

CODE OF PRACTICE FOR CITY INFRASTRUCTURE &
LAND DEVELOPMENT

ENGINEERING STANDARDS MANUAL

SECTION 9

PUBLIC LIGHTING

Public Lighting

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1. INTRODUCTION

The intent of this document is to set suitable benchmarks for materials, energy efficiency, systems and workmanship for lighting systems intended for use in Waitakere City.

This should in turn ensure that these installations are attractive, robust, easy to maintain, cost and quality effective, suitable in relation to performance and minimise obtrusive effects. Good design principles are expected, including:

- Minimising obtrusive effects (to neighbours, traffic and sky glow).
- Designing vehicular route lighting for vehicle and pedestrian safety.
- Designing pedestrian lighting for pedestrian safety, to minimise crime and to enhance the environment.
- Designing equipment construction and finishes to retain serviceability and a good standard of appearance for the service life of the equipment.
- Reducing energy consumption and maintenance costs associated with lighting

The document is generally prescriptive, but designed to allow for the wide range of equipment currently available. It also outlines the related procedures required by Waitakere City Council (WCC).

Designers are to evaluate the life cycle costs of proposed lighting systems and provide details of their evaluations with their submissions.

This applies to all lighting installations that will be designed and constructed by parties other than WCC, but that will be maintained by WCC.

This will *include* but not be limited to:

- Roads.
- Pedestrian Crossings.
- Pedestrian and Cycle Paths.
- Parks and Reserves.
- Public Precincts (e.g. Shopping Precincts)
- Outdoor Carparks.
- Steps, Stairs, Ramps, Subways and Footbridges.

It will *exclude*:

- Building Interiors.
- Building Facades.
- Signs.
- Indoor car parks

Where clauses differ from existing standards, the requirements of this document shall apply.

It should also be noted that:

- Lighting other than street lighting in a designated public road may also require Resource Consent and Building Consent.
- Street lighting shall be designed in accordance with this standard and all applicable New Zealand Standards including but not restricted to the current AS/NZS 1158 series of standards.
- A lighting plan is required as part of the engineering plan approval.
- The developer's representative is required to certify that all luminaires have been installed in accordance with the approved plans and specifications.
- The developer's representative shall ensure that a post-completion street lighting audit is undertaken in accordance with Section 12 of AS/NZS1158.1.3:1997. Two copies of the audit report shall be submitted to Council – one for the development file and one for the appropriate asset manager.

- This manual shall be read in conjunction with the Waitakere City Council Code of Practice for City Infrastructure and Land Development – Engineering Manual and the Waitakere City Council Code of Practice for City Infrastructure and Land Development – Electrical Specification.

Other related documents and standards are:

- WCC - Public Lighting Guidelines
- WCC – Specification for the Safety of Pedestrians in Construction Zones
- WCC - Standard Specification – Electrical Services
- LTNZ - Pedestrian Planning and Design Guide
- Austroads – Lighting for paths and cyclists (section 6.9)

In using this Document, the category of road shall be determined by the City Transport Engineer, Waitakere City Council according to the Standard(s) for the type of road, applicable at the time. For parks and reserves contact the City Parks manager for the appropriate lighting category.

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1.1 The Approval Process

The approval process is detailed in Section 9 and Appendix E.

1.2 Lighting Classifications

While the classifications shall be determined by WCC, the following Table 1.1 provides an informative guide of the typical classifications philosophy. WCC may elect to depart from this guide at their total discretion. This table shall be read in conjunction with AS/NZS1158.

Table 1.1: Classifications

AS/NZS11 58 Cat.	NOMINAL ROAD CATEGORY (as defined in the WCC District Plan)	GENERAL APPLICATION GUIDE	SPECIFIC CRITERIA (ADT = Average Daily Traffic Count) (NTOR = Night time occupancy rates)	
			Arterial / Distributor Road (/Criteria for areas other than roads)	Collector Road
V1		ROADS: WCC discretion. Only for very high mixed pedestrian & vehicle movements.		
V2	Regional Arterial	ROADS: Busy Arterial, mixed vehicles & pedestrians	ADT>20,000	
V3	District Arterial	ROADS: Busy Arterial, mixed vehicles & pedestrians	8,000<ADT<15,000	
V4		ROADS: Distributor or collector or local road in an industrial area.	ADT<8,000	
V5		Not used in NZ		
P1		ROADS & PATHS: Pedestrian / cycle way with high risk of crime		
P2		ROADS & PATHS: Pedestrian / cycle way with medium risk of crime &/or high night time activity levels		ADT>8,000
P3	Collector	ROADS & PATHS: Typical for new subdivision Collector Road		2,000<ADT<8,000
P3R	Collector	ROADS: Existing area Collector Road – using power poles		2,000<ADT<6,000
P4	Local	ROADS & PATHS: Typical for minor roads in new subdivisions & pedestrian walkways		ADT<2,000
P4R	Local	ROADS: Existing area minor roads – using power poles		ADT<2,000
AS/NZS11 58 Cat.	NOMINAL ROAD CATEGORY (as defined in the WCC District Plan)	GENERAL APPLICATION GUIDE	SPECIFIC CRITERIA (ADT = Average Daily Traffic Count) (NTOR = Night time occupancy rates)	
			Arterial / Distributor Road (/Criteria for areas other than roads)	Collector Road
P5		ROADS & PATHS: Typical for private access ways (Note 1) – WCC discretion (Generally longer than 100m & / or with bend(s))		
P6		PUBLIC ACTIVITY AREAS: High risk of crime / high night time activity level		
P7		PUBLIC ACTIVITY AREAS: Medium risk of crime / medium night time activity level		
P8		PUBLIC ACTIVITY AREAS: Low risk of crime / low night time activity level		
P9		STEPS, STAIRWAYS, RAMPS FOOTBRIDGES & PEDESTRIAN WAYS		
P10		SUBWAYS, INCLUDING ASSOCIATED RAMPS OR STAIRWAYS		
P11a		OUTDOOR CARPARKS: – High risk of crime / high night time activity level	NTOR>75%	

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P11b		OUTDOOR CARPARKS: – Medium risk of crime / medium night time activity level	25%<NTOR<75%	
P11c		OUTDOOR CARPARKS: – Low risk of crime / low night time activity level	NTOR<25%	
P12		OUTDOOR CARPARKS – SPACES FOR PEOPLE WITH DISABILITIES		

NOTE: 1. Where it is determined that a Private Access Way is to be lit, the lighting shall be supplied from a common metered switchboard (i.e. Not from multiple residences).

NOTE: 2. Where a road is identified for future extension to a different use (e.g. a dead end road that is planned to be continued in the future to become a collector or arterial), the design is to be based on the proposed road category.

NOTE: 3. Other spaces (e.g. public precincts, transport terminals, etc) shall be classified in accordance with AS/NZS 1158.3.1:2005

1.3 Standard Equipment

WCC have adopted a range of standard equipment for:

- Public Roads – Refer Appendix F Drawing SDE 501
- Amenity lighting* – Refer Appendix F Drawing SDE 502
- Sports lighting – Refer Appendix F Drawing SDE 503
- Town Centres – Refer Appendix F Wraight Athfield Drawings LP 1.01, LP 1.02, LP 1.03.

*WCC has a preference for solar power for amenity lighting where instructed and/or where cost effective.

2. GENERAL

2.1 Definitions

For the purpose of this Standard the definitions listed below apply. The definitions are the same as those used in AS/NZS 1158.

Arrangement (lighting arrangement) – the pattern according to which luminaires are sited in plan, e.g. single sided, staggered, opposite or central.

Average Illuminance (E_{ave}) – the mean illuminance in a horizontal plane at ground level over a specified area, derived in a specified manner.

Azimuth or C-angle – the angle, in azimuth, between the vertical plane containing the direction of a particular value of intensity and the vertical plane parallel to the axis of the road. See figure 2, AS/NZS1158.0:2005, for details of the CIE C, γ angle co-ordinate system, which is used for the photometry of road lighting luminaires.

Carriageway – that portion of the road devoted particularly to the use of motor vehicles, inclusive of shoulders and auxiliary lanes.

Carriageway lighting design width (W_k) – The width of carriageway which is used for the calculation or assessment of road lighting performance.

Disability glare – glare that impairs the visibility of objects without necessarily causing discomfort.

Discomfort glare – glare that causes discomfort without necessarily impairing the visibility of objects.

Footpath (pathway) – a public way reserved for the movement of pedestrians and non-motorised vehicles.

Glare – condition of vision in which there is discomfort or a reduction in ability to see, or both, caused by an unsuitable distribution or range of luminance, or to extreme contrasts in the field of vision.

Illumination – a general expression for the quantity of light arriving at a surface. The physical measure of illumination is illuminance.

Illuminance (E) - the luminous flux arriving at a surface divided by the area of the illuminated surface. Unit: lux (lx); 1 lx = 1 lumen/m².

Illuminance uniformity - the ratio of the maximum illuminance to the average illuminance within a specified area of the road reserve. Symbol: U_E.

Initial light output (of a discharge lamp) - the total luminous flux emitted by a lamp after 100 hours of operation.

Intersection – a place at which two or more roads cross at grade or with grade separation.

Junction – a place where two or more roads meet.

Kerb – a raised border of rigid material formed at the edge of the carriageway.

Lamp – a generic term for a man-made source of light.

Lighting column – a vertical structure of any appropriate material, which is designed to support luminaires either directly or by the use of outreach arms or mounting frames.

Light output – the total luminous flux emitted by a lamp or luminaire, as appropriate.

Light output distribution – the distribution of luminous intensity from a luminaire in various directions in space.

Luminaire (lantern) – apparatus which distributes, filters or transforms light transmitted from one or more lamps and which includes, except for the lamps themselves, all the parts necessary for fixing and protecting the lamps and, where necessary, circuit auxiliaries together with the means for connecting them to the electrical supply.

Luminance (L) – the physical quantity corresponding to the brightness of a surface (e.g. a lamp, luminaire, sky or reflecting material) in a specified direction. It is the luminous intensity of the surface divided by that area. Unit: candela per square metre (cd/m²).

Luminous flux (Ø) – the measure of the quantity of light. For a lamp or luminaire it normally refers to the total light emitted irrespective of the directions in which it is distributed. Unit: lumen (lm). Note: Values of luminous flux in this Standard refer to new lamps, viz. Initial 100-hour values.

Luminous intensity (I) – the concentration of luminous flux emitted in a specified direction. Unit: candela (cd).

Maintenance factor (light loss factor) – a factor applied to lighting design calculations, to take account of the light losses resulting from the depreciation in the lamp lumen output due to ageing and the accumulation of dirt on the optical surfaces of the luminaire, during the interval between scheduled maintenance of the lighting system.

Minimum illuminance (E_{min}) – the lowest value of illuminance in a horizontal plane at ground level, within a specified area.

Mounting height (H) – the vertical distance between the centre of a luminaire and the surface which is to be illuminated, e.g. the road surface.

Outreach – The distance, measured horizontally, from the photometric centre of a luminaire, to-

- For lighting columns with outreach arms – the centre of the vertical section of the column, or
- For bracket arms – the mounting plate by means of which the bracket arm is secured to the column, wall or other supporting surface.

Peak intensity – the highest value of luminous intensity from a given luminaire.

Property line – the boundary between a road reserve and the adjacent land.

Road reserve width (W) – the width of the entire way, between property lines, devoted to public travel.

Roundabout – an intersection where all traffic travels in one direction around a central island.

Spacing – the distance between successive luminaires in a road lighting installation measured along the centre-line of the carriageway. This applies irrespective of whether the carriageway is straight or curved.

Note: in a staggered installation, the distance is measured along the centre-line of the carriageway, between the luminaire on one side of the carriageway and the next luminaire on the other side of the carriageway.

Threshold increment (TI) – the measure of disability glare expressed as the percentage increase in contrast required between an object and its background for it to be seen equally well with the source of glare present.

Upcast angle; tilt angle – the angle by which the axis of the fixing spigot entry is tilted above the horizontal when the luminaire is installed.

Upward waste light ratio (UWLR) – the proportion of luminous flux emitted by the luminaire above the horizontal, when mounted as installed. Note: For conventional road lighting luminaires-

$$UWLR = ULOR \div LOR$$

Where:

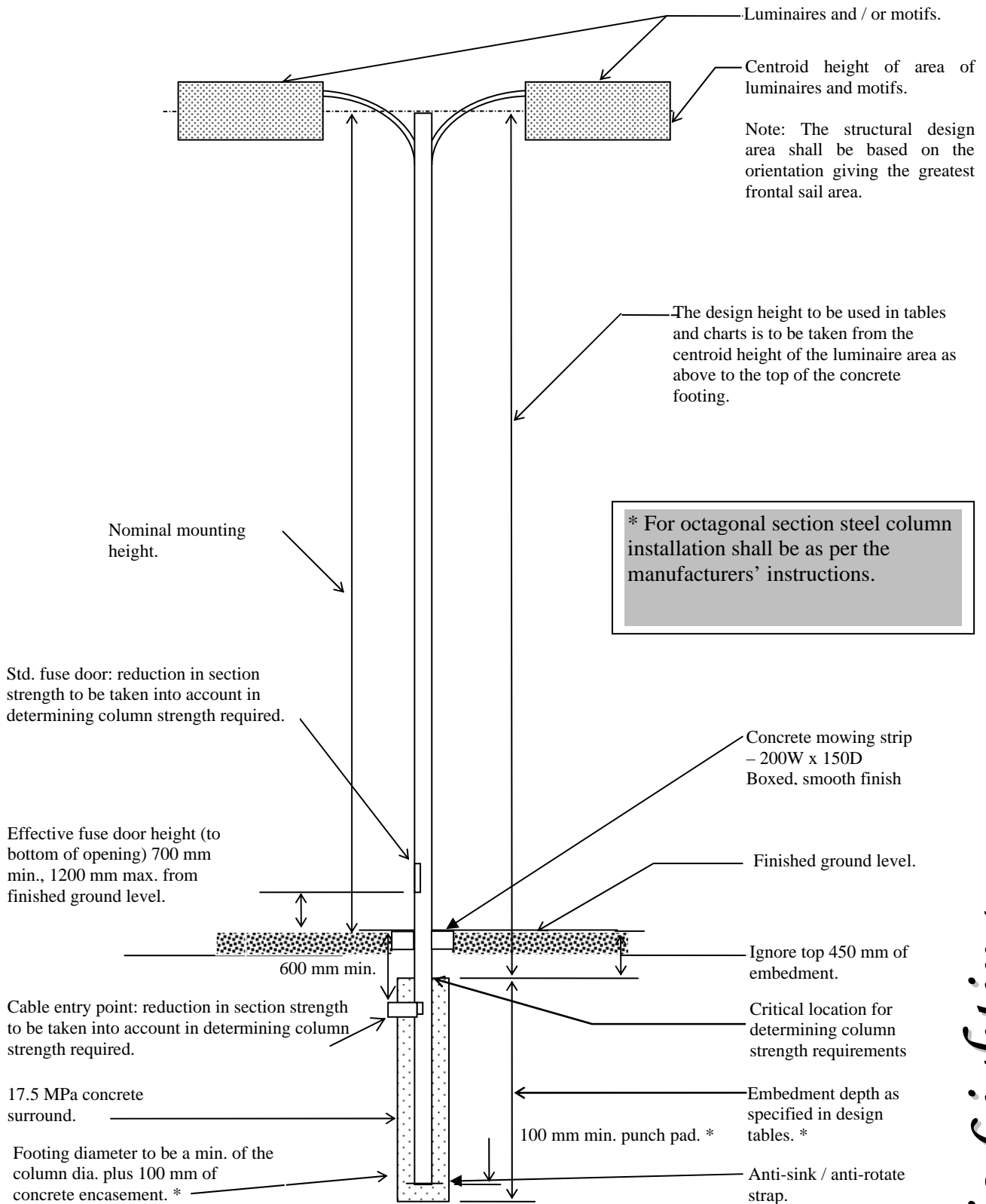
ULOR = upward light output ratio of the luminaire

LOR = total light output ratio of the luminaire

However the degree of upcast, if any, should be taken into account in assessing compliance with the specified *UWLR*.

