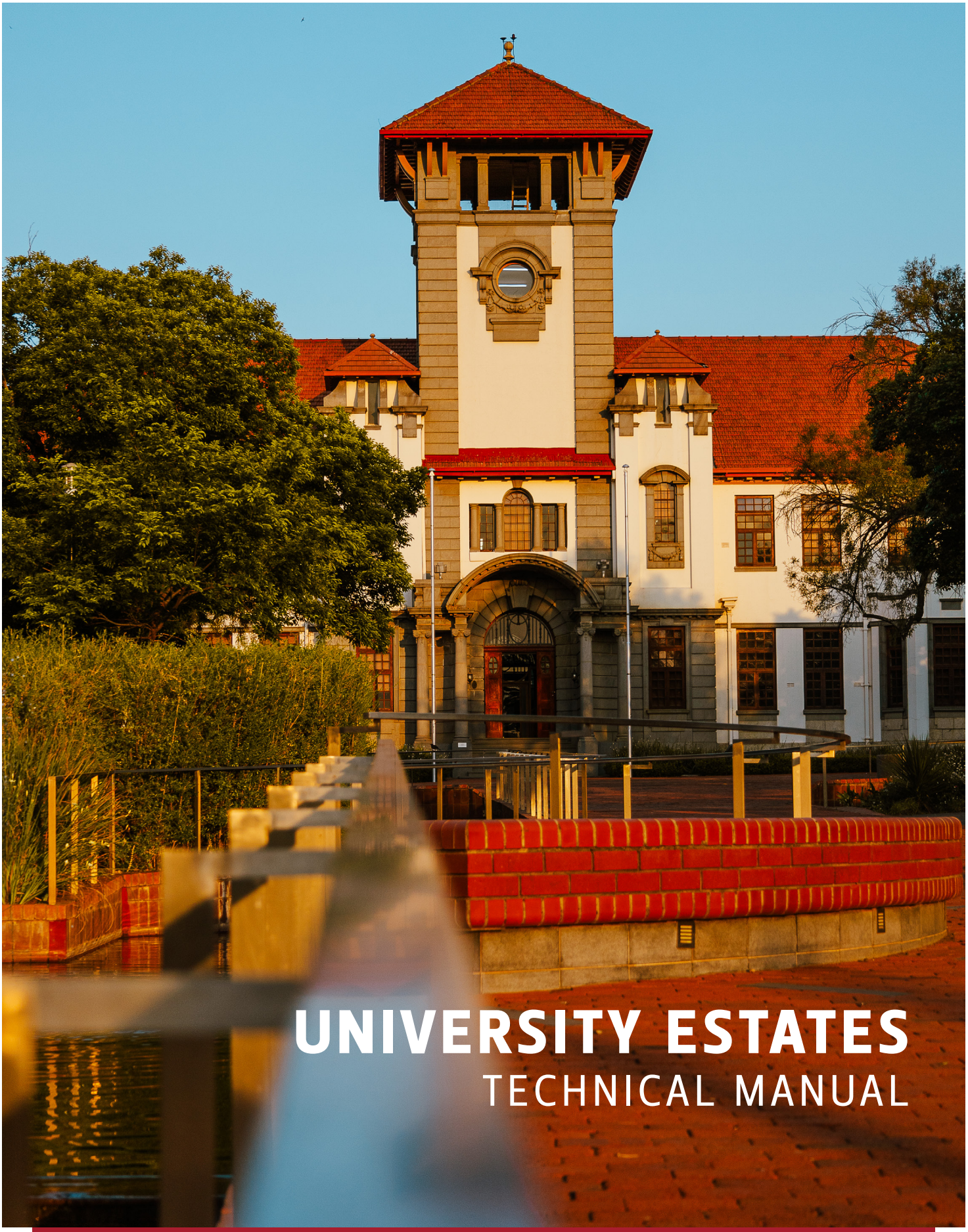

UNIVERSITY ESTATES
TECHNICAL MANUAL

Inspiring excellence, transforming lives through quality, impact, and care.

VISION 130
Renew and Reimagine for 2034

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS

This document is of utmost importance for the correct implementation of technical guidelines and was designed to address specific and unique needs as compiled by University Estates, University of the Free State. This guideline manual is directed specifically at problem-solving as a preventative informational guideline within the University and took time and knowledge to compile. It may not be copied/altered/re-designed or provided/introduced to a third party, unless under specific direction (in writing) from University Estates.

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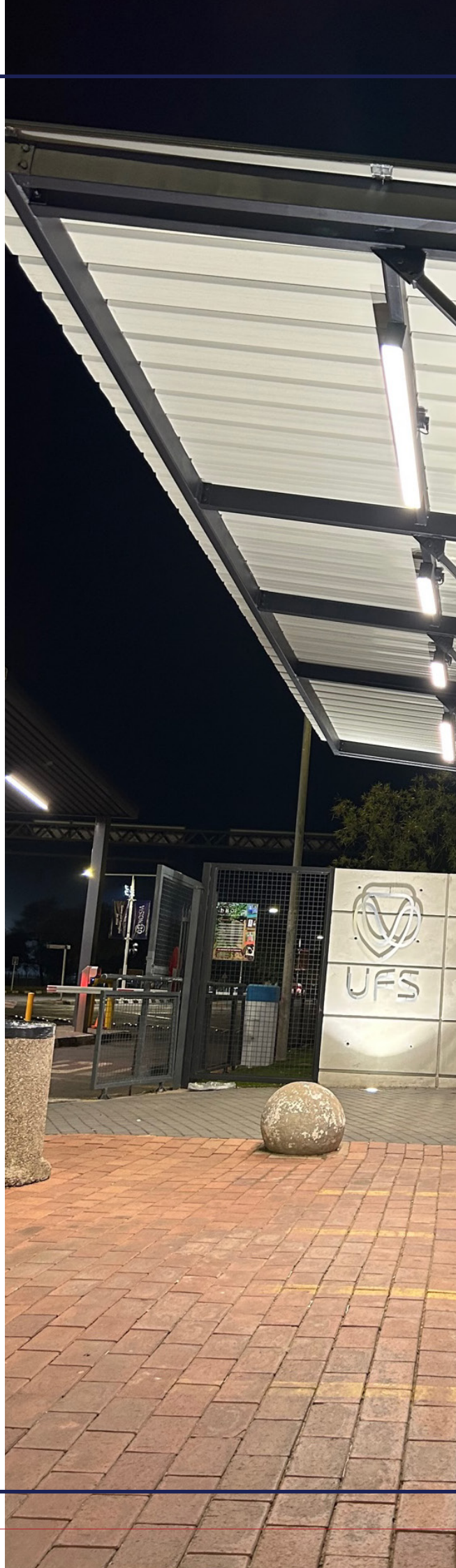

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Introduction

This document presents an overview of specific elements of the building material and/or methods to be used in all UFS projects, replacing all preceding directives. It was compiled to establish building principles, while at the same time endeavouring to promote uniformity in terms of the usage of materials. Building materials and methods given preference will be suitable for a long-term lifespan and implementation to reduce maintenance and repair work. Alternatives needs to be approved by UE in writing before specification.

The guidelines in this manual will be updated regularly. If, for any reason, there should be a deviation from the regulations set out in this document, such deviation will have to be cleared with UE before any action is taken. The descriptions of the different products/items/materials in this document only serve as a guideline. All items must be clearly and meticulously described when drawings are made and Bills of Quantities drawn up to avoid any doubt regarding intended meanings.

Abbreviations:

UE = University Estates

UFS = University of the Free State

PA = Principal Agent

1. GENERAL SPECIFICATIONS

- It is considered that if a professional service is being rendered, the service provider is aware of national legislation and provincial and municipal regulations and will adhere to such requirements. It remains the responsibility of the PA to see that all inspections, etc., applicable in this respect are adhered to.
- It is the responsibility of each consultant to take accountability for their domain to ensure compliance.
- It is the responsibility of the PA to obtain all relevant service plans and existing fixtures from UE before planning, and these must be indicated on site before construction commences.
- Consultants shall consider the current ongoing activities of the UFS in their roll-out plan.
- Rubble shall be removed weekly with as little disruption as possible. Where necessary, rubble must be removed daily.
- It is the responsibility of the PA to issue Contractor working drawings and services, for example, sewerage, low- and high-voltage cabling, and water, and to arrange a coordination meeting with all stakeholders to orientate the Contractor of all existing services.
- All Bills of Quantities shall be submitted for approval to UE prior to tender invitation.
- Only selected UE-approved sub-contractors may be appointed for electrical and mechanical installations.
- All Bills of Quantities above R250 000 shall contain targeted procurement.
- The Contractor shall provide public liability cover of between R5 million and R10 million.
- No payment guarantees shall be issued by the UFS.
- Escalation shall always be excluded (fixed sum contracts).
- The Contractor is allowed to use the option of retention as guarantee.
- Security provisions that will also be considered by UE are fixed or variable construction guarantees, which will be subject to UE approving the guarantor firm.
- The applicable municipal inspections shall always be adhered to.
- The following health and safety requirements shall be included in the tender document: Project OHS Specifications, baseline risk assessment, and OHS Bill of Quantities. Safety requirements shall be clearly stipulated in this document.
- Compulsory health and safety induction shall be conducted prior to occupation of the site.
- The JBCC principal building agreement shall be used as contract. Deviations shall be included as supporting annexures as specified by UE.
- A “Building Life Cycle Maintenance” document shall be handed over to UE within three months after project completion. Consultants shall acquaint themselves with the required content.
- No construction is allowed above or over existing infrastructure without prior written approval by UE.
- Colour schemes and finishes shall be presented to UE as a complete presentation and be approved before issuing any instructions to the Contractor.
- Staff quarters shall be provided at each building in consultation with UE.
- Professional cleaning of buildings shall be included in the Bill of Quantities.

- All ground floors of buildings shall be accessible for persons with disabilities and must include accessible ablution facilities.
- All work shall comply with NBR (National Building Regulations) and SABS (South African Bureau of Standards).
- Final completion may not be approved without the submission of:
- The correct as-built drawings in DWG format to Property Management, after practical completion.
- The maintenance manual.
- Installation of the door numbers and internal signage as specified.
- Municipal-approved drawings, if applicable.

2. DRAWINGS

Drawings per project: Schematic line diagrams/ reticulation drawings shall be submitted at the design and completion stage to the University.

Upon a project completion, prior to submission to the University, the Contractor shall, at their expense, submit to the Engineer for approval the drawings/documents/calculation records as shown below:

- Approval documentation from the local Supply Authority.
- All general arrangement drawings, including a dimensioned plant room layout and workshop drawings.
- Detailed dimensioned drawings of all plant, equipment, switchboards and distribution boards.
- Complete wiring diagrams and block schematic diagrams.
- In-house Factory Acceptance Testing procedures and results.
- Calculation records of all equipment/ material selected.
- Drawings shall comply with the local authority and UE specifications.
- As-built revised drawings shall be submitted electronically to UE on the site handover date by e-mail to krohnhj@ufs.ac.za, and hard copies delivered to UE Office 117.
- The electronic format of drawings shall be in CAD format (Caddie or AutoCAD) – thus DWG or DXF format.
- If Caddie format is used, edition 9-27 is acceptable.
- If AutoCAD format is used, up to edition 2024 is acceptable.

2.1 New buildings or changes/ extensions to existing buildings shall consist of the following, as applicable:

- foundations;
- electrical;
- mechanical;
- water;
- floor plans;
- elevations;
- roofing layout;
- ceilings;
- all schedules: doors, windows; and
- cabinets and other detail drawings.

2.1.1 Title block

The title block shall indicate the following:

- project name;
- consultant's name/logo and contact details;
- date of final revision;

- scale; and
- north arrow.

2.1.2 Site layout

The site layout must show the accurate and final layout of the project site, including parking, structures, utilities, and landscaping, as applicable.

2.1.3 Elevations and sections

Exterior appearance, materials and dimensions shall be shown from the applicable viewpoints.

2.1.4 Floor plans

- Detailed floor plans shall be provided for each level of the building and indicate the final placement of walls, doors, windows and other architectural features.
- Fixtures and fittings shall be indicated, including firefighting equipment, emergency exists and signage, etc.
- Final door numbers are to be provided by Property Management.
- Window and door schedules shall be indicated.
- Drawings shall be “cleaned”, that is, have no double lines.
- Hatching (if applicable) lines shapes/ polygons.
- Layers shall be correctly applied.
- All lines shall be trimmed and joined as applicable.
- Emergency evacuation plans shall be indicated for all new buildings.
- No layers may be locked or hidden.

2.1.5 Door numbers

- The architect shall submit the design drawings to Property Management to obtain door numbers.
- Door numbers shall be forwarded to the architect to be included in the signage scope and shall also be indicated on the as-built drawings.
- The manufacturing and installation of door numbers shall be included in the scope of work. Should changes occur, Property Management shall be informed before submission of the as-built drawings.
- Door numbers shall be fixed to door frames or, if not possible, on the wall above the doorframe (centred).
- Door numbers shall be 60 mm x 20 mm in size.
- Door numbers shall be made of black vinyl on brushed aluminium/silver composite board and installed with screws or strong adhesive.
- Door number shall be in Arial font.

2.1.6 Internal signage

New/amended internal directional signage shall be included in the scope of work. (Refer to point 11.1.2.)

2.2 Changes to Existing Buildings

2.2.1 In general

This relates to smaller construction projects that will have an impact on the floor plans/door numbers/signage or evacuation plans of UFS buildings (e.g., consolidation or subdivision of a space; removing or addition of doors, windows, basins, toilets, etc.).

The project or maintenance manager or their delegates shall contact Property Management to inform the division of the planned changes. Assistance can also be requested concerning a floor plan with dimensions of the status quo.

On works completion, Property Management shall be duly informed so that final measurements can be taken and the UFS floor plan updated for accurate Hemis submission and future space allocation/planning.

3. EARTHWORKS

The soil/filling of foundations and under floors shall be treated with soil insecticide to eliminate termite infestation. A certificate should be obtained from the Contractor and included when submitting a maintenance manual.

4. CONCRETE, FORMWORK AND REINFORCEMENT

Concrete, formwork and reinforcement shall be done in accordance with Engineer specifications.

5. MASONRY

- No cement bricks are to be used.
- Lintels shall be installed above doors, arches and windows.
- Brick force to be minimum every third course and above lintel height every second course.
- Only prior approved face bricks shall be used.
- The cavity between the wall and the sides of steel door frames shall be filled.

6. WATERPROOFING

- A damp-proof membrane shall always be placed underneath concrete floors up to the outer end of the brickwork.
- Only ABE and Sika products are approved. Any other product must be approved before specified.
- Waterproofing shall carry a minimum 10-year written guarantee.
- Damp-proof course shall be installed under windowsills.

7. ROOF COVERING

- Rainwater goods shall be omitted and only used by exception. Sufficient provision shall be made for run-off water.
- If gutters and downpipes are used (the exception), they shall be sealed off with waterproofing material. All downpipes shall be at least 100 mm in diameter.
- Plastic downpipes and gutters are NOT approved.
- Outlets and downpipes are NOT to be installed inside concrete columns.
- Outlets must be easily accessible.
- New gutters and downpipes are not to be painted.
- Only 45-degree bends may be used for downpipes.
- Roof slopes must be sufficient for easy run-off of water.
- Overflow shoots shall be installed where possible.

7.1 Metal

Corrugated roof iron must be a minimum of 0.6 mm thick.

7.2 Roof Tiles

Plastic damp-proof membrane shall be placed over trusses before battens are installed.

- Every second tile on the ridge of the roof shall be secured with nails.
- The bottom three rows of roof tiles shall be nailed to the battens and, thereafter, every consecutive row. The final row at the ridge, regardless of the subsequent row of tiles, shall also be nailed to the battens.

7.3 Fascia Boards

- Fascia boards shall be fixed to trusses/ purlins with screws, not nails, and joined with 0.5 mm thick H-profile galvanised sheet-metal cover strips.
- Fascia boards may not be painted.

8. CARPENTRY AND JOINERY

- SupaWood shall be used and not chipboard.
- All wall plates, including areas where building work around trusses, etc., are required, shall be treated with Carbolineum before installation.
- Trusses shall be fixed to brickwork with wire ties and then secured to wall plates with hoop iron roof ties.
- All purlins shall be fixed in accordance with Engineer specifications.

8.1 Skirtings

All skirtings shall be prior approved and fixed with Hilti nails.

8.2 Doors

8.2.1 Internal doors

All internal doors must be semi-solid or solid wood.

8.2.2 External doors (wooden)

All external doors must be made of meranti or saligna.

Where FLB doors are used, braces shall be applied.

8.2.3 Doorstops

All doors must have door stops.

8.3 Cupboards

- Cupboards should have a base to match skirtings.
- Impact edging shall be used.
- Where doors exceed 700 mm in width, three hinges shall be used.
- Tops of cupboards shall be prior approved.

9. CEILINGS PARTITIONS AND ACCESS FLOORING

9.1 Ceilings

- 600 mm x 1200 mm acoustic ceilings shall be used. Specifications shall be prior approved by UE.
- 100 mm aerolite (think pink) insulation shall be installed.
- Brandering shall be tampered screwed to trusses.
- No plastered ceilings, bulkheads or decorative ceilings may be installed without prior approval by UE.
- Access to ceilings must be sufficient.
- 38 mm x 38 mm brandering may not exceed 300 mm centres when fixed to bearers.
- Brandering, joists or runners shall be fixed with the larger dimension in the vertical position.
- Supporting brandering shall be installed where light fittings are to be suspended.
- No decorative cornices are to be used.

9.2 Drywalling

- Partition walls shall be constructed using 2 x 15 RhinoBoard® FireStop® dB on both sides of the frame fixed to studs at 220 mm centres, including Isover Cavitybatt™ / Cavitylite® 102 (drywall to be in accordance with SANS 10177-2) board colour.
- Drywalls shall be faced with pink-coloured paper. The reverse side shall be faced with brown-coloured paper.

10. FLOOR COVERINGS

Floor coverings by Belgotex, Polyflor and Floorworx are approved for installation. Alternatives shall be presented to UE for consideration and approval prior to specifying.

10.1 Laminated Flooring

- Wooden laminated flooring is not to be used.
- Entrances must have dust trappers.

10.2 Vinyl Tiles

- Where vinyl tiles are to be specified, only preapproved brands as indicated are to be used and the specification shall be prior approved by UE.
- Where luxury vinyl tiles are to be specified, only preapproved brands are to be used and the specification shall be prior approved by UE.
- Where vinyl sheeting is to be specified, only preapproved brands are to be used and the specification shall be prior approved by UE.
- Vinyl coverings shall be stripped and sealed by specialists with a relevant guarantee, if required.

10.3 Tiling

- Locally available tiles shall be used.
- Tiles must be A-grade.
- All tiles must be non-skid.
- Sufficient expansion joints shall be used.
- Expansion joints shall be lined with movable joint strips with synthetic rubber inserts.
- Ceramic and porcelain tiles are preferred in areas of high frequency.

10.4 Carpets

500 mm x 500 mm Berber Point 920 or similar carpet tiles are to be used in offices. The colour is to be approved by UE. Where not available, Berber Point 920 broadloom carpet is also acceptable and shall be prior approved by UE. Where alternative carpet ranges are to be specified,

this shall be presented for prior approval by UE.

11. IRONMONGERY

- A presentation regarding ironmongery shall be presented to UE and approved before being specified.
- Only UE-approved items are to be used (REFER TO ANNEXURE).

11.1 Signage

11.1.1 External signage

11.1.1.1 Building names

- Building names are to be attached to the exterior of the building.
- Cut-out lettering shall be in “Optima” font.
- 320 mm-high letters shall be used for the building name (any other size to be submitted for approval to UE).
- 2/3 mm laser-cut mild steel is to be used with 5/6 mm machine screw pins welded on – powder-coated and Duco-sprayed to the required colour.
- A drilling template shall be used, with holes drilled to allow for the required stand-off distance.
- Signs shall be mounted using chemical epoxy cement.
- Distance from wall: 35 mm to 80 mm letters, 10 mm stand-off; 100 mm to 200 mm letters, 15 mm stand-off; 200 mm to 300 mm letters, 20/25 mm stand-off.

11.1.1.2 Directional road signs

- Reflective vinyl shall be used for lettering, frame and symbols.
- Board: 1 mm Chromadec sheet, reinforced at the back.
- Framework: round tubing, painted white with 2k paint.
- 2/50 x 3 x 300 long plates welded to CHS, installed on a 600 x 600 x 500 concrete base.
- Lettering: Helvetica, 100 mm high, upper and lower case.
- Frame: 20 mm with a radius of 75 mm.
- Arrow: 222 mm wide when directing left of right.
- Lettering is to be applied 315 mm from the left of the board (minimum starting point) and 70 mm from the right of the board (ending point).
- The spacing between the end of the arrow to the left and the starting point of the lettering must be 238 mm.
- A full detailed drawing is available on request from UE.

11.1.2 Internal Signage

Internal signage shall be Vista or match existing signage.

11.1.2.1 Office signage

- Office signage may be Vista (V150 mm x 400 mm).
- Signs shall be mounted 50 mm from the left door frame and 1600 mm from the floor. It

may only be mounted on the door at the user client's request.

- Signs shall be black on white, with the logo in colour, or black on silver, with the logo in black.
- The font must be Leitura Sans Grot 2.
- The UFS logo is to be placed to the left.
- Specifications subject to the guidelines are provided by Communication and Marketing.
- Signs shall be fastened with mirror tape and adhesive.

11.1.2.2 Directional wall signs

- Directional wall signs may be Vista.
- Signs shall be aluminium-coloured Vista curved header with black endcaps at a head height of 100 mm to 120 mm.
- The font must be Leitura Sans Grot 3.
- Signs shall be black on silver/white.
- The height of the slats shall be 40 mm to 100 mm, depending on the space available, curved with black endcaps.
- Signs must have clear, non-glare acrylic covers.
- Signs are to be installed with silicone and double-sided tape/Hilti fasteners.

11.1.2.3 Suspended signs

- Suspended signs must be in VL series, landscape format. The size will depend on the building layout and quantity of information, normally 150 mm x 600 mm (landscape).
- Signs shall be mounted with cables provided by the supplier, mounted on the ceiling, 2.5 m from the floor.
- Signs are to be installed with ceiling hooks.
- The font must be Leitura Sans Grot 3.
- Signs must be black on silver/white with black endcaps.
- Signs must have clear, non-glare acrylic covers.

11.1.3 Safety Signage

11.1.3.1 Escape route signs

- Signs must be photoluminescent (SANS 1186-1 approved).
- The size must be 190 mm x 380 mm or 190 mm x 570 mm.

11.1.3.2 Fire signage

- Signs must be photoluminescent (SANS 1186-1 approved).
- The size must be 190 mm x 380 mm or 190 mm x 570 mm.

11.1.3.3 Electrical distribution points

- Signs must be photoluminescent WW7 (SANS approved).
- The size must be 190 mm x 190 mm.

11.1.4 Corporate Logos and Colours

The official UFS and faculty logos and colours are available at https://www.ufs.ac.za/branding/brand-elements. No official documents or plans may display the former UFS/UV logo.

11.2 Locks

A minimum of two keys to every door shall be marked and handed to UE.

11.2.1 Door locks

- Internal doors shall be fitted with minimum 2-lever locks. Use well-known brands such as Esco, Union, Yale or BBL.

- External doors shall be fitted with minimum 4-lever locks. Use well-known brands such as Esco, Union, Yale or BBL.

11.2.2 Magnetic locks

- Magnetic locks shall be fitted so as not to reduce the door opening.
- They must be installed with top and bottom barrel bolts.

11.2.3 Automatic door closers

11.2.3.1 Overhead type

When installed onto aluminium doors, two hinges shall be installed at the top of the door.

11.2.3.2 Floor type

The floor type shall be installed on floor level.

12. STRUCTURAL STEELWORK

Structural steelwork shall be done strictly according to Engineer details and specifications.

13. ALUMINIUM WORK

- All aluminium doors, windows, shop fronts, etc., are to be manufactured, supplied and installed completely by an approved firm of specialists and shall comply with AAAMSA design criteria.
- Anodising or powder coating should have been processed in accordance with SANS 999 and SANS 1796, respectively.
- Glazing shall be installed in accordance with SANS 0137.

14. PLASTERING

- No double-plastered walls are allowed.
- Screed thickness on floors must be cast to a minimum of 25 mm, with a 1:4 ratio of sand:cement.

15. PLUMBING AND DRAINAGE

15.1 In General

- Only UE-approved plumbing materials are to be used. Refer to Annexure ____ for the schedule of approved plumbing items.
- Regarding material, etc., when specifying pipes, fittings, components and fixtures, the following shall be considered when items are selected:

o durability;

o effect on water quality;

o internal and external corrosion; and

o availability.

- Pipes laid under walls or surface slabs shall be installed inside a sleeve.
- Inlets to sump pumps shall be protected by placing a grid in front of the inlet openings to keep away unwanted objects.
- All new water pipes installed in walls shall be pressure-tested, inspected and insulated with brown paper legging.
- High-quality, heavy-duty material shall be used as a basic principle, for example, Cobra heavy-duty taps with code starting with 1.
- Where PVC piping is specified, Class 12 pipes shall be used – to be prior approved by UE.
- Hilti clamps shall be used to fasten piping

against walls and ceilings. The use of wire is not acceptable.

- Where piping stops, it shall not be bent over but sealed with stoppers.
- When installing PVC or sewerage piping, avoid sharp 90-degree bends. Rather make use of 2 x 45-degree bends where applicable.

15.2 Inside Buildings

- Use Class 2 copper pipes with Conex connections (soldering material not allowed).
- Heavy pattern taps shall be used and (proposed taps to be signed off by UE Plumbing).
- PVC, HDPE, Plasson or PEX piping can be used; where used, Class 12 pipe and up must be used.
- Geysers shall be installed securely and in such way that the electrical heating elements can be easily removed.
- Only cold water is to be provided unless otherwise instructed.
- Hydro-boils are prohibited.
- Pressure taps do not need to be specified. Where proposed, a pressure-reducing valve must also be installed.

15.3 Outside Buildings

Class 1 and Class 2 copper pipes and Cobra PEX piping can be used for installations. For soldering or Connex, Classi with soldering fittings shall be used in walls. Class 2 or PEX piping is to be used in ceilings or surface-mounted. (All new piping in ceilings or surface-mounted to be properly insulated.)

- Class 12 to Class 16 HDPE or MPVC piping shall be used for underground water supply pipes.
- Standard galvanised piping is to be used where applicable.
- Hilti clamps or brackets are to be used to fasten piping.
- Where T-pieces and bends are installed on main water supply pipes, ensure that proper thrust blocks are constructed, where applicable.
- Use of proper joints on piping, such as cascade clamps, ranger couplings, etc., is required, depending on the type of pipe used (UE Plumbing to sign off).
- Only high-pressure piping shall be used on the water supply network and irrigation.
- All water installations shall be flushed and pressure-tested before sanitaryware is installed.
- Gullies shall be fitted with a grid.
- All PVC and polythene pipes in shafts and labs shall be thoroughly clamped and supported.
- Sewerage inspection eyes shall be built above ground and covered with a cast iron lid.
- Stormwater pipes must be big enough to accommodate bigger than usual water run-off.

