

DEP SPECIFICATION

## DESIGN AND ENGINEERING OF BUILDINGS

DEP 34.17.00.32-Gen.

September 2012

DESIGN AND ENGINEERING PRACTICE



© 2012 Shell Group of companies  
All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, published or transmitted, in any form or by any means, without the prior written permission of the copyright owner or Shell Global Solutions International BV.

## PREFACE

DEP (Design and Engineering Practice) publications reflect the views, at the time of publication, of Shell Global Solutions International B.V. (Shell GSI) and, in some cases, of other Shell Companies.

These views are based on the experience acquired during involvement with the design, construction, operation and maintenance of processing units and facilities. Where deemed appropriate DEPs are based on, or reference international, regional, national and industry standards.

The objective is to set the standard for good design and engineering practice to be applied by Shell companies in oil and gas production, oil refining, gas handling, gasification, chemical processing, or any other such facility, and thereby to help achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to Shell companies 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 Units to adapt the information set forth in DEPs to their own environment and requirements.

When Contractors or Manufacturers/Suppliers use DEPs, they shall be solely responsible for such use, including the quality of their work and the attainment of the required design and engineering standards. In particular, for those requirements not specifically covered, the Principal will typically expect them to follow those design and engineering practices that will achieve at least the same level of integrity as reflected in the DEPs. If in doubt, the Contractor or Manufacturer/Supplier shall, without detracting from his own responsibility, consult the Principal.

The right to obtain and to use DEPs is restricted, and is typically granted by Shell GSI (and in some cases by other Shell Companies) under a Service Agreement or a License Agreement. This right is granted primarily to Shell companies and other companies receiving technical advice and services from Shell GSI or another Shell Company. Consequently, three categories of users of DEPs can be distinguished:

- 1) Operating Units having a Service Agreement with Shell GSI or another Shell Company. The use of DEPs by these Operating Units is subject in all respects to the terms and conditions of the relevant Service Agreement.
- 2) Other parties who are authorised to use DEPs subject to appropriate contractual arrangements (whether as part of a Service Agreement or otherwise).
- 3) Contractors/subcontractors and Manufacturers/Suppliers under a contract with users referred to under 1) or 2) which requires that tenders for projects, materials supplied or - generally - work performed on behalf of the said users comply with the relevant standards.

Subject to any particular terms and conditions as may be set forth in specific agreements with users, Shell GSI disclaims any liability of whatsoever nature for any damage (including injury or death) suffered by any company or person whomsoever as a result of or in connection with the use, application or implementation of any DEP, combination of DEPs or any part thereof, even if it is wholly or partly caused by negligence on the part of Shell GSI or other Shell Company. The benefit of this disclaimer shall inure in all respects to Shell GSI and/or any Shell Company, or companies affiliated to these companies, that may issue DEPs or advise or require the use of DEPs.

Without prejudice to any specific terms in respect of confidentiality under relevant contractual arrangements, DEPs shall not, without the prior written consent of Shell GSI, be disclosed by users to any company or person whomsoever and the DEPs shall be used exclusively for the purpose for which they have been provided to the user. They shall be returned after use, including any copies which shall only be made by users with the express prior written consent of Shell GSI. The copyright of DEPs vests in Shell Group of companies. Users shall arrange for DEPs to be held in safe custody and Shell GSI may at any time require information satisfactory to them in order to ascertain how users implement this requirement.

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

## TABLE OF CONTENTS

|           |                                                                      |           |
|-----------|----------------------------------------------------------------------|-----------|
| <b>1.</b> | <b>INTRODUCTION .....</b>                                            | <b>5</b>  |
| 1.1       | SCOPE.....                                                           | 5         |
| 1.2       | DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS .....       | 5         |
| 1.3       | DEFINITIONS .....                                                    | 6         |
| 1.4       | CROSS-REFERENCES .....                                               | 6         |
| 1.5       | SUMMARY OF MAIN CHANGES.....                                         | 6         |
| 1.6       | COMMENTS ON THIS DEP .....                                           | 7         |
| 1.7       | DUAL UNITS.....                                                      | 8         |
| <b>2.</b> | <b>DESIGN AND ENGINEERING DRAWINGS .....</b>                         | <b>9</b>  |
| 2.1       | BASIC INFORMATION .....                                              | 9         |
| 2.2       | SCHEMATIC DEVELOPMENT.....                                           | 9         |
| 2.3       | DESIGN DEVELOPMENT .....                                             | 10        |
| 2.4       | FINAL DEVELOPMENT.....                                               | 11        |
| 2.5       | BUILDING ACCEPTANCE .....                                            | 13        |
| <b>3.</b> | <b>LAYOUT OF BUILDINGS .....</b>                                     | <b>13</b> |
| 3.1       | LAYOUT OF THE CONTROL BUILDING.....                                  | 13        |
| 3.2       | LAYOUT OF THE FAR .....                                              | 15        |
| 3.3       | LAYOUT OF LOCKER ROOMS .....                                         | 16        |
| 3.4       | LAYOUT OF ELECTRICAL STATIONS AND ANALYSER HOUSES.....               | 16        |
| 3.5       | LAYOUT OF WAREHOUSES.....                                            | 16        |
| <b>4.</b> | <b>DESIGN LOADS.....</b>                                             | <b>18</b> |
| <b>5.</b> | <b>CLIMATIC ASPECTS, INSULATION AND NOISE.....</b>                   | <b>18</b> |
| 5.1       | GENERAL .....                                                        | 18        |
| 5.2       | HEATING, VENTILATION AND AIR CONDITIONING OF PLANT BUILDINGS.....    | 18        |
| 5.3       | HVAC OF NON-PLANT BUILDINGS.....                                     | 18        |
| 5.4       | INSULATION.....                                                      | 19        |
| 5.5       | NOISE ABATEMENT/VIBRATION .....                                      | 20        |
| 5.6       | COMPUTERISED EQUIPMENT.....                                          | 22        |
| <b>6.</b> | <b>BUILDING ELEMENTS/COMPONENTS .....</b>                            | <b>23</b> |
| 6.1       | GENERAL .....                                                        | 23        |
| 6.2       | MATERIALS AND METHODS OF CONSTRUCTION.....                           | 23        |
| 6.3       | WALLS .....                                                          | 23        |
| 6.4       | ROOFS .....                                                          | 24        |
| 6.5       | CEILINGS .....                                                       | 25        |
| 6.6       | FLOORS .....                                                         | 26        |
| 6.7       | DOORS.....                                                           | 28        |
| 6.8       | WINDOWS.....                                                         | 31        |
| 6.9       | SPECIAL REQUIREMENTS FOR PLANTS HANDLING VERY TOXIC<br>PRODUCTS..... | 34        |
| 6.10      | STAIRCASES .....                                                     | 34        |
| 6.11      | LABORATORY CASEWORK .....                                            | 35        |
| <b>7.</b> | <b>UTILITIES .....</b>                                               | <b>36</b> |
| 7.1       | DRAINAGE AND SEWERAGE.....                                           | 36        |
| 7.2       | PLUMBING AND WATER SUPPLY .....                                      | 37        |
| 7.3       | TELECOMMUNICATIONS AND INSTRUMENTATION.....                          | 42        |
| 7.4       | ELECTRICAL .....                                                     | 42        |
| 7.5       | LIGHTING .....                                                       | 43        |
| 7.6       | MISCELLANEOUS UTILITIES.....                                         | 43        |
| <b>8.</b> | <b>FIRE PROTECTION .....</b>                                         | <b>44</b> |
| 8.1       | GENERAL .....                                                        | 44        |
| 8.2       | SURFACE SPREAD OF FLAME .....                                        | 44        |
| 8.3       | FIRE RESISTANCE.....                                                 | 44        |
| 8.4       | FIRE-FIGHTING EQUIPMENT/SYSTEMS.....                                 | 46        |

