height	70–75
4 visitor shelf height	100–105
5 overall screen height	100–120

note: where it is felt desirable to increase the seated receptionist's eye level to coincide more closely with that of the standing visitor, by employing a raised floor or high chair, all vertical dimensions will increase by 20–25 cm overall

6 task chair
7 keyboard support
8 work surface
9 screen to conceal rear of PC etc.
10 shelf for visitors
11 finished floor level

5/ Meeting room: It is the meeting place of the administrators.

The conference room space = 50 m 2 is divided into two rooms.

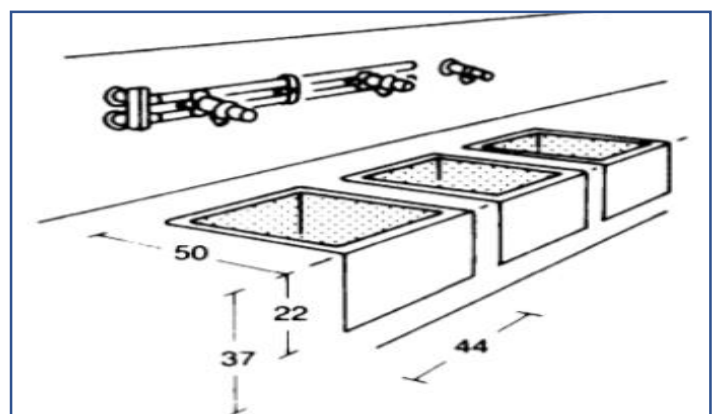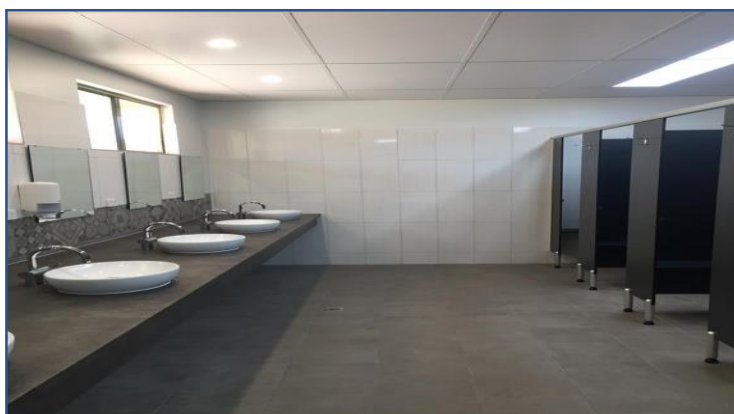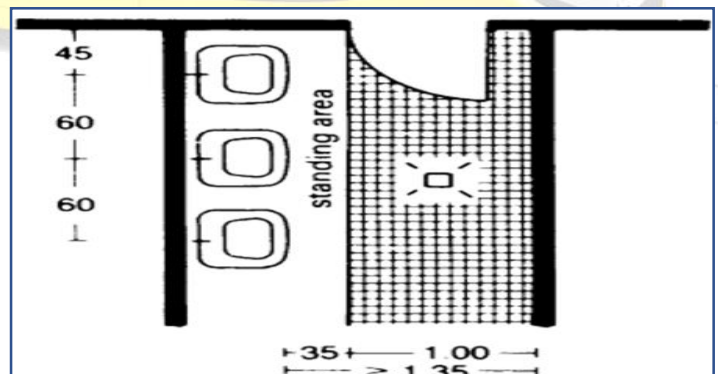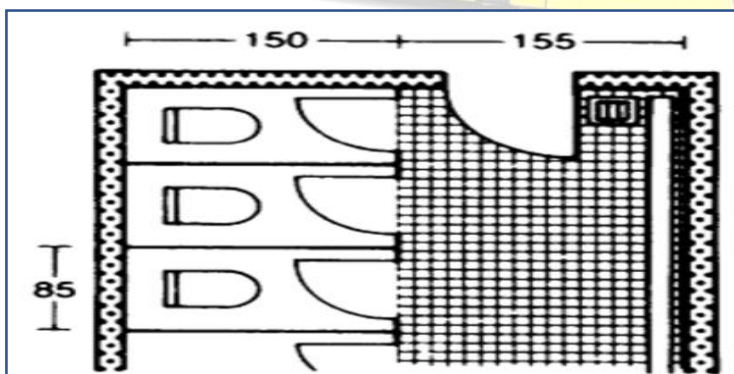formal meetings – rectangular table
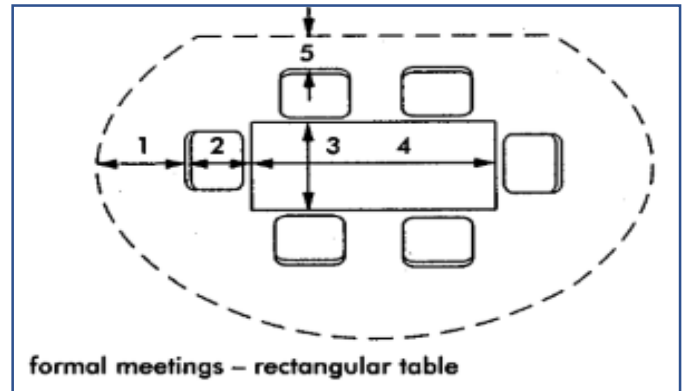
		(cm)
1	circulation space	65–75
2	conference chair	50–70
3	table width	90–120
4	table length	200–250
5	distance to wall	10–30