15.4 Stop Taps

- Stop taps must be easily accessible; if installed behind a panel, the panel should have hinges.
- One visible and easily accessible CP lever ball stopcock tap shall be installed on the main pipeline that leads to each bathroom.
- Additional to the main water supply stop tap (code: 1060-15), full-way CP ballcocks shall be installed on warm- and cold-water pipes under the taps of basins, sinks, lab basins, etc., as well as toilet ball valves. Note that ballcocks may not be coupled directly to existing pipes.

- Stop taps shall be installed on both sides of the compression valves on a geyser. Ballofix taps are allowed.
- All disconnected services shall be properly blanked off with stop ends in floors, walls, ceilings, etc. (concrete poured in pipes not acceptable).

15.5 Fire Equipment

- Fire hose valves (preferably Saunders valves) must be clearly visible and easily accessible and must not be locked.
- The connection point of fire hoses must be easily accessible.
- Seal all exposed water and drainage pipes during construction to ensure that no rubble will block the pipes. Also, make sure that there are no stoppages before completing the work.

15.6 Bathroom Equipment

- Inspection eyes shall be installed with every bend/junction.
- Install a good-quality closable door at the side of a bath.
- Plastic toilet bowls, basins, etc., are not allowed.
- A stretch joint in a pipe is needed at the expansion joint.
- For waterless urinals, the waste pipe shall be located on a branch line downstream of a hand wash basin (to reduce the smell) flushing devices & WC flushing cisterns.
- To conserve water, dual-flush WC units will be considered.
- Water-saving fill valves will be considered.

16. UNIVERSAL ACCESS

16.1 Purpose of this Document

The UFS commits itself, within reasonable capacity (e.g., finance, facilities, etc.), to create a barrier-free physical and built environment for the inclusion of persons with disabilities.

- All buildings must be accessible.
- Stairs must be avoided and only ramps are allowed.
- Ramps are preferred as the main access to a building.

The purpose of the introduction and first chapter of this technical manual is therefore to assist with and expand the application of the South African National Standard (SANS) 10400-S: 2011 which addresses facilities for persons with disabilities at the UFS by providing:

- Principles of universal design.
- Universal design guidelines.
- Norms and standards for specific building types.

The guidelines apply to contractors, architects and other persons involved with capital projects as well as the upgrading of existing infrastructure projects with the UFS UE.

16.2 Principles of Universal Design

Best practices in universal design are defined as building practices and procedures that comply with universal design principles and provide affordable design practices that meet the needs

of the broadest possible range of people who use the facilities. Not all best practices apply in the same situation and therefore all technical specifications must be carefully considered and discussed together with local authorities, architects and building owners.

16.2.1 Universal design

“Universal Design is the design of products and environments to be usable by all people to the greatest extent possible, without the need for adaptation or specialized design” (Ron Mace).

“The intent of the universal design concept is to simplify life for everyone by making products, communication and the built environment more usable by more people at little or no extra cost. The universal design concept targets all people of all ages, sizes and abilities” (Ron Mace).

“Universal Design is a strategy which aims to make the design and composition of different environments and products accessible and understandable to as well as usable by everyone, to the greatest extent in the most independent and natural manner possible, without the need for adaptation or specialized design solutions” (Council of Europe Committee of Ministers).

The main basis of universal design is to move away from the concept of the “average person” or the “individual with a problem” and to thus recognise human diversity. Previous approaches to the concept of universal design included “environmental access”, “special needs facilities”, “barrier-free design” and many other initiatives, which focused more on physical access. Conversely, universal design extends to information and communication technology, orientation and way-finding systems, and most importantly, pro-active management and operational systems.

16.2.2 Principles of universal design

16.2.2.1 Principle One: Equitable Use

“The design is useful and marketable to people with diverse abilities.”

Guidelines	Measurements
Provide the same means of use for all users; identical wherever possible, equivalent when not	All potential users could use this product in essentially the same way, regardless of differences in personal capabilities
Avoid segregating or stigmatising any users	Potential users could use this product without feeling segregated or stigmatised because of differences in personal capabilities
Make provisions for privacy, security and safety equally available to all users	Potential users of this product have access to all features of privacy, security and safety, regardless of personal capabilities
Make the design appealing to all users	This product appeals to all potential users

16.2.2.2 Principle Two: Flexibility in use

Guidelines	Measurements
Provide choice in methods of use	Every potential user can find at least one way to use this product effectively
Accommodate right- or left-handed access and use	This product can be used with either the right or left hand alone
Facilitate the user’s accuracy and precision	This product facilitates (or does not require) user accuracy and precision
Provide adaptability to the user’s pace	This product can be used at whatever pace

16.2.2.3 Principle Three: Flexibility in use

"Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level."

Guidelines	Measurements
Eliminate unnecessary complexity	This product is as simple and straightforward as it can be
Be consistent with user expectations and intuition	An untrained person could use this product without instructions
Accommodate a wide range of literacy and language skills	Any potential user can understand the language used in this product
Arrange information to be consistent with its importance	The most important features of this product are the most obvious
Provide effective prompting and feedback during and after task completion	This product provides feedback to the user

16.2.2.4 Principle Four: Perceptible information

"The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities."

Guidelines	Measurements
Use different modes (pictorial, verbal, tactile) for redundant presentation of essential information	This product can be used without hearing
Maximise 'legibility' of essential information	This product can be used without sight
Differentiate elements in ways that can be described, that is, make it easy to give instructions or directions	The features of this product can be clearly described in words (e.g., in instruction manuals or on telephone helplines)
Provide compatibility with a variety of techniques or devices used by people with sensory limitations	This product can be used by persons who use assistive devices (e.g., eyeglasses, hearing aids, sign language or service animals)
Provide effective prompting and feedback during and after task completion	This product provides feedback to the user

16.2.2.5 Principle Six: Low physical effort

"The design can be used efficiently and comfortably and with a minimum of fatigue."

Guidelines	Measurements
Allow user to maintain a neutral body position	This product can be used comfortably (e.g., without awkward movements or postures)
Use reasonable operating forces	This product can be used by someone who is weak or tired
Minimise repetitive actions	This product can be used without repeating any motion enough to cause fatigue or pain
Minimise sustained physical effort	This product can be used without having to rest afterwards

16.2.2.6 Principle Seven: Size and space for approach and use

"Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture or mobility."

Guidelines	Measurements
Provide a clear line of sight to important elements for any seated or standing user	It is easy for a person of any size to see all the important elements of this product from any position (e.g., standing or seated)
Make reach to all components comfortable for any seated or standing user	It is easy for a person of any size to reach all the important elements of this product from any position (e.g., standing or seated)
Accommodate variations in hand and grip size	This product can be used by a person with hands of any size
Provide adequate space for the use of assistive devices or personal assistance	There is enough space to use this product with devices or assistance (e.g., wheelchair, oxygen tank, or service animal)

16.3 Design Guidelines: Parking and Loading/Unloading Zones

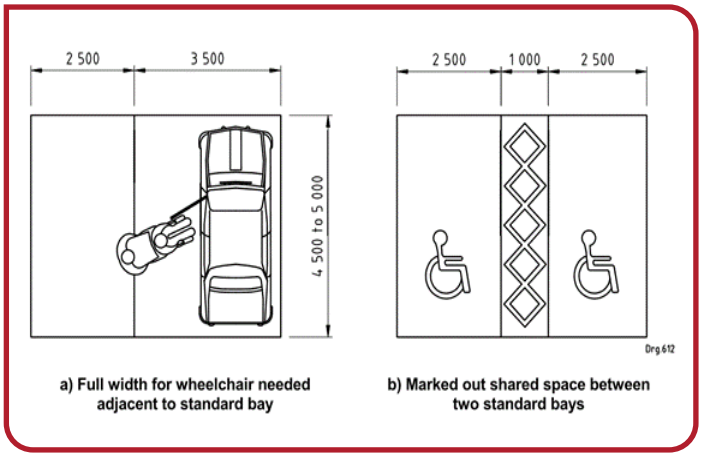
16.3.1 Run-in/-out

- The location of parking areas and loading/unloading areas should be clearly visible at the run-in/-out, with adequate directional signage wherever necessary.
- Signage for the direction to the way out should be clearly visible from the parking areas and loading/unloading facilities.

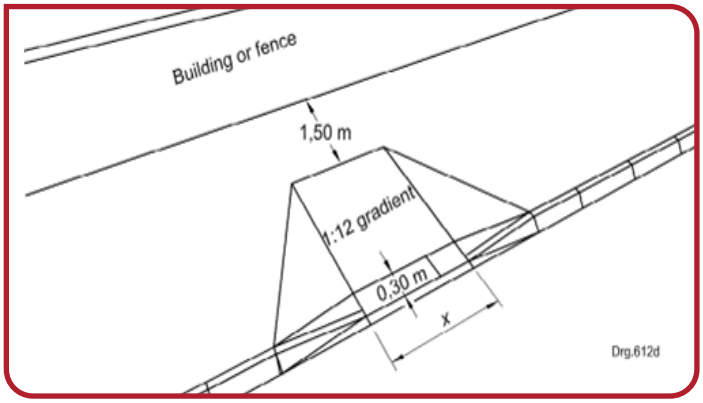
16.3.2 Accessible car parking

Accessible car parking means that sufficient space is provided next to the vehicle so that the user of a wheelchair and individuals requiring assistive devices can transfer and manoeuvre to and from the vehicle on level ground. The following items require attention:

- The accessible car parking space should be on level ground and the gradient of the accessible parking area should not exceed 1:50.
- Designated parking bays should be located close to the main building entry or lift lobby linking to the main entrance and upper floors.
- A safe, accessible path should be provided to the building entry, that is, the main front door or the entry to the building used by most individuals.
- The International Symbol of Accessibility must be placed in front of each designated car parking space. It should not be lower than 1500 mm from the floor so that it can be seen over the car, and must have good colour contrast with the background.
- Kerb ramps must be provided for safe access to adjacent walkways.
- Restricted speed limit signage must be posted at clearly visible locations in the car park.



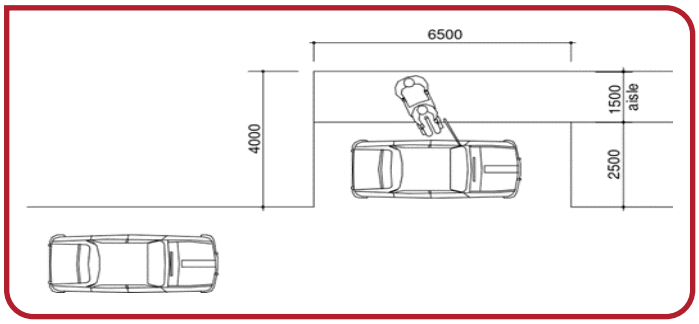
- Adequate manoeuvring space must be provided at junctions where the vehicular access links with the vehicular ramp to higher levels of the car park.



- Consider a gentler gradient like 1:8 for the vehicular ramp to higher levels of car parks to allow for manoeuvring requirements of larger paratransit vehicles, mini-vans and coaches.

16.3.3 Loading/unloading areas

- Loading/unloading areas for vehicles with wheelchair passengers shall be provided near the access to the main entrance or lift zone.
- A smooth and safe accessible route shall be provided from the loading/unloading areas to the major facilities, entrance or lift lobby.



16.3.4 Continuous accessible route

In planning for accessible parking, the principle of the continuous accessible route and details such as signage, kerb ramps and car park entry shall be considered. The following items require attention:

- The access aisle for shared use of two accessible car spaces shall be a minimum of 1500 mm wide.
- Slip-resistant floor finish and paving shall be provided at the accessible path.
- Clear directory signage shall be posted showing entrances to lifts, and along accessible routes to the car park.

16.4 Design Guidelines: Signage

Wayfinding shall be included with general signage.

16.4.1 Information

Facilities for people with diverse abilities shall be identified by the International Symbol of Accessibility.

Inaccessible routes shall have directional signage to indicate the route to the nearest accessible entrance.

16.4.2 Information counters

- A tactile guide path should lead from the entrance to the information counter, and from the counter to major circulation routes, lift zones or major circulation routes.
- High and low counters should be with a projecting countertop.
- Low counters should have a projecting countertop to provide knee space for wheelchair users.
- Notches at the sides of countertops are preferable for holding crutches, guiding sticks and umbrellas.

16.4.3 Orientation

- The design of distinct functional areas and routes in a building shall be clearly identified through colour, signage and other ways to assist with orientation inside a building. Landmarks that can be easily distinguished by visually impaired individuals are useful as orientation cues. Such cues include changes in illumination level, bright colours, unique patterns, murals, location of special equipment or other architectural features.
- The internal layout of public facilities should be able to communicate itself to orientate visitors with a sense of direction within the space.
- Major functional points should have a heightened design language to indicate their location.
- The spatial treatment of different facilities should be able to reflect their relative significance.

16.4.4 Landmarks

- Landmark objects can assist at wayfinding decision points, for example, sculptures, wall paintings, trees and plants or water features.

16.4.5 Signage disposition

- Signage shall be adequately provided at eye-catching locations at an appropriate height and of an appropriate size.
- Directional signage shall be provided at wayfinding decision points.
- Effective lighting shall be provided to make the signage noticeable at all times.
- Warning signs shall be provided for all clear glazed panels and glass doors.

16.4.6 Information transmission

- Directional and location signs shall be provided to inform about accessible routes, lifts and escalators, entrances and exits, information counters, sanitary facilities, health care facilities, communication facilities and functional areas.
- Assistive listening systems shall be provided for hearing-impaired persons, where possible.

16.4.7 Maps and directions

- Directories and floor plans, where provided, shall be located at the main entrance to a building or in a designated place on the floor of entry, and at other strategic locations on different floors and levels. Although they should be located at a prominent position, they should not obstruct the general pedestrian flow. The bottom level of directories shall be at a maximum height of 900 mm from floor level, wall mounted and indicating “You are here”.

16.4.8 Signage details

- Contrasting colours shall be used for signs against their background.
- Words and letters shall be of adequate size, height, boldness and suitable fonts for legibility.
- Graphics and wording shall be informative and easy to comprehend.

16.4.9 Identification and room signs

- Many people with disabilities have limitations in the movement of their heads and have reduced peripheral vision. Signage positioned perpendicular to the path of travel is easiest for them to notice. People can generally distinguish signage within an angle of 30 degrees to either side of the centrelines of their face without moving their head.

16.4.10 Illumination and colour contrast

- Signage should be well-lit. Illumination levels on the sign surface should be in the range of 100 to 300 lux and shall be uniform over the sign surface. Signs shall be located such that the illumination level on the surface of the sign is not significantly exceeded by the ambient light or visible bright lighting source behind or in front of the sign. Signs are more legible for persons with low vision when characters contrast with their background by at least 70%.

16.4.11 Visual text

- Text on signs should be clear and simple. Avoid long lists of items on signs. Shorter columns are easier to read and remember.

16.4.12 Tactile text and braille

- For tactile text, all characters should preferably be uppercase in a simple font style such as a sans-serif style. Characters should preferably not be italic, oblique, script, highly decorative or of other unusual forms.
- Tactile characters shall be raised a minimum of 1 mm above their background and should be accompanied by a braille directly below the text. The depth of any embossing should be at least 2 mm.

- Braille shall be located below the corresponding text and preferably be justified to the left. If text is multi-lined, the braille shall be placed below the entire text. The braille shall be separated a minimum of 6.5 mm from any other tactile characters.

16.4.13 Pictorial symbols

Internationally recognised pictorial symbols or pictograms with explanatory text shall be used wherever possible. Pictograms shall have a minimum field height of 150 mm. Characters or braille should preferably not be in the pictogram field.

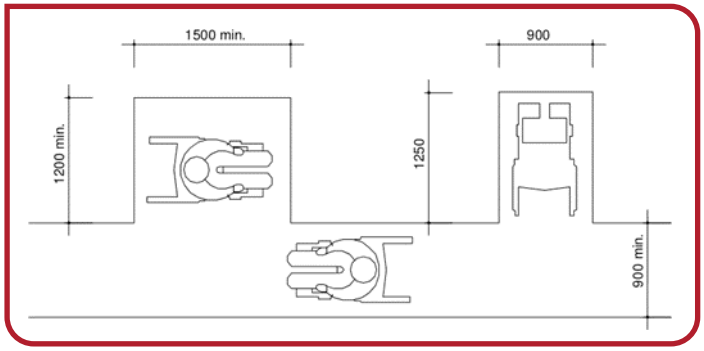
16.5 Traffic calming

- Galvanised steel speed bumps should be ±60 mm in height and 325 mm in diameter.
- Installation is to be done at ±3 units per meter.
- Bumps shall be filled with high-density concrete.
- A ten-year product guarantee is recommended, accompanied by a two-year guarantee on the installation.
- Installation shall be done with epoxy glue.

16.6 Pedestrian Circulation

Design guidelines.

16.6.1 Configuration



- The pathway width should be sufficient to allow at least two wheelchair users to pass each other.
- A straight pathway is preferred.
- Pathway edges should be clearly visible and protected to prevent wheels from dropping off.
- Projections should be of suitable height and projecting width to avoid accidental bumping and should not obstruct the pathway users.
- Channel grating slots should not be parallel to the major traffic direction, and slot sizes should be small enough to avoid trapping crutches or wheels.
- Effective lighting shall be provided.
- The walking surface should be accessible.
- Persons with special needs or with a disability shall have the same level of freedom of movement inside buildings or in external areas as ordinary persons.
- Access shall be made available for all individuals to approach, enter or leave a building and use the facilities independently.
- A walkway with a gradient not steeper than 1 in 20 or a ramp with a gradient not steeper than 1 in 12 would form an accessible route.

16.6.2 Walkways

- The width of walkways shall not be less than 1100 mm clear. The best practice is to provide a 1200 mm-wide walkway to enable a wheelchair to turn, but preferably 1500 mm to allow two wheelchairs to pass each other.
- Safety measures such as buffer planters, railings, safety barriers or warning signs shall be provided if a walkway passes through any area.
- Walkways should be clear of obstruction.
- Special consideration is required to recess or eliminate obstacles when walkways cross over spaces with low headroom, such as spaces under escalators and staircases, or

when fittings projecting more than 100 mm beyond the wall surfaces and below 2000 mm high are found along the walkway.

- A covered walkway or ramp is recommended where access is provided between platforms or facilities at different levels. A covered walkway shall be provided linking two buildings where frequent access between the buildings is required.

16.6.3 Surface and level changes

- Walkway surfaces should be stable, firm and, generally, follow a continuous plan, with minimal surface warping.
- Walkway cross-slopes should not exceed 1:50 pavement on streets, with the natural topography not exceeding 1:20.
- Walkways should have a continuous common surface and not be interrupted by steps or changes in level greater than 6 mm.
- Thresholds should not exceed 25 mm in height and should be levelled to facilitate the smooth passing of wheels.
- The intersecting surface where a walkway crosses or joins a street, public footpath, driveway or parking area should blend into a common surface level, with a slope no greater than 1:20, or a dropped kerb should be provided.

16.6.4 Drainage

- Fall and drainage shall be designed to minimise water-ponding or flow of water across walkways.
- Channel cover gratings in walkways shall be designed with spaces smaller than 13 mm. Holes in channel covers should not be greater than 20 mm.
- Covers to a channel shall be flush with the surface of the walkway.
- Outdoor walkways, ramps and their approach shall be designed so that water will not accumulate on walking surfaces.
- Structural failure shall be considered for effective rainwater discharge.

16.6.5 Braille and tactile guide

Tactile routes and guides shall be allowed for in general circulation as part of landscaping.

16.6.6 Changes in level

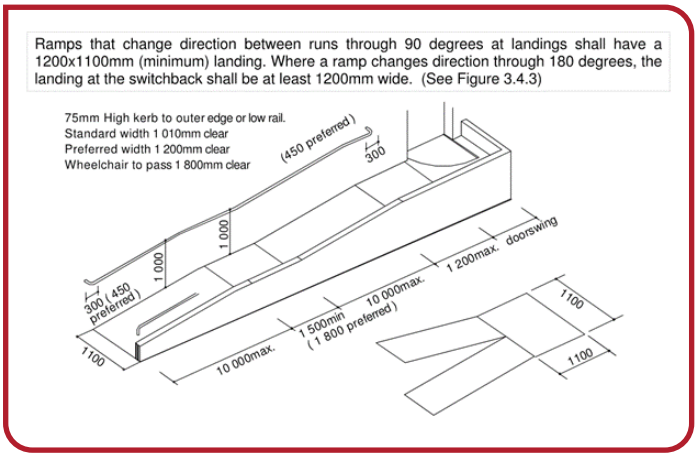
- Ramps, dropped kerbs or sloping grounds shall be used to connect changes in level, in addition to steps and stairs, if any.
- Warning shall be provided at a suitable distance before the change in level.
- For a slight change in level, a full-width continuous sloping ground accessible for all is preferable to a separate ramp.
- Effective lighting or footlight shall be provided to make the change in level clearly visible.

16.7 Design Guidelines: Ramps And Sloping Grounds

Ramps are sloping walkways and should have the least possible gradient. It is desirable to have more gentle slopes and slopes are recommended to reduce a gradient of 1 in 20, if possible. The maximum gradient of a ramp shall be 1:12 measured between any two points on the ramp.

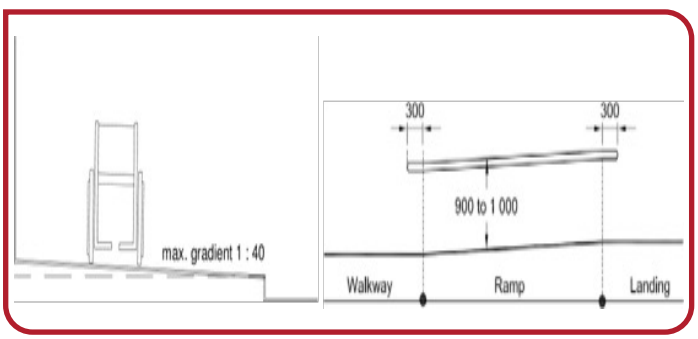
The minimum clear width of a ramp shall be 1100 mm. Similar to walkways, a width of a ramp should be at least 1200 mm for a wheelchair to turn or at least 1500 mm for two wheelchairs to pass each other. Handrails shall be provided on both sides of a ramp.

16.7.1 Gradient, rise and landing



- The recommended maximum rise for any run is 800 mm.
- Landings for turning and resting shall be provided. A minimum landing of 1500 mm x 1500 mm shall be located at the bottom and the top of each ramp. A landing width and length no less than the width of the ramp shall be provided where the ramp changes direction.
- The maximum length of a ramp run between landings shall not exceed a 10 m length of horizontal run or part thereof, and the landing shall not be less than 1200 mm long.
- Circular ramps are not recommended.
- The cross slope of ramp surfaces should not be greater than 1:50.
- Landings shall be level and unobstructed by protections and door swings.

If a ramp with a rise greater than 200 mm leads down towards an area with vehicular traffic, a railing or barrier across the entire width of its lower end shall be provided for safety purposes. The railing or barrier shall be no less than 1500 mm from the foot of the ramp.



16.7.2 Surfaces

- Ramp surfaces shall be stable, firm and slip-resistant.
- Similar to walkways, ramps shall be clear of obstruction. If unavoidable, they shall extend downwards to the ramp level or be guided by tactile flooring materials.
- Outdoor pedestrian ramps shall be provided with adequate drainage gullies at each side of the ramp to drain away exclusive surface water running down the ramp.

16.7.3 Edge Protection

- Ramps and landings with drop-offs should have edge kerb, railings or projecting surfaces to prevent users from slipping off the ramp.
- Edge kerbs should have a minimum height of 100 m. For differences in adjacent levels greater than 600 mm, the lowermost solid protective edge should be 150 mm high.

16.7.4 Stairs and steps

Staircases and steps shall not be used as the primary means of vertical circulation if alternative means such as ramps or elevators are feasible. This is because staircases cannot be used by wheelchair users and are not easily negotiated by a number of users, for example, persons with mobility impairments, pregnant women and the young and elderly.

- The 150 mm level difference between the floor next above the external ground or adjoining surface is required.
- Slopes not steeper than 1:20 or ramps not steeper than 1:12 should replace the 150 mm step at all entrances/exits to buildings or facilities wherever feasible. The priority choices in access provision are shown in the table below.

Priority	Means of access	Approach space requirement (150 mm rise)
1st	The whole width of the entrance/exit is accessible with a slope not steeper than 1:20	3000 mm (if there is no door) + 1500 mm (landing for door)
2nd	The whole width of the entrance/exit is accessible with a ramp not steeper than 1:12 (railings are required on both sides)	1800 mm (if there is no door) + 1500 mm (landing for door)
Last	150 mm step with a 1:12 ramp attached (railings are required on both sides of ramps)	1800 mm for a perpendicular ramp (no door) + 1500 mm (landing for door) or 1500 mm for a ramp parallel to the entrance

- An alternative accessible route, for example, by means of a lift or ramp, shall be provided nearby within sight from the position of the staircase.
- If the accessible route is not available within sight, appropriate signage shall be provided to guide users in need of the accessible route.Stairlifts are not a means of universal access. Facilities requiring universal access shall not be considered to satisfy the universal access requirement if only stairlifts are provided without an alternative accessible route. Stairlifts shall not be used in the design of new buildings.

16.8 Design Guidelines: Floor Surface Materials

- External ground floor materials should be non-slippery.
- Floor materials should not be too rough to make the surface too bumpy or to cause flat fires.
- Surface materials with less glare are preferred.
- Material joints should be smooth with minimum recess/projections and a minimum width.
- In instances where there is a step at an ablution facility, a “mind your step” sign shall be installed.
- Floor surfaces should be level and even.
- Types of surface materials should preferably be different for the main pathway and other pathways, but too many different surface materials may cause confusion.

16.8.1 Gratings

- If gratings are located on walking surfaces, the size of the openings shall be as small as possible to avoid trapping wheelchairs or guiding sticks.
- Small grating openings shall be used at stormwater channels to avoid the build-up of debris and blockages.
- Elongated openings in gratings shall be placed so that the long dimension is perpendicular to the dominant direction of travel.
- The gratings shall be of approximate material and securely fixed to avoid removal; otherwise, the uncovered drainage channel will form a problematic barrier.

