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02.16.2023

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
OFFICE OF THE SECRETARY
Manila

FEB 15 2023

DEPARTMENT ORDER)
)
NO. 19)
Series of 2023)
dt 2/16/2023

SUBJECT: Guidelines and Standard Design Drawings for Solar-Powered Roadway Lighting Along National Roads

In line with the continuing efforts to improve the quality of technology for more effective and expeditious implementation of infrastructure projects, and in the interest of efficient public service, this Department has approved the use of solar-powered roadway lighting along national roads. Guidelines and standard drawings for the aforementioned lighting are now available for reference.

The solar-powered roadway lighting has the advantages of stability, long service life, simple installation, safety, great performance, and energy conservation, making it ideal for use along new or existing roads. Said guidelines and standard drawings shall serve as references for DPWH Regional Offices, District Engineering Offices, Unified Project Management Office Clusters, and DPWH Consultants in the preparation of design plans.

The above-mentioned plan can be downloaded from the DPWH Bureau of Design Intranet under Standard Plans (http://dpwhweb/bureau-service/bod/plans/engineering.asp).

For reference and compliance.

MANUEL M. BONOAN
Secretary

Department of Public Works and Highways
Office of the Secretary
WIN3R01580

5.1 DLB/ECM

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
BONIFACIO DRIVE, PORT AREA, MANILA

GUIDELINES AND STANDARD DESIGN DRAWINGS FOR SOLAR-POWERED ROADWAY LIGHTING

SUBMITTED:

ROMEO C. RAAGAS
CHIEF, HIGHWAYS DIVISION
BUREAU OF DESIGN

DATE: 2/6/23

RECOMMENDING APPROVAL:

EDWIN C. MATANGUIHAN
OIC - DIRECTOR
BUREAU OF DESIGN

DATE: FEB 0 6 2023

ERIC A. AYAPANA
ASSISTANT SECRETARY FOR
INFORMATION MANAGEMENT AND
TECHNICAL SEVICES

DATE:

APPROVED:

MAXIMO L. CARVAJAL
UNDERSECRETARY FOR
INFORMATION MANAGEMENT AND
TECHNICAL SEVICES

DATE:

INDEX OF DRAWINGS

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
HIGHWAYS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET TITLE:	GUIDELINES AND STANDARD DESIGN DRAWINGS FOR SOLAR-POWERED ROADWAY LIGHTING
SHEET CONTENTS:	INDEX OF DRAWINGS
PREPARED BY:	JERICO D. SALVADOR, ENGINEER II (IEB)
DRAWN BY:	HONEE KIMBERLY S. GUMPAYA, DRAFTSMAN I
REVIEWED BY:	JONATHAN A. SANTIAGO, OIC-ENGINEER IV, SECTION CHIEF
SUBMITTED:	ROMEO C. RAAGAS, CHIEF - HIGHWAYS DIVISION, B.O.D., DATE
RECOMMENDING APPROVAL:	EDWIN C. MATANGUIHAN, O.I.C. - DIRECTOR, BUREAU OF DESIGN, DATE FEB 06 2023
	(SEE COVER SHEET) ERIC A. AYAPANA, ASSISTANT SECRETARY FOR INFORMATION MANAGEMENT AND TECHNICAL SERVICES, DATE
APPROVED:	(SEE COVER SHEET) MAXIMO L. CARVAJAL, UNDERSECRETARY FOR INFORMATION MANAGEMENT AND TECHNICAL SERVICES, DATE
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GENERAL NOTES AND GUIDELINES

GENERAL NOTES

1. ALL ELECTRICAL WORKS SHALL BE DONE IN ACCORDANCE WITH THE PROVISION OF THE LATEST EDITION OF THE PHILIPPINE ELECTRICAL CODE PART I AND II. THE LAWS AND ORDINANCES OF THE LOCAL CODE ENFORCING AUTHORITIES AND THE REQUIREMENTS OF THE LOCAL POWER COMPANY.

2. THE ELECTRICAL WORK SHALL BE DONE UNDER THE DIRECT AND IMMEDIATE SUPERVISION OF A DULY REGISTERED ELECTRICAL ENGINEER.

3. PERFORMANCE OF THE ROAD LIGHT SUCH AS ILLUMINANCE LEVEL SHALL COMPLY WITH THE REQUIREMENTS OF THE SPECIFICATION.

4. THE ELECTRICAL CONTRACTOR SHALL SECURE ALL PERMITS AND PAY ALL FEES REQUIRED FOR THE WORK AND FURNISH THE OWNER THROUGH THE ENGINEERS FINAL CERTIFICATE OF ELECTRICAL INSPECTION AND APPROVAL FROM PROPER GOVERNMENT AUTHORITIES FOR COMPLETE WORK.

5. THE ELECTRICAL MATERIALS TO BE USED AND EQUIPMENT TO BE INSTALLED SHALL BE BRAND NEW AND SHALL BE OF THE APPROVED TYPES FOR THE PARTICULAR LOCATION AND PURPOSE INTENDED.

6. ALL ROAD LIGHTS AND WARNING LIGHTS SHALL BE POWERED FROM SOLAR PHOTOVOLTAIC (PV) SYSTEM WITH STORAGE BATTERY.

7. ALL BOXES SHALL BE OF STEEL AND ZINC CHROMATED PROTECTED.

8. ALL UNDERGROUND CONDUIT PIPES AND CONDUIT RUN EMBEDDED IN CONCRETE SHALL BE UNPLASTICIZED POLYVINYL CHLORIDE CONDUIT (uPVC).

9. UNDERGROUND CONDUIT RUNS SHALL BE BURIED AT A MINIMUM OF 600mm BELOW GROUND LEVEL CONDUIT RUN CROSSING STREET SHALL BE ENCASED IN CONCRETE WITH STEEL BAR REINFORCED, 2500 psi CONCRETE WITH MINIMUM 75mm (3 INCHES) COVER ALL AROUND.

10. UNPROTECTED CONDUIT RISERS AND EXPOSED CONDUIT RUNS SHALL BE INTERMEDIATE METAL CONDUITS. (IMC)

11. ALL STREET LUMINAIRE ASSEMBLY INCLUDES LED LUMINAIRE, PV POWER SUPPLY EQUIPMENT, CONTROL AND BATTERY PANEL, AND FOUNDATION SHALL WITHSTAND UP TO 340KPH PER HOUR GUSTING WINDS WITHOUT PERMANENT DEFORMATION.

12. ALL SPARE PIPES INCLUDING PULL BOXES EMBEDDED IN THE STRUCTURE WALL SHOWN ON THE STRUCTURE DRAWINGS WILL BE USED AS CONDUIT. IN CASE THAT THE ROAD LIGHT IS POWERED FROM ELECTRIC UTILITY COMPANY (EC) IN FUTURE OR EMERGENCY, THE SPARE PIPES, PULL WIRE AND PULL BOXES SHALL BE INSTALLED BY THE ELECTRICAL WORKS.

13. FOR EXISTING CABLE RUNS WHICH WILL BE REPLACED BEFORE REMOVING THE CABLE SHALL BE TESTED IF FREE FROM GROUND AND CAN STILL BE RE-USED. IF FOUND GROUNDED, THESE CABLES SHALL BE REMOVED AND TURN-OVER TO THE CLIENT.

DESIGN GUIDELINES FOR ROADWAY LIGHTING

SECTION 1 OBJECTIVE

THESE GUIDELINES SET OUT FACTORS THAT NEED TO BE TAKEN INTO ACCOUNT IN DESIGNING ROADWAY LIGHTING SOLAR-POWERED SYSTEMS USED TO ILLUMINATE ROADWAYS SUCH AS PRIMARY, SECONDARY, AND TERTIARY ROADS AS WELL AS ROADS THAT IS MODIFIED, EXTENDED, EXPANDED, OR ADDED TO EXISTING ROADWAY INSTALLATIONS.

SECTION 2 MINIMUM TECHNICAL REQUIREMENTS

SECTION 2.1 ELECTRICAL SYSTEM (SOLAR-POWERED)

1. THE ILLUMINATION SHALL BE UNIFORM WITHOUT DARK BANDS OR ABRUPT VARIATIONS, AND SHOULD BE SOOTHING TO THE EYE. THE LIGHT OUTPUT FROM THE WHITE LIGHT-EMITTING DIODE (LED) LIGHT SOURCE SHOULD BE ALMOST CONSTANT AND HIGHER LIGHT OUTPUT WILL BE PREFERRED. THE ACCEPTABLE LEVELS OF LUMINANCE SHALL BE ACHIEVED UNDER NORMAL OPERATIONS.

2. COLOR TEMPERATURE FOR LED CAN VARY BETWEEN "WARM WHITE" AND "WARM YELLOW" THE USE OF LEDS WHICH EMITS ULTRAVIOLET LIGHT SHALL NOT BE PERMITTED.

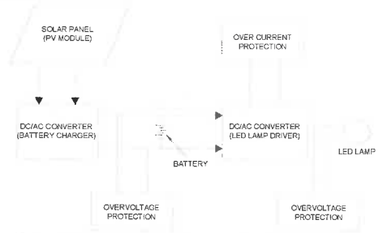
3. THE LAMPS SHALL BE HOUSED IN AN ASSEMBLY SUITABLE FOR OUTDOOR USE AND SHALL BE RATED AS IP 65 RATED PER IEC WITH A REFLECTOR ON ITS BACK. THE LED HOUSING SHALL BE MADE OF CORROSION-RESISTANT PRESSURE DIE-CAST ALUMINUM WITH A POWDER COATED FINISH OF A NEUTRAL COLOR HAVING A SUFFICIENT AREA FOR HEAT DISSIPATION AND HEAT RESISTANT TOUGHENED CLEAR GLASS/ HIGH-QUALITY POLYCARBONATE FITTED WITH PRESSURIZED DIE-CAST ALUMINUM FRAME WITH SCREWS.

   THE TEMPERATURE OF THE HEAT SINK SHOULD NOT INCREASE MORE THAN 30 °C ABOVE AMBIENT TEMPERATURE EVEN AFTER 48 HOURS OF CONTINUOUS OPERATION. THE DUTY CYCLE OF THE LED SHOULD COMPLY WITH THE DUSK TO DAWN OPERATION OF THE LAMPS WHILE THE BATTERY OPERATES AT ANY VOLTAGE BETWEEN THE LOAD DISCONNECT AND CHARGE REGULATION SET POINT.

   LEDS SHALL BE PROCURED FROM A MANUFACTURER WHO HAS TEST REPORTS FROM IESNA LM80-08 AND TM-21-11 QUALIFIED FOR RELEVANT LED PRODUCT TESTING, PARTICULARLY FOR ROADWAY LIGHTING.

4. THE ELECTRIC CABLE SHALL BE TWIN CORE PVC INSULATED WATER AND UV RESISTANT COPPER CABLE OF 1.5 MM DIAMETER MINIMUM SIZE.

5. THE CHARGE CONTROLLER SHALL HAVE AN AUTOMATIC DUSK UNTIL DAWN CIRCUIT BASED ON A SOLAR PHOTOVOLTAIC MODULE AS A SENSOR FOR SWITCHING ON/OFF THE STREET LIGHT WITHOUT MANUAL INTERVENTION AND AS SPECIFIED OPERATION PROFILE DURING PROJECT ANALYSIS. ALL THIS CONTROL SHOULD KEEP THE SYSTEM OPERATING AT PEAK PERFORMANCE SHALL INCREASE THE SYSTEM'S LIFESPAN, AND SHOULD OPERATE AS ILLUSTRATED IN THE FIGURE BELOW.



6. THE PHOTOELECTRIC CONTROL'S OPERATING CONDITION SHALL TURN ON AT A NOMINAL LIGHT LEVEL SETTING OF 10.76 LUX WHICH IS WITHIN THE LIMITS OF 5.38LUX TO 21.52LUX AT RATED VOLTAGE OF 240VOLTS, 60HERTZ. THE RATIO OF THE TURN-OFF TO THE TURN-ON LIGHT LEVEL SHALL BE DESIGNED WITH A FAIL-ON FAILURE MODE AND SHALL BE INSTALLED AT EACH LIGHTING POST FOR INDIVIDUAL LAMP CONTROL. THE EYE OF THE CELL SHOULD BE ORIENTED TO FACE NORTH, CONTROL CONDUCTOR AND THE NECESSARY CONNECTION SHALL BE MADE FOR COMPLETE SATISFACTORY OPERATION OF THE STREET LUMINAIRE.

7. THE BATTERY SHALL BE LITHIUM-ION OR DEEP CYCLE, LEAD-ACID TYPE ELECTROLYTE PLATE LEAD ACID WITH LOW ANTIMONY LEAD ALLOY PLATES, AND CERAMIC VENT PLUGS AND SHALL BE CATEGORIZED BY LOW MAINTENANCE REQUIREMENTS, LONG SERVICE LIFE, AND EXCELLENT CAPACITY PERFORMANCE EVEN IN HIGH-TEMPERATURE.

8. THE SOLAR PHOTO VOLTAIC MODULE MUST BE MADE OF CRYSTALLINE HIGH POWER/EFFICIENCY CELLS AND SHALL BE USED AND MUST BE WARRANTED FOR OUTPUT WATTAGE, WHICH MUST BE GREATER THAN 90% AFTER 10 YEARS AND LESS THAN 80% AFTER 25 YEARS. THE PROJECT WILL ONLY USE INDIGENOUS MODULES FROM REPUTABLE BRANDS.

   THE TERMINAL BOX ON THE MODULE MUST BE DESIGNED FOR LONG-TERM OUTDOOR OPERATION IN HARSH ENVIRONMENTS, WITH AN OPENING FOR REPLACING THE CABLE IF NECESSARY. HENCE, PROTECTIVE DEVICES AGAINST SURGES AT THE PV MODULE SHALL BE PROVIDED.

9. THE GROUNDING SYSTEM SHALL HAVE LOW RESISTANCE AND LOW IMPEDANCE ATTRIBUTE TO PROTECT SOLAR STREET LIGHTS FROM EXTENSIVE LIGHTNING DAMAGE. AFTER ESTABLISHING THE STABLE GROUNDING SYSTEM, A SURGE PROTECTION DEVICE (SPD) SYSTEM SHOULD BE INSTALLED.

10. AUTOMATIC SELF-CLEANING MECHANISM SHALL HAVE A BRUSH WITH THICK AND SOFT BRISTLES IDEAL FOR CLEANING HEAVY DUST PARTICLES WITH FLAT FITTING ON THE SOLAR PANEL SHALL BE DESIGNED FOR AREAS WHERE SEA SPRAY, DUST, AND DIRT THAT MAY COVER THE PANEL PREVENTING THE BATTERY FROM BEING FULLY CHARGED. THE BRUSH SHOULD BE AUTOMATED TO ALLOW THOROUGH CLEANING EVERY FOUR HOURS AND SHALL ROUTINELY RETURN TO ITS INITIAL POSITION TO PREVENT FROM BEING JAMMED WHEN ENCOUNTERING LARGE OBSTACLES THAT MAY CAUSE MOTOR DAMAGE. THE CASING SHALL BE MADE OF AN ALUMINUM ALLOY FOR INCREASED DURABILITY.

