Internship Program Report
By

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GUDLAVALLERU ENGINEERING COLLEGE
(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)
(Sponsored by A. A. N. M & V. V. R. S. R Educational Society, Gudlavalleru)
Approved by AICTE, New Delhi and Permitted by AP State Government
Accredited by NAAC with 'A' Grade
Counselling Code : GDLV

In association with

Smart Internz

Contents

Introduction

Internship program arranged by GUDLAVALLERU ENGINEERING COLLEGE in association with Smart Internz, Hyderabad for the benefit of 3rd /4th year EEE batch 2018-2022 on Electrical Detailed design Engineering for Oil& Gas, Power and Utility industrial sectors.

Program organiser

Smart Bridge, Hyderabad.

Pioneer in organising Internships, knowledge workshops, debates, hackathons, technical sessions and Industrial Automation projects.

Courtesy

Dr. Sri B. Dasu – HOD – EEE, GEC

Mr. Rama Krishna –Coordinator

Mr. Ramesh V - Mentor

Mr. Vinay Kumar - System Support

Mr. Harikanth – Software/Technical Support

Program details

Smart Internz program schedule: 4 weeks starting from 3rd May 2021

Daily schedule time shall be 4PM to 6.30PM

Mode of Classes: Online through ZOOM

Presenter: Mr Ramesh V

Internship program

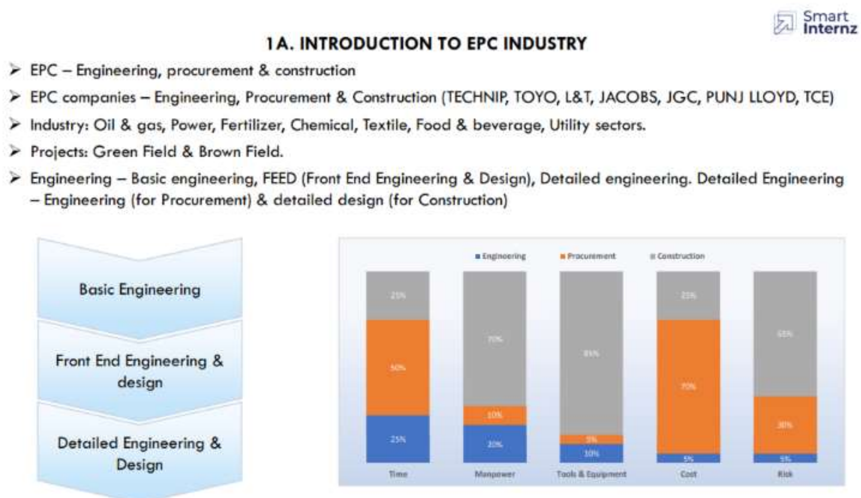
We have been given the opportunity to learn and interact with industry experienced engineering specialist to learn the Electrical detailed design engineering for various industrial sectors.

3rd May2021: Introduction to EPC Industry

1	EPC Industry & Electrical Detailed Engineering	EPC Industry	Introduction
		Engineering	Types of Engineering
		Procurement	Engineering role in procurement
		Construction	Engineering role during construction

Topic details:

Engineering phases, Engineering deliverables (drawings & documents) list, Design Engineer role at various phases of project.