16.8.2 Tactile surfaces

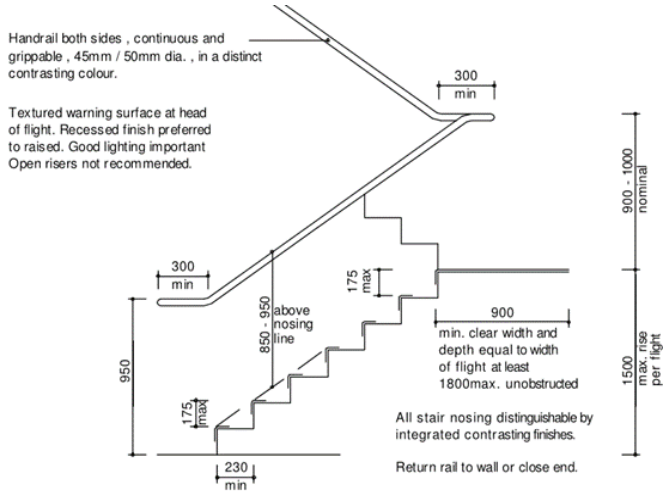
Tactile surfaces are used for guidance paths, information and warning about openings and edges for persons with visual impairments. Three types of tactile surfaces are commonly used to guide and alert people:

- **Directional tile:** It consists of raised parallel bars to guide people along the direction of a tactile path.
- **Warning tile:** It consists of raised truncated domes arranged in a square grid parallel to the sides of the tile to alert people of potential hazards, such as the top and bottom of stairs, door openings and pedestrian crossings.
- **Positional tile:** It consists of raised small dots arranged in staggered positions to indicate a change of walking direction.

In designing an accessway to a facility or building, the selection of floor materials may be different for exterior and interior environments. In all cases, it is important to bear in mind that the tactile surfaces should be firm and slip-resistant.

- The material used to provide contrast should be an integral part of the walking surface.
- It is preferable that tactile surfaces be used on interior surfaces that differ from adjoining walking surfaces in resiliency or in the sound made by contact with the guiding stick of the visually impaired.
- Tactile surfaces should convey meaningful and continuous information to the user. For example, the tactile guide path to the lift lobby should lead to the lift button position and then the lift door opening position. The call buttons and other associated information in braille should convey the necessary information to complement accessibility.
- Continuous tactile guide paths shall be provided to entrances/major facilities, information counters, braille maps and lifts.
- Directional, positional, location and hazard warning tactile surfaces shall be correctly laid to convey the correct information.
- Tactile surfaces shall be laid at a distance from wall surfaces to facilitate left- or right-handed persons with guiding sticks.
- Door swings into the tactile surfaces shall be avoided.
- Tactile surfaces shall preferably be segregated from pathways for wheelchair users to avoid conflict between the two user groups.
- Contrasting colours can make the tactile surface noticeable.

16.9 Design Guidelines: Handrails



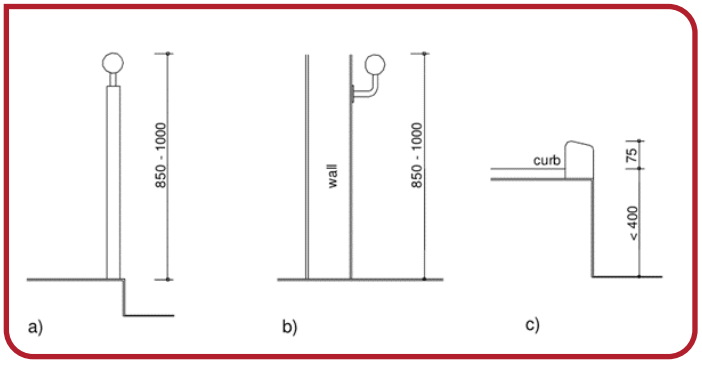
External stair (stepped approach)

Handrails shall be provided for all ramps, staircases and steps. They can also be used alongside a tactile guide path, along corridors, as protective barriers and guards against hazards, and can be a directional guide to doorways or positions of signage.

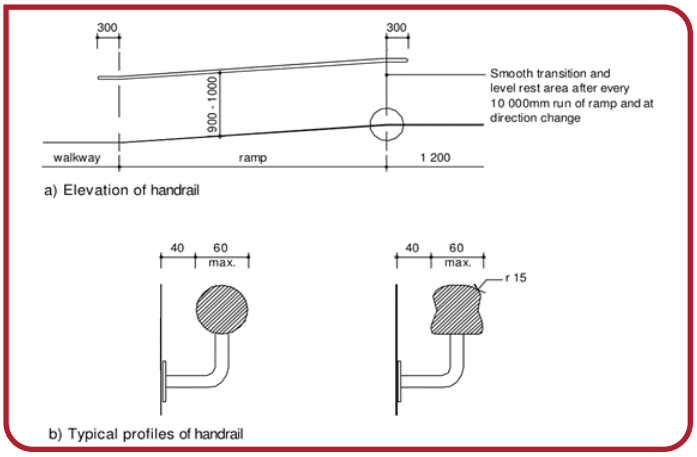
Where continuous handrails are necessary, for example, in elderly residencies, or where a handrail is used for way-finding by persons with visual impairments, the arrangement at openings such as doorways, service ducts or hose reels shall be carefully considered to avoid conflict or breaking of the handrail.

The following items require attention:

- Handrails at two-level mounting heights shall be provided for places frequently visited by children.
- Handrails shall be continuous with recessed brackets
- The ends of handrails shall be returned to the wall, floor or post so that they do not become obstructions.
- Handrails shall be2 securely fixed and durable to avoid posing a danger to users relying on them for assisted walking.
- Materials should be smooth and offer a firm grip.
- The size and shape of handrails should offer a firm grip.
- Materials for external handrails should not retain much heat or cold.



- Braille, tactile or 3-dimensional signage at the top and bottom ends of handrails can provide direction and location information.
- The entire component shall be securely fixed to the building structure and conveniently located to provide a secure hand grip for persons to take their entire weight when required. Handrails should not rotate within their fittings.
- Railing designs that allow children to climb shall be avoided.
- Handrail heights shall preferably be provided in pairs for adults and children, respectively. The higher one should be at a height of 850 mm to 950 mm, and the lower one at a height of 450 mm to 500 mm, measured vertically from the surface of the ramp or finished floor level to the top of the handrail.
- Handrails shall be continuous without interruption, except at doorways and openings, and with recessed brackets so that a hand can move from end to end without interruption.
- The gripping surface shall be free of any sharp or abrasive elements.
- The handrail should be consistent throughout the entire length to avoid sending false messages to visually impaired persons due to changes in the material.
- Handrails shall be installed to resist a load of not less than 1.3 kN applied vertically or horizontally.



17. LIGHTING AND ILLUMINATION

Indoor Lighting

All light switches and socket outlets (or other outlets) shall be numbered with the relevant circuit number and the distribution board name. A Brother “label printer” is sufficient for this. Emergency light fixtures shall also be marked as such. In exceptional cases, the VB legend card may be sufficient.

17.1 Photocells

Only Royce Thompson or National (in box) with BYPASS Schneider ISOLATOR in DB shall be used. An agreement shall be reached on the need for a contractor (AC3) per project.

17.1.1 Luminaires

- Luminaires shall comply with SANS 60598 (relevant parts).
- Luminaires shall be supplied with lamps of a type suitable for the luminaire design as per the Engineer’s design.
- Samples of luminaires (and LED lamps) shall be submitted by the Electrical Contractor before installation for purposes of the Facilities Management Maintenance Database. For projects where aesthetics are important, examples of luminaires shall be pre-installed and the approval of the architect and Facilities Maintenance shall be obtained.
- Light fixtures in toilets/bathrooms/ corridors/ stairs must contain LED light bulbs and comply with the minimum levels of OHSA (not productivity index). Example: 1 x 9/18 W instead of 2 x 26 W.
- Only energy-saving lighting (LED tubes and light bulbs) is to be used. As part of energy-saving, no decorative lighting is allowed; in other words, 12 V 50 W downlights are out.

17.1.2 Control gear and enclosures

- Control gear shall be fully compatible (both physically and electrically) with the type of lamp and luminaire it is intended to be used with.
- High-frequency, electronic control gear shall be used for tubular (double-capped) and compact (single-capped) fluorescent lamps and, if appropriate, for discharge lamps.
- The temperature rating of the control gear shall be appropriate for its operating environment.
- If the control gear is not integral to the lamp or housed within the luminaire, it shall be housed within a suitable enclosure.

17.1.3 Switches

Flush-mounted switches

- Flush-mounted switches shall comply with SANS 60669-1 and shall bear the SABS mark.
- All flush-mounted switches shall be suitable for mounting in 100 mm x 50 mm x 50 mm galvanised steel or PVC wall boxes unless otherwise specified by the Engineer.
- The switch mechanism shall be of the tumbler-operated micro-gap type with silent operation and shall be rated for 16 A at 250 V and 50 Hz.
- Switches shall have protected terminals for safe wiring. Multi-lever switches shall be constructed to enable individual defective switches to be removed and replaced without removing the remaining ones.
- The mounting holes provided on the yoke strap shall be slotted to allow for easy alignment. Furthermore, a brass earthing terminal shall be provided on the yoke to ensure the positive earthing of the switch assembly.

Switches with pilot light indication

- Flush-mounted switches with pilot light indication shall comply with the relevant parts of SANS 60669-1 and shall bear the SANS mark.
- Switches with pilot light indication shall be suitable for mounting in 100 mm x 50 mm x 50 mm galvanised steel wall boxes.
- The switch shall be rated at 16 A at 250 V and 50 Hz. A red indication lamp shall form an integral part of the switch lever and shall light up when the switch is in the on position.

Cover plates for switches

Cover plates for flush-mounted switches shall have levelled edges that overlap the wall box to conceal all wall imperfections.

Surface-mounted switches

- Surface-mounted switches shall comply with SANS 60669-1 and shall bear the SANS mark.
- Surface-mounted switches shall consist of single or multiple switches, not exceeding four, and shall be mounted in a pressed steel box of heavy-duty construction.
- The switch mechanism shall be of the tumbler-operated micro-gap type with silent operation and shall be rated for 16 A at 250 V and 50 Hz.
- A brass earthing terminal shall furthermore be provided on the switch construction to ensure the positive earthing of the switch assembly and enclosure.
- The covers of surface-mounted switches shall have toggle protectors.

Watertight switches

Watertight switches shall consist of 10 A switches on porcelain bases in cast iron or aluminium alloy housing. Contacts must be of heavy-duty brass construction and a quick-acting spring mechanism shall be fitted. A rigid operating knob shall be clearly marked to indicate the “ON” and “OFF” positions. Conduit entry shall be provided through a tapped hole. The complete unit shall be watertight.

Photo-electric daylight switches

- The photo-electric daylight switch unit shall comprise a photocell, thermal actuator and change-over switch. The cover of the unit shall be manufactured from a tough, durable material that protects against tampering. The cover shall have good anti-weathering properties. It shall be ultraviolet resistant and shall not deteriorate when exposed to sunlight for prolonged periods.
- The units shall be capable of operating in dusty conditions between -5 °C and +55 °C.
- The units shall be designed to withstand damage by either stone throwers or hail. If the units do not possess this quality, separate wire screens shall be provided for this purpose.
- All parts shall be treated to be corrosion-proof.
- The operation level shall be factory preset for “ON” at a light level of approximately 54 lux and “OFF” at approximately 108 lux. Voltage variations shall not affect the operational levels.
- A time delay of not less than 15 s shall be provided to prevent the unit from functioning due to lightning or other short-period changes in illumination.
- The unit shall be effectively safeguarded against voltage surges using a suitable surge protector, preferably forming an integral part of the unit.
- The unit shall be of the wall-mounting type and supplied completely with a suitable bracket.
- The change-over switch shall be capable of switching a 10 A alternating current at 230V.

17.1.4 General interior lighting schedule

DESCRIPTION
Surface open channel 2 x 1.2 m–4000 k LED luminaire with 4000 k 20 W advanced Osram LED tubes included

AREAS
Passage/Storeroom

DESCRIPTION
Surface open channel 2 x 1.5 m–4000 k LED luminaire with 4000 k 20 W advanced Osram LED tubes included.

AREAS
Passage/Storeroom

DESCRIPTION
Surface vapour proof 2 x 1.2 m–4000 k LED luminaire with 4000 k Osram LED lamps. UFS standard specification.

AREAS
Bathroom

DESCRIPTION
Surface vapour proof 2 x 0.6 m–4000 k LED luminaire with 4000 k Osram LED lamps. UFS standard specification.

AREAS
Bathroom

DESCRIPTION
Spazio Saturn

AREAS
Passage/Bathrooms

DESCRIPTION
Beka Rondo LED

AREAS
Passage/Bathrooms

DESCRIPTION
AC10 Downlighter with E27 LED lamp

AREAS
Passage/Bathrooms

DESCRIPTION
Synerji downlight SY101 white Al Tilt/72 mm cut

AREAS
Passage/Display area

DESCRIPTION
Synerji downlight SY121 white Al Tilt/62 mm cut

AREAS
Passage/Display area

17.1.5 General outside and area lighting schedule

DESCRIPTION
BEKA series 40 18 W LED bulkhead with eyelid black

AREAS
External walls

DESCRIPTION
BEKA series 300

AREAS
External walls / Canopies

DESCRIPTION
BEKA series 30

AREAS
External walls / Canopies

DESCRIPTION
BEKA Zela

AREAS
Walkways / External areas

DESCRIPTION
BEKA LEDLUME-MAXI 5068-128 198W LED-350MMA

AREAS
Street and roadway lighting

DESCRIPTION
LED LUME-MAXI 5068-96 108W350MMA

AREAS
Large open areas and parking

17.1.6 General office lighting schedule

DESCRIPTION
Regent recessed 600 mm x 600 mm 40W panel 4000 k LED-type fitting complete with 3 m cabtyre and 5A plug

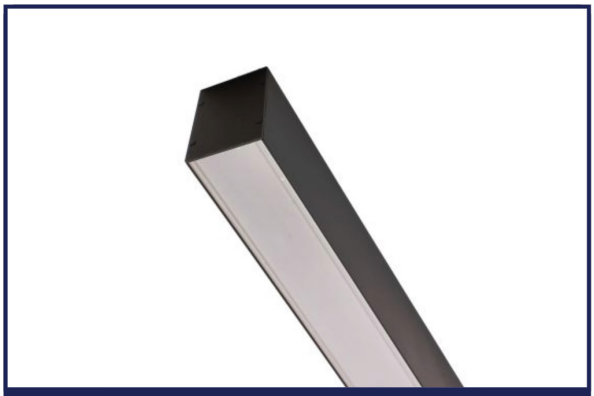
AREAS
Office / Gazellies

DESCRIPTION
Regent recessed 1200 mm x 600 mm 40W panel 4000 k LED-type fitting complete with 3 m cabtyre and 5A plug

AREAS
Office / Gazellies

DESCRIPTION
0.6 m T5 Waco luminaire with 3 x 20W Synerji LED glass tubes, side termination with gland only

AREAS
Office / Gazellies



DESCRIPTION
Regent linear suspended – PRO 70

AREAS
Boardroom

DESCRIPTION
BEKA disk

AREAS
Lobbies / Reception

DESCRIPTION
Pendant aluminium white LED 1 x 33W radiant lighting

AREAS
Lobbies / Reception

17.1.7 Special lighting schedule

DESCRIPTION

Spazio lone track 3-wire white 15 W GU10 LED spotlight 4000 K

AREAS

Passages

DESCRIPTION

Spazio pendant Roma 8579.1.30 medium with aluminium shade and a 3 m suspension wire (15 W/230 V/e27 LED)

AREAS

Dining room

DESCRIPTION

BEKA Vapourline 46 W LED 4000 K

AREAS

Labs

DESCRIPTION

BEKA LEDBAY

AREAS

Lecture/ exam rooms

DESCRIPTION

Hutz theatre ceiling simulation area Luvis LED s300 c. as per UFS specification

AREAS

Simulation area

DESCRIPTION

Sani UVGI ceiling disc ultraviolet air sanitation

AREAS

Labs

17.2 Mechanical Interfacing

1. All new mechanical installations, as well as upgrades to existing infrastructures, shall fully comply with the mechanical specification as provided by the Mechanical Engineer.
2. This specification covers the mechanical works regarding electrical installations. The Electrical Contractor shall provide all equipment sleeves and conduiting as well as items on the Bill of Quantities and as indicated on the contract drawings.
3. A suitably rated double pole isolator shall be supplied and installed within 1 m of fans and air conditioners. Where the equipment is out of reach, the isolator shall be installed 1.5 m above floor level. Flexible cords of sufficient rating may be used for the final connection to the equipment.

17.3 ICT & Security Interfacing

All new ICT and security interfacing installations, as well as upgrades to existing infrastructures, shall fully comply with the ICT specifications provided by the UFS ICT Department. The UFS ICT Department shall provide the specifications for all ICT equipment and their installation.

These specifications cover the ICT services with regard to electrical installations. The Electrical Contractor shall provide all equipment sleeves and conduiting as well as items on the Bill of Quantities and as indicated on the contract drawings.

The Electrical Contractor shall only supply and install all materials required for the provision of mechanical works distribution wireways and outlets as indicated on the relevant drawings. Cabling and installation of mechanical equipment shall be undertaken by others.

17.3.1 Conduit and Sleeves

All ICT standard conduit shall be 25 mm PVC or galvanised steel. Flexible conduit shall be used when it is the only practical solution. If flexible conduit is used, the size shall be increased to the next industrial conduit size available. ICT sleeves shall be 110 mm- and 50 mm-diameter PVC.

Conduit runs shall be designed to:

- Run in the most direct route possible.
- Contain no continuous sections longer than 30m.
- Withstand the environment they will be exposed to.

For runs longer than 30 m, draw boxes shall be installed at no longer than 30 m intervals. All conduits and sleeves to telephone outlets or sub-distribution boards in the buildings or elsewhere on the site, as well as the main incoming sleeves, shall terminate at the main telephone distribution board as shown on the relevant drawing.

Separate sleeves with different colours shall be installed for the following services:

a) Telephone network – blue

b) Data network – green

c) Security network – yellow

17.3.2 Data and telephone outlets

The Electrical Contractor shall only supply and install all materials required for the provision of telephone distribution wireways and outlets as indicated on the relevant drawings. Data and telephone cabling installation shall be undertaken by others.

Telephone distribution boards shall be flush-mounted in the wall in the position indicated on the relevant drawing, unless otherwise stated. The mounting height for the board shall be indicated on the drawings or as otherwise indicated by the UFS ICT Department.

Conduits, sleeves and wireways provided for telephone, data or other related services shall under no circumstances be used for any other purpose. Power cables shall be installed at a

minimum distance of 300 mm away from the routes reserved for telecommunication cables.

Data and telephone outlets in walls shall comprise 100 mm x 100 mm x 50 mm deep wall boxes, which shall be flush-mounted in the wall, in the position shown on the relevant drawing.

Data and telephone outlets in power skirtings shall be provided in the positions shown on the relevant drawing. The outlet points shall match the power skirting colour.

17.3.3 Network outlet points

The Electrical Contractor shall only supply and install all materials required for the provision of network distribution wireways and outlets as indicated on the relevant drawings. Cabling installation shall be undertaken by others. All conduits for network purposes shall be 32 mm².

17.3.4 Documentation

On completion of the ICT installation, the third parties shall provide as-built drawings to the Electrical Contractor, who will submit these to the UFS with their OMS.

17.4 Street and Area Lighting

17.4.1 Floodlight luminaires

- Luminaires shall be of the totally enclosed weatherproof type complete with a high-pressure sodium discharge lamp with integral mounted igniter and control gear unless otherwise specified.
- The housing shall be robustly constructed of die-cast LM6 aluminium alloy or other corrosion-proof and UV-resistant material and be effectively sealed against the ingress of moisture, dust, etc. The front glass cover shall be constructed from heat-resistant armoured glass and have retaining clips, fasteners, etc., manufactured from stainless or ferritic steel. The fitting shall incorporate a protractor scale to allow for the correct and accurate adjustment of the downward to vertical aiming angle.
- The internal wiring shall be by means of high-temperature-grade silicone rubber insulated high-quality flexible stranded cables not subject to deterioration. Low-voltage wiring shall not be less than 660 voltage grade, and in the case of high-voltage wiring, the continuous voltage grade shall be suitable for the open circuit voltage of the ballast.
- The section in which the capacitor, igniter, choke gear and terminals, etc., are located shall be accessible for ease of maintenance. The section shall be complete with an earthing terminal and 660-V insulated line connector block. Capacitors shall be the metal-clad, totally enclosed type complete with sealed-in cable tails. Capacitors shall be manufactured fully in accordance with SANS 61048 and be capable of improving the overall PF to at least 0.95 and be fitted with safety-discharge resistors. Chokes shall be of the totally encapsulated type that has terminal blocks for ease of maintenance. The electronic ignition device shall be of the three-wire type operating on the superposed pulse principle. The circuitry shall be such that should a lamp fail, the ignition shall not continue pulsing.
- The lamp holder endcap shall be porcelain, with silver-plated metal parts of the GES type, and able to withstand a high starting voltage. The lamp holder shall incorporate a spring-wire-type supporting device at the end of the lamp, opposite the cap.

17.4.2 Poles

- Poles shall be of the round cross-section-tapered type with a mounting height of the luminaires. The poles shall be manufactured of glass filament wound and be smooth, tapered and seamless.
- The pole tops shall be provided with a multiple-luminaire assembly, two-way, three-way or four-way diameter to suit the luminaires offered.

- An opening of 250 mm high by 80 mm wide shall be provided at a height of 1000 mm above ground level. A gland plate that can take up to three cables, 6.3 A/5 kA MCB, a terminal block and an earth stud shall be installed on a mounting plate in this opening. A shaped weatherproof cover plate, manufactured from the same material as the pole, shall be provided to cover the opening. The cover plate shall provide total protection of IP55 to SANS 475. The cover plate shall be fastened in place with Allen key-type countersunk screws.
- The internal wiring between the luminaire and terminal block shall be by means of 2.5 mm² PVC-insulated conductors and a 1.5 mm² bare copper earth conductor. The terminal block shall be suitable for the incoming cables and the internal wiring conductors specified.

17.4.3 Luminaire mounting carriage

- The luminaire mounting carriage shall be constructed from galvanised mild steel and be provided with all the necessary brackets for the mounting of the luminaires, control gear and terminal boxes.
- The carriage shall be designed to carry the weight of the luminaires and associated equipment.
- Ballasts should replace the missing luminaires to ensure that the weight is uniformly spread over the luminaire mounting carriage.

17.4.4 Electrical connection to the luminaires

The connection to the luminaires shall be by means of a suitably rated multicore trailing cable. The cable shall have numbered cores, with one green/yellow earth core. The cable shall be terminated in an adequately sized terminal box mounted on the luminaire mounting carriage from where the individual luminaires and ancillary equipment shall be connected. The cable shall be provided with an approved tension sock at the point of suspension.

17.5 Training, Testing & Commissioning

All electrical installations shall be inspected and tested in accordance with SANS 10142-1 and in the presence of UFS and the Engineer. Inspection and testing shall only be performed by personnel with approved, current qualifications. The Contractor shall provide qualified personnel for the supervision of all inspection and testing activities. All necessary safety equipment and test instruments shall be provided by the Contractor and all tests need to comply with SANS 61010. The Contractor's safe working arrangements shall comply with the safety management procedures of the UFS. A risk assessment, safety file and method statement shall be submitted to the UFS for approval prior to starting work.

The Contractor shall make provision for all inspection and testing activities to be witnessed. Unless otherwise specified, the period of notice for witness testing shall be five working days. Where most of the inspection and testing activities are not witnessed, the Contractor shall allow for 10% of the inspection and testing activities to be repeated for witness testing.

Unless otherwise agreed by the UFS, no part of the installation shall be commissioned until all defects or omissions revealed by inspection and testing have been rectified. Where a defect or omission renders all or part of the installation unsafe for use, the Contractor shall take approved precautions to ensure that no part of the installation can be commissioned.

Upon commissioning, the complete installation and equipment shall be formally handed over to the UFS.

17.6 Lightning Protection

The lightning protection system shall be designed and installed in accordance with:

d) The latest issue of SANS 10313: "Protection against lightning – Physical damage to structures and life hazard".

e) The latest issue of SANS 62305-1: "Protection against lightning Part 1: General principles".

f) The latest issue of SANS 1239: "Plugs, socket-outlets and couplers for industrial purposes".

A set of drawings shall be submitted to the UFS and approved by the UFS Engineer prior to commencement of the installation.

17.7 Metering

In the event that an electrical meter is required, one of the following meters shall be installed, depending on the electrical supply:

4. Kamstrup Omni power single-phase meter.

5. Kamstrup Omni power three-phase meter.

6. Kamstrup Omni power three-phase CT meter.

7. Kamstrup Omnia E-meter.

If a modem is required, the Riecktron modem for Kamstrup electrical meters (M2M smart modem with RS 485 modules) shall be installed.

The programming and setting up of the meter shall be done by a third party and is not the responsibility of the Electrical Contractor.

18. ELECTRICAL INSTALLATION

18.1 Standard

18.1.1 National statutory requirements

The installation shall be erected and tested in accordance with the following acts and regulations:

g) The Occupational Health and Safety Act, 1993 (Act 85 of 1993) as amended.

h) The Local Government Ordinance 1939 (Ordinance 17 of 1939) as amended and the municipal by-laws and.

i) Any special requirements of the local supply authority,

j) The Fire Brigade Services Act 1993 (Act 99 of 1987) as amended.

k) The National Building Regulations and Building Standards Act 1977 (Act 103 of 1977) as amended.

l) The Post Office Act 1958 (Act 44 of 1958) as amended.

m) The Electricity Act 1984 (Act 41 of 1984) as amended.

n) The Regulations of the Local Gas Board, where applicable.

18.1.2 Guidelines & recommended codes of practice

The following guidelines and recommended codes of practice shall be adhered to for all electrical installations:

o) The latest issue of SANS 10142: "Code of practice for the wiring of premises".

p) The latest issue of SANS 1085: "Wall outlet boxes for the enclosure of electrical accessories".

q) The latest issue of SANS 1239: "Plugs, socket-outlets and couplers for industrial purposes"

18.1.3 UFS general requirements

All projects and installations shall be in accordance with the following UFS requirements:

r) Estimate stage: All electrical estimates shall first be issued to the Engineering Office for review and approval prior to being issued to quantity surveyor (QS).

s) Tender stage: All design drawings, specifications and Bills of Quantities are to be issued to the Engineering Office for review and approval prior to being included in the tender documentation.

t) Construction stage: All shop drawings shall be reviewed and verified by the Engineering Office in conjunction with the maintenance team prior to instruction to proceed with manufacturing.

u) All contract instructions (CIs) shall be issued to the Engineering Office for verification prior to being issued to QS.

v) Project communication: Only the UFS project manager is to liaise or communicate with clients; there will be no correspondence with clients from the consultant and Contractor unless otherwise instructed (written instruction).

18.1.4 FS health & safety requirements

18.1.4.1 In general

The Contractor will have to submit a health and safety (H&S) plan for approval to the UFS prior to any construction. The H&S plan must incorporate the UFS H&S policy, site rules and regulations, emergency contact details and underground plans. Delays in the submission of the H&S plans will result in delays in project execution.

The Principal Contractor shall carry full responsibility and accountability regarding the adherence to any H&S issues when contractors (sub-contractors) are used to execute any construction work on the project.

Should the work not be in accordance with the UFS H&S specifications or rules for the duration of the project or pose a threat to the H&S of any person, the UFS safety representatives may stop the work.