2.2 Typical Column Terminology

Fig.1.1: Terminology (Schematic only – Do not scale)



2.3 Codes, Regulations and Standards

The codes, regulations and standards referenced in this document shall be the latest version complete with all amendments.

All works are to be carried out in accordance with all relevant statutes, bylaws and regulations and in particular:

- a) The Electricity Act 1992, Electricity Regulations 1997, the relevant Electrical Codes of Practice (ECP) referred to in this, and relevant Standards referenced in ECP3.
- b) New Zealand Radio Interference Notices 1958 and 1985 and Radio (Television) Interference Notice 1961.
- c) Health and Safety in Employment Act 1992.
- d) Relevant Statutory Acts, Regulations and Bylaws.
- e) The requirements of Network Supplier's Health and Safety Standards (NHSS)
- f) AS/NZS3000 – Australia/New Zealand Wiring Rules
- g) AS/NZS1158 – Road Lighting
- h) Waitakere City Council Code of Practice for City Infrastructure and Land Development Engineering Standards Manual – Standard Specification Electrical Services

2.4 Workmanship

All work shall be performed in accordance with best trade practice utilising good quality new materials.

Specific items:

- Avoid damage to materials during transport and installation.
- Ensure columns are weatherproof.
- Do not use ceramic fuses or fuse holders.

2.5 Weatherproofing

The equipment shall comply with the following parameters in relation to AS 1939 or IEC 529.

Table 2.1: IP Ratings

ITEM	MOUNTING HEIGHT	MINIMUM IP RATING
Luminaire Optical Chamber	> 3 m	IP65
	≤ 3 m	IP65
Luminaire Control Gear Chamber	> 3 m	IP44
	≤ 3 m	IP55
Column Gear/Fuse Door	-	IP43
Remainder of Column	-	IP24
Switchboard	-	IP56
In-ground equipment	-	IP67

Columns shall be equipped with any necessary drain holes, vent holes, glands and gaskets to comply with the above requirements. Any vent holes shall be arranged to prevent rain entry. Any drain or vent holes shall be arranged to prevent vermin entry. Ensure that the design of the column intrinsically prevents the occurrence of water filling the base of the pole or entering the lantern.

Outreaches for top-suspended lanterns shall be detached from the main column in such a manner as to prevent the possibility of condensation / capillary action transferring moisture from the main column to the outreach. The cable access path into the lantern shall be sealed to prevent moisture & debris entering the lantern. The connection shall at least meet the requirements of AS/NZS1158.6.

2.6 Materials

The steel materials and fasteners shall be as given in NZS 3404.1 or AS 4100. The minimum thickness of steel plate used in any structural column element shall not be less than 2.0 mm.

Dissimilar metals shall not be used in contact with one another. Where this is unavoidable the components shall be plated with a metal of intermediate potential to prevent any electrochemical

reaction. In the case of screw fastenings the fastener is to be captive and the system is to be corrosion resistant for the service life of the equipment, i.e. 20 years.

Where cast aluminium is used, the grade shall be LM6 or better with a copper content not exceeding 0.1%.

2.6.1 Recyclability

All materials used for the installation (luminaries, lamps, control gear, accessories, etc) shall comply with European Community (EC) Directive on Waste Electrical and Electronic Equipment (WEEE) – also known as the WEEE Directive.

All packaging associated with the equipment shall be recycled. Contact Michelle Dawson at WCC for appropriate recycling contractors.

2.7 Aesthetics

The style of any existing nearby lighting equipment shall be considered when selecting new luminaires, columns and finishes to ensure that the new installation blends in visually.

3. LIGHTING COLUMNS

3.1 Design

3.1.1 Introduction

The design requirements for columns shall be in accordance with the Australian/New Zealand Standard AS/NZS 4676: “Structural design requirements for utility services poles”. In particular, Sections 2, 4.1 & 5.3 and Appendices C & D.

Appendices A & B of this document provide details for calculating minimum requirements for column strength and ground embedment.

Charts that set out basic minimum requirements for the design of street light columns to meet the requirements of the New Zealand Building Code (NZBC) with respect to street light column strength are contained in Appendix A. Also Australian/New Zealand Standard AS/NZS 4676: “Structural design requirements for utility services poles” has been used as a guideline.

Design of components for strength will be subject to specific design by the suppliers.

Interpolation between charts is permitted for intermediate values. Extrapolation outside the scope of the charts is not permitted without further input by a Chartered Professional Engineer whose area of expertise is Structural Engineering.

All construction is to comply with the NZBC and the appropriate New Zealand Standards.

3.1.2 Column Types

The design charts provided are based on constant diameter – uniform wall thickness columns.

Where tapered or variable wall thickness columns are proposed, specific design details and calculations proving that equivalent structural performance will be achieved are to be provided.

3.1.3 Wind Loadings

The column shall be designed to safely sustain the appropriate loads as set out in NZS 4203:1992. The wind loading shall be as per the wind zone maps included in Appendix A of this document unless otherwise instructed by Council in writing.

Wind loadings are assumed to be non-directional. i.e. the worst orientation of the light standard is considered. Specific design considering wind direction, with respect to the orientation of the light standard, may be warranted in special cases, but this is considered not generally necessary.

Wind Pressures are based on design wind speeds for each wind zone as per NZS 3604 and are calculated in accordance with NZS4203 as tabulated in table A1.1 in Appendix A.

The minimum drag coefficient is taken as for a smooth round shape ($C_d = 1.2$). Other shapes will require modification with the appropriate modification factor determined by the manufacturer.

The frontal area of luminaires shall be taken from the orientation that results in the greatest wind exposed surface and the force on these is assumed to act at the top of the column. The frontal area shall include all other attachments, motifs etc., which are not part of the main street light column structure.

The height of the column used in the charts is to be taken as the height from the centroid of the frontal area of the luminaires and attachments as above, to the top of the concrete foundation. Table A1.1 in Appendix A shows wind zone values in kPa.

3.1.4 Minimum Column Strengths

Concrete column strengths are based on the requirements of NZS 3101 for ultimate limit state design. Steel Column Strengths are based on the requirements of NZS 3404 (Structural Steel) and AS/NZS 4600 (Cold-Formed Steel Structures).

Steel sections strength requirements apply to the base of the column (at the top of the concrete footing) i.e., not necessarily at the ground surface.

Minimum section modulus requirements must take into account any service opening near the critical location at the base. Locations of openings other than at the base should also be considered.

Steel strengths other than G250 and G350 ($f_y = 250$ MPa and $f_y = 350$ MPa respectively) will require the required strength to be modified by the ratio of F_{ytable}/F_{yused} .

Aluminium section requirements are based on 6061-T5 alloy. Other alloys will require a minimum Z value obtained by multiplying the tabulated value by the ratio of F_{ytable}/F_{yused} .

For modification factors for minimum column strengths, refer to Appendix A.

3.1.5 Deflection & Vibration

The complete assembly (e.g. column, outreach & luminaire) shall be designed to minimise deflection and vibration. Specific design requirements include:

- The luminaire manufacturer shall, upon request, provide a guarantee that the service life of 20 years for the luminaire and the lamp manufacturer's stated service life for the lamp will not be compromised by the support systems.

The axis of the main light beam shall remain fixed under the design wind conditions to $\pm 2^\circ$.

In locations where high vibration is possible, e.g. bridge structures, the lamps shall be fitted with an anti-vibration device (e.g. Sylvania wire hangar)

3.1.6 Dynamic Response Check

a. TRANSLATIONAL RESPONSE

Dynamic response of a light standard may subject the structure and fixtures to excessive acceleration and forces. The loadings Standard, NZS 4203:1992; 5.2.2.2 requires a dynamic analysis of wind sensitive structures where the period of the structure is greater than one second.

The dynamic response of a light standard may be in a number of vibrational modes, including fundamental translational (lateral) cross wind and along and response as well as torsional response, particularly where the fixtures are eccentric and have high mass.

The dynamic analysis of a wind sensitive structure is outside the scope of this document and specialist design will be required where the structure is deemed to be wind sensitive.

We have included a simple check for dynamic response below which should not be taken as a rigorous assessment, however, it can be used to quantitatively assess whether dynamic response might be a problem.

i. Determine the total mass of the fixtures and other top attachments, including outreach arms etc. and include the mass of the top half of the post = M (kg).

ii. The minimum section inertia of the post, I_{min} , is then obtained from:

$$I_{min} = k_m 65.83 M h^3 \text{ (mm}^4\text{) (for steel posts)}$$

$$= k_m 0.006583 M h^3 \text{ (cm}^4\text{)}$$

where: M = lumped mass (kg) as above

h = approximate height to centre of lumped mass (m)

k_m = material modification factor

iii. The post size chosen should meet both the strength (Z_{min}) and stiffness (I_{min}) criteria to ensure adequate performance.

Example: for M = 100kg
 h = 6m
 required I_{min} = $142 \times 10^4 \text{ m}^4$
 = 142 cm^4 for a steel post.

i.e.: a suitable minimum size would be, say, a 100NB x 3.18 API Line Pipe with $I = 171 \text{ cm}^4$ subject to a strength check.

A modification factor for other materials must be applied where applicable by multiplying the required I_{min} by the following:

material:	Aluminium = $k_m = 2.857$	where E = $70 \times 10^3 \text{ MPa}$
	Timber = $k_m = 30.77$	E = $6.5 \times 10^3 \text{ MPa}$
	Concrete = $k_m = 7.782$	E = $25.7 \times 10^3 \text{ MPa}$ ($f_c = 30 \text{ MPa}$)

b. TORSIONAL RESPONSE

The torsional response is much more difficult to predict and may be combined with the translational response. Included in Appendix C, is a sample spreadsheet calculation that includes a formula for the torsional period.

As with the translational response, a period in excess of one second would indicate a more rigorous dynamic analysis is required.

3.1.7 Control Gear / Fuse – Access Door

The door shall be positioned to permit safe access for maintenance, i.e.:

- Not facing the street.

- Not facing the property boundary behind the column, unless clearance to the property boundary or any obstruction is greater than 1000mm.
- 1000mm minimum clear of any fixed obstructions.
- Fixings shall be vandal & child resistant and shall require a specialised tool to open.

The bottom of the door shall be located between 700mm and 1200mm above finished ground level.

It shall be of sufficient size for safe and easy maintenance access.

The door shall be prevented from being opened by unauthorised persons, by the use of fasteners requiring a specific tool to gain access to the fuses and terminations.

3.1.8 Shear Base Columns

All shear base type columns shall incorporate IP68 plug & socket connections to ensure that the pole does not become live in the event of vehicle impact or similar event (Transnet Amerace 65U or equivalent).

3.2 Construction

This section details the requirements for finishes and their application, as solutions considered satisfactory by WCC. Alternative products and processes may be submitted for approval for specific projects and / or for future incorporation in this document.

Approved coating systems are listed in Appendix D.

This section relates particularly to columns and column-mounted luminaires. While the spirit of this document shall also apply to other styles of luminaires and supports, proposed finishes and their application details shall be submitted for approval.

Surface preparations, coatings and repairs shall be in accordance with one of the approved systems (refer Appendix D) and be performed by one of the companies approved for that system to meet the minimum warranty period.

Painting is optional. However, columns shall be finished in one of the following forms:

- Hot dipped galvanised mild steel – painted (externally) or unpainted.
- Mild steel – painted (externally & internally).
- Stainless steel (316 grade) – painted (externally) or unpainted.
- Marine grade aluminium – painted (externally).
- Contact Michelle Dawson at WCC regarding other clear acrylic coatings.

Surface finishes shall be smooth and free from obvious blemishes.

3.2.1 Standards

The following standards are applicable to this section

AS/NZS 2312	Guide to the Protection of Iron & Steel Against Exterior Atmospheric Corrosion.
SSPC-SP1	Cleaning Using Liquid Solvents & Alkaline Solutions.
SSPC-SP10	Abrasive Blast Cleaning.
SSPC-PA2	Measurement of Dry Paint Thickness with Magnetic Gauges.
AS/NZS 4680	Hot-Dip Galvanised (Zinc) Coatings on Fabricated Ferrous Articles.

3.2.2 Repair of Damage to Surfaces

Welded Areas & Inorganic Zinc Surfaces.

Degrease in accordance with SSPC-SP1 to remove all visible deposits of oil, grease, dirt, dust and other contaminants.

Remove all weld spatters, radius sharp edges and grind weld seams.

Power tool clean welds etc in accordance with SSPC-SP3. Prime the prepared areas by brush within 4 hours, or before rust bloom appears. Lap the primer coat at least 25 mm over the surrounding sound paint.

Prime and paint in accordance with the WCC approved paint manufacturer's system.

Damaged Top Coat not back to Inorganic Zinc Primer.

Sand to mechanically roughen the coating at the damaged area to ensure adhesion of the topcoat. Remove all rust and dust particles with compressed air or by vacuuming.

Paint in accordance with the WCC approved paint manufacturer's system.

3.2.3 In-Ground Section of all Columns

All bare metal must be covered in a zinc rich coating which must then be coated with High Build Epoxy of minimum dry film thickness of 150 microns to match the above ground level specification for the type of column used.

Bare, untreated metal is not acceptable.

3.2.4 Alternatives

Where alternative materials or paint finishes are required to those described above the applicant shall submit full details of the proposed process and materials for review with the submission.

3.2.5 Warranty

Providing the coating applicator has been certified by the paint supplier as an approved provider of the proposed coating system (proof to be supplied to WCC), a copy of the coating applicator's certification that the galvanising and/or paint has been applied in accordance with the coating manufacturer's specification to meet or exceed the Standards in section 4.2.1 of this manual. This certification shall be provided before installation of the columns & lanterns.

If the applicator does not possess the necessary "certified applicator" status, then the paint supplier shall monitor the work and provide the required certification.

Materials and paint finishes of columns, and luminaire bodies shall be unconditionally guaranteed against fair wear and tear for a minimum of 10 years, commencing from the date of hand-over of the installation to WCC.

3.2.6 Inspection

The paint manufacturer shall be responsible for inspections as necessary, sufficient to enable the specified warranty to be provided.

3.2.7 Protection

Before transporting to the site, or when handling during installation etc, the columns shall be individually wrapped in heavy duty polythene "bubble wrap", or similar method of protection, to protect the equipment from damage. The protective wrapping shall not remain in place for any extended period of time, e.g. during site storage, as damage to the paint finish is likely to occur.

The columns shall be carefully handled by forklift with carpet cladding on the forks &/or HIAB type vehicles using at least 2 nylon strops.

The column wrapping shall be applied whilst the column is installed and stood upright in the excavation & then the wrapping shall be removed. The column shall be lifted into position with a minimum of two suitable soft surface straps (nylon or similar) to avoid damage to the finish.

