Hospital Engineering Services

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Introduction

- The engineering services of a healthcare facility support the delivery of patient care and help to maintain a healing and safe environment.
- Engineering services are integral part of hospital infrastructure
- Engineering services account for approximately 35-40% of the capital costs in the construction of health care facilities
- The requirement for the healthcare design is that it facilitates high quality patient care for the most cost effective capital and recurrent cost

Introduction (Contd.)

- Engineering services have large contribution towards shaping the environment of care
- The goal of Environment of Care is to provide a safe, functional and supportive environment for patients, staff and visitors
- The environment of care is composed of the building, the equipment and the people

Components of Engineering Services

- Engineering services of a hospital include:
  - The civil assets - Includes:
    - Building, Roads, Storm Water Drainage, Waste water drainage, Sewage Treatment Plant
  - Electricity supply
  - Water supply including plumbing and fixture
  - Steam supply
  - Acoustics and Lighting

Components of Engineering Services

- Piped medical gas and vacuum system (PMGV)
- Air conditioning and refrigeration
- Lifts, pneumatic tube system and dumbwaiters
- Public health services
  - Solid Waste Disposal System
- Communication system, paging, CCTV
- Building management system
- Workshop facilities for repair and maintenance

Civil Assets

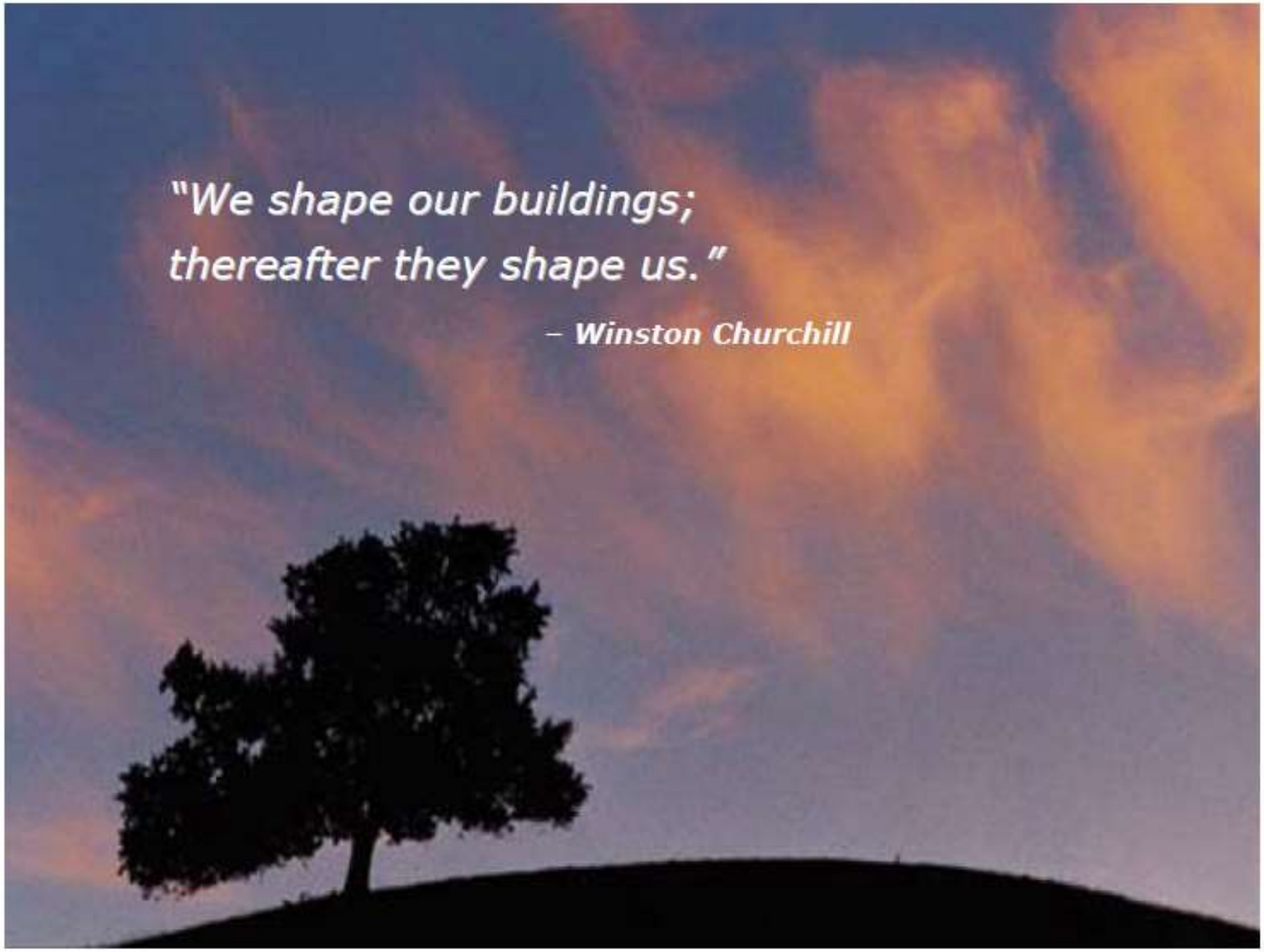
- Hospital building is a complex structure
  - The layout, space, circulation should conform to national and international guidelines
  - The form of the building should follow function
  - The design and construction of the building should be environmentally sustainable
  - It should provide a safe, patient friendly and healing environment
  - The design should be evidenced based

What's wrong with the pictures?