18.1.4.2 Health and safety plan requirements

- The H&S management programme shall at least provide a detailed overview of the following:
- Structure and organisation of OHS ACT responsibilities and appointments.
- Management of the project's occupational health and safety hazards and risks.
- Communication of the health and safety management programme.
- Programme for occupational health and safety internal audits and inspections.
- Programme for occupational health and safety investigations regarding incidents/ accidents.

18.1.4.3 Health and safety training

The contents and syllabi of all training required by the acts and regulations, including any other related or relevant training as required, must be made available to the University safety representatives. The Contractor shall be responsible for ensuring that all their employees are adequately orientated, inducted and trained to perform their tasks.

18.1.4.4 General health and safety site requirements

The general H&S site requirements shall include:

- Site administration details.
- Principal Contractor's Health and Safety

Management Programme indicating involvement and adherence of employees in improving SHE management, promotion of H&S on site, reporting of H&S matters on site as well as eliminating unsafe and hazardous situations.

- Personal protective equipment (PPE) required or that will be used for the project.
- Employee site facilities that will be provided.
- Health and safety signage/site fencing.
- Health and safety notice board.
- Availability of first-aid station.
- Site establishment, lay down and storage.
- Housekeeping.
- Intoxicating liquor or drug usage on site.
- Smoking – where dedicated smoking areas are to be located.
- Emergency procedures and communication.
- Contractor management.
- Ladders (portable).
- Stacking and storage of material on site.
- Electrical works on site.
- Logbooks and registers kept on site.

18.1.4.5 Construction site requirements

The Principal Contractor is to be aware of the following on site and always comply with the stipulated requirements:

- Work on elevated positions.
- Scaffolding.
- UFS active areas.

18.1.4.6 Risk assessment programme

The Contractor shall ensure that continuous risk assessments are conducted and that proper monitoring and review of risk assessments are conducted. The purpose of a continuous risk assessment is to operationally identify occupational SHE hazards for the purpose of treating significant risks.

18.1.4.7 Mandatory construction signages

All signages in the figures below must be visible to every person who accesses the construction site and all persons who might be affected by the site activities.

18.2 Detailed Requirements

18.2.1 In general

This specification covers the design, manufacturing, supply, installation, delivery and testing and commissioning of electrical installations on voltages up to 1000 V AC/ 1500 V DC. This specification aims to ensure a safe, reliable and operational electrical installation. In all cases where a device or part of the equipment is referred to in the singular, it is intended that such reference shall apply to as many devices as are required to complete the installation. This specification applies to all. offices, residential areas, lecture rooms and general and specialised areas.

18.2.2 Low-voltage cables

18.2.2.1 In general

Cables shall be manufactured strictly in accordance with the requirements of SANS 1507. Cables shall be delivered within 12 months of manufacture and delivered to the site on cable drums or coiled with protective wrappings.

Cables shall be delivered, stored and handled in accordance with the manufacturer's instructions. Where the performance of the cable is likely to be adversely affected by the ingress of moisture, it shall be adequately sealed at either end. The end protruding from the drum shall be protected against mechanical damage.

Cable selection and sizing should comply with SANS 10142-1. Cables shall have copper conductors that comply with SANS 1411-1. The cores of a cross-sectional area greater than 1.5 mm² shall be stranded or flexible.

Where neutral conductors are provided, they shall be of the same cross-sectional area as the associated phase conductor.

18.2.2.2 Types of low-voltage cables

The type of cables to be used will be determined by the Engineer, with approval from the UFS. The acceptable cable types are indicated below.

PILC/PVC and PILC/SWA/PVC

Paper-insulated lead-covered cables shall not be used in low-voltage installations, except where specified, and shall comply with SANS 97. In addition, multicore cables shall have single-wire armour.

PVC/AWA/PVC and PVC/SWA/PVC

Cables shall comply with SANS 1507-3 and be rated at 600/1000 V. Single-core cables shall have aluminium-wire armour, and for multicore cables comprising five conductors and above, each core shall be individually coloured or coloured white with black numerals.

XLPE/AWA/PVC/PVC and XLPE/SWA/PVC/PVC

Cables shall comply with SANS 1507-4 and be rated at 600/1000 V. Single-core cables shall have aluminium-wire armour.

PVC/PVC

Cables shall comply with SANS 1507-3 and be rated at 600/1000 V.

XLPE/PVC

Cables shall comply with SANS 1507-3 and SANS 1507-4 and be rated at 600/1000 V.

SINGLE-CORE PVC

Cables shall comply with SANS 1507-2 and be rated at 600/1000 V. The insulation shall be phase-coloured where used in single-phase systems; line cables shall be red, neutral cables black and earth cables yellow and green.

MULTI-CORE PVC

Cables shall comply with SANS 1507-3:2020 and be rated at 600/1000 V. All multi-core cables shall have a minimum of 12 cores.

FLAT TWIN AND EARTH PVC

Copper conductors shall comply with SANS 1411-1, PVC insulated in compliance with SANS 1411-2, laid up with a bare copper earth continuity conductor between them, with PVC bedding complying with SANS 1411-2.

18.2.3 Earth continuity conductors

Earth continuity conductors shall consist of stranded copper conductors of cross-sections indicated in the Particular Specification. A single earth conductor may be used where two or more cables run together, providing the earth conductor's cross-sectional area is based on the largest size cable in the run.

18.2.4 Cable accessories

Concrete protective slabs and cable markers

Concrete cable markers shall be placed at a minimum of 50 m intervals, changes in trench direction and road crossings.

Concrete protective slabs shall have the following dimensions:

- Length – 1000 mm
- Width – 350 mm
- Thickness – 50 mm

The slabs shall be constructed of 20 MPa concrete and each slab shall be reinforced with one longitudinal and three transverse mild steel rods of a minimum diameter of 8 mm. The slabs shall be manufactured in such a way that they interlock with each other, thus avoiding shifting of the slabs after installation.

18.2.5 Installation of cables

In general

The cable installation shall comply with the requirements of SANS 10142-1 and cables shall be installed as indicated on the Engineer's drawings. Cables shall run in straight lines and not cross over each other, except where transposing of cables is required to reduce capacitive or inductive effects. Those installed above ground shall, as far as possible, run parallel with the lines of building construction.

Cables and wireways shall only be installed in horizontal and vertical runs, and the installation shall be as visually unobtrusive as possible. Those installed underground shall, as far as possible, follow site features, such as roadways and building lines. Where a redundant cable installation is required, the cables shall not be installed along the same route, and their routes shall be through separate fire compartments (except where no separation occurs, as may be the case in the vicinity of the source and load).

Separation of cables

Cables of different classifications and/or purposes (e.g., data, audio or power) shall not be installed in the same duct or wireway, and the minimum separation distance shall be kept even when their ducts or wireways are bonded (since radio frequency interference may then still be exhibited).

Table 1: Separation distance

Separation (mm)	Extra low voltage	Low voltage	Other services (above ground)	Other services (below ground)
Extra low voltage		As specified	150	500
Low voltage	As specified	2 x cables above ground, 100 mm below ground	150	500
High-voltage cables	500	300	300	500
Other services (above ground)	150	150		
Other services (below ground)	500	500		

Excavation

The cable trench shall be excavated along the routes indicated on the relevant drawings.

Should the Contractor, during the excavation operations, come across obstacles (e.g., soil drenched with hydrocarbon-based solvents such as spilt oil, which could adversely affect cable insulation), the Contractor shall report the matter to the Engineer, who shall then advise an appropriate course of action. Trenches shall be dug within the dimensional tolerances given by SANS 1200, parts DB and LC.

Where the Contractor cannot excavate by means of machines due to limited access and the proximity of other services, excavations shall be done by hand. The bottom of the trench shall be level and shall follow the contours of the final ground level. Where the excavation is more than the required depth, the excavation shall be backfilled and compacted with suitable material to the required depth.

The Contractor shall trim the trenches and clean up the bottom of the trenches after they have completed the required excavation.

The Contractor shall remove all sharp projections that could damage the cable where the trench is excavated through rocky formations and shall remove all loose rocks, material, etc., from the bottom of the trench.

No excavated material shall be left closer than 300 mm from the side of the excavation. Once the excavations for cable trenches have been completed, the Contractor shall give the Engineer one working day's notice to inspect the trench and to be present when the measurements are made.

The Contractor shall maintain the excavation in a good condition, free of water, mud, loose ground, rocks, stones, gravel and other strange materials until the cables are installed.

Table 2: Excavation of trenches

	Width	Depth
Telecommunication cable	450 mm	650 mm
Low-voltage cable	450 mm	650 mm

Table 3: Minimum clearances

	Vertical	Horizontal
Data and telecom cables	300 mm	300 mm
Water pipes	300 mm	300 mm
Sewer pipes	300 mm	800 mm
Stormwater pipes	300 mm	600 mm
LV cables on the same route	100 mm	One cable diameter of larger cable

Where a cable will cross over other services, the cable shall not be installed at a depth less than 600 mm below ground level, and if this is not possible, the cable shall be installed underneath the other service and protected in the prescribed manner by means of concrete slabs. The depth of the cable shall be maintained for 1 m on either side of the crossing.

If it is not possible to cross over or underneath a service in the prescribed manner, the matter shall be referred to the Engineer for a decision. Where more than one cable needs to be installed in a trench, the width of the trench shall be increased with a distance equal to the clearance required.

Bedding & backfilling

A sand bed layer of soft soil shall be installed and levelled at the bottom of each trench after the Engineer has approved the trench, and prior to cable laying.

If the excavated material is not suitable for the sand bed layer, then suitable soil shall be imported for this purpose. Quarried sand, man-made sand, sand clay and loam are usually suitable; sea sand, river sand, clay, chalk, unmixed ouklip, peat and mine sand may not be used. The cost of importing shall be included in the price for the excavation.

The minimum thickness of the sand bed layer shall be 50 mm.

If the soil for the sand bed and sand cover must be sifted, a sieve with holes not larger than 6 mm shall be used.

The cable shall, after the completion of the trench, be laid as soon as possible so that the trench can be backfilled.

The sand bed cover for LV cables shall be 150 mm thick, of similar soil and be placed directly after the cable(s) has been inspected by the Engineer.

Only one cable shall be laid at a time and the Contractor shall take precautions that the cables that are already installed are not damaged.

When the cable has been laid, inspected and approved and the sand bed cover has been installed, the trench shall be backfilled with soil containing not more than 40% rock or shale that will be able to pass through a 100 mm sieve and is approved by the Engineer.

Where more than 40% but less than 70% rock occurs, the Contractor shall replace the rock with imported soil. However, should more than 70% rock occur, all the backfilling material shall be imported.

The Contractor may import further stone-free material to the site or sieve the excavated material for sand bedding and cover, but payment shall only be made for the actual quantity of imported material required as determined by the Engineer. The quantity of imported material required shall be calculated from the nominal trench width.

The excavated material shall be backfilled in layers of 150 mm and shall be well compacted and consolidated to 90% Mod AASHTO. Where the Engineer deems it necessary, the Contractor shall use a mechanical vibrator to compact the trench.

The Contractor shall maintain the completed sections of the cable trench in a proper and safe condition for the duration of the contract. The Contractor shall refill and compact the trench where subsidence occurs.

After completion of the work, the route of the cable shall be neatly finished and cleared. All stones bigger than 25 mm, as well as all loose organic material and rubble, shall be removed.

Electrical warning tape, consisting of two tapes laid side by side and overlapping (such that their combined width is 150% of a single tape width), shall be installed on all cable routes (LV and MV), 200 mm above the top cable layer. Where a cable route exceeds 600 mm in width, multiple warning tapes shall be run in such a way that the space between adjacent warning tapes does not exceed 150 mm.

18.2.6 Distribution boards and LV switchgear

Construction

All distribution boards shall be manufactured according to the detailed specifications and drawings and shall be inspected and approved by the Engineer before installation.

The Engineer shall first approve any other type of distribution board that may be submitted as an alternative. All busbars and lugs shall be insulated, and wiring shall enter the switchgear from the back of the distribution board. Distribution boards of 10 kA and more shall comply with SABS' type-tested assembly (TTA). The board manufacturer shall provide a certificate and DB label.

All new distribution boards shall have 30% spare capacity for future sub-circuits. All new distribution boards must be accessible for maintenance staff; for example, installation should preferably be in passage or common areas. Where a separate room must be provided, the door may be provided with a lock.

Distribution boards and all switchgear shall be constructed to withstand the minimum fault current as indicated on the Engineer's drawings.

The controller for the mechanical equipment shall be installed in the electrical DB; thus, sufficient space must be allowed in the DB during construction.

Doors

Doors shall be of the removable type.

Colour

The colour of distribution boards and distribution board panels shall be as follows:

- White board, white panel – all standard distribution boards.
- White board, red panel – all emergency distribution boards.
- White board, blue panel – all uninterrupted power supply boards.

All cover plates on panels must be "powder coated" and adapt exactly to the existing colour, where applicable.

Compartments

Where distribution boards have separate compartments, they shall be separated by means of a metal dividing section and be equipped with individual removable circuit breaker covers. Cables shall enter the relevant cable compartment from the bottom, except where otherwise specified.

Wiring

The manufacturers shall do the internal wiring for all distribution boards. Wiring between switchgear and busbars shall be done by means of PVC-insulated stranded copper conductors, fixed to the busbars with copper lugs and brass bolts.

Only colour-coded wiring will be accepted, for example, red, yellow and blue for phases and black for neutral. Wiring coloured by means of PVC-insulated tape will not be accepted. Wiring shall be neatly strapped vertically and horizontally.

All instrument and control wiring shall be 2.5 mm² PVC-insulated copper conductors and shall be numbered for ease of tracing circuits.

Switchgear

All switches and socket outlets (or other outlets) shall be indicated by the relevant circuit number and the distribution board name. A Brother "custom label printer" is sufficient for this and, in exceptional cases, the DB legend card will suffice as label.

Circuit breakers for new buildings or installations must, as far as possible, be from the same manufacturer as the nearest "upstream" circuit breaker. (For example, a new small plant

imported from a distribution box with an old Fuchs circuit breaker as the main circuit breaker and this closet out in turn from a substation where an M & G circuit breaker roll, then CBI is used.) The board manufacturer must specify the type in the quotation.

Only Schneider circuit breakers shall be specified and supplied in all electrical installations (until further notice).

Labelling & legend cards

All distribution boards shall be labelled in the following manner:

- The name of the distribution board shall be labelled in the mini-substation.
- Information and size of the cable shall be supplied. For example: Fed from Mini-sub with 1 x 50 mm² x 4-core Cu cable and 25 mm² BCEW.
- All circuit breakers shall be marked with an engraved type of label (black letters on white background) and secured to the metal panel.
- Legend cards covered by removable glass or 1.6 mm transparent acrylic plastic shall be fitted to the inside of the door of the distribution board and circuits shall be noted on these legend cards. Legend card layout and description for each DB shall be submitted to the Engineer for approval and be labelled as below:
    - o Main – Main Isolator Switch OR Local Isolator Switch (as the case may be).
    - o L1 – Lights; Bedroom 1, Bedroom 2 & Kitchen.
    - o P1 – Plugs; Bedroom 1, Bedroom 2 & Kitchen.
    - o ELU1 – Earth Leakage Unit for plug circuits 1, 2 & 3.

Voltage drop

Calculations of voltage drop shall use the respective nominal system voltage, the maximum impedance of each component and the full-load current of each cable in the distribution network. At each voltage level, the size of the conductors shall be such that the maximum voltage drop in the cable for both AC and DC circuits will be:

- Between the main board and final equipment – 5% when using full load current.
- Between the main board and final sub-distribution board, using the sub-distribution board busbar-rated current – 1% if both are in the same room and 2% otherwise.
- Between the final sub-distribution board and final equipment or most distant load – 3% when using full load current.
- Between the final sub-distribution board and a motor during motor start-up – 15% when using motor start-up current.

18.2.7 Cable support systems

Cable trays

All cable trays shall, unless otherwise specified, be heavy-duty cable tray standard pattern by O-line or equal. Metal cable trays shall be manufactured from perforated rolled steel. Metal trays manufactured to the following standards shall be used:

- Less than 150 mm wide – 1.2 mm minimum thickness with 12 mm minimum return.
- 150 mm to 450 mm – 1.2 mm minimum thickness with 19 mm minimum return.
- Above 450 mm (heavy duty) – 2.5 mm minimum thickness with 76 mm return.

The cable tray edges shall be turned up on both sides to improve rigidity, but where necessary, the sides of the tray shall be reinforced with galvanised steel angle with a minimum size of 25 mm x 25 mm x 3 mm with 25 mm x 3 mm cross braces at 600 mm centres.

The upstands of trays up to 450 mm wide shall not be perforated and the top of the upstand shall be smooth. The same cable tray type shall be used in long parallel tray runs.

Both standard electrical- and heavy-duty trays shall be hot-dip galvanised after perforation and bending of the edges.

Cable trays shall be sized to provide a spare capacity of 20%.

Cable ladders

Metal cable ladders shall consist of 120 mm high side rails of 2 mm minimum thickness and be similar or equal to O-line. Cross pieces shall be spaced at maximum intervals of 300 mm. Where cables of 10 mm² or smaller are installed on cable ladders, the spacing of the cross pieces shall be 125 mm.

Cable ladders consisting of slotted metal rails which accommodate plastic or metal cable binding bands may be used in vertical cable runs against walls, etc. These cable ladders will be considered in horizontal cable runs for small cables for communication and control wiring upon the prior approval of the Engineer.

Cable ladders shall be sized to provide a spare capacity of 20%.

Cable trays shall be used to support cables that would sag excessively across runs.

Installation of cable trays and ladders

Spacing between ladder/tray tiers shall be a minimum of 300 mm. Fixing materials shall be compatible with ladder/tray materials and resist corrosion. Where practicable, cuts in trays shall not pass through perforations.

Cable trays shall be mounted with a minimum air gap of 25 mm between the underside of the tray and the mounting surface.

Cables installed in groups in cable trays shall be installed in a straight line and not cross over each other. Cables shall not be installed in more than two layers, comprising a maximum size group size of seven. Where cables leave the cable tray, it shall be formed or covered with PVC to ensure a smooth surface for the cable to exit.

Where single-core cables are installed in trefoil formation, trefoil cable clamps shall be used.

Conduit

Plain-end metallic conduit and accessories

Plain-end conduit shall be manufactured from mild steel with a minimum wall thickness of 0.9 mm and shall comply with SANS 60614.

Bending and setting of plain-end conduit shall be undertaken using the correct bending apparatus as recommended by the manufacturer of the conduit.

Galvanised conduits shall be hot-dipped on both the internal and external surfaces, in accordance with SANS 121.

All plain-end metallic conduit accessories shall be of malleable cast iron or pressed steel and comply with SANS 60614.

PVC conduit and accessories

PVC conduit shall comply with SANS 950 and bear the SANS mark.

PVC conduit shall be constructed from rigid PVC. PVC conduit shall be white in colour and non-inflammable. The minimum softening temperature shall be at 75 °C.

All PVC conduit accessories shall be fully in accordance with SANS 950 and bear the SABS mark.

Flexible conduit

Flexible steel conduit and adaptors shall comply with IEC 50086 where applicable. Flexible steel conduit shall be of a galvanised steel construction that is not required to be waterproof but shall be vermin-proof and suitable for the protection of cables against mechanical damage.

In moist or damp areas, flexible steel conduit shall be of the plastic-sheathed galvanised steel type.

Flexible polypropylene tubing shall only be fastened to PVC conduit installations.

Conduit accessories

Earth clamps

Earth clamps shall comprise copper strips with a minimum thickness of 1 mm and not be less than 12 mm wide. Earth clamps shall be provided complete with a 25 mm x 4 mm brass bolt, washer and nut and constructed so that the clip can be firmly attached to the conduit without the need for any additional packing.

Flush-mounted PVC wall boxes

Flush-mounted PVC wall boxes shall be manufactured from rigid PVC and be white in colour. All PVC wall boxes shall comply with SANS 950.

The boxes shall be provided with the necessary mounting lugs to suit the units for which the box is intended. Mounting lugs shall be drilled at 82.5 mm centres and provided with no. 6 UNC screw threads.

The boxes shall have approximately the same physical dimensions as those specified for steel wall boxes above and shall have 20 mm knockouts.

Facilities shall be provided for the fixing of earth terminals to the box.

Round group-type PVC boxes

The boxes shall be similar in shape to those specified in “Round group-type steel boxes” and shall have spouts that are to be reinforced with webs.

The cover screw pillars shall be provided with tapped brass inserts and provision shall be made for a brass earthing terminal adjacent to one or both of the pillars.

PVC round box covers shall be of PVC and secured by means of brass screws at 50 mm centres.

The boxes shall be fully in accordance with SANS 950.

Draw wires

All draw wires for unused conduits shall be of galvanised steel wire with a minimum diameter of 1.6 mm or nylon.

Conduit installation

In general

- The conduit installation shall conform to par. 6.5 of SANS 10142-1.
- Spacebar saddles shall be used to keep clear mounting surfaces.
- The conduit system shall be mechanically continuous, secure and rewirable.
- All unused, screwed entries shall be fitted with a blanking plug. Female PVC bushes shall be fitted to all free ends.
- Conduits shall not be used to support the weight of fittings, etc., except where specifically designed to do so. Conduit boxes supporting luminaires or accessory boxes shall be fixed to the structure of the building independently of the conduit.
- Sufficient conduit and drawing boxes shall be provided to facilitate cable installation. In general, no more than two bends, off-sets or one coupling shall be permitted without a conduit draw box.
- Steel conduit shall not be relied upon for earth continuity
- All PVC conduit shall be installed in accordance with Appendix C, SANS 950.
- The edges of flush-mounted outlet boxes shall not be deeper than 10 mm from the final surface. Spacer springs shall be used under screws where necessary.

- Oversised cover plates shall be provided on all flush-mounted round conduit boxes, where required. Surface-mounted boxes shall be provided with standard-size cover plates.
- A maximum of three circuits shall be installed in a single conduit; this is for both light and plug circuits.

Flexible conduit

In installations where the equipment has to be moved frequently to enable adjustment during normal operation, for the connection of motors or any other vibrating equipment, for the connection of thermostats and sensors on equipment, for stove connections and where otherwise required, flexible conduit shall be used for the final connection to the equipment.

Flexible conduit shall be connected to the remainder of the installation by means of a draw box. The flexible conduit may be connected directly to the end of a conduit if an existing draw box is available within 2 m of the junction and if the flexible conduit can be rewired easily.

Flexible conduit shall consist of metal-reinforced plastic conduit or PVC-covered metal conduit with an internal diameter of at least 15 mm, unless approved to the contrary. In false ceiling voids, flexible conduit of galvanised steel constructions may be used. Connectors for coupling to the flexible conduit shall be of the gland or screw-in type, manufactured from either brass or mild steel plated with zinc or cadmium.

Installation in concrete

In order not to delay building operations, the electrical sub-contractor shall ensure that all conduits and accessories that are to be cast in concrete are placed in position in good time. The Electrical Contractor or their representative shall be in attendance when the concrete is cast.

Draw boxes, expansion joints and round ceiling boxes shall be installed where required and neatly finished to match the finished slab and wall surfaces. Ceiling draw boxes shall be of the deep type. In columns where flush-mounted draw boxes are installed, the conduits shall be offset from the surface of the column immediately after leaving the draw box.

Elbows for conduits of 32 mm diameter and smaller and sharp bends shall not be allowed in concrete slabs.

Draw boxes and/or inspection boxes shall, where possible, be grouped under a standard-approved cover plate. The cover plate shall be secured by means of brass screws.

All conduits shall be installed as close as possible to the neutral axis of concrete beams, slabs and columns. The conduits shall be rigidly secured to the reinforcing to prevent movement towards the surface of the concrete.

All conduits, draw boxes, etc., shall be securely fixed to the shuttering to prevent displacement when concrete is cast. Draw boxes and outlet boxes shall preferably be secured by means of a bolt and nut installed from the back of the box through the shuttering. Fixing lugs may also be used to screw the boxes to the shuttering where off-shutter finishes are required. Where fibreglass shuttering is used by the builder, the equipment shall be fixed to the steel only and no holes shall be drilled or made in shuttering. All draw boxes and outlet boxes shall be plugged with wet paper before they are secured to the shuttering.

As far as possible, conduits shall not be installed across expansion joints. Where this is unavoidable, a conduit expansion joint shall be provided. The expansion joint shall consist of two draw boxes with an interlinking flexible conduit connection. The draw box shall be installed adjacent to the expansion joint of the structure, and a conduit sleeve, one size larger than that specified for the circuit, shall be provided on the side of the draw box nearest to the joint. The one end of the sleeve shall terminate at the edge of the joint and the other shall be secured to the draw box. The circuit conduit passing through the sleeve shall be terminated 40 mm inside the draw box, and in the case of metallic conduit, the conduit end shall be fitted with a brass bush. The gap

between the sleeve and the conduit at the joint shall be sealed with “Pratley Tic-Tac” or an equivalent sealing compound to prevent the ingress of wet cement. The other end of the circuit conduit shall be secured to the draw box by means of a standard bushed adaptor for other PVC types. The cover plates shall be installed before the ceiling is painted. Where a number of conduits are installed in parallel, they shall cross the expansion joint of the structure via a single draw box. Several draw boxes adjacent to each other will not be allowed.

The installation of conduits in floor screed shall be kept to a minimum. Where conduits are installed in screed, the top of the conduit shall be at least 20 mm below the surface of the screed. Where the screed is laid directly on the ground, galvanised conduits shall be used. A minimum distance of twice the outside diameter of the conduit shall be left free between adjoining conduits. Conduits shall be secured to the concrete slab at intervals not exceeding 2.0 m. The Electrical Contractor shall ensure that conduits are not visible above the screed where the conduits leave the screed.

All draw boxes, conduits, etc., installed in concrete shall be cleaned with compressed air and provided with draw wires two days after removal of the shuttering. Errors that occurred during the installation of the conduits, any lost draw boxes, or blocked conduits, shall be reported to the Engineer immediately.

Where it is necessary to cut or drill holes in the concrete structure, prior permission shall be obtained from the Engineer in writing.

Installation in brickwork

Recessed conduits and accessories installed in brickwork shall be built-in. To not delay building operations, the Electrical Contractor shall ensure that all conduits and accessories that are to be built-in are placed in position in good time.

Any conduit draw boxes, outlet boxes, etc., that have been damaged, lost or omitted shall be reported to the Engineer immediately.

Surface and roof space installations

All conduits shall be installed horizontally or vertically as determined by the route. The Electrical Contractor shall take all measures to ensure a neat installation.

Conduits shall be firmly secured by means of saddles and screws and in accordance with SANS 10142, par. 5.4.2(b). Conduits shall be secured within 150 mm before and after each 90°C bend.

Only approved plugging materials such as fibre or plastic plugs and round-head screws shall be used when fixing saddles, switches, plugs, etc., to walls. Wood plugs are not acceptable, nor should plugs be installed in joints in brick walls.

Chasing and builder’s work

Except where otherwise specified, the Builder or Principal Contractor shall be responsible for the building in of conduits, outlet boxes, switchboard trays, bonding trays and other wall outlet boxes. The Electrical Contractor shall notify the builder of their requirements, and the responsibility lies with the Contractor to ensure that all the builder’s work is clearly indicated or marked where necessary and provided in accordance with their requirements.