Bathrooms

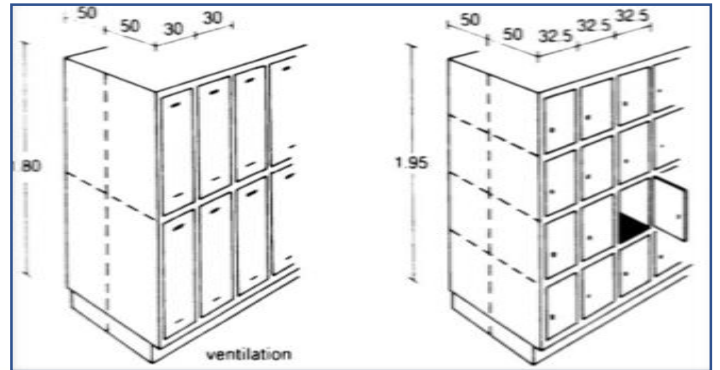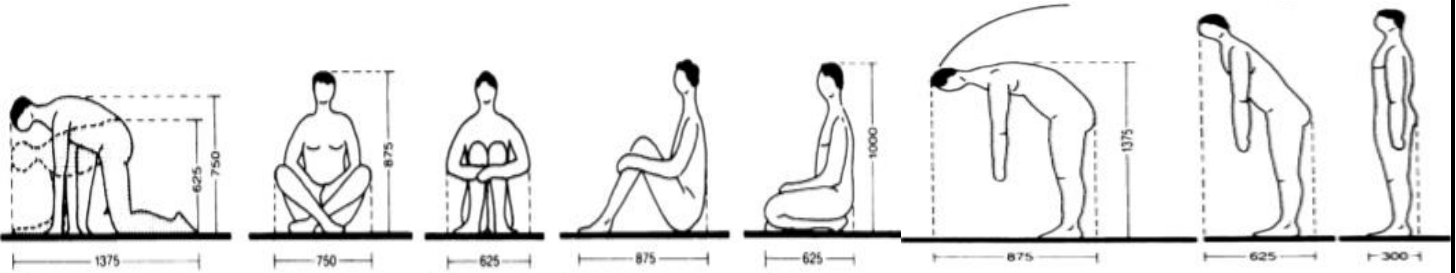One of the most important services in public buildings.

One toilet per 75 people.

Chapel prayer

One of the most important services in public buildings

With an area of 140 m2 including the area of movement.

ventilation

Parking

One of the most important services in public buildings.

With an area of 12.50 m2 including the area of movement

90° parking for medium sized cars

standard car

min. opening w × h = 2.30 m × 2.00 m
max. permissible gradient 20%