11. THE MOTION SENSOR FEATURE SHALL HAVE DIFFERENT POWER CONTROL DEPENDING ON THE PERIOD WITH AN 8-METER RADIUS AND SHALL SET AND LOWER BRIGHTNESS IN A REDUCED PEDESTRIAN AFTER MIDNIGHT TO SAVE ENERGY AND IMPROVE PRACTICALITY.

SECTION 2.2 STRUCTURAL SYSTEM

1. THE POLE SHALL BE CONSTRUCTED OF ROUND TAPERED HOT-DIP GALVANIZED STEEL GI PIPE OF 3 MM MINIMUM THICKNESS, A MINIMUM LOWER AND UPPER DIAMETER OF 200 MM AND 75 MM DIAMETER AND ITS SURFACE MUST BE PAINTED WITH REFLECTORIZED WHITE ENAMEL COATING. THE POLE SHOULD HAVE THE PROVISIONS TO HOLD THE WEATHERPROOF LAMP HOUSING INDIVIDUALLY PER CASE, THE BATTERY BOX AT AN APPROPRIATE HEIGHT, AND THE SOLAR PHOTOVOLTAIC PANEL, THAT SHALL BE MOUNTED ON TOP OF THE POLE.

   STANDARD LIGHT POLES TO BE UTILIZED WITH SOLAR SHOULD HAVE LARGER BASES AND MORE SUBSTANTIAL FOUNDATIONS DUE TO THE WEIGHT OF THE SOLAR POWER ASSEMBLY AND SHOULD HAVE AN EFFECTIVE PROJECTED AREA (EPA) CAPACITY THAT COULD WITHSTAND SEVERAL WIND VELOCITIES UP TO 340 KPH IN ACCORDANCE WITH AASHTO LTS-6, AS STANDARD POLES ARE TOO WEAK TO HANDLE THE WEIGHT OF THE SYSTEM AND CAN QUICKLY FAIL. POLES SHOULD BE MANUFACTURED EXCLUSIVELY FOR THE PROJECT WITH APPROPRIATE HEIGHT AS IT INFLUENCES THE INTENSITY, UNIFORMITY, AND AREA OF ILLUMINATION.

   THE LOCATION OF STREET LIGHTING POSTS SHOWN ON THE DRAWINGS ARE APPROXIMATE AND THE EXACT LOCATION SHALL BE DETERMINED/ESTABLISHED BY THE ENGINEER IN THE FIELD.

2. SOLAR FIXTURE BRACKET SHOULD DIRECT THE PV SOLAR FACING SOUTH (OR TOWARDS THE EQUATOR) AND SHOULD ALLOW THE FIXTURE INSTALLATION TO FACE THE CORRECT DIRECTION IF IT IS ATTACHED TO THE PANEL. SHALL BE DESIGNED TO MEET THE STRENGTH REQUIREMENTS OF THE LATEST EDITION OF THE NATIONAL STRUCTURAL CODE OF THE PHILIPPINES (NSCP) AND SHOULD BE PROVIDED WITH A MOUNTING PLATE AND STIFFENER TO INCREASE ITS LOAD-BEARING CAPACITY.

   HARDWARE SUCH AS HINGES, LATCHES, SPRINGS, NUTS, SCREWS, WASHERS, PINS, AMONG OTHERS, SHALL BE MADE OF MATERIALS COMPATIBLE TO THE HOUSING MATERIAL AND SHALL BE INHERENTLY CORROSION PROOF OR HAVE BEEN PROTECTED BY FINISHES APPROVED FOR CORROSION RESISTANCE. HOWEVER, THOSE EXPOSED TO THE ELEMENTS SHALL BE MADE OF HIGH-GRADE STAINLESS STEEL.

3. STREET LIGHTING POST CONCRETE FOOTING SHALL BE CLASS A AND SHALL CONFORM WITH SUBSECTION 405.2, MATERIAL REQUIREMENTS OF ITEM 405, STRUCTURAL CONCRETE.

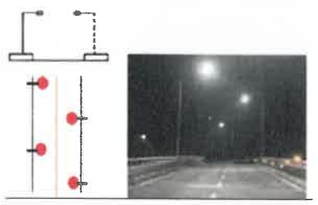
   ALL ELECTRICAL LIGHTING POST FOOTINGS WITH DIMENSIONS INDICATED IN THE PLANS SHALL BE REINFORCED CONCRETE AND SHALL CONFORM WITH THE REQUIREMENTS FOR CONCRETE STRUCTURES OF THIS SPECIFICATION. EXCAVATION AND BACKFILL FOR FOUNDATION INCLUDING DISPOSAL OF SURPLUS MATERIAL SHALL BE PROVIDED. EXCAVATED HOLES FOR CONCRETE FOOTINGS SHALL BE NEAT OR PROPERLY FORMED AND FREE FROM LOOSE MATERIALS WHEN THE CONCRETE IS PLACED.

   CONCRETE FOUNDATION SHALL BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH THE LATEST EDITION OF THE NATIONAL STRUCTURAL CODE OF THE PHILIPPINES (NSCP) TO RESIST WIND VELOCITY AND VIBRATIONS INHERENT IN THE AREA WHERE THE POLES WILL BE CONSTRUCTED AND LOCATED TO PROVIDE ADEQUATE SUPPORT FOR THE LUMINAIRE AND POLE STRUCTURE.

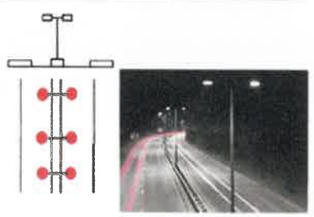
SECTION 3 ROADWAY LIGHTING SECTION AND CONFIGURATION

SECTION 3.1 LIGHTING ARRANGEMENT

IN SINGLE-SIDED POLE ARRANGEMENT, ALL LUMINAIRES ARE LOCATED ON ONE SIDE OF THE ROAD. THIS SHALL BE USED WHEN THE ROAD WIDTH IS **LESS THAN OR EQUAL** TO THE MOUNTING HEIGHT.



IN STAGGERED ARRANGEMENT, ALL LUMINAIRES ARE ALTERNATELY PLACED ON EACH SIDE OF THE ROAD. THIS SHALL BE USED WHEN THE ROAD WIDTH IS EQUAL TO **1 TO 1.5 TIMES THE** MOUNTING HEIGHT.



IN AXIAL ARRANGEMENT, ALL LUMINAIRES ARE MOUNTED ON CENTRAL TWIN MASTS IN THE MIDDLE OF THE ISLAND. THIS SHALL BE USED WHEN THE ROAD WIDTH IS **LESS THAN OR EQUAL** TO THE MOUNTING HEIGHT.

REPUBLIC OF THE PHILIPPINES
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SHEET TITLE:	SHEET CONTENTS:
GUIDELINES AND STANDARD DESIGN DRAWINGS FOR SOLAR-POWERED ROADWAY LIGHTING	GENERAL NOTES AND DESIGN GUIDELINES

PREPARED BY: JESSIE C. SALVADOR, ENGINEER II (EE), DRAFTSMAN I
DRAWN BY: HONEE KIMBERLY S. GIMPAYA
REVIEWED BY: JONATHAN A. SANTIAGO, OIC-ENGINEER IV, SECTION CHIEF

SUBMITTED: ROMEO C. RAAGAS, CHIEF - HIGHWAYS DIVISION, B.O.D., DATE

RECOMMENDING APPROVAL: EDWIN C. MATANGUIHAN, O.I.C. - DIRECTOR, BUREAU OF DESIGN, DATE FEB 06 2023

(SEE COVER SHEET) ERIC A. AYAPANA, ASSISTANT SECRETARY FOR INFORMATION MANAGEMENT AND TECHNICAL SERVICES, DATE

APPROVED: (SEE COVER SHEET) MAXIMO L. CARVAJAL, UNDERSECRETARY FOR INFORMATION MANAGEMENT AND TECHNICAL SERVICES, DATE

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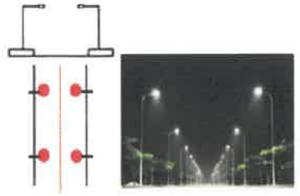
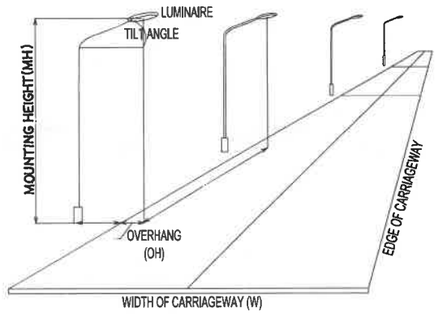


IN OPPOSITE ARRANGEMENT, ALL LUMINAIRES ARE POSITIONED DIRECTLY OPPOSITE AND FACING EACH OTHER. THIS SHALL BE USED WHEN THE ROAD WIDTH IS GREATER THAN **1.5 TIMES** THE MOUNTING HEIGHT.

ARRANGEMENTS SUCH AS OPPOSITE, STAGGERED, AND ONE-SIDED ARE TYPICALLY INSTALLED 30 TO 40 METERS APART WHEN DESIGNING PRIMARY AND SECONDARY ROADS. IF AXIAL AND OPPOSITE ARRANGEMENTS LACK THE REQUIRED ILLUMINATION, THEY CAN BE COMBINED WITH SINGLE-SIDED ARRANGEMENTS.

SECTION 3.2 MOUNTING HEIGHT, SPACING, MAST ARM, AND OVERHANG

THE STREET LIGHTING GEOMETRY IS SHOWN BELOW TO FURTHER ILLUSTRATE THE FOLLOWING DESIGN PARAMETERS:



MOUNTING HEIGHT

THE MOUNTING HEIGHT SHALL BE THE PERPENDICULAR DISTANCE FROM THE CENTER OF THE LAMP TO THE GROUND SURFACE. IN GENERAL, THE MINIMUM MOUNTING HEIGHT SHALL BE GENERALLY 8 METERS AND A LUMINAIRE THAT DOES NOT OVERHANG THE ROADWAY SHALL HAVE A MINIMUM MAST ARM LENGTH OF 1.5 METERS. PROVIDED THAT THE INSTALLED LUMINAIRE USED WOULD NOT RESULT INTO DISABILITY GLARE TO THE MOTORIST AND THE POLE IS INSTALLED IN ACCORDANCE WITH THE LATEST EDITION OF PHILIPPINE ELECTRICAL CODE (PEC) 2. TABLE 2. ROADWAY LIGHTING STATIONING AND PARAMETERS SHOULD BE CONSIDERED AS IT SPECIFIES THE SUITABLE MOUNTING HEIGHT FOR THE ENTIRETY OF ROADWAY LIGHTING.

SPACING

SPACING SHALL BE DEFINED AS THE HORIZONTAL DISTANCE BETWEEN SUCCESSIVE LUMINAIRES IN AN INSTALLATION. TO PRESERVE LONGITUDINAL UNIFORMITY, THE SPACE-HEIGHT RATIO SHOULD GENERALLY BE GREATER THAN 3. MINIMUM AND MAXIMUM ALLOWABLE SPACING SHALL BE FOLLOWING THE VALUES ESTABLISHED IN TABLE 2. ROADWAY LIGHTING STATIONING AND PARAMETERS

POLE SPACING IS ALSO SPECIFIED DEPENDING ON THE ILLUMINATION LEVEL OF THE AREA. INTERSECTIONS AND OTHER MERGING SECTION OF THE ROADWAY SHOULD HAVE A HIGHER LEVEL OF ILLUMINATION.

OVERHANG

THE HORIZONTAL DISTANCE BETWEEN THE CENTER OF A LUMINAIRE MOUNTED ON A BRACKET AND THE ADJACENT EDGE OF A CARRIAGEWAY IS DEFINED AS OVERHANG. TO AVOID REDUCED VISIBILITY OF CURBS AND OBSTACLES, THE OVERHANG SHOULD NOT EXCEED ONE-FOURTH OF THE MOUNTING HEIGHT.

POLE ARM

THE USE OF AN ARM BRINGS THE LIGHT SOURCE CLOSER TO THE TRAVELED PATH WHILE ALLOWING THE POLE TO BE PLACED FURTHER AWAY FROM THE EDGE OF THE PATH'S EDGE. DEPENDING ON THE APPLICATION, POLEARMS CAN BE SINGLE AND/OR DOUBLE DAVIT OR MAST ARMS AND LOCATED AT THE UPPER MOST PART OF THE POLE.

THE POLE ARM'S ANGLE OF TILT SHALL BE KEPT FROM 15° TO 30°, OTHERWISE STRONG LIGHT SHALL AFFECT THE DRIVER'S EYES BY CAUSING DISCOMFORT GLARE. THE TILT GETS LARGER AS THE UNIFORMITY RATIO INCREASE.

SETBACK

THE SETBACK IS THE HORIZONTAL DISTANCE BETWEEN THE FACE OF A LIGHT POLE AND THE EDGE OF THE TRAVELED WAY. THE MINIMUM ALLOWED VALUE IS SET AT 0.80 TO 1.5 METERS SINCE EXTREMELY SHORT SETBACK GRAZES THE SURFACE AND ENHANCES ITS TEXTURE AND LONG SETBACKS CAUSE SHADOWS AT LOW LEVELS.

THE TABLE BELOW SHALL BE CONSIDERED IN DESIGNING THE LUMINAIRE SETBACK BASED ON VEHICULAR SPEED ON A PARTICULAR ROADWAY AND EQUIVALENT.

DESIGN SPEED FOR THE ROADWAY (KPH)	POLE SETBACKS (M)
50	0.8
80	1.0
100	1.5
120	1.5

TABLE 1. DESIGNATED ALLOWABLE SETBACK VALUES WITH A ROADWAY DESIGNED SPEED EQUIVALENT.

OUTREACH

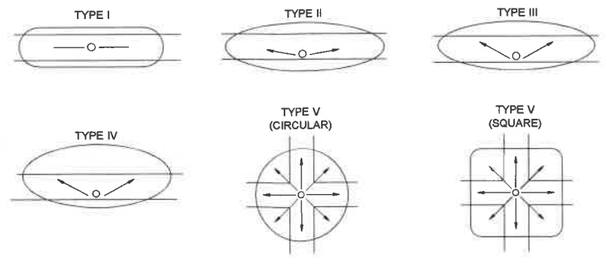
THE OUTREACH OR HORIZONTAL DISTANCE BETWEEN THE LUMINAIRE'S CENTER AND THE COLUMN'S CENTER IS TYPICALLY ESTABLISHED IN ACCORDANCE WITH THE ARCHITECTURAL AESTHETIC CONDITIONS.

