TECHNICAL SPECIFICATION

MINIMUM REQUIREMENTS FOR DESIGN AND ENGINEERING OF BUILDINGS

DEP 34.17.00.32-Gen.

September 1992
(DEP Circular 34/96 has been incorporated)

DESIGN AND ENGINEERING PRACTICE

USED BY

COMPANIES OF THE ROYAL DUTCH/SHELL GROUP

PREFACE

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Shell International Oil Products B.V. (SIOP)
and
Shell International Exploration and Production B.V. (SIEP)
and
Shell International Chemicals B.V. (SIC)

The Hague, The Netherlands,

and other Service Companies.

They are based on the experience acquired during their involvement with the design, construction, operation and maintenance of processing units and facilities, and they are supplemented with the experience of Group Operating companies. Where appropriate they are based on, or reference is made to, national and international standards and codes of practice.

The objective is to set the recommended standard for good design and engineering practice applied by Group companies operating an oil refinery, gas handling installation, chemical plant, oil and gas production facility, or any other such facility, and thereby to achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual operating companies to adapt the information set forth in DEPs to their own environment and requirements.

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All administrative queries should be directed to the DEP Administrator in SIOP.

NOTE: In addition to DEP publications there are Standard Specifications and Draft DEPs for Development (DDDs). DDDs generally introduce new procedures or techniques that will probably need updating as further experience develops during their use. The above requirements for distribution and use of DEPs are also applicable to Standard Specifications and DDDs. Standard Specifications and DDDs will gradually be replaced by DEPs.

TABLE OF CONTENTS

APPENDICES

1. INTRODUCTION

1.1 SCOPE

Amended per Circular 34/96

This DEP gives the minimum general requirements for the design and engineering of all new buildings in oil refineries, gas plants, chemical plants, onshore exploration and production facilities and, where applicable, supply/marketing installations.

This DEP is a revision of an earlier DEP of the same number and title, dated April 1989.

Additional requirements for specific buildings are specified in the following documents:

- Analyser houses	DEP 32.31.50.31-Gen. Standard Drawing S 17.001 Standard Drawing S 17.002
- Fire stations	DEP 80.47.10.33-Gen.
- Laboratories	DEP 34.17.10.31-Gen.
- Substations and switch houses	DEP 33.64.10.10-Gen. Drawing T 1.707.055
- Reinforced control buildings	DEP 34.17.10.30-Gen.
- Workshops	DEP 70.08.10.11-Gen. DEP 70.08.10.13-Gen. DEP 70.08.10.14-Gen.

The design of warehouse buildings for storage of chemicals is excluded from the scope of this DEP.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by SIPM, the distribution of this document is confined to companies forming part of the Royal Dutch/Shell Group or managed by a Group company, and to Contractors nominated by them (i.e. the distribution code is "C", as defined in DEP 00.00.05.05-Gen.).

This DEP is intended for use in oil refineries, gas plants, chemical plants, onshore exploration and production facilities and, where applicable, supply/marketing installations.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this document which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this document as closely as possible.

1.3 CROSS-REFERENCES

Where cross-references are made, the number of the section or sub-section referred to is shown in brackets.

All publications referred to in this document are listed in (13).

1.4 DEFINITIONS

For the purpose of this DEP, the following definitions shall hold:

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **Shall** indicates a requirement.

The word **Should** indicates a recommendation.

2. DESIGN DRAWINGS

2.1 BASIC INFORMATION

The scope of work shall be indicated to the Contractor by the Principal in the project specification. This project specification will generally include one or more basic instruction drawings, showing the essential data and information on the buildings and their relationships with adjoining buildings and/or constructions.

Where no basic instruction drawings are given, the Contractor shall use his own judgement in arriving at sound designs based on all other information given. This other information may be in the form of a list of requirements possibly accompanied by one or more 'typical' drawings.

With the approval of the Principal, the Contractor may make alterations in the arrangement and orientation, if such alterations are considered necessary in view of local climatic conditions, improvement to landscape, or other reasons.

The Contractor shall adhere to modern building practices with regard to codes, material specifications, safety, ease of maintenance, etc.

The lay-out and design of buildings (including drain systems, utility piping, cabling, etc.) shall be such as to allow future horizontal extension, unless this requirement is explicitly excluded in the project specification or the list of requirements.

The appearance of buildings shall be plain, yet in accordance with local customs and existing buildings (if applicable).

An architect shall be contracted to design the buildings and to coordinate their installations. The choice of the architect shall be subject to approval by the Principal.

2.2 PRELIMINARY DESIGN

A preliminary design shall be made for each building. This design shall consist of the following:

- A lay-out plan, showing the position of the buildings on site, including plant and true north and prevailing wind direction(s).
- A plan of every floor, indicating positions, dimensions, levels and intended use of the rooms in the building.
- A schematic drawing of essential elevations and typical cross sections. The appearance of the administration buildings shall be in harmony with the local architecture.
- For buildings with basements, the highest ground water level shall also be indicated.
- Schedule of basic structural materials proposed to be used. Locally available materials shall be specified as much as possible, provided they are technically acceptable.
- Typical structural design calculations, as described in DEP 34.00.01.30-Gen.
- A description of the mode of temperature and humidity control, ventilation and lighting facilities, stating approximate temperature and humidity ranges, air changes, and light intensities expected in the buildings.
- Preliminary calculations for insulation against sun-load and proposed devices to be used for protection.
- A description, including material specifications, of other installations like lifts, plumbing, drainage, sewage disposal, etc.

2.3 FINAL DESIGN AND ENGINEERING

The final design shall comprise:

- A lay-out plan, showing the locations and orientation of the building.

- Drawings showing the structural design of the main elements of the building and its foundation.
- Plans of every floor and roof, cross-sections through individual floors, and essential elevations of the building. These drawings shall show the position, form, dimensions and materials of the various parts of the building.
- Collected design data and calculations for climatic consideration, logically leading to the conditions expected to prevail in the building.
  Proof shall be provided by means of calculations, material and equipment data that the criteria for comfort will be satisfied.
- Specifications of the works, in sufficient detail to invite competitive bids from erection Contractors and drafted so as to provide the minimum possible disparity between the interpretations of such Contractors.
  These specifications shall also include a programme of erection, the final material specifications and working details.
- Preparation of such additional detailed designs, specifications and drawings in order to define fully all details of the building and to ensure an effective and smooth completion of the erection work.

Drawings and related documents shall be made in accordance with DEP 34.00.01.30-Gen.

The scales to be used for various drawings shall, however, be as mentioned below:

Plot plan	1:500
Plans, sections and elevations (for preliminary design)	1:200 or 1:100
Plans, sections and elevations (for final design)	1:100 or 1:50
Details, as required for erection Contractors	1:20, 1:10, 1:15, 1:2 or 1:1

2.4 STRUCTURAL DESIGN

For the structural design of buildings, reference is made to:

DEP 34.00.01.30-Gen. - Minimum requirements for structural design and engineering
DEP 34.28.00.31-Gen. - Steel structures
DEP 34.11.00.12-Gen. - Geotechnical and foundation engineering
DEP 34.19.20.31-Gen. - Reinforced concrete foundations and structures

3. DESIGN LOADS

3.1 DEAD LOADS

The own weight of the various building elements comprising the structure shall be calculated, and used in the design.

3.2 LIVE LOADS

The following minimum live loads shall be used. If equipment has to be supported which would create a load exceeding those shown below, then the affected area shall be designed for the heavier load.

Type of building/room	Loads in kN/m^2
Offices, first-aid buildings, guard houses, toilets, wash and locker rooms, analyser houses, control room, computer room, instr. aux. room, electrical equipment room, laboratory room	3
Canteens, lunchrooms, training centres, corridors, stairs, halls	4
Library, filling rooms	5
Battery rooms, simulator room in training centre	10
Mechanical, electrical, instrument workshop building (inclusive of covered area), workshop area in training centre, consumable store	20
Bulk store	40

For structural calculations, local codes/regulations and the actual loading situation shall be adhered to if these are more stringent.

For garages and fire stations, the live loads shall include the maximum weight of trucks and/or fire-fighting equipment.

3.3 WIND LOAD, SNOW/SAND AND EARTHQUAKE LOADS, LOADS DURING ERECTION, DYNAMIC LOADS AND LOAD COMBINATIONS

See DEP 34.00.01.30-Gen.

3.4 CRANE LOADS

3.4.1 General

Crane loads shall be assumed at their maximum values, including the lifting capacity as well as the maximum horizontal loads caused by braking or acceleration, producing worst conditions but not acting simultaneously with maximum wind forces.

3.4.2 Workshop building

Unless otherwise stated in the project specification, the following cranes shall be installed:

- In the workshop building two electrically operated overhead travelling cranes shall be installed to serve the mechanical and electrical workshops.

These overhead travelling cranes shall meet the requirements for handling the heaviest piece or part of equipment to be serviced, e.g. tube bundles or parts of stripped rotating equipment, etc. In any case the minimum capacity shall be:

Hoisting capacity 10 tonnes

Speed data shall be as follows:

Normal hoisting speed	6	m/min
Slow hoisting speed	0.75	m/min
Crab travelling speed	18	m/min
Crane travelling speed	18	m/min

The minimum distance between the two cranes shall be 1000 mm. This distance shall be guaranteed by spacers fixed to the crane.

- In the welding area of the mechanical workshop a separate electrically or pneumatically operated overhead crane shall be installed.

  Hoisting capacity 5 tonnes
  Same speeds as above

- A closed trolley system with protected power tracks shall be used for the electric power supply of these travelling cranes. See also T-1.765.282, 'Specification for electrical overhead travelling cranes'.

- A trolley beam with a hand-operated hoist, with a capacity of 1 tonne, shall be installed in the safety relief valve test area of the mechanical workshop.

- A 2-tonne jib crane with an arm of 3000 mm shall be installed on one of the steel columns of the mechanical workshop building. As the exact location is to be decided later on, all columns of the building shall be designed for this additional load.

- A trolley beam with a hand-operated hoist, capacity 2 tonnes, shall be provided in the instrument workshop. The beam shall extend 1500 mm outside the building.

3.4.3 Other buildings

- In the control building a trolley beam with a hand-operated hoist, capacity 2 tonnes, shall be installed over each hoisting area, see DEP 34.17.10.30-Gen.

- In the CFR engine room of the main laboratory, a trolley beam including a hand-operated hoist with a capacity of 2 tonnes shall be installed above the test engines, extending to the external door.

- In electrical stations the building structure shall be capable of supporting a trolley beam including a hoist with a capacity of 2 tonnes.
  The requirement for the actual installation of this beam and hand-operated hoist shall be checked with the Principal.

- In other buildings, housings, e.g. for chilled water plants, compressors, gas turbine generators, etc., trolley beams with hand-operated hoists shall be installed for maintenance purposes. The hoisting capacity depends on the type of equipment to be hoisted. This shall be checked with the Principal.

3.5 LOADS DUE TO EQUIPMENT, ETC.

Where equipment and machinery are to be installed, e.g. in workshops, the loads shall be taken from Manufacturer's data.

3.6 EXPLOSION RESISTANCE

The distance of a building to process equipment will determine the design principles and general design rules to be applied as described in (3.6.2) and (3.6.3) respectively.