When not being re-used, recycle all packaging and protective material in accordance with clause 2.6.1.

Any damage caused prior to the hand-over to the Waitakere City Council shall be repaired as new with all warranties remaining intact. Where the damage is considered too severe the contractor shall, upon written instruction from WCC, or their representative, replace the damaged equipment with new at no cost to WCC.

3.2.8 Mowing Strip

A smooth concrete mowing strip shall be provided around the base of every lighting column, lighting bollard and in-ground luminaire (except within garden beds). The concrete shall be 25MPa strength with a minimum width of 200mm on all sides and depth of 150mm. The concrete shall be boxed, finish level with the surrounding ground level and have a smooth trowel finish, slightly graded away from the column to eliminate water collecting next to the column.

4. LUMINAIRES

4.1 General

Luminaires shall be manufactured & tested in accordance with AS/NZS 1158.6 and AS/NZS60598 as applicable and a Certificate of Compliance from an accredited, independent testing laboratory shall be provided on request.

The steel materials and fasteners shall be as given in NZS 3404.1 or AS 4100.

Dissimilar metals shall not be used in contact with one another. Where this is unavoidable the components shall be plated with a metal of intermediate potential to prevent any electrochemical reaction. In the case of screw fastenings the fastener shall be captive and the system shall be corrosion resistant for the service life of the equipment, i.e. 20 years.

The luminaire finish shall be guaranteed for a minimum of 7 years.

The spigot design shall prevent moisture ingress to the luminaire, including moisture from within the column & outreach as well as external moisture.

All equipment and components shall be readily available for maintenance purposes.

All equipment within 3m of the ground shall have a maximum surface temperature in accordance with AS/NZS 60598.1: 2003;

- Metal parts 70°C
- Non-metal parts 85°C

In-ground up-lights shall also meet the following minimum requirements:

- In trafficable areas, the luminaire shall not present a tripping or slip hazard.
- Impact resistance of IK10.
- Ingress protection of IP 68.
- Anti-glare attachment.

Road lighting luminaires (excluding LED's) – lamp and control gear compartments shall be accessible for servicing within 60 seconds of commencement of work without the requirement for special tools. Removable sections of the luminaire (e.g. lens/cover glass/gear tray) shall be secured by means of a lanyard or hinge.

4.2 Optical Performance

The optical performance of the luminaire shall comply with the applicable standard (AS/NZS 1158 or AS 2560) with respect to the objectives of the lighting, characteristics of the lanterns and the installation geometry parameters as described.

Reflectors shall be specifically designed to suit the type of lamp proposed (note: Cosmopolis lamps tend to be glary and in general cannot satisfactorily be substituted into a luminaire designed for other lamp types without optical design alterations. LED luminaires for road/street/area lighting shall have asymmetric micro-optics for each LED.

All luminaires shall have test certificates from a registered independent laboratory for all IP ratings and photometry.

4.3 Lighting Design

The lighting design shall comply with the following standards as well as the additional constraints set out in this section.

- AS/NZS 1158.1 – For predominantly vehicular area (Category V) lighting.
- AS/NZS 1158.3 – For predominantly pedestrian area (Category P) lighting.
- AS 2560 – for Sports Lighting.
- AS 4282 – For control of the obtrusive effects of lighting.

AS/NZS 1158.1 Category V5 shall not be used for road lighting design.

4.3.1 Quantities

Use the least quantity of luminaires that will satisfactorily meet the lighting parameters.

4.3.2 Obtrusive Light

Particular attention shall be given to AS 4282-1997, Section 2, and AS/NZS 1158.3.1:2005, Clause 2.5.3 and the International Dark Sky Association (IDA) for limitations related to adverse environmental effects.

4.3.3 Refractors

In an effort to minimize the glare, luminaires which have optical control dominated by refractor control, or in which the lamp is positioned as to be more than 50% below the natural screened edge of the luminaire canopy (or opaque section), shall not be used in subdivisions containing residential properties or areas adjacent to residential properties.

4.3.4 Light Distribution

The light distribution pattern for road lighting shall be asymmetric with a forward and sideways throw. Symmetrical patterns shall not be used for road lighting.

4.3.5 Rural Areas

While road lighting in Rural Areas is suitably addressed in AS/NZS 1158, other lighting will need to be addressed on a case-by-case basis.

Primarily, since the ambient light and sky glow in Rural Areas is significantly less than that in built-up areas, the impact of obtrusive light is much greater.

AS 4282-1997 (Control of the Obtrusive Effects of Outdoor Lighting) will be used as a guide in these situations.

The following design guidelines apply:

- Keep road lighting to the minimum applicable standard at intersections and road terminations.
- Minimize lighting beyond these areas (intersections and terminations). Only provide sufficient luminaires such that a pedestrian walking along the road always has a light in view, for orientation and guidance.

4.3.6 Spill Lighting & Glare Control

The spill of artificial light into adjacent household units can have an adverse effect on amenity values. It can cause annoyance, discomfort, distraction and loss of sleep. It can also reduce the ability to see.

Looking to manage these effects, all exterior lighting facilities shall be designed, located and at all the times directed, screened, adjusted and maintained to ensure that:

- The luminance or glare does not cause a significant level of discomfort or inconvenience to adjacent household units.
- Lighting facilities which may cause confusion with lights for navigation and traffic purposes shall not be installed.
- Lighting shall not be installed so that direct or indirect luminance or glare causes adverse effects on traffic safety.

The standards of AS 4282 – 1997 may be used to determine glare and discomfort.

Also, the requirements of the WCC District Plan shall be satisfied.

4.3.7 Safety & Security Lighting

Following the principles of CPTED (Crime Prevention Through Environmental Design), lighting is considered one of a number of measures to be taken to reduce the risk of crime, improving safety levels on local roads and public spaces. Particular attention shall be given to AS/NZS 1158.3.1:2005, Appendix C, to assist in applying the appropriate criteria to reduce the fear of crime and to enhance the prestige of the locality.

4.3.8 Pedestrian Crossing Lighting

Pedestrian Crossings including signalised pedestrian crossings shall be lit in accordance with Land Transport Rule: Traffic Control Devices 2004, the Traffic Regulations and AS/NZS 1158.

In summary;

- A minimum of 40 lux maintained is required across the entire crossing.
- Lamps shall provide white light (metal halide/Cosmopolis/LED) for better visibility and an appropriate colour rendering.
- Lanterns shall be purpose-designed for pedestrian crossings.
- The TI (Threshold Increment) along the road shall be no greater than 20% with the pedestrian traffic lights included in the calculation as well as the adjacent street lights.
- At an un-signalised pedestrian crossing, a reflective orange Belisha disc shall be affixed to each column with the disc oriented towards traffic approaching the pedestrian crossing.
- The column shall be designed & located in accordance with NRB TR11.
- Care should be taken that the contrast between the pedestrian crossing and the approach road is not too great. This is particularly so on unlit streets. Transition lighting should be provided.

Controlled (traffic signals) Pedestrian Crossings shall be lit to a minimum of 20 lux maintained across the entire crossing. The same type of lamp used in the streetlights in the vicinity of the crossing will be suitable. Belisha discs will not be required for controlled crossings.

Note: At the time of drafting this document the AS/NZS Standard for Pedestrian Lighting (AS/NZS 1158:4) is in the process of being reviewed prior to being adopted. When this document has been adopted it shall be used to determine the lighting parameters for pedestrian crossings.

4.3.9 Roadway Lighting Column Locations

The minimum column set back from face of kerb to face of column shall be 1000mm, unless otherwise directed by WCC in writing.

Street lighting columns shall generally be located in line with property boundary separations. Where this is impractical, columns shall be positioned to avoid future driveways. Normally this would mean positioning the column at the middle of a section frontage and avoiding properties with short frontages.

The location of the column shall comply with the recommendations in AS/NZS1158.1.3:2005 Appendix B, taking into account the speed zone, pedestrian activity and column type (rigid / slip base / impact absorbing). Where this cannot be achieved, detail the reasons to Council for approval.

A staggered or double sided column arrangement shall be used in all new road lighting installations where trees will be planted within the road reserve and the locations shall be co-ordinated with the proposed tree locations. Where no trees will be planted within the road reserve a single sided arrangement may be approved.

4.3.10 Energy Efficiency

The installation shall be designed for economic use of energy, applying the following principles:

- Low loss control gear (as per the table below).
- High power factor (≥ 0.95 lagging, & < 1.0).
- High efficacy lamps.

Where size of equipment or other practical constraints conflict with the following requirements, submit details for approval. Departures will only be considered for small quantities of fittings in any one development.

Acceptable ballast loss factors for fluorescent lamps:

Ballasts for fluorescent lamps shall meet the following Minimum Energy Performance Standards (MEPS) in accordance with NZHB 4783.2:

TYPE	ENERGY EFFICIENCY INDEX (EEI)
Ferromagnetic	B1
Electronic	A2
Dimmable electronic	A1

Acceptable ballast loss factors for HID lamps:

Mercury Vapour	
Lamp W	Loss W (hot)
80	9.5
125	12
175	15
250	19.5
400	23
700	32
1000	48

Metal Halide	
Lamp W	Loss W (hot)
50	9
70	13.5
100	13.5
150	19
250	20
400	25
1000	50

High Pressure Sodium	
Lamp W	Loss W (hot)
50	10.5
70	12
100	14
150	18
250	25
400	35
600	42
1000	60

LED Equipment losses

LED luminaires shall have a combined lamp & control gear loss of no greater than 10%.

Fluorescent lamp efficacy

All fluorescent lamps of length 550 mm or greater shall comply with NZHB 4782.2. In particular, they shall meet the requirements of Class R in relation to lamp efficacy.

4.3.11 Adjacent Access Routes

Where the primary area to be lit is accessed by a road, path or similar that is also required by the WCC to be lit as part of the development conditions, the access way shall be lit to the same standard with lighting systems of similar appearance and quality as those in the primary area.

4.3.12 Alternative Solutions

Road lighting design solutions utilising computer calculations based upon CIE standards are acceptable provided that clear correlation is supplied to prove equivalence with AS/NZS 1158 requirements for the specific project parameters.

High efficiency and low maintenance solutions are encouraged. Refer also to the Introduction regarding life cycle cost analysis.

4.3.13 Sports Field Lighting

Lighting for sports fields shall be in accordance with the recommendations of AS 2560 (Sports Lighting).

Luminaire mounting heights shall not be less than 16m above the playing field unless otherwise approved by WCC.

Luminaires shall be flat glass asymmetric IP66 floodlights with metal halide lamps and shall be installed with zero upward tilt unless otherwise approved by WCC.

Lighting for television broadcasting purposes may require the use of projector style luminaires with upward tilt, but the design shall be in accordance with best design practice to minimise off-site obtrusive lights effects and glare to players and spectators. Design for all lighting for television broadcasts shall be undertaken by a registered professional lighting engineer, MIES or equivalent minimum qualification.

4.4 Maintenance And Serviceability

Lamp and control gear compartments shall be accessible for servicing within 60 seconds of commencement of work, without the requirement for special tools.

The luminaire control gear shall be readily maintainable without the need to dismantle significant portions of the luminaire. Where feasible, a removable gear tray shall be provided.

Removable sections of the lantern, i.e. lenses, visors, cover glass and gear tray assemblies, shall be secured by means of a lanyard or hinge type arrangement for safety and ease of maintenance.

LED luminaires are fully sealed and repairs are to be undertaken on a repair by replacement policy for the luminaire.

4.5 labelling

Labelling shall be in accordance with AS/NZS 1158.6. In particular, the lamp type & rating shall be indelibly marked on the luminaire body (e.g. S 150 C).

In addition, a smaller permanent heat-resistant label with permanent adhesive shall be fixed to the underside of the luminaire detailing the brand, model, lamp & gear type.

4.6 Bollard Luminaires

Bollards are not preferred and will only be permitted if approved in writing by Council. A recognized possible application would be for narrow walkways between residential boundaries where the spill light limits required under the District Plan may not otherwise be achievable. (Even so, in such circumstances, close louvered pole mount alternatives will typically be able to achieve the design parameters and shall be used if possible).

Where permitted, bollards shall be rugged commercial grade units suitable for use in vandal-prone areas. They shall possess the following features:

- A maximum of 3% upward waste light output.
- Refractors not permitted.
- Sturdy concrete foundations with 200mm wide mowing strips in grassed areas.
- Internal light baffles where required to keep spill light within District Plan limits.
- Metal halide, Cosmopolis or compact fluorescent lamps
- Construction & finishes as per the relevant sections of this document for Columns & Luminaries.
- Electrical items as per the Electrical sections of this document.
- The maximum luminous intensity in any normal viewing direction when installed (i.e. this is site specific to suit the local topography, etc), shall not exceed 500 cd/m².

5. EQUIPMENT & COMPONENTS

Electrical equipment & components shall be manufactured to comply with the applicable New Zealand or International Standards and shall be readily available as spare parts. These components shall be incorporated into the lantern or in the column, be protected against the ingress of moisture and be easily accessible for repair or replacement. Warranties on these components shall be the manufacturers' standard warranty, but no less than 12 months, and be applicable from the date of hand-over of the installation to Council.

5.1 Lamps

Standard lamp wattages adopted by WCC are 250 watt, 150 watt, 100 watt, 90 watt (Cosmopolis) 70 watt 60 watt (Cosmopolis) and 50 watt. Lamps for street lighting shall be Philips Cosmopolis unless approved otherwise by WCC.

For other areas and tasks, e.g. parks & reserves, metal-halide is preferred. Details of these shall be included on the submission drawings.

Cosmopolis, LED, Fluorescent, Metal Halide and high pressure sodium lamps are preferred for all applications. Incandescent (G.L.S.) and low pressure sodium mercury vapour lamps shall not be used.

Lamps shall be manufactured by BLV, Dura, GE, Osram, Philips, Radium, Sylvania or Venture. Alternatives will not be permitted unless approved in writing by Council.

6. ELECTRICAL

All electrical work shall comply with the requirements listed in the WCC Standard Specification – Electrical Services document.

6.1 Permits

Make application to the Network Supplier for permits and approvals as required to complete the work. All work shall be carried out in accordance with the Electricity Regulations 1997, AS/NZS3000 and the applicable Electrical Codes of Practice. In addition work shall be in accordance with the Network Supplier's Street Lighting Standard with respect to pilot cable installation.

All underground cabling for street lighting shall be supplied & installed by one of the contractors approved to work on the Power Lines Company Network to ensure that retain responsibility for the ongoing maintenance of this asset.

The point of demarcation will be the fuse in the base of the column for street lighting, or the point of supply for metered area lighting.

6.2 Power Charges

The Developer shall be responsible for notifying the Power Lines Company (Vector / Trust Power, etc), when the new street lights are commissioned and for direct payment to the Power Lines Company of all line and energy charges covering the period up until the "Hand-over to Council".

6.3 Connection To Power Supply

All non street light new connections shall be arranged through the WCC Energy/Sustainability manager.

The Contractor shall supply and install power supply cabling to all of the new lights from the nominated/agreed source of power for road lighting.

Any supplies that are no longer required, such as for removed lights shall be disconnected from the supply, correctly terminated and left in the ground.

The Contractor shall provide on request a schematic diagram for the Engineer's approval prior to construction showing cable, control switches, cable route from existing power supply and methodology if this differs from the cable routes proposed.