(Pictures follow)


7th Floor
Surgical Department
← 701-714
7th Floor
Surgical Department
715-729 →


Hill-Rom


"We shape our buildings;
thereafter they shape us."
– Winston Churchill

Communication

- Communication services required are:
  - Assistance Call system
  - Building services monitoring
  - Data Communication
  - Door call
  - Radio paging
  - Public Address
  - Duress Alarm System
  - Voice Communication System

Maintenance Services

- Objective of building maintenance is to provide an optimum medical and operational environment at all times
- The maintenance service may be in-house or outsourced with an on-call repair service
- Following areas require 24 hour per day, 7 day per week on-call maintenance service:
  - Medical gases and suction system
  - Lifts

Maintenance Services

- Fire systems
- Bio-electronic equipment
- Any life-support systems
- Boiler plant
- Telecommunication system including:
  - Paging
  - Emergency warning and Intercommunication system
  - Nurse call

Electrical Services

- Electricity is vital to hospital operation and patient safety
- Electrical services shall include:
  - Provision of normal, vital (30 sec.), instantaneous (1 sec.), and uninterruptible (no break) electricity supplies
  - Switchgear and circuit protection to safely operate and control the supplies

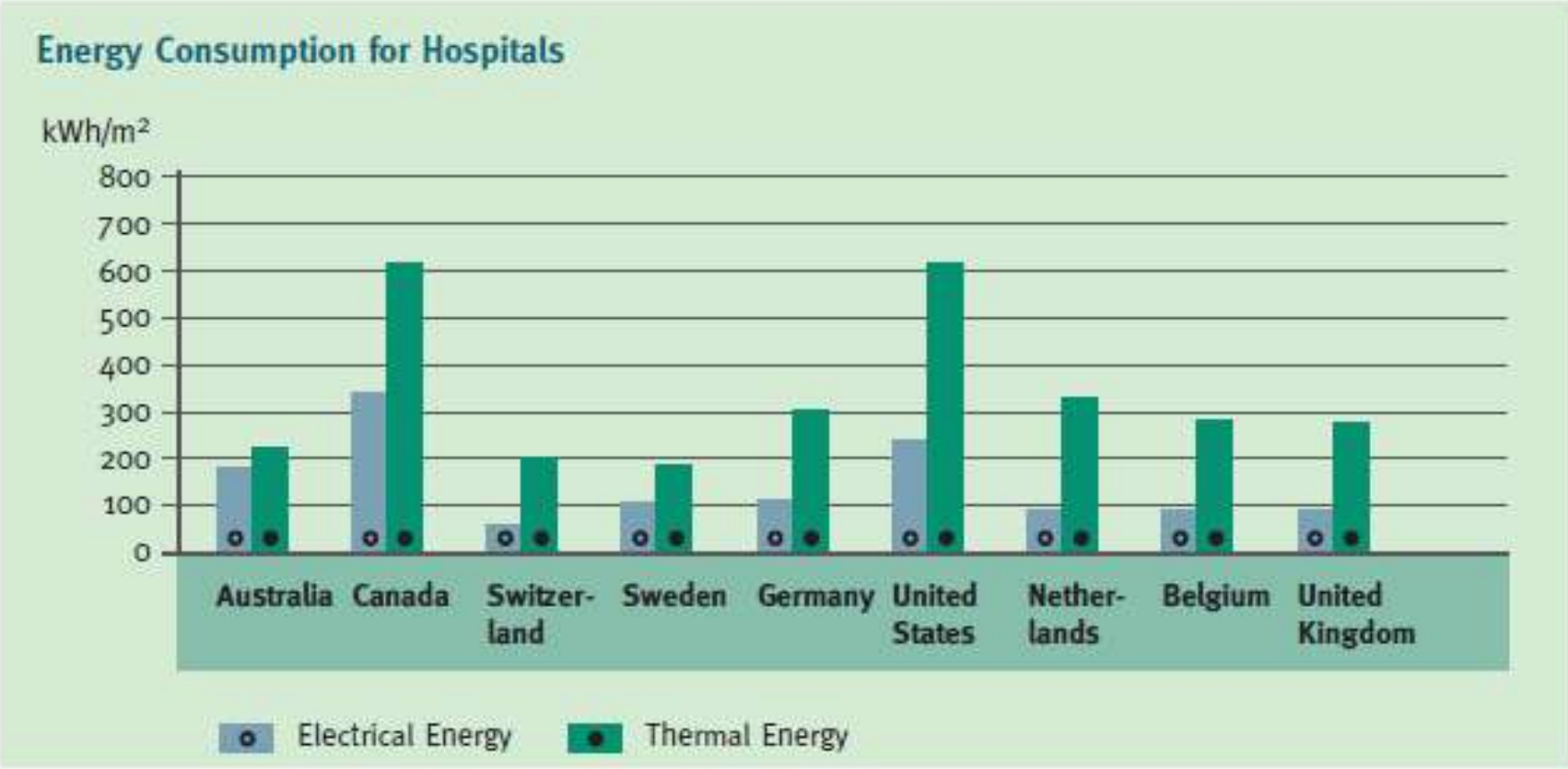


Figure 2.6 Energy consumption for hospitals (kWh/m²)

6 Energy Information Administration, 1995 Commercial Buildings Energy Consumption and DOE www.eia.doe.gov, Joelle Davis Michaels

7 Center for the Analysis and Dissemination of Demonstrated Energy Technologies CADDET, Energy Efficiency Organization Study on Hospitals Maxi Brochures