ROAD CLASSIFICATION	LIGHTING ARRANGEMENT	ROAD WIDTH (meter)	POLE PLACING (meter)	MOUNTING HEIGHT (meter)	LAMP WATTAGE (watt)		MAST ARM LENGTH (meter)
					HPS	LED	
PRIMARY	SINGLE	6.7	10-25	10	150-250	80-125	1.5
		13.4	15-35	12	150-250	80-125	3.0
	AXIAL	13.4	20-35	10	150-250	80-125	1.5
		20.1	20-40	12	150-250	80-125	3.0
		26.8	20-45	12	300-400	200-300	3.0
	OPPOSITE	6.7	20-35	10	70-120	50-80	1.5
		13.4	20-35	12	150-250	80-125	1.5
		20.1	20-40	12	300-400	200-300	1.5
		26.8	20-45	12	300-400	200-300	1.5
	STAGGERED	6.7	10-25	8	70-120	50-80	1.5
		13.4	10-25	10	150-250	80-125	1.5
		20.1	15-25	12	300-400	200-300	3.0
		26.8	15-25	12	300-400	200-300	3.0
SECONDARY	SINGLE	6.7	15-35	10	150-250	80-125	1.5
	OPPOSITE	6.7	20-40	8	150-250	80-125	1.5
	STAGGERED	6.7	15-35	8	150-250	80-125	1.5
TERTIARY	SINGLE	5.0	10-25	8	70-120	50-80	1.5
		6.1	10-25	8	70-120	50-80	1.5
	STAGGERED	5.0	10-25	8	70-120	50-80	1.5
		6.1	10-25	8	70-120	50-80	1.5

TABLE 2. ROADWAY LIGHTING STATIONING AND PARAMETERS

SECTION 3.3 PHOTOMETRIC REQUIREMENTS AND COMPUTATIONS

ONE OF THE MOST IMPORTANT ASPECTS OF OUTDOOR AREA LIGHTING IS THE PROPER DISTRIBUTION OF LIGHT FLUX FROM LUMINAIRES. THE LIGHT EMITTED BY THE LUMINAIRES IS DIRECTED AND PROPORTIONED ACCORDING TO THE REQUIREMENTS FOR SEEING AND VISIBILITY. LIGHT DISTRIBUTION IS TYPICALLY DESIGNED FOR A TYPICAL RANGE OF CONDITIONS SUCH AS LUMINAIRE MOUNTING HEIGHT, TRANSVERSE (OVERHANG) LOCATION OF THE LUMINAIRES, LONGITUDINAL SPACING, WIDTHS OF AREAS TO BE EFFECTIVELY LIGHTED, LUMINAIRE ARRANGEMENT, AND MAINTAINED SYSTEM EFFICIENCY.



LUMINAIRE'S TRANSVERSE (PROJECTION) CAN BE CONSIDERED AS TYPES I, II, III, IV, AND V, AS SHOWN IN THE FIGURE ABOVE. CHARACTERISTICS THAT SHOW THE MAXIMUM INTENSITY OF THE LIGHT IS ABOVE 180° AND 90° TO EVADE GLARE AND SPILL LIGHT, IT IS CLASSIFIED AS FULL CUTOFF, CUTOFF, SEMI-CUTOFF, AND NON-CUTOFF.

ON A TWO-LANE ROADWAY, ADDING LIGHT TO ONE SIDE AND USING A TYPE 2 WILL ALLOW THE LIGHT TO FOCUS ALONG THE ROADWAY. ALLOCATING A TYPE 5 OR TWO (2) TYPE 3 LIGHTS BACK-TO-BACK IS PREFERRED WHEN DESIGNING A FOUR-LANE HIGHWAY WITH A MEDIAN SHALL ENHANCE THE ILLUMINATION OF THE AREA. ADDITIONAL TYPE 2 OR 3 ON THE OUTSIDE EDGES OF THE ROADS COULD ALSO EVENLY ILLUMINATE THE AREA.

GENERAL EQUATION

FOR ILLUMINANCE

$$E_{wp} = \frac{(\theta_{TOTAL})(CU)(LLF)}{A_{wp}}$$

E_{wp} = *Average Maintained Illuminance on the Work Plane*
θ_{TOTAL} = *Total System Lamp Lumen Output*
CU = *coefficient of utilization*
LLF = *Light Loss Factor*
A_{wp} = *Area of the Work Plane*

FOR STREETLIGHT SPACING

$$S = \frac{(LL)(MF)(CU)}{(fc)(W)}$$

S = *Spacing*
LL = *Lamp Lumen*
MF = *Maintenance Factor*
CU = *Coefficient of Utilization*
fc = *Foot Candle*
W = *Width of Road*

NOTE: ILLUMINATION CALCULATION CAN ALSO BE ATTAINED USING DIGITAL SOFTWARE FOR THE LAMP WATTAGE RATING.

EACH LUMINAIRE HAS ITS OWN COEFFICIENT OF UTILIZATION AND CAN BE OBTAINED FROM THE REPUTABLE MANUFACTURER'S DATA, SPECIFIC TO ITS LIGHT DISTRIBUTION AND EFFICIENCY.

THE TABLE BELOW ILLUSTRATES HOW THE DESIGN VARIES DEPENDING ON THE STANDARD VALUES LISTED FOR DIFFERENT SURFACE REFLECTANCE CONTINGENT ON THE PAVEMENT TYPE TO BE LIGHTED WHETHER CONCRETE OR ASPHALT.

ILLUMINANCE METHOD - RECOMMENDED VALUES						
ROADWAY & PEDESTRIAN CONFLICT AREA		PAVEMENT CLASSIFICATION			UNIFORMITY RATIO EAVE/EMIN	VEILING LUMINANCE RATIO LMAX/LAVG
ROAD	PEDESTRIAN CONFLICT AREA	R1 LUX/ FC	R2 & R3 LUX/ FC	R4 LUX/ FC		
FREEWAY CLASS A		6.0/ 6.0	9.0/ 0.9	8.0/ 0.8	3	0.3
FREEWAY CLASS B		4.0/ 4.0	6.0/ 0.6	5.0/ 0.5	3	0.3
EXPRESSWAY	HIGH	10.0/ 1.0	14.0/ 1.4	13.0/ 1.3	3	0.3
	MEDIUM	8.0/ 0.8	12.0/ 1.2	10.0/ 1.0	3	0.3
	LOW	6.0/ 0.6	9.0/ 0.9	8.0/ 0.8	3	0.3
MAJOR PRIMARY	HIGH	12.0/ 1.2	17.0/ 1.7	15.0/ 1.5	3	0.3
	MEDIUM	9.0/ 0.9	13.0 /0.3	11.0/ 1.1	3	0.3
	LOW	6.0/ 0.6	9.0/ 0.9	8.0/ 0.8	3	0.3
COLLECTOR SECONDARY	HIGH	8.0/ 0.8	12.0/ 1.2	10.0/ 1.0	4	0.4
	MEDIUM	6.0/ 0.6	9.0/ 0.9	8.0/ 0.8	4	0.4
	LOW	4.0/ 0.4	12.0/ 1.2	5.0/ 0.5	4	0.4
LOCAL TERTIARY	HIGH	6.0/ 0.6	9.0/ 0.9	8.0/ 0.8	6	0.4
	MEDIUM	5.0/ 0.5	7.0/ 0.7	6.0/ 0.6	6	0.4
	LOW	3.0/ 0.3	4.0/ 0.4	4.0/ 0.4	6	0.4

TABLE 3. IESNA RECOMMENDED MAINTAINED AVERAGE HORIZONTAL ILLUMINANCE LEVELS (LUX) FOR DIFFERENT TYPES OF ROADS, PAVEMENTS, AND PEDESTRIAN CONDITIONS
(EXCERPT FROM IESNA 2000)

✱ ACCORDING TO NATIONAL ROAD CLASSIFICATIONS

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SHEET TITLE: GUIDELINES AND STANDARD DESIGN DRAWINGS FOR SOLAR-POWERED ROADWAY LIGHTING

SHEET CONTENTS: GENERAL NOTES AND DESIGN GUIDELINES

PREPARED BY: JEVIE S. SALVADOR, ENGINEER I
DRAWN BY: HONEE KIMBERLY S. GIMPAYA, DRAFTSMAN I
REVIEWED BY: JONATHAN A. SANTIAGO, OIC-ENGINEER IV, SECTION CHIEF

SUBMITTED: ROMEO C. RAAGAS, CHIEF - HIGHWAYS DIVISION, B.O.D., DATE

RECOMMENDING APPROVAL: EDWIN C. MATANGUIHAN, O.I.C. - DIRECTOR, BUREAU OF DESIGN, DATE FEB 06 2023

(SEE COVER SHEET) ERIC A. AYAPANA, ASSISTANT SECRETARY FOR INFORMATION MANAGEMENT AND TECHNICAL SERVICES, DATE

APPROVED: (SEE COVER SHEET) MAXIMO L. CARVAJAL, UNDERSECRETARY FOR INFORMATION MANAGEMENT AND TECHNICAL SERVICES, DATE

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SECTION 4 DESIGN CONSIDERATIONS

SURFACE LUMINANCE AND SOURCE LUMINANCE ARE THE TWO MOST IMPORTANT FACTORS TO BE CONSIDERED IN DESIGNING ROADWAY LIGHTING SYSTEMS. SURFACE LUMINANCE ADDS INTEREST AND DEPTH TO AN OUTDOOR SCENE AND CAN BE NECESSARY FOR GOOD VISIBILITY, ESPECIALLY FOR THE SAFETY OF THE DRIVERS.

FACTORS IN DESIGNING ROADWAY LIGHTING SYSTEM

THE EXPERTISE REQUIRED FOR LIGHTING DESIGNS INCLUDES:

- LAMP TYPES AND CHARACTERISTICS, INCLUDING DEPRECIATION FACTORS
- BALLAST AND DRIVER TYPES AND CHARACTERISTICS
- FIXTURE MECHANICAL CHARACTERISTICS
- LENS TYPES
- PHOTOMETRIC PERFORMANCE OF LUMINAIRES AND FACTORS IMPACTING SUCH PERFORMANCE
- FIXTURE MOUNTING TYPES
- POLE MECHANICAL AND ELECTRICAL CHARACTERISTICS
- BREAKAWAY DEVICE OPTIONS AND WHEN APPROPRIATE TO USE
- CLEAR ZONE CRITERIA
- POLE TYPES, MOUNTING OPTIONS, AND LOADING CONSIDERATIONS
- FOUNDATION AND SUPPORT DETAILS
- PAVEMENT REFLECTION FACTORS
- MOUNTING HEIGHT AND SPACING OPTIONS
- LIGHT TRESPASS AND SKY GLOW ISSUES INCLUDING LAWS AND ORDINANCES
- LIGHTING QUALITY REQUIREMENTS, SUCH AS ILLUMINANCE, VEILING LUMINANCE, VISIBILITY.
- ENERGY AND LIFE-CYCLE COSTS

MASTER LIGHTING PLAN

A MASTER LIGHTING PLAN IS A FORMAL ARRANGEMENT BETWEEN RELEVANT GOVERNMENT AGENCIES AND OTHER ENTITIES WITHIN A REGIONAL AREA TO COORDINATE AND STANDARDIZE THE DESIGN, OPERATION, MAINTENANCE OF PUBLIC LIGHTING. BASIC BENEFITS OF LIGHTING INCLUDE SAFETY, BEAUTIFICATION, AND SECURITY FOR PEOPLE AND PROPERTY.

ILLUMINANCE CONSIDERATIONS

ILLUMINANCE IN ROADWAY LIGHTING IS A MEASURE OF THE LIGHT INCIDENT ON THE PAVEMENT SURFACE MEASURED IN FOOT-CANDLES (LUX). THE ILLUMINANCE AT ANY CERTAIN POINT WILL BE THE SUM OF ILLUMINANCE FROM ONE OR SEVERAL CONTRIBUTING SOURCES.

LUMINANCE IN ROADWAY LIGHTING IS A MEASURE OF THE REFLECTED LIGHT FROM THE PAVEMENT SURFACE THAT IS VISIBLE TO THE MOTORIST'S EYE. DIFFERENT ROAD SURFACE MATERIALS, SUCH AS PORTLAND CEMENT CONCRETE OR ASPHALT HAVE DIFFERENT LUMINANCE COEFFICIENTS. FOR A SECTION OF ROADWAY, LUMINANCE UNIFORMITY IS CALCULATED BOTH AS THE RATIO OF AVERAGE LEVEL TO MINIMUM POINT, AND MAXIMUM POINT TO MINIMUM POINT. THE EVALUATION OF GLARE FROM THE FIXED LIGHTING SYSTEM IS ALSO RELEVANT AND INCLUDED WITH THE LUMINANCE CRITERIA.

PEDESTRIAN	VEHICULAR TRAFFIC CLASSIFICATION			
	VERY LIGHT	LIGHT	MEDIUM	HEAVY TO HEAVIEST
TRAFFIC	UNDER 150	150-500	500-1200	1200 AND UP
HEAVY	9.68	12.91	16.14	21.52
MEDIUM	6.46	8.61	10.26	12.91
LIGHT	2.15	4.3	6.46	9.68

TABLE 4. RECOMMENDED AVERAGE HORIZONTAL ILLUMINATION LEVEL, LUX
(ELECTRICAL LAYOUT AND ESTIMATE, 2000)

ROAD CLASSIFICATION	PEDESTRIAN CONFLICT	POLE HEIGHT (M) 1 LANE ONE SIDE	2 LANES ONE SIDE	3 LANE ONE SIDE	4 LANES OPPOSITE	5 LANES OPPOSITE
FREEWAY CLASS A		12 (40')	12 (40')	12 (40')	15 (49')	15 (49')
FREEWAY CLASS B		12 (40')	12 (40')	12 (40')	15 (49')	15 (49')
EXPRESSWAY	HIGH		12 (40')	12 (40')	12 (40')	12 (40')
	MEDIUM		12 (40')	12 (40')	12 (40')	12 (40')
	LOW		12 (40')	12 (40')	12 (40')	12 (40')
MAJOR PRIMARY	HIGH		12 (40')	12 (40')	12 (40')	12 (40')
	MEDIUM		12 (40')	12 (40')	12 (40')	12 (40')
	LOW		12 (40')	12 (40')	12 (40')	12 (40')
COLLECTOR SECONDARY	HIGH		10 (33')	10 (33')	10 (33')	12 (40')
	MEDIUM		10 (33')	10 (33')	10 (33')	12 (40')
	LOW		10 (33')	10 (33')	10 (33')	12 (40')
LOCAL TERTIARY	HIGH	7(23')	7(23')	10 (33')		
	Medium	7(23')	7(23')	10 (33')		
	Low	7(23')	7(23')	10 (33')		

TABLE 5. POLE HEIGHT BY ROADWAY CONFIGURATION (IESNA RP-8-05)

WARRANTING CONDITIONS

LIGHTING BENEFITS MOTORIST'S BY IMPROVING THEIR ABILITY TO SEE ROADWAY GEOMETRY AND OTHER VEHICLES AT EXTENDED DISTANCE AHEAD. THIS RESULTS IN GREATER DRIVER CONFIDENCE AND IMPROVED SAFETY, WHICH IN TURN IMPROVES HIGHWAY CAPACITY, PEDESTRIAN SAFETY, PUBLIC SAFETY, SECURITY AND CONVENIENCE.

