Alpha
Consulting Engineers Pte Ltd

FEEDBACK REPORT FORM

Ref No: 139- 100410 (C)

To: LCT From: LFY

Job No./Project: LIFT MASTER SPECS
Section 11 - Electrical Cabling *(where applicable)*

Source of feedback:

Scope of Feedback: * ☐ Quality ☐ Environmental ☐ Administrative ☐ Contractual
☐ Technical ☒ Specification ☐ Others

Section A : Problem & Cause

Remove clause on MI cables.

Section B : Mitigating Action Taken, if any

Section C : Suggested Corrective Action

Update specs.

Section D : Approved Corrective Action

Document Affected * : ☑ Yes ☐ No Affected Document : L/11-1 to L/11-8

Approved By : (LCT) Date : 21/4

Section E : Action

Action By : NA hm

Targeted Completion : April 2010

Actual Completion : 19 April 2010 Verified By : (LCT)

** Mark [X] where appropriate*

Distribution:

Select one of the following headings

LIFT & ESCALATOR INSTALLATION

LIFT INSTALLATION

ESCALATOR INSTALLATION

SECTION 11 - ELECTRICAL CABLING

11.1 General

All installation materials and work shall comply with the current editions of the following Singapore Standards and British Standard Codes of Practice where applicable:

SS.CP 2	:	Code of Practice for installation, operation and maintenance of Electric Passenger and Goods Lifts
SS.CP 5	:	Code of Practice for Electrical Installation
SS.CP 209	:	Standard Specification for Battery Operated Emergency Power Supply for Lighting & Ventilation of Passenger Lifts
SS.CP 15	:	Code of Practice for the installation, operation and maintenance of Escalators
CP 321.102	:	Installation and maintenance of electric machine, transformers, rectifiers, capacitors and associated equipment
BS 5323	:	Code of Practice for Scissor Lifts

11.2 Wiring

Unless otherwise shown on the Specification Drawings, all wiring shall be carried out using multi-strand copper conductors insulated with polyvinyl chloride complying with SS 80 rated at 450/750 volts and shall be delivered to site with the manufacturer's seals intact which should be retained for inspection. All power cables shall be colour coded using PVC sleeves of appropriate colour at all terminations.

The wiring of control circuits shall be segregated from that of main power or lighting circuits by running in separate conduits or trunkings.

All cables for main power and lighting shall be sized to carry the design load in accordance with current edition of Singapore Standard CP 5: Code of Practice for Electrical Installations. Appropriate temperature derating factors, grouping factors and permissible volt drop, etc shall be taken into account when the cables are being sized. Cables shall only be drawn into the conduits or trunkings after they have been finally fixed and cleaned out.

11.3 LV Cables & Installation

The installation of the LV cables and all necessary materials shall be carried out in accordance with the current edition of Code of Practice, relevant standards and rules & regulations currently in force in Singapore and the specified requirements for each type of cable. The cables shall be routed in cable trenches, ducts, trunking or conduits or ladders or trays as shown on the Specification Drawings and/or detailed in this Specification.

The cable routes and cable ducts where shown on the Specification Drawings are for general guidance only. It is the contractor's responsibility to check and ensure the feasibility of these routes. Modifications shall be made where necessary to suite site conditions. Details of cable routes, terminations and support system shall be submitted to the Architect prior to installation.

Conductors of less than 1.5 sq. mm cross-sectional area shall not be used in mains voltage circuit.

11.4 Cable Codes

Where applicable, the following abbreviations are used in this Specification and Drawings:

(a)	PVC	-	Polyvinyl chloride insulated
(b)	PVC/PVC	-	Polyvinyl chloride insulated and polyvinyl chloride sheathed
(c)	XLPE/PVC	-	Cross linked polyethylene insulated and polyvinyl chloride sheathed
~~(d)~~	~~MI~~	~~-~~	~~Mineral insulated copper covered sheathed~~
(d)	FR	-	Fire resistant

11.5 PVC & PVC/PVC Cables

PVC & PVC/PVC cables and PVC/PVC flexible cords shall be of 450/750 volt grade comprising high conductivity stranded copper conductors of sizes shown on the Specification Drawings, to BS 6360, PVC insulated and PVC sheathed to SS 79 or BS 6746 and manufactured to SS 358 for PVC insulated, non-sheathed cables and to IEC 502 for PVC insulated PVC sheathed cables. Insulant colours shall be in accordance with the current edition of Singapore Standard CP 5: Code of Practice for Electrical Installations.