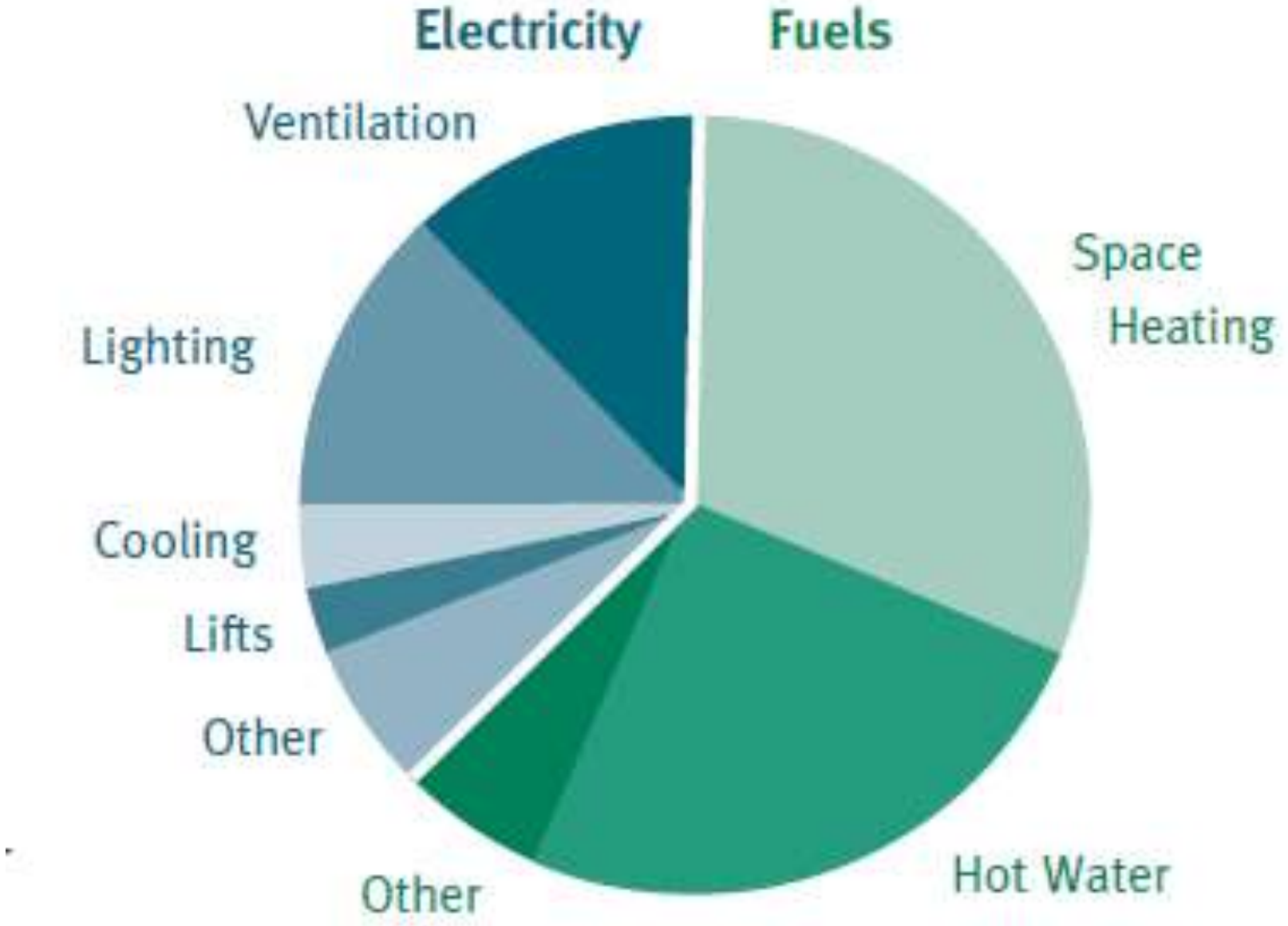


Figure 2.7 Hospital energy consumption by major applications [8]

Electrical Services

- Distribution arrangements to supply electricity to each end use
- Equipment to transform and condition voltage from supply voltage to end use voltage and within voltage and frequency tolerances
- Equipment to use the electricity for lighting, heating and motive power

Electrical Services

- High Voltage Installation
  - Where there are high voltage transformers and switch gear on site it shall:
    - Either be housed in buildings or structures remote from patient areas or be located in a fire isolated part of the main building
    - Only be accessible to authorised persons
    - Provided with instantaneous lighting served from the vital electricity supply
    - Provided with instantaneous power to control switching served from the vital electricity supply

Electrical Services

- Earthing
  - There shall be an earthing diagram mounted in the main switch room
  - This shall identify the earthing arrangement of the system and
  - Earth resistance parameters to be achieved

Electrical Services

- Cabling
  - Cabling should have a 25% spare capacity above the calculated maximum demand
  - Cabling shall be located so as not interfere with medical equipment sensitive to magnetic fields
  - Cabling carrying heavy loads should not be located adjacent to ICU, OT, and similar areas where electro-cardiograph-monitoring equipment is to be operated

Electrical Services

- Emergency / Vital (30 second) Electricity Supply
  - Generators should have fuel supply arrangements that will keep them in operation for the longest credible normal supply outage
  - Be installed in an environment where they can be serviced and maintained in the most unfavourable conditions

Electrical Services

- Instantaneous and Uninterruptible Electricity Supplies
  - The following lighting to be connected:
    - Fixed Surgical Luminairs
    - Procedure Room Examination Light
    - Birth Room Examination Lights
    - Emergency Evacuation and Exit Lights
    - PABX, Paging, Alarm and Call System Supplies

Engineering Services, Fire

- Fire services shall be provided to comply with requirements of National Building Code, 2005
- These shall include (but not limited to):
  - Provision of materials and methods of construction to comply with codes and regulations
  - Compartmentation of the buildings into fire and smoke compartments

Engineering Services, Fire

- Provision of complying fire egress arrangements
- Provision of fire and smoke alarms
- Storage arrangements for fire fighting water
- Fire fighting water pressure boosting arrangements
- Provision of smoke clearing ventilation
- Provision of escape route air pressurisation
- Provision of hose reel and hydrant fire extinguishing equipment

Engineering Services, Fire

- Provision of automatic fire extinguishing systems
- Provision of portable fire extinguishers
- Provision of equipment to aid transportation of disabled persons
- Provision of escape diagrams

Engineering Services, Hydraulic

- Extent of Services
  - Cold potable water service
  - Hot potable water service
  - Warm potable water service
  - Water filtering and conditioning equipment
  - Water storage tanks
  - Gardens and ground irrigation

Engineering Services, Hydraulic

- Bore water supplies
- Sanitary drainage service
- Process waste water discharge conditioning facilities
- Sanitary fittings and fixtures
- Roof plumbing
- Storm Water Drainage
- Sub soil drainage
- Sewage treatment facilities

Engineering Services, Hydraulic

- Drinking Water Specification (Indian Standard)
  - IS 10500: 2012
- Water requirement
  - 450 Lit per bed per day

Engineering Services - Mechanical

- Mechanical services may include but not be limited to:
  - Air cooling and heating services
  - Building automation control system
  - Energy Management System
  - Ventilation services
  - Plants and Machinery

Engineering Services - Mechanical

- Ventilation Service
  - Good ventilation is fundamental to proper hospital function
  - It shall provide breathing air free from contamination harmful to building occupants
  - Capture as close as practicable to source, any air contaminated by persons or processes within the buildings and remove it to discharge at a safe place

Engineering Services - Mechanical

- Provide special air environments for:
  - Isolation and infectious disease
  - Protection of immuno-deficient patients
  - Surgery
  - Handling sterile instruments and goods
  - Safe handling and storage of hazardous materials
  - Body holding, viewing in mortuary areas