WARRANTS FOR CONTINUOUS EXPRESSWAY LIGHTING, COMPLETE INTERCHANGE LIGHTING, AND PARTIAL INTERCHANGE LIGHTING ARE PROVIDED IN TABLE 4. COMPLETE INTERCHANGE LIGHTING IS DEFINED AS A LIGHTING SYSTEM THAT PROVIDES RELATIVELY UNIFORM LIGHTING WITHIN THE LIMITS OF THE INTERCHANGE, LANES, RAMP TERMINALS, CROSSROAD INTERSECTIONS.

CASE	WARRANTING CONDITIONS
CEL-1	SECTIONS IN AND NEAR CITIES WHERE THE CURRENT AVERAGE DAILY TRAFFIC (ADT) IS 30,000 OR GREATER
CEL-2	SECTIONS WHERE THREE OR MORE SUCCESSIVE INTERCHANGES ARE LOCATED WITH AN AVERAGE SPACING OF 2.3KM OR LESS, AND ADJACENT AREAS OUTSIDE THE RIGHT-OF-WAY ARE SUBSTANTIALLY URBAN IN CHARACTER.
CEL-3	SECTIONS OF 3 KM OR MORE PASSING THROUGH A SUBSTANTIALLY DEVELOPED URBAN OR SUBURBAN AREAS IN WHICH ONE OR MORE OF THE FOLLOWING CONDITIONS EXIST: LOCAL TRAFFIC OPERATES ON A COMPLETE STREET GRID HAVING SOME FORM OF STREET LIGHTING, PARTS OF WHICH ARE VISIBLE FROM THE EXPRESSWAY, THE EXPRESSWAY PASSES THROUGH A SERIES OF DEVELOPMENTS – SUCH AS RESIDENTIAL, COMMERCIAL, INDUSTRIAL, AND CIVIC AREAS, COLLEGES, PARKS, TERMINALS, ETC. THAT INCLUDE LIGHTED ROADS, STREETS, PARKING AREAS, YARDS, ETC., THAT ARE LIGHTED AS PART OF THE LOCAL STREET SYSTEM THE EXPRESSWAY CROSS SECTION ELEMENTS, SUCH AS MEDIAN AND BORDERS, ARE SUBSTANTIALLY REDUCED IN WIDTH BELOW DESIRABLE SECTIONS USED IN RELATIVELY OPEN COUNTRY.
CEL-4	SECTIONS WHERE THE RATIO OF NIGHT TO DAY CRASH RATE IS AT LEAST 2.0 TIMES THE REGION AVERAGE FOR ALL UNLIGHTED SIMILAR SECTIONS, AND A STUDY INDICATES THAT LIGHTING MAY BE EXPECTED TO RESULT IN A SIGNIFICANT REDUCTION IN THE NIGHT CRASH RATE. WHERE CRASH RATE DATA IS NOT AVAILABLE, RATE COMPARISON MAY BE USED AS A GENERAL GUIDELINE FOR CRASH SEVERITY.

TABLE 6. WARRANTING CONDITIONS FOR CONTINUOUS EXPRESSWAY LIGHTING
(AASHTO 2005, ROADWAY LIGHTING DESIGN GUIDE)

CASE	WARRANTING CONDITIONS
CIL-1	WHERE THE TOTAL CURRENT ADT RAMP TRAFFIC ENTERING AND LEAVING EXPRESSWAY WITHIN THE INTERCHANGE AREAS EXCEEDS 10,000 FOR URBAN CONDITIONS, 8,000 FOR SUBURBAN CONDITIONS, OR 5,000 FOR RURAL CONDITIONS.
CIL-2	WHERE THE CURRENT ADT ON THE CROSSROAD EXCEEDS 10,000 FOR URBAN CONDITIONS, 8,000 FOR SUBURBAN CONDITIONS, OR 5,000 FOR RURAL CONDITIONS.
CIL-3	WHERE EXISTING SUBSTANTIAL COMMERCIAL OR INDUSTRIAL DEVELOPMENT THAT IT LIGHTED DURING HOURS OF DARKNESS IS LOCATED IN THE IMMEDIATE VICINITY OF THE INTERCHANGE, OR WHERE THE CROSSROAD APPROACH LEGS ARE LIGHTED FOR 0.75 KM OR MORE ON EACH SIDE OF THE INTERCHANGE.
CIL-4	WHERE THE RATIO OF NIGHT TO DAY CRASH RATE WITHIN THE INTERCHANGE AREA IS AT LEAST 1.5 TIMES THE REGION AVERAGE FOR ALL UNLIGHTED SIMILAR SECTIONS, AND A STUDY INDICATES THAT LIGHTING MAY BE EXPECTED TO RESULT IN A SIGNIFICANT REDUCTION IN THE NIGHT CRASH RATE. WHERE CRASH DATA IS NOT AVAILABLE, RATE COMPARISON MAY BE USED AS A GENERAL GUIDELINE FOR CRASH SEVERITY.

TABLE 7. WARRANTING CONDITIONS FOR COMPLETE INTERCHANGE LIGHTING
(AASHTO 2005, ROADWAY LIGHTING DESIGN GUIDE)

DESIGN CRITERIA

1. DPWH DESIGN GUIDELINES, CRITERIA, AND STANDARDS (DGCS) 2015 EDITION
2. NATIONAL STUCTURAL CODE OF THE PHILIPPINES
3. PHILIPPINE ELECTRICAL CODE, PART 2, 2017
4. ROADWAY LIGHTING DESIGN GUIDE, 7TH EDITION, 2018
5. ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA) LIGHTING HANDBOOK, 9TH EDITION, 2000

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DRAWN BY: HONEE KIMBERLY S. GUIPAYA, DRAFTSMAN I
REVIEWED BY: JONATHAN A. SANTIAGO, OIC-ENGR IV, SECTION CHIEF

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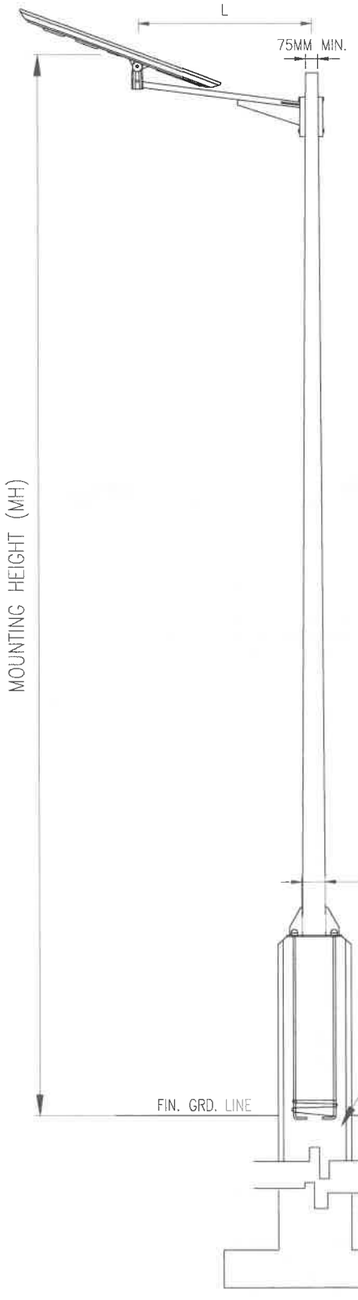
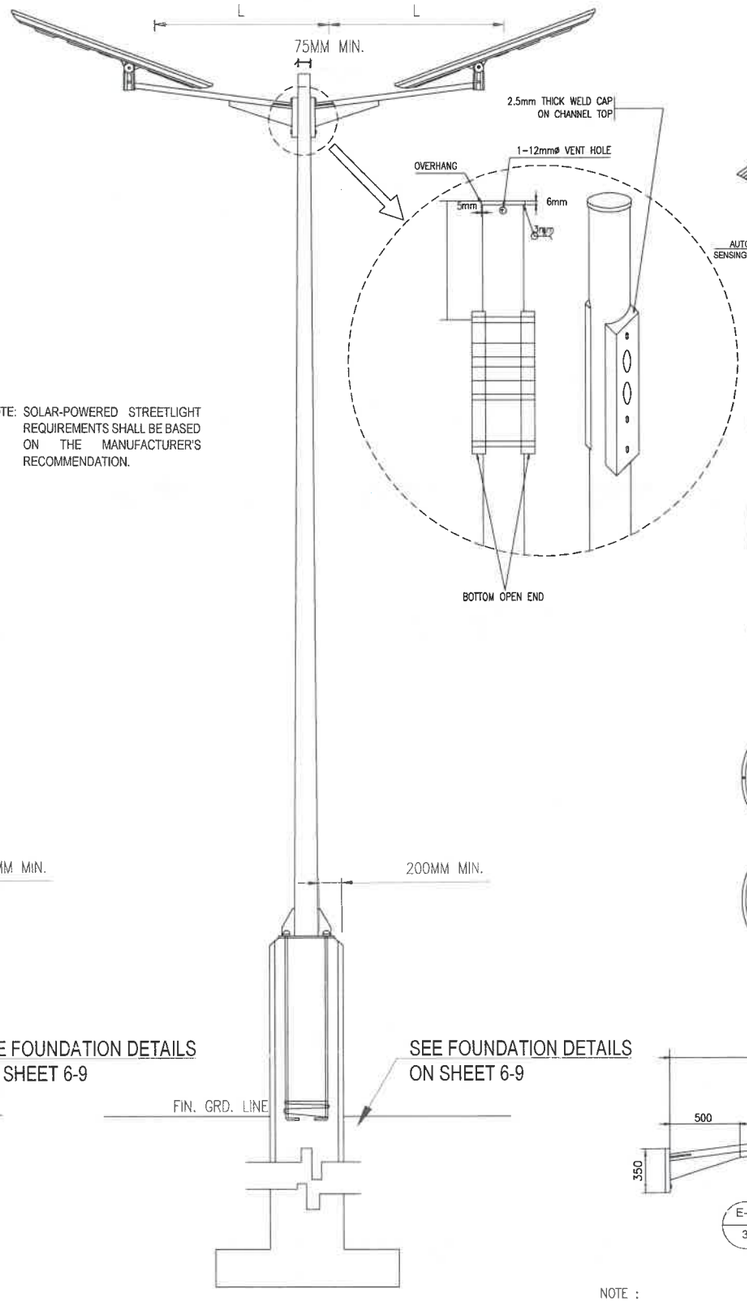
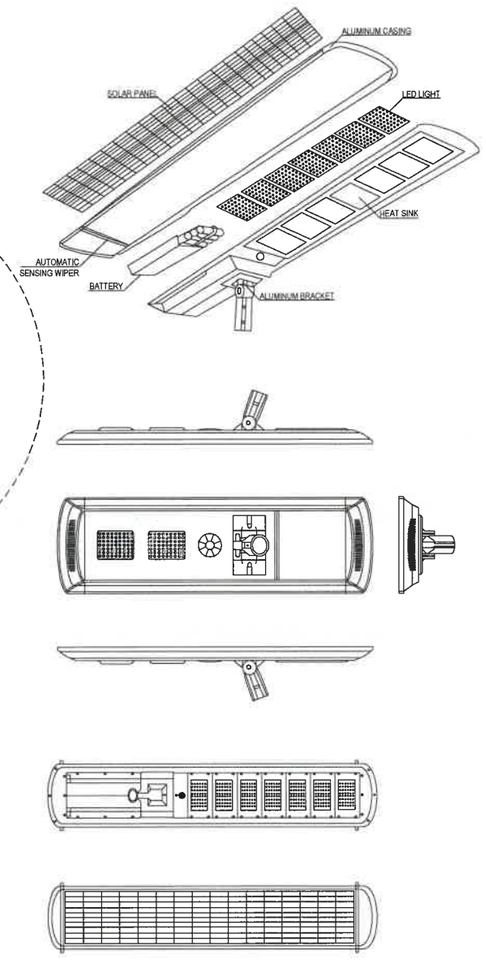


E-1 / 1 SINGLE ARM POST DETAILS
NOT TO SCALE

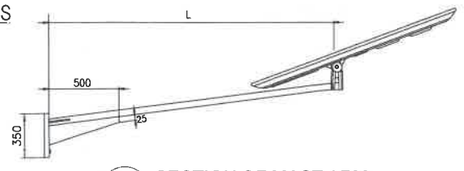


E-1 / 2 DOUBLE ARM POST DETAILS
NOT TO SCALE

NOTE: SOLAR-POWERED STREETLIGHT REQUIREMENTS SHALL BE BASED ON THE MANUFACTURER'S RECOMMENDATION.



E-1 / 4 LED LUMINAIRE DETAILS
NOT TO SCALE



E-1 / 3 SECTION OF MAST ARM
NOT TO SCALE

NOTE :

1. INCLUDE ADDITIONAL DETAIL FOR DESIRED LAMP POST TO BE USED AND REFER AND VERIFY TO MERALCO STANDARDS
2. REFER TO DPWH ELECTRICAL TECHNICAL SPECS FOR LAMP POST WATTAGE RATING, MOUNTING HEIGHT, AND SPACING EQUIVALENT.