PVC cables shall be routed in conduits and/or trunkings.

PVC/PVC cables shall be routed at high level on proprietary make horizontal cable trays or ladders and support system similar to UNISTRUT or equivalent system. All vertical runs including cable to control panels etc. shall be secured on cable ladder system similar to BICC VANTRUNK or equivalent system. For horizontal runs, PVC/PVC cables shall be secured neatly on the cable trays or ladders at close intervals by means of moulded polythene cleats similar to BICC 'Telcleat' or other equivalent whereas cleats shall be used for securing vertical cables. Fixing shall be made with rawlbolts or other patented fixing devices.

PVC and PVC/PVC cables shall be terminated in suitably sized tinned copper compression connector to relevant BS standard requirements.

11.6 XLPE and XLPE/PVC Cables

XLPE and XLPE/PVC shall be of 600/1000 volt grade comprising high conductivity stranded copper conductors manufactured and tested in accordance with BS 6469. The PVC sheath for XLPE/PVC cables shall be in accordance to BS 6746.

For XLPE and XLPE/PVC cables, the installation details and method shall be same as those specified elsewhere in this Specification for PVC and PVC/PVC cables respectively.

11.7 FR Cables

Fire resistant (FR) cables shall be of 600/1000 volt grade comprising high conductivity copper conductors, insulated with an extruded thermoset flame retardant and fire resistant, moisture proof compound [silicon rubber or special ethylene propylene rubber (EPR)] and overlapped with a copolymer coated aluminium strip extruded with a special flame retardant PVC out jacket. The cables shall be tested to comply with IEC 331 Specification for fire resisting characteristics of the cables and Category CW2 of Singapore Standard SS 299 Specification for Fire Resistant Cable Part 1: Performance Requirement for Cables Required to Maintain Circuit Integrity Under Fire Conditions.

For cinemas, theatres, computer centres, medical clinics, hospitals, halogen-free, low smoke and flame retardant, fire resistant cables complying with IEC 332-3 (minimum Category B), IEC 754-1 & 2, and SS 299 Category CW2 shall be used. Test certificates from relevant testing authorities shall be submitted when requested by the Architect.

FR cables shall be installed in accordance with the maker's recommendations and instructions. FR cables shall be run on proprietary make cable trays, conduits, trunkings or cable ladders depending on the sizes of the cables.

All installation accessories shall be of manufacturer's standard products. Cable glands shall be of fire rating equal to that of the cable. The bending radius of the cables measured from the inside of the bend shall be not less than eight times the diameter of the cable.

11.8 Not Used ~~MI Cables~~

~~MI cables shall be of the heavy duty grade manufactured to BS 5486 comprising high conductivity copper conductors, embedded in pure and pressure packed magnesium oxide insulation, contained in a ductile seamless, solid drawn copper sheath.~~

~~MI cables shall be supplied and installed strictly in accordance with the maker's recommendations and instructions.~~

~~Jointing and termination of MI cables shall be carried out using cold seals and all necessary short brass ring type universal glands, screw on pot types seals, compounds, coloured neoprene sleeving for phase identification, cone shaped beads, fibre discs, locknut and purpose made single or multi way, as required, two screw fixing, copper spacer base saddles and other necessary accessories.~~

~~Insulation and continuity test shall be carried out before and after MI cables are installed. The insulation resistance of a terminated cable should be greater than 100 Mega ohm when measure with a 500V or 1000V Megger. This test should be repeated immediately after sealing and once again, 24 hours later.~~