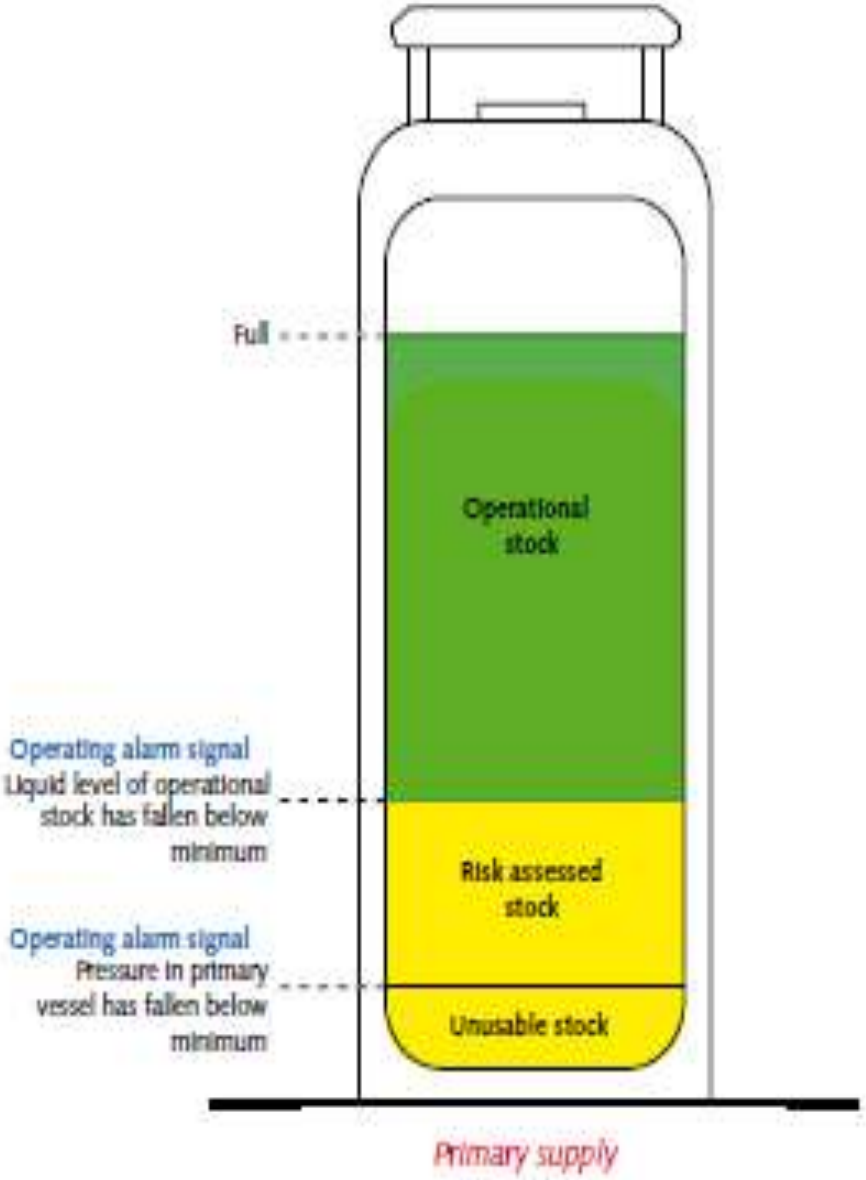
Engineering Services - Mechanical

- Provide air pressure to control outside air infiltration and provide an internal airflow gradient from clean to dirty areas and processes
- Provide air flow or pressure, in the event of fire, to prevent smoke entering escape routes

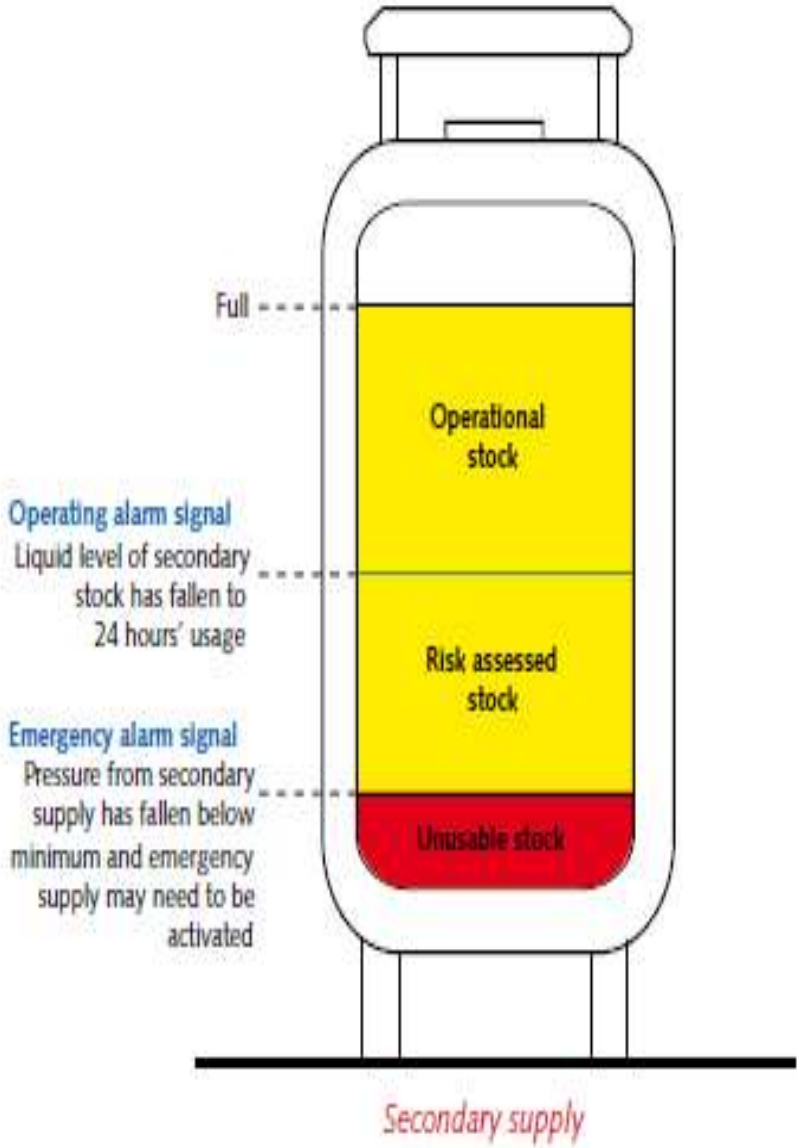
Engineering Services – Medical Gases

- Medical gas services may include but not limited to:
  - Oxygen storage and distribution
  - Nitrous oxide storage and distribution
  - Compressed air storage and distribution
  - Medical suction pumping storage and distribution