|            |                                             |           |
|------------|---------------------------------------------|-----------|
| <b>9.</b>  | <b>SECURITY .....</b>                       | <b>46</b> |
| 9.1        | GENERAL .....                               | 46        |
| 9.2        | ENTRANCE GATES .....                        | 46        |
| 9.3        | WAREHOUSES .....                            | 46        |
| <b>10.</b> | <b>SURFACE PROTECTION .....</b>             | <b>47</b> |
| 10.1       | PAINTING AND COLOUR SCHEMES .....           | 47        |
| 10.2       | GALVANISING AND ZINC SPRAYING .....         | 47        |
| <b>11.</b> | <b>SITE PREPARATION AND FINISHING .....</b> | <b>47</b> |
| 11.1       | SITE PREPARATION .....                      | 47        |
| 11.2       | LANDSCAPING AND SITE FEATURES .....         | 47        |
| 11.3       | MATERIAL STORAGE YARD .....                 | 47        |
| <b>12.</b> | <b>MISCELLANEOUS .....</b>                  | <b>47</b> |
| 12.1       | SIGNAGE .....                               | 47        |
| 12.2       | COMPANY EMBLEMS AND LETTERING .....         | 47        |
| 12.3       | PROVISIONS FOR EXTERNAL CLEANING .....      | 48        |
| 12.4       | ACCESS TO UTILITY PIPING, ETC. ....         | 48        |
| 12.5       | FURNITURE AND FURNISHINGS .....             | 48        |
| 12.6       | FLAGPOLES .....                             | 48        |
| 12.7       | OTHER BUILDING APURTENANCES .....           | 48        |
| <b>13.</b> | <b>REFERENCES .....</b>                     | <b>49</b> |

## APPENDICES

|                    |                                                                                        |           |
|--------------------|----------------------------------------------------------------------------------------|-----------|
| <b>APPENDIX 1</b>  | <b>FINISHES OF FLOORS, CEILINGS, AND WALLS .....</b>                                   | <b>51</b> |
| <b>APPENDIX 2</b>  | <b>TYPICAL WINDOW DETAIL .....</b>                                                     | <b>55</b> |
| <b>APPENDIX 3</b>  | <b>CLIMATIC CONDITIONS FOR ROOMS IN NON-PLANT BUILDINGS .....</b>                      | <b>56</b> |
| <b>APPENDIX 4</b>  | <b>TYPICAL LOCATION OF CONTROL BUILDING .....</b>                                      | <b>58</b> |
| <b>APPENDIX 5</b>  | <b>TYPICAL LAYOUT OF CONTROL BUILDING .....</b>                                        | <b>59</b> |
| <b>APPENDIX 6</b>  | <b>TYPICAL CROSS SECTIONS OF CONTROL BUILDING .....</b>                                | <b>60</b> |
| <b>APPENDIX 7</b>  | <b>BIRD'S EYE VIEW OF A CONTROL BUILDING .....</b>                                     | <b>61</b> |
| <b>APPENDIX 8</b>  | <b>TYPICAL CROSS SECTION OF CONTROL BUILDING WITH<br/>VENTILATION PROVISIONS .....</b> | <b>62</b> |
| <b>APPENDIX 9</b>  | <b>TYPICAL CROSS SECTION OF CONTROL ROOM .....</b>                                     | <b>63</b> |
| <b>APPENDIX 10</b> | <b>DESIGN LOADS RECOMMENDATIONS .....</b>                                              | <b>64</b> |
| <b>APPENDIX 11</b> | <b>PRELIMINARY DIMENSIONS .....</b>                                                    | <b>67</b> |
| <b>APPENDIX 12</b> | <b>HVAC FOR NON-PLANT BUILDINGS .....</b>                                              | <b>69</b> |
| <b>APPENDIX 13</b> | <b>ACCESSABILITY CONSIDERATIONS .....</b>                                              | <b>72</b> |
| <b>APPENDIX 14</b> | <b>PROJECT DOCUMENTATION REQUIREMENTS .....</b>                                        | <b>73</b> |

## 1. INTRODUCTION

### 1.1 SCOPE

This DEP specifies the requirements and gives recommendations for the design and engineering of new buildings in oil refineries, gas plants, chemical plants, power generation plants, utility plants, onshore exploration and production facilities and, supply/marketing installations.

The requirements for the siting of buildings are defined in DEP 80.00.10.11-Gen. These requirements specify when a building needs to be designed to resist blast loads using DEP 34.17.10.30-Gen. and when a conventional design is acceptable using this DEP.