The Contractor shall notify Vector of the installations and obtain their approval before proceeding with the work. Before livening of any light installations the work shall be inspected by a registered inspector, recognised by Vector, and carrying appropriate Vector warrants. All documentation required by Vector shall be submitted to them.

Contractor's staff working on light installations attached to shared reticulation poles shall hold appropriate authorisations to work from Vector, and abide by all their requirements.

6.4 Vector Requirements

Installation of any cabling, which will become part of the Vector Reticulation system, shall be installed by a suitably Vector warranted contractor.

The contractor shall submit a final design of their proposal for approval by Vector before work on site starts.

A copy of the Certificate of Compliance is required as part of the "as-built" documentation, signed off by the suitably warranted contractor.

Vector streetlight installation / alteration forms shall be completed for all new, altered or removed lights. The energy usage of the lighting system shall be calculated and included on the forms for all new installations.

6.5 Cabling

6.5.1 Supply to luminaires

All supply cables shall be underground unless agreed in writing by Waitakere City Council.

If any new power supply cable is required to be installed it shall be minimum 10mm² two core (three core if metered) PVC insulated neutral screened with soft drawn copper conductors, having a heavy grade sheath of radial thickness no less than 3.2mm. The size of neutral screened cable is to be determined by the Contractor taking into account the allowable voltage drop. AS/NZS 3008.2.1 shall be used to determine current, thermal and voltage drop ratings.

The successful Contractor can amend the suggested runs, but shall get the proposed runs approved by Council before commencing work. The location of all ducting and cables shall be recorded and both Council and Vector notified. Existing ductwork can be used if sufficient space is available.

All ducting and underground cables shall be installed with a minimum of 600mm of cover.

Vector shall be informed when the new lights are livened.

Road crossings and sealed areas shall be thrust and ducted.

6.5.2 Cabling within Columns

New wiring within columns and outreaches shall be round 2C+E NS Cu cable. Cables and flexible cords will be standard conductor type and a minimum size of 1.5mm² for cables and 32/0.20mm² for flexible cords.

All cabling within the streetlight column will be terminated in a proprietary in-line plug and HRC socket-fuse combination or on an Engineer approved insulated panel, as defined in the "Fuses" section.

Suitably heat resistant wiring shall be used.

6.5.3 Identification

All cores shall be phase identified with, if necessary, a coloured PVC sleeve firmly attached to the core.

A polythene signal strip as per the utility service provider (bright orange with warning message) shall be installed to identify the presence of underground cables.

6.5.4 Routes

Search on site and on any drawings that are available for evidence of existing underground services, or factors that may affect the installation of cables and/or ducts on the proposed routes. Any services exposed or damaged during trenching shall be reported immediately and any damage caused to existing services during the course of the work shall be made good at no cost to WCC.

6.5.5 Spacing

Minimum cable spacing from other services shall be as follows:

HV	300 mm
MV or LV	150 mm
Water or Gas	200 mm
Telecommunications	200 mm
Fibre Optics	500 mm
Sewer/storm water	200 mm

6.5.6 Fuses

All fuses shall comply with AS/NZS 60269 for HRC cartridge fuses.

The rated breaking capacity of 90 kA/415 Volts AC will apply with Class Q1 general fuse links for industrial purposes unless detailed otherwise.

Provide an HRC fuse and fuse holder, for and at, each luminaire or column.

Within road lighting columns, use a proprietary in-line plug & socket-fuse combination (Transnet Amerace 65U or equal approved). All terminated cables shall be so equipped (provide solid links for neutral and earth plugs). This shall be located & fixed to the manufacturer's recommendations to ensure the best opportunity for the lower portion to remain intact following a car-column collision. Ensure sufficient slack in the incoming cable to enable the fuse to be pulled up to the gear door for changing.

If an in-line plug and socket fuse combination is not practical, then an approved insulated panel may be used with permission of the engineer. The panel shall be compliant with current electrical regulations and be securely fixed at the base of the pole just inside the cover plate upon which the fuse holder shall be bolted. The supply cable/connection shall be made in an approved insulated terminal block with a PVC insulated conductor from the terminal block into the fuse base. The earth shall be terminated on the body of the pole by drilling and affixing with a suitable galvanised nut and bolt, with a crimped terminal fitting on the earth cable.

Where in-line kits are not used, a proven method to restrict condensation and moisture entering the fuse holder shall be provided.

6.6 Earthing

Each column shall be earthed in accordance with AS/NZS 3000, the electricity regulations and the requirements of the power network provider. An appropriate earth tag, cable and earth stake shall be provided for this purpose. Earth stakes shall be CAD welded to the earth conductor and shall be located in a toby box with a flush hinged brass lid.

The earth cable shall be a minimum single 10mm² TPS stranded copper cable.

The Contractor shall ensure that all new steel poles have earths terminating in the body of the pole by drilling and affixing with a suitable galvanised nut and bolt with a crimped terminal fitting on the earthed cable. They are to be securely fixed to the approved insulated panel and all cables are to be continuous between the terminals.

Fuse/Inspection covers shall be earthed as above.

7. INSTALLATION

Installation of streetlights/columns shall be in accordance with AS/NZS 1158.1.3, Section 12 and this document.

On installation of the new light unit a 'first service' inventory of all components shall be carried out and submitted to Council.

All new or upgraded installations will require a Certificate of Electrical Compliance. This certificate shall be forwarded to the Engineer prior to payment of any works.

7.1 Location

The location of each light/column shall be clearly marked on the drawing(s) submitted to Council for review. Ensure all underground services are located and safe before the commencement of any excavation work. Where underground services obstruct the installation of the light/column, seek the Engineer's approval to relocate the column.

7.2 Columns

Roadway lighting columns shall be complete with lantern mounting spigot, base mounted 10 Amp HRC fuse, 2C+E 1.5 mm² (minimum) Cu NS/PVC/PVC cable to lantern, terminal and control gear space and base shear flange as required with access and underground cable.

Cables shall be connected to proprietary terminals within the chamber. Tee crimp connections shall not be used. The access aperture for the fuse holder shall be no less than 120 mm wide x 240 mm

high (unless otherwise approved in writing by WCC) to enable safe & easy removal of the fuse holder (Structural integrity shall be maintained).

Provide an earth tag within each column and luminaire.

Access facilities for small diameter (low height) columns (e.g. for path & area lighting) shall be designed to provide safe and easy maintenance access. Details shall be submitted for approval.

All road lighting column outreaches shall be supplied with a standard 42mm OD spigot. Provide an additional adapter if necessary to suit the proposed lantern. The purpose of this is to provide maintenance flexibility for the Council.

7.2.1 Frangible & Shear Base Columns

Frangible or shear base columns shall be used for all major intersections and appropriate locations as per the guidelines in AS/NZS 1158, Part 1.3, Appendix B.

The selection (frangible vs. shear base), installation, alignment and fixing are critical. These shall be strictly in accordance with AS/NZS 1158, as well as the manufacturer's instructions and recommendations.

Certification shall be provided prior to practical completion that all bolts on shear base poles have been torqued to the settings recommended by the manufacturer.

7.2.2 Erection

The columns shall be erected:

- Vertical to within +/- 1 degree
- Outreach arms within +/- 1 degree of normal to the edge of carriageway.
- To ensure the correct roll lanterns shall be mounted +/- 1 degree parallel to the road surface in the driving direction.
- On flange base ground stubs or foundation pads. These shall be neatly back filled with cast in-situ concrete and finished with a neat concrete surround and within 50 mm of final ground level.

Details of embedment depth requirements shall be calculated using the charts and tables contained in Appendix B.

7.3 Controls

Road lighting in designated public roads shall be connected to the Vector Network. Photocell (daylight switch) control is preferred. Ripple relay and pilot systems are not preferred due to historical lack of reliability and such systems shall only be permitted where no other practical option exists and then only with prior written council approval.

At the time of preparing this document (May 2008), WCC are reviewing possible centralised monitoring and control of road lighting utilising dimming and/or switching. Confirm whether such provisions are required prior to submitting details for approval.

7.4 Disposal Of Equipment

The Contractor shall make provision for the safe and legal disposal of all materials that are replaced or removed from service. All possible components shall be recycled in accordance with clause 2.6.1.

7.5 Damage To Road Facilities

Refer to the WCC Standard Specification – Electrical Services document for requirements relating to this work.

7.6 Thrusting, Trenching & Reinstatement

Refer to the WCC Standard Specification – Electrical Services document for requirements relating to this work.

8. STREET LIGHTING SITE AUDIT

This section sets out the requirements for the audit of the street lighting after installation.

This is final audit which will ensure that the asset performance and quality of the work comply with Councils requirements, before handover to WCC.

The audit parameters and methodology are defined in AS/NZS 1158.1.3.

A successful site audit will enable handover of the street lighting asset to Council. A copy of the Certificate of Compliance is required as part of the “as-built” documentation, signed off by the installation contractor.

Any installation which fails this audit shall be actioned as per the audit comments. A subsequent audit(s) will follow, to confirm rectification of the issues raised.

9. THE PROCESS

A flow chart has been provided in Appendix E outlining the process. The full requirements are detailed in this section.

9.1 General

The process will typically be as follows:

1. Request roading classification from Waitakere City Council. Confirm the exact designation prior to commencing design.
2. Design, prepare all details as specified, complete the checklist and review form(s) – submit to WCC.
3. Provide any supplemental information requested by WCC or their representatives to clarify the submission.
4. WCC will advise whether the submission is accepted and if so, under what conditions.
5. If the conditions of acceptance affect the plans as submitted, then modify and resubmit as required until accepted.
6. Fabrication of the equipment may proceed once WCC final approval of the design is received (and not before).
7. Supply warranties to WCC, **prior** to installation.
8. Proceed with the installation. Advise WCC when the installation is due to commence to arrange inspections.
9. WCC will inspect the works in progress and on completion. Attend to any remedial works as required by WCC.
10. The developer's representative is required to certify that the streetlights have been installed in accordance with the approved plans.
11. The developer's representative is required to ensure that an independent post-completion street lighting audit is undertaken in accordance with section 12 of AS/NZS1158.1.3:1997 with two copies of the audit report forwarded to Council – one for the development file and one for the appropriate asset manager.
12. Upon completion, supply as-built drawings & SLIM forms to WCC. This may require amendment & re-submission if incomplete or of unsatisfactory quality.

13. Supply WCC with signed copies of electrical certificates of compliance (COC). This will be a requirement for the issue of a WCC Certificate of Compliance where applicable.

9.2 Procedure Details

Four copies of the plans and two copies of isolux plots, computer calculation output files & written submissions shall be submitted to the appropriate section of Waitakere City Council:

Subdivision Engineer or, Parks Manager (as applicable)

Waitakere City Council
Private Bag 93109
Henderson 0650
WAITAKERE CITY

Allow approximately 3 weeks for processing **fully completed** submissions. To assist in this process, applicants are encouraged to complete the form and checklist contained in Appendix E of this document and forward with their submission. Where data supplied is not complete, additional time will be required to process the submission. All of the time required to review the submission will be charged to the applicant. Hence, it is in the applicant's best interests to provide a fully completed submission in the first instance.

Where the review indicates that design changes are required, adjust the documents and resubmit until approval is obtained.

No installation work shall be carried out until written approval is received from Council.

A representative of the Waitakere City Council will undertake a site inspection during the installation to verify compliance. AS/NZS 1158, Part 1.3, Section 12.2 will form the basis of this inspection for streetlights.

In order for Council to issue a Compliance Certificate, all lighting equipment must be installed and working correctly, and Council in receipt of the developers installation audit, all applicable SLIM forms, written warranties, and the completed as built documentation. Council will not issue a Compliance Certificate for the subdivision until all aspects of the subdivision have been verified for compliance with applicable council standards.

9.3 Documentation Required

1. A covering letter with details of the proposed installation, contact details for the lighting designer, completed checklist and review forms (refer Appendix E) and other items as listed below.
2. Where applicable, all documentation required in Appendix D of AS/NZS 1158.1.1:2005, or Appendix E of AS/NZS 1158.3.1:2005 (as appropriate), that is not listed below shall also be provided.
3. Certification confirming that the Embedment Depth, Base Moments, Column Strengths comply with and dynamic response the requirements of the Structural section of this specification.
4. Detailed installation and maintenance instructions for the lantern and column combination including handling, transport and storage instructions as well as minimum foundation details as above.
5. A detailed written warranty, minimum 10 years, stating the extent and any conditions of the warranty and the remedial action proposed in the event of a claim.
6. Copies of photometric test reports for the proposed luminaires, from an accredited Testing Laboratory in hard copy and, on request, in IESNA or CIE electronic format.
7. Relevant Luminance and Illuminance information calculated by approved methods, e.g. computer software, and based on the appropriate photometric information provided above, using the observer position indicated by the current applicable NZ standard.

8. A site plan showing the proposed locations of all luminaires, supporting structures and foundations included in the project. Where the project is a continuation of, or intersects an existing lighting system, the columns affecting or contributing to the proposed system shall also be shown and clearly marked as existing. Lighting plans shall also show proposed landscaping. The landscaping design must be developed around street lighting.
9. On completion of commissioning and prior to hand-over to Council, "As-built" drawings of the completed works and completed Street lighting Inventory Management (SLIM) forms shall be supplied to the Waitakere City Council, for approval before acceptance of the hand-over. This includes full working drawings for manufacture made available to the Maintenance department so that replacement installations can be the same as the original.
10. Prior to hand-over to Council, where the columns have been painted, the paint supplier's 10 year warranty shall be provided. This will necessitate that the paint supplier has witnessed and approved the painting applicator's work in process & on completion.
11. "As-built" drawings, to the Network Supplier's standards, shall be supplied to the Network Supplier for all underground and overhead power supply and pilot cables.

9.3.1 As-built Drawings

The drawings shall be in accordance with the Waitakere City Council Engineering Quality Standards.

9.3.2 SLIM Forms

Obtain the current version of the master SLIM (Street Lighting Inventory Maintenance) forms; complete with user guidance notes, from WCC (Asset Management Engineer – Roadings).

Complete sheets for each luminaire and support system and submit for approval.

Appendix A

Determination of Column Strength

10. APPENDIX A – CALCULATING REQUIRED COLUMN STRENGTH

Wind Loadings

Table A1.1: Wind Pressures (kPa)

WIND ZONE	L (Low)	M(Medium)	H(High)	VH(Very High)	SD(Specific Design)
Pressure, qz (kPa)	0.61	0.82	1.16	1.50	2.60

MODIFICATION FACTORS FOR MINIMUM COLUMN STRENGTHS

Table A2.1: Drag Coefficient Modification Factors for Minimum Column Strengths

Section Shape	Modification Factor
Circular	1.00
Square	1.33
Octagonal	1.17
12 Sided Polygon	1.08

Table A2.2 is based on the following:

- Drag coefficients for circular sections of 1.2, square sections of 1.6, Octagon sections of 1.4, and 12 sided polygons of 1.3.
- Modification Factors are the same for all wind zones and soil types.
- Minimum column strengths obtained from the corresponding charts are to be multiplied by the above factors as applicable.