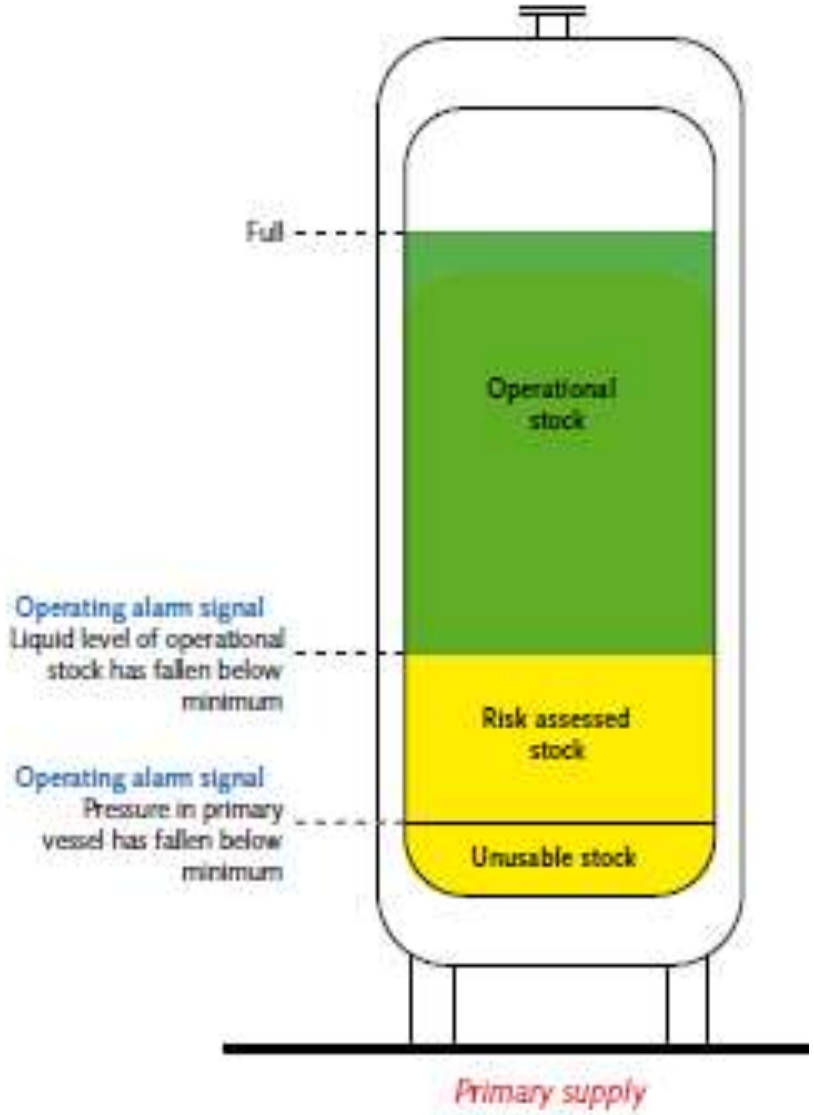
Primary supply (liquid cylinder)



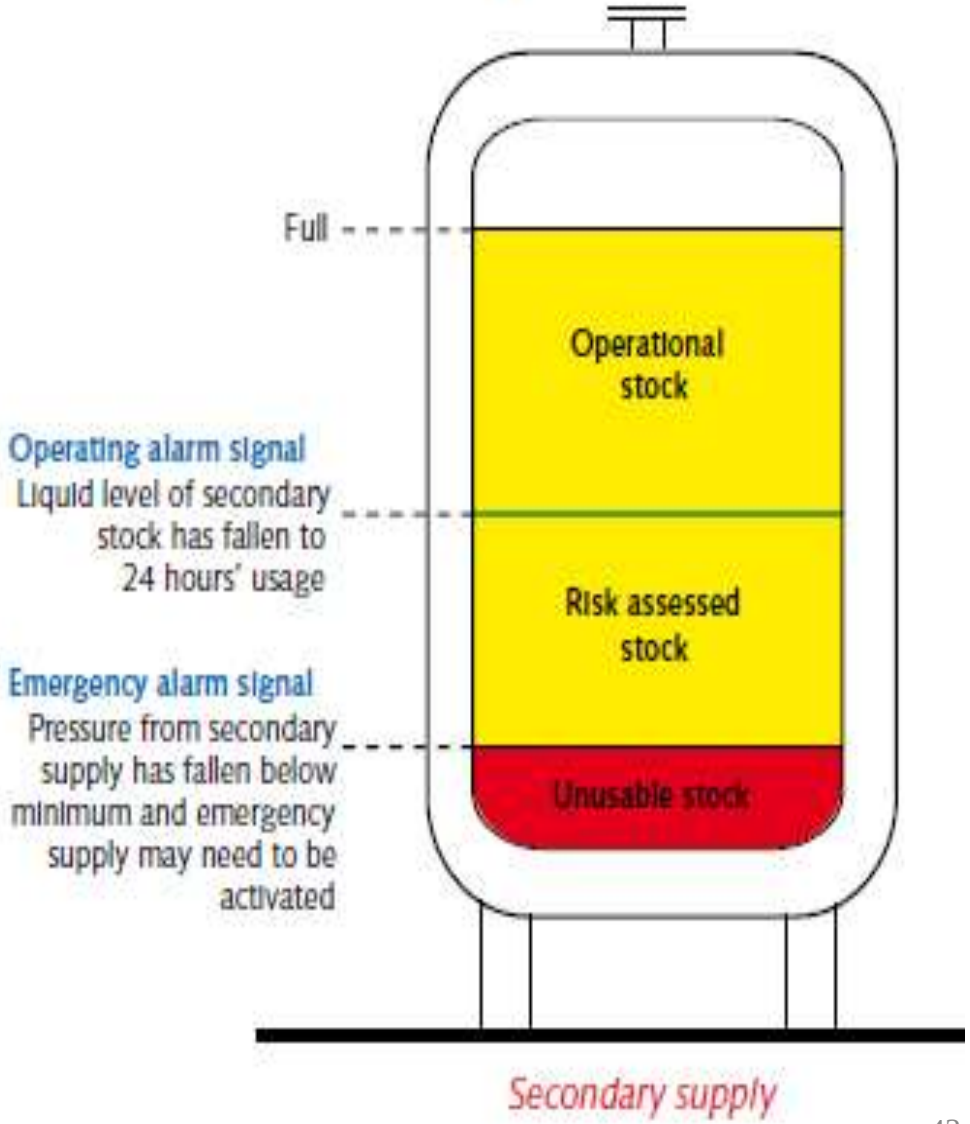
Secondary supply (liquid cylinder)