~~Minimum bending radius shall not be less than six times the overall diameter of the cable; saddle spacing not less than 60 times the cable diameter and not greater than 750mm whichever is the smaller.~~

~~Where Cables subjected to vibration or constant movement shall have a loop formed immediately before the entry point to the equipment/device.~~

~~Electricians experienced in the termination of MI cables shall be employed and the work will be stopped, if, in the opinion of the Architect, insufficient care and/or skill have been exercised for this portion of the works.~~

~~All MI terminations shall be carried out using an earth tail pot type seal to ensure effective bonding of non-current carrying metalwork, including switch boxes, to the copper sheath of~~

~~the cable. Reliance shall not be placed on metalwork for earth continuity and separate copper connections shall be provided for this purpose.~~

~~For terminating single core MI cables to equipment, a non-ferrous insulated end plate of Tufnol materials or equivalent shall be provided.~~

~~Due to the low surge strength of MI cables, surge diverters shall be installed at the conductors terminations for all switched inductive loads such as discharge lamps, motors and other similar circuits.~~

11.9 Erection of Cables

Erection of cables shall include inter-alia the following:

(a) Temporary sealing of cable ends where necessary.

(b) Supply, delivery and erection of all racks, clamps, saddles, trays, supports, framing systems, bushes and other items required for erection and fixing of cables including excavation where necessary.

(c) Design, provision, erection and painting of all additional supporting steelwork.

(d) Sheath bonding in the case of single core cables.

(e) Phase identification of cores by suitably coloured PVC sleeving.

(f) Sealing of cables in pipes or ducts where called for.

(g) Tests at site on completion.

(h) In the vertical risers/ducts, all cables passing through floors shall be sealed effectively with suitable materials of fire rating equal to that of the floors, to the approval of Building Authority and the Architect.

(i) All cables shall, where they pass through floor or otherwise in such positions vulnerable to damage by mechanical or other means be protected by a short length of steel pipe suitably bushed to prevent abrasion of the cable.

11.10 Jointing

Cable sealing and jointing shall be carried out in accordance with the best current practice and of first-class workmanship. Where cable sheaths are used as earth continuity conductors, glands are to have the necessary contact surfaces or straps to provide a low resistance path under fault conditions.

The cost of all jointing and sealing materials for the termination of cables into sealing boxes, attached to equipment supplied under other contracts, is to be included in the prices for jointing of these boxes.

Straight joints in any of the cables installed will not be allowed, however, exceptions may be made due to limitation of manufacturing lengths or nature of the routing of the cable. In these circumstances, the intended method of cable joint to be used shall be submitted for review prior to execution. The cost of such straight joints shall be included in the Works unless such joints arise from changes in design after ordering of cables.

All cable joints shall be mechanically and electrically sound, protected against mechanical damage and any vibrations that may occur. It shall not impose any appreciable mechanical strain on the fixings of the connection, and shall not cause any damage to the cable conductor.

No strand of a stranded conductor shall be cut in making the joint. The appropriate tools specified by the manufacturers of the joint connectors shall be used.

Tee-off joints where required for tapping off from the main rising cable to individual circuits shall be designed for such purposes. The conductors to be jointed shall be secured by means of purposely designed compression type mechanical connectors, enclosed in plastic protective housing and filled with acrylic resin.

A record is to be kept of all joints and terminations made and is to include the name of the jointer and mate, the date of testing and the weather conditions prevailing. Three signed copies of these records shall be supplied to the Architect.

11.11 Cable Trunkings

Cable trunkings shall be manufactured from epoxy coated electro-galvanised mild sheet steel. The minimum thickness of the steel sheet for the trunkings shall be 1.2mm for trunking sizes up to 100mm (W) x 75mm (D) and 1.6mm for sizes above 100mm (W) x 75mm (D).

The trunkings shall be complete as required with standard bolted flanged outlets, blank ends, reducers, outlet bushes, bends, tees, sleeve couplings, intersection four way boxes and fittings or adaptors of the same manufacturer. The trunking shall not be used to form flanges and attachments. All cut edges shall be anti-rust treated.