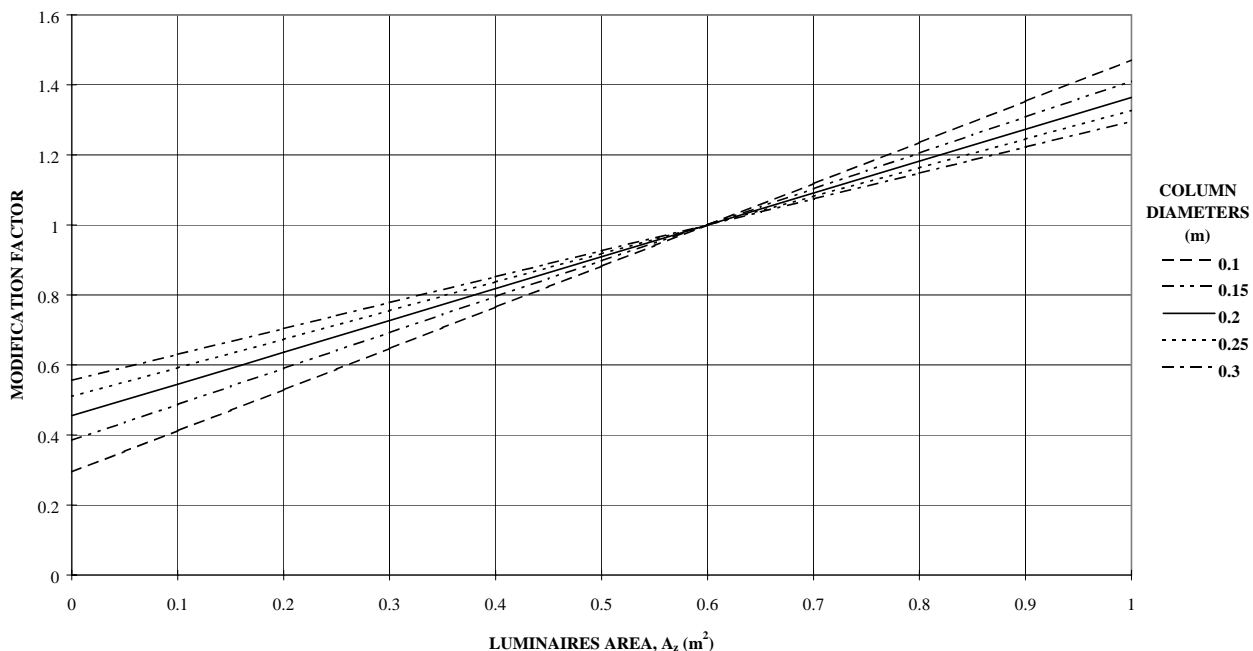
Figures A2.1, A2.2, A2.3, A2.4 and A2.5 are based on the following:

- Circular section with a drag coefficient of 1.2.
- Modification Factors are the same for all wind zones and soil types.
- Minimum column strengths obtained from the corresponding charts are to be multiplied by the above factors as applicable.

Table A2.2 : Luminaires Area Modification Factors for Minimum Column Strengths

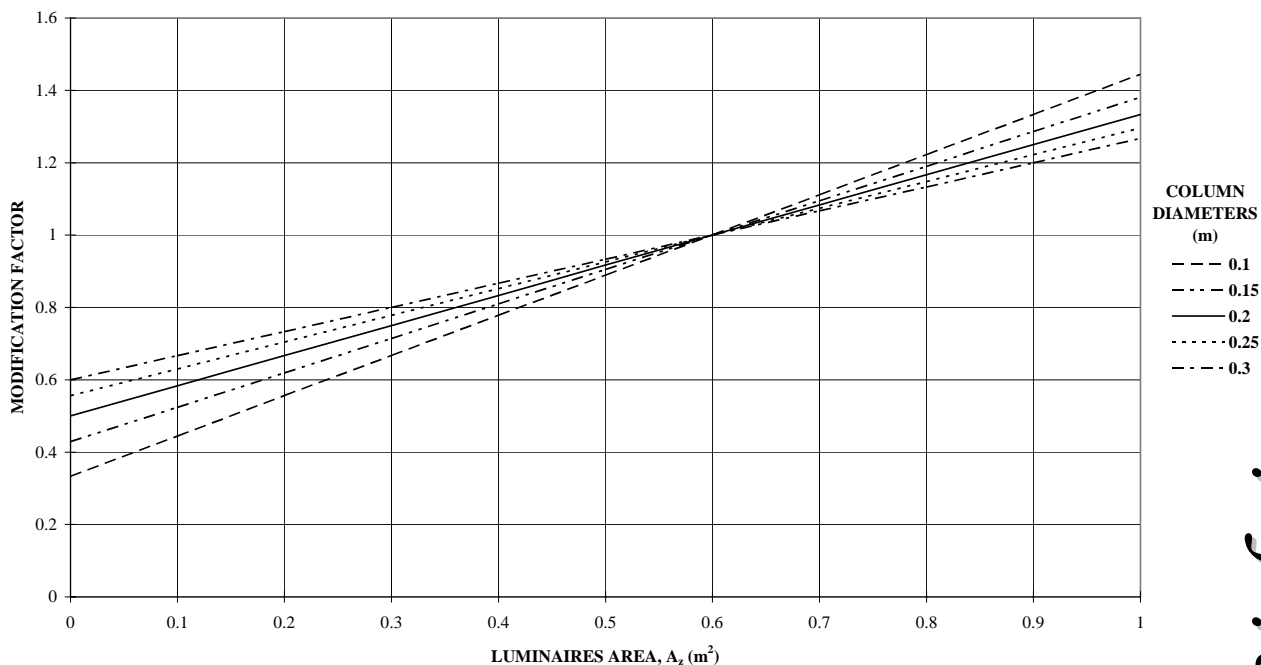
COLUMN HEIGHT (m)	COLUMN DIAMETER (m)	LUMINAIRES AREAS, A_L (m ²)										
		0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
6.5	0.1	0.294	0.412	0.529	0.647	0.765	0.882	1	1.118	1.235	1.353	1.471
	0.15	0.385	0.487	0.59	0.692	0.795	0.897	1	1.103	1.205	1.308	1.41
	0.2	0.455	0.545	0.636	0.727	0.818	0.909	1	1.091	1.182	1.273	1.364
	0.25	0.51	0.592	0.673	0.755	0.837	0.918	1	1.082	1.163	1.245	1.327
	0.3	0.556	0.63	0.704	0.778	0.852	0.926	1	1.074	1.148	1.222	1.296
7.5	0.1	0.385	0.487	0.59	0.692	0.795	0.897	1	1.103	1.205	1.308	1.41
	0.15	0.484	0.57	0.656	0.742	0.828	0.914	1	1.086	1.172	1.258	1.344
	0.2	0.556	0.63	0.704	0.778	0.852	0.926	1	1.074	1.148	1.222	1.296
	0.25	0.61	0.675	0.74	0.805	0.87	0.935	1	1.065	1.13	1.195	1.26
	0.3	0.652	0.71	0.768	0.826	0.884	0.942	1	1.058	1.116	1.174	1.232
8.5	0.1	0.415	0.512	0.61	0.707	0.805	0.902	1	1.098	1.195	1.293	1.39
	0.15	0.515	0.596	0.677	0.758	0.838	0.919	1	1.081	1.162	1.242	1.323
	0.2	0.586	0.655	0.724	0.793	0.862	0.931	1	1.069	1.138	1.207	1.276
	0.25	0.639	0.699	0.759	0.82	0.88	0.94	1	1.06	1.12	1.18	1.241
	0.3	0.68	0.733	0.787	0.84	0.893	0.947	1	1.053	1.107	1.16	1.213
10	0.1	0.455	0.545	0.636	0.727	0.818	0.909	1	1.091	1.182	1.273	1.364
	0.15	0.556	0.63	0.704	0.778	0.852	0.926	1	1.074	1.148	1.222	1.296
	0.2	0.625	0.688	0.75	0.813	0.875	0.938	1	1.063	1.125	1.188	1.25
	0.25	0.676	0.73	0.784	0.838	0.892	0.946	1	1.054	1.108	1.162	1.216
	0.3	0.714	0.762	0.81	0.857	0.905	0.952	1	1.048	1.095	1.143	1.19
12	0.1	0.5	0.583	0.667	0.75	0.833	0.917	1	1.083	1.167	1.25	1.333
	0.15	0.6	0.667	0.733	0.8	0.867	0.933	1	1.067	1.133	1.2	1.267
	0.2	0.667	0.722	0.778	0.833	0.889	0.944	1	1.056	1.111	1.167	1.222
	0.25	0.714	0.762	0.81	0.857	0.905	0.952	1	1.048	1.095	1.143	1.19
	0.3	0.75	0.792	0.833	0.875	0.917	0.958	1	1.042	1.083	1.125	1.167

FIGURE A2.1: LUMINAIRES AREA MODIFICATION FACTORS FOR COLUMN STRENGTHS - 6.5m HIGH COLUMNS



NB: Modification Factors are based on a circular section, a drag coefficient factor needs to be applied to other section shapes as well as the above factor. Luminaires Area Modification Factors apply for all wind zones.

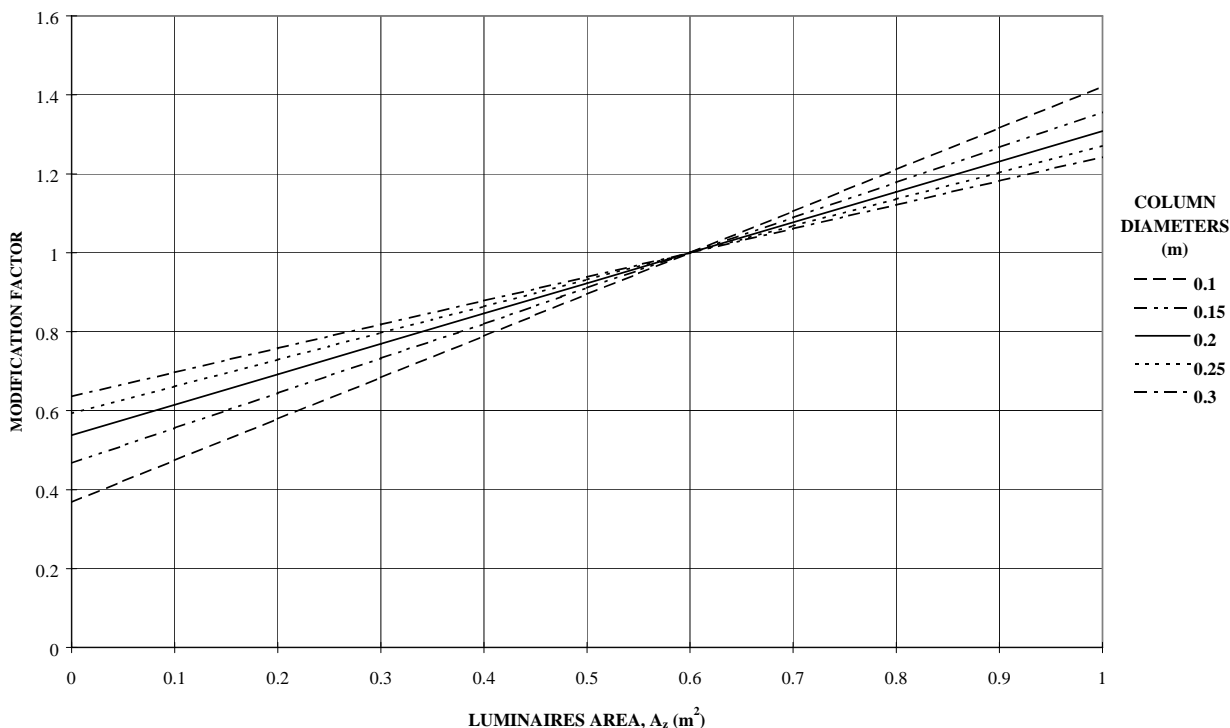
FIGURE A2.2: LUMINAIRES AREA MODIFICATION FACTORS FOR COLUMN STRENGTHS - 7.5m HIGH COLUMNS



NB: Modification Factors are based on a circular section, a drag coefficient factor needs to be applied to other section shapes as well as the area factor. Luminaires Area Modification Factors apply for all wind zones.

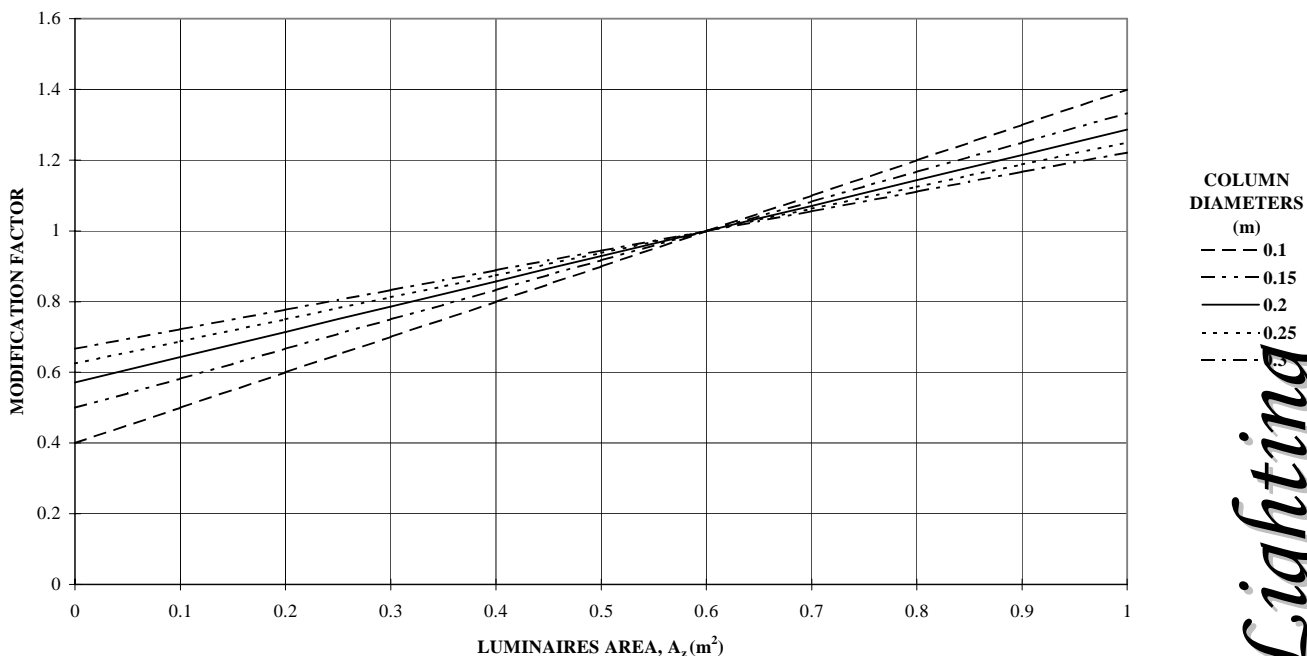
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FIGURE A2.3: LUMINAIRES AREA MODIFICATION FACTORS FOR COLUMN STRENGTHS - 8.5m HIGH COLUMNS



NB: Modification Factors are based on a circular section, a drag coefficient factor needs to be applied to other section shapes as well as the above factor. Luminaires Area Modification Factors apply for all wind zones.