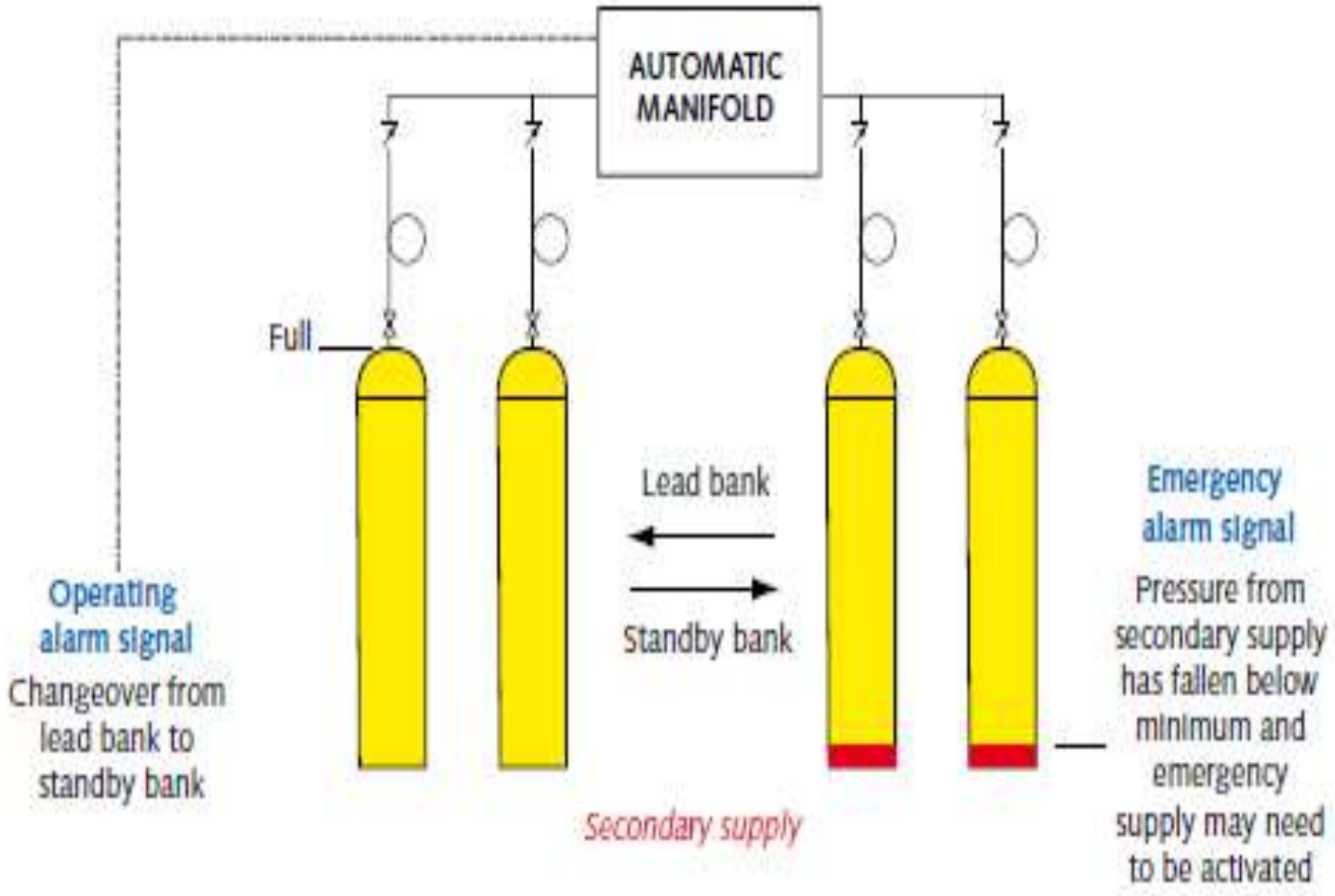
Primary supply (VIE)



Secondary supply (VIE)



Secondary supply cylinder manifold



Which System to select?

- For smaller hospitals, where the demand is typically below 3000 m^3 per annum, the most cost-effective method of supplying medical oxygen is from a compressed gas cylinder manifold.
- As the demand increases, it becomes less practicable to use compressed gas cylinders and more cost effective to use medical liquid oxygen

Which System to select?