Bridge pieces used as cable retainers shall be readily removable. Covers for the trunkings shall be of quick fix pattern with centre captive screw, other fixing arrangements will not be acceptable. The inner radius of any bend shall not be less than 2.5 times the minor dimension or rectangular section trunking.

A copper link shall be provided on both sides of every trunking joint to provide earth continuity.

Individual length of trunkings shall be independently supported by suitable brackets fabricated from galvanised mild steel angle at intervals of 1.2m to 1.5m.

Vertical runs of trunkings within electrical riser ducts which pass through floors must be provided with fire resistant barriers inside and around the trunking of fire rating equal to that of the floors. These barriers should consist of fire rated material cut way to enable the cables to pass through. Similar fire barriers shall be provided for cable trunking passing through fire rated walls.

Cables for lighting and power circuits shall not be run in the same trunking as the cables for extra low voltage circuits unless they are segregated effectively by means of a rigidly fixed metal barrier or screen. Wiring for emergency lighting shall be run exclusively in separate trunkings. Trunking runs shall be completely erected before cables are drawn in. A space factor of 45% shall not be exceeded.

11.12 Conduit Installation

All surface mounted conduits, fittings and accessories shall be of galvanised steel complying with BS 4568. Conduits shall be screwed and welded Class 3. Fittings shall be manufactured from steel or malleable cast iron.

UPVC conduits may be used in areas where they are concealed in walls, columns or floors. However, in cases where part of the conduit system is run on surface and the remaining part is concealed, then the entire run of the conduit shall be of galvanised steel including those parts which are concealed, in order to ensure an electrically continuous system.

UPVC conduits shall be of heavy duty manufacture to BS 6099 and the accessories shall be manufactured to BS 4607. The conduits shall be halogen free, has low smoke density under fire, flame-retardant and impact resistant. Permanent adhesive shall be used for all joints and terminations to provide a rigid watertight joint. For long conduit runs or where structural/movement is anticipated, a non-hardening adhesive shall be used in conjunction with expansion couplers.

All GI conduits and accessories shall be painted with one coat of red lead primer whenever the exposed galvanised surface has been cut or otherwise damage, including exposed threads and connection after erection.

The whole of the conduit system shall be electrically continuous throughout and in addition a separate circuit protective conductor shall be provided in all conduits. Furthermore, all conduits shall be earthed at terminations.

The appropriate space factors for the conduits shall be taken into account when drawing in cables and shall not be smaller than 20mm in diameter.

Cables for low voltage circuits and extra low voltage circuits shall not be drawn in the same conduit. In addition, lighting and power final circuits shall be run in separate conduits. Where an adaptor box is employed as a final distribution point, a number of final circuits may be grouped together in larger conduits between the distribution board and the adaptor box; provided that all circuits in the conduit are of the same phase. In the case of three phase circuits, all three phases and neutral of any circuit should be drawn into the same conduit. Wiring for emergency lighting shall be run exclusively in separate conduits.

Where condensation is likely to occur in surface conduits, they shall be laid with falls so as to drain off condensed moisture without entry into terminations. Provisions shall be made where necessary for leading the drainage away from outside walls, ceilings, fittings and accessory boxes and collecting spots and small bore tubing may be used for this purpose.

The inside surface of all conduits and fittings used in connection therewith shall be smooth and free of corrosion, burrs and all other defects.

The bending radius of all bends shall not be less than 2½ times the outside diameter of the conduit. Where it is not possible to set the conduit, normal or half normal, factory made bends may be permitted but in no circumstances shall inspection elbows or bends and tees be used in a concealed position.

All switches, socket outlets, accessories and other fittings shall be mounted in conduit boxes of suitable size. Where for reasons of construction, the box face is not reasonably flush to the finished surface of wall or ceiling, purpose made extension rings of the same construction and diameter as the box shall be employed.

Conduit terminations to apparatus subject to vibration or movement shall be made of flexible metallic conduit, coated with be heavy gauge weatherproof type PVC and sweated into heavy brass adaptors with a male thread for connection to the rigid conduit system at each end. The flexible tubing shall not be used as an earth conductor. A bare tinned flexible copper wire of not less than 2.5mm^2 shall be used as the earth conductor.