3.6.1 Safe distance

- Buildings in non-hydrocarbon processing plants and all buildings located more than 500 m away from hydrocarbon processing plants do not require special provisions with regard to explosion resistance.
- Buildings which are normally occupied by personnel, such as main office, laboratories, work shops, training centre, canteens, etc., and buildings needed during a calamity (telephone building, first aid, fire-fighting garage, main guard house, emergency control centre, etc.) shall be built at a safe distance from hazard sources, which is normally more than 200 m away from process plants, and more than 100 m away from storage areas/transfer operation sites.
  Shorter distances to low risk plants may be acceptable. This, however, shall be confirmed by a safety assessment which shall take into account the nature and quantity of product, the degree of plant congestion, the potential sources of ignition and the design of the building.
- Buildings exclusively for operating and or maintenance personnel performing their normal work in or near processing plants, and located within 200 m from process plants or 100 m from storage areas/transfer operation sites, shall be constructed in such a way that the occupants are protected against partial or total collapse of the building and its components (including glass fragments).
  Such buildings need therefore to incorporate enhanced resilience. The Principal shall be consulted for approval in such instances
- Control buildings should be incorporated with the main office block, which shall be located at a safe distance as mentioned above. If this is not possible, control buildings and other buildings such as FAR's (Field Auxiliary Rooms) may be located in close proximity of a plant. For safe distances in these cases refer to DEP 34.17.10.30-Gen.

  NOTE: Even when incorporated with the main office block, control rooms and other 'plant buildings' shall have HVAC systems in accordance with DEP 31.76.10.10-Gen. (see 4.2).

3.6.2 Design principles

- All buildings beyond the 500 m zone (from hydrocarbon processing equipment) shall be designed in accordance with the national and/or local building regulations.
- Buildings within the 200-500 m zone shall be designed with a certain resilience against explosions. This requirement aims at relatively inexpensive measures allowing a large deflection of the essential structural elements and external wall panels prior to collapse of the building, without imposing additional strength requirements. See (3.6.3).

- Buildings within 200 m from hydrocarbon process equipment:
  - Analyzer houses and substations shall be designed in accordance with (3.6.3) and DEPs/drawings referenced in (1.1).
  - Control buildings and other buildings, such as FAR's, which are essential for the safe shutdown of a plant after an explosion shall, in addition to (3.6.3), be designed to the relevant design rules given in DEP 34.17.10.30-Gen.
  - Plant buildings need to incorporate enhanced resilience to protect the occupants against partial or total collapse of the building and its components (including glass fragments).

3.6.3 General design rules for all buildings within 500 m distance from hydrocarbon processing plants

- Buildings shall be supported by a steel or reinforced concrete frame with such structural details that plastic deformation can occur without a total collapse.
- The joints shall ensure the ductile behaviour of the completed element. The supports shall be large enough to allow horizontal movements.
- Materials with a brittle behaviour, such as masonry, shall not be used in such a way that they have a strength function.
- The buildings shall have brick infill walls and/or steel cladding or shall be constructed as prefabricated reinforced concrete modules.
- Infill wall constructions shall not have a design function for either vertical loads or bracing.
- For steel structures, structural steel bracing shall be provided in roofs and walls
- Roofs and ceilings, electrical fittings etc. shall be applied such that they cannot easily collapse during an explosion in the plant. All roofs shall be made of monolithic reinforced concrete or galvanized steel sheeting (box rib).
  Loose light-weight concrete roof slabs or asbestos cement sheeting shall not be used.
  Gravel as a protection of roof finish, or loose tiles for walkways on top of the roof finish, shall not be used.

  This design approach, when combined with the design wind loadings, will result in buildings having improved structural capacity for blast resistance.
- Unless otherwise specified, all buildings in the administration area shall have no more than a ground floor and a first floor.
- All windows in outer walls of all buildings shall have laminated glass.

4. CLIMATIC ASPECTS, INSULATION AND NOISE.

4.1 GENERAL

Buildings may require climatic conditioning, i.e. heating, ventilation and/or air conditioning (HVAC), to maintain the temperature, relative humidity and air quality within defined limits, in order to provide reliable operation of electronic equipment and acceptable human working conditions.

Careful attention shall be paid to the prevailing climatic conditions in various seasons, and records of all local climatic design data like air temperature, temperature differences, saline atmosphere, sand and dust storms, infiltration of sand in buildings, humidity, solar influence, wind, micro-climatic variations, etc. shall be used to arrive at a satisfactory design which ensures good conditions for equipment and personnel. In addition, the location and orientation of the building shall be taken into account.

The meteorological data required for the design of the air conditioning shall be collected by the Contractor if not specified by the Principal in the project specification.

For various geographical locations, climatic data such as temperatures, humidity, wind, saline content of the atmosphere, chances of sand and dust storms, micro-climatic variations, altitude, etc. can be found in handbooks issued by, for example, the Meteorological Office in London.

HVAC systems are generally supplied by specialized manufacturers as package units or as single components. Standard HVAC equipment, suitable for the prevailing conditions, shall be applied as far as possible. Where alternative suitable refrigerants exist which are less harmful to the environment than chlorofluorohydrocarbons (CFCs), HVAC equipment shall be capable of satisfactory operation with such refrigerants.

Sufficient space shall be reserved for positioning and maintenance of the HVAC equipment and ducting.

4.2 HEATING, VENTILATION AND AIR CONDITIONING OF PLANT BUILDINGS

Requirements and information regarding HVAC of plant buildings are specified in DEP 31.76.10.10-Gen.

Plant buildings are buildings such as control buildings, field auxiliary rooms (FARs), analyser houses, electrical substations and others (e.g. dedicated flowmetering buildings).

4.3 HEATING, VENTILATION AND AIR-CONDITIONING OF NON-PLANT BUILDINGS

4.3.1 General

The category non-plant buildings includes:

- Office buildings
- Laboratories (non-plant)
- Training centre
- Workshop
- Warehouses
- Fire-station
- Guard-houses/Gate-houses/Security building
- Residential buildings

In temperate climates, air conditioning is usually not considered for this category of buildings unless required for the proper operation of equipment. In that case air conditioning shall be limited to the rooms concerned.

4.3.2 Human comfort

As per ASHRAE standard 55-1981, air-conditioned rooms which are continuously occupied by people shall have the following conditions:

Temperature : between 20 and 26°C
Relative humidity : between 30 and 70%

The advised climatic conditions for various rooms are further specified in Appendix 3.

4.3.3 Heating

Heating may be required to raise the temperature inside a building to the required level.
The dissipated heat from personnel, lighting and electronic equipment etc., shall not be taken into account for heating capacity calculations. Heat losses through walls, floors and roofs shall be taken into account.

The Contractor shall submit the "heating load" calculations to the Principal. The calculations shall be based on ASHRAE Fundamentals 1989, chapter 25.

4.3.4 Cooling

Cooling may be required to lower the temperature and/or humidity inside a building to the required level.

Cooling capacity calculations shall be based on heat generation from heat sources such as:

- personnel;
- electronic equipment;
- lighting;
- (fresh) air intake;
- solar radiation through transparent surfaces such as windows;
- heat transmission through walls, roofs/ceilings, floors, etc.

Cooling load calculations shall be based on the method of calculation in ASHRAE Handbook Fundamentals (1989), Chapter 26.

The Contractor shall submit the "cooling load" calculations to the Prinicpal.

Condensation on air ducting, chilled water piping etc. shall be avoided under all climatic conditions specified. Reference is made to Appendix 3.

4.3.5 Humidification

Humidification may be required to increase the relative humidity inside a building to the required level. The Contractor shall submit the humidity calculations to the Principal.
When humidification is required, steam humidification shall be employed and the humidifiers should be connected to the drinking water system. The water quality shall be checked with respect to the humidifiers applied.

Precautions shall be taken to avoid excessive fouling of humidifiers.

4.3.6 Fresh air ventilation

Fresh air ventilation may be required in order to:
- provide a minimum fresh air intake quantity per unit of time: (refer to ASHRAE 62);
- maintain an overpressure, in order to prevent the ingress of contaminants;
- compensate for specific exhaust, such as in toilets, laboratories.

Requirements for fresh air ventilation systems are:
- a positive flow from outdoors to indoors, and thereafter outdoors, shall be provided.
- the airflow direction shall be such that the flow is from clean rooms e.g. offices etc. to polluted rooms e.g. toilets, HVAC machine room, laboratory. Air from polluted rooms shall be exhausted.

In order to cope with abnormal situations (see Note below) a fire and gas detection system shall be installed with gas-tight, quick-closing, spring-operated dampers in the fresh air intakes and exhausts.

NOTE: Abnormal situations are:

- Flammable or toxic gas detected outside the building.
- Flammable gas, smoke or fire detected inside the building.
- An explosion or fire in the plant.
- Mains electrical power supply failure.

Where ventilation systems are installed in an office, a constant supply of fresh or purified air shall be ensured. The recommended number of air changes per hour (ACH) in various areas are as follows:

Area	ACH	
Offices Kitchens Toilets Enclosed Car Parking Area	4 - 6 20 - 20 3 - 10 4 - 10	For further detailed information regarding ventilation rates reference is made to appendix 3

4.3.7 Filtration

Fresh air ventilation units for offices etc. shall be provided with a pre-filter for 65% efficiency ASHRAE dust spot test, unless otherwise specified.
A dust collector shall be applied if the dust concentration at the fresh air intake is more than 10 mg/m^3.
Re-circulation air handling units shall be provided with 65 % efficiency ASHRAE dust spot test filters.

4.3.8 Control and alarming

HVAC control and alarm systems shall be in line with the HVAC vendor's standards. HVAC control systems should at least include the following:

(a) Temperature control

- for constantly manned rooms;
- for certain rooms which are less frequently used (e.g. meeting rooms).
- for equipment rooms (e.g. electrical room, computer room).

(b) Humidity control

- for continuously manned rooms where the outside climate is so extreme that the humidity requirements of (4.3.2) are not reliably achieved without humidity control.
- for all rooms and buildings where vital (see Note below) electronic equipment is installed.

NOTE: Vital electronic equipment is equipment which must stay in operation even under abnormal situations. It includes fire and gas detection and control equipment, telecommunications equipment (including CCTV) and all related electrical power supply equipment. The Contractor shall submit a listing of all vital equipment (rooms) for approval of the Principal.

Control systems shall normally operate in automatic mode but manual operation shall be possible.

HVAC alarms shall be individually displayed on local HVAC panels. Common HVAC alarm signals generated by the HVAC control system and to be displayed on the DCS screen in the main control room shall be routed either via potential-free contacts and interface boxes or via software links. First failure alarm detection is not required. "Mimic" type alarm display panels (ADP) are not required.

Control signals coming from a HVAC control system cabinet and going to a HVAC motor control centre (power) cabinet shall pass via an interface box. The HVAC control/alarm cabinet and the motor control centre (power) cabinet shall be physically separated. For central air handling units, both cabinets should be located in the HVAC machine room.

4.3.9 Logging

For rooms in which vital electronic equipment is installed, permanent long-term monitoring of temperature and relative humidity is required if specified by the Principal.

4.3.10 Microprocessor-based control systems

Microprocessor-based control systems such as Programmable Logic Controllers (PLCs) shall be considered, but their application needs the approval of the Principal.

For buildings containing both the control room(s) and administration offices, the integration of HVAC control systems and the Building Automation System shall be considered.

For engineering requirements of both PLC and Building Automation Systems the Contractor shall consult the Principal.

4.3.11 Electrical power supply

To ensure that in case of abnormal situations (see Note in 2.3.6) certain vital electronic equipment continues to operate, the electrical power supply for vital HVAC systems (i.e. HVAC systems for rooms containing vital equipment) shall be either AC interruptible maintained or AC uninterruptible maintained.