The requirements for blast load design are defined in DEP 34.17.10.30-Gen.

The requirements for human factors engineering are defined in DEP 30.00.60.15-Gen.

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

|                               |                           |
|-------------------------------|---------------------------|
| Analyser houses               | DEP 32.31.50.13-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.      |
|                               | Standard Drawing S 68.040 |
| Workshops                     | DEP 70.08.10.11-Gen.      |
|                               | DEP 70.08.10.13-Gen.      |

This DEP is not applicable for buildings on offshore facilities.

This is a revision of the DEP of the same number, dated September 2011; see (1.5) regarding the changes.

### 1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorisation to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil and gas production, chemical processing, power generation, utilities, onshore exploration and production and, supply/marketing. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could 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 with regards to the safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP 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, the objective being to obtain agreement to follow this DEP as closely as possible.

## 1.3 DEFINITIONS

### 1.3.1 General definitions

The **Contractor** is the party that 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 that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. 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.

### 1.3.2 Specific definitions

| Term                           | Definition                                                                                                                                                                                                                                                                                              |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Blast Resilient</b>         | Structures or their components that have already a certain elasticity/flexibility in their conventional design to receive some low (limited) blast loads; or structures or their components that are designed with an improved conventional (enhanced resilient) design to receive limited blast loads. |
| <b>Blast Resistant</b>         | Structures or their components that are designed to receive blast loads.                                                                                                                                                                                                                                |
| <b>Plant Building</b>          | Generic term for control building (including plant laboratory), field auxiliary room, analyser house, electrical substation, compressor building or other related buildings for plant process operating activities.                                                                                     |
| <b>Non-Plant Building</b>      | Generic term for buildings not related to plant process operating activities, e.g., administration building/office, training centre, canteen, warehouse, workshop, chemical store, laboratory, gate/guard house, security office or fire station.                                                       |
| <b>Very Toxic (Substances)</b> | Substances that are very hazardous for the environment or human health, as specified in DEP 01.00.01.30-Gen. (which also identifies "toxic" substances by reference to chemical substances databases).                                                                                                  |

### 1.3.3 Abbreviations

| Term        | Definition                                |
|-------------|-------------------------------------------|
| <b>CFR</b>  | Combustion Fuel Reference                 |
| <b>FAR</b>  | Field Auxiliary Room                      |
| <b>HVAC</b> | Heating, Ventilation and Air Conditioning |

## 1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets ( ). Other documents referenced by this DEP are listed in (13).

## 1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated September 2011.

Content of the previous version that was background information, explanation and guidance and therefore not required to be communicated to the Contractor, has been moved into a companion document called a "DEP Informative" accessible from the Shell Standards web page.

| Old section   | New Section   | Change                                                                                                                                                                              |
|---------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.1           | 1.1           | Exclusion of warehouse buildings for storage of chemicals removed.                                                                                                                  |
| -             | 3.5           | Added new section Layout of Warehouses.                                                                                                                                             |
| -             | 6.4.4         | Added new section Warehouse roofs.                                                                                                                                                  |
| 5.5.3         | 5.5.3         | 70dB category description amended to cover electrical/switch/HVAC rooms                                                                                                             |
| 6.6.2         | 6.6.2         | 'shall' replaced by 'may' in first line.                                                                                                                                            |
| -             | 6.6.3         | Added new section Warehouse (floors).                                                                                                                                               |
| 6.6.4         | 6.6.4         | Cavity floor loading criteria amended                                                                                                                                               |
| 6.7.1         | 6.7.1         | Air lock and revolving/sliding door requirements amended                                                                                                                            |
| 7.2.2         | 7.2.2         | Additional Legionella design requirements added                                                                                                                                     |
| 7.2.3         | 7.2.3         | Toilet requirements amended                                                                                                                                                         |
| 7.2.4         | 7.2.4         | Shower and washbasin allocation rates amended                                                                                                                                       |
| 8.1           | 8.1           | Paragraph added to cover fire walls in warehouses storing chemicals.                                                                                                                |
| 8.3           | 8.3           | Table 8.3 Office category external fire rating revised from 2 to 1 hr + Notes 4 and 5 added.<br>Paragraph and Figure 8.3 added to cover warehouse fire doors with vehicular access. |
| -             | 9.3           | Added new section Warehouses (security).                                                                                                                                            |
| 13            | 13            | The Shell Guide to the Warehousing of Chemicals reference details updated.                                                                                                          |
| Appendix 1    | Appendix 1    | Fair Faced Finish definition reference added                                                                                                                                        |
| Appendix 3    | Appendix 3    | Table first row titles added                                                                                                                                                        |
| Appendix 10.4 | Appendix 10.4 | Workshop crane provision and operating speeds amended                                                                                                                               |
| Appendix 11   | Appendix 11   | Ceiling heights for Canteen/Auditorium added and office space requirements amended                                                                                                  |
| Appendix 12   | Appendix 12   | Section 4: Abnormal situation requirements removed.<br>Section 5: Smoking areas requirements amended.                                                                               |

## 1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using the DEP Feedback Form by:

- Entering comments directly in the DEP Feedback System on the Technical Standards Portal <http://sww.shell.com/standards> (mandatory for users with access to Shell Wide Web);
- Clicking on the DEP Feedback Form button on the DEPs DVD-ROM main page (for users without access to Shell Wide Web);
- Requesting a copy of the DEP Feedback Form from the Administrator at [standards@shell.com](mailto:standards@shell.com) (for users without access to Shell Wide Web).

For the last two options, the completed DEP Feedback Form can be attached to an email and submitted to the Administrator at [standards@shell.com](mailto:standards@shell.com). Only feedback that is entered into the Feedback Form will be considered.

#### 1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

## **2. DESIGN AND ENGINEERING DRAWINGS**

### **2.1 BASIC INFORMATION**

The Principal shall indicate the scope of work to the Contractor in the form of a project specification.

The design scope for the development of buildings shall adhere to the following stages:

- Schematic Development
- Design Development
- Final Development
- Building Acceptance

The documents from each stage shall be submitted for Principal approval and shall meet the requirements and consider the guidance in the rest of the document.