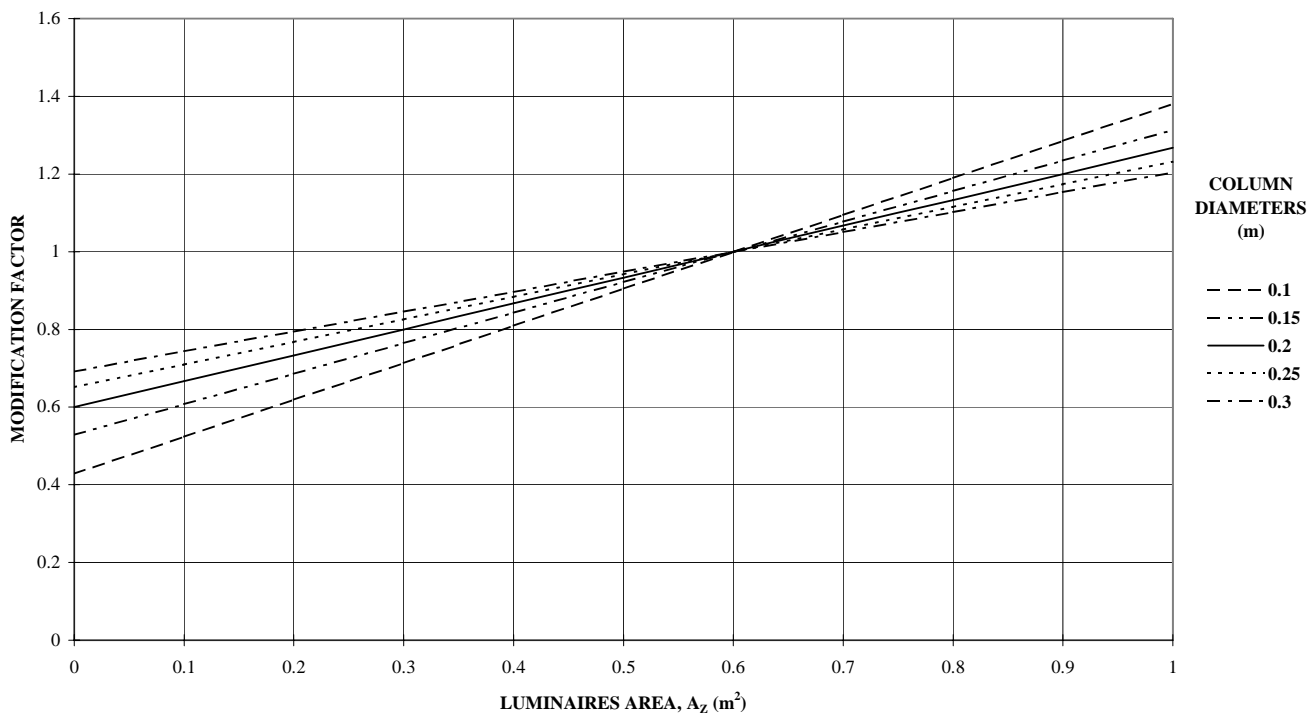
FIGURE A2.4: LUMINAIRES AREA MODIFICATION FACTORS FOR COLUMN STRENGTHS - 10m HIGH COLUMNS



NB: Modification Factors are based on a circular section, a drag coefficient factor needs to be applied to other section shapes as well as the area factor. Luminaires Area Modification Factors apply to all wind zones.

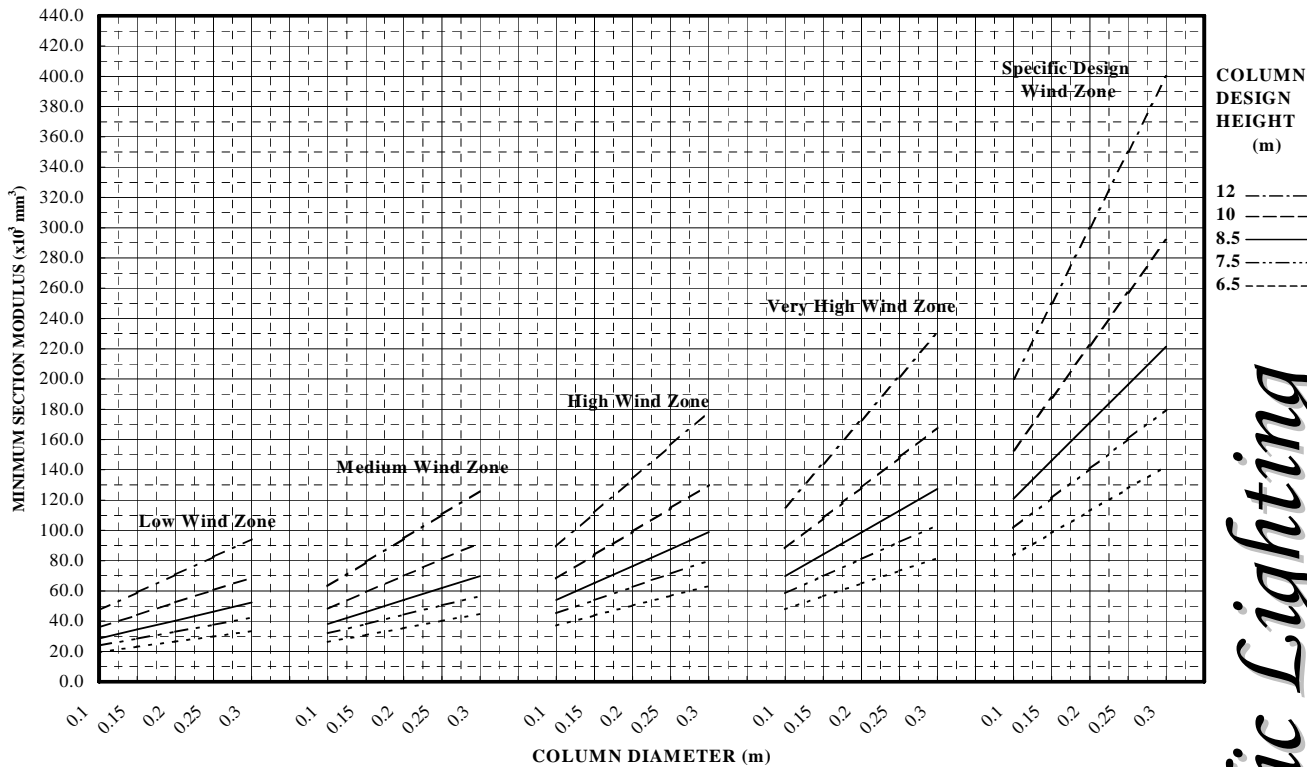
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FIGURE A2.5: LUMINAIRE AREA MODIFICATION FACTORS FOR COLUMN STRENGTHS - 12m HIGH COLUMNS



NB: Modification Factors are based on a circular section, a drag coefficient needs to be applied to other section shapes as well as the area factor. Luminaire Area Modification Factors apply to all wind zones.

FIGURE A2.6: Minimum Section Modulus for G250 CIRCULAR STEEL SECTIONS



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FIGURE A2.7: Minimum Lighting Column Strength for G350 CIRCULAR STEEL SECTIONS

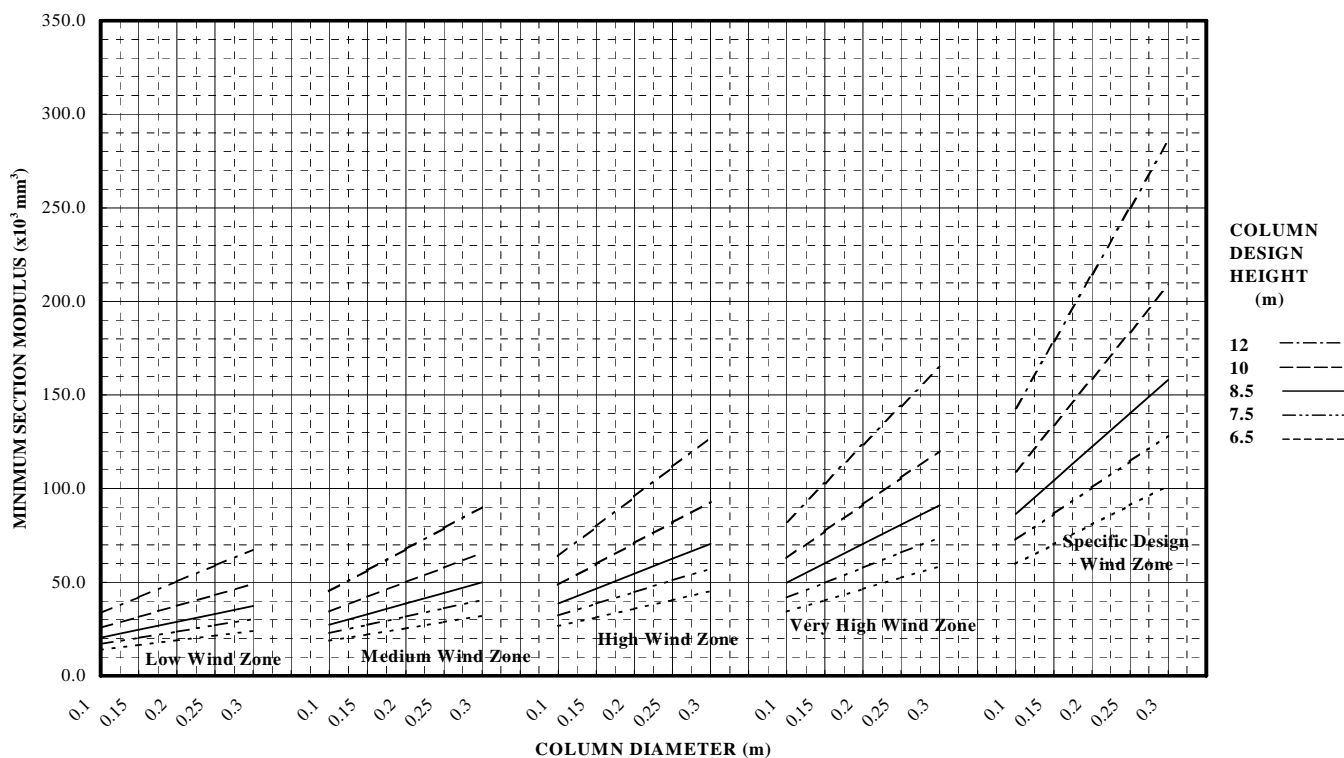
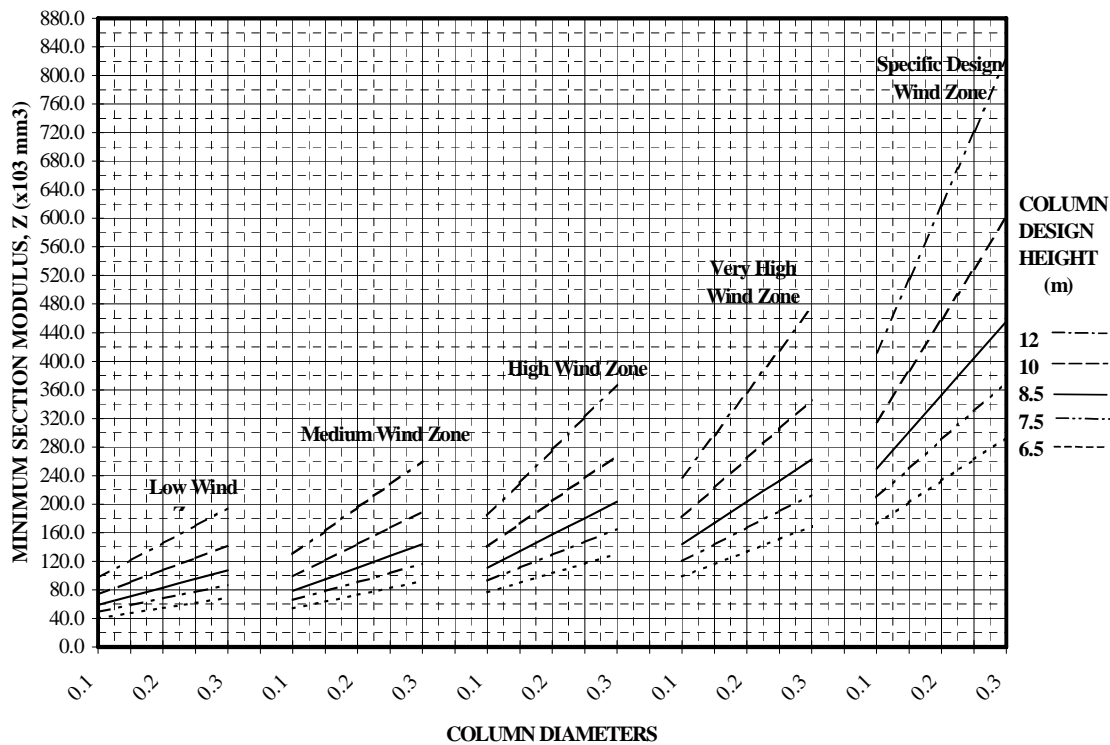


FIGURE A2.8: Minimum Section Modulus, Z, for 6061-T5 ALUMINIUM SECTIONS



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Appendix B

Calculating Foundation Requirements

11. APPENDIX B – CALCULATING FOUNDATION REQUIREMENTS

Embedment

Soil types as per table B.1 are based on the following qualitative assessment in the field:

Table B.1: Soil Type Classification

	Soil Type	Description	S_u (kPa)*
1	Topsoil	Friable containing organic matter	20
2	Soft Clays	Readily squeezed through fingers	35
3	Medium Clays	Can be deformed with some effort	50
4	Hard Clays, Tuff, Rock	Difficult to deform by hand	75

Note:

- S_u is the assumed undrained shear strength used in embedment calculations.
- Soil testing may be required if any doubt exists as to the correct category to be used.
- *Embedment depths are to be taken from the top to the bottom of the concrete pile.
- Pile diameters are assumed to be the street light column diameter plus 100mm minimum. Larger diameters may utilise smaller embedments.
- Minimum concrete strength for piles is to be 17.5 MPa @ 28 days.
- Cover to unprotected steel to be not less than 75mm.

MODIFICATION FACTORS FOR EMBEDMENT DEPTHS

a) Shape Modification Factors for Embedment Depths

Table B.2: Drag Coefficient Modification Factors for EMBEDMENT DEPTHS

Section Shape	Modification Factor
Circular	1.00
Square	1.18
Octagonal	1.09
12 Sided Polygon	1.05

Table B.2 is based on the following:

- Drag coefficients for circular sections of 1.2, square sections of 1.6, Octagon sections of 1.4, and 12 sided polygons of 1.3.
- Modification Factors are the same for all wind zones and soil types.
- Embedment depths obtained from the corresponding charts are to be multiplied by the above factors as applicable.