Electrical materials to be built in shall be supplied, placed and fixed in position by the Electrical Contractor when required to do so by the Builder or Principal Contractor. The Electrical Contractor shall also ensure that these materials are installed in the correct positions.

Unless specifically stated to the contrary in the Particular Specification, all flush-mounted conduits, accessories, switchboard trays, bonding trays, etc., shall be built-in and no chasing shall be allowed.

Installation of cables in conduit

The cable installation in the conduit shall conform to par. 6.5.6 of SANS 10142-1 and

other parts, where applicable. Conduit shall be deburred and swabbed prior to cables being pulled in. DC and AC shall be installed in separate conduits. The entire conduit system shall be complete prior to installing cables. Circuits supplied from different distribution boards shall not be installed in the same conduit. Final sub-circuits shall not be installed in the same conduit as sub-main circuits

18.2.8 Wiring and outlets

Commercial socket outlets

All socket outlets with switches shall fully comply with SANS 164 and SANS 60669-1. Units for flush mounting shall be suitable for a 100 mm x 100 mm x 50 mm-deep flush wall box. Surface-mounted patterns shall be housed in heavy-pressed steel boxes. All socket outlets with switches shall be continuously rated at 16 A and shall be suitable for operation on a 250 V, 50 Hz, AC system. Socket outlets with switches for flush mounting and surface-mounted patterns shall be similar and equal to “Crabtree”. Cover plates shall have bevelled edges that overlap the box.

Industrial socket outlets

The plugs, couplers and socket outlets shall conform to the requirements of SANS 1239. Where pilot connections are required, they shall disconnect before the main phase connectors disconnect.

3-phase socket outlets

32 A, 400 V socket outlets shall be five-pole (3-phase, one neutral and one earth), coloured red, incorporating isolation mechanically interlocked with the plug.

The equipment enclosures shall be IP55 to SANS 60529.

All welding plug and socket outlets shall be 3-phase, plus neutral, plus earth.

Single-phase outlets

16 A, 230 V socket outlets shall be two-pole and earth, incorporating isolation mechanically interlocked with the plug.

Local isolators

Local isolators shall be selected from the following:

- Isolator in accordance with SANS 60947-3, complete with additional late-make, early-break auxiliary contacts as required.
- Plug and socket assembly to SANS 60309-1 and SANS 60309-2, incorporating isolation mechanically interlocked with the plug.
- Plug and socket assembly to SANS 60309-1 incorporating a de-contactor arrangement or additional late-make early-break auxiliary contacts.

Moulded case isolators shall be of the double-pole ON-load type similar and equal to “CBI”. Heavy-duty metal-clad isolators must be similar and equal to “ABB” or “SIEMENS”. Toggles shall be interlocked with the covers. To distinguish the switches from circuit breakers, the operating handles of isolators shall have a distinctive colour and be clearly labelled “ISOLATOR”. The local isolator shall be pad-lockable in the “OFF” position.

18.2.9 Power skirting

In general

This section covers the supply and installation of two- or three-compartment power skirting.

Construction

The power skirting shall be similar or equal to Cabstrut. The skirting and covers shall be installed in standard lengths as per the manufacturer. The covers shall either snap on or be fixed by means of toggle or swivel nuts. Proprietary socket outlets that are compatible

with the power skirting shall be used. Proprietary internal and external bends and off-sets of the same source shall be used.

Installation

Conduits for the circuit wiring to the power skirting shall be installed in the floor slabs and chased into the walls to terminate in flush conduit boxes behind the power skirting at the respective heights of the telephone, power and other service compartments. The wiring shall pass through large-diameter holes, suitably bushed, cut in the rear of the power skirting. Where power skirting is interrupted by doorways, bridging conduits shall be installed for each of the service compartments.

19. MECHANICAL INSTALLATION

19.1 In General

19.1.1 Office installation

A complete heat load calculation shall be done. The optimum room temperature should be 22 °C. The Mechanical Engineer shall look at different options for units, including mid-wall split or cassette units. Cassette units are typically preferred in the boardrooms to keep the sound levels down. Condensate pumps shall not be installed, unless stated otherwise. Where an office block needs air conditioning that consists of multiple offices and restrictions on space for condenser units are a challenge, a centralised system can be considered. All installation guidelines and specifications shall be followed as mentioned below.

19.1.2 Lecturing hall

A complete heat load calculation shall be done. The optimum room temperature should be 22 °C. The Mechanical Engineer shall look at different options, including under-ceiling, ducted-hide-away or package units. The Mechanical Engineer must keep in mind to keep the sound levels appropriate when designing a system that operates in a lecture environment. All installation guidelines and specifications shall be followed as mentioned below.

19.1.3 Residence

The Mechanical Engineer shall be responsible for the hot water, hot water storage and hot water supply to the residence. All installation guidelines and specifications shall be followed as mentioned below

19.2 Maintenance Manuals

Each installation shall include a maintenance manual (1 x hard copy and electronic copy) upon final completion of the project for approval (final account will not be processed without this information). Details of the maintenance manual are included in the annexure below.

19.3 Service Manuals

The 12-month guarantee period will start on the date of the first delivery as indicated on the completion certificate. During this period, the Contractor shall be responsible for servicing the entire installation at regular intervals of no longer than three months, doing all repairs and replacing all broken parts at no cost to the client. Monthly services shall also include cleaning of filters and, if necessary, fine adjustments of temperatures. The Contractor shall compile a service book in which all services must be documented. The book will be kept at Facilities Planning to sign off when a service is completed. The book must have a checklist to indicate what was inspected and by whom. Refrigerant pressures shall also be documented.

19.4 BMS Compatibility

The UFS makes use of a building management system that is connected to centralised or multiple air conditioning units, hot storage vessels and boilers. Johnson Controls with BACnet over IP is preferred. All units should be compatible with this standard (except individual units).

There are two main goals:

- Monitoring and reporting of units.
- Energy management of unit to limit demand and inefficiencies to save as much as possible on energy. All BMS units communicate over IP to the UFS BMS server. All installations will therefore require network access.

19.5 Chillers

19.5.1.1 Approved manufactures

- Daikin
- Carrier
- Climaveneta
- Mitsubishi

19.5.2 Installations specifications

- The electrical point of supply shall be confirmed and verified to be within the operation limits of the specified equipment.
- The service provider shall do a heat load calculation to determine the size of the chiller.
- Hail guards on the chillers are a requirement where the condenser coil will be exposed to the elements and vandalism.
- Units shall be cordoned off with easy access to prevent vandalism.
- All pipes shall be clearly marked with arrows indicating the direction of flow.
- All pipes are to be treated for all weather conditions.
- All pipes should have adequate brackets to support their weight.
- All new installations shall be fitted with inlet and outlet shutoff valves.
- Municipal water shall be strained before entering the system.
- Units must have strainers on both condensing and evaporative inlet pipes.
- Thermometers shall be installed on both supply and return lines.
- Pressure-balancing bladders need to be installed to prevent water hammering.
- Units shall be installed with anti-vibration pads.
- Laminated wiring diagrams of the unit shall be kept in the panel.
- All chilled water pipes need to be covered with lagging.
- All valves shall be clearly marked with their operation.
- Practical completion shall not be given if the system is not on the BMS.
- Units must be BMS compatible (see specifications below).
- Units must have an asset tag.
- The following information will be required for commissioning.
- Make
- Model number
- Cooling cap (kW)
- Chilled water flow (l/s)
- Condenser water flow (l/s)
- Chilled water temperature (in/out °C)
- Condenser water temperature (in/out °C)

- Serial number
- Capitalisation form

19.5.3 BMS configuration

A network point shall be allowed for:

- BMS enable ON/OFF
- BMS auto/manual
- Water temperature entering chiller °C
- Water temperature exiting chiller °C
- Chiller setpoint °C
- Chilled water
- Differential pressure setpoint kPa
- Supply pressure setpoint kPa
- Return pressure setpoint kPa
- Flow switch Flow/No flow
- Trip status Tripped/Running

Graphics shall be included with the following:

- Water entering temperature trend
- Water exiting temperature trend

The unit shall be connected to demand limiting and load rolling on Campus.

19.6 Package units

19.6.1 Approved manufactures

- Daikin
- Mitsubishi
- Carrier

19.6.2 Installation specifications

- The electrical point of supply shall be confirmed and verified to be within the operation limits of the specified equipment.
- The service provider shall do a heat load calculation to determine the size of the unit.
- Hail guards on the condensers are a requirement where the condenser coil will be exposed to the elements and vandalism.
- All units must be heating and cooling – heat pumps.
- Units shall be of the non-inverter type, unless stated otherwise.
- Units shall be installed on anti-vibration pads.
- Drain piping must have a minimum outer diameter of 32 mm and blue uPVC irrigation piping shall be used.
- A spare set of washable primary filters shall be allowed for maintenance purposes.
- Allowance shall be made for a water point near the unit/s.
- Installation shall come with surge protection.
- All components need to be labelled.
- Laminated wiring diagrams of the unit shall be kept in the panel.
- Units must be BMS compatible.
- Practical completion shall not be given if the units are not on the BMS.
- Units must have an asset tag.
- The following information shall be required for commissioning:
- Area served (e.g., “Offices North”) room number
- Make
- Model number
- Supply air (l/s)
- Return air (l/s)
- Fresh air (l/s)
- Coil on (°C DB / °C WB)
- Coil off (°C DB / °C WB)

- Total cooling (kW)
- Sens. cooling (kW)
- Serial number
- Capitalisation form

19.6.3 BMS configuration

A network point shall be allowed for:

- BMS enable ON/OFF
- Room setpoint °C
- Supply air temperature °C
- Return air temperature °C
- Room temperature °C
- Condenser temperature °C
- Outside temperature °C
- Room CO2 setpoint ppm
- Defrost ON setpoint °C
- Defrost OFF setpoint °C
- Room CO2 level ppm
- Fresh air damper level 0% –100%
- Unit in auto/manual DB and graphics
- Supply fan ON/OFF
- Airflow Flow/No Flow
- Compressor start ON/OFF
- Reverse valve Cooling/Heating
- Dirty filter status Clean/Dirty
- Laminated wiring diagrams of the BMS shall be kept in the DB panel.

Graphics shall be included with the following:

- Schedule
- Room temperature trend
- Supply temperature trend

The unit shall be connected to demand limiting and load rolling on Campus.

The controller inside the lecture hall must have the following specifications:

- Room temperature on display
- Room setpoint °C
- The user must have the option to adjust the setpoint 3 °C up or down from the pre-programed setpoint on the system (22 °C).
- If the user forgets to switch off the unit after using the lecture hall, the BMS must shut down the unit with the pre-programed schedule.

19.7 VRV

19.7.1 Approved manufactures

- Mitsubishi

19.7.2 Installation specifications

- The electrical point of supply shall be confirmed and verified to be within the operation limits of the specified equipment.
- The service provider shall do a heat load calculation to determine the size of the units.
- The VRV system shall be of the inverter type.
- Hail guards shall be installed on all exposed condenser units. All air conditioning VRV indoors shall be standard factory-assembled, pipe-wired and charged with refrigerant.
- The air conditioning units, pipes, cable connection and the installation thereof shall have the approval of the unit's manufacturer and it shall be according to their recommendations.
- All refrigerant pipework shall be insulated with thermal insulation, Armaflex. All exposed Armaflex shall be covered against all weather conditions.
- Units shall be installed on anti-vibration pads.
- Pipework shall be continuously purged during

all brazing operations.

- Drain piping shall have a minimum outer diameter of 32 mm and blue uPVC irrigation piping shall be used. No drain piping shall be chased into walls. If surface mounting is not possible, all pipes shall be installed in steel trunking with removable lids. If wall thickness permits, trunking may be chased into walls with the removable lids flush with the wall finish.
- Practical completion shall not be given if the units are not on the BMS.
- Allowance must be made for a water point near the unit/s.
- Training shall be included with installation.
- Laminated wiring diagrams of the unit shall be kept in the panel.
- Installation shall come complete with surge protection.
- Corresponding indoor and outdoor units shall be clearly marked.
- Units must have an asset tag.
- Units must be BMS compatible.

The following information shall be required for commissioning:

- Make
- Model number outdoor unit
- Cooling capacity
- Heating capacity
- Refrigerant
- Serial number
- Indoor units:
- Area served
- Type
- Sens. cooling cap (kW)
- Sens. heating cap (kW)
- Serial number
- Capitalisation form

19.7.3 BMS Configuration

A network point shall be allowed for:

- Start-stop command ON/OFF
- Room setpoint °C
- Room temperature °C
- Unit mode command Cooling/ Heating
- Fan only/Auto
- Unit mode status Cooling/ Heating / Fan only/Auto
- Fan speed command High/Low/Auto
- Fan speed status High/Low/Auto
- Indoor fan status ON/OFF
- Alarm status Normal
- Malfunction code E3/E6 ect.
- Communication status Online/Offline
- Unit in Auto/Manual DB and Graphics
- Remote control
- AirCon mode set Enable/Disable
- Remote control start Enable/Disable
- Remote control
- Temperature adjust Enable/Disable

Graphics shall be included with the following:

- Schedule
- Room temperature trend

The unit shall be connected to demand limiting and load rolling on Campus.

19.8 Standalone units

19.8.1 Approved manufactures

- Dunham-Bush
- Fravega
- HiSense
- Midea
- Carrier
- Samsung
- Aliance
- Daikin
- Mitsubishi

19.8.2 Installation specifications

- Powder-coated canter-lever brackets shall be supplied for the condenser: bolted to the wall with M2 rawl bolts 600 mm long and complete with M10 spring nuts and washers. The serial and model numbers shall be supplied to project management. All removed air conditioners shall remain the property of the UFS and must be delivered to project management, unless stated otherwise. All air conditioning units shall be heating and cooling – heat pumps. Units shall be of the non-inverter type unless stated otherwise. Where under-ceiling and cassette units have been removed, the ceiling shall be repaired, replaced and painted to match the existing. Where mid-wall, window shaker and console units have been removed or replaced, the wall shall be repaired to match the existing surface and the glass fitted to match.
- Condenser units shall be installed on anti-vibration pads where applicable.
- All exposed Armaflex shall be dressed in a waterproofing membrane and painted with waterproofing.
- Copper tubing for refrigerant circuits shall be hard- or soft-drawn refrigeration grade. The piping shall be done with a pipe bender.

Drain piping shall have a minimum outer diameter of 25 mm and blue uPVC irrigation piping shall be used. No drain piping shall be chased into walls. If surface mounting is not possible, all pipes shall be installed in steel trunking with removable lids. If wall thickness permits, trunking may be chased into walls with the removable lids flush with the wall finish.

The following information shall be required for commissioning:

- Area served (office number) room number
- Make
- Type
- Model number
- Nominal cooling (kW)
- Serial number indoor
- Serial number outdoor
- Capitalisation form
- Asset tag

19.8.3 BMS Configuration

Normally, standalone units shall not be connected to the BMS. Where multiple units are installed, an NAE shall be installed. A schedule shall be implemented as well with graphics. The NAE shall also be connected to the demand limiting and load rolling schedule.

19.9 Hot Water Supply

HEAT PUMPS

19.9.1 Approved manufactures

- Daikin
- Carrier
- Mitsubishi
- Tekni-Heat

19.9.2 Installation specifications

- The electrical point of supply shall be confirmed and verified to be within the operation limits of the specified equipment.
- Heat pumps shall be designed for South African conditions and shall be locally manufactured units where local companies can also supply expertise, competent service and spares.
- The system shall allow 100 litres of hot water per person per day and a storage capacity of 60 litres of hot water per day.
- Approved hot water pipes are Rifeng and Geberit Mepla.
- The consultant is to take note that the UFS no longer works with the design of municipal water and return water in a separate storage tank as the hot water.
- A water point shall be allowed for.
- Municipal water shall run through a strainer before entering the system.
- Only machines with a 60 °C hot water coefficient of performance (COP) of at least 3.6 at 15 °C wet-bulb ambient shall be considered. All heat pumps shall have the following minimum capacities at the following conditions at sea level:
- The heat pumps shall be of the air-to-water type specifically designed to heat water to a constant 60 °C at condensing temperatures at or below 55°C. The heat pumps shall be completely self-contained units with robust casing manufactured from Grade 304 stainless steel.
- Removable panels shall be provided to ensure access to all parts of the unit.
- Each heat pump unit shall be complete with independent compressor circuits where more than one compressor is utilised, including tube-in-tube water heater condenser, evaporation coil, axial fan(s), primary water circulation pump, check valves, gate valves, gauges and automatic control system.
- Time delay relays and/or system design shall prevent cycling of the compressors, and the number of starts per hour shall not exceed the number recommended by the compressor manufacturer.
- The following operating and safety controls shall be provided:
    - o High- and low-refrigerant pressure, manual reset type, safety switch.
    - o Low-ambient air temperature safety switch.
    - o Current overload protection on compressor(s), pump(s) and fans.
    - o The manufacturer shall provide a recommended control unit to ensure that only one of two heat pumps runs when only circulation losses are to be replaced, as indicated in the schematic. This control unit will provide a choice to change the “lead/lag” unit.
- Condensers/water heaters shall be designed for a working pressure of at least 10 000 kPa water side and 3000 kPa refrigerant side. Normal operating condenser temperatures shall not exceed 55 °C.
- Condensers shall be manufactured in accordance with the relevant SABS, BS or other recognised codes, which shall comply with the requirements of the Health and Occupational Safety Act (No 85 of 1993).
- Condensers shall be guaranteed against scaling for 10 years. Required capacities shall be based on a fouling factor of 1762 x 10^-4 k/w. Tube-in-tube condensers shall have the water flow in the inner tube and the hot gas in the annular space.
- Refrigerant tubing shall be Class 2 medium copper tubing in accordance with SABS 460.
- Refrigerant tubing shall be provided with soldered copper fittings. For small lines of less than 16 mm outside diameter and on packaged equipment, flared fittings may be used.

- All joints in pipelines shall be soldered with an appropriate copper solder. Ordinary soft solder shall not be used. All soldered joints on proprietary manufactured units shall be carefully checked and remade if found damaged in transit.
- Refrigerant piping shall be arranged so that normal inspection and servicing of the compressor and other equipment is not hindered. The location where copper tubing will be exposed to mechanical damage shall be avoided. Receivers shall be provided in the liquid line between the condenser and evaporator if the condenser does not have sufficient capacity to hold the full refrigerant charge.
- The liquid piping from the condenser to receiver shall allow for free drainage of the liquid. The condenser-to-receiver piping shall be as short as possible and be pitched towards the receiver. A refrigerant drier shall be provided in the liquid line. A reliable moisture indicator shall be provided to indicate when the drier should be replaced.
- A strainer shall be provided in the liquid line. Combination filter-dryers are also acceptable. Strainers shall be adequately sized to ensure adequate foreign material storage capacity without excessive pressure drop. Sight glasses shall be installed in a vertical section of the liquid line after the receiver or condenser (if no receiver is used) and before the expansion valve to check the state of the refrigerant.
- A central digital control box shall be provided by the manufacturer, which will act as the thermostat(s) to activate and control the heat pump(s). The set point of these digital displays shall be protected from tampering/ adjustment by third parties.
- The system circulating return line temperature shall be controlled automatically at 40 °C with a Danfoss AVTA20 temperature control valve in the plant room. This return line shall be connected to the cold-water inlet to the hot-water tank.
- The heat pump plant room installation shall have a central plant room control panel with communications electronics for Internet monitoring of faults, amps, running time, and with external stop-start thermostat reset capability.
- The external viewing of control stop-start temperature settings, alarms, leaving tank hot water and return circulating water temperatures shall be monitored and recorded remotely on an Internet system provided by the supplier.
- A local digital display of control stop-start digital temperature settings, alarms and leaving tank hot water temperature shall also be housed in the plant room.

Each heat pump shall be fitted with a sheet-metal exhaust air plenum on top to divert the vertically discharged air through the mesh-covered openings in the side wall of the building. The plenums shall be lined internally with 25 mm thick Sonic Liner for sound attenuation purposes to avoid disturbing fan noise being caused at the nearby residences if it is necessary.

The following information shall be required for commissioning:

- Make
- Model number
- Total heating (kW)
- Sens. heating (kW)
- Serial number
- Capitalisation form
- Asset tag
- Water point to wash coils
- Supply water is to be strained with a strainer.
- Pipes are to be cladded with arrows to show direction of flow.
- Water meter shall be installed.
- An Elster electricity meter shall be installed to monitor power usage.

- A booster pump shall be installed (with auto restart after load shedding).
- A drainage point shall be installed to measure discharge by the maintenance team.
- The unit shall be BMS compatible (see specifications below).

19.9.3 BMS configuration

A network point shall be allowed for:

- BMS enable | ON/OFF
- Supply hot water temperature | °C
- Return hot water temperature | °C
- Unit in auto/manual | DB and graphics
- Flow switch | Flow/No Flow
- Panel heaters | ON/OFF
- In-line heaters | ON/OFF

Sensors shall be installed inside hot water storage tanks.

Sensors shall be installed in the shaft of the residence to monitor supply hot water temperature to each block on the furthest point.

Graphics shall be included with the following:

- Schedule for the BMS enable
- Schedule for the panel heaters
- Supply hot water temperature trend
- Return hot water temperature trend
- Storage hot water temperature trend
- Water meter reading
- Water meter reading trend
- Electric measurement
- Litre/kW usage (to be discussed)
- Shaft supply hot water temperature trend

20. PAINTWORK

20.1 General Preparations

All surfaces must be clean, sound and dry. Remove all loose flakes and apply Plaster Seal/ Alkyd Plaster Prime/Plascon Plaster Primer/ Alkali Plaster Primer to obtain a stable surface. Even out imperfections with WallSkim/Terraco Handycoat Ext/Smooth over Skim Plaster and fill cracks with Fill. To stabilise chalky surfaces, apply Plaster Seal/Alkyd Plaster Prime/Plascon Plaster Primer/Alkali Plaster Primer. Previously painted sound surfaces can be washed with sugar soap and rinsed thoroughly with clean water. To ease application, sand previously painted stable surfaces. For water-damaged, porous and alkaline surfaces, apply Plaster Seal/Alkyd Plaster Prime/Plascon Plaster Primer/Alkali Plaster Primer to stabilise surfaces. Remove rust on mild steel and galvanise. Apply Hydroflex/Multi Seal/Rainshield to stabilise surfaces. If rust cannot be removed completely, spot prime with a rust converter before application of primer. Before recoating, sand previously varnished surfaces well to remove mirror-like image to a flat film.

20.2 Precautions

Do not paint over surfaces with moisture content above 15%. Stir paint well with a flat paddle. Avoid painting in moist/humid conditions. To allow applied paint to cure, there should be no rain forecast for at least seven days. Ideal application conditions and surface temperature should be between 10 °C and 35 °C with a relative humidity of less than 75%. It is not recommended to paint in direct sunlight as this will result in the paint drying too fast, leading to visible “lap-marks”. Windy conditions might have a similar effect and can cause a deposit of dust particles on the wet paint. To ensure colour- and sheen-level consistency, purchase from the same production batch of paint. Tint bases contain fewer litres than advertised. Spreading

rates are theoretical and based on smooth/flat surfaces. Do not wash or abrade newly painted surfaces until properly cured. Allow seven days for paint to dry properly and thirty days to reach full strength.

20.3 Safety Precautions for Paintwork

Keep any paint or paint products out of children's reach. Do not eat, drink or smoke during any application. Ensure appropriate ventilation during application and drying. Paint may be harmful if swallowed. Wear protective equipment during preparation, application and cleaning. Avoid contact with eyes. In case of contact, immediately rinse with clean water and seek medical advice. Avoid contact with skin. In case of contact, wash thoroughly with soap and water. If skin irritation occurs, seek medical advice.

Every manufacturer shall provide a Safety Data Sheet (SDS) listing the hazardous ingredients of a product, its physical and chemical characteristics (e.g., flammability, explosive properties), its effect on human health, the chemicals with which it can adversely react, handling precautions, the types of measures that can be used to control exposure, and emergency and first aid protocols.

20.4 Specifications 1

20.4.1 Exterior walls: Previously painted

PLASTERED WALLS, SMOOTH CONCRETE SURFACES, FAIR-FACED BRICKWORK, ROUGH PLASTER AND STIPPLE PLASTER

20.4.1.1 Products required

- EnviroSilk/Wall & All/WallGuard
- Alkyd PlasterPrime/Plascon Plaster Primer/ Alkali Plaster Primer
- PlasterSeal/Waterbased Masonry Filler/ Ecosure Plaster Primer
- HydroFlex/Multi Seal/Rainshield

20.4.1.2 Surface preparation

Wall areas to be recoated shall be high-pressure washed to remove any loose and flaking paint and contaminants and to provide a sound surface for subsequent paint coatings. All areas containing fungal growth shall be brushed off and treated with anti-fungal wash.

20.4.1.3 Hairline and structural cracks

- Open and allow to dry until moisture content is below 15%.
- Apply Kwartz Fill/Polyfilla/Smoothover Skim Plaster to surface cracks.
- WallSkim/Terraco Handyco Ext/ Smoothover may be applied to smooth out uneven surfaces.

20.4.1.4 Application primer

Substrate moisture content must be below 15%. Apply a single coat Alkyd PlasterPrime/Plascon Plaster Primer/Alkali Plaster Primer to all bare and unstable previously painted surfaces for superior moisture tolerance.

OR

Apply a single coat PlasterSeal/Waterbased Masonry Filler/Ecosure Plaster Primer to all bare, unstable dry and porous previously painted surfaces.

20.4.1.5 Application undercoat

Universal UnderCoat/Universal Undercoat (UC 1)/Universal Undercoat may be applied to improve opacity and adhesion over previously painted stable water-based and alkyd systems.

OR

MaxiCoat/PEM 600/Bergermaster Nukote may be applied to improve opacity and adhesion over previously painted stable water-based systems.

20.4.1.6 Application topcoat

Apply two coats EnviroSilk/Wall & All/WallGuard according to datasheet specification.

PARAPETS

All parapets shall be sealed by applying two coats of HydroFlex/Multi Seal/Rainshield in a crisscross pattern.

20.4.2 Interior walls: Newly plastered

PLASTERED WALLS, SMOOTH CONCRETE SURFACES, FAIR-FACED BRICKWORK, ROUGH PLASTER AND STIPPLE PLASTER

20.4.2.1 Products required

- TruVelvet/Double Velvet/Luxurious Silk
- Alkyd PlasterPrime/Plascon Plaster Primer/ Alkali Plaster Primer
- PlasterSeal/Masonry Sealer (GPS 1)/ Ecosure Plaster Primer
- WallSkim/Terraco Ez Skim/Smoothover Skim Plaster

20.4.2.2 Surface preparation

Newly plastered surfaces must be sound, dry and stable, with moisture content below 15%. Apply Kwartz Fill/Polyfilla/Multi-Purpose Crack Filler to surface cracks.

WallSkim/Terraco Ez Skim/Smoothover Skim Plaster may be applied to smooth out uneven surfaces.