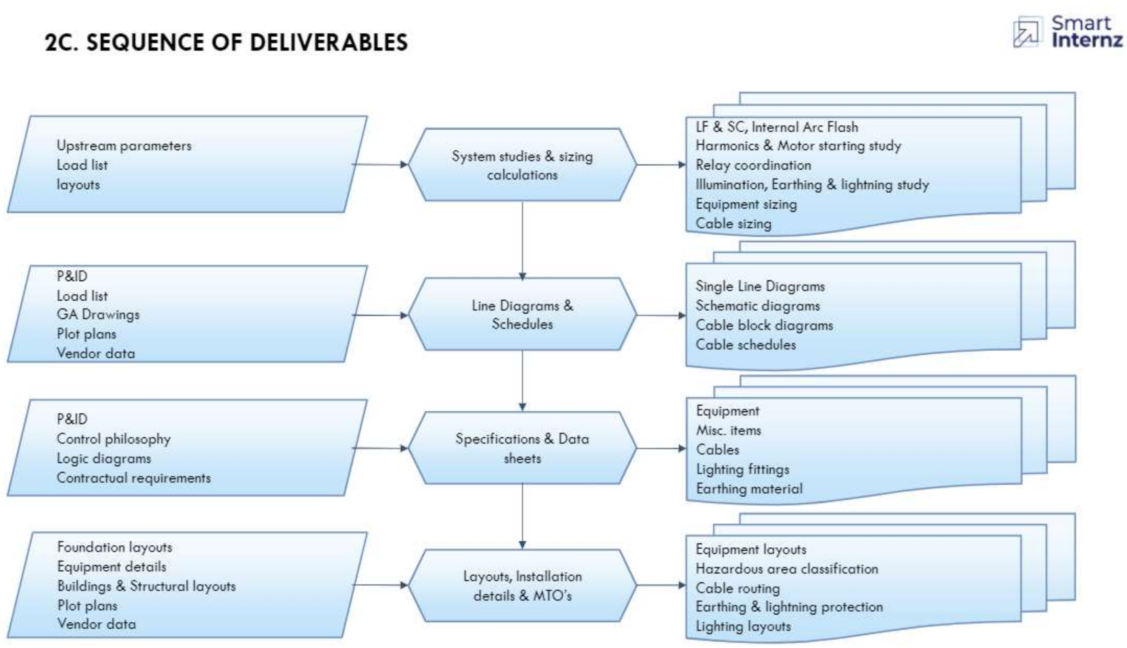


Here we get to know about EPC. EPC (Engineering, Procurement & Construction) is a prominent form of contracting agreement in the construction industry. EPC industry are companies who are involved in executing projects involving multiple engineering disciplines with overall responsibility for the performance of a "unit" or the whole plant.

4th May2021: Engineering documentation for EPC projects

2	Electrical Design Documentation	Engineering Deliverables list	Sequence of deliverables
		Detailed Engineering workflow	Detailed engineering process
		Document transmission	Document submission and info exchange
		Deliverables types	Different types of deliverables

Topic details:



We learned that Engineering deliverables are the final product from project Engineering Management discipline and are the results from the Engineering and Project Engineering disciplines work.

The project and technical information must be exchanged between various domains and linearity must be maintained in the workflow. The sequence of deliverables must be identified and followed.

5th May2021: Engineering documentation for commands and formulae

3	Document & Drawing tools	MS Word	Report / Calculations formats
		MS Excel	Basic excel commands
		AutoCAD	Basic line diagrams and layout commends

Topic details:

MS Word, Excel, and Auto CAD Commands.

3C. AUTOCAD BASIC COMMANDS

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AUTOCAD BASIC KEYS							
STANDARD		DRAW		MODIFY		FORMAT	
NEW	Ctrl+N	LINE	L	ERASE	E	PROPERTIES	MO
OPEN	Ctrl+O	RAY	RAY	COPY	CO	SELECT COLOR	COL
SAVE	Ctrl+S	PLINE	PL	MIRROR	MI	LAYER	LA
PLOT	Ctrl+P	3DPOLY	3P	OFFSET	O	LINETYPE	LT
PLOT PREVIEW	PRE	POLIGONE	POL	ARRAY	AR	LINEWEIGHTS	LW
CUT	Ctrl+X	RECTANGLE	REC	MOVE	M	LT SCALE	LTS
COPY	Ctrl+C	ARC	A	ROTATE	RO	LIST	LI
PASTE	Ctrl+V	CIRCLE	C	SCALE	SC	DIMEN. STYLE	D
MATCH PROPE.	MA	SPLINE	SPL	STRECH	S	RENAME	REN
CLOSE	Ctrl+F4	ELLIPSE	EL	TRIM	TR	OPTION	OP
EXIT	Ctrl+Q	BLOCK	B	EXTENED	EX		
		POINT	PO	BRAKE	BR		
		HATCH	H	CHAMFER	CHA		
		GRADIENT	GD	FILLET	F		
		REGION	REG	EXPLODE	X		
		BOUNDARY	BO				
		DONUT	DO				

EXTRA				DRAFTING		PAPER SIZE
UNIT	UN	UCS	UCS	ORTHO	F8, Ctrl+L	A4=210*297
LIMITS	LIMITS	SINGLE TEXT	DT	OSNAP	F3, Ctrl+F	A3=297*420
(0,0; 1000,1000)		MULTILINE TEXT	MT	POLAR	F10, Ctrl+U	A2=420*594
ZOOM	Z	EDIT TEXT	ED	GRID	F7, Ctrl+G	A1=594*841
ALL	A	OBJECT SNAP	OB	OTRACK	F11	A0=841*1189
PAN	P	DIMENTION	DIM	SNAP	F9	
CLEAN SCREEN	Ctrl+0	HORIZONTAL	HOR			
COMMAMD WIN	Ctrl+9	VERTICAL	VER			

By using the commands, we can make document clearer and easier to understand. Shortcut keys reduces consumption of time and it is more flexible to create a document with shortcut keys rather than cursor usage.