The Contractor shall be responsible for documenting the functional requirements and all design code requirements and construction restrictions that are to be addressed. The Contractor shall involve Principal operations personnel in reviewing and approving the proposed approach to meeting regulatory standards, detail design, equipment, and furniture selection.

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

The layout 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.

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

### **2.2 SCHEMATIC DEVELOPMENT**

The schematic architectural preliminary review of design and drawings should include all of the following scope of services and deliverables.

1. Review and refine the building operational requirements including:
  - a) Space area requirements for the building
  - b) Schematic diagrams for all major functions
  - c) Material handling and staging requirements
  - d) Support areas for all functions
  - e) Maintenance and service requirements
  - f) Flexibility of multi function areas
  - g) Future expansion
2. Research and identify influences (zoning, other structures, etc.) that impact building siting. Site plan shall indicate future expansion of the facility.
3. The Principal's Technical Safety Specialist shall be consulted to determine the blast resilience/resistance requirement for the facility.
4. Develop a layout plan, showing the position of the buildings on site, including plant and true north and prevailing wind direction(s).
5. Develop preliminary floor plans of every floor indicating positions, dimensions and levels, including intended use of the rooms in the building.
6. Develop a schematic drawing of essential elevations and typical cross sections. The appearance of the administration buildings, e.g., canteen, training centre,

engineering and office buildings, shall be in harmony with the local architecture.

7. For buildings with basements, the highest ground water level shall be indicated.
8. Develop general equipment arrangement plans.
9. Develop preliminary building elevations, building sections, roof plan.
10. Develop material flow diagram and personnel flow diagrams.
11. Schedule of basic structural materials proposed to be used. Locally available materials shall be specified as much as possible provided they are technically acceptable.
12. Structural design methodology to meet each design requirement.
13. 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.
14. Preliminary calculations for insulation against solar and proposed equipment load and economic heat conservation.
15. A description, including material specifications, of other installations such as lifts, plumbing, drainage, sewage disposal, etc.
16. One line electrical drawing of the power system.
17. Coordinate design efforts with all disciplines and operations personnel.
18. Schedule of overall design activities for all disciplines.

## 2.3 DESIGN DEVELOPMENT

A design development architectural review shall be conducted for each building. The scope of services and deliverables should consist of the following:

1. Review the Principal's comments and concerns developed during the schematic architectural preliminary review.
2. Finalize building program of space compiling all space area (square meters or square foot) requirements for the functional building program.
3. Preliminary building code(s) review and assess building design's current compliance.
4. Preliminary insurance underwriter's requirements review (if applicable).
5. Preliminary review and have initial contact with fire marshal and building and zoning agencies (if applicable).
6. Update of material flow diagram and personnel flow diagrams.
7. Outline Specifications and/or lists with descriptions of significant materials, systems and equipment and their performance criteria and quality standards.
8. Update of floor plans, layouts, buildings elevations and sections, roof plan, architectural rendering of exterior of building, and appropriate preliminary detailing to convey design intent and standard of quality suitable for estimating quotation of cost.
9. Develop laboratory casework and laboratory equipment layouts detailing to convey design intent and standard of quality suitable for estimating quotation of cost at this phase (if applicable).
10. Finalize general equipment arrangement plans.
11. Identify room functional requirements (room data sheets).
12. Identify and review signage requirements for interior and exterior of building.
13. Preliminary lighting plan/reflective ceiling plan.
14. Preliminary smoke detection system layout drawing.

15. Preliminary plumbing plan.
16. Preliminary HVAC plan and details.
17. Preliminary HVAC equipment schedule.
18. Preliminary HVAC exhaust fans plan.
19. Coordinate design efforts with all disciplines.
20. Schedule of overall design activities for all disciplines.

## 2.4 FINAL DEVELOPMENT

The final design development shall comprise:

1. Review of Principal's comments and concerns from design development architectural review.
2. Final review of compliance of Building Code(s) analysis; all submittal of sealed documents for review by all review agencies will be a part of this scope.
3. Final review of insurance underwriter's requirements (if applicable); all submittal of sealed documents for review by the agencies will be a part of this scope.
4. Detailed design documentation.
5. Complete laboratory casework layout, details and parts list to provide a complete package of laboratory amenities including hoods (if applicable).
6. Final functional space program (includes space and layout requirements).
7. Final material flow diagram and personnel flow diagrams.
8. Complete layout plan, showing the locations and orientation of the building.
9. Complete construction documents, drawings and specifications for all project related buildings. The number of drawings is required by building size and complexity. The drawings shall show the position, form, dimensions and materials of the various parts of the building. These documents are to include, but not be limited to:
  - a) Cover sheet
  - b) Abbreviation sheet
  - c) Site and building location plan
  - d) Site details
  - e) Landscaping and planting plans
  - f) Access/egress and occupancy plans (scale as required by approval agency)
  - g) Architectural general notes
  - h) Final drawings showing the structural design of the main elements of the building and its foundation
  - i) Floor plans for each level of the project
  - j) Roof plans
  - k) Building elevations
  - l) Building sections
  - m) Building wall sections
  - n) Exterior building details
  - o) Roofing details
  - p) Enlarged floor plans

- q) Interior elevations
  - r) Interior details
  - s) Room finish schedules
  - t) Partition types and door details
  - u) Door schedules
  - v) Window schedule and details
  - w) Reflected Ceiling plans for each level of the building
  - x) Smoke detection system layout drawing
  - y) Plumbing plan
  - z) HVAC plan and details
  - aa) HVAC equipment schedule
  - bb) HVAC exhaust fans plan
  - cc) Stair plans, sections, and details
  - dd) Elevator plans, sections, and details
  - ee) Laboratory casework plans and elevations
  - ff) Miscellaneous section and details
  - gg) Signage plans and details
  - hh) Architectural rendering of exterior of building
10. HVAC collected design data and calculations for climatic consideration, logically leading to the conditions expected to prevail in the building. Calculations and material and equipment data shall be provided as means to substantiate that the criteria of comfort will be satisfied.
  11. Specifications for the scope of works, in sufficient detail to invite competitive bids from fabrication and erection Contractors and drafted so as to provide the minimum possible disparity between the interpretations of such Contractors. These specifications shall also include a program of erection, the final material specifications, and working details.
  12. 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.
  13. For blast-resilient/resistant buildings, two (2) hard copies and electronic files of structural drawings and calculations shall be submitted to Principal. One set shall be submitted to the location and the other set to the Principal's technical safety specialist.
  14. Drawings and related documents shall be made in accordance with DEP 34.00.01.30-Gen.
  15. The scales to be used for various drawings shall be as defined below:

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

## 2.5 BUILDING ACCEPTANCE

The following documents shall be submitted to the Principal at building acceptance:

1. As built drawings.
2. Operating and maintenance manuals and recommended spare parts list for building equipment.
3. Program documentation and backup media for programmable building equipment.
4. HVAC testing documentation that certifies that it performed successfully in accordance to all local codes and regulations.
5. Elevator inspection and testing documentation that certifies that elevators performed successfully in accordance to all local codes and regulations.

## 3. LAYOUT OF BUILDINGS

The following requirements are applicable for all buildings:

1. The Principal shall determine the occupation rate of offices/rooms.
2. The width of doors, stairs and passages shall comply with the applicable regulations, permitting free and easy exit in emergencies, as well as easy transportation of equipment. The travel distance from any occupied space shall also be in compliance with local codes.
3. Batteries for emergency power supply shall not be located under wash and toilet areas and shall have dedicated separate exhaust facilities.
4. The spaces provided for mechanical equipment, instrument and computer equipment shall have sufficient free working space.
5. Buildings may contain smoking permitted areas and smoke-free areas or classified as smoke free in its entirety. When smoking areas are to be included in the building, areas shall be classified as either smoking-free areas or smoking permitted areas. Signs posted outside each entrance to a smoking permitted area shall indicate "Smoking Permitted Area". All other areas are smoke-free areas and do not require signs.
6. All exceptions to a corridor width of 2000 mm (6 ft 8 in) shall be subject to approval by the Principal.

### 3.1 LAYOUT OF THE CONTROL BUILDING

#### 3.1.1 General

The control building should normally comprise the following:

- a) The control room;
- b) The computer room;
- c) A training/conference room;
- d) A supervisory area adjacent to the control room;
- e) An auxiliary instrument and computer room, if required;
- f) The electrical equipment and battery room;
- g) The HVAC room;
- h) The first-aid compartment/ office;
- i) The plant laboratory, if necessary (see Note 1);
- j) The offices (see Note 2) and social amenities (mess room, wash, locker and toilet rooms);

k) Air sluice(s).

- NOTES:
- 1) To minimise the number of people near potential hazards, and to reduce the size of control buildings, a general site laboratory shall not be part of the control building. The general site laboratory shall be located, if possible, near the administration area and in a non-major hazard area.
  - 2) Provision of office space in the control building should be determined per project, taking into account the local organisation (including future plans) and local needs.
  - 3) If sufficient space is not available, a basement may be designed. All utilities and E/I equipment should be located in the basement.

For a typical drawings layout for control buildings, see (Appendix 4), (Appendix 5), (Appendix 6), (Appendix 7), (Appendix 8) and (Appendix 9). With the approval of the Principal, the Contractor may make alterations in the arrangement and orientation of these typical drawings.

**3.1.2 Control room**

The control room shall be designed so that sufficient space for installation of equipment for future plant extensions is incorporated without the need to extend the building.

**3.1.3 Computer room**

A separate room for the accommodation of digital process computers, etc., shall be incorporated in the control building. This computer room shall be in such a location that the risk of exposure to fire, water, smoke and dust from adjoining areas and activities are kept to a minimum. This room shall not be located in a basement (if provided).

The computer room shall not be located adjacent to rooms with equipment which could cause electrical interference, such as rotating electrical machinery, transformers or electrical switchgear, unless special precautions have been taken to safeguard the proper functioning of the computer equipment.

**3.1.4 Instrument basement and computer basement**

Auxiliary instrument and computer equipment may be installed in a personnel accessible basement (if permitted and required) under the control room and the computer room.

**3.1.5 Electrical equipment and battery room**

Important equipment, such as panels, switchgear, or radio base stations, etc., shall not be installed against external walls.

Batteries for emergency power supply shall be located in separate rooms (ground level or basement) with separate exhaust facilities. The rooms shall not be located under wash and toilet areas because of possible plumbing leakages.

**3.1.6 HVAC machine room**

The machine room for heating, ventilating and air-conditioning equipment should be located in the basement (if provided) or on the ground floor. This machine room shall be located to reduce mechanical and electrical interference from power cables/switchgear to control and computer cables/equipment. To avoid large space requirements for HVAC duct work and/or air distribution problems, the HVAC machine room should be located as centrally as possible in relation to the vital rooms served.

The entrance to the machine room should be located so that the HVAC maintenance personnel can reach the machine room without having to pass through the instrument, computer or electrical areas.

**3.1.7 First-aid compartment/HSSE office**

A closet compartment shall be provided in the control building for first aid equipment. Local medical policy shall be consulted to determine what is to be provided in the first aid kit. The compartment space shall be sized for spare safety equipment such as helmets, gloves and spectacles, and a collapsible stretcher for the transport of injured personnel.

Cabinetry shall be provided for portable breathing apparatus. These cabinets shall be installed at a convenient height inside the control building, at the exits, for immediate use should the need arise.

### **3.1.8 Interconnections**

There shall be no direct connection between the control room (and the basement if provided) and the other rooms in the building by direct doors, by slots in walls, or via the drainage system with exception of the following rooms:

- Office (for shift supervisor);
- Mess room;
- Computer auxiliary room (computer office).

All other rooms should be connected with the control room and its basement via air locks or corridors (with at least 2 doors to pass).

The plant laboratory (lab), where provided in the control building, shall be designed and located as to prevent gases from entering the control room, offices or other sensitive areas of the building. Gas cylinders, that may be required for the lab, shall be kept outside the building.

In control buildings, a lockable cupboard should be installed for each shift.