20.4.2.3 Application primer

Substrate moisture content must be below 15%. Apply a single coat Alkyd PlasterPrime/Plascon Plaster Primer/Alkali Plaster Primer for superior moisture tolerance.
OR

Apply a single coat PlasterSeal/Masonry Sealer (GPS 1)/Ecosure Plaster Primer to dry and porous surfaces.

20.4.2.4 Application topcoat

Apply two coats TruVelvet/Double Velvet/ Luxurious Silk according to datasheet specification.

20.4.3 Woodwork: Previously painted

TIMBER SURFACES TO BE PAINTED

20.4.3.1 Products required

- WoodPrime/Pink Wood Primer (UC 2)/ Pink Wood Primer
- HiGloss/Super Universal Enamel/Gloss Enamel

20.4.3.2 Surface preparation

Remove all loose and flaking paint to provide a sound surface for subsequent paint coatings.

20.4.3.3 Application primer and undercoat

Apply one coat WoodPrime/Pink Wood Primer (UC 2)/Pink Wood Primer to all bare wooden substrates.

Apply Kwartz Fill/Polyfilla/Multi-Purpose Crack Filler to surface cracks.

WallSkim/Terraco Handycoat Ext/Smoothover Skim Plaster may be applied to smooth out uneven surfaces.

20.4.3.4 Application topcoat

Apply two coats HiGloss/Super Universal Enamel/Gloss Enamel according to datasheet specification, for interior and exterior use.

OR

Apply two coats NonDrip/Velvaglo/Trade Pearlglo according to datasheet specification, for a satin-finish interior only.

20.4.4 Woodwork: Newly painted

TIMBER SURFACES TO BE PAINTED

20.4.4.1 Products required

- WoodPrime/Pink Wood Primer/Pink Wood Primer
- HiGloss/Super Universal Enamel/Gloss Enamel

20.4.4.2 Surface preparation

Wooden surfaces must be sound, dry and stable. Apply Kwartz Fill/Polyfilla/Multi-Purpose Crack Filler to surface cracks. WallSkim/Terraco Handycoat Ext/Smoothover Skim Plaster may be applied to smooth out uneven surfaces.

20.4.4.3 Application primer and undercoat

Apply one coat WoodPrime/Pink Wood Primer/ Pink Wood Primer to all bare wooden substrates. Apply Kwartz Fill/Polyfilla/Multi-Purpose Crack Filler to surface cracks.

WallSkim/Terraco Handycoat Ext/Smoothover Skim Plaster may be applied to smooth out uneven surfaces.

20.4.4.4 Application topcoat

Apply two coats HiGloss/Super Universal Enamel/Gloss Enamel according to datasheet specification, for interior and exterior use.

OR

Apply two coats NonDrip/Velvaglo/Trade Pearlglo according to datasheet specification, for a satin finish interior only.

20.4.5 Woodwork: Newly varnished

TIMBER SURFACES TO BE VARNISHED

20.4.5.1 Products required

- WoodVarnish Interior/Woodcare Ultra Varnish X33 X44/Double Life Timbavarnish
- WoodVarnish Exterior/Woodcare Sunproof (WSP)/Timbavarnish

20.4.5.2 Surface preparation

Wooden surfaces must be sound, dry and stable.

20.4.5.3 Application topcoat

Apply one coat of WoodVarnish Interior/ Woodcare Ultra Varnish X33 X44/Double Life Timbavarnish thinned with 10% mineral turpentine, followed by two undiluted coats.

OR

Apply one coat of WoodVarnish Exterior/ Woodcare Sunproof (WSP)/Timbavarnish thinned with 10% mineral turpentine, followed by two undiluted coats.

20.4.6 Woodwork: Previously varnished

TIMBER SURFACES TO BE VARNISHED

20.4.6.1 Products required

- WoodVarnish Interior/Woodcare UltraVarnish X33 X44/Double Life Timbavarnish
- WoodVarnish Exterior/Woodcare Sunproof (WSP)/Timbavarnish
- Wood Preserve/Woodcare Preservative/ Timbapreservative

20.4.6.2 Surface preparation

Sand existing varnish to remove mirror-like image to a flat surface. Sand lightly if previously coated with a wax sealer or oil.

20.4.6.3 Application topcoat

Apply three coats WoodVarnish Interior/ Woodcare Ultra Varnish X33 X44/Double Life Timbavarnish if previously coated with a varnish.

OR

Apply three coats WoodVarnish Exterior/ Woodcare Sunproof/Timbavarnish if previously coated with a varnish.

OR

Apply three coats Wood Preserve/Woodcare Preservative/Timbapreservative if previously coated with.

20.4.7 Fiber cement: Previously painted

20.4.7.1 Products required

- Alkyd PlasterPrime/Plaster PR/Alkali Plaster Primer
- PlasterSeal/Masonry Sealer (GPS 1)/ Ecosure Plaster Primer
- EnviroSilk/Wall & All/WallGuard
- SuperAcrylic/Polvin/Trade 65 Matt
- TruVelvet/Double Velvet/Luxurious Silk

20.4.7.2 Surface preparation

Remove all loose and flaking paint to provide a sound surface for subsequent paint coatings.

20.4.7.3 Application primer

Substrate moisture content must be below 15%. Apply a single coat Alkyd PlasterPrime/Plaster PR/Alkali Plaster Primer to all bare and unstable previously painted surfaces for superior moisture tolerance.

OR

Apply a single coat PlasterSeal/Masonry Sealer (GPS 1)/Ecosure Plaster Primer to all bare, unstable dry and porous previously painted surfaces.

20.4.7.4 Application topcoat

Interior ceilings: Apply two coats SuperAcrylic/ Polvin/Trade 65 Matt according to datasheet specification.

Interior walls: Apply two coats TruVelvet/Double Velvet/Luxurious Silk according to datasheet specification.

Exterior walls and ceilings: Apply two coats EnviroSilk/Wall & All/WallGuard according to datasheet specification.

20.4.8 Fiber cement: Previously painted

20.4.8.1 Products required

- Alkyd PlasterPrime/Plascon Plaster Primer/ Alkali Plaster Primer
- PlasterSeal/Masonry Sealer (GPS 1)/ Ecosure Plaster
- EnviroSilk/Wall & All/WallGuard
- SuperAcrylic/Polvin/Trade 65 Matt
- TruVelvet/Double Velvet/Luxurious Silk

20.4.8.2 Surface preparation

Surfaces must be sound, dry and stable. Apply Kwartz Fill/Polyfilla/Multi-Purpose Crack Filler to surface cracks.

WallSkim/Terraco Ez Skim/Smoothover Skim Plaster may be applied to smooth out uneven surfaces.

20.4.8.3 Application primer

Substrate moisture content must be below 15%. Apply a single coat Alkyd PlasterPrime/Plascon Plaster Primer/Alkali Plaster Primer for superior moisture tolerance.

OR

Apply a single coat PlasterSeal/Masonry Sealer (GPS 1)/Ecosure Plaster Primer to dry and porous surfaces.

20.4.8.4 Application topcoat

Interior ceilings: Apply two coats SuperAcrylic/ Polvin/Trade 65 Matt according to datasheet specification.

Interior walls: Apply two coats TruVelvet/Double Velvet/Luxurious Silk according to datasheet specification.

Exterior walls and ceilings: Apply two coats EnviroSilk/Wall & All/WallGuard according to datasheet specification.

20.4.9 Fiber cement: Previously painted

20.4.9.1 Products required

- Alkyd PlasterPrime/Plascon Plaster Primer/ Alkali Plaster Primer
- PlasterSeal/True Colour Primer, Sealer/ Ecosure Plaster Primer
- EnviroSilk/Wall & All/WallGuard
- SuperAcrylic/Polvin/Trade 65 Matt TruVelvet/ Double Velvet/Luxurious Silk

20.4.9.2 Surface preparation

Remove all loose and flaking paint to provide a sound surface for subsequent paint coatings.

20.4.9.3 Application primer

Substrate moisture content must be below 15%. Apply a single coat Alkyd PlasterPrime/Plascon Plaster Primer/Alkali Plaster Primer to all bare and unstable previously painted surfaces for superior moisture tolerance.

OR

Apply a single coat PlasterSeal/True Colour Primer, Sealer/Ecosure Plaster Primer to all bare, unstable dry and porous previously painted surfaces.

20.4.9.4 Application topcoat

Interior ceilings: Apply two coats SuperAcrylic/ Polvin/Trade 65 Matt according to datasheet specification.

Interior walls: Apply two coats TruVelvet/Double Velvet/Luxurious Silk according to datasheet specification.

Exterior walls and ceilings: Apply two coats EnviroSilk/Wall & All/WallGuard according to datasheet specifications.

20.4.10 Ceiling boards (gypsum): Previously painted

20.4.10.1 Products required

- Alkyd PlasterPrime/Plascon Plaster Primer/ Alkali Plaster Primer
- PlasterSeal/True Colour Primer, Sealer/ Ecosure Plaster Primer
- EnviroSilk/Wall & All/WallGuard
- SuperAcrylic/Polvin/Trade 65 Matt
- TruVelvet/Double Velvet/Luxurious Silk

20.4.10.2 Surface preparation

Remove all loose and flaking paint to provide a sound surface for subsequent paint coatings.

20.4.10.3 Application primer

Substrate moisture content must be below 15%. Apply a single coat Alkyd PlasterPrime/Plascon Plaster Primer/Alkali Plaster Primer to all bare and unstable previously painted surfaces for superior moisture tolerance.

OR

Apply a single coat PlasterSeal/True Colour Primer, Sealer/Ecosure Plaster Primer to all bare, unstable dry and porous previously painted surfaces.

20.4.10.4 Application topcoat

Interior ceilings: Apply two coats SuperAcrylic/ Polvin/Trade 65 Matt according to datasheet specification.

Interior walls: Apply two coats TruVelvet/Double Velvet/Luxurious Silk according to datasheet specification.

Exterior walls and ceilings: Apply two coats EnviroSilk/Wall & All/WallGuard according to datasheet specification.

20.4.11 Ceiling boards (gypsum): Newly painted

20.4.11.1 Products required

- Alkyd PlasterPrime/Plascon Plaster Primer/ Alkali Plaster Primer
- PlasterSeal/True Colour Primer, Sealer/ Ecosure Plaster Primer
- EnviroSilk/Wall & All/WallGuard
- SuperAcrylic/Polvin/Trade 65 Matt
- TruVelvet/Double Velvet/Luxurious Silk

20.4.11.2 Surface preparation

Surfaces must be sound, dry and stable. Apply Kwartz Fill/Polyfilla/Multi-Purpose Crack Filler to surface cracks.

WallSkim/Terraco Ez Skim/Smoothover Skim Plaster may be applied to smooth out uneven surfaces.

20.4.11.3 Application primer

Substrate moisture content must be below 15%. Apply a single coat Alkyd PlasterPrime/Plascon Plaster Primer UC 56/Alkali Plaster Primer for superior moisture tolerance.

OR

Apply a single coat PlasterSeal/True Colour Sealer, Primer/Ecosure Plaster Primer to dry and porous surfaces.

20.4.11.4 Application topcoat

Interior ceilings: Apply two coats SuperAcrylic/ Polvin/Trade 65 Matt according to datasheet specification.

Interior walls: Apply two coats TruVelvet/Double Velvet/Luxurious Silk according to datasheet specification.

Exterior walls and ceilings: Apply two coats EnviroSilk/Wall & All/WallGuard according to datasheet specification.

20.4.12 Metal work – Mild steel: Previously painted

20.4.12.1 Products required

- HiGloss/Super Universal Enamel/ Enamel
- Hydro Etch/Galvanised Iron Primer/ Steel Primer Grey
- Rust Converter/Rust End/Hammerite No. Primer

20.4.12.2 Surface preparation

Remove all loose and flaking paint to provide a sound surface for subsequent paint coatings.

20.4.12.3 Application primer and undercoat

Apply Rust Converter/Rust End/Hammerite No. 1 Primer to existing rusted areas. Apply a single coat HydroEtch/Galvanised Iron Primer/Steel Primer Grey.

20.4.12.4 Application topcoat

Apply two coats HiGloss/Super Universal Enamel/Gloss Enamel according to datasheet specification.

20.4.13 Metal work – Mild steel: Newly painted

20.4.13.1 Products required

- Roof/Nu Roof Cool/Roofguard
- Hydro Etch/Galvanised Iron Primer (GIP 1)/ Steel Primer Grey
- Galvanised Cleaner/Galvanised Iron Cleaner GIC/Galvanised Iron Cleaner

20.4.13.2 Surface preparation

Wash surface with Galvanised Cleaner/ Galvanised Iron Cleaner GIC/Galvanised Iron Cleaner. Rinse thoroughly with clean water until a water-break-free line is acquired.

20.4.13.3 Application primer and undercoat

Apply a single coat Hydro Etch/Galvanised Iron Primer (GIP 1)/Steel Primer Grey.

20.4.13.4 Application topcoat

Apply two coats HiGloss/Super Universal Enamel/Gloss Enamel according to datasheet specification.

20.4.14 Metal work – Galvanised steel: Previously painted

20.4.14.1 Products required

- Roof/Nu Roof Cool/Roofguard
- Hydro Etch/Galvanised Iron Primer/ Galvanised Iron Primer
- Galvanised Cleaner/Galvanised Iron
- Cleaner (GIC 1)/Galvanised Iron Cleaner

20.4.14.2 Surface preparation

Remove all loose and flaking paint to provide a sound surface for subsequent paint coatings.

20.4.14.3 Application primer and undercoat

Apply a single coat Hydro Etch/Galvanised Iron Primer/Galvanised Iron Primer.

20.4.14.4 Application topcoat

Apply two coats Roof/Nu Roof Cool/Roof Guard according to datasheet specification.

20.4.15 Metal work – Galvanised steel: Newly painted

20.4.15.1 Products required

- Roof/Nu Roof Cool/Roofguard
- Hydro Etch/Galvanised Iron Primer/ Galvanised Iron Primer
- Galvanised Cleaner/Galvanised Iron Cleaner (GIC 1)/Galvanised Iron Cleaner

20.4.15.2 Surface preparation

Remove all loose and flaking paint to provide a sound surface for subsequent paint coatings.

20.4.15.3 Application primer and undercoat

Apply a single coat Hydro Etch/Galvanised Iron Primer/Galvanised Iron Primer.

20.4.15.4 Application topcoat

Apply two coats Roof/Nu Roof Cool/Roof Guard according to datasheet specification.

20.4.16 Roofs: Tiles

20.4.16.1 Products required

- Roof/Nu Roof Cool/Roofguard
- Hydro Flex/Hydro Seal/Multi Seal/Rain Shield/Damp Shield System
- Bond All (Acrylic)/ N/A/ Bonding Liquid

20.4.16.2 Surface preparation

Wash with high pressure to ensure that the surface is free from dust, loose debris or flaking paint. Replace all old and inadequate roof-seal membrane and reseal with Hydro Flex/ Hydro Seal/Multi Seal/Rain Shield/Damp Shield System. Remove all fungal growth and treat with fungal wash.

20.4.16.3 Application primer

Apply Bond All (Acrylic)/ N/A /Bonding Liquid to all bare surfaces until stabilised.

20.4.16.4 Application topcoat

Apply two coats Roof/Nu Roof Cool/Roofguard according to datasheet specification.

Every manufacturer shall provide a Safety Data Sheet (SDS) listing the hazardous ingredients of a product, its physical and chemical characteristics (e.g., flammability, explosive properties), its effect on human health, the chemicals with which it can adversely react, handling precautions, the types of measures that can be used to control exposure, emergency and first aid protocols.

21. PASSENGER ELEVATORS

21.1 Car Illumination

The lift car shall be adequately illuminated by utilising low-energy-type light fittings such as LED spotlights or similar. The illumination level shall not be less than 150 lux at the lift floor level.

21.2 Emergency Lighting

The lift car shall be provided with emergency rechargeable battery-operated lighting and alarm units. The alarm switch shall be connected to the emergency battery source to ring the alarm bell in the lift shaft when the normal and the standby power source is not available. A button for the testing of the emergency-light battery power pack shall be mounted on top of the car. The emergency light unit shall form an integral part of the normal car lighting, including fluorescent lighting and downlights. Separate emergency light units mounted within the car enclosure shall not be accepted. The lighting shall be automatically switched on in the event of failure of the normal lighting supply to the lift.

21.3 Emergency Alarm Bells

The lift shall be provided with two emergency alarm bells, which are operated by a push button inside the lift car. One alarm bell shall be installed on the roof of each car, and one common alarm bell shall be installed at a high level on the landing of a designated point of entry. The electricity supply for the alarm bells shall be fed from the batteries in Clause 10.2.

21.4 Lift Enclosure Fan

Provide silent-running squirrel-cage centrifugal-flow exhaust blowers mounted in the car roof to draw air out of the car enclosure from the landing when the doors are open and through car vents and door clearance gaps when doors are closed. The car ceiling or suspended ceiling shall be designed so as not to restrict the flow of air to the fan. The extraction fan(s) must be capable of delivering not less than 5 litres per second of free air per square metre of floor area. The fan shall be switched via a toggle switch or latching push button mounted in the car-operating panel. The Contractor shall provide the ventilation specification to prove that the ventilation provided meets the requirements of this specification.

21.5 Emergency Exits

The lift car shall be provided with an imperforate emergency exit in the roof of a minimum size of 500 mm x 350 mm or 400 mm in diameter.

Panels for emergency exits shall:

- Be opened only from the outside.
- Be clear of any apparatus mounted above the roof of the lift car.
- Be capable of being opened, reclosed and relocked without a key.
- Be provided with an electric safety device, which will prevent operation of the lift when the panel is not locked and operate the alarm bells.

21.6 Control Station in Car

The lift car shall have a flush-mounted control station comprising:

- Call buttons with acceptance signals to correspond with the landing served.
- An alarm push button with protection from being operated accidentally; the colour of this button shall be yellow.
- “Door open” and “Door close” push buttons.
- Audible and visible signals in connection with the overload device.
- Light switch, alarm reset switch, fan switch and cleaner’s “Stop-switch” keeping the car door open in the form of key switches or housed in a recessed metal box with hinged or sliding lid which will be key-locked.
- Two-way intercom speaker.

All push buttons shall be at a height that will be in reach of disabled persons in wheelchairs. All wordings shall be engraved in English characters. The material for the control station shall be stainless steel with a thickness of not less than 2.5 mm. The control station shall be fixed onto the car panel with stainless-steel screws of the secret-head type.

The direction indicators and the position indicator shall be of the digital-type display with lamp matrix actuated by solid-state circuitry. The position indicator shall have a minimum height of 50 mm and be easy to read even from a wide angle of view and under an illumination level of 500 lux.

The indicators shall be mounted onto the back of at least 2.5 mm stainless-steel faceplates with weld studs and screws.

All push buttons shall be of vandal-resistant design and flush-mounted construction.

21.7 Hall Position Indicators and Call Buttons

BRAILLE BUTTONS

One panel with call buttons and digital position indicators shall be installed next to the door opening on each floor.

The panels shall have stainless-steel faceplates matching the lift door finishes. It shall be installed at a height within reach of a person in a wheelchair.

The call button shall be of the vandal-proof type.

Car call buttons shall have Braille incorporated (engraved) into the button unit. Stick-on Braille plates shall not be accepted.

The car operating panels shall be disabled-friendly and shall be located so that all operating and emergency buttons are located within 1200 mm and 900 mm above the car platform. The emergency buttons and switches, including the alarms, door-open button, intercom button and control key switches, shall be mounted at the bottom, and the call buttons shall be mounted in numerical order starting above the emergency button and with numbering from left to right.

The minimum area of the active part of the button shall be 490 mm2 or an inscribed circle of 20 mm2 diameter.

The position of the symbol shall be on the active part or 10 mm to 15 mm left of it.

The minimum distance between active parts of the buttons shall be 10 mm.

21.8 Voice Annunciation

The lift car shall be provided with blind-friendly full-range volume-controlled voice annunciation/ voice synthesiser in each lift. The voice annunciation shall be software-generated and have the capability of being reprogrammed to enunciate special words or messages as required and approved by the PA.

Voice annunciation shall be in English and shall have a clearly understandable English accent. Voice annunciation shall include:

- The next selected landing at which the lift will stop.
- The direction in which the lift is committed to travel.
- Special door safety instructions.
- Special instructions if the lift is held up at a landing for an extended period.

21.9 Car And Landing Doors

The lift car entrance shall be provided with an imperforate car door which shall extend the full height and width of the car opening. The top track of the door shall not obstruct the car entrance.

All landing openings in lift well enclosures shall be protected by imperforate doors which shall extend the full height and width of the landing opening. The top track of the landing door shall not obstruct the entrance to the lift car. Every such door shall have an F.R.P. of not less than two hours.

Any projections on or recesses in the exposed parts of the car doors or landing doors shall be kept to a minimum to avoid finger trapping between sliding parts of the door and any fixed part of the car or landing entrance.

The clearance between panels or between panels and any fixed part of the car or landing entrance shall not exceed 6 mm. Sliding car and landing doors shall be guided on door tracks and sills for the full travel of the doors. The distance between the car and landing sills shall not exceed 35 mm.

The clear height of all entrances on cars and landings shall not be less than 2 m. The doors for the passenger lift shall be of metal construction, and the internal face of the car door shall be lined the same as the car. The doors shall be two panels, centre-opening with automatic-power opening and closing.

The car shall be equipped with an electronic door sensor that can detect an obstruction at the car entrances and control the closing of the doors. This prevents the passenger, wheeled stretcher or wheeled chair from getting bumped by the closing doors and relieves the user from holding down the “OPEN” button. The sensor shall scan for any object across the full height of the car entrance. The doors shall reverse immediately if the sensor detects any obstruction at the car entrances, and reverse operation is possible up to two times.

21.10 Emergency Key Switch for Passenger Lift

An emergency key switch system comprising the following facilities shall be provided for the passenger lift:

- An on-off key switch above the landing fixture at each landing and on the lift car control station.
- “Emergency Use” indicator in English at each landing and on the lift car control station.
- The emergency key switch shall be operated as follows:
- When the key switch at the required landing

is operated, the lift will immediately stop at the next floor in the direction in which it is travelling. Lift doors will remain closed, and the lift will immediately go to the floor on which the key switch has been operated. Should the lift already be travelling in the direction of the floor on which the key switch has been operated, the lift will go to that floor without stopping. At the same time of the key switch operation, an indicator will illuminate on the car control station and on each landing to warn the passengers that the lift is required for 'Emergency Use' only.

- On arrival at the requesting floor, the lift will stop and doors will open and remain open until the same key is used to operate the key switch in the lift car. Should the key switch in the lift car not be operated for an adjustable period of five minutes, the lift will return to its normal operation.
- With the same key to operate the key switch in the lift car, the person requiring the lift will gain full control over the lift. The lift will return to its normal operation when the key switch in the lift car is returned to its "OFF" position.
- The key at each landing shall be of the spring-loaded type to ensure that the switch returns to the "OFF" position. The key in the lift car shall be withdrawn at the "OFF" position only. The operation of the key switch in the lift car will override the "ON" position of the key switch at any landing. The 'Emergency Use' indicators will remain illuminated until all the key switches are returned to their "OFF" positions or the pre-set period or time has expired. This emergency key switch shall not override the Fireman's Switch.

21.11 Direction and Position Indicator

Audible and visual direction indicators shall be provided on each landing. The indicator shall sound once for the arriving lift that is travelling upwards and twice for downwards. The audible signal shall be at least 58 dBA measured at 1 m from the landing door, while the visual signal shall be an illuminated directional indicator with an illuminated area not less than 1125 mm2. The visual direction indicator shall be designed with a minimum protrusion of 10 mm to give a better visual effect to the passengers waiting.

An illuminated position indicator shall be provided only at the landing of the designated point of entry and on other floors.

21.12 Safety Gear and Overspeed Governor

The lift shall be provided with a safety gear capable of operating only in the downward direction and stopping a fully laden car, at the tripping speed of the overspeed governor, even if the suspension devices break, by gripping the guides and holding the car there.

If accessible spaces do exist underneath the counterweight, the counterweight, as well as the car, shall be provided with a safety gear. Safety gears shall comply with the following general requirements:

1. The release of the safety gear on the car (or the counterweight) shall only be possible by raising the car (or the counterweight).
2. Each safety gear shall be tripped by its own overspeed governor.
8. The operation of the safety gear shall not cause the car platform to slope at more than 1 in 20 to the horizontal.
9. Vibration of the car shall not, in any case, cause a safety gear to operate.
10. The tripping of safety gears by devices which operate electrically, hydraulically or pneumatically is forbidden.

21.13 Overspeed Governor

The lift shall be equipped with an overspeed governor of the centrifugal type which shall operate the safety gear at a speed at least equal to 115% of the rated speed. The means of adjusting the overspeed governor shall be sealed after setting the tripping speed.

The motor-control and brake-control circuits shall be opened before or at the same time as the governor trips and cause the lift to stop. The governor ropes shall not be less than 6 mm in diameter and shall be of flexible wire rope. The breakage or slackening of the governor rope shall cause the motor to stop by means of an electric safety device.

21.14 Overload Device and Full-Load Device

The lift shall be provided with an overload device which shall operate when the load in the car is 10% or more than the rated load of such lift.

The overload device, when in operation, shall:

- Prevent any movement of the car.
- Prevent the closing of any power-operated door, whether fitted to the car or to the landing at which the car is resting.
- Give audible and visible signals.

The lift shall resume normal operation automatically upon removal of the excessive load.

The overload device shall be inoperative while the lift car is in motion.

The lift shall also be provided with a full-load device with an adjustable setting range from 80% to 100% of the rated load and when operated, it shall by-pass all landing calls. When the load in the car is reduced, the car shall stop for landing calls as normal.

21.15 Lift Motor

The lift motor shall be of the gearless traction, permanent magnet type mounted inside the lift shaft. The motor shall be fitted with internal double brakes to comply with safety regulations.

21.16 Solid State Controls

A microprocessor-based control shall include the following design features:

11. The system hardware shall be capable of supporting fully software-based supervisory and motor-control systems.

1. Interruption of the electrical supply to the lift shall not affect the system memory or software.

12. It shall be possible to change the supervisory control algorithm to meet a change in the use of the building by re-programming the instruction memory.

13. It shall be possible to interrogate, by means of communication access/test points on the controller, the system operating functions by use of a portable unit using diagnostic routines.

2. Visual indicators, for example, LEDs, shall be provided on the controller to display information on the operational status of the lift.

14. Multiplexing techniques may be employed to reduce the number of trailing cables normally required, if considered cost-effective to do so.

15. Automatic push button control shall allow only one call to be registered at a time. The car answers one call before another can be registered. All car and landing doors must be properly closed before the car will respond to either a landing or car call. On stopping, a short period elapses during which no landing call is effective,

and priority is given to the car pushes to allow passengers to enter the car and register a car call.

16. If no car call is registered after the car stops at a floor and the car and landing doors remain closed, then a landing call may be registered after an adjustable time delay of not more than eight seconds, when the lift becomes free.

17. All calls shall be stored in the system and answered in sequence, regardless of the order in which they are registered.