Examples:

- vital HVAC control systems and local panels:

  :AC uninterruptible maintained electrical supply

- vital recirculation air handling units (including ventilators, pumps and chilled water system):

  :AC interruptible maintained electrical supply

4.3.12 Electrical safety

Area classification drawings show the electrical safety requirements for HVAC equipment.

4.3.13 Instrument air supply

Pneumatic instrumentation shall be connected to the "priority instrument air header". Refer to DEP 31.37.00.11-Gen.

4.3.14 Installation, testing and balancing and commissioning of HVAC systems

Requirements and information are specified in DEP 31.76.10.11-Gen.

4.3.15 Handover documents

The final documentation shall at least include:

- Engineering flow schemes;
- Design criteria and data summary;
- Layout and location drawings for each building;
- Calculation sheets for ventilation rates, pressurisation, normal and abnormal cooling, heating load etc.;
- Control and alarm schemes;
- Control panel drawings;
- Electrical power supply and distribution drawings;
- Hardware/software related drawings for control, alarm and shutdown functions;
- Start-up, shutdown, trouble shooting and regular maintenance procedures;
- Operating manuals;
- Technical data books and spare parts listings;
- Commissioning test reports.

The Contractor shall submit a listing of handover documents to the Principal.

4.4 COVERED WALKWAYS AND PARKING BAYS

In tropical and Middle East areas, the buildings in the administration area shall be connected by covered walkways, consisting of only a roof over a paved walkway. The parking bays for cars used for travelling to and from the plant shall also be covered by a roof.

4.5 INSULATION

Buildings requiring heating, air conditioning or ventilation shall have properly insulated roofs and walls.

The average thermal transmittance shall be :

- for combined roof and ceiling construction: $U < 0.8$ W/m^{2}K
- for external walls, including windows: $U < 1.2$ W/m^{2}K

This requirement may be waived for temporary facilities and unoccupied buildings such as warehouses and storage spaces for goods insensitive to temperature extremes. However, when the exact use may be subject to change, full thermal insulation shall be installed.

Vapour barriers shall be specified to protect the construction elements and the insulation itself.

All insulation materials shall be stable, fire-resistant or self-extinguishing (see 8.1), and properly applied to eliminate pinching and sagging to maintain their effectiveness. Insulation materials shall be rot and vermin resistant.

Materials evolving toxic vapour in a fire shall be avoided.

4.6 NOISE ABATEMENT/VIBRATION

4.6.1 Reverberation

The reverberation time (for definition see ISO 31/VII) in empty rooms, but with finished floors (in accordance with Appendix 1), shall not exceed the following values:

Office rooms, training rooms, laboratories, control rooms, instrument and electrial shops:	1 second
Mess rooms, canteens, corridors and other circulation spaces:	1.25 seconds

4.6.2 Noise transmission values

Transmission loss between offices

Minimum rating or airborne sound insulation between office rooms, assuming closed doors, shall be 40 dB, determined according to ISO 717-1.

Transmission loss between indoors and outdoors

Minimum rating of airborne sound insulation of external wall against external noise, assuming closed windows, determined according to ISO 717-3, shall be:

Administration buildings	-	30 dB
Control building and laboratory	-	35 dB
Social facilities	-	40 dB

Transmission loss through floors (structure-borne noise)

Noise level in a room from a standard tapping machine on the finished floor of the room above (in accordance with Appendix 1), shall not exceed:

Frequency, Hz	Maximum sound level, dB
250	72
500	70
1000	67
2000	58

NOTE: The standard tapping machine consists of 5 hammers of 500 gram each, falling from a height of 40 mm, 10 times per second.

4.6.3 Noise limits

If noise generating equipment is installed in the building, DEP 31.10.00.31-Gen. shall be followed to determine acceptable equipment limits.

Noise levels in buildings shall not exceed the following limits:

Area description	Maximum allowable sound pressure level db (A)
• Areas in workshops and machinery buildings where communication is required. • Workshops for light maintenance.	70
• Workshop offices. • Control rooms, not continuously manned. • Computer rooms	60
• Control rooms, continuously manned. • Open plan offices • Social rooms, changing rooms, wash places and toilets.	50
• Offices and conference rooms	45
• Accomodation (bedrooms, private cabins etc.).	40

NOTE: Noise that is not related to equipment but is produced by users of the various areas need not be considered.

If noise has an impulsive and/or tonal character, the above limits shall be taken 5 dB(A) more stringent.

4.6.4 Noise and vibrations generated by HVAC equipment

Noise from HVAC equipment transmitted through ducts shall not result in sound pressure levels inside the room higher than 10 dB(A) below the maximum acceptable noise level in that room.

Noise caused by HVAC installations shall be reduced by applying one or more of the following measures:
- air duct silencers;
- sound proofing of air ducts.
- isolation of rotating/vibrating equipment from piping, ducting and structures by means of flexible piping, air duct connectors, vibration isolators etc, For equipment vibration limits reference is made to ASHRAE Handbook HVAC Applications (1991).

5. MINIMUM DIMENSIONS

5.1 OFFICE BUILDINGS

These buildings shall be designed with offices at least 3.6 m wide and at least 5 m deep. The corridors shall be at least 2 m wide, except for infrequently used corridors which shall be at least 1200 mm wide (or at least 1650 mm wide if leading to exits).

The occupation rate of offices/rooms shall be determined by the Principal. However, the recommended minimum space per person is 18 m^3; 7.2 m^2 in floor area and not less than 2.5 m in ceiling height.
In offices accommodating more than 25 persons at least two exits shall be provided.

Provisions shall be made for installation of partition walls at 1.8 m intervals, so that rooms can be formed of 5 x 3.6, 5 x 5.4, 5 x 7.2 m, etc.

5.2 MESS ROOMS

The size of these rooms shall be based on min. 1.35 m^2 per person for large canteens to 1.5 m^2 per person for smaller rooms (excluding the kitchen area, counter area, stores, etc.). In control buildings, a lockable cupboard shall be installed for each shift.

5.3 SANITARY BUILDINGS

- Toilets shall be 1000 x 1500 mm (in offices, toilets shall be min. 900 x 1200 mm).
- Showers shall be 1000 x 2000 mm, divided into a wet area and a dry area by a 400 mm wide dividing wall. Each shower shall have a seat in the dry area.
- In locker rooms, two lockers for each shift worker shall be installed, 300 - 350 mm wide, 500 - 550 mm deep and 1800 - 2000 mm high.

All lockers shall be installed on a concrete or steel plinth, about 500 mm high, with a hardwood seat, 500 mm wide, in front of the lockers. The distance between the front of the seats shall be at least 1400 mm.

The lockers shall have adequate natural ventilation. In air-conditioned and/or mechanically ventilated locker rooms the lockers shall be exhausted at the top.

The area above the lockers shall be enclosed or a sloping steel cap shall be mounted to prevent accumulation of dirt and placing of items on top of the lockers. This area shall also accommodate the exhaust piping.

5.4 WORKSHOP AND WAREHOUSE BUILDINGS

Unless otherwise specified, these buildings shall have a width of 15 m and a length of a multiple of 6 m.

5.5 ELECTRICAL STATIONS AND ANALYSER HOUSES

Amended per Circular 34/96

For electrical stations, see drawing T-1.707.055. For analyser houses, see Standard Drawings S 17.001 and S 17.002.

For certain applications container-size modules may be utilized if approved by the Principal. This type of building, consisting of one or more interconnecting modules, shall comply with the general design rules under (3.6.3).

5.6 CEILING HEIGHTS

The following minimum clear dimensions shall apply:

	Height
Office rooms	2500 mm
Control room, laboratory, analyser house, computer room	3000 mm (Note 1)
Electrical station	4000 mm (Notes 1 and 2)
Basement in control building	3300 mm (Note 1)
Basement in offices	2600 mm (Note 1)
Basement in substation	1800 mm (Note 1)
Fenced area under substation on stilts	1500 mm
Toilets, wash/locker rooms, etc.	2500 mm
Corridors	2400 mm

All height dimensions are to underside of ceiling or beams, whichever is the lower.

Notes:
1. This height shall further depend on dimensions of equipment and handling space required.
2. The free space required above the (high voltage) switchgear also depends on the type of short circuit relief devices on top of the switchgear.

6. BUILDING ELEMENTS/COMPONENTS

6.1 GENERAL

This chapter gives general information on elements and components for all buildings. However, requirements for certain buildings are specified in more detail owing to the fact that these requirements are not covered in separate documents such as the DEPs, drawings, etc. mentioned in (1).

Materials containing asbestos shall not be used.

6.2 WALLS

6.2.1 External walls

External walls shall be designed to prevent condensation and to resist penetration of external moisture (due to rain or snow) into the inside of the building. External walls should be made of fair-faced bricks; plastering and painting (or cladding) shall only be used where bricks of suitable appearance are not available locally. If administration and service buildings are made of concrete blocks, the external surfaces shall be plastered and painted.

A damp-proof course shall be included in all walls over the full length at a minimum height of 150 mm above the finished grade level. Whenever necessary, termite barriers shall be provided in the construction.

Where wall cladding is used, plastering and painting of the wall behind it shall be omitted. If cladding is used in service buildings, a dwarf wall of 2000 mm height shall be erected to protect the cladding against damage by motor vehicles (see also DEP 34.28.00.31-Gen). Steel crash barriers may only be used as an alternative to a dwarf wall if approved by the Principal.

Electrical stations, analyser houses, auxiliary rooms, control buildings and similar buildings shall be made gas-tight. The joints between brickwork and concrete structure shall be sealed, as well as the joints between door and window frames and the brickwork or concrete structure.
Where louvres are used for ventilation they shall be of the "vertical louvre" type.
The minimum thickness of the cladding shall be 0.75 mm.

In tropical areas double sheeted, insulating cladding shall be considered for buildings frequently occupied by people. Where natural or forced draft ventilation is required, a ridge vent shall be provided over the full length of the building in combination with vertical wall louvres.

To prevent possible accumulation of gases in the walls, cavity walls shall not be used in electrical stations, analyser houses, auxiliary rooms, and similar buildings. Hollow concrete blocks shall not be used for outside brickwork, unless the cavities are filled with concrete/mortar. The holes for cable entries below ground shall be sealed gas and water tight; Multi Cable Transit (MCT) blocks should be used. Unused cable entries shall be closed with spare solid blocks. Material to be used for closing of aboveground holes for cable entries shall have the same fire rating as the particular element.

Preventive measures shall be taken to avoid inflow of rain water or released flammable liquids. All openings for cables or piping shall be above groundwater level. External walls for buildings shall satisfy the general requirements given in (3.6).

Lightly coloured, heat-reflecting, thermal insulating properties and low maintenance shall be the major considerations in the selection of all exterior finishes. Appropriate jointing and backing systems shall be incorporated into the design of all exterior finish systems.

Such systems shall resist all local weather conditions, such as rainstorms, high winds, effects of severe sandstorms, etc.
Special attention shall be paid to the selection of appropriate coatings for the finishing of exterior surfaces. In particular, metals require special coatings as a protection against corrosion and heat absorption. See DEP 30.48.00.31-Gen.

6.2.2 Interior walls and partitions

Only moisture-proof finishes shall be specified in toilet rooms, bath facilities, kitchens and other areas exposed to humidity or water. Walls surrounding water closets, showers, bath tubs and urinals shall be finished with ceramic tiles, or specially designed sanitary partition walls.