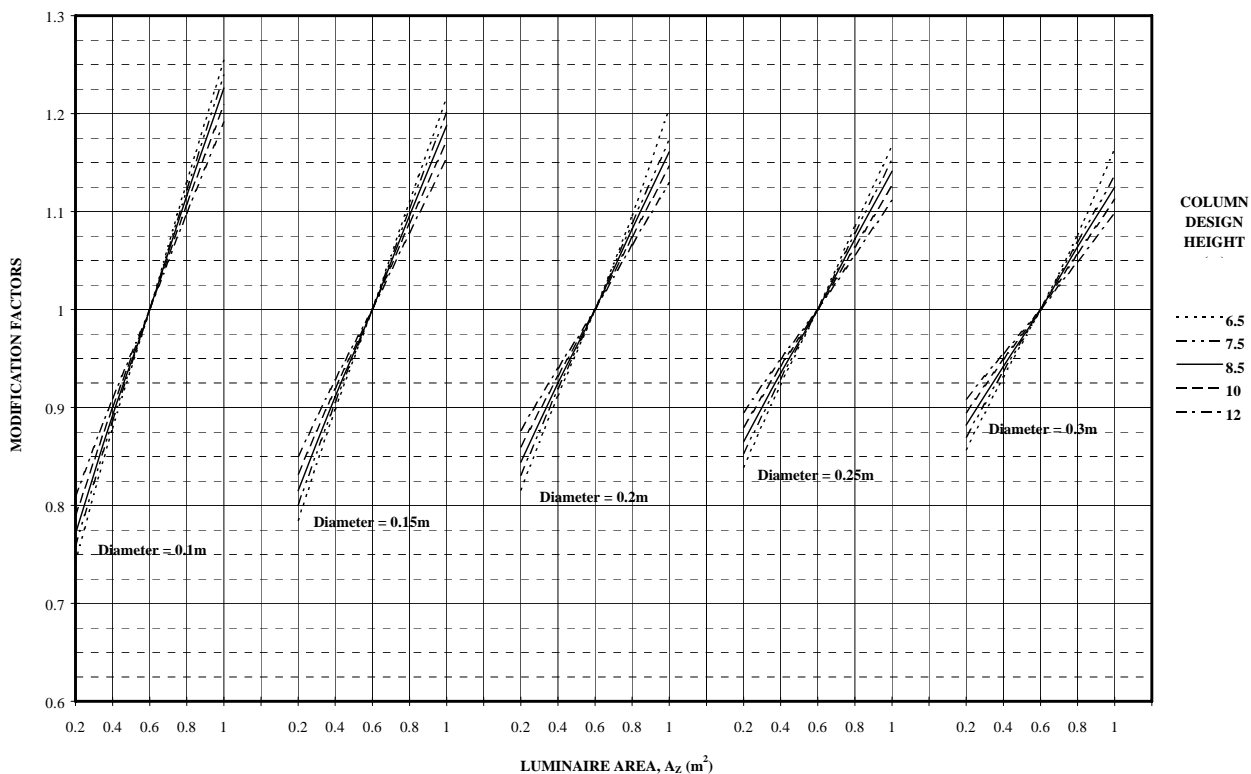
b) Luminaires Area Modification Factors for EMBEDMENT DEPTHS

Figure B1.1 shall be used to obtain a modification factor for varying frontal areas.

Figure B1.1 is based on a circular section with a drag coefficient of 1.2

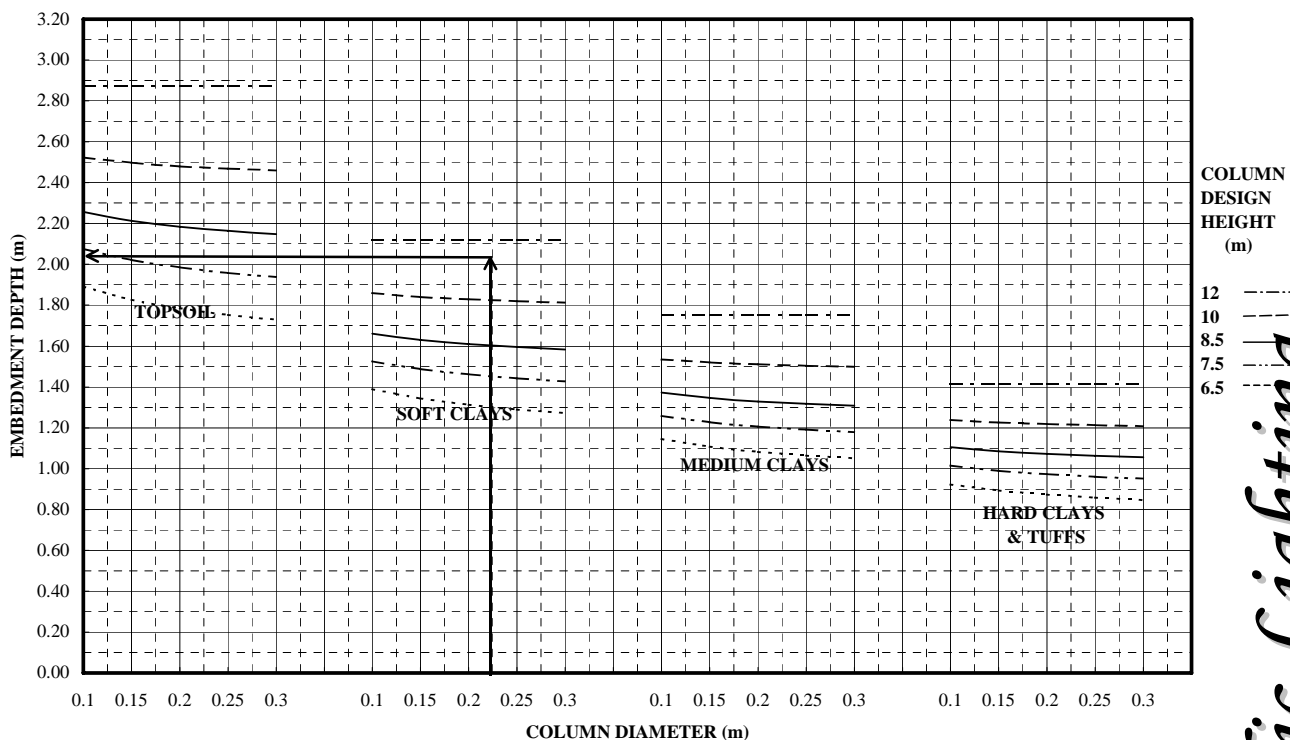
Modification Factors apply for all wind zones.

FIGURE B1.1: LUMINAIRE AREA MODIFICATION FACTORS FOR COLUMN EMBEDMENT DEPTHS



NB: Modification Factors are based on a circular section, a shape factor needs to be applied for other section shapes.
Luminaires Area Modification Factors apply to all wind zones.

FIGURE B1.2: Embedment Depths of Columns for LOW WIND ZONES



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FIGURE B1.3: Embedment Depths of Columns for MEDIUM WIND ZONE

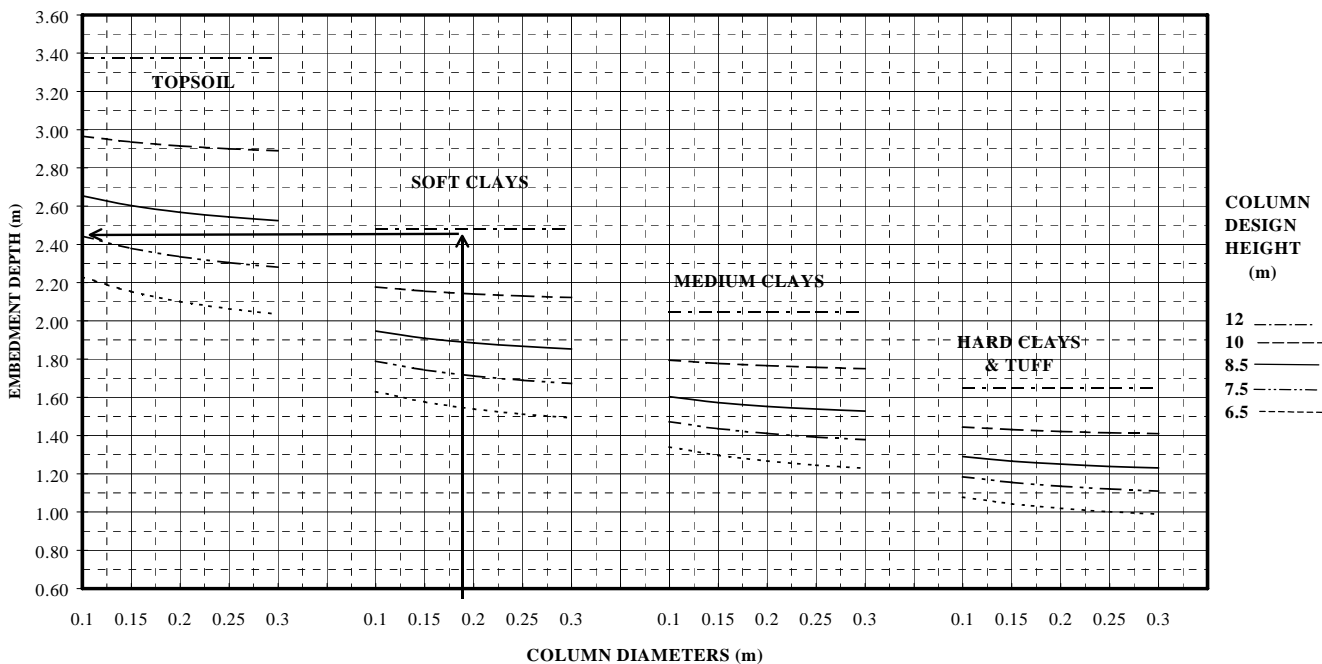
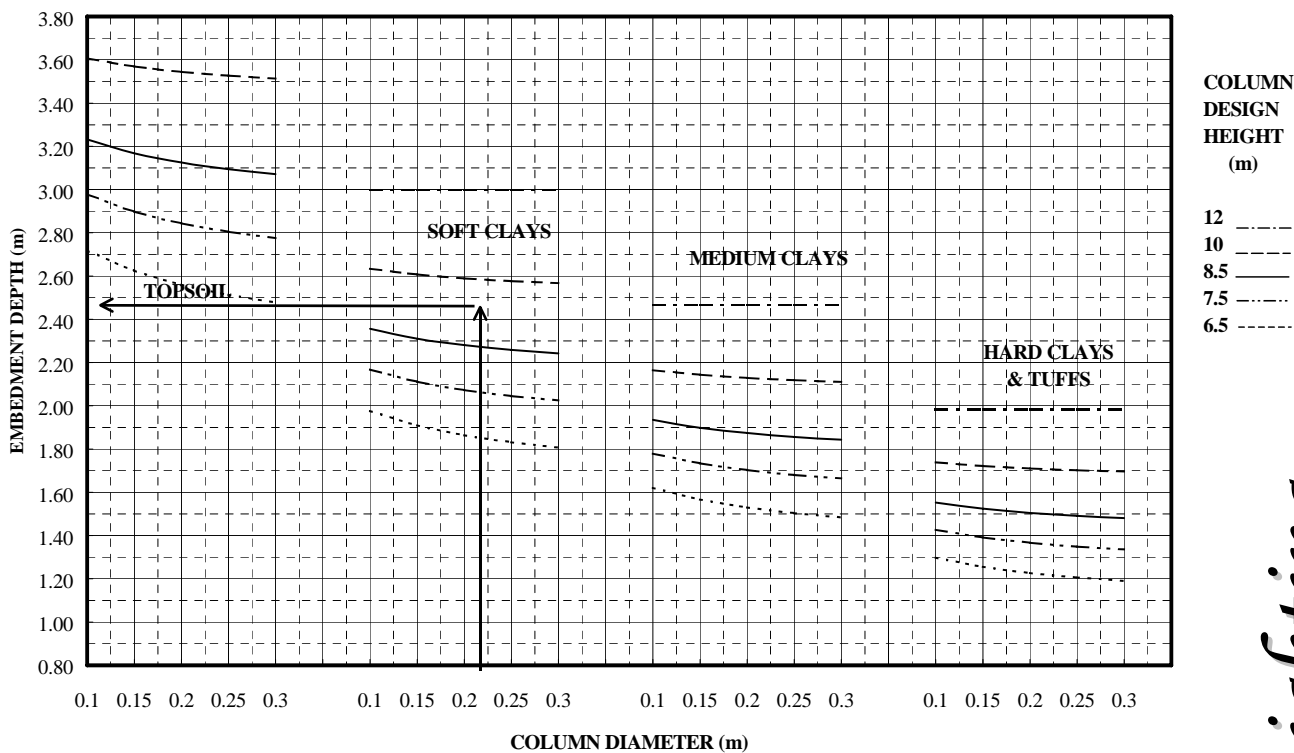


FIGURE B1.4: Embedment Depths of Columns for HIGH Wind Zones



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FIGURE B1.5: Embedment Depth of Columns for VERY HIGH WIND ZONE

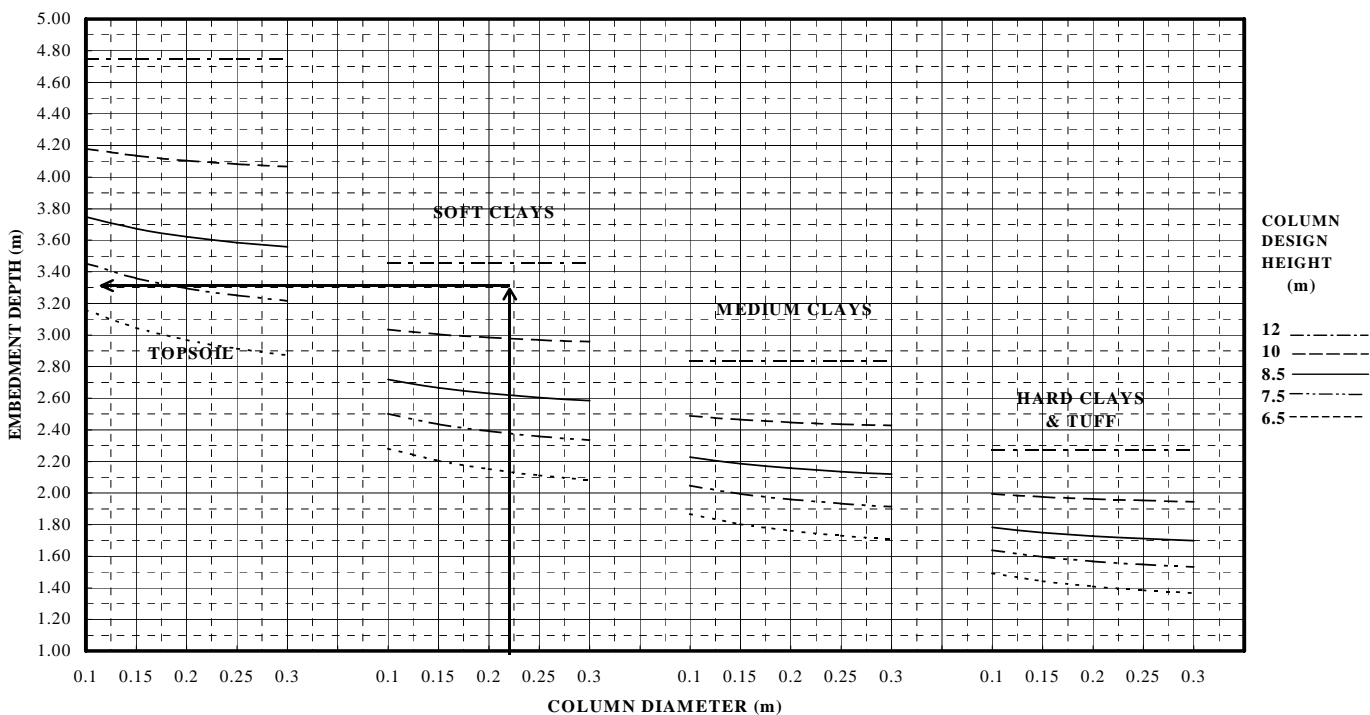
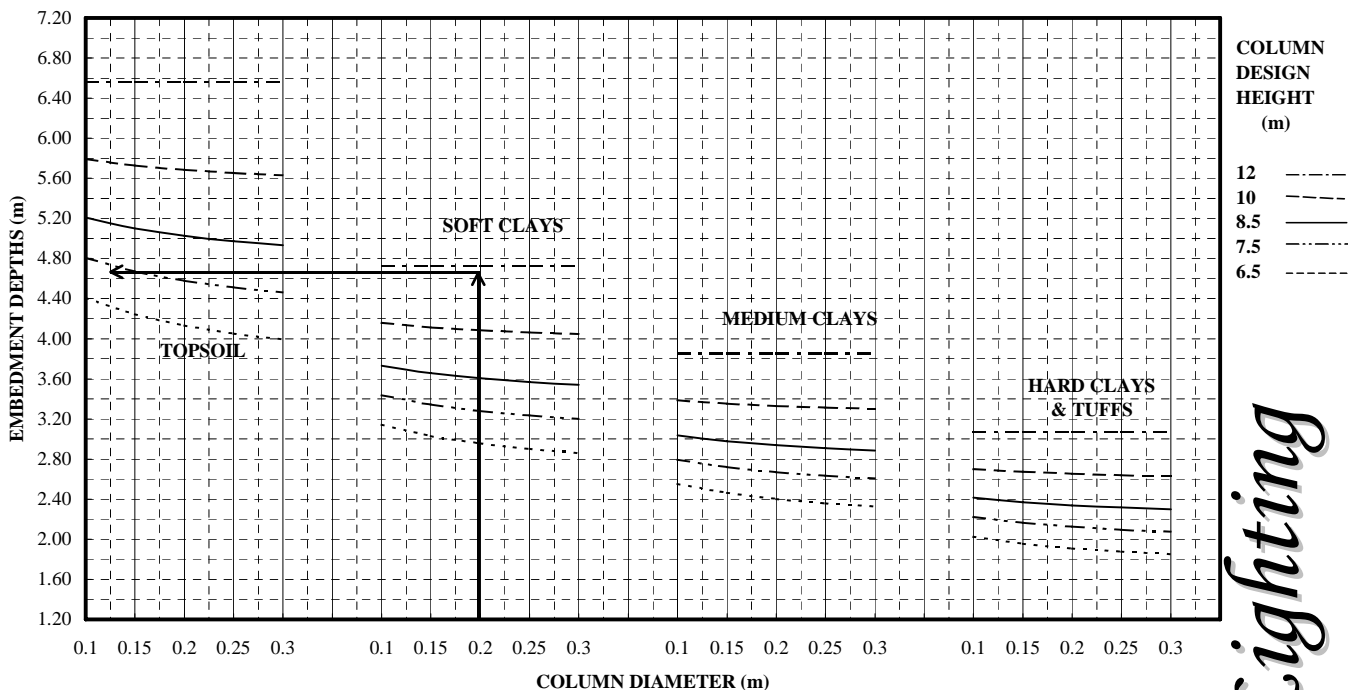