18. When travelling in the 'Up' direction, the car travels to the highest call, stopping at any intermediate floor for which a car call has been registered. On stopping for the highest call, preference is established for the 'Down'

19. When travelling downwards, the car stops for all car and landing calls that have been registered. When all calls have been answered, the car remains with doors closed on the floor to which it last travelled.

21.17 Guide Rails and Brackets

Rigid steel guides shall be used for guiding lift cars and counterweights throughout their travel. The strength of the guides, their attachments and joints shall comply with BS 5655 Part 9 and be sufficient to withstand the forces imposed due to the operation of the safety gear and deflection due to uneven loading of the car.

The guides shall have machined guide surfaces for rated speeds exceeding 0.4 m/s. Guide brackets shall be provided at suitable intervals and shall be fixed to the lift shaft walls with anchor bolts. Wood or fibre blocks or plugs shall not be used for securing any guide brackets.

21.18 Buffers

Buffers shall be provided at the bottom limit of travel for cars and counterweights.

21.19 Counterweights

The counterweights shall be of metal and constructed from multiple sections, contained and secured within a steel frame, and shall be equal to the weight of the complete car plus approximately 40% to 45% of the contract load.

At least four guide shoes, capable of being easily renewed or having renewable linings, shall be provided on the counterweight.

If there are pulleys on the counterweight, they shall incorporate devices to avoid:

- The suspension ropes, if slack, leaving the grooves.
- The introduction of objects between ropes and grooves.

21.20 Suspension Ropes

The lift shall be provided with hoist ropes of sizes and numbers sufficient to comply with the requirements of the relevant code and traction requirements. The shop drawings shall indicate the type, number and sizes of ropes proposed, together with the name of the manufacturer, type, ultimate strength, the proper working load and that the core is of manila fibre. All hoist ropes shall be cut in sequence form.

The ends of the hoist ropes shall be properly secured to the car and counterweight crosshead or to the dead-end hitch plates on 2:1 roping, with adjustable rope shackles having approved sockets. Screw adjustment shall permit equalisation of the tension in all ropes. A minimum of 9 mm wire rope shall be threaded and clamped to prevent the group of shackles from turning.

21.21 Governor Ropes

Governor ropes shall be in accordance with SABS 1545. The two ends shall be securely fastened together at the lift and shall be attached to the safety operating mechanism. The governor rope shall pass over the governor sheave and over an approved tensioner sheave in the pit. An electrical contact shall be fitted to the pit sheave and shall stop the lift if the governor rope becomes slack or breaks.

21.22 Hoisting Rope Attachment

The lift car hoisting rope attachment/hitch shall be suitably vibration-isolated to prevent rope noise from being transferred to the car enclosure and shall ensure ride quality as specified.

Rope dead-end hitching points (2:1 roping) shall be accomplished with up-stands of adequate construction and height floor to allow the inspection of the entire rope fixing and sockets. Removable kick plates shall be provided if the kick plate inhibits the inspection of the rope fixing and socket. Hoisting rope sockets shall be suitably vibration-/noise-isolated from the hitching plate, and this shall be accomplished by inserting nylon sleeves into the hitching plate rope holes before inserting the sockets.

Hoisting rope noise: The suspension rope hitch and sheaves shall be designed to limit the rope noise to a level that is not audible in the car enclosure or on the landings during travel. Sheave and rope hitch designed, and manufacture shall prevent hoisting ropes from vibrating against each other during travel.

21.23 Terminal Stopping and Final Limit Switch

The lift shall be provided with normal terminal stopping switches and final limit switches. They shall be positively operated by the movement of the car. These switches shall be mounted either on the car frame or in the lift well.

21.24 Final Limit Switches

The final limit switches shall either open directly when required by mechanical separation the power feeding the motor and brake or break by an electric safety device the circuit controlling two contactors, the contacts of which are in series in the circuit of the motor and brake.

21.25 General Requirements

All dangerous parts shall be effectively guarded. Where applicable, components shall be designed to be inherently safe, obviating the need for external or removable guards. Counterweights shall be guarded by means of a rigid metal screen extending from a position 0.30 m above the lift pit floor to a position at least 2.50 m above the lift pit floor. The lift car body shall be carried in a steel car frame sufficiently rigid to withstand the operation of the safety gear without permanent deformation of the car frame. The deflection of the members carrying the platform shall not exceed 1/1000 of their span under static conditions, with the rated load evenly distributed over the platform.

At least four renewable guide shoes, or guide shoes with renewable linings, or sets of guide rollers, shall be provided, two at the top and two at the bottom of the car frame.

21.26 Requirements for the Disabled Essential

Lift control buttons such as the emergency alarm button, intercom button, door opening button, call buttons on landings, or floor buttons in the lift car shall not be lower than 900 mm or higher than 1200 mm above floor level. Braille and tactile markings shall be placed either on or to the left of the control buttons. Such markings shall be a minimum of 15 mm in height and 1 mm raised. All lift control buttons shall have a minimum dimension of 20 mm.

21.27 Handrail

A tubular stainless-steel handrail of between 45 mm and 51 mm in diameter shall be provided on three sides of the lift car, extending to within 150 mm of all corners. The handrail shall be 25 mm or more clear of walls and other obstructions and shall be above floor level.

21.28 Landing and Car Doors

On arrival of the lift to a landing in response to a car call or landing call, the landing and car doors shall open automatically and be kept open for a period before closing. This period shall be adjustable from 5 seconds to 30 seconds. An audible signal shall be provided to signify the closing action of the doors. The closing landing and car doors shall be reopened in the event that a person is about to be struck.

Emergency Alarm Push Button and Intercom: There shall be an emergency alarm push button together with an indication light, a buzzer and an intercom inside the lift car so that the person inside can speak to the Building Management Office or the caretaker's office, as the case may be. The indication light for acknowledgement shall be in the form of a blinking light adjacent to the intercom speaker and the notice "When light blinks, please speak or press alarm button again" shall be provided next to the indication light.

21.29 Controller

21.29.1 Construction

The controller shall be mounted in a ventilated steel cubicle with hinged front doors and removable hinged rear panels, in which all contactors, solenoids, relays, motor starting equipment, etc., shall be fitted. All steel sheets shall be no less than 1.2 mm thick.

21.29.2 General requirements

20. Materials used in the construction of the control equipment shall not support combustion.

21. The components shall be designed and mounted to facilitate inspection, maintenance, adjustment andreplacement. Wirings shall be terminated in such a way that the wires are not damaged. Accessible terminals, suitably marked, shall be provided for incoming and outgoing cables.

22. Control circuits at normal mains voltage shall be connected between phases and neutral and shall be supplied through a double-wound isolating transformer.

23. Where a rectifier is used, it shall be of the full-wave silicon type fed from a transformer.

24. The control circuit shall be protected by suitably rated over-current circuit breakers or HRC fuses independently.

25. The brake solenoid and any retiring cam shall operate on direct current.

26. Motors connected to polyphase AC power supplies shall incorporate means to prevent the motor from being energised in the event of phase failure.

21.29.3 Solid state controls

A microprocessor-based control shall include the following design features:

27. The system hardware shall be capable of supporting fully software-based supervisory and motor control systems.

28. Interruption of the electrical supply to the lift shall not affect the system memory or software.

29. It shall be possible to change the supervisory control algorithm to meet a change in the use of the building by re-programming the instruction memory.

30. It shall be possible to interrogate, by means of communication access/test points on the controller, the system operating functions by use of a portable unit using diagnostic routines.

31. Visual indicators, for example, LEDs, shall be provided on the controller to display information on the operational status of the lift.

32. Multiplexing techniques may be employed to reduce the number of trailing cables normally required, if considered cost-effective to do so.

21.29.4 Automatic Full-Load By-Pass

To eliminate the inconvenience of having fully loaded cars stop for landing calls, all lifts shall be equipped with a full-load device which detects the load condition in the car and allow landing calls to be by-passed.

21.29.5 Automatic Push Button Control

Automatic push button control shall allow only one call to be registered at a time. The car answers one call before another can be registered. All car and landing doors must be properly closed before the car will respond to either a landing or car call. On stopping, a short period elapses during which no landing call is effective, and priority is given to the car pushes to allow passengers to enter the car and register a car call.

If no car call is registered after the car stops at a floor and the car and landing doors remain closed, then a landing call may be registered after an adjustable time delay of not more than eight seconds, when the lift becomes free.

21.29.6 Electrical Equipment and Wiring

The electrical supply for the lift installation is existing. All electrical work carried out shall be of a high standard and shall conform in all respects with SABS 0142. Work of inferior standard shall not be accepted and shall be rectified at the cost of the Contractor without any extension of the contract period.

21.29.7 ARD (Automatic Rescue Device)

An automatic rescue device shall be included. When the power fails, the lift shall travel to the nearest floor and the doors will open automatically.

21.29.8 Sump Pump

A submersible pump shall be included in the tender.

22. OPERATION AND MAINTENANCE MANUALS

- The Contractor shall submit to the Engineer all operational manuals for approval prior to submission to UE.
- An operational manual for items such as aircons, fire and alarm system, etc., shall be submitted to UE upon project completion.
- The PA shall arrange workshop/training for user clients to acquaint them with operating the said systems.
- The Maintenance Manual shall be submitted to UE three months upon completion.
- For the required information, see the attached checklist in Annexure 1 Page 85.

23. LANDSCAPING

23.1 In General

- It is the Consultant's responsibility to obtain and familiarise themselves with all relevant requirements, service plans and existing fixtures from UE before planning.
- Only waterless landscaping is allowed and must be approved by UE.
- All relevant current services – plumbing, electrical and irrigation – must be indicated before implementation.

23.2 Landscaping

- Sufficient waterless and waterwise landscaping must be allowed/included within planning, including social spaces, if required.
- Sufficient sleeves for services under hard surfaces and garden beds must be provided.
- Tree planting and landscaping shall be done according to horticultural standards and the UFS preferred plant list.
- The as-built landscaping plan and manual shall be supplied to the UE office after completion.
- All building rubble shall be removed from the UFS site.
- The site shall be rehabilitated to its original state.

23.3 Refuse

- Refuse trucks must have accessibility to the collection point.
- There shall be a truck stop area or covered refuse site built with a watering point for cleaning, depending on refuse size.
- Sufficient outside UFS-approved concrete bins shall be supplied.

23.4 Water Supply

As a counteractive measure to times of drought and water-shedding, rainwater harvesting shall be implemented for watering plants and toilet flushing.

23.5 Parking and Paving

- Parking and paving shall be compacted to level at 93% Mod AASHTO density.
- Levels shall be aligned for water flow and services covers.

23.6 Pedestrian Crossings

- A removable grid shall be installed for leaves and debris to flow through on road surfaces.
- No piping shall be allowed on pedestrian crossings!

24. CLEANING SERVICES

24.1 Items to be Included when Undertaking New Projects (New Building/Upgrading)

24.1.1 New Buildings

24.1.1.1 Ablution

- There shall be T5s in every ablution facility, with keys (that must be handed over to the cleaning division).
- Stainless-steel hand-soap dispensers shall be installed that must be filled with liquid soap, not sachets.

- Stainless-steel hand blowers shall be installed.
- Inclusive toilets shall be supplied with a mirror, soap dispenser, T2 toilet paper holder and hand blower.

24.1.1.2 Service quarters

- Contact UE Cleaning to determine how many cleaners will be placed in a new building.
- Fixed items are applicable; all loose items will be bought by UE Cleaning.
- The following specifications are required:
    - o Serving table in the middle of the service quarter, depending on the number of cleaners that will use it.
    - o Chairs.
    - o Cupboard and surface to place a microwave and kettle, sufficient to accommodate the number of cleaners placed.
    - o Enough electrical plugs for kettle, microwave, fridge, fans/ heaters in case of no air conditioning, and charging points for office radios and cell phones.
    - o Wash basin.
    - o A separate chemical storeroom and sufficient separate space and shelves for mop trolleys and cleaning equipment and material.

24.1.2 Renovations in existing buildings:

24.1.2.1 Service quarters

Existing service quarters in the building shall be checked. If compliant, it can be signed off; if not, and in case workers are situated in storerooms as service quarters, the necessary planning shall be done for a suitable service quarter.

25. FINANCE

25.1 Submission of Invoices for Payment

Invoices should be submitted to ue_invoices@ufs.ac.za before 12:00 on a Friday. It will be processed in the following week and paid according to the payment terms as agreed upon.

All invoices (including professional fees) shall be signed by the Principal Agent (if applicable) as confirmation that it matches the cost report, before submission.

The following must appear on all invoices submitted:

- The words ‘Tax invoice’
- University of the Free State, PO Box 339, Bloemfontein, 9300.
- UFS VAT number (4240 106 866)
- Serial number and date of issue of invoice
- Supplier VAT number
- The following must be attached to all professional fee accounts submitted:
- Detailed calculation based on the applicable Professional fee guideline (year published) including discount as agreed upon.
- The relevant fee scale as published in the Government Gazette (only the applicable page).
- Detail of disbursements claimed (Please see Guidelines for Fee Accounts)
- The latest cost report.

The following must appear / be attached to all contractor invoices submitted:

1. Purchase order, the relevant purchase order number must appear on the invoice and PO attached.

2. JBCC contract, the approved JBCC payment certificate with relevant calculations must be attached.

a. In case of any material on site claims the following should be attached:

   i. the Material on Site form must be attached, signed by the contractor, the relevant consultant as well as the UFS project manager.

   ii. Confirmation that Material on Site is insured and secured.

b. The latest cost report.

c. Recovery statement

d. UE summary

3. Cession payment, a purchase order must be issued as soon as the cession agreement is signed. Only the invoice from the cession holder with the purchase order number should be submitted for payment.

Invoices should be submitted to ue_invoices@ufs.ac.za before 12:00 on a Friday. It will be processed in the following week and paid according to the agreed-upon payment terms.

All invoices (including professional fees) shall be approved by the PA before submission.

26. FURNITURE SPECIFICATION

When a project includes the acquisition of loose furniture, the relevant consultant shall consult with UE to determine if there are any preferred/standardised items that should be specified. The consultant shall provide a furniture schedule with images and quantities for discussion and sign-off by the user client and UE. The request for quotations shall include images of the furniture on which quotations are requested and indicate that the same or similar will be considered to avoid situations where suppliers are excluded from quoting due to exclusive items being specified. Furniture suppliers must provide images and specifications in their quotation documents to ensure that alternative items are of the same or better quality and design as those specified.

27. Annexure 1: Close-Out

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS

	INDEX	YES	NO	N/A
1	Contractor's contact details			
2	Sub-contractor's contact details			
3	Consultant team contact details			
	Architectural Aspects			
4	Municipal approvals			
5	Architectural drawings			
6	Architect specifications (ironmongery, aluminium, window schedule, door schedules, sanitary schedule, etc.)			
7	Guarantees for loose and fixed furniture			
8	Roof certificate			
9	Glass and aluminium installation certificate			
10	As-built drawings			
11	Plumbing plan/shop drawings			
	Summary of Colours and Finishes			
12	Paint supplier's contact details			
13	Paint colours			
14	Floor coverings: Tiles/carpets/LVT/vinyl sheeting			
15	Wall tiles			
16	Finishes: Care instructions			
17	Worktops / Granite spec			
18	Built-in cupboards – wood spec			

Mechanical Aspects				
19	Mechanical drawings			
20	Mechanical COC			
21	Fire installation certificate			
22	Gas COC			
Electrical Aspects				
23	Electrical drawings			
24	Electrical shop drawings			
25	Electrical COC			
Structural Aspects				
26	Structural drawings			
27	Survey & geotechnical report			
28	Mix designs			
29	Soil poisoning/Pest control certificate			
30	Compaction results			
31	Concrete cube results			
32	Roof covering workmanship guarantee			
33	Waterproofing supplier guarantee			
34	Waterproofing installer guarantee			
35	Structural shop drawings			
36	Structural as-built drawings			
Civil Aspects				
37	Civil drawings			
38	Traffic count & survey report			
39	Compaction test results			

40	Concrete cube results			
41	Pressure test certificate			
42	Plumbing and drainage COC			
44	Civil as-built drawings			
Health and Safety				
45	Fire COC			
46	Occupancy certificate			
47	LPG COC if installation is done			
48	Emergency evacuation maps			
49	Certificate of practical completion			
Attic Stock – to be Signed by All Relevant Parties				
50	Signed register of receipt of attic stock			
Keys				
51	Keys – tagged according to door numbers and signed register			
Signage				
52	Register of installed signage (door numbers, internal directional signage and building name)			
53	Certificate of works completion			
54	Retention period			
55	Certificate of final completion			
56	Lessons learned report by the team and how the team can improve			
57	Signed final account statement summary			
58	Final cost report			
59	Building maintenance management control sheet (PA to request from UE Maintenance)			

28. Annexure 2: Electrical Checklists

CHECKLIST 1: DISTRIBUTION BOARDS					
NO	COMMENT	ACTION BY		COMPLETION STATUS	COMPLETION DATE
		CONTRACTOR	CONSULTANT		
1.	Is the distribution board properly and securely installed with adequate spare capacity?				
2.	Is the distribution board properly rated?				
3.	Is the distribution board according to the SLD and approved workshop drawings?				
4.	Are the feeder cables clearly labelled?				
5.	Is the distribution board and circuit breakers properly labelled?				
6.	Are fuses, circuit breakers and other electrical devices correctly rated for the circuit they protect?				
7.	Is the distribution board labelled according to UFS standards?				

CHECKLIST 2: TRUNKING AND CONDUITS					
NO	COMMENT	ACTION BY		COMPLETION STATUS	COMPLETION DATE
		CONTRACTOR	CONSULTANT		
1.	Is the wire mesh and trunking damaged?				
2.	Is the correct sized and specified wire mesh and trunking installed?				
3.	Is the wire mesh and trunking securely fixed and supports correctly spaced and installed?				
4.	Is electrical equipment properly separated within the trunking and conduit system?				
5.	Are the wire mesh, trunking and conduit bends satisfactory?				
6.	Are screws, bolts and nuts properly fastened?				
7.	Are trunking, cable ladder and wire mesh properly earthed?				
8.	Is the trunking and conduit installation neat and evenly spaced?				
9.	Is the specified conduit type (PVS or steel) installed?				
10.	Does a conduit contain only one circuit wire?				
11.	Is the trunking and conduit system earthed and grounded?				

CHECKLIST 3: WIRING					
NO	COMMENT	ACTION BY		COMPLETION STATUS	COMPLETION DATE
		CONTRACTOR	CONSULTANT		
1.	Are the electrical wires securely fixed?				
2.	Are any electrical wires exposed or causing obstruction?				
3.	Is the correct wiring conductor installed for the various equipment?				
4.	Are wiring conductors correctly terminated in the junction boxes and distribution boards?				

CHECKLIST 4: LIGHTING					
NO	COMMENT	ACTION BY		COMPLETION STATUS	COMPLETION DATE
		CONTRACTOR	CONSULTANT		
1.	Are the correct light fittings installed?				
2.	Are the light fittings and light switches installed in the correct positions, at the right heights?				
3.	Do the light fittings and switches work properly?				
4.	Do the light fittings make any crackling sounds?				
5.	Do the light switch plate covers cover the light switch hole?				
6.	Are the light switches labelled according to UFS standards?				
7.	Are the conductors properly terminated on the light switches?				
8.	Is the lighting network bonded and earthed?				
9.	Is the installed photocell as per UFS standards?				

CHECKLIST 5: ISOLATORS AND SOCKET OUTLETS					
NO	COMMENT	ACTION BY		COMPLETION STATUS	COMPLETION DATE
		CONTRACTOR	CONSULTANT		
1.	Are the socket outlets and isolators installed in the correct positions, at the right heights?				
2.	Do the socket outlets and isolators work properly?				
3.	Do the socket outlets make any crackling sounds?				
4.	Do the socket outlet plate covers cover the outlet wall hole?				
5.	Are the socket outlets and isolators labelled according to UFS standards?				
6.	Are the conductors properly terminated on the socket outlets and isolators?				
7.	Is the lighting network bonded and earthed?				

CHECKLIST 6: SMOKE AND HEAT DETECTORS					
NO	COMMENT	ACTION BY		COMPLETION STATUS	COMPLETION DATE
		CONTRACTOR	CONSULTANT		
1.	Are the smoke and heat detectors securely fastened to the wall or ceiling?				
2.	Are the smoke and heat detectors damaged?				
3.	Have all detectors in the installation been tested?				
4.	Are the detectors securely fastened?				
5.	Is the earthing system earthed and grounded?				

29. Annexure 3: Landscaping

GENERAL MAINTENANCE

Damages to irrigation

- Report damage to irrigation to PMO, refer to Gardening Services for assistance.
- Repair for Contractors' cost if not repaired within 36 hours. The work must be of a professional standard, utilising correct fittings and methods.
- Where irrigation damages occur and the Contractor is unaware thereof, Gardening Services will notify the Contractor through the PMO Office.

Paving repairs

- Open face fill (G6) or excavation to levels for paving level. Repairing the area includes compacting; compacted to level at 93% Mod AASHTO density.
- Treatment should be applied underneath with approved weed killer and/or coarse salt.
- Utilise bevel pavers; no concrete blocks.

Rubble on site

- The Contractor shall remove all building rubble of the project no later than each Friday.
- Non-compliance will be for the Contractor's account.
- Includes rehabilitation of the site.

Landscaping

- Supply adequate time for Gardening Services to determine the removal of irrigation, plants and hard landscaping where applicable beforehand. Some items may be included in the project for removal by the Contractor. Arrange for storage on Campus through Gardening Services.
- All new designs should be waterless designs.
- Utilise ornamental gravel, artificial lawn, paving, bark and plants on the UFS approved plant list that only utilise rainwater for survival.
- Supply sufficient refuse bins in the area. Dimensions: 500 mm diameter x 740 mm height. Only utilise standard High Street/Main Street bins with an aggregate finish.
- The UFS UE to approve all landscaping plans before implementation.

- All development must supply a detailed final and corrected as-built landscaping plan.

Irrigation

- The area shall be levelled to facilitate uniform drainage of the site. Such levelling shall conform to facilitate to the natural fall of land, and the Contractor shall ensure that the general shape, profile and levels of the area are in keeping with the context.
- No irrigation from municipal sources is permitted for new designs. Only greywater or rainwater may be utilised if available.
- In parking areas, install adjustable bubblers for trees if alternative water sources are available. Bubblers may not be higher than 50 mm above the soil level.
- Alternatively, utilise 110 mm piping laid on a bed of gravel at root level for watering purposes for new trees planted.
- Pop-up sprayers with nozzles are to be utilised as standard irrigation. Exceptions on standpipes with nozzles can be made with the necessary permission from Gardening Services. The use of the same fabrication of sprayers or nozzles is important. Hunter fabricates are the only irrigation equipment utilised on UFS campuses.
- No rotary MP nozzles may be used. Use only standard U or PSU nozzles.
- Utilise a circular feed water system for irrigation supply.
- Do not utilise fixed-nozzle and rotary sprayers on the same station.
- Utilise anti-theft sockets on pop-up sprayers and standpipes to minimise theft.
- Utilise a check valve seal device in all pop-up sprayers to prevent low head drainage.
- Place the connection for opening and closing of water for easy accessibility. Place irrigation taps or valves underneath a plastic valve box with a green lid to indicate where the irrigation valves or taps are situated.
- Only PVC pipe with a diameter greater than 25 mm shall be utilised on campuses for irrigation.
- Trenches dug for irrigation pipes should be at least 300 mm deep. Pipes of 40 mm and larger should be placed 450 mm deep.
- A pressure and flow test should be done beforehand to decide on the thickness and class of the pipe used for the area according to specifications used in the industry.
- Only utilise 25 mm Cobra copper taps with a washer for the stop valve on piping between 25 mm and 32 mm. Use only Saunders stop valves for irrigation pipes greater than 40 mm in diameter. Stop valves are essential to isolate the irrigation system for maintenance purposes. No other gate valves may be utilised on the campuses.
- Battery or electric controllers with electric valves are recommended for use to regulate water usage and save water on Campus.
- Gravel sized 13 mm or 19 mm should be placed beneath all valves to provide drainage.
- Sprayers, according to the spray arc, should be spaced to overlap no less than 70% to prevent dry

patches and to shorten watering time.

- The Contractor should complete the setting of the nozzles and arc after installation.
- The different types of plants in beds must be considered to install the correct irrigation sprayers to address the height of the plants planted.
- The irrigation controller position and power supply should be predetermined for installation. Contact Gardening Services for assistance.
- The controller and power supply should be mounted securely to an outside wall in a lockable, durable, weather-resistant unit. Supply the key to the unit to Terrain and Ground Services after final handover.
- Where needed, PVC sleeves of 110 mm should be placed 100 mm under paving or road surfaces. Repair to hard elements must be done immediately after insertion of the sleeve.
- If any PVC/galvanised pipes are identified during soil preparation for a project with or without water, notify Gardening Services for assistance to determine if it is used or will be active after the project.
- After pressure testing and before sprinkler heads and nozzles are installed, all pipes and fittings shall be systematically flushed until no foreign matter or debris remains in the system.
- The Contractor and the University shall agree upon the completion date of the project.
- A detailed irrigation plan shall be supplied after installation to Gardening Services and Planning Division for future planning/repairs and reference for the University.

Planting

1. Planting in beds:

- Remove all stones exceeding 30 mm, debris and building rubble from the site.
- Garden beds must be levelled to facilitate uniform drainage of the site. Such levelling shall conform to facilitate the natural fall of land, and the Contractor shall ensure that the general shape, profile and levels of the area are in keeping with the context.
- Beds should be prepared thoroughly by loosening the soil up to 250 mm deep – cultivated mechanically or by hand.
- A layer of compost of 50 mm thick must be spread over the area and worked into the soil.
- Utilise fertilizer 2:3:2 at a rate of 60 g/m2 and gently fork into the soil. Rake area even before planting.
- Placement of plants should be inspected by Gardening Services before planting.
- Black planter bags must be removed before planting!
- Plants must be planted with the roots under the soil level.
- Loosen and rake area after planting to obtain an even and completed look. This is achieved by gently forking and raking through the soil.

- Water plants at least 300 mm deep. Plants are to be kept moist until the final inspection and handover is completed.
- Road surfaces and paving must be swept clean after installation.
- Rose beds, where applicable, must have a mulch layer of coarse bark of 40 mm.

2. Planting of trees:

- Holes dug for the planting of trees should be square. Measurements in comparison to a 20-liter tree: 500 mm x 500 mm x 750 mm deep.
- Compost mixed with soil: 30 dm (one bag) or one-third of the total amount of soil placed back in the hole of the tree.
- Superphosphate: 60 g per tree, mixed with the above-mentioned soil before backfilling.
- Water-retaining granules: 3% of backfill volume added to backfill.
- Comply with trees planted without black bags and root ball under soil level.
- All trees shall be supplied with a tree ring of 350 mm or 11 mm piping at the base for protection against machine damage and for watering purposes.
- Staking is necessary for all newly planted trees. Two stakes per tree must be driven into the pit, one on either side of the centre position of the tree. The stakes must consist of round timber 40 mm to 50 mm in diameter, exceeding 2000 mm in height. The tree shall be attached to the stakes using approved tree ties; ensure that the stakes do not chafe the tree. Two tree ties shall be placed approximately 600 mm above ground level and two within the crown of the tree, approximately 300 mm below the top end of the stake.
- Plants shall be watered to a depth of at least 300 mm. The plants must be kept moist until the final inspection and handover is completed.

