A Source of Design Reference Standards

Handbook to Build an Hospital

Prepared by:

Construction Délegation

Malé _Maldives_ 20 / 08 / 06
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I. General organization of a hospital

1. Area

- A hospital has to be placed:
  - In a quiet place,
  - On a healthy and flat plot without dust, bad smells, insects…
- Some vacant places have to be planned for future extensions of the hospital.

2. Layout

- A hospital consists of several sectors:
  - Treatments, cares, examination,
  - Administration,
  - Technical and storage zones,
  - Waste water discharge,
  - Hotel,
  - External areas: park and parking.
- There are two main types of building layouts:
  - Wings/Pavilions for specialized sectors,
  - A central space and rays.
- It is necessary:
  - To differentiate main sectors/annexes/circulation passages,
  - To separate hospitalized patients and other patients,
  - To minimize distances between services.
- Note that:
  - A park is required for acoustic isolation of rooms,
  - A maximal partition in isolated sections is required.

3. Plot orientation (in the northern hemisphere)

- Treatment zones and storage locals: in the North, North-West or North-East.
• Patients’ rooms: in the South or South-East.
• However, few patients’ rooms have to be placed in the North (no direct sun light).

4. Number of beds and dimensioning of the hospital

• The required number of beds depends on the number of inhabitants.

• Number of patients in one year for 1 000 inhabitants:
  - 200 in all hospitals,
  - 174 in emergency hospitals,
  - 26 in specialized hospitals.

• Number of beds for 1 000 inhabitants:
  - 11 in all hospitals,
  - 8 in emergency hospitals,
  - 4 in specialized hospitals.

• Average duration of hospitalization:
  - 18 days in all hospitals,
  - 14 days in emergency hospitals,
  - 49 days in specialized hospitals.

• Required area/volume for one bed (for the whole built area/volume including annexes, technical and storage rooms):
  - Area: from 70 m² to 100 m²,
  - Volume: from 200 m³ to 280 m³.

• Area sharing in a common hospital (advised):
  Ea= effective area

<table>
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<tr>
<th>Area Description</th>
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<th>Volume Range</th>
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<td>Supplying/ discharging</td>
<td>30-50 m² (ea per bed)</td>
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<tr>
<td>Cares</td>
<td>19-25 m² (ea per bed)</td>
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<td>Intensive treatment</td>
<td>30-40 m² (ea per bed)</td>
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<td>Operating wings</td>
<td>130-160 m² (ea per wing)</td>
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<td>Radiology</td>
<td>60-70 m² (ea per unit)</td>
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<td>Waking units</td>
<td>25-30 m² (ea per bed)</td>
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<tr>
<td>Reception</td>
<td>140-160 m² (ea per unit)</td>
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<tr>
<td>Maternity unit</td>
<td>85-100 m² (ea per bed)</td>
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<tr>
<td>Specialized services</td>
<td>55-75 m² (ea per unit)</td>
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5. Connections between services

Interdependent services have to be close to each others:

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● Short and required connection
+ Short and useful connection
☐ Advised connection

6. Entrances

- Main entrance:
  - Only one main entrance,
  - Secondary entrances have to be pointed out apart (hygiene measures).

- Entrance hall:
  - Conceived as a waiting room for visitors (principle of open doors),
  - Like a hotel hall,
  - Its size depends of number of beds,
  - Different ways (for patients, visitors, staff) separated from the entrance hall,
  - Reception (12 m²): with a reception desk to supervise entrances and circulation ways.

- Entrances for laying patients:
  - For admission, a closed hall and an entrance slope are required; they have to be separated from the entrance hall but visible from the reception,
  - Short connections with emergencies separated from main circulation ways are required.
7. Circulation

- Circulation ways have to be dimensioned for the most important circulation.
  - Access passages: 1.5m wide,
  - Passages for lying patients’ transfer: 2.25m wide minimum,
  - Ceilings in passages: 2.40m high minimum,
  - Maximal distance between two windows in a passage way: 25m,
  - Width of passage ways mustn’t be reduced by any object or post,
  - According to the regulations fire doors are required in passage ways.

- Doors:
  - Coverings have to be resistant to the maintenance and disinfectant products.
  - The same sound insulation as the one for walls is required: a leaf with two walls can absorb noises up to 27 dB minimum.
  - Height of doors: 2.1-2.2m,
  - Height of over designed doors for cars: 2.5m,
  - Height of doors for the passage of transport vehicles: 2.7-2.8m,
  - Minimal height of doors for access to a hall for lying people: 3.5m.

8. Circulation for handicapped people

- Circulation in a wheelchair requires a specific design of the circulation ways (Picture 1)
  - Passages: 1.30m wide minimum, better if 2m wide,
  - Doors: 0.95m wide minimum, a magnetic closure is advised,
  - Switches, handles, windows closure... have to be within easy reach: 1-1.05m high,
  - Wide pushbuttons are required,
  - Access ways: 1.20-2m wide,
  - Slopes: 5% maximum, 6m long maximum,
  - Width between handrails: 1.20m.