- Liquid cylinders are ideal for an annual consumption of between 3000 m^3 and 40,000 m^3
  - They can be connected together by a manifold to provide adequate storage capacity and flow rate.
- For hospitals with larger demands, a bulk medical oxygen VIE will generally be used
- There is a nominal overlap of annual consumption between 27,500 m^3 and 40,000 m^3,
  - Here, either a bulk VIE or a liquid cylinder installation could be considered

Services - security

- Extent of services
  - Access control systems
  - Asset tracking systems
  - Video surveillance systems
  - Door intercommunication system
  - Security lighting

Lifts

- Any building of more than one storey shall have adequate lifts to provide safe and reliable vertical transport for persons and goods
- The number of lifts and their size, speed and load carrying capacity shall be determined by a professional analysis

Lifts

- Healthcare buildings are dependent on lifts
  - They provide an efficient, fast, comfortable, safe and reliable vertical transportation for movement of staff, patients, visitors, medical equipment and ancillary services items
  - Required also for fire fighting and evacuation facilities
  - Lifts are subject to strict statutory regulations

Lifts

- Location
  - Should be based on medical function and service function such as goods, fire fighting, etc
  - Lifts should be located away from sensitive areas
  - Wherever possible lifts should be provided, at least in pairs, to provide service in the event of breakdown or unavailability for maintenance or inspection
- Types
  - Passenger, goods/passenger and goods only

Lifts

- They fall into one of the following categories
  - General passenger lifts,
  - trolley /stretcher lifts,
  - bed lifts,
  - goods lift, and
  - service lifts