Terrazzo shall have an integral coved base. All plastered corners shall be protected against impact damage by an integral bullnose element.

Partition walls installed in buildings shall be based on a module of 1.8m (5.1). Unless otherwise specified, they need not be of the removable type. Floors, ceilings, windows,

heating, ventilation, air-conditioning and electrical fittings shall be designed in such a way that partition walls can be built and demolished in future at 1800 mm centres, without undue damage to the building.
A damp-proof course may be omitted for partition walls, if erected on the concrete floor, except for wash rooms and other wet rooms.

6.2.3 Finish of walls

See Appendix 1.

6.3 ROOFS

6.3.1 Flat roofs

- Nominally flat roofs shall be made of reinforced concrete, poured in situ. Prefab concrete elements shall not be used for roof construction, in order to satisfy the requirements of (3.6). The minimum slope for nominally flat roofs shall be 1:100.
- Roofs and curbs shall be made completely water-proof by any proprietary water-proofing treatment. The composite roof shall comply with criteria for thermal insulation and fire protection. Condensation shall be avoided. Where frequent roof traffic is expected, adequate walkways made of steel grating on steel supports shall be provided. Gravel shall not be used to protect the water-proofing.
- In very dry (e.g. Middle East) areas, the roof shall be flat with run-off (nominal) slopes and surrounded by a curb. Gutters shall not be provided. Only PVC oversized overflow spouts shall be installed. The build-up roofing felt shall be protected against direct sun radiation by means of a protective layer, i.e. light-weight concrete or mortar with white-reflecting surface on top of the insulation/roofing felt. Loose tiles or gravel shall not be used.

6.3.2 Pitched roofs

For pitched roofs, the plan shape shall be kept as simple as possible, without hips and valleys. The construction shall be such as to result in a completely water-proof roof.

For pitched roofs, the roofing shall be long-span profiled carbon steel panels, with the same protection system as facade panels, see DEP 30.48.00.31-Gen.

Proper ventilation between roof and ceiling of laboratory buildings is required to prevent accumulation of vapours (toxic or inflammable).

Roofs will generally have two slopes at 20°. In tropical areas, rainwater gutters and downspouts shall only be provided over entrances and other areas where people have to pass.
Under all outer roof lines without a roof gutter, adequate concrete gutter facilities shall be designed at floor level with concrete slabs on both sides to prevent erosion.

6.4 CEILINGS

6.4.1 Materials

Moisture-resistant materials shall be used for the ceilings of all toilet rooms, bathing facilities, kitchens and other areas exposed to moisture and humidity. All materials to be used for ceilings shall consist of non-combustible materials or fire-rated materials in accordance with the applicable codes.

6.4.2 Finish of ceilings

See Appendix 1.

6.5 FLOORS

6.5.1 General

Floors shall be made of either:

- Mass concrete supported directly on soil with an intervening vapour barrier (applicable to ground floors only if soil conditions permit), or
- reinforced concrete, or
- prefabricated concrete slabs supported by concrete or steel beams, but only when no people are accommodated underneath.

Where requirements warrant it, epoxy-based flooring could be considered. However, alternative materials shall be used only with the Principal's approval.
All floors exposed to weather, liquid spillage or washing-down operations shall be laid with adequate falls, e.g. a minimum of 1 in 100 to gullies or channels placed in such a way that quick and effective drainage is possible. The falls shall be such that, allowing for normal tolerances, there is no possibility of ponding, or water being trapped by stanchions or footings. Drains from upper floors shall be routed in such a way that blockages are unlikely and shall have adequate inspection covers so that, if blockages do occur, they can be cleared easily.

The finished floor level shall be at least 150 mm above the pathway around the building.

6.5.2 Workshop

In the workshop floor, provisions shall be made to allow for cable-laying and machine foundations.

The floor shall be constructed as follows:

- A reinforced concrete construction floor to base all machine foundations.
- A layer of sand about 200 mm thick to accommodate cables and piping.
- A thin reinforced concrete floor, strong enough to carry all the traffic in the workshop, which can be easily removed for relocation of equipment without disturbing the lower construction floor. This top floor shall be level with the surrounding floors

6.5.3 Raised floors

For the installation of computers and other instrument or electrical equipment with cable connections at the bottom of the equipment, a special cavity floor shall be installed.

The elevated floor shall be flush with the surrounding floor finishes. For this reason the reinforced concrete floor shall be constructed at a lower level.

The removable panels shall be 600 x 600 mm and 40 mm thick, constructed of plywood or chipboard, finished with 2 mm thick factory-applied, anti-static, wearing surface at the top and aluminium foil at the bottom.

The floor panels shall rest on adjustable pedestals manufactured of mild steel with mild steel foot and top plates.

The pedestals shall be glued to the concrete floor, adjustable in height, providing a distance between the top of the cavity floor and the top of the concrete floor of 750 mm. The adjustable part shall have automatic positive locking.

Electrical requirements shall be in accordance with IEC 364.

Bracings shall be installed to prevent lateral movement of the flooring system.

Separate steel structures shall be provided to support electrical equipment and battery benches.

Each floor panel shall be capable of supporting a concentrated load of 4450 N, applied on an area of 650 mm^2 at any point, or 15 kN/m^2 with a max. deflection of 1 mm.

The reinforced concrete floor and the walls under the cavity floor shall be painted with an epoxy paint to prevent formation of dust.

6.5.4 Finish of floors

See Appendix 1.

6.6 DOORS

6.6.1 General

- In external walls, doors and frames shall be made of galvanized steel.
  In exceptional cases, solid hardwood doors can be used, treated with a fire retardant.

  NOTE: Aluminium shall not be used, because this material is too weak to hold the door or window pane in place during an explosion.

  Plastic shall not be used because of the development of dangerous gases in the case of fire.

- Steel doors and frames shall also be used for internal doors in electrical stations, basements of control buildings, bottle wash and CFR engine rooms of laboratories, consumable stores, instrument, electrical and mechanical workshops.
- Steel doors shall be double-sheeted and insulated.
- In all other internal walls where doors are required, pressed steel or hardwood door frames, solid-cored, with flush-veneered wooden doors shall be used.
- All main entrances and all other entrances to buildings which are frequently used shall have airlocks with adequately separated doors to control the indoor temperature and to prevent sand accumulation in the case of desert conditions.
- Where visibility is required, doors shall be glazed. The clear opening for glazing shall not exceed 0.25 m^2 per door. Outside doors in administration buildings may have a clear opening for glazing not exceeding 1.0 m^2 per door.
- External doors shall always open outwards and in the direction of the escape route. Revolving doors and sliding doors are not allowed for emergency exits.
- If the dimensions of doors are unpractical for easy handling, a wicket door shall be provided for frequent passage of persons, i.e. in workshop doors, the door for the receiving bay of the store and the equipment doors of electrical stations and control buildings.
- Weather stripping to maintain the climate inside the building and to exclude all dust and moisture infiltration. Sliding doors shall be designed in such a way that an accumulation of dust and sand does not influence the proper functioning of the doors. The tracks shall be easily cleanable.
- The external doors of the substation shall be made tight-fitting by means of heavy-duty PVC seals, so that no dust, gas or other foreign matter can enter the building.
- The sealing of the analyser house doors, internal and external, shall be made tight-fitting by means of heavy-duty PVC seals.
- In corridors of office buildings self-closing smoke doors shall be installed at maximum 30 m intervals. These doors shall also be used for separating staircases from corridors.
- Mat wells shall be installed inside all entrances of the following buildings:

  Office building
  Canteen
  First-aid building
  Laboratory
  Control building
  Training centre
  Instrument workshop
  Electrical workshop

- The door frame stanchions of the sliding door between work-shop and covered area shall not be connected by a top rail in order to allow free movement of the overhead travelling crane with load. If required by climatic conditions, a crane door shall be additionally installed in the above wall.

- In non-freezing areas, fire-fighting garages should not have doors in front of the fire-fighting vehicles. If doors are required for climatic reasons they shall be made of light material so that the fire truck can break them open in case the doors are blocked during an emergency.
- Doors may be electrically operated but shall have a facility for quick disconnection of the electric driver after which easy manual opening shall be possible (balanced doors).
- Internal doors to toilets and showers shall have a 100 mm free opening from the finished floor.
- Doors in corridors of office buildings should not be located directly opposite each other. Doors should be installed preferably in niches, in order to create more room in the corridor near the entrance of office rooms.

6.6.2 Dimensions

Required minimum dimensions shall be as shown below. All these dimensions shall be increased if required for installation of equipment in the buildings.
For firestations, see DEP 80.47.10.33-Gen.

MINIMUM CLEAR OPENINGS OF **INTERNAL** DOORS	WIDTH X HEIGHT (mm)
First-aid facsilities, for passage of stretcher only	1500 x 2100
Instrument shop	1400 x 2100
Between electrical shop and mechanical shop	2000 x 2100
Basement of control building between instrument and electrical room	1800 x 2500
Between warehouse and bulk store	1800 x 3000
One door in each laboratory room	large enough for the necessary equipment (e.g. fume cupboard) to pass through
Toilets and showers	600 x 2100
Other doors	900 x 2100

MINIMUM CLEAR OPENINGS OF **EXTERNAL** DOORS		WIDTH X HEIGHT (mm)
Main entrances of offices, canteen, training and first-aid building		1500 x 2100
Control building	equipment entrance	1800 x 2500
	all other doors	900 x 2100
Workshops and warehouses (shall be sliding doors)		3000 x 3000
Between covered area and workshop (shall be sliding doors)		4000 x 4000
Store for heavy field tools or rigging equipment (shall be sliding doors)		1800 x 3000
Substations	equipment entrances	See dwg T 1.707.055
	personnel entrance	900 x 2100
Analyser houses		900 x 2100
Other external doors		900 x 2100

6.6.3 Fixing

- Fixing of frames for doors and windows to the building shall be such as to ensure solid, void-free, water-proof joints.
- Steel frames shall be built into the building by using galvanized/sherardized metal lugs.
- The joints shall be caulked with a building mastic which does not sag or run, is non-hardening, non-staining and can be painted.

6.6.4 Fittings

- Locks, handles, handle plates, barrel bolts, panic bolts, door stops, kick plates, and automatic door closers shall be provided as necessary. For doors to air locks, airconditioned rooms, pressurized rooms, main entrances to sanitary blocks, and for all fire-check doors, automatic door closers or self-closing doors shall be installed. For other external doors, door catches shall be provided.
- All fittings of the same kind shall be of one make and type. Fittings shall be in anodized aluminium and shall be fixed with non-corroding screws.
- Fittings for industrial buildings shall be of steel and shall have a corrosion-resistant finish.

- The single doors of analyser houses, electrical substations and the active leaf of the double door of electrical substations shall be provided with a single panic bolt. As only the single doors shall be used for normal passage, the panic bolts of these doors shall be operated by means of a cylinder lock with key and locking knob. These locks shall be keyed to a master key system.
  In each refinery one separate locking system for all electrical substations and one for all analyser houses shall be provided. For extensions to existing refineries, door-locking facilities shall exactly match those of the existing buildings.
- Both leaves of the double doors shall be provided with a vertical grip handle on the inside.
- Doors to toilets and showers shall be provided with an indicator bolt only. On the inside of these doors coat hooks shall be fitted, one on each toilet door and three on each shower door. These coat hooks can also be mounted against the wall on a strip of hardwood.