All boxes shall be fixed securely to walls, ceilings, etc., by means of at least two screws correctly spaced and all conduit runs shall be straight and run either horizontally or vertically; diagonal runs will not be permitted.

Conduit work and accessories where not concealed shall be fixed effectively by means of heavy pattern spacing saddles to hold the conduit onto from the surface. Metal or other non-disintegrable plug of proprietary manufacture shall be used for fixings.

On straight runs, the conduit shall be supported by saddles at intervals not exceeding 900mm, this is in addition to supports provided by structure, box or fitting included in the run. However for conduits of 32mm diameter and larger, saddles may be spaced at intervals of not more than 1200mm apart.

Bends must in all cases be supported on each side by two saddles as near thereto as possible and a draw-in box shall be provided after two bends and after not more than 9 metres of straight run.

Where conduits are or may be in contact with steelwork of any description, an efficient and permanent metallic bond shall be made between conduit and steelwork.

Where conduits cross expansion joints they shall be installed so as not to resist relative movement of the sections.

Immediately on completion of any conduit work, all exposed conduits and boxes shall be plugged effectively against the ingress of water and dirt particularly where concrete will be poured. Such seals shall be maintained in good order for such time as is necessary to complete wiring and connection of fittings and switches.

Upon completion of installation, the conduits will be inspected by the Architect and may be tested at his discretion by ball or plug gauge before any wire is drawn in. All conduits shall be swabbed out and free from moisture to the Architect's satisfaction before wiring is commenced.

On completion of the installation, all exposed conduits shall be painted with two coats of good quality orange paint or any other colour as may be advised by the Architect.

11.13 Fixings

All fittings, switches, socket outlets, cables, cable tray, cable trunking, conduits, etc. shall be supplied and erected as follows:

(a) In woodwork by appropriate size of wood screw.

(b) In brickwork or concrete by appropriate size non-shrinkable rawplug and sheradised round head wood screw.

(c) On steel work by proprietary made galvanised girder clip.

No drilling of structural steel work will be permitted except as agreed by the Architect.

11.14 Flexible Conduits

Flexible metallic conduits shall be of heavy gauge, weatherproof type, PVC sheathed overall and sweated into heavy brass adaptors, with a male thread for connection to the rigid conduit system at each end. The flexible tubing should not be used as an earth conductor and a tinned

copper wire coloured green and of not less than 2.5 sq. mm shall be run inside and connected to the equipment terminal at each end.

11.15 Switch Socket Outlets for Lift Cars and Pits

Switch socket outlets to BS 1363 of single pole, 13 amp, 3 pin rectangular type shuttered outlets, metalclad surface mounted, and provided with integral switches, shall be installed in the lift pits and on the top of lift cars for maintenance and inspection purposes.

11.16 Fuses

All fuses shall be of the HRC type category 440/AC3 Class 'Q' to BS 88.

11.17 Earthing

Copper earth bars shall be installed in the various lift sub-switchboards supplied by others at the respective lift machine rooms. All earthing necessary for the lift equipment shall be effectively connected to these earth bars.

The requirements for earthing shall be as detailed in the current edition of Singapore Standard CP 5: Code of Practice for Electrical Installations. The earth connections for all sections of the installation shall be electrically continuous throughout.

Joints shall be tinned, rivetted and soldered. All connections to electrical apparatus shall be made by a bolted connection in a visible and accessible position.

For the escalators, where earth terminal will be provided in the isolators provided by others; all necessary earthing for the escalator equipment shall be effectively connected to these terminals.

Earthing to all the main equipment frames and the main earth bars shall be carried out using 25 mm x 3mm copper tapes or PVC insulated green cables of equivalent size.

For copper tapes Furse No. 44 gunmetal saddles of appropriate size shall be used for securing tapes at intervals not exceeding 300 mm and the copper tapes shall be supplied in long unbroken lengths to avoid unnecessary jointing.