Figure 26 General traffic lift

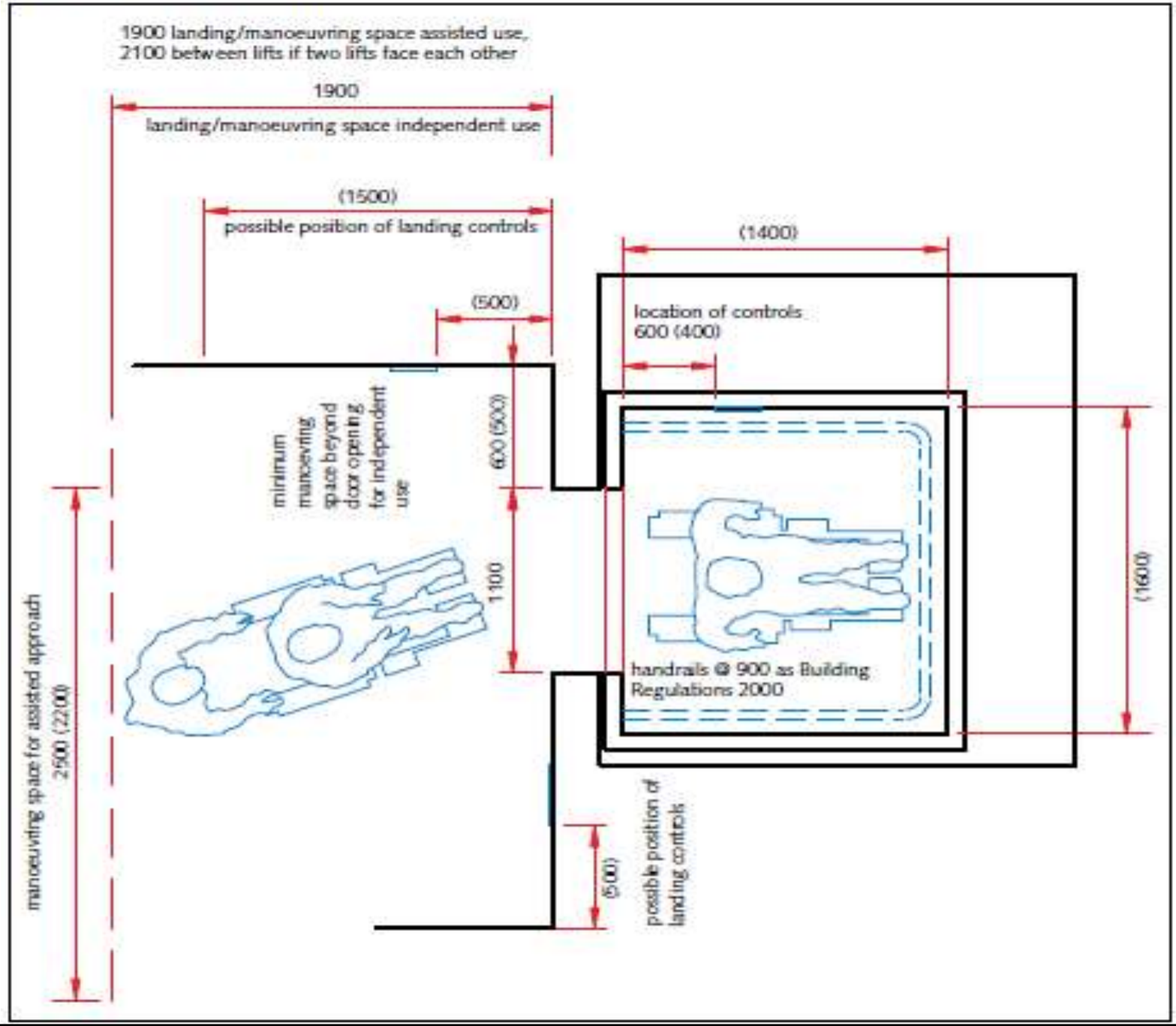


Figure 27 Lift for trolley/stretcher movement

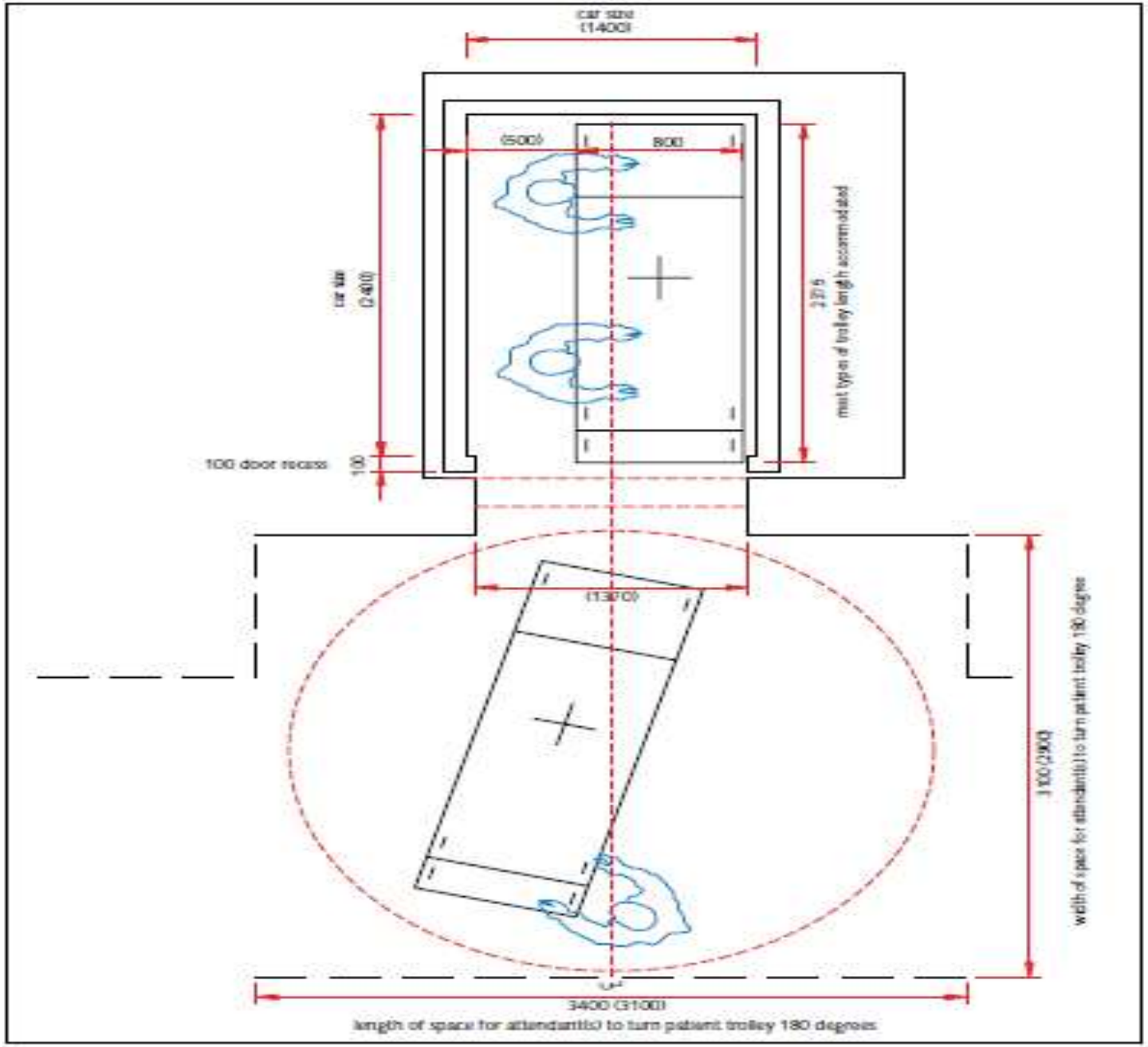
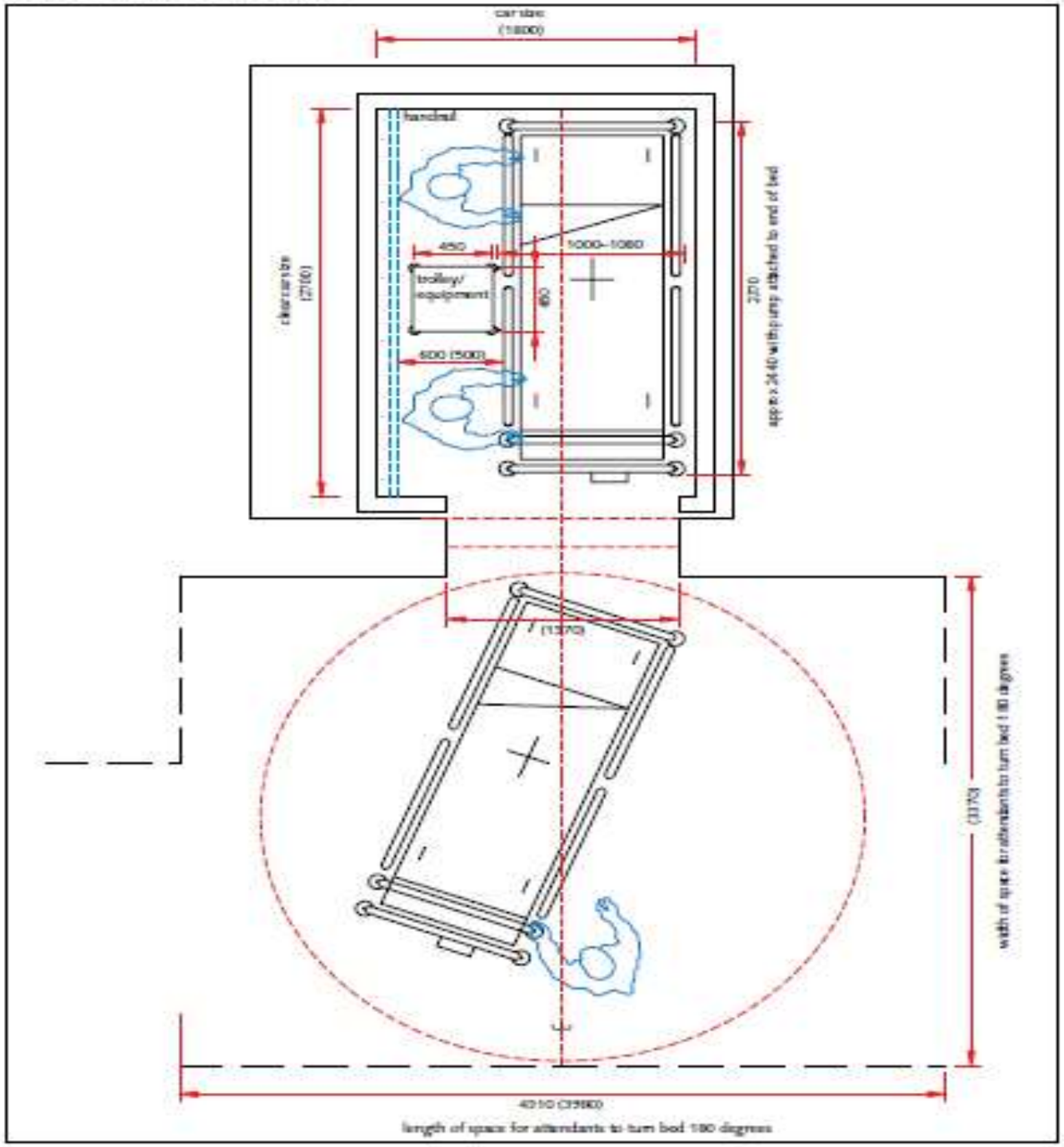


Figure 28 Lift for bed movement



Thank you