- Connections have to be as short as possible.

9. Duration of use

- Equipment and second work have to be changed every 10-15 years.
  So a sufficient space has to be planned for assembling and dismantling.
Picture 1: Specific design of circulation ways for handicapped people
II. Specialized services

1. Surgical services

- Localization:
  - Generally speaking surgical units have a central localization in the hospital.
  - Surgical services have to be placed close to emergencies, intensive cares services, waking units and sterilization services. Short connections between those services are required, particularly with emergencies units.
  - Hygiene standards require a disconnection between surgical units and other services: tambours are advised for this separation.

- Organization of a surgical unit: (Picture 2)
  - Operating room: 40-48 m²
  - Ante-operating room: 15-20 m²
  - Post-operating room: 15-20 m²
  - Cleaning room: 12-15 m²
  - Implement room: 10-15 m²

- Are required:
  - A airlock for staff,
  - A airlock for patients,
  - Sterilized passages for work,
  - An anesthesia local,
  - A airlock for distribution and evacuation,
  - A local for nurses,
  - A waiting room,
  - A waking room.

- 35 m² more are required (in the airlock for patients if possible) for:
  - Changing of beds,
  - Preparation and storage of operating tables,
  - Washbasins.

- A two-passage circulation: (Picture 3)
  - A separation between different working units is required to reduce germs transmission,
  - A separation between circulation of non-sterilized and sterilized patients and implements is also required.
Picture 3: Surgical wings
Picture 4: Operating lamp, mobile ceiling fixture

Picture 5: Sterilization unit
• Operating room:
  - A squared room is advised,
  - Height of artificial lighting: 3m +0.7m for ventilation and electric fittings,
  - Shades are required,
  - Safety electrical supply: 1.20m above the floor minimum,
  - Operating rooms have to be fit with a mobile ceiling fixture (Picture 4),
  - Uniformly smooth and easily washable walls and floors.

• Post-operating room:
  - 3.80 m x 3.80 m
  - Fit up like the ante-operating room: a refrigerator, washtubs, cupboards, connectors for anesthesia implements, a safety generator,
  - A pivoted door, 1.25m wide, opening on the working passage,
  - A sliding door with a glazed oculus and an electrical control, opening on the operating room, 1.40m wide, is required.

• Local for sterilized implements:
  - 10 m² fit up with shelves,
  - A direct connection with the operating room is advised.

• Apparatus room:
  - 20 m², close to the operating room,
  - A direct connection is advised.

• Sterilization room: (Picture 5)
  - A direct connection with the operating room is required,
  - Two different sides are required: a non-sterilized side with non sterilized implements and a sterilized one,
  - Fit up with a sink, working and storage areas.

• Plaster casts room:
  - For hygiene standards: not localized in the operating unit, but in cares services,
  - In case of emergency, the patient has to go through a airlock to enter the operating room.

• Waking room:
  - It is advised to avoid a too important proximity between beds,
  - A bed has to be accessible on 3 sides for the anesthetist and care apparatus,
  - Supply in vacuum, oxygen and electricity is required,
  - Several doors between the waking room and the operating one are required.
2. Postoperative cares – watching of patients

- **Waking room:**
  - This room has to be planned for receiving patients from different operating units,
  - Number of beds: 1.5 x number of operating rooms,
  - Natural lighting is required for the patient,
  - An annexed room is required for nurses (fit up with a sink and a large pane for observation of patients).

- **Nurses local:**
  - The area depends on the size of surgical services,
  - 8 persons per operating team,
  - Fit up with cupboards, sinks and chairs.

- **Office of the head of nurses:**
  - A central localization is required,
  - It has to be glazed on the passage way,
  - Fit up with a board and a cupboard,
  - An annexed local for debriefings can be planned (5 m²)

- **Medicines local:**
  - Revolving shelves are advised for storing medicines.

- **Cleaning local:**
  - 5 m², close to the operating room,
  - An area for disinfected beds is required.
  - An area close to the patients’ tambour has to be planned for preparing disinfected beds and storing a clean bed per operating room.

- **Annexes :**
  - They have to be served by proper passages that aren’t designed for patients’ circulation.
  - In annexes: sliding doors, 1m wide.

- **Toilets**
  - Only in the airlock area, not in the operating room for hygiene standard.

3. Intensive cares

- **Organization of intensive cares units:**
  - A airlock,
  - A room for registration and administration,
  - A secretary’s office: nurses have to watch the arrival of patients, medicines…
  - Cares units,
- Annexes and staff rooms.