REFUSE

- Supply access for heavy-duty refuse removal trucks (loading zone) and sufficient space to turn the vehicle around.
- Supply an adequate refuse area to meet the demand of the project scope – drop off–pick up or a covered built site.
- The built refuse area must have a concrete/paved slanted floor with a grid as cover, running into a 110 mm drain outlet.
- A 20 mm Cobra or similar tap with removable key handle shall be installed for cleaning purposes.
- The enclosed refuse area should have suitable ventilation.
- The door should be solid with kick plates at the bottom for protection.
- Limit unauthorised access to the area – lockable gate, spikes on open walls.
- Otto/wheelie bins, if applicable, must be installed and secured to a wall with a chain and padlock,

depending on the type of constructed refuse area. Supply the padlock key in triplicate to Gardening Services after implementation.

PARKING AND PAVING

- Open face fill (G6) or excavation to levels for paving level. Repairing the area includes compacting; compacted to level at 93% Mod AASHTO density.
- Treatment should be applied underneath with approved weed killer and/or coarse salt.
- Utilise bevel pavers; no concrete blocks.
- Align levels for water-flow and services covers.

30. Annexure 4: Sanitaryware, Ironmongery

Standard Maintenance Specification: Material

PLUMBING

01. WC: Hibiscus Elite Front Flush Close Coupled Suite. Vaal Sanitaryware

02. WHB: Vaal Tuscany wall hung basin/Vaal Cameo-Drop in Basin

Tuscany Wall hung

Cameo Drop-in

03. Shower Tap

3.1 Mixer: Hansgrohne Mixer. HG Décor shower mix. Conc Chr. Export. Model: 31967000

3.2 Stop taps: Cobra Carina Heavy Pattern Stop taps

04. Basin Tap

4.1 Mixer: Hansgrohe Mixer.
HG single lever basin mixer 70
with push open waste set.
Model: 31730003.

4.2 Pillar tap: Cobra Carina/Star

Pattern Carina

Heavy Star

05. Bath Mixer: Cobra Carina
Heavy Pattern Bath Mixer

06. Shower head – Match Existing

6.1 Normal: Cobra Prestex Shower Head

6.2 Water saving: Walcro V3–6/V2

V2

V3–6

07. Kitchen

7.1 Sink: Franke Quinline Double bowl sink – Drop in

7.2 Mixer: Cobra Carina Kitchen Mixer

BUILDERS

1. **Steel Window Ironmongery : Only solid brass**
2. **Waterproofing**

2.1	Shower walls and floors	: ABE Duraflex 2 coats
2.2	Concrete roofs	: ABE Unigum with 2 coats Silvakote
2.3	Ceramic Tiles	: Match existing (Always check for Stock at HRA store before procuring or HRA to supply spec)
		: For new tiles, HRA to supply spec

CARPENTRY

1.	**Doors**	: Semi-solid/Solid
2.	**Door handles**	: Union Gower Chrome or match existing
3.	**Lockbody's**	: Union lockset

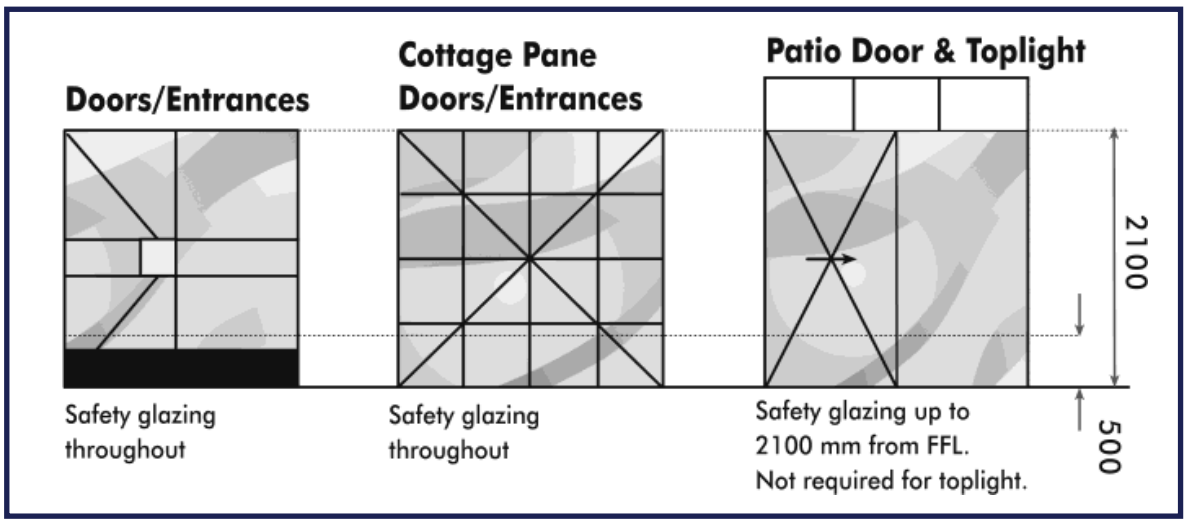
PAINTERS

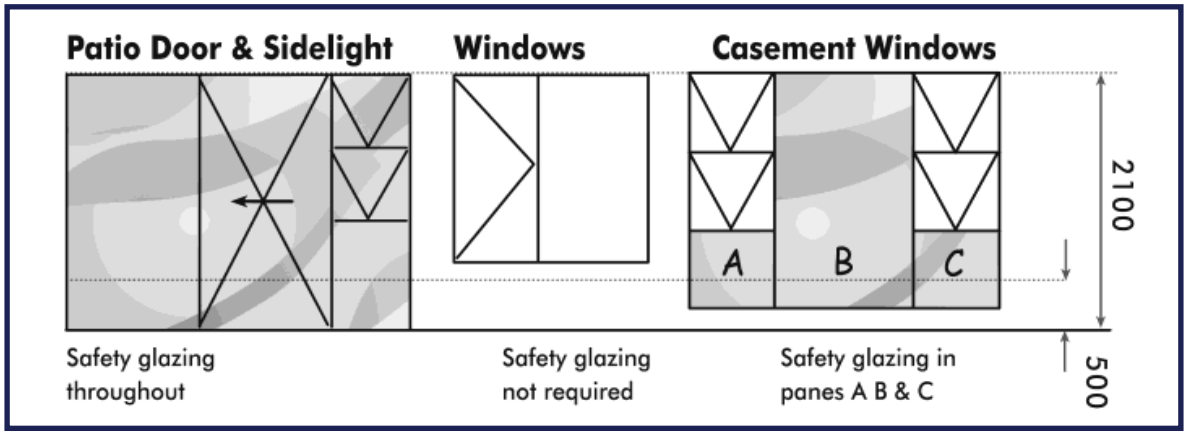
1. **Blinds: 50mm Blinds – colour to match existing**
2. **Vinyl Tiles: Floorworx Marley Tiles**
3. **Paint: Dulux, Plascon, Laminin as per UFS Paint Spec**

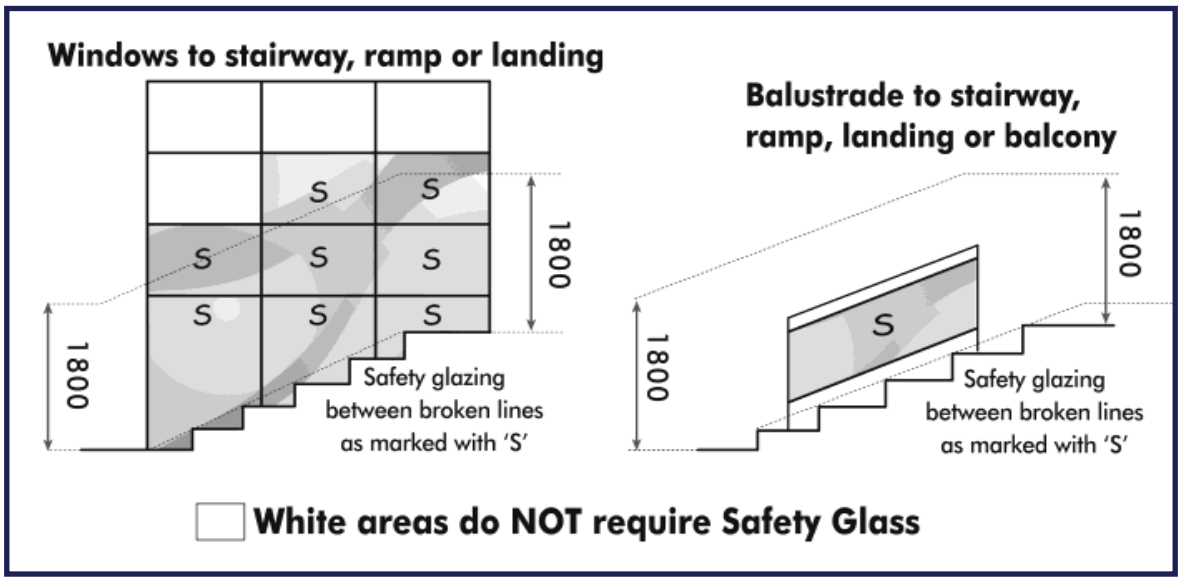
3.1	Bathroom Ceilings and walls	: Enamel
3.2	All other interior walls	: Washable Acrylic Paint
3.3	Colour to match existing or spec to be provided by HRA	

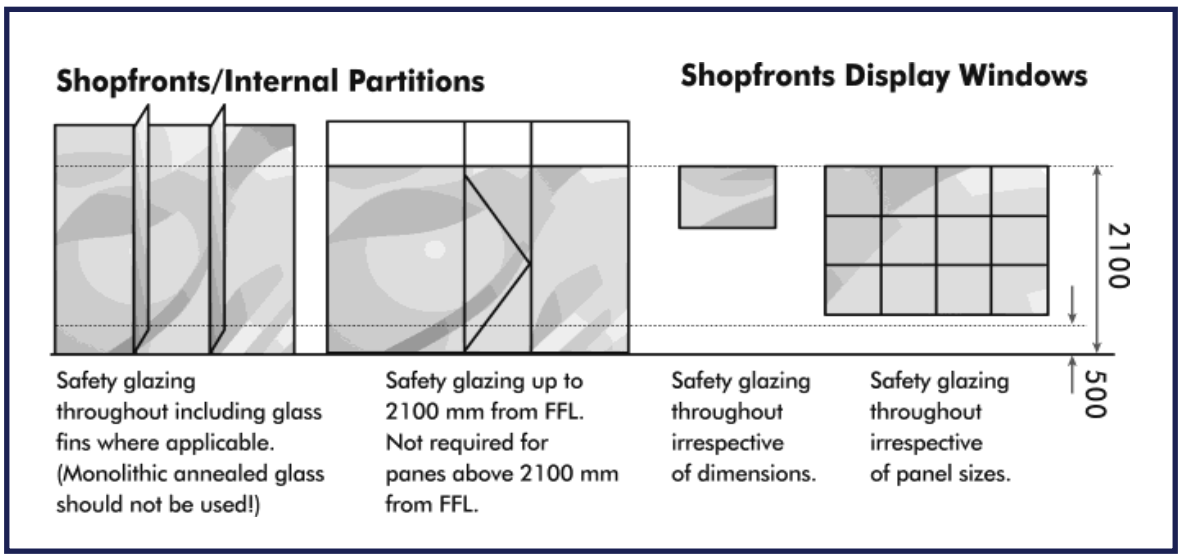
VERTICAL GLAZING SUPPORTED ALL AROUND - EXTERNAL							
Maximum Pane Sizes in Square Metres							
Nominal Glass Thickness (mm)	3	4	5	6	8	10	12
Monothilic Annealed Glass	0.75	1.5	2.1	3.2	4.6	6.0	6.0
Patterned Annealed & Wired Glass	-	0.75	1.2	1.9	2.6	3.4	-
Laminated Annealed Safety Glass	-	-	-	2.9	4.3	5.7	5.7
Toughened Safety Glass	-	1.9	3.0	4.5	8.0	8.0	8.0

VERTICAL GLAZING SUPPORTED ALL AROUND - INTERNAL							
Maximum Pane Sizes in Square Metres							
Nominal Glass Thickness (mm)	3	4	5	6	8	10	12
Monothilic Annealed Glass	0.75	1.5	2.1	3.2	4.6	6.0	6.0
Patterned Annealed & Wired Glass	-	0.75	1.2	1.9	2.6	3.4	-
Laminated Annealed Safety Glass	-	-	-	4.1	6.0	7.2	7.2
Toughened Safety Glass	-	-	-	4.1	6.0	7.2	7.2




Patio Door & Sidelight
Windows
Casement Windows
A
B
C
2100
500
Safety glazing throughout
Safety glazing not required
Safety glazing in panes A B & C


Windows to stairway, ramp or landing
S
1800
1800
Safety glazing between broken lines as marked with 'S'
Balustrade to stairway, ramp, landing or balcony
1800
1800
S
Safety glazing between broken lines as marked with 'S'
White areas do NOT require Safety Glass


Shopfronts/Internal Partitions
Shopfronts Display Windows
2100
500
Safety glazing throughout including glass fins where applicable. (Monolithic annealed glass should not be used!)
Safety glazing up to 2100 mm from FFL. Not required for panes above 2100 mm from FFL.
Safety glazing throughout irrespective of dimensions.
Safety glazing throughout irrespective of panel sizes.

IRONMONGERY SET

D01 - TYPICAL ENTRANCE DOOR: **DOUBLE ALUMINIUM**

		Qty	Unit
	Aluminium Flush Bolt BY DOOR FRAME MANUFACTURER	2.00	Each
	DC500 CAM ACTION CLOSER EN1-4 SIL	2.00	EA
	M72X18SCGMK CYL EURO 7X7 SC GMK Mul-T-Lock	1.00	Each
	B3446 RUBBER DOOR STOP. BLACK.	2.00	Each
	M51058898 KEY BLANK 7X7	5.00	EA
	5905BBSS BACK TO BACK PULL HANDLE 457MMX32MM	2.00	PR
	8852SC DUST PROOF STRIKE	1.00	EA
	QD35X85MM-SS	1.00	EA

IRONMONGERY SET

D03 - TYPICAL LOUNGE DOOR: **ALUMINIUM**

		Qty Unit
	M72X18SCGMK CYL EURO 7X7 SC GMK Mul-T-Lock	1.00 Each
	B3446 RUBBER DOOR STOP. BLACK.	1.00 Each
	M51058898 KEY BLANK 7X7	5.00 EA
	6503-05SS NARROW STILE FURNITURE PROFILE	1.00 PR
	Q35X85MM-SS SPRING LATCH & DEADBOLT LOCK	1.00 EA

IRONMONGERY SET

D04A - TYPICAL STUDY SPACE DOOR: **ALUMINIUM**

		Qty Unit
	M72X18SCGMK CYL EURO 7X7 SC GMK Mul-T-Lock	1.00 Each
	B3446 RUBBER DOOR STOP. BLACK.	1.00 Each
	M51058898 KEY BLANK 7X7	5.00 EA
	6503-05SS NARROW STILE FURNITURE PROFILE	1.00 PR
	Q35X85MM-SS SPRING LATCH & DEADBOLT LOCK	1.00 EA

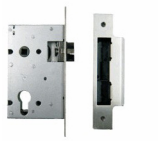
IRONMONGERY SET

D05 - TYPICAL KICK OUT WINDOW: **ALUMINIUM**

		Qty Unit
	SP(5774)SPECIALIST ALUMINIUM KICK-OUT WINDOWS	1.00 Each

IRONMONGERY SET

D06 - TYPICAL BEDROOM ENTRANCE DOOR: **TIMBER**

		Qty Unit
	L-2215-78SS/SL UNION MORTICE SASH LOCK SS	1.00 EA
	M72X19SCGMK CYL EURO 7X7 TURN KNOB SC GMK	1.00 Each
	B3446 RUBBER DOOR STOP. BLACK.	1.00 Each
	M51058898 KEY BLANK 7X7	5.00 EA
	SS6166-05SS NEW HANDLE ON PLATE PROFILE	1.00 PR

IRONMONGERY SET

D07 - TYPICAL LAUNDRY/CLEANERS DOOR: **TIMBER**

		Qty Unit
	M72X18SCGMK CYL EURO 7X7 SC GMK Mul-T-Lock	1.00 Each
	B3446 RUBBER DOOR STOP. BLACK.	1.00 Each
	M51058898 KEY BLANK 7X7	5.00 EA
	L-22315-76SS UNION 315 DOORLOCK SS	1.00 EA
	SS5089-150W KICK PLATE 150X800MM WORKS	2.00 EA
	SS6166-05SS NEW HANDLE ON PLATE PROFILE	1.00 PR

IRONMONGERY SET

D08 - TYPICAL BATHROOM ENTRANCE DOOR: **TIMBER**

		Qty Unit
	DC500 CAM ACTION CLOSER EN1-4 SIL	1.00 EA
	SS5023-06-304W PUSH PLATE 152x304mm STAINLESS STEEL BLANK, 304SS 304mm high X 152mm wide X 1,2mm thick with no sharp corners or edges, 4 times coutersunk drilled for back to back screw fixing. Blank with no piercing. Brushed finish. 304 grade SS	1.00 Each
	SS5D152X304-06 UNION 22MM DIAMETER TUBULAR STAINLESS STEEL pull handle bolted to 304mm high X 152mm wide back plate. Latter to have no sharp corners or edges.	1.00 Each
	B3446 RUBBER DOOR STOP. BLACK.	1.00 Each
	SS5066-06SSE12 MALE AND FEMALE SIGN	1.00 EA
	SS5089-150W KICK PLATE 150X800MM WORKS	2.00 EA

IRONMONGERY SET

D09 - TYPICAL SHOWER CUBICLE DOOR: **MANUFACTURER**

		Qty Unit
No image available	SP(1866)MANUFACTURER AS SUPPLIED BY MANUFACTURER	1.00 Each

IRONMONGERY SET

D10 - TYPICAL TOILET CUBICLE DOOR: **TIMBER**

		Qty Unit
	CZ80941SCR INDICATOR BOLT SC PLATED IMP	1.00 EA
	SS5066-06SS PUSH PLATE BLANK	1.00 EA
	SS5D66-06SS DOVE STAINLESS STEEL PULL HANDLE ON 152X152 BACKPLATE PULL HANDLE ON BACK PLATE; DOVE; 152 X 152mm; BLANK; S/STEEL	1.00 EA
	SS8025SS HAT & COAT HOOK WITH BUFFER	1.00 EA

IRONMONGERY SET

D09 - TYPICAL PASSAGE DOOR: **TIMBER**

		Qty Unit
	DC500 CAM ACTION CLOSER EN1-4 SIL	1.00 EA
	M72X18SCGMK CYL EURO 7X7 SC GMK Mul-T-Lock	1.00 Each
	SS5D152X304I-05 22MM DIAMETER TUBULAR STAINLESS STEEL PULL HANDLE ON 152X304	1.00 Each
	SS5D152X304R-05 22MM DIAMETER TUBULAR STAINLESS STEEL PULL HANDLE ON 152X304	1.00 Each
	B3446 RUBBER DOOR STOP. BLACK.	1.00 Each
	M51058898 KEY BLANK 7X7	5.00 EA
	L-21315-76SS UNION 323 CYL DEADLOCK SS	1.00 EA
	SS5089-150W KICK PLATE 150X800MM WORKS	2.00 EA

IRONMONGERY SET

D12 - TYPICAL KITCHEN DOOR: **TIMBER**

		Qty Unit
	M72X18SCGMK CYL EURO 7X7 SC GMK Mul-T-Lock	1.00 Each
	B3446 RUBBER DOOR STOP. BLACK.	1.00 Each
	M51058898 KEY BLANK 7X7	5.00 EA
	L-22315-76SS UNION 315 DOORLOCK SS	1.00 EA
	SS5066-06SSE02 TEA/KITCHEN SIGN	1.00 EA
	SS5089-150W KICK PLATE 150X800MM WORKS	2.00 EA
	SS6166-05SS NEW HANDLE ON PLATE PROFILE	1.00 PR

IRONMONGERY SET

D13A - TYPICAL ELECTRICAL CUPBOURD DOOR: **TIMBER**

		Qty Unit
	M72X18SCGMK CYL EURO 7X7 SC GMK Mul-T-Lock	1.00 Each
	B3570GA-200MM GALVANIZED PADBOLT - 200MM LONG	1.00 Each
	M51058898 KEY BLANK 7X7	5.00 EA
	2700SS UNION 2700 REBATE SET SS	1.00 EA
	L-22315-76SS UNION 315 DOORLOCK SS	1.00 EA
	SS6166-05SS NEW HANDLE ON PLATE PROFILE	1.00 PR

IRONMONGERY SET

D13B - TYPICAL FHR DOOR: **TIMBER**

		Qty Unit
	B3570GA-200MM GALVANIZED PADBOLT - 200MM LONG	1.00 Each
	26310-76SS UNION 310 LATCH LOCK SS	1.00 EA
	2700SS UNION 2700 REBATE SET SS	1.00 EA
	SS5066-06SSE05 FIRE HOSE SIGN	1.00 EA
	SS6166-06SS NEW HANDLE ON PLATE BLANK	1.00 PR

IRONMONGERY SET

D14 - TYPICAL DUCT GATE: **STEEL GATE**

		Qty Unit
	UN335070206300 50MM BRASS PDLK 63MM SH MK	1.00 EA

IRONMONGERY SET

D15 - TYPICAL DISABLED SHOWER DOOR: **TIMBER**

		Qty Unit
	21314-76/8SS UNION WC 8MM DEADLOCK SS	1.00 Each
	B3446 RUBBER DOOR STOP. BLACK.	1.00 Each
	SS5004-73SS ESCUTCHEON ON ROSE BATHROOM	1.00 EA
	SS5066-06SSE14 PARAPLEGIC TOILET SIGN	1.00 EA
	SS5089-150W KICK PLATE 150X800MM WORKS	2.00 EA
	SS5D66-06SS DOVE STAINLESS STEEL PULL HANDLE ON 152X152 BACKPLATE PULL HANDLE ON BACK PLATE; DOVE; 152 X 152mm; BLANK; S/STEEL	2.00 EA

IRONMONGERY SET

D17 - TYPICAL STORE ROOM DOOR: **TIMBER**

		Qty Unit
	M72X18SCGMK CYL EURO 7X7 SC GMK Mul-T-Lock	1.00 Each
	B3446 RUBBER DOOR STOP. BLACK.	1.00 Each
	M51058898 KEY BLANK 7X7	5.00 EA
	L-22315-76SS UNION 315 DOORLOCK SS	1.00 EA
	SS5089-150W KICK PLATE 150X800MM WORKS	2.00 EA
	SS6166-05SS NEW HANDLE ON PLATE PROFILE	1.00 PR

IRONMONGERY SET

D18 - TYPICAL MALE/FEMALE WC DOOR: **TIMBER**

		Qty Unit
	B3446 RUBBER DOOR STOP. BLACK.	1.00 Each
	2X815/TNP 815T/B31 W/C PRIVACY CYL	1.00 EA
	L-22315-76SS UNION 315 DOORLOCK SS	1.00 EA
	SS5066-06SSE12 MALE AND FEMALE SIGN	1.00 EA
	SS6166-05SS NEW HANDLE ON PLATE PROFILE	1.00 PR

IRONMONGERY SET

D19 - TYPICAL FOYER DOOR: **DOUBLE ALUMINIUM**

		Qty Unit
	Aluminium Flush Bolt BY DOOR FRAME MANUFACTURER	2.00 Each
	DC500 CAM ACTION CLOSER EN1-4 SIL	2.00 EA
	M72X18SCGMK CYL EURO 7X7 SC GMK Mul-T-Lock	1.00 Each
	B3446 RUBBER DOOR STOP. BLACK.	2.00 Each
	M51058898 KEY BLANK 7X7	5.00 EA
	5905BBSS BACK TO BACK PULL HANDLE 457MMX32MM	2.00 PR
	8852SC DUST PROOF STRIKE	1.00 EA
	PZ-05SS ESCUTCHEON ON ROSE PROFILE	1.00 EA

DEADBOLT LOCK 35MM

IRONMONGERY SET

D20 - TYPICAL LOUNGE DOOR: **DOUBLE ALUMINIUM**

	Qty	Unit
 Aluminium Flush Bolt BY DOOR FRAME MANUFACTURER	2.00	Each
 M72X18SCGMK CYL EURO 7X7 SC GMK Mul-T-Lock	1.00	Each
 B3446 RUBBER DOOR STOP. BLACK.	2.00	Each
 6503-05SS NARROW STILE FURNITURE PROFILE	1.00	PR
 8852SC DUST PROOF STRIKE	1.00	EA
 Q35X85MM-SS SPRING LATCH & DEADBOLT LOCK	1.00	EA

IRONMONGERY SET

D23 - TYPICAL SCULLERY DOOR: **DOUBLE ALUMINIUM**

		Qty Unit
	M72X18SCGMK CYL EURO 7X7 SC GMK Mul-T-Lock	1.00 Each
	B3446 RUBBER DOOR STOP. BLACK.	1.00 Each
	M51058898 KEY BLANK 7X7	5.00 EA
	L-22315-76SS UNION 315 DOORLOCK SS	1.00 EA
	SS6166-05SS NEW HANDLE ON PLATE PROFILE	1.00 PR
	21314-76/8SS UNION WC 8MM DEADLOCK SS	1.00 Each
	B3446 RUBBER DOOR STOP. BLACK.	1.00 Each
	SS5004-73SS ESCUTCHEON ON ROSE BATHROOM	1.00 EA

SS5066-06SSE14 1.00 EA
PARAPLEGIC TOILET SIGN

SS5089-150W 2.00 EA
KICK PLATE 150X800MM WORKS

SS5D66-06SS 2.00 EA
DOVE STAINLESS STEEL PULL HANDLE ON 152X152 BACKPLATE
PULL HANDLE ON BACK PLATE; DOVE; 152 X 152mm; BLANK; S/STEEL

IRONMONGERY SET

D26 - TYPICAL DATA CUPBOARD DOOR: **DOUBLE TIMBER**

		Qty Unit
	M72X18SCGMK CYL EURO 7X7 SC GMK Mul-T-Lock	1.00 Each
	B3570GA-200MM GALVANIZED PADBOLT - 200MM LONG	1.00 Each
	M51058898 KEY BLANK 7X7	5.00 EA
	2700SS UNION 2700 REBATE SET SS	1.00 EA
	L-21315-76SS UNION 323 CYL DEADLOCK SS	1.00 EA
	SS5D66L-05SS DOVE STAINLESS STEEL PULL HANDLE ON 152X152MM PLATE WITH EUR PULL HANDLE ON BACK PLATE; DOVE; 152 X 152mm; LEFT HAND; PROFILE PIERCING; S/STEEL	1.00 EA

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