## **3.2 LAYOUT OF THE FAR**

### **3.2.1 General**

The building should normally comprise:

- The process control and safeguarding room;
- The electrical equipment and battery room (if necessary);
- The HVAC machine room (if necessary);
- The room for Uninterrupted Power Supply (UPS) equipment (if necessary).

NOTES: 1) The building shall normally be unmanned and therefore no offices shall be designed to accommodate personnel.

2) If the FAR is also used to provide facilities for field operators (e.g., a remote control room), a central access by means of an air lock shall be provided to maintain the required overpressure inside the building.

3) The building shall have no basement.

### **3.2.2 Process control and safeguarding room**

Sufficient space shall be provided around the process control and safeguarding equipment to allow for its installation, inspection and maintenance.

### **3.2.3 Electrical equipment/battery room**

Batteries for emergency power supply shall be located in separate rooms with separate exhaust facilities.

### **3.2.4 HVAC machine room**

The HVAC machine room shall be so located as to reduce mechanical and electrical interference from power cables/switchgear to control and computer cables/equipment. No windows shall be provided. To avoid large space requirements for HVAC duct work and/or air distribution problems, the HVAC machine room should be located as centrally as possible in relation to the vital rooms served.

### 3.3 LAYOUT OF LOCKER ROOMS

In locker rooms, two lockers for each shift worker shall be provided. Typical dimensions should be 300 mm to 350 mm (12 in - 14 in) wide, 500 mm to 550 mm (1 ft 8 in - 22 in) deep, and 1800 mm to 2000 mm (6 ft - 6 ft 8 in) high.

All lockers should be installed on a concrete or steel plinth, approximately 500 mm (1 ft 8 in) high, with a hardwood seat, 500 mm (1 ft 8 in) wide, in front of the lockers. The distance between the fronts of opposite seats shall be a minimum of 1400 mm (4 ft 8 in).

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.

### 3.4 LAYOUT OF ELECTRICAL STATIONS AND ANALYSER HOUSES

For electrical stations, see Standard Drawing S 68.040. For analyser houses, see Standard Drawing S 17.001 and Standard Drawing S 17.002.

Container-size modules for analyser houses and electrical substations may be utilised. This type of building, consisting of one or more interconnecting modules, shall comply with the design principles and general design guides as defined in (1.1).

### 3.5 LAYOUT OF WAREHOUSES

#### 3.5.1 Emergency exits

Emergency exits other than those afforded by the main doors shall be provided to meet the requirements in (8.1). In planning these, considerable thought should be given to all conceivable emergencies, the prime requirement being that nobody should be trapped in the warehouse.

Escape should be possible from any enclosed area in *at least two directions*.

Emergency exits should be clearly marked with exit sign lighting and provided with panic bars.

#### 3.5.2 Other accommodation

As far as is practicable there should be no offices, mess rooms or changing rooms built as an integral part of the warehouse. Where there are such facilities within a warehouse holding flammable chemicals they should be *separated* from the warehouse by fire walls and self-closing fire doors, both with a minimum fire resistance of 90.

#### 3.5.3 Handling facilities

The basic design should take into account whether stock is to be manually or mechanically handled.

Where large drums are to be manually handled, warehouses should be constructed so that the height of the loading area is at the height of the vehicle bed (Figure 3.5.1).

Where packaging is to be handled by fork lift truck, the warehouse floor may be constructed at, or below, ground level (Figure 3.5.2).

In both instances a covered loading bay shall be provided to facilitate loading operations in wet weather.

Marked walkways and where possible, physical barriers should be provided to segregate pedestrians from vehicles.