6.6.5 Finish

- Doors, windows, frames and fittings made out of steel shall be hot-dip galvanized or zinc-sprayed. See DEP 34.28.00.31-Gen.

6.7 WINDOWS

6.7.1 General

- Windows, including their frames in external walls, shall be made of galvanized steel. Other materials are not strong enough to keep the window pane in place during an explosion.
- Movable parts of external windows shall open outwards.
- Where insect screens are required, they shall be easily removable and rustproof.
- Electrical substations shall not be provided with any windows or other light openings.
- The upper part of external doors of the analyser house shall be glazed. The maximum pane size shall be 0.25 m^2.
- The underside of all windows in workshop and warehouse buildings shall be at least 1200 mm above finished floor level. The underside of all other windows, where possible, shall be min. 1000 mm above finished floor level.
- External window sills shall be set weathered, and project beyond the external wall face. Internal sills shall be made of tiles, or similar material to suit the type of room concerned. To prevent accumulation of dirt, these internal sills shall be set sloping inwards in control buildings, wash and locker rooms and toilets.
- All exterior windows in heated and/or air-conditioned buildings shall be designed with weather-stripping as described for doors.
- For fittings of windows, see (6.6.4).
- Bracings and rainwater down-pipes shall not obstruct the windows in steel-framed buildings.

6.7.2 Sun-load protection

- The design of buildings shall be such that the heat due to solar radiation through glazed areas shall not raise the temperature in the rooms above the allowable design conditions. This may be achieved by installation of louvres, heat-absorbing/reflecting window panes, canopies, or similar sun-protection devices. A study of their optimum shape in relation to the sun, as well as their economics related to HVAC equipment and operation costs, should be made. Such devices should have low heat-absorptive properties and minimum contact with the building surfaces to which they are attached.
- In addition, interior shading, such as blinds and curtains, should be provided, ensuring sufficient air circulation between them and the window pane. Blinds shall be designed using materials resistant to intense heat, and curtains shall have stable colours that resist fading. All curtains and draperies shall be self-extinguishing.
- Windows shall be designed to minimize heat gain and ultraviolet light transmission. Excessively glazed surfaces shall be avoided wherever possible, particularly when they are unshaded or directly oriented towards the sun. Double glazing for large glazed areas is desirable.

When specifying special glazing, such as reflective mirror glass and heavily tinted glass, consideration shall be given to replacements and availability in the country in question.

6.7.3 External glazing

- The number of windows and the sizes of the glass panes shall be restricted to the minimum required by local building authorities.
- The maximum pane area should be 1 m^2. All window openings shall be designed in such a way that only a minimum of different glass sizes is required.
- In all buildings, laminated glass shall be used consisting of two layers of float glass of at

least 3 mm each and a polyvinyl-butyral (PVB) interlayer of 1.9 mm (see appendix 2).

- Hermetically-sealed double-glazing units shall be used when transparency needs to be combined with heat insulation. The double-glazing units reduce sound transmission appreciably, but this is an incidental benefit.

  These glazing units, prefabricated by the manufacturer, shall be composed of two spaced glass panes with a cavity of dehydrated air.
  Each unit shall consist of:

  - an outer pane of normal float glass, minimum thickness 5 mm,
  - an air space, minimum 6 mm,
  - an inner pane of laminated glass consisting of two layers of glass, minimum thickness 2 mm each, and
  - a PVB interlayer of 1.9 mm.

The outer and inner pane of the unit shall be fixed to the spacers of the air cavity by a polysulphide adhesive compound. The edges of the units shall not be provided with a channel-shaped metal cover.

NOTES:
1. To prevent mistakes during fitting of the units into the frames, the inner pane of laminated glass shall be marked clearly by the manufacturer (e.g. the Principal's name or company logo in the glass).

2. When these units are to be exposed to low pressure (e.g. during air transport or if mounted at a level above 800 m) the manufacturer of these units shall be informed and the necessary precautions taken.

3. If considerable protection against the spread of fire is required, as well as protection during an explosion, wired laminated glass shall be applied, e.g. in analyser houses. This glass shall consist of one layer of wired glass, 6 mm thick and one layer of float glass, 3 mm thick with an interlayer of PVB of 1.9 mm.

6.7.4 Fixing requirements for external glazing

To enhance keeping the glass pane in the window frame in the case of an explosion, the following requirements shall apply (see also Appendix 2):

- The window frame of galvanized steel shall have a minimum rebate of 18 mm instead of the normal standard of 12 mm. The glass manufacturer may specify even more than 18 mm, in which case this bigger rebate shall be provided.
- The glass panes shall be fitted from the outside.
- Single and double external glazing shall be fixed with metal beads, corresponding in height to the height of the rebate. The steel beads shall be fixed with 5 ½ mm diameter screws spaced at maximum 200 mm intervals.
- As shown in Appendix 2, each of the edges of the pane shall have a minimum clearance of 5 mm with the frame. Both faces of the pane shall have a minimum 3 mm clearance with the frame.

The clearances shall be maintained by the use of neoprene setting blocks and side spacers (see Appendix 2).

- The glass shall be fitted in the steel frame using a non-hardening adhesive compound. A self-adhesive aluminium tape shall be taped on the edge of the window pane to act as a separation between the adhesive compound and the PVB interlayer in the case of possible harmful reaction between components of the adhesive compound and the PVB interlayer.
- The fixing method shall ensure void-free and water-proof joints.
- The transport, the application of primers, compounds, aluminium to neoprene setting blocks and neoprene side spacers shall be in accordance with the instructions of the manufacturers of the glass and the compounds.

6.7.5 Internal glazing

Normal glass with a minimum thickness of 3 mm shall be applied. The panes shall be fitted in steel frames composed of standard sections, and fixed with a non-hardening, non-staining type of putty.

Internal glass in timber doors and in hardwood frames shall be fixed with screwed hardwood beads.

If considerable protection against the spread of fire is required, transparent Georgian polished wired glass shall be applied in view of its resistance to fragmentation.

Wired glass, thickness 6 mm, shall be fixed with screwed metal beads in steel frames and with wooden beads in wooden doors.
Transparent Georgian polished wired glass shall be used if visibility is required, otherwise translucent Georgian wired-cast glass shall be applied.

6.7.6 Issue counters

A hatch with a hardwood issue counter shall be provided in the dividing wall between the workshop and the toolroom, and in the warehouse
These issue counters, as well as the issue counter in the canteen, shall be provided with metal sliding shutters with suitable locking arrangements.

6.7.7 Translucent sheeting, dome lights and glass bricks

If a clear view is not required, translucent sheeting and dome lights may be used for daylight entrance in parts of the external enclosure of industrial buildings.

If applied:

- Both shall be of glass fibre-reinforced polyester resin of self-extinguishing quality and with a resin-rich external surface to prevent ageing.
  The fire-retardant grade shall be approved by the local authorities or the Principal in case no local regulations exist.
  Materials which develop toxic products or excessive smoke in a fire are not allowed.

  Profiled translucent sheeting shall be of the same profile as the adjacent standard types of wall cladding and/or roofing sheets.
- Number, area or sizes shall be restricted to a minimum.
- No more than 20% of the wall surface shall be fitted with translucent sheeting, due to smoke development in the case of fire.
- To prevent condensation and to restrict solar heat load inside the building, double-skin dome roof lights shall be applied. The shape shall be square or rectangular.
- In tropical areas translucent roofing sheets and dome roof lights shall not be used.
- Solid or hollow glass bricks shall not be applied.

6.8 SPECIAL REQUIREMENTS FOR PLANTS HANDLING TOXIC PRODUCTS

Walls, floors, ceilings, windows, doors, air ducts, partitions, piping, etc., and all internal surfaces shall be designed and constructed to eliminate as far as possible any ledges or surfaces on which dust and dirt can settle. All surfaces shall have a smooth texture and shall be easy to clean.

The floor surface of the plant shall be smooth and impervious (e.g. by means of non-slippery glazed tiles) in order to prevent absorption of any toxic residue in the floor. The floor should slope gently (1:100) towards the drainage point. A small ridge around the more critical areas or recess of this area, i.e. underneath the filling equipment, shall be applied. This separated area should also be connected with a drainage system suitable for toxic materials.

The mixing room shall have self-closing doors, to restrict the spreading of toxic product as far as possible.

6.9 STAIRCASES

6.9.1 General

All stairs shall be designed and located to meet the local fire authority requirements for means of escape in the case of fire. The proposed location shall be approved by the Principal.

All doors shall open in the direction of the escape route and be positioned so as not to block any stairway.

Signs shall be supplied and erected to indicate clearly the route of escape in an emergency.

Hand-rails shall be provided on both sides of the stairs, except when the slope of stair is less than 30° **and** the stair is not higher than 2000 mm, in which case hand-rails are not required.

Main internal staircases of administration buildings, control buildings, laboratories, etc., along with their related lobbies and landings, shall be enclosed by suitable fire-resistant materials (see 8.1.3). Winding treads shall not be used for such staircases.

Where equipment is located on top of a roof, the installation of a steel staircase or cage ladder will depend on the maintenance/inspection/operating requirements of the equipment, subject to the approval of the Principal. For steel staircases and ladders, see DEP 34.28.00.31-Gen.

The concrete platforms in front of equipment doors shall be calculated to be able to bear the equipment that will be transported through these doors.
If in an electrical substation a basement is required, two manholes of 600 x 800 mm covered with 25 mm deep galvanized grating and located in opposite corners of the building shall be provided in the ground floor, providing access and natural ventilation to the basement.
A fixed vertical steel ladder leading to each manhole shall be provided in the basement.
A vertical steel handrail 38 mm diameter shall be fixed to the wall next to each manhole.

6.9.2 Dimensions

Minimum width between handrails	1250 mm.
Width and length of landings	same as width of stair.
Minimum head room	2100 mm.
Height of handrail above front of tread	900 mm.
Height of handrail above landing	1100 mm.
Doorway to staircase, min. width	1250 mm.

No stairway shall exceed 16 rises in any one flight, but if more are necessary a landing shall be provided.

The maximum slope shall be 3:4.

For risers and goings the following shall apply:
Risers (R) : in. 160 mm, max. 190 mm.
Goings (G) : in. 250 mm, max. 310 mm.

and further:
(R x G) min. 48 000 mm^2, otherwise too dangerous to descend.
(R x G) max. 55 000 mm^2, otherwise too tiring to ascend.

7. UTILITIES

7.1 DRAINAGE AND SEWERAGE

7.1.1 General

Drainage systems outside the area of 1 m from the outside of the buildings, shall comply with DEP 34.14.20.31-Gen. Within 1 m of the outside of the building, the following is applicable:

A complete drainage system including floor drains and sewage piping from sanitary fitments shall be provided. The design shall be adequate to cover future extensions of various buildings.

Drainage lines shall be designed to provide self-cleansing velocities and easy access for clearing of obstructions. Such access points within buildings shall have screwed or bolted air-tight covers. Interconnecting pits outside the buildings shall be provided with cast-iron removable covers.

In areas likely to be affected by frost, the external drain lines shall be laid at frost-free level.

Suitable intercepting chambers and vents shall be provided where required, to prevent foul liquids or gases from flowing back into the buildings. Special attention shall be paid to having these vents at a suitable distance from air-conditioning inlet openings.

Particular attention should be paid to the provision of seals to prevent any possible ingress of process gas or hydrocarbon liquids.
A grease trap shall be provided for the waste water from the canteen building and mess room. The grease traps shall be located such that the temperature does not exceed 37 °C, as this will inhibit the grease dispersing agent.