INTEGRATED SOLAR STREETLIGHT TECHNICAL PARAMETERS		
SOLAR PHOTOVOLTAIC PANEL	OPERATING VOLTAGE AND POWER	12V – 36V
		60 – 310 W
		(SHOULD BE GREATER THAN 90% AFTER 10 YEARS AND LESS THAN 80% AFTER 25 YEARS)
	LIFETIME	>25 YEARS
	MATERIAL	MONOCRYSTALLINE/POLYCRYSTALLINE SILICON
	WEIGHT	<25 KG
	ALLOWABLE AMBIENT TEMPERATURE RANGE	-40°C TO +60°C
BATTERY	INPUT VOLTAGE	12.8V
	TYPE	LITHIUM-ION OR LEAD-ACID TYPE ELECTROLYTE PLATE LEAD ACID WITH LOW ANTIMONY LEAD ALLOY PLATES AND CERAMIC VENT PLUGS
	LIFETIME	6 – 8 YEARS
	CHARGING AND DISCHARGING CYCLES	2000
	CHARGING TIME	7 HOURS
	WORKING TIME UNDER RAINY DAYS	10 DAYS
CHARGE CONTROLLER	INTELLIGENT CONTROL FOR CIRCUIT PROTECTION	
	FEATURE	TIMING, DIMMING, AND SENSOR
LIGHT-EMITTING DIODE (LED) LAMP	LIGHT OUTPUT	50W TO 300 W
	SYSTEM FLUX	6000 – 30,000 LM
	COLOR TEMPERATURE	2,500K - 3,500K (WARM WHITE) 3,000K - 4,500K (COOL WHITE) 5,500K - 6,500K (DAYLIGHT)
	OPTICAL COVER / LENS TYPE	UV STABILIZED
		POLYCARBONATE COVER
	DRIVER	DIMMABLE AND DESIGNED TO OPERATE MAINTENANCE FREE FOR 50,000 HOURS WITH A COMPATIBILITY TO WIRELESS LIGHTING CONTROL PROTOCOLS.
	LIFETIME	>50,000 HOURS
	PHOTO CONTROLLER	INDIVIDUAL OR GROUP
	HOUSING	HIGH PRESSURE DIE-CAST ALUMINUM WITH HEAT MANAGEMENT SYSTEM AND RUST RESISTANT
ALLOWABLE AMBIENT TEMPERATURE	RANGE	-40°C TO +60°C
	RANGE FOR CHARGING	0°C TO +45°C
	RANGE FOR DISCHARGING	-20°C TO +35°C
CHARGE TIME	7 HOURS UNDER DIRECT AND STRONG SUNLIGHT	
IP RATING	IP 65	
WARRANTY PERIOD	6 YEARS MINIMUM	

INITIAL LUMEN OF HIGH PRESSURE LAMPS		
TYPES OF LAMPS	WATTAGE	INITIAL LUMEN
HIGH PRESSURE SODIUM (HPS)	100	9500
	150	16000
	250	26000
	450	50000

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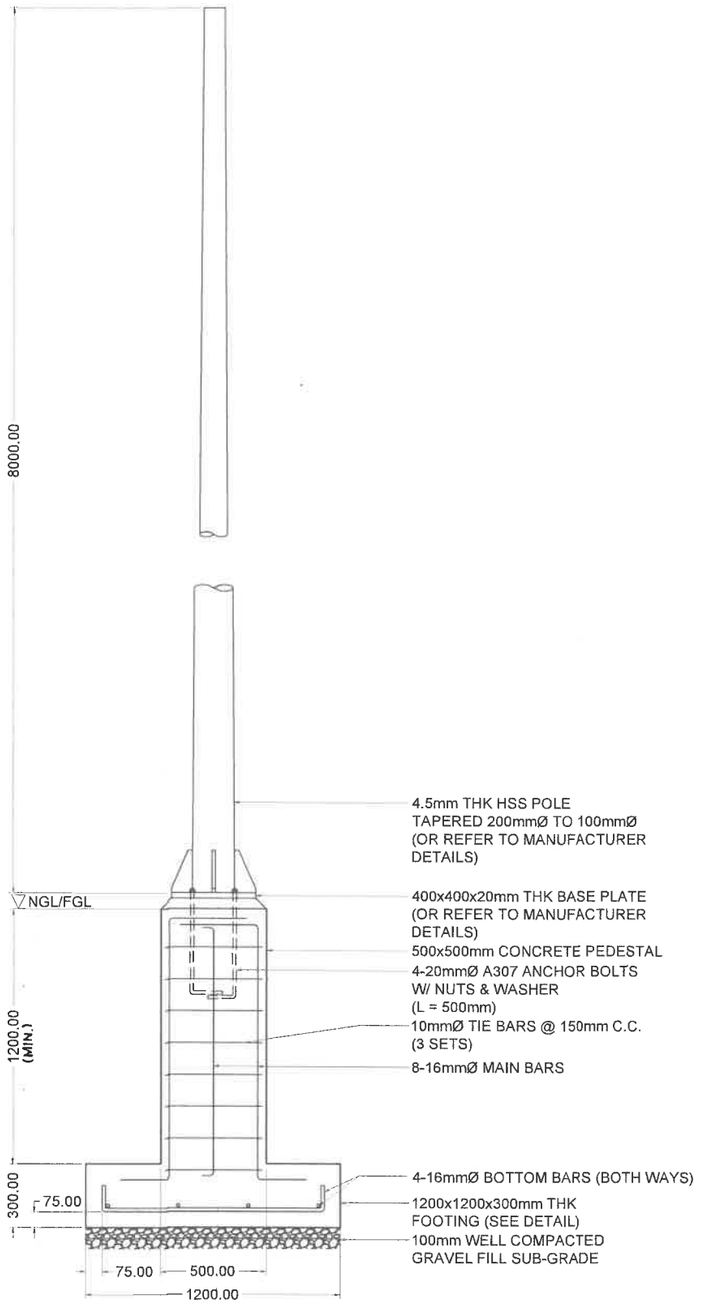
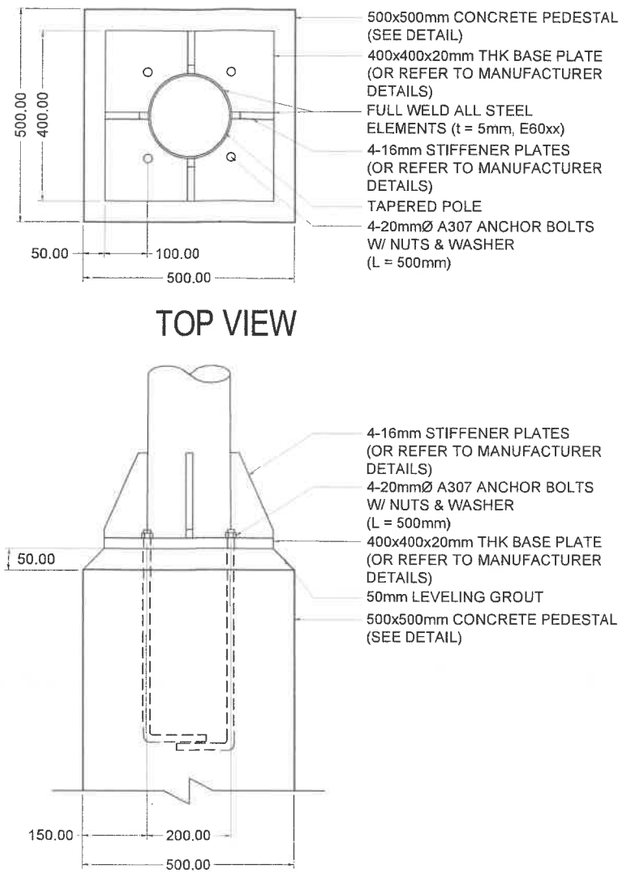
GUIDELINES AND STANDARD DESIGN DRAWINGS FOR SOLAR-POWERED ROADWAY LIGHTING	SINGLE ARM POST DETAILS DOUBLE ARM POST DETAILS SECTION OF MAST ARM LED LUMINAIRE DETAILS & INTEGRATED SOLAR STREETLIGHT TECHNICAL PARAMETERS	JEFF C. SALVADOR ENGINEER II (EA) DRAWN BY: HONEY KIMBERLY S. GUMPAYA DRAFTSMAN I REVIEWED BY: JONATHAN A. SANTIAGO OIC-ENGINEER IV, SECTION CHIEF	ROMEO C. RAAGAS CHIEF - HIGHWAY DIVISION, B.O.D. DATE	EDWIN C. MATANGUIHAN O.I.C. - DIRECTOR, BUREAU OF DESIGN DATE FEB 06 2023	(SEE COVER SHEET) ERIC A. AYAPANA ASSISTANT SECRETARY FOR INFORMATION MANAGEMENT AND TECHNICAL SERVICES DATE	(SEE COVER SHEET) MAXIMO L. CARVAJAL UNDERSECRETARY FOR INFORMATION MANAGEMENT AND TECHNICAL SERVICES DATE	E 1 | 3	5 11



1 S-2 FOUNDATION ELEVATION

SCALE 1:20 MTS.

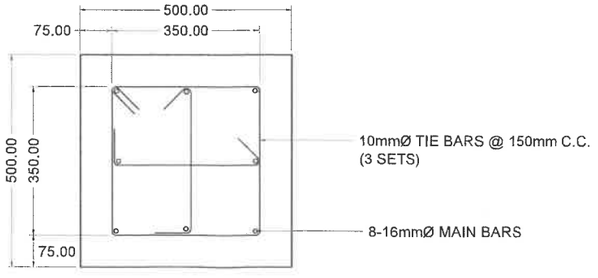


TOP VIEW

FRONT VIEW

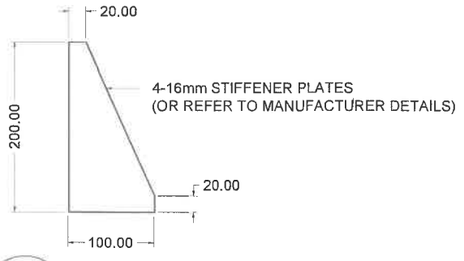
2 S-2 BASE PLATE DETAIL FOR 8M POLE

SCALE 1:10 MTS.



3 S-2 PEDESTAL DETAIL

SCALE 1:10 MTS.



4 S-2 STIFFENER DETAIL

SCALE 1:5MTS.

DESIGN CRITERIA

A. **REFERENCES**
- a. NATIONAL STRUCTURAL CODE OF THE PHILIPPINES (NSCP), 7TH EDITION (2015)
- b. AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE) 360
- c. AMERICAN CONCRETE INSTITUTE (ACI) 318
- d. AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC) 360

B. **DESIGN LOADS**

a. DEAD LOAD		
	i. CONCRETE	24 kN/m³
	ii. STEEL	77 kN/m³
	iii. SOIL	18 kN/m³
	iv. POLE ATTACHMENTS	50 kg
b. WIND LOAD		
	i. WIND SPEED	250 kph
	ii. EXPOSURE CATEGORY	D
	iii. DIRECTIONALITY FACTOR	0.85
	iv. OCCUPANCY CATEGORY	V (MISCELLANEOUS STRUCTURES)

C. **MATERIALS**

a. NORMAL WEIGHT CONCRETE	F_c = 28 MPa (4000 psi)
b. REINFORCING STEEL	
i. 12MMØ AND BELOW	F_y = 276 MPa (Grade 40)
ii. 16MMØ AND ABOVE	F_y = 414 MPa (Grade 60)
c. STRUCTURAL STEEL	
i. STEEL POLE	F_y = 240 MPa (A53 GRADE B) F_u = 415 MPa
ii. BASE PLATE & STIFFENER	F_y = 276 MPa (A36) F_u = 400 MPa
d. STRUCTURAL BOLTS AND FASTENERS	F_{nt} = 310 MPa (A307) F_{nv} = 165 MPa
e. WELDS	E60xx ELECTRODE

D. **DESIGN APPROACH**
- a. LOAD AND RESISTANCE FACTORED DESIGN (LRFD) IS USED TO DESIGN THE STEEL ELEMENTS.
- b. ULTIMATE STRENGTH DESIGN (USD) IS USED TO DESIGN THE CONCRETE ELEMENTS.
- c. WORKING STRESS DESIGN (WSD) IS USED TO PARTIALLY DESIGN THE FOUNDATION.
- d. LOAD COMBINATIONS CORRESPONDING TO THE DESIGN PHILOSOPHIES MENTIONED ABOVE ARE UTILIZED WHICH ARE BASED ON THE NSCP 2015.

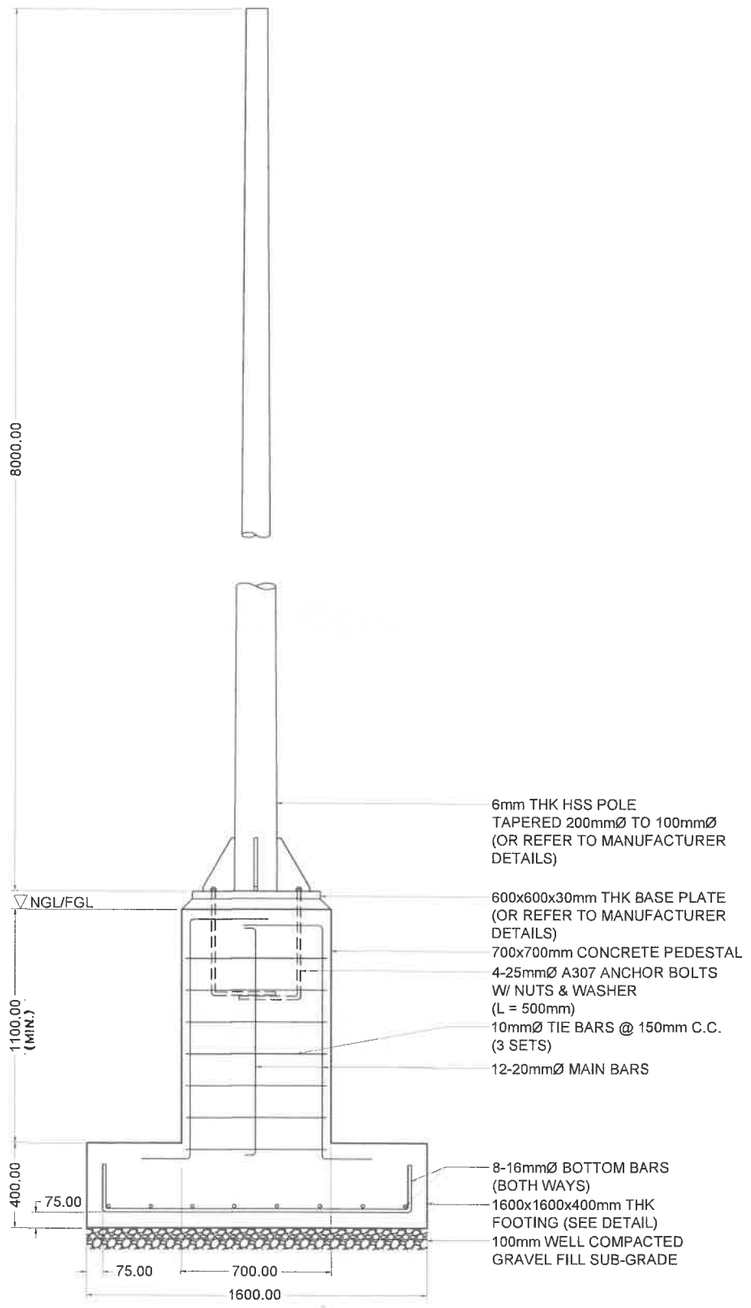
E. **NOTES ON DESIGN LOADS**
- a. IF THE ASSUMED DESIGN LOADS IS NOT APPLICABLE FOR THE REQUIRED DESIGN, THE DESIGN SHALL BE REVISED ACCORDINGLY.