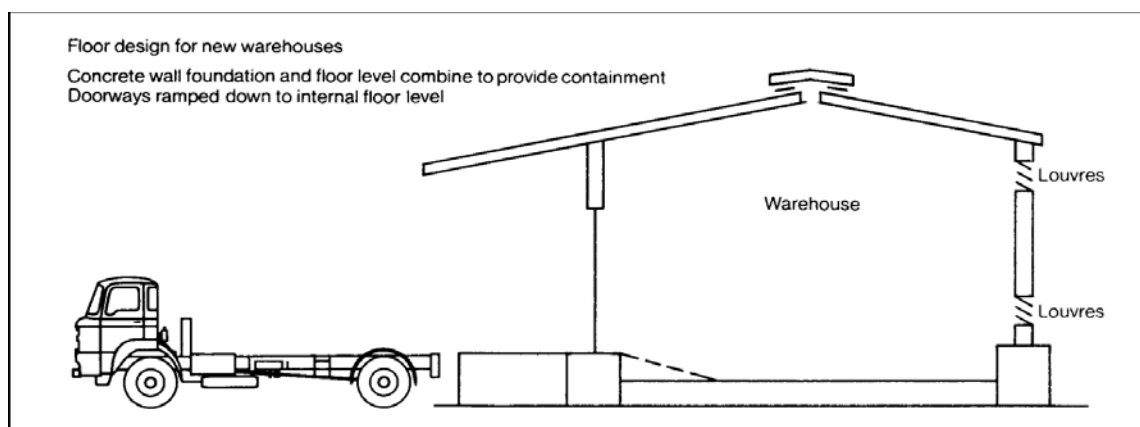


**Figure 3.5.1 Warehouse construction for manual handling**

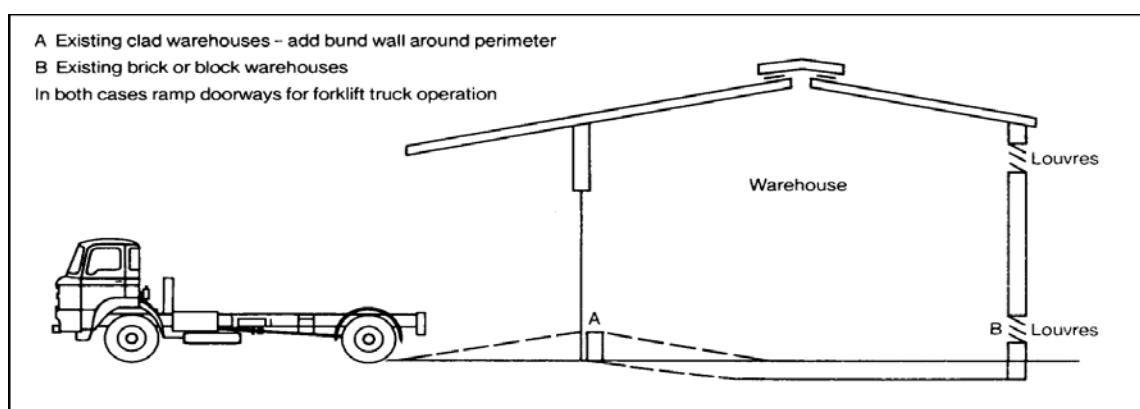


**Figure 3.5.2 Warehouse construction for mechanical handling**

### 3.5.4 Heating ventilation and air conditioning

For warehouses storing chemicals, it should be well ventilated, taking account of the products stored and the need to provide generally agreeable working conditions. For further guidance, refer to SR.12.11324 . See (13).

For warehouses storing chemicals, electrical heating equipment, or portable gas or oil-fired, hot air units, shall not be used.

Climate control should be provided for the storage of materials requiring climate controlled storage.

### 3.5.5 Bunding

For warehouses storing chemicals, bunding shall be provided based on the safety data sheets for the materials being stored. For further guidance refer to SR.12.11324 . See(13).

### 3.5.6 Lightning protection

For warehouses storing chemicals, all steel warehouse structures shall be earthed.

#### 4. DESIGN LOADS

New buildings shall be designed to resist the minimum loads defined in accordance with applicable local design codes, standards, regulations, the actual loading situation and government requirements.

In the absence of local building codes, refer to (Appendix 10) for recommendations on design loads. In addition to the loads defined in (Appendix 10), other loads shall be considered as appropriate. These design loads shall include, but not to be limited to: wind, earthquake, snow, ice, rain, dynamic and erection loads. Future loads shall be considered if specified by the Principal.

Blast and radiation loads shall be determined through consultation with the Principal's technical safety specialist and reference to the layout of onshore facilities, DEP 80.00.10.11-Gen., and the blast load design, DEP 34.17.10.30-Gen.

For existing buildings, actual loads should be used in lieu of the minimum specified loads.

#### 5. CLIMATIC ASPECTS, INSULATION AND NOISE

##### 5.1 GENERAL

Buildings shall be provided with climatic conditioning (HVAC) where it is required 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. Records of all local climatic design data such as 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 Contractor shall collect and reference the local code to determine the meteorological data required for the design of the air conditioning if not specified by the Principal in the project specification.

Standard HVAC equipment, suitable for the prevailing conditions, shall be applied as far as possible. The refrigerants shall comply with the "Montreal Protocol on Substances that Deplete the Ozone Layer", including amendments.

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

##### 5.2 HEATING, VENTILATION AND AIR CONDITIONING OF PLANT BUILDINGS

HVAC of plant buildings shall be designed in accordance with applicable industry standards and local codes and regulations. Plant buildings include buildings such as:

- Control buildings, field auxiliary rooms (FARs);
- Analyser houses;
- Electrical substations and others (e.g., dedicated flow metering buildings).

HVAC and electrical equipment shall be suitable for the applicable hazardous area.

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

##### 5.3 HVAC OF NON-PLANT BUILDINGS

HVAC of non-plant buildings shall be designed in accordance with applicable industry standards and local codes and regulations. The category of non-plant buildings includes:

- a) Administration buildings;
- b) Laboratories (non-plant);
- c) Training centres;
- d) Workshops;
- e) Warehouse buildings not used for the storage of chemicals;
- f) Fire-stations;
- g) Guard-houses/gate-houses/security buildings;
- h) Residential buildings.

Requirements and information regarding HVAC of non-plant buildings are provided in (Appendix 3) and (Appendix 12).

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

In the HVAC machine room, the floor shall be constructed with door thresholds of 100 mm (4 in) minimum height, to prevent condensate and other leakages from entering other parts of the building. Drain facilities shall be installed in the machine room.

The Contractor shall submit the "heat load" calculations used to determine heating and air conditioning capacity to the Principal for approval. The calculations shall be based on ASHRAE Handbook Fundamentals or EN 15243, as specified by the Principal.

Installation, testing, and balancing and commissioning of HVAC systems shall be in compliance with the requirements and information defined in DEP 31.76.10.11-Gen.

#### 5.4 INSULATION

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

Insulation should have a flame-spread rating of less than 25 and shall not be exposed to potential fire areas.

Insulation shall be used for separation between roof decks and the roofing membranes.

Insulation systems shall be provided in exterior walls and roofs, and in walls separating conditioned/non-conditioned areas or zones of differing temperature requirements to prevent condensation and provide heat conservation.

The average thermal transmittance (U) shall be in accordance with all local codes and the local environmental conditions.

The minimum requirements shall meet local requirements. In the absence of these, the following minimum requirements shall be used:

- for combined roof and ceiling construction:  $U < 3.34 \text{ W/m}^2\text{K}$  ( $0.05 \text{ BTU/ft}^2 \text{ }^\circ\text{F}$ .)
- for external walls, including windows:  $U < 1.9 \text{ W/m}^2\text{K}$  ( $0.9 \text{ BTU/ft}^2 \text{ }^\circ\text{F}$ ).

The thermal transmittance requirement specified above 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 should be installed.

Insulation systems for walls ceilings and roofs shall include vapour barriers to protect the construction elements and the insulation itself.

Architectural building insulation materials shall be stable, fire-resistant or self-extinguishing, see (8), and properly applied to eliminate pinching and sagging to maintain their effectiveness. Insulation materials shall be rot and vermin resistant.

In tropical areas, double sheeted, insulating cladding should be considered for buildings frequently occupied by people.

#### 5.4.1 Pipe and ductwork insulation and pipe coating

All cold/chilled water piping, horizontal roof drains, overflow piping and HVAC ductwork subject to condensation (air ducting, chilled water piping, etc.) shall be insulated to prevent condensation for all applicable climatic conditions.

The Contractor shall consider the flame spread and combustible properties of pipe and duct insulation. The Contractor shall select, and submit for approval to the Principal, all insulation materials that are included in a supply or return air plenum.