The basements shall be provided with an emergency drain pit of 600 x 600 mm, depth approximately 250 mm, with cover. This drain pit shall be located near the access opening to the basement, to facilitate easy connecting of a hose from a movable emergency pump outside the building.

Rainwater downpipes and other drainpipes shall not pass through electrical equipment rooms or basements.

7.1.2 Connection to oil-contaminated drainage system

The oil-contaminated water drain from laboratories, analyser buildings and similar buildings shall be connected to the continuous oil-contaminated drainage system of the process plant, through suitable water seals, keeping these drainage lines always flooded. The water table shall be at least 50 mm above the inside top of the highest part of the drain line.
If the laboratory is too far away from the above drainage system, an underground oil collecting tank shall be installed, to be emptied by a vacuum truck.

7.1.3 Connection to existing third-party sewage system

If a sewage system belonging to a local authority exists in the neighbourhood, the building sewage may, after the necessary permission has been procured, be connected to this existing system. The drainage design shall then be completely governed by the stipulations made by the local authority concerned. See also DEP 34.14.20.31-Gen.

7.1.4 New sewage disposal system

If there are no possibilities of discharging into an existing system, a new disposal system shall be designed. Rainwater from the buildings shall be directly connected to the storm water channels. Sewage and waste water shall be jointly or separately treated in effective septic tanks or other treating plants according to the specifications or local practice.
Further purification of the effluent from the treating plants shall be designed, if necessary, so that the final effluent can be discharged into the natural storm water channels without objections from the neighbours or local authorities.
Alternatively, if approved by the Principal, the rainwater and purified effluent from the sewage treatment plants may be discharged into the oil-free drainage system of the

refinery. See DEP 34.14.20.31-Gen.

7.1.5 Sewage materials

Materials shall be selected and laid in such a manner that underground pipes or fittings, traps, pits, etc., shall not give rise to leakage, particularly after settlement of the overburden or surrounding soil, or from any other cause. All drain pipes shall be resistant to corrosion, erosion, the action of acids, detergents, hot water or other wastes to be drained.

Rainwater downtake pipes and roof gutters should be of PVC and shall be designed to discharge all rainwater effectively without causing dampness in any part of the buildings. The bottom two metres of exposed down-pipes shall be made of steel. Rainwater down-pipes shall be mounted on the outside of the building where possible.
Rainwater gutters shall be designed to bear snow load where applicable. The materials shall be clearly indicated on the drawings.
In areas with high solar exposure, ultraviolet resistant materials shall be used.

7.1.6 Testing

Prior to any back-filling, all underground drain pipes and pits shall be water-tested in accordance with DEP 41.14.20.31-Gen.

7.2 WATER SUPPLY AND RELATED PLUMBING

7.2.1 Minimum flow rates

Fitment	Flow rate (L/min)	
	Cold water	Hot water (minimum 60 °C)
Lavatory hand basins	10	7
Wash throughs, per tap	10	7
Sinks	15	20
Showers/sprays	7	7

7.2.2 Piping systems

A complete cold water piping system shall be designed for all buildings.

The type of water to be used for the different services shall be as specified in the project specification.

Facilities for supply of hot water shall be designed for wash rooms, mess rooms, kitchen, pantry, and first-aid facilities. Additional designs for installation of cold and hot water supply shall be made as indicated in the project specification. Garden water shall be made available by installing taps and hose connections at convenient locations on the exterior walls of buildings adjacent to the proposed garden areas.

In very dry areas a permanent underground garden water piping system shall be installed in the administration area. The use of treated effluent water should be considered.

Piping materials shall be copper for hot water and copper or PVC for cold water.

Piping and fittings shall be such that back-siphonage is excluded. The entire piping system shall be capable of being drained at low points conveniently located. Dismantling points shall be provided at easily accessible locations. All pipes shall be firmly fixed to the building.

Supply lines to fitments shall be provided with stop valves and unions so that any fitment can be isolated and replaced.

All pipes and fittings shall be hydrostatically tested after installation at 1.5 times the system pressure.

7.2.3 Toilets

The accommodation for male and female personnel shall be kept separate. The minimum number of fitments shall be as follows:

- For offices, laboratories, training centres, canteens, etc., see table below.

Fitment	Male Personnel	Female Personnel
WC	1 for 1 - 15 persons 2 for 16 - 40 persons 3 for 41 - 70 persons 4 for 71 - 100 persons	1 for 1 - 12 persons 2 for 13 - 25 persons 3 for 26 - 40 persons
Urinals	nil up to 2 persons 1 for 3 - 10 persons 2 for 11 - 20 persons 3 for 21 - 40 persons 4 for 41 - 100 persons	
Hand-wash basins	1 for 1 - 20 persons 2 for 21 - 40 persons 3 for 41 - 60 persons 4 for 61 - 80 etc.	1 for 1 - 15 persons 2 for 16 - 30 persons 3 for 31 - 45 persons 4 for 46 - 60 etc.

- For processing plants, 1 WC and 1 handwash basin shall be provided for every 10 persons on day shift. In addition, 1 urinal shall be provided for every 10 men.
- Each toilet area in industrial and utility buildings, including canteens, shall have a tap with hose connection and floor drain.

NOTE: In certain Middle East and Far East areas, local religious customs and/or regulations shall be followed with respect to the location of WC suites and the like, including the installation of foot washing facilities.

7.2.4 Washrooms/locker rooms

In non-processing sections of a plant (i.e. washrooms in workshops and fire stations etc.), showers shall be provided at the rate of one per twenty persons. Water troughs shall be provided at a length of 600 mm for every six persons.
In processing plants, for every five operators in day shift one shower shall be installed and 1200 mm length of water trough with two taps. In dirty plants (e.g. crude distillers, Epicote plants) for every three operators in day shift one shower shall be installed and 800 mm length of water trough with one tap.

For female personnel the same numbers shall be used.

Each washroom shall have a tap with hose connection and a floor drain. The locker room shall be provided with a tap with hose connection and sufficient floor drains.

7.2.5 Battery rooms

Each battery room except those with sealed batteries shall be provided with an eye-wash basin, a sink and a floor drain.

7.2.6 Equipment rooms

Rooms within the buildings where equipment will be installed (e.g. compressors, engines etc. for air-conditioning, heating or other purposes), shall be provided with a tap, hose connection and a floor drain.

7.2.7 Cleaners' cupboards

Each cupboard shall be provided with a bucket sink, a hose connection, a floor drain, racks for brooms and other cleaning/polishing equipment, and shelves for small material.

7.2.8 Fitments

All fitments of the same kind shall be of one uniform make and type.

7.2.8.1 Pedestal-type WC suite

This type WC shall consist of white-glazed vitreous china closet with 'S' or 'P' trap, seat lugs, solid plastic seat with seat cover, hinges, buffers and necessary flushing facilities. A toilet roll holder and ash-tray shall be provided, but the latter shall be omitted in 'non-smoking' areas. Flushing facilities shall be capable of delivering a minimum of eight litres of water per flush, in not more than six seconds.

7.2.8.2 Squatting-type WC

This, where required by local custom, shall consist of white vitreous fire-clay or stainless steel washdown closet, with 'S' or 'P' trap, vertical inlet, flushing rim, integral foot treads, and necessary flushing facilities of the same capacity as in (7.2.8.1). A pair of hand grips and a toilet roll holder shall be provided. An extra water tap shall be installed at a convenient location.

7.2.8.3 Urinal

This shall consist of a stainless steel or white-glazed vitreous china wall-type urinal with flushing rim, complete with flushing facilities and trap. Where urinals are installed in multiple units, each unit shall be separated by partitions. Flushing facilities shall be capable of discharging five litres of water per flush per urinal.

For multiple units of urinals automatic flushing facilities may be provided, maintaining the above capacity. In areas where smoking is allowed, an ash-tray shall be provided near each urinal.

7.2.8.4 Hand-wash basins and foot-wash basins

Material shall be white-glazed vitreous china or stainless steel. Minimum dimensions shall be 550 x 400 mm. Basins shall be provided with chromium-plated, easy-clean, screw-down type pillar taps or, if hot water is also provided, mixing valves shall be installed. Waste water shall be led through a sealed trap to the waste water system.

An overflow slot shall be provided

The drain should be provided with a plug and chain.

Each hand wash basin shall be provided with a mirror (minimum size 550 x 400 mm).

7.2.8.5 Sinks

Material shall be vitreous white-glazed fire-clay, or, if with draining boards, stainless steel. For cold water, chromium-plated bib taps shall be installed. Where hot water facilities are provided, a chromium-plated mixing valve with swivel spout shall be installed. Waste water fittings shall be as in (7.2.8.4). The sink in the cleaners' cupboard shall be provided with a chromium-plated bucket grating with hinges. Taps shall be installed at such a height as to facilitate easy filling of buckets.

7.2.8.6 Wash troughs

These shall be made of stainless steel and shall be provided with chromium-plated mixing valves at 600 mm centres. Mirrors shall be provided, one set for every two mixing valves. Waste water fittings shall be as in (7.2.8.4).

7.2.8.7 Showers

Shower basins shall be recessed in the floor, made of stainless steel and be provided with a seal trap connected to the waste water drainage system. The shower rose shall be connected to a hot and cold water mixing valve. Each shower shall be provided with a seat and a recessed soap holder.

7.2.8.8 Emergency showers and eye-baths

Emergency showers and eye-baths shall be provided in laboratories (see DEP 34.17.10.31-Gen.) and in other areas where people can come into contact with dangerous products. For connection of these showers, the instructions of the manufacturer shall be followed.

NOTE: The cold feed to emergency showers and eye washes shall not be subject to unacceptable heat gains.

7.2.8.9 Drinking water coolers

Provisions shall be made for future installation of water coolers at locations indicated in the Project Specification. These shall consist of installation of water supply, drain and electrical connections, all suitably plugged off.

7.2.8.10 Vending machines

Provisions for the connection of vending machines for coffee, tea, cocoa, cool drinks, cigarettes, chocolate, etc. shall be provided at convenient places in the buildings when specified.

7.3 TELECOMMUNICATIONS AND INSTRUMENTATION

Telecommunications include telephone, plant radio and closed-circuit television. The requirements for these items are dealt with in DEP 32.71.00.10-Gen.
The requirements for instrument signal lines are laid down in DEP 32.37.20.10-Gen. Due attention shall be paid to the provision of facilities such as Building Automation Systems, local area networks etc. The Principal shall be consulted for advice and approval.

7.4 ELECTRICAL

The electrical installations of buildings shall comply with DEP 33.64.10.10-Gen.

7.5 LIGHTING

Light intensity levels for the various rooms and areas shall be as specified in DEP 33.64.10.10-Gen.

7.6 INSTRUMENT AND TOOL AIR, GAS, WATER AND STEAM LINES IN WORKSHOPS AND KITCHENS

These lines shall be specified separately. All hose couplings, etc. shall be located at a height of 1000 mm above floor level. For all types of buildings where service lines pass through walls, the openings shall be sealed gas-tight.

8. FIRE PROTECTION

8.1 GENERAL

For explanations of terms used and tests mentioned below, see BS 476.

Where ventilation or other ducts or piping/cabling pass through roofs, walls or floors, the surrounding gaps shall be closed air- and water-tight by using materials of the same smoke and fire resistance of that particular element allowing essential thermal movements.

It shall be impossible for smoke or fire to travel from one floor to the other through ducting, etc.