F. **NOTES ON FOUNDATION**
- a. THE FOUNDATION IS DESIGNED FOR AN ASSUMED ALLOWABLE SOIL BEARING CAPACITY (SBC) OF 96 kPa (2000 psf). IF THE LOCATION IS KNOWN OR FOUND OUT TO HAVE AN SBC OF LESS THAN THE ASSUMED, THE FOOTING DESIGN SHALL BE REVISED ACCORDINGLY.
- b. NO FOOTING SHALL REST ON FILL. PROVIDE 100mm THICK PROPERLY WELL COMPACTED GRAVEL BED BEFORE CASTING

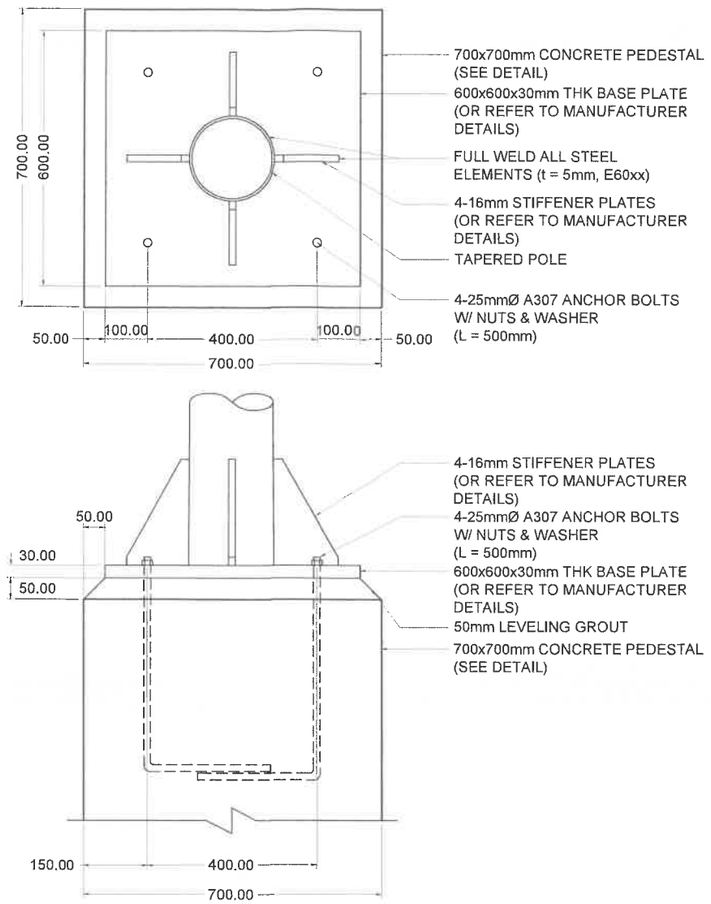
G. **NOTES ON ASSEMBLY**
- a. MANUFACTURER MAY SUPPLY A PRE-ASSEMBLED STEEL POST WITH ACCESSORIES (MAST ARM, STIFFENERS, AND/OR BASE PLATE) PROVIDED THAT ITS DESIGN IS SUFFICIENT FOR THE DESIGN LOADS AND MATERIAL STRENGTHS PROVIDED IN THE ITEMS ABOVE.
- b. DESIGN CALCULATIONS/SPECIFICATIONS OF THE PRE-ASSEMBLED STEEL POST MUST BE SUBMITTED TO THE ENGINEER FOR APPROVAL PRIOR INSTALLATION.

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
HIGHWAYS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

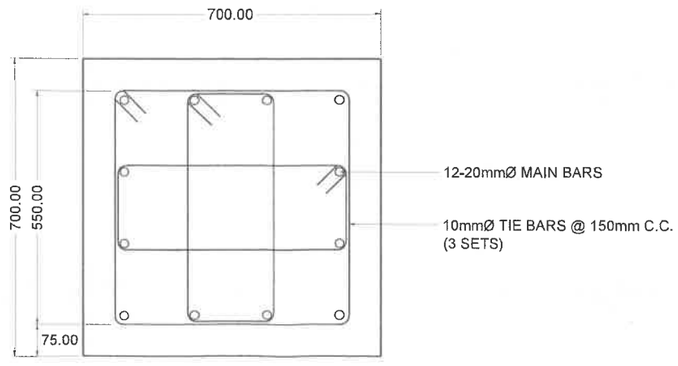
SHEET TITLE:	GUIDELINES AND STANDARD DESIGN DRAWINGS FOR SOLAR-POWERED ROADWAY LIGHTING
SHEET CONTENTS:	- DESIGN CRITERIA - FOUNDATION ELEVATION - BASE PLATE DETAIL FOR 12M POLE - STIFFENER DETAIL - PEDESTAL DETAIL
PREPARED BY:	LEVINCCI D. TAN, ENGINEER II
CAD BY:	BIANCA G. DELA CERNA, ENGINEERING ASSISTANT
REVIEWED BY:	WILFREDO S. VALLO, ENGINEER IV, SECTION CHIEF
SUBMITTED:	ERIBERTO B. SIOSON, CHIEF - BUILDINGS DIVISION, B.O.D. — DATE
RECOMMENDING APPROVAL:	EDWIN C. MATANGUIHAN, O.I.C. - DIRECTOR, BUREAU OF DESIGN — DATE FEB 06 2023
	(SEE COVER SHEET) ERIC A. AYAPANA, ASSISTANT SECRETARY FOR INFORMATION MANAGEMENT AND TECHNICAL SERVICES — DATE
APPROVED:	(SEE COVER SHEET) MAXIMO L. CARVAJAL, UNDERSECRETARY FOR INFORMATION MANAGEMENT AND TECHNICAL SERVICES — DATE
SET NO.	S 1 | 4
SHEET NO.	6 | 11



1 S-2 **FOUNDATION ELEVATION**
SCALE 1:20 MTS.



2 S-2 **BASE PLATE DETAIL FOR 8M POLE**
SCALE 1:10 MTS.



3 S-2 **PEDESTAL DETAIL**
SCALE 1:10 MTS.

DESIGN CRITERIA

A. **REFERENCES**
- a. NATIONAL STRUCTURAL CODE OF THE PHILIPPINES (NSCP), 7TH EDITION (2015)
- b. AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE) 360
- c. AMERICAN CONCRETE INSTITUTE (ACI) 318
- d. AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC) 360

B. **DESIGN LOADS**

a. DEAD LOAD		
	i. CONCRETE	24 kN/m^3
	ii. STEEL	77 kN/m^3
	iii. SOIL	18 kN/m^3
	iv. POLE ATTACHMENTS	50 kg
b. WIND LOAD		
	i. WIND SPEED	340 kph
	ii. EXPOSURE CATEGORY	D
	iii. DIRECTIONALITY FACTOR	0.85
	iv. OCCUPANCY CATEGORY	V (MISCELLANEOUS STRUCTURES)

C. **MATERIALS**

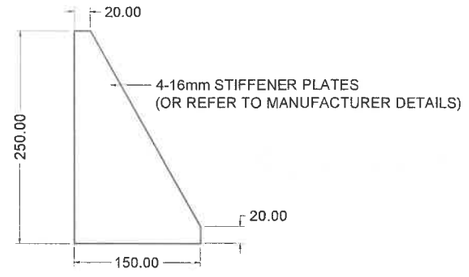
a. NORMAL WEIGHT CONCRETE		F'_c = 28 MPa (4000 psi)
b. REINFORCING STEEL		
	i. 12MMØ AND BELOW	F_y = 276 MPa (Grade 40)
	ii. 16MMØ AND ABOVE	F_y = 414 MPa (Grade 60)
c. STRUCTURAL STEEL		
	i. STEEL POLE	F_y = 240 MPa (A53 GRADE B) F_u = 415 MPa
	ii. BASE PLATE & STIFFENER	F_y = 248 MPa (A36) F_u = 400 MPa
d. STRUCTURAL BOLTS AND FASTENERS		F_{nt} = 310 MPa (A307) F_{nv} = 165 MPa
e. WELDS		E60xx ELECTRODE

D. **DESIGN APPROACH**
- a. LOAD AND RESISTANCE FACTORED DESIGN (LRFD) IS USED TO DESIGN THE STEEL ELEMENTS.
- b. ULTIMATE STRENGTH DESIGN (USD) IS USED TO DESIGN THE CONCRETE ELEMENTS.
- c. WORKING STRESS DESIGN (WSD) IS USED TO PARTIALLY DESIGN THE FOUNDATION.
- d. LOAD COMBINATIONS CORRESPONDING TO THE DESIGN PHILOSOPHIES MENTIONED ABOVE ARE UTILIZED WHICH ARE BASED ON THE NSCP 2015.

E. **NOTES ON DESIGN LOADS**
- a. IF THE ASSUMED DESIGN LOADS IS NOT APPLICABLE FOR THE REQUIRED DESIGN, THE DESIGN SHALL BE REVISED ACCORDINGLY.

F. **NOTES ON FOUNDATION**
- a. THE FOUNDATION IS DESIGNED FOR AN ASSUMED ALLOWABLE SOIL BEARING CAPACITY (SBC) OF 96 kPa (2000 psf). IF THE LOCATION IS KNOWN OR FOUND OUT TO HAVE AN SBC OF LESS THAN THE ASSUMED, THE FOOTING DESIGN SHALL BE REVISED ACCORDINGLY.
- b. NO FOOTING SHALL REST ON FILL. PROVIDE 100mm THICK PROPERLY WELL COMPACTED GRAVEL BED BEFORE CASTING

G. **NOTES ON ASSEMBLY**
- a. MANUFACTURER MAY SUPPLY A PRE-ASSEMBLED STEEL POST WITH ACCESSORIES (MAST ARM, STIFFENERS, AND/OR BASE PLATE) PROVIDED THAT ITS DESIGN IS SUFFICIENT FOR THE DESIGN LOADS AND MATERIAL STRENGTHS PROVIDED IN THE ITEMS ABOVE.
- b. DESIGN CALCULATIONS/SPECIFICATIONS OF THE PRE-ASSEMBLED STEEL POST MUST BE SUBMITTED TO THE ENGINEER FOR APPROVAL PRIOR INSTALLATION.



4 S-2 **STIFFENER DETAIL**
SCALE 1:5MTS.

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
HIGHWAYS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET TITLE:	GUIDELINES AND STANDARD DESIGN DRAWINGS FOR SOLAR-POWERED ROADWAY LIGHTING
SHEET CONTENTS:	- DESIGN CRITERIA - FOUNDATION ELEVATION - BASE PLATE DETAIL FOR 12M POLE - STIFFENER DETAIL - PEDESTAL DETAIL
PREPARED BY:	LUVINCCI D. TAN, ENGINEER II
CAD BY:	FRANCIS DELY CERNA, ENGINEERING ASSISTANT
REVIEWED BY:	ALFREDO S. VALLO, ENGINEER IV/SECTION CHIEF
SUBMITTED:	ERIBERTO B. SIOSON, CHIEF - BUILDINGS DIVISION, B.O.D. — DATE
RECOMMENDING APPROVAL:	EDWIN C. MATANGUIHAN, O.I.C. - DIRECTOR, BUREAU OF DESIGN — DATE FEB 06 2023
	(SEE COVER SHEET) ERIC A. AYAPANA, ASSISTANT SECRETARY FOR INFORMATION MANAGEMENT AND TECHNICAL SERVICES — DATE
APPROVED:	(SEE COVER SHEET) MAXIMO L. CARVAJAL, UNDERSECRETARY FOR INFORMATION MANAGEMENT AND TECHNICAL SERVICES — DATE
SET NO.	S 2 4
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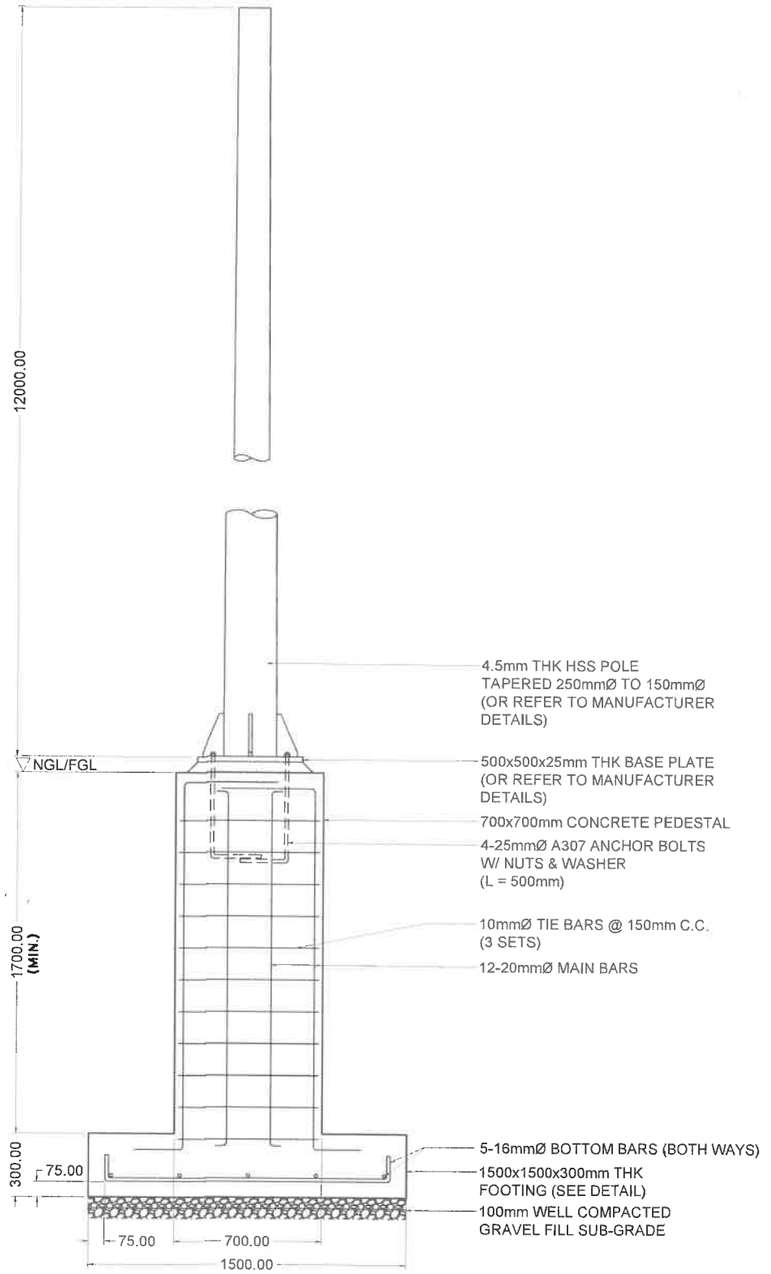
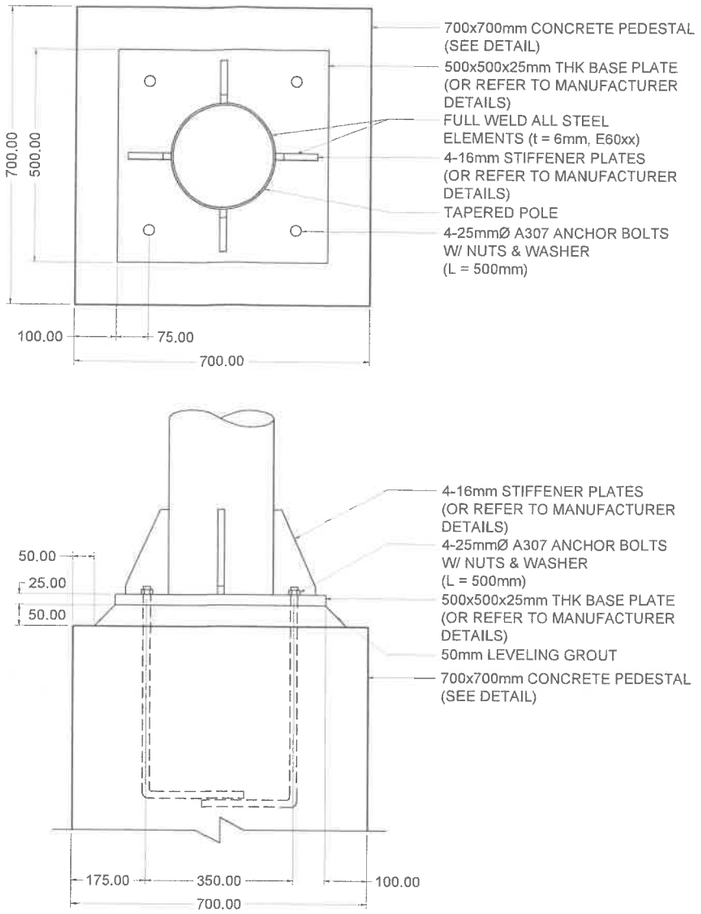
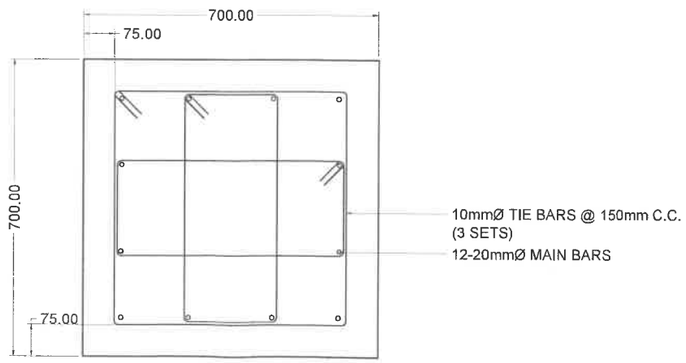