All hot and cold water pipes shall be insulated for energy conservation and to control Legionella (see 7.2.2).

Cold water pipes shall be kept away from hot ducting and other hot piping to prevent excessive temperature rises in the cold water supply.

Underground steel piping shall be coated and wrapped.

### 5.5 NOISE ABATEMENT/VIBRATION

#### 5.5.1 Reverberation

The reverberation time 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 electrical shops: | 1 s    |
| Mess rooms, canteens, corridors and other circulation spaces:                               | 1.25 s |

#### 5.5.2 Noise transmission values

##### 5.5.2.1 Transmission loss between offices

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

##### 5.5.2.2 Transmission loss between indoors and outdoors

The minimum rating of airborne sound insulation of external walls against external noise, assuming closed windows, determined according to ISO 717-1, shall be:

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

##### 5.5.2.3 Transmission loss through floors (structure-borne noise)

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

| 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 g each, falling from a height of 40 mm, 10 times per second.

### 5.5.3 Noise limits

If noise-generating equipment is installed in the building, DEP 31.10.00.31-Gen. shall be followed to determine acceptable equipment noise 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.<br>Workshops for light maintenance<br>Electrical/switch/HVAC rooms | 70                                           |
| Workshop offices<br>Control rooms, not continuously manned<br>Computer rooms                                                                   | 60                                           |
| Control rooms, continuously manned<br>Open plan offices<br>Social rooms, changing rooms, wash places and toilets                               | 50                                           |
| Offices and conference rooms                                                                                                                   | 45                                           |
| Accommodation (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 as more stringent by 5 dB(A).

For Control buildings, assessment and mitigation of noise shall be included in the Human Factors Engineering (HFE) study.

### 5.5.4 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".

### 5.5.5 Vibration levels for the control building computer room

Vibrations in the control room shall be limited in order to ensure continuously reliable operation of the (process) computer equipment.

The maximum allowable vibration intensities as applied to the equipment are:

- a) sustained vibration (5 s or longer) at frequencies less than 14 Hz: 0.25 mm peak to peak;

- b) sustained vibration at frequencies of 14 Hz or higher: 0.1 G peak (0.07 G root mean square);
- c) intermittent vibration (less than 5 s) at frequencies less than 7 Hz: 2.5 mm peak to peak;
- d) intermittent vibration of 7 Hz and higher: 0.25 G peak (0.18 G root mean square);
- e) sustained vibrations or noise shall not be at a level that is annoying or distracting to operators;
- f) intermittent vibrations or noise shall not be at a level that is intolerable, and intermittent vibrations or noise at a level that is annoying or distracting to operators shall be minimised.

## 5.6 COMPUTERISED EQUIPMENT

The following shall be followed for the installation of computerised equipment, especially in control buildings and FARs:

- a) Instrument rooms and control rooms shall be completed and the air conditioning system operating, prior to the installation of its associated computer equipment. If the plant is not yet commissioned, special attention shall be paid to the availability of reliable electrical power for the air conditioning system, while the computer is being installed, tested and commissioned.
- b) The air conditioning installation in these rooms shall be in operation at least one week before the computer equipment is installed. During this period, the performance of the air conditioning system shall be checked by means of electric heaters to simulate the heat dissipation of the computer equipment to be installed. The results of this test shall be satisfactory before the installation of the computer equipment can proceed.
- c) No concrete work shall be done after the installation of the equipment.
- d) Pile driving or other vibratory operations in the vicinity of operational computer equipment shall only be permitted if these activities will not exceed the vibration limits provided in this DEP or by the equipment supplier.
- e) Before unpacking the microprocessor-based computer equipment, the relevant rooms shall be made dust free. During the installation and testing period, cleaning shall be carried out in close cooperation with the responsible computer specialist. Dust producing activities shall be restricted to a minimum.

## **6. BUILDING ELEMENTS/COMPONENTS**

### **6.1 GENERAL**

This Section gives general information on architectural elements and components for all buildings. However, requirements for certain building components are specified in more detail in documents referenced in (1.1).

Foundations or floor slabs shall not be elevated or constructed with an open ventilated space beneath the building.

For occupied buildings (as defined in DEP 80.00.10.11-Gen.) load-bearing unreinforced masonry walls shall not be used.

### **6.2 MATERIALS AND METHODS OF CONSTRUCTION**

All products for buildings materials shall be designed in accordance to contract documents and applicable local codes and governing jurisdictions. The following materials can be used for the design of buildings, but not limited to:

- a) Concrete
- b) Masonry
- c) Metals
- d) Woods
- e) Plastics
- f) Gypsum board assemblies

Materials containing asbestos shall not be used.

The buildings shall be designed with the materials and methods of construction appropriate for its occupancy. The type of construction shall be in accordance with the requirements of the governing building codes.

### **6.3 WALLS**

#### **6.3.1 External walls**

External walls shall be designed to resist penetration of external moisture (due to rain, snow, condensation or humidity) into the building interior. External walls may be constructed with metal cladding, composite metal cladding, concrete or masonry. For masonry plastering and painting (or cladding) may also be used, especially if bricks of suitable appearance are not available locally. If administration and service buildings (office, canteen, laboratory, warehouse, security buildings, etc.) are made of concrete blocks, the external surfaces should be plastered and painted.

For occupied buildings (as defined in DEP 80.00.10.11-Gen.) load bearing unreinforced masonry walls shall not be used.

The use of roof load-bearing exterior unreinforced masonry walls for unoccupied buildings shall be approved by the Principal.

A damp-proof course at a minimum height of 150 mm (6 in) above the finished grade level shall be included over the full length in all masonry walls. Whenever necessary, termite barriers shall be provided in the construction.

The minimum thickness of the cladding shall be 0.75 mm (1/34 in). If wall cladding is used, plastering and painting of the wall behind the cladding shall be omitted. If cladding is used in service buildings, a dwarf wall of 2000 mm (6 ft 8 in) height shall be erected to protect the cladding against damage by motor vehicles. Alternatively, steel crash barriers may be used.

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. A light colour, heat reflecting, thermal insulating properties,