- For one care unit:
  - 6-10 beds,
  - An office for nurses,
  - A care room (to prepare medicines),
  - A local for apparatus,
  - In general: 1 chamber for 2-3 beds with visual partition between beds.

- Annexes:
  - An operating room (for slight operations): 25-30 m²
  - A laboratory,
  - A sterilization local: 20 m²
  - A local for non sterilized apparatus,
  - A local for sterilized apparatus,
  - A cleaning local.

- Hygiene standards:
  - Beds have to be accessible on 3 sides,
  - Supply in vacuum, oxygen and electricity (low and high current) is required for each bed.

4. Treatment zone including beds

- For one unit: 18-24 patients.

- Rooms:
  - With 1, 2 or 3 beds,
  - Fit up with toilets, a shower or a bath (no separated showers),
  - With natural light,
  - Beds have to be accessible on 3 sides,
  - For each bed: a bedside table, a table (90cm x 90cm), a chair and a cupboard built into the wall. This cupboard has to be opened without moving any sanitarian piece of furniture.
  - On each head of bed a supply of fluids (oxygen, pressured air, vacuum) is required,
  - A wooden or synthetic protective strip has to cover all the walls in chambers and passages,
  - An acoustic insulation (up to 32dB) is advised.

- Dimension of a room: 3.20m wide minimum
  - With 1 bed: 10 m² minimum, (Pictures 6a, b)
  - With 2 or 3 beds: 8 m² per bed, (Picture 7)
  - Each bed has to be evacuated out of the chamber without moving the other ones,
- Doors of the chambers: 1.25 x 2.13 m²; an electric closure is advised.

- In the washroom: specific design for wheelchairs:
  - Height of the dressing table: 86cm minimum
  - Height of the toilet: 49cm

  Picture 6a: Room with one bed and an entranceway.
  Picture 6b: Room with one bed, watching from the corridor.

- Shared washrooms for patients:
  - Bath with an elevator, accessible on 3 sides.

- An office for nurses:
  - Central localization,
  - Area: 25-30 m²
  - Glazed on the passage way
  - Regulated access to a local for the storage of medicines

- Sterilized local:
  - Required for a group of 6 beds,
  - Area: 8-10 m²
  - Direct access for the staff from the room,
  - Fit up with a washbasin, cupboards, and a lit desk.

- Non sterilized local:
  - Area: 10 m² minimum,
  - Fit up with cupboards.

- Technical local:
  - Area: 8 m²
  - Fit up with a secondary electric supply.
- Room for the doctor on duty:
  - Fit up for examination of patients: an examination bed and cupboards.

- Relaxation room: 15 m²
  Shared room for patients: area of 22-25 m²

5. Radiology

- This service requires a direct access from the emergencies for lying patients. It must be situated on the ground floor or at the first ground (because of weight of apparatus). It is required to minimize distances between rooms.

![Picture 8: Radiography unit.](image)

- Area of locals for sonography, mammography, jaws: 15-18 m² (Picture 8)
  Area of locals for radiography and reception: 20-30 m²
  Patients have to enter those rooms through two cabins,
  Width of doors: 1.25m,
  A supply of medical gas is required.

- Tomography local: 35 m² fit up with a computer, (Picture 8)
  Angiography local: a preparatory local fit up with a washbasin and a refrigerator (to store medicines) is advised.

- Safety standards:
- A protector covering made of lead on walls, doors and ceilings is required,
- Its characteristics depend on the apparatus.

6. Obstetrics

- An operating local is required near delivery rooms. The obstetrics service has to be separated from the units for patients after delivery and for infants.

- Organization of the obstetrics service: it consists of: (Picture 9)
  - A watching room,
  - Reception and waiting rooms,
  - Rooms for pre-delivery,
  - Delivery rooms (fit up with a bash for patients),
  - An operating room (12 m²) has to be near delivery rooms,
  - A sterilized local (12 m²),
  - A non sterilized local (12 m²),
  - A registration office (12 m²),
  - A living room for the staff (15 m²),
  - A local for midwives (20 m²),
  - Toilets.

7. Maternity unit

- Temperature: 24-26°C,
- Ventilation: renewal of 8 volumes per hour,

- In care units for children and infants:
  - A safety system on each window is required,
  - Electric installations and radiators have to be secured,
  - Floors and walls (up to 1.50m) have to be easily washable.
8. Laboratories

- They are designed for blood samples and analysis of those samples.

- They consist of:
  - Locals for rinse, disinfecting, preparation of sterilized implements,
  - A storage room,
  - A cold room,
  - A meeting room,
  - A waiting room,
  - An administration office.

- For microbiology: independent unit or access through a tambour.
- All rooms ought to be lit with natural light.
- Rooms with microscopes have to be orientated northern.
- Width of doors: 1m minimum.
9. Examination unit

- It consists of: (Picture 11)
  - Examinations rooms: 15 m², access through cabins (Picture 10)
  - An administration office,
  - A waiting room,
  - A storage local.