1 S-1 **FOUNDATION ELEVATION**
SCALE 1:20 MTS.



2 S-1 **BASE PLATE DETAIL FOR 12M POLE**
SCALE 1:10 MTS.



3 S-1 **PEDESTAL DETAIL**
SCALE 1:10 MTS.

DESIGN CRITERIA

A. **REFERENCES**
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- c. AMERICAN CONCRETE INSTITUTE (ACI) 318
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B. **DESIGN LOADS**

a.	DEAD LOAD	
i.	CONCRETE	24 kN/m³
ii.	STEEL	77 kN/m³
iii.	SOIL	18 kN/m³
iv.	POLE ATTACHMENTS	50 kg
b.	WIND LOAD	
i.	WIND SPEED	250 kph
ii.	EXPOSURE CATEGORY	D
iii.	DIRECTIONALITY FACTOR	0.85
iv.	OCCUPANCY CATEGORY	V (MISCELLANEOUS STRUCTURES)

C. **MATERIALS**

a.	NORMAL WEIGHT CONCRETE	F_c = 28 MPa (4000 psi)
b.	REINFORCING STEEL	
i.	12MMØ AND BELOW	F_y = 276 MPa (Grade 40)
ii.	16MMØ AND ABOVE	F_y = 414 MPa (Grade 60)
c.	STRUCTURAL STEEL	
i.	STEEL POLE	F_y = 240 MPa (A53 GRADE B) F_u = 415 MPa
ii.	BASE PLATE & STIFFENER	F_y = 276 MPa (A36) F_u = 400 MPa
d.	STRUCTURAL BOLTS AND FASTENERS	F_{nt} = 310 MPa (A307) F_{nv} = 165 MPa
e.	WELDS	E60xx ELECTRODE

D. **DESIGN APPROACH**
- a. LOAD AND RESISTANCE FACTORED DESIGN (LRFD) IS USED TO DESIGN THE STEEL ELEMENTS.
- b. ULTIMATE STRENGTH DESIGN (USD) IS USED TO DESIGN THE CONCRETE ELEMENTS.
- c. WORKING STRESS DESIGN (WSD) IS USED TO PARTIALLY DESIGN THE FOUNDATION.
- d. LOAD COMBINATIONS CORRESPONDING TO THE DESIGN PHILOSOPHIES MENTIONED ABOVE ARE UTILIZED WHICH ARE BASED ON THE NSCP 2015.

E. **NOTES ON DESIGN LOADS**
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F. **NOTES ON FOUNDATION**
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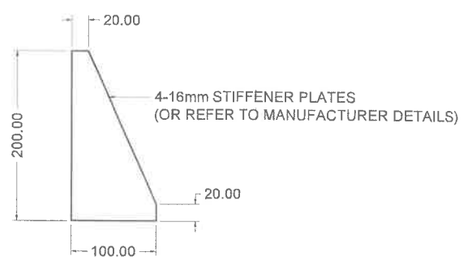
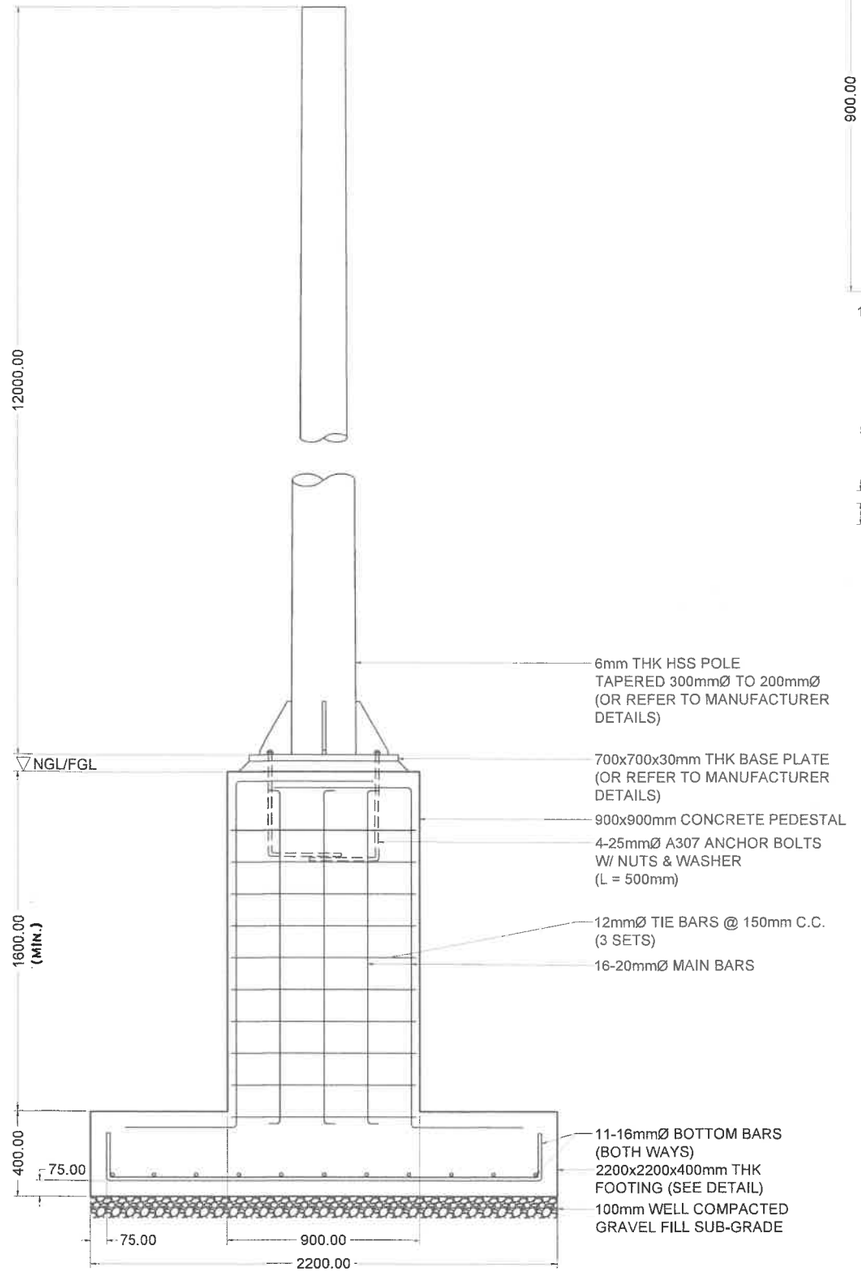


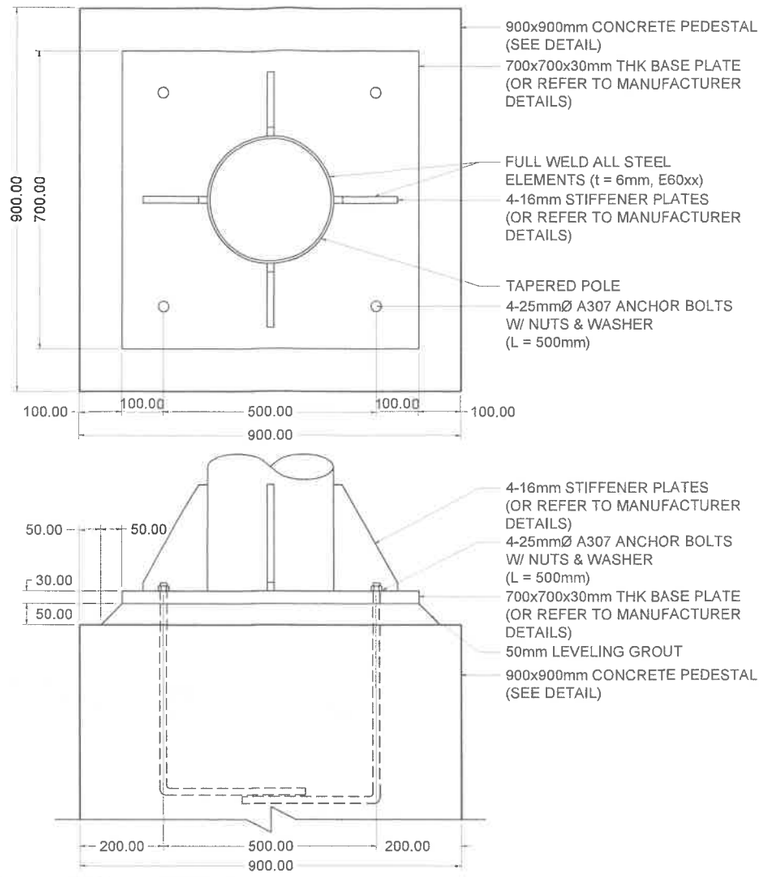
4 S-1 **STIFFENER DETAIL**
SCALE 1:5MTS.

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
HIGHWAYS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

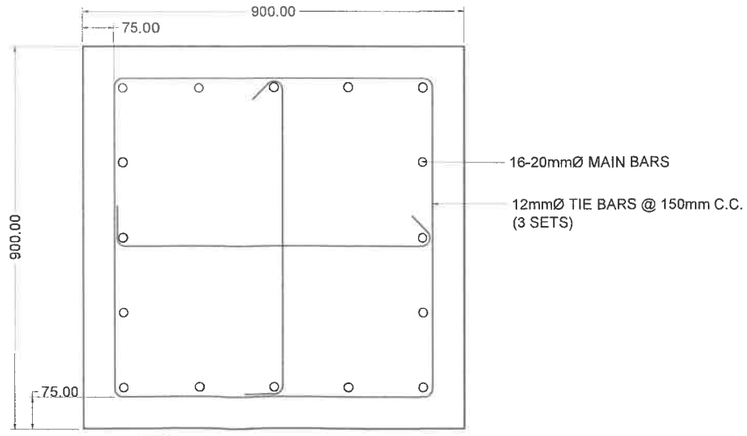
SHEET TITLE:	SHEET CONTENTS:	PREPARED BY:	SUBMITTED:	RECOMMENDING APPROVAL:		APPROVED:	SET NO.	SHEET NO.
GUIDELINES AND STANDARD DESIGN DRAWINGS FOR SOLAR-POWERED ROADWAY LIGHTING	- DESIGN CRITERIA - FOUNDATION ELEVATION - BASE PLATE DETAIL FOR 12M POLE - STIFFENER DETAIL - PEDESTAL DETAIL	LUVINCO D. TAN ENGINEER II CAD BY: EDUARDO S. DELA CERNA ENGINEERING ASSISTANT REVIEWED BY: WILFREDO S. VALLO ENGINEER V, SECTION CHIEF	ERIBERTO B. SIOSON CHIEF - BUILDINGS DIVISION, B.O.D. DATE	EDWIN C. MATANGUIHAN OIC - DIRECTOR, BUREAU OF DESIGN DATE FEB 06 2023	(SEE COVER SHEET) ERIC A. AYAPANA ASSISTANT SECRETARY FOR INFORMATION MANAGEMENT AND TECHNICAL SERVICES DATE	(SEE COVER SHEET) MAXIMO L. CARVAJAL UNDERSECRETARY FOR INFORMATION MANAGEMENT AND TECHNICAL SERVICES DATE	S 3 4	8 11



1 S-1 **FOUNDATION ELEVATION**
SCALE 1:20 MTS.



2 S-1 **BASE PLATE DETAIL FOR 12M POLE**
SCALE 1:10 MTS.



3 S-1 **PEDESTAL DETAIL**
SCALE 1:10 MTS.

DESIGN CRITERIA

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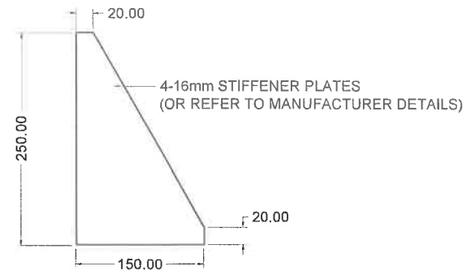