FIGURE B1.6: Embedment Depths of Columns for SPECIFIC DESIGN WIND ZONES



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Appendix C

Dynamic Response Spreadsheets

12. APPENDIX C – DYNAMIC RESPONSE SPREADSHEETS

Torsional and translational period calculations:

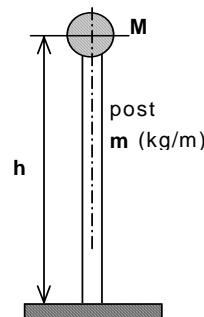
a) Translational: Lumped mass on top of uniform mass post

$$\text{Translational Period, } T_t = (2 \pi / 1.732) \sqrt{(M h^3 + 0.236 m h^4) / (E I)}$$

M =	118.9	lumped mass (kg)
m =	1.0	uniform mass per m of post (kg/m)
h =	6.0	height to lumped mass (m)
E =	200.0	modulus of elasticity (GPa)
I =	171.00	bending inertia of post (x10 ⁴ mm ⁴)
post =	100NB x 3.18 API line pipe	

⇒ Translational Period, $T_t = 1.00$ second

Note: Lumped mass includes all fixtures and top half of post mass.



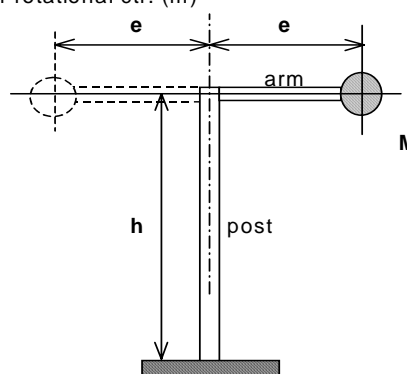
b) Torsional: Lumped mass(es) eccentric to top of post

$$\text{Torsional Period, } T_t = 2 \pi \sqrt{M ((h e^2) / (I_p G) + e^3 / (3 E I))}$$

M =	29.9	total lumped mass (kg)
e =	1.0	eccentricity of lumped mass(es) from rotational ctr. (m)
h =	5.0	height to lumped mass (m)
E =	200.0	modulus of elasticity of arm (GPa)
G =	80.0	shear modulus of post (GPa)
I_p =	3.45	polar inertia of post = J (x10 ⁶ mm ⁴)
I =	16.33	bending inertia of arm (x10 ⁴ mm ⁴)
post =	100NB x 3.18 API line pipe	
arm =	40 NB light PE BS 1387	

⇒ Torsional Period, $T_t = 1.00$ second

Note: Lumped mass includes all fixtures and arms (both sides if applicable) but ignores post mass.



Appendix D

List of Approved Coating Systems

13. APPENDIX D – LIST OF APPROVED COATING SYSTEMS

The following list contains coating systems approved for use by Waitakere City Council for painting lighting columns, enclosures and luminaires. The list is current as at the date indicated in the footer of this document but is subject to change at the total discretion of the Waitakere City Council.

If further systems are submitted in the future and deemed satisfactory then Waitakere City Council may choose to include them on this list.

Similarly, if Waitakere City Council considers that a previously approved system is no longer satisfactory, then Waitakere City Council may choose to remove them from this list.

Manufacturer	Reference
• Azko Nobel Coatings	• Specifications dated 19/07/00.
• Altex	• Specifications dated 06/05/00.
• Ameron	• Specifications dated 05/05/00.
• Dulux	• Specifications dated 19/11/00.
• Resene	• Specifications dated 03/99

Appendix E

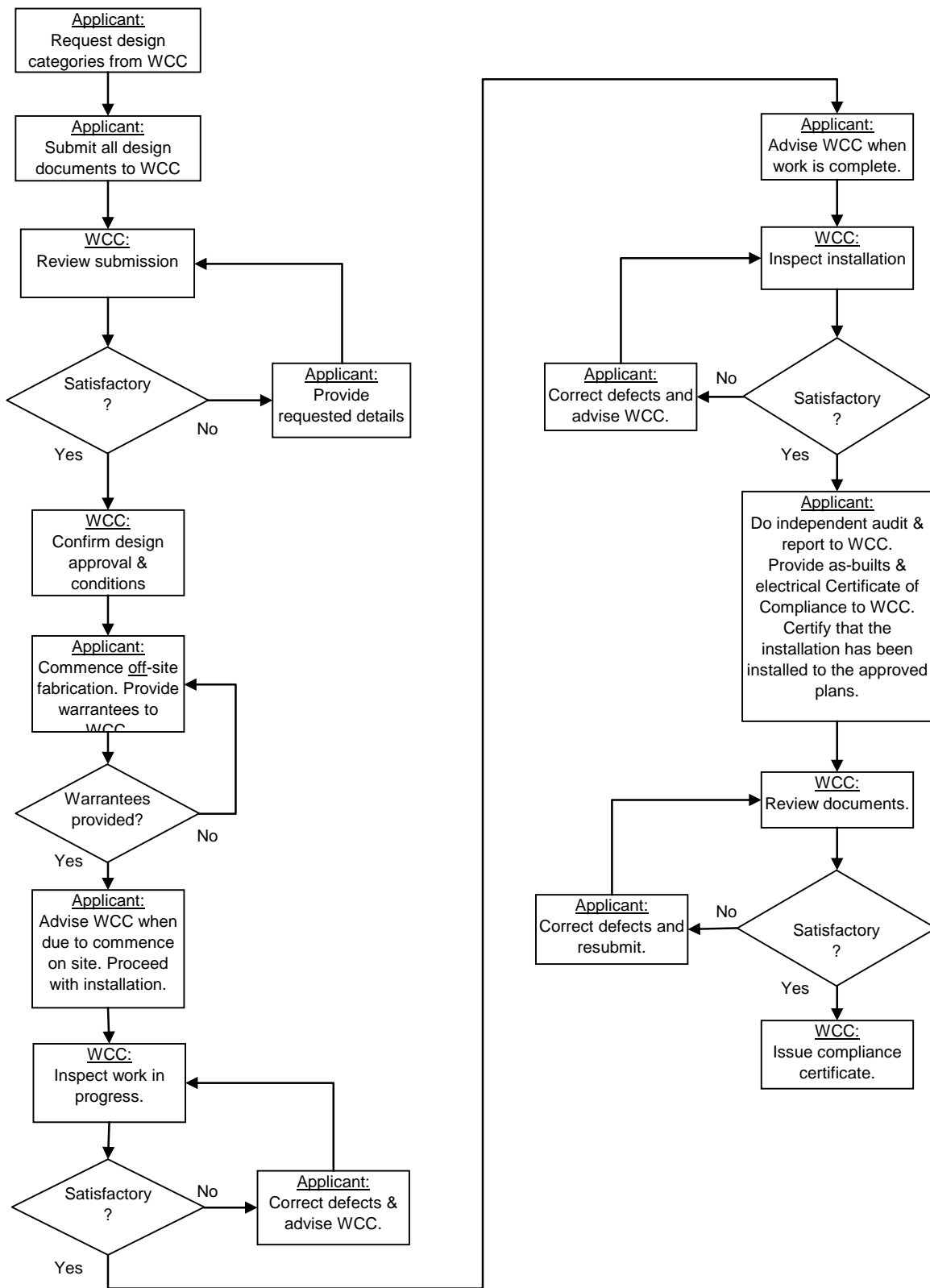
Approval Process

14. APPENDIX E – APPROVAL PROCESS

This Appendix contains a flow chart outlining the procedures applicable to the consent process for lighting designs, as well as the forms required to be completed and submitted with the application.

E.1 FLOW CHART

A flowchart outlining the approval process follows on the next page.



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E.2 Forms

All Review Forms and the Application Checklist shall be completed and attached with each submission. Use a separate Review Form for each section of road if required. Where the installation is other than a road, provide equivalent details to establish compliance with AS/NZS1158 or AS 2560 as applicable.

APPLICATION CHECKLIST

The following items have been included with this submission:

Tick here:

1. A covering letter identifying the project, listing the enclosures and providing full contact details (contact name, company, phone, fax & e-mail).
2. A site plan showing:
 - the proposed locations of all columns included in the project.
 - the Mounting height, Overhang, and Upcast angle of each luminaire.
 - the existing columns & luminaires affecting or contributing to the proposed system clearly marked as existing.
3. Isolux diagrams to the extent required by AS/NZS1158.
4. Copies of photometric test reports for the proposed luminaires, from an accredited testing laboratory in hard copy are available (supply if requested).
5. Copies of reports generated by the Computer Design program declared on the Lighting Review Forms showing relevant luminance and illuminance information.
6. Certification confirming that the Embedment Depth, Base Moment, Column Strength and Dynamic Response complies with the requirements of the Structural section (Appendices A, B & C) of the WCC Public Lighting Manual.
7. The following details are available on request:
 - installation instructions for the luminaire (and column combination where applicable) including handling, transport and storage instructions.
 - maintenance instructions for the luminaire (and column combination where applicable) e.g. instruction and anatomy of the lantern for the purpose of maintenance and replacement.
8. A recommended maintenance schedule (Cleaning, lamp replacement, etc) is available (supply if requested).
9. A detailed written warranty, minimum 10 years for the luminaire (and column combination where applicable) (excluding the lamp or control gear), stating:
 - the extent and any conditions of the warranty.
 - the remedial action proposed in the event of a claim.
10. A copy of the coating applicator's certification that the galvanising and / or paint has been applied in accordance with the coating manufacturer's specifications.

NOTE:

- The information required herein shall be provided to enable completion of the review. Failure to provide the required information in full may result in a delay in processing the review.
- If in doubt about what is required for any of the above, please contact Waitakere City Council.

SUB-DIVISION STREETLIGHTING REVIEW FORM – CATEGORY V ROADS

	<i>Please enter the required information below:</i>
Names and Lighting Categories (e.g. V1 - V4) of roads / areas involved	
Name of the WCC person who supplied/approved the categories of the roads / areas involved	
Luminaire details Manufacturer and product name Lamp type and rating Luminous flux (Note 1) Origin of the photometric data	
Computer Design assumptions Name and source of the computer program Road surface reflectance used Maintenance factor used	
Design result – for straight or curved roads Min. average carriageway luminance (cd/m ²) Min. overall luminance uniformity [min/ave] Min. longitudinal luminance uniformity [min/max] Max. threshold increment (%) Min. surround illuminance ratio Max. upward waste light ratio (%)	
Design result – for intersections, junctions, and other specified locations (Isolux plots shall be provided) Min. illuminance (lux) Max. illuminance uniformity [max/ave]	

NOTE:

1. Use standard lamp lumens regardless of whether a higher output lamp is proposed. eg. for 150 Watt HPS use 14500 lumens not 16500. This is to align with anticipated maintenance practices.

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PUBLIC LIGHTING REVIEW FORM – CATEGORY P AREAS

	<i>Please enter the required information below:</i>
Names and Lighting Categories (e.g. P1 – P12) of roads / areas involved	
Name of the WCC person who supplied/approved the categories of the roads / areas involved	
Luminaire details Manufacturer and product name Lamp type and rating Luminous flux (Note 1) Origin of the photometric data	
Computer Design assumptions Name and source of the computer program Road surface reflectance used Maintenance factor used	
Design result – for roads or other areas Ave. horizontal illuminance (lux) Min. horizontal illuminance (lux) Horizontal illuminance uniformity [max/ave] Vertical illuminance (lux) Luminaire Classification (Type) [AS/NZS 1158:3.1 – Table 2.5]	
Design result – for pedestrian refuges & traffic management devices (Isolux plots shall be provided) Min. illuminance (lux)	

NOTE:

1. Use standard lamp lumens regardless of whether a higher output lamp is proposed. eg. for 150 Watt HPS use 14500 lumens not 16500. This is to align with anticipated maintenance practices.
2. Provide separate details covering these aspects for more complex areas.

15. APPENDIX F – STANDARD EQUIPMENT DRAWINGS

Comply with the following standard drawings as applicable:

- Typical Outdoor Switchboard Metered Supply – Drawing SDE 101
- Typical Trench Section – Drawing SDE 201
- Typical Schematic Public Road Lighting Unmetered Supply – Drawing SDE 301
- Typical Schematic Public Amenity Lighting & Power Metered Supply – Drawing SDE 302
- Typical Schematic Sports Lighting Metered Supply – Drawing SDE 303
- Typical Cabling Public Road Lighting Unmetered Supply – Drawing SDE 401
- Typical Cabling Amenity Lighting Metered Supply – Drawing SDE 402
- Typical Column Public Road Lighting - Drawing SDE 501
- Typical Column Amenity Lighting – Drawing SDE 502
- Typical Column Sports lighting – Drawing SDE 503
- Typical Column Town Centres – Drawings LP 1.01, LP 1.02, LP 1.03 by Wraight Athfield Landscape Architects.