The layout of the building shall be such that the maximum travel distance from any point of a floor in the building to the nearest exit of that floor shall be 25 m.

Insulation materials used inside and outside buildings shall be mineral wool blankets with galvanized wire netting and with no flammable materials attached to them (used in wall cladding, ceilings, partition walls, etc.). As an exception to this, translucent sheeting and build-up bituminous roofing felt, glass fibre based, are allowed but should, where possible, be avoided.

Staircases shall be separated from corridors by automatic closing doors. These doors shall be smoke-tight.

All materials on the outside of the building shall be of a non-combustible type.

In order to prevent smoke or fire travelling from one room to another, separation walls shall extend to the underside of the above laying floor or roof (or supporting beams of roof/floor whichever is applicable).

To prevent the spreading of smoke and fire through air duct systems, the latter shall consists of separate systems. Certain rooms may in this respect be combined. The guidelines of NFPA 90A shall be followed and approval of the Principal shall be obtained.

8.2 SURFACE SPREAD OF FLAME

Lining materials for walls and ceilings shall be of non-combustible materials. The degree of resistance to surface spread of flame shall correspond to class 1 of BS 476, Part 7.

For individual rooms in office and canteen buildings of which the floor area is less than 30 m^2, surfaces corresponding to class 2 may be allowed, except in lift and staircase walls.

8.3 FIRE RESISTANCE

The minimum fire-rating values of the elements of the buildings shall be as indicated in the following table.

Roofs and shaft enclosure walls around lifts, stairs and other vertical openings, including doors, shall have the same fire rating as the external walls.

Building type	Minimum period of smoke and fire resistance Fire rating in hours	
	External walls including doors excluding windows	Internal walls including doors excluding windows
Offices, bulk store, canteen, medical centre, fire station, gate house, traininng centre, workshops	1	½
Warehouses	1	1
Laboratory, computer room	2	1
Analyser buildings, substations	2	-

In addition, floors in elevated buildings shall have a minimum period of smoke and fire resistance of 1 hour.
Raised floors (computer floors) shall have a minimum period of smoke and fire-resistance of ½ hour.

Walls of heater/boiler rooms shall have a minimum period of smoke and fire resistance of 1 hour.

8.4 EXTERNAL FIRE EXPOSURE

The roofs of all buildings shall satisfy Class P60 of BS 476, part 3, without developing cracks or holes.

8.5 FIRE-FIGHTING EQUIPMENT/SYSTEMS

DEP 80.47.10.30-Gen., DEP 80.47.10.31-Gen., and DEP 80.47.10.32-Gen. shall apply.

9. SECURITY

9.1 GENERAL

Overall site security shall be subject to a separate security survey which is outside the scope of this DEP.
Specific requirements resulting from this survey affecting the building(s) shall be separately specified by the Principal.

9.2 ENTRANCE GATES

Unless otherwise specified in the project specification, the main entrance gate for vehicles shall be placed adjacent to the guard house nearby the administration office building. The guard house shall be located such that a guard sitting inside has an unrestricted view of the approach road on both sides of the gate. Due consideration shall be given to the provision of remote operation of the gate(s). In case of emergencies, manual operation shall be possible as well. An additional pedestrian gate shall be provided adjacent to the vehicle gate.

Two boom-type remote-controlled barriers shall also be provided adjacent to the main gate to control vehicle movements. The booms shall be operable from the guard house. Material for the gates shall be as specified for the main refinery fence. See Section 7 of DEP 34.13.20.31-Gen.

10. SURFACE PROTECTION

10.1 PAINTING AND COLOUR SCHEMES

Painting shall be carried out in accordance with DEP 30.48.00.31-Gen.

Colour schemes for buildings shall be designed by the local architects, agreed by the Principal.

10.2 GALVANIZING AND ZINC SPRAYING

Hot-dip galvanizing or zinc spraying shall be carried out in accordance with DEP 34.28.00.31-Gen.

11. SITE PREPARATION AND FINISHING

11.1 SITE PREPARATION

For site preparation requirements, see DEP 34.11.00.10-Gen., DEP 34.11.00.11-Gen., DEP 34.11.00.12-Gen., and DEP 34.13.20.31-Gen.

11.2 LANDSCAPING AND SITE FINISHING

The existing topography shall determine the relative elevations of individual buildings, except as otherwise indicated. Thus on fast-sloping terrain, stepped lay-out may be used, so as to reduce site preparation work. Careful consideration shall be given to the aesthetic appearance of the surroundings of the buildings within the earmarked building plot. Design of storm water drains, approaches to buildings, parking lots, gardening areas, and entrance gates, shall be approved by the Principal.

11.3 MATERIAL STORAGE YARD

An open storage yard shall be provided near the warehouse building. It shall be hard-surfaced and properly drained. The yard shall be completely fenced-in and provided with one gate 6 m wide and one passenger gate 1 m wide.
The total area shall be as specified in the project specification.

12. MISCELLANEOUS

12.1 ROOM NUMBERS AND NAMEPLATES

Panels for these shall be made of formica or similar material which can be engraved. Room number panels can be permanently fixed on the wall next to the doors, but nameplates shall be so fixed as to be easily interchangeable.

12.2 EMBLEMS AND LETTERING

The local company emblem and the letters forming the company name shall be compatible with the size of the building and made of natural anodized aluminium. The shapes shall be in accordance with local company standards.

12.3 PROVISIONS FOR EXTERNAL CLEANING

For tall buildings exceeding three storeys (over 10 m high), devices shall be installed to facilitate external cleaning of the building and windows.
Suspended platforms shall be designed to carry a minimum of two men plus 100 kg of equipment.

12.4 ACCESS TO UTILITY PIPING, ETC.

Adequate and safe means of access to piping, ducts, cables, etc. shall be provided, e.g. by means of trap-doors, walkways, step irons with hand rails and similar facilities.

12.5 FURNITURE AND FURNISHINGS

Although appearance shall be a primary consideration in the selection of furniture and furnishings, equal importance shall be given to strength, durability and ergonomic design.
Generally, such items shall be of a contemporary design and shall utilize, wherever possible, replaceable, modular component construction. They shall be of a design proven in service under conditions similar to those prevailing at the site.
All upholstered items, fabrics and coverings shall be of a self-extinguishing or fire-resisting type. Generally, fabrics should be durable and easy to clean. Materials and finishes used should be easily and locally repairable.

12.6 FLAGPOLES

Three identical flagpoles shall be located in the most prominent position near the entrance to the office area. Each flagpole shall be designed, along with its fixtures and foundations, to carry a flag of 2500 x 4000 mm.

The effective height shall be 6500 mm and the pole shall be assembled from tapering tubular steel sections, hot-dip galvanized inside and outside. The pole shall be hinged at the footing so that it can be lowered to a horizontal position.

13. REFERENCES

Amended per Circular 34/96

In this DEP reference is made to the following publications:

NOTE: Unless specifically designated by date, the latest edition of each publication shall be used, together with any amendments/supplements/revisions thereto.

SHELL STANDARDS

Index to Dep Publications and Standard Specifications	DEP 00.00.05.05-Gen.
Painting and coating for new construction projects	DEP 30.48.00.31-Gen.
Noise control	DEP 31.10.00.31-Gen.
Instrument air supply	DEP 31.37.00.11-Gen.
Heating, ventilation and air-conditioning of plant buildings	DEP 31.76.10.10-Gen.
Installation, testing and balancing and commissioning of HVAC systems	DEP 31.76.10.11-Gen.
On-line process stream analysers	DEP 32.31.50.13-Gen.
Instrument signal lines	DEP 32.37.20.10-Gen.
Plant telecommunication	DEP 32.71.00.10-Gen.
Electrical engineering guidelines	DEP 33.64.10.10-Gen.
Minimum requirements for civil design and engineering	DEP 34.00.01.30-Gen.
Site investigation	DEP 34.11.00.10-Gen.
Site preparation and earthworks	DEP 34.11.00.11-Gen.
Geotechnical and foundation engineering	DEP 34.11.00.12-Gen.
Roads, paving, surfacing, slope protection and fencing	DEP 34.13.20.31-Gen.
Drainage systems and primary treatment systems	DEP 34.14.20.31-Gen.
Reinforced control buildings	DEP 34.17.10.30-Gen.
Laboratories	DEP 34.17.10.31-Gen.
Reinforced concrete foundations and structures	DEP 34.19.20.31-Gen.
Steel structures	DEP 34.28.00.31-Gen.
Equipment and tools for maintenance and inspection	
- Part 2	DEP 70.08.10.11-Gen.
- Part 4	DEP 70.08.10.13-Gen.
- Part 5	DEP 70.08.10.14-Gen.

Requirements for fire protection in onshore oil and gas processing and petrochemical installations	DEP 80.47.10.30-Gen.
Active fire protection systems and equipment for onshore facilities	DEP 80.47.10.31-Gen.
Portable and mobile equipment for fire fighting	DEP 80.47.10.32-Gen.
Fire-fighting vehicles and fire stations	DEP 80.47.10.33-Gen.

STANDARD DRAWINGS

Specification for electrical overhead travelling cranes	T-1.765.282
Typical analyser house for tropical areas	S 17.001
Typical analyser house for non-tropical areas	S 17.002
Typical drawing for electrical station	T-1.707.055

AMERICAN STANDARDS

Thermal environmental conditions for human occupance	ASHRAE 55
Ventilation for acceptable indoor air quality	ASHRAE 62
ASHREA Handbook:	
"Fundamentals"	ASHRAE 1989
"HVAC Systems and Applications"	ASHRAE 1987
"Equipment"	ASHRAE 1988
"HVAC Applications"	ASHRAE 1991

Issued by:
American Society of Heating, Refrigeration and Air-Conditioning Engineers Incorporated,
1971 Tullie Circle NE, Atlanta, GA 30329, USA.

Standard for the installation of air conditioning and ventilating systems	NFPA 90A

Issued by:
National Fire Protection Association
470 Atlantic Avenue,
Boston, Massachusetts, MA 02210, USA.

BRITISH STANDARD

External fire exposure roof test	BS 476 Part 3
Fire tests on building materials and structures	BS 476 Part 7

Issued by:
British Standards Institution,
2 Park Street, London
England.