4 S-1 **STIFFENER DETAIL**
SCALE 1:5MTS.

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
HIGHWAYS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET TITLE:	GUIDELINES AND STANDARD DESIGN DRAWINGS FOR SOLAR-POWERED ROADWAY LIGHTING
SHEET CONTENTS:	- DESIGN CRITERIA - FOUNDATION ELEVATION - BASE PLATE DETAIL FOR 12M POLE - STIFFENER DETAIL - PEDESTAL DETAIL

PREPARED BY:	LUVINCCI D. TAN ENGINEER II	
CAD BY:	BIANCA G. DELA CERNA ENGINEERING ASSISTANT	
REVIEWED BY:	WILFREDO S. VALLO ENGINEER III / SECTION CHIEF	
SUBMITTED:	ERIBERTO B. SIOSON CHIEF - BUILDINGS DIVISION, B.O.D. DATE	
RECOMMENDING APPROVAL:	EDWIN C. MATANGUINAN D.C. - DIRECTOR , BUREAU OF DESIGN DATE FEB 06 2023	(SEE COVER SHEET) ERIC A. AYAPANA ASSISTANT SECRETARY FOR INFORMATION MANAGEMENT AND TECHNICAL SERVICES DATE
APPROVED:	(SEE COVER SHEET) MAXIMO L. CARVAJAL UNDERSECRETARY FOR INFORMATION MANAGEMENT AND TECHNICAL SERVICES DATE	
SET NO.	S 4|4	
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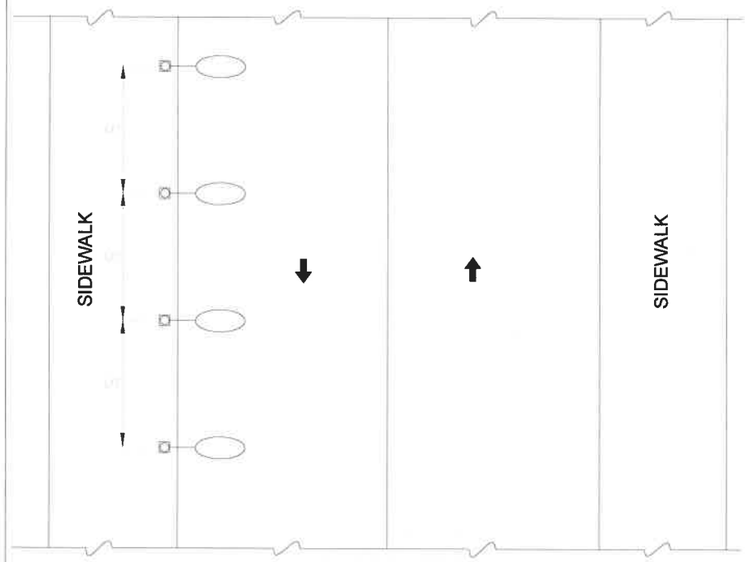
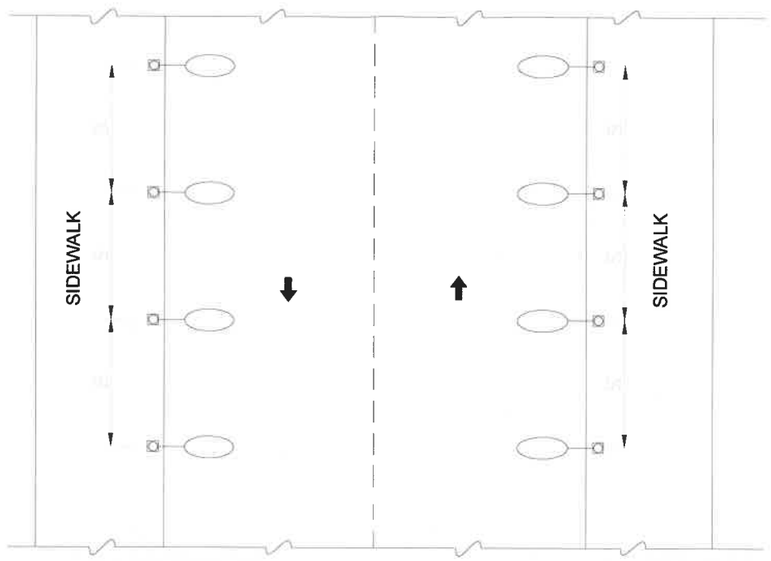
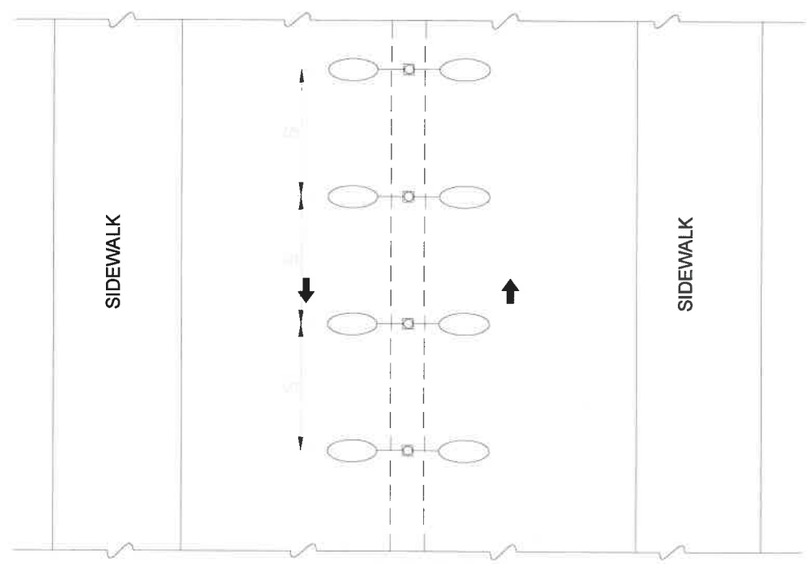
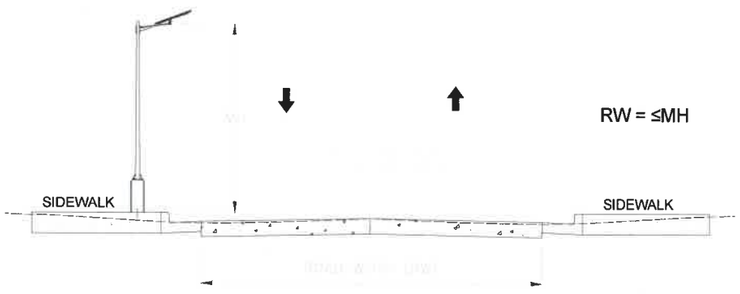




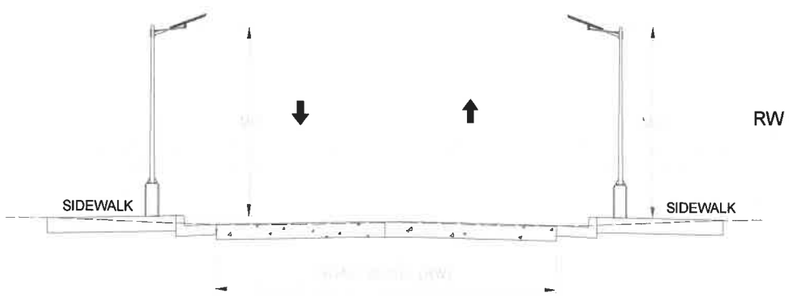


LIGHTING LAYOUT

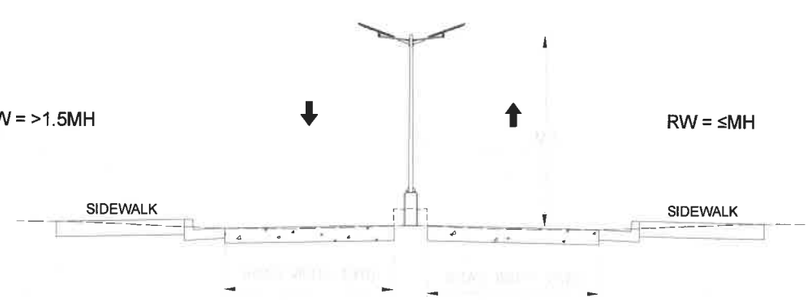
NOT TO SCALE



SINGLE - SIDED LIGHTING ARRANGEMENT



OPPOSITE LIGHTING ARRANGEMENT



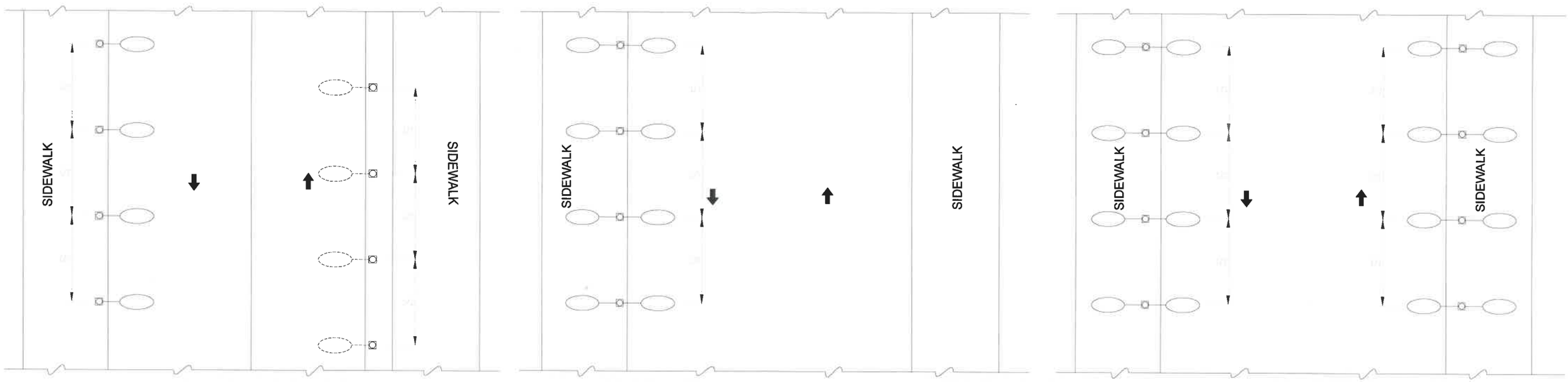
AXIAL LIGHTING ARRANGEMENT

E-2 / 1 TYPICAL CROSS-SECTION OF STREETLIGHTING

NOT TO SCALE

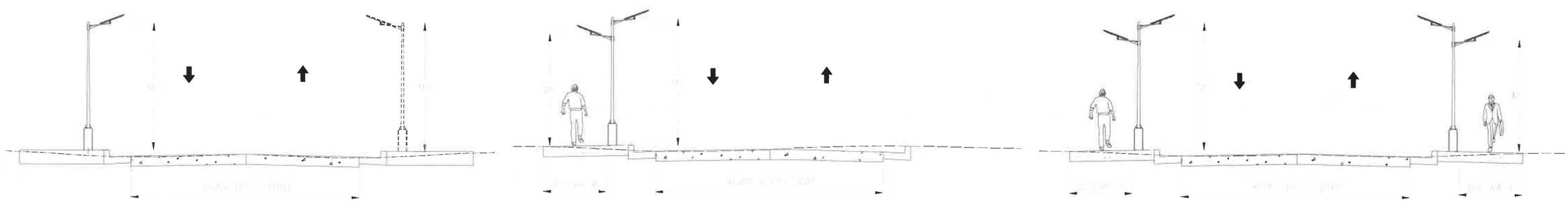
REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
HIGHWAYS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET TITLE:	SHEET CONTENTS:	PREPARED BY:	SUBMITTED:	RECOMMENDING APPROVAL:	APPROVED:	SET NO.	SHEET NO.
GUIDELINES AND STANDARD DESIGN DRAWINGS FOR SOLAR-POWERED ROADWAY LIGHTING	TYPICAL CROSS-SECTION OF STREETLIGHTING	ISLEA C. SALVADOR, ENGINEER II (LEE) DRAWN BY: HONEE KIMBERLY S. GIMPAYA, DRAFTSMAN REVIEWED BY: JONATHAN A. SANTIAGO, OIC-ENGINEER IV, SECTION CHIEF	ROMEL C. RAAGAS, CHIEF - HIGHWAYS DIVISION, B.O.D. DATE	EDWIN C. MATANGUIHAN, O.I.C. - DIRECTOR, BUREAU OF DESIGN DATE FEB 06 2023 (SEE COVER SHEET) ERIC A. AYAPANA, ASSISTANT SECRETARY FOR INFORMATION MANAGEMENT AND TECHNICAL SERVICES DATE	(SEE COVER SHEET) MAXIMO L. CARVAJAL, UNDERSECRETARY FOR INFORMATION MANAGEMENT AND TECHNICAL SERVICES DATE	E 2 3	10 11



LIGHTING LAYOUT

NOT TO SCALE



STAGGERED LIGHTING ARRANGEMENT

SINGLE - SIDED LIGHTING ARRANGEMENT
(WITH SIDEWALK)

OPPOSITE LIGHTING ARRANGEMENT
(WITH SIDEWALK)

E-3 / 1 TYPICAL CROSS-SECTION OF STREETLIGHTING WITH SIDEWALK

NOT TO SCALE

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
HIGHWAYS DIVISION
BONIFACIO DRIVE, PORT AREA, MANILA

SHEET TITLE:	SHEET CONTENTS:	PREPARED BY:	SUBMITTED:	RECOMMENDING APPROVAL:		APPROVED:	SET NO.	SHEET NO.
GUIDELINES AND STANDARD DESIGN DRAWINGS FOR SOLAR-POWERED ROADWAY LIGHTING	TYPICAL CROSS-SECTION OF STREETLIGHTING WITH SIDEWALK	JESUS C. SALVADOR, ENGINEER II (EP) DRAWN BY: HONEE KIMBERLY S. GIMPAYA, DRAFTSMAN I REVIEWED BY: JONATHAN A. SANTIAGO, OIC-ENGINEER IV, SECTION CHIEF	ROMEO C. RAAGAS CHIEF - HIGHWAYS DIVISION, B.O.D. DATE	EDWIN C. MATANGUIHAN O.I.C. - DIRECTOR, BUREAU OF DESIGN DATE FEB 0 6 2023	(SEE COVER SHEET) ERIC A. AYAPANA ASSISTANT SECRETARY FOR INFORMATION MANAGEMENT AND TECHNICAL SERVICES DATE	(SEE COVER SHEET) MAXIMO L. CARVAJAL UNDERSECRETARY FOR INFORMATION MANAGEMENT AND TECHNICAL SERVICES DATE	E 3 | 3	11 11