- Flexibility of this unit is advised for a later extension

10. Dairy hospital

- For patients hospitalized only for one day.
- A special entrance, a hall and a reception desk are required for these patients. (Pictures 12, 13)
Picture 13: Daily hospital

Clinique chirurgicale de jour de Lippstadt
Arch. U. et A. Weicken
III. Safety standards

1. Electrical installation

- 220V for normal current,
- 380V for high current,
- At least two isolated transformer sections with antivibratil functions are required.

In surgical wings:
- Safety electrical supply: 1.20m above the floor minimum,
- extra accumulators for electricity supply and emergency power supply,
- Have to work continually:
  - One operating lamp/ceiling fixture in each operating room for 3 hours minimum,
  - Devices to maintain vital bodily functions.

2. Gas installation

- Pumps for Oxygen, Nitrogen, vacuum and pressured air have to be installed in double.
- Oxygen: supplying with air stored in steel bottles out of battery with an automatic switch.

3. Lighting

- Lighting standards in hospitals:
  - Luminosity of 1000 lx in operating rooms,
  - Luminosity of 500 lx in annexes.

- Operating rooms have to be fit with a mobile ceiling fixture.

4. Ventilation

- Filtering, dilution and extraction of air,
- Renewal: 15-20volumes for one hour.
- It is required to consult safety measures for ventilation ducts

- Any uncontrolled air current can’t enter the operating room by:
  - A hermetically sealed closure of the room
- Keeping an overpressure in the room.

- High pressure: in the operating room to take the air away from the room, Low pressure: in annexes.

5. Sanitarian installations

- For horizontal water network: looped pipes are advised
- Water distribution pipes should be put in the **plenum of the suspended ceiling**, to make future transformations easier.
- Water preparation is centralized except for specific services (sterilization…).
- Water quantity per bed and per day: 400-450 L.

6. Airlocks

- A airlock is a specific zone situated between care areas and examination zones.

- There are different types of airlocks: *(Picture 14)*
  - Airlock for patients is required to separate sterilized and not sterilized rooms (1. 2)
  - A airlock for staff: (3 – 8)
    - One airlock per gender,
    - It is an access to care zones,
    - Two rooms inside:
      - A ‘dirty’ room = **cloakroom** and showers,
      - A ‘clean’ room = to put on operating clothes,
  - A airlock for supplying and discharge, (9)
    - It can be used as a dump room,
    - Passage through this type of airlock is forbidden,
  - Airlock s in front of intensive care zones to disinfect implements. (12)

- Hygiene standards require a disconnection between surgical units and other services: airlocks are advised for this separation.
7. Sterilization zone

- It has to be close to specialized services.
- It is advised not to place it in operating sector [green zone].

8. Storage locals for anesthesia products

- In those locals explosives and inflammable products are stored.
- Electrical fittings have to be installed 1.20m minimum above the floor.
- Those locals can't have any connections with anesthesia, delivery and operating rooms.

- It is required:
  - To avoid materials with a high electrostatic charge,
  - To use conductors materials (conductor rubber),
  - To cover the floor with a conductor covering,
  - To keep the rate of air humidity between 60 and 65%.

9. Radiology units:

- It is required to respect safety standards (depending on apparatus) to define thickness and rate of lead in protecting covering on walls, floors and doors to absorb radiations.
10. Supplying

- Supplying on the Northern side of the hospital is advised.

- It consists of supplying with:
  - Medicines,
  - Beds and sheets,
  - Technical material.

- On this side it is advised to put also:
  - The heating system,
  - The gas power station,
  - The waste water discharge system.
IV. Index for French speakers

- Waste water discharge: evacuation des eaux usées
- leaf with two walls: porte a double vantail
- magnetic closure: fermeture magnétique
- handrail: main courante
- second work: second oeuvre
- tambour: sas
- Washbasin: évier
- Pivot door: porte pivotante
- sliding door: porte coulissante
- Plaster casts room: salle des plâtres
- Revolving shelves: dispositif de rayonnage tournant
- isolated transformer section with antivibratile functions: transformateur électrique isolé avec fonction antivibratile
- operating lamp/ceiling fixture: plafonnier
- hermetically sealed closure: fermeture hermétique
- mobile ceiling fixture: plafonnier scyalitique mobile
- the plenum of the suspended ceiling: plenum (espace vide) d’un plafond suspendu
- cloakroom: vestiaire
- conductor rubber: caoutchouc conductible
- conductor covering: revêtement conductible
- lead: plomb

V. Bibliography

- Data and plans come from:
  Les éléments et projets de construction (8e édition) – Ernst NEUFERT
  Editions DUNOD

- Report written by Amélie PIERDAIT