INTERNATIONAL STANDARDS

Electrical installation requirements	IEC 364

Issued by:
Central Office IEC (Sales Department)
3 rue de Varembé, CH-1211 Geneve 20,
Switzerland

Quantities and units of acoustics	ISO 31/VII
Acoustics - Rating of sound insulation in buildings and of building elements	ISO 717
Part 1: Airborne sound insulation in buildings and of interior building elements	
Part 3: Airborne sound insulation of facade elements and facades	

Issued by:
International Organization for Standardization
PO Box 56, CH-1211 Geneve 20, Switzerland

APPENDICES

APPENDIX 1 FINISHES OF FLOORS, CEILINGS, AND WALLS

AREA	FINISHES															
	FLOORS							CEILINGS					WALLS			
	F_1	F_2	F_3	F_4	F_5	F_6	F_7	C_1	C_2	C_3	C_4	C_5	W_1	W_2	W_3	W_4
Office building/ Training centre																
Office/classrooms		X	X	X				X					X			
Corridors/airlocks	X							X					X			X
Staircase	X							X					X			X
Aircond./ventilation						X					X		X			
Toilets/showers	X								X	X				X		
Kitchen/pantry	X								X	X				X		
Mech. training shop					X						X		X			X
El./instr. training shop					X						X		X			X
Training laboratory	X							X						X		
Basement						X					X				X	
Canteen building/ Mess room																
Sitting area		X	X	X				X					X			
Area around counter	X							X						X		
Kitchen/pantry	X								X					X		
Stores	X									X				X		
Where applicable other specific rooms as for Office building/Training centre above																
Laboratory and Plant Laboratory																
Rooms in general	X							X						X		
Offices	X	X	X					X					X			
Corridors	X							X						X		X
Bottle washing	X									X				X		
Glass/chemical stores	X									X				X		
CFR Engine room	X							X					X			
Where applicable other specific rooms as for Office building/Training centre above																
First aid/Fire brigade building																
Doctors room		X	X	X				X					X			
First aid nurse	X							X						X		
Laboratory	X							X						X		
Waiting room	X							X					X			
Garage					X						X				X	
Stores fire-fighting						X					X				X	
Where applicable other specific rooms as for Office building/Training centre above																
Gatehouse																
Guards room	X							X					X			
Where applicable other specific rooms as for Office building/Training centre above																

APPENDIX 1-2 FINISHES (cont'd)

AREA	F I N I S H E S															
	FLOORS							CEILINGS					WALLS			
	F_1	F_2	F_3	F_4	F_5	F_6	F_7	C_1	C_2	C_3	C_4	C_5	W_1	W_2	W_3	W_4
Control building																
Control room	X	X					X					X	X			
Offices	X	X	X					X					X			
Computer room							X	X					X			
Laboratory	X							X						X		
Instr. aux. basement/room							X	X					X			
Computer basement							X				X				X	
Electr. equipm. room						X	X				X				X	
Battery room	X					X					X				X	
Air-cond. machine room						X					X				X	
Corridors, airlocks	X							X					X			
Locker room/toilets	X								X	X				X		
Washroom	X								X	X				X		
Analyser house																
Analyser room	X	(acid resistant)									X		X			
Sample area						X					X		X			X
Switchhouse, substation																
Switch room						X					X		X		X	X
Workshops																
Mechanical workshop					X						X		X		X	X
Covered area					X						X		X		X	X
Electrical workshop					X						X		X		X	X
Instrument workshop (air conditioned)	X								X				X			X
Instrument workshop					X				X				X			X
Tool room					X						X				X	X
Offices	X	X	X					X					X			
Locker room	X								X	X				X		
Washroom	X								X	X			X	X		
Toilets	X								X	X				X		
Cleaner's cupboard	X										X			X		
Stores																
Consumables store					X						X		X		X	X
Bulk store					X								X		X	X
Storekeeper's office	X	X	X					X					X			
Covered walkways						X					X					

LEGEND FOR APPENDIX 1.

F = Floor finishes:

Note: In order to facilitate easy maintenance of floors a minimum of different floor finishes shall be used in one building. The use of locally available material shall be considered.

F1 = Vitreous clay tiles, min. 100 x 100 mm, with ditto skirting 100 mm high. For stairs special tiles shall be used to prevent slippage. In showers non-slip tiles to be used. Stair treads to be fitted with non-slip nosing.

F2 = PVC tiles with PVC skirting stair treads to be fitted with PVC nosing.

F3 = Linoleum with hardwood plinth.

F4 = Wall-to-wall carpets, if there is no chance that carpets will be damaged by oily shoes.

F5 = Steel-trowel finished green concrete with a carborundum surface finish (2.5 kg/m^2) and a 50 mm high sand cement skirting.

F6 = Steel-trowel finished green concrete with a 50 mm high sand cement skirting and a dustproof epoxy-resin based sealant (two layers) total min. dry film thickness 200-250 µm.

F7 = Cavity floor, top finished with F3 or F4 in tiles of 600 x 600 mm. See also DEP 34.17.10.30-Gen.

C = Ceiling finishes:

Note: Ceiling materials, including the entire suspension and the fixings, shall be non-combustible.

C1 = Suspended prefabricated acoustic panels.

C2 = Suspended, plastered and painted.

C3 = Plastered and painted.

C4 = Fair-faced and painted (ceiling will be formed by underside of floor or roof construction).

C5 = Lowered egg-crate diffusing panels of aluminium. Light fittings without reflecting assemblies above, installed in lines against concrete ceiling. Concrete ceiling to be lined with white acoustic tiles. For computerised control buildings, a different ceiling system may be necessary to prevent glare on the monitor screens. This shall be agreed with the Principal.

W = Internal wall finishes:

W_1 = Plastered and painted

W_2 = Glazed ceramic tiles up to door frame height, rest of wall W1.

If ceiling is low, wall tiles up to ceiling height (i.e. in toilets).

W_3 = Fair-faced and painted.

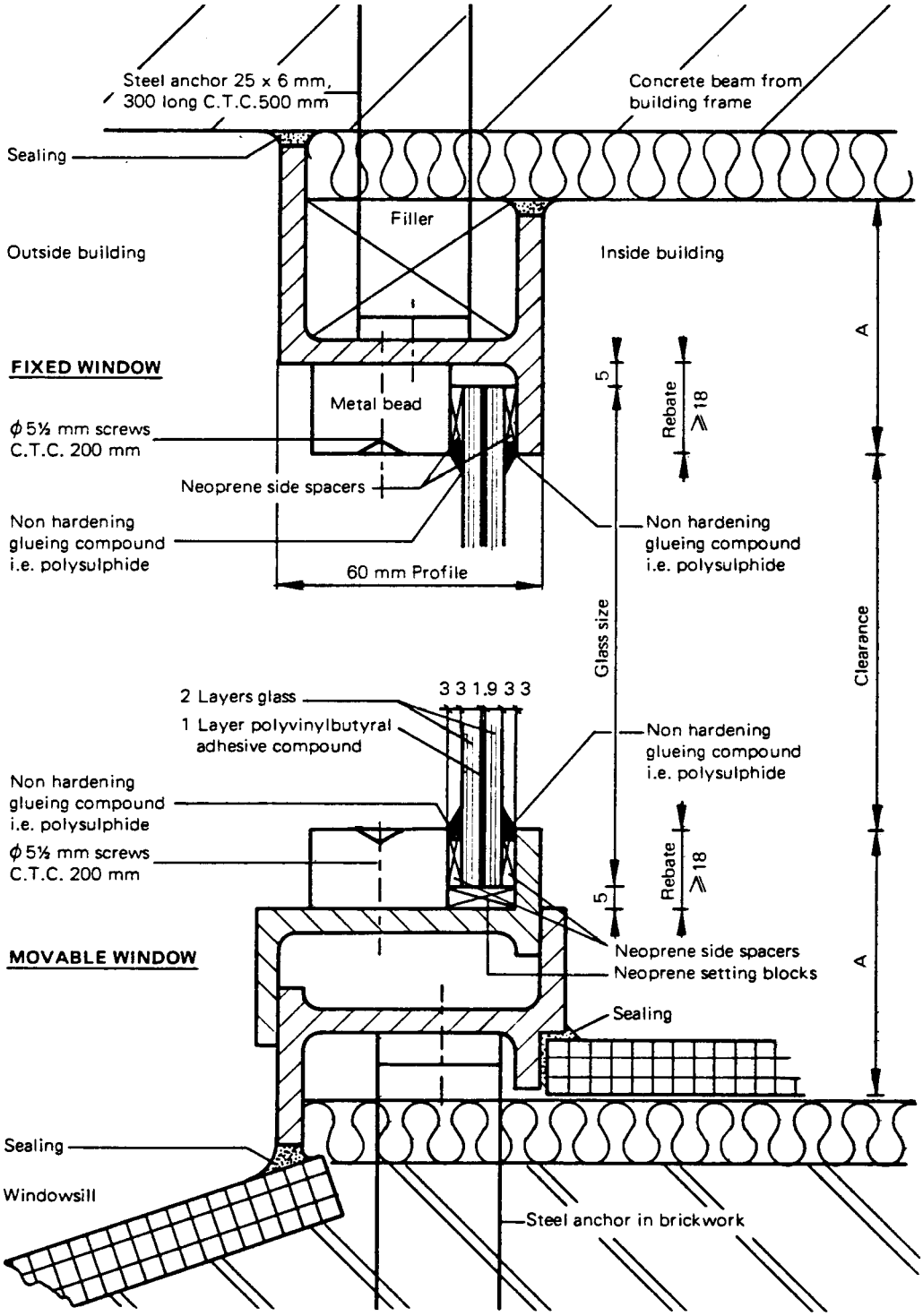
W_4 = Fair-faced, if attractive facing bricks are available

Note: In mess room, tea pantry, analyser room, battery room, only tiling above and next to sink and sideboard, about 450 mm high and wide.

Outer walls:

Where painting of wall surface consisting of concrete or rendering work is specified, two or more coats of fungus-resistant cement-based washable distemper shall be applied after the necessary surface treatment.

APPENDIX 2 TYPICAL WINDOW DETAIL



APPENDIX 3 CLIMATIC CONDITIONS FOR ROOMS IN NON-PLANT BUILDINGS

Space	Normal Db Temp.		Humidity		Ventilation		Over-pressure	Filters Specification		Type of room	Internal Air Recirculation		Type of Air Distribution	
	Min °C (9)	Max °C (9)	Min % RH	Max % RH	Req.'d	Rate	Pa (8)	Fresh Air % (3)	Recirc. Air %	Quality (1)	Req.'d	Separat e (4)	Fresh Air blown from	Used Air Removal from
Office Building														
Computer Room	20	26	30	70	Yes	10 l/s pers	10	65	65	Clean	Yes	Yes		
Office	20	26	30	70	Yes	10 l/s pers	10	65	-	"	No	No	Top (5)	Top
Canteen	20	26	30	70	Yes	10 l/s pers	10	65	-	"	"	"	Top	Top
Kitchen	20	26	30	70	Yes	(6)	-	65	-	"	"	"	"	"
Laboratory	20	26	30	70	Yes	(6)	(6)	(6)	-	Foul (6)	"	"	"	(10)
HVAC Mach.	5	-	-	-	Yes	0.5 ac/h (2)	-	-	-	"	-	-	"	Top
Corridor	15	-	-	-	No	-	-	-	-	"	-	-	-	-
Staircase	15	-	-	-	No	-	-	-	-	"	-	-	-	-
Toilet	20	-	-	-	Yes	(7)	-	-	-	"	-	-	-	Top
Wash/Dressing	20	-	-	-	Yes	(7)	-	-	-	"	-	-	-	"
Shower	20	-	-	-	Yes	(7)	-	-	-	"	-	-	-	"
Parking Areas	-	-	-	-	Yes	(7)	-	-	-	-	-	-	-	-

NOTES: (1) Clean means: Generation of fouling (polluting) substances is not expected.
Foul means: Generation of fouling (polluting) substances may take place.

(2) ac/h: air change per hour.

(3) Efficiency ASHRAE dust spot test, according to ASHRAE Standard 52-76.

(4) Separate air recirculation system is required to cope with spread of smoke in case of fire.

(5) If a raised floor is available, from the bottom.

(6) User to specify, but it is likely that ventilation rates will be dictated by the extract requirements of equipment.

(7) Ventilation rates according to guidelines ASHRAE standard HVAC.

(8) (Over)pressure control is not required.

(9) Minimum temperature in principle holds for heating capacity calculation (at minimum outdoor temperature).

Maximum temperature in principle holds for cooling capacity calculation (at maximum outdoor temperature).

(10) From top and bottom.