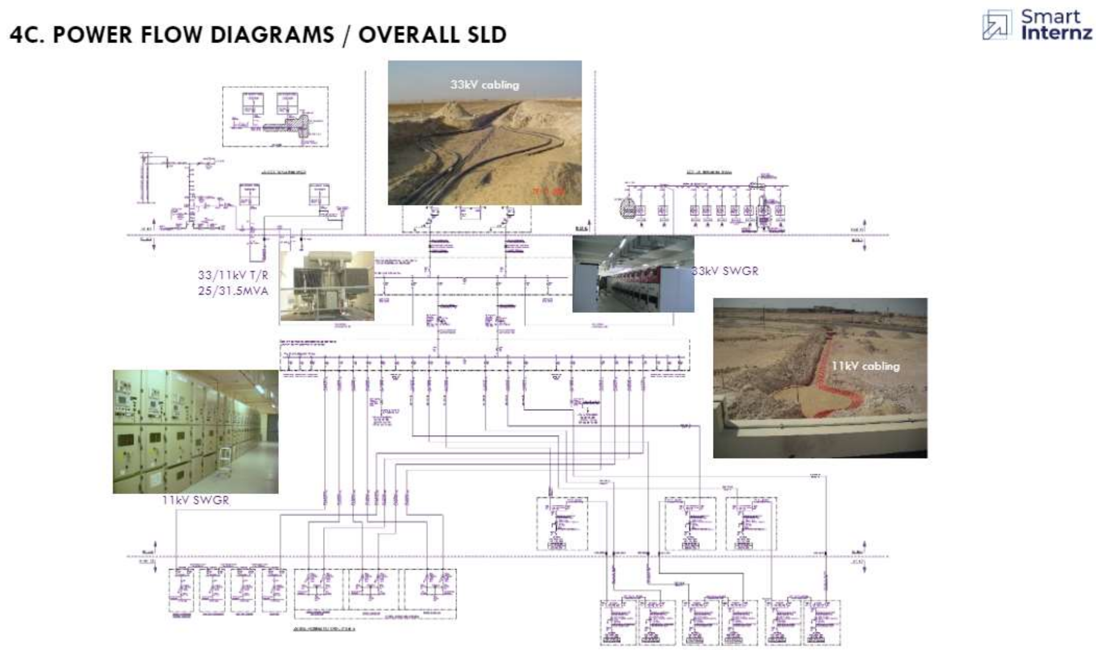
AUTOCAD commands are used to make project. These helps us to know about AUTOCAD workspace.

7th May 2021: Engineering documentation for Electrical system design

4	Estimation of Plant Electrical Load & SLD	Load List / Power balance	Load / Maximum demand calculation
		Single Line Diagram	Development of SLD
		Power Distribution system	Various power distribution systems

Topic details:

Overall plant description, approach to detailed design.



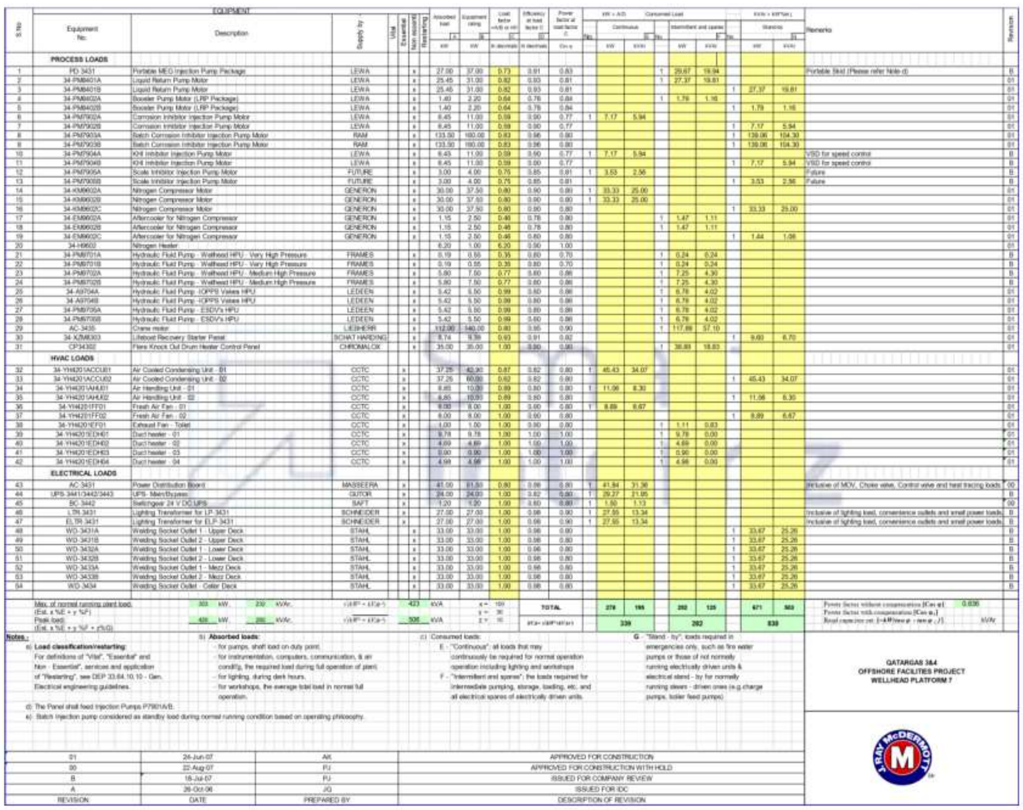
We observed that how to do a project and Sequence of approach to detail designand Overall plant distribution system. Importance of Single Line Diagram is described.

10th May 2021: Engineering documentation for Typical diagrams

5	Electrical system design for typical diagrams	Load lists schedule	Power flow diagram
		Single line diagram	Typical schematic diagram

Topic details:

Typical diagrams and Load calculations.



We learned how to do load calculations, draw and illustrate Typical diagrams, internal structure and also about the power flow diagram.

11th May 2021: Classification of Transformers and Generators

6	Classification of Transformers and Generators	Different types of Transformers	Different types of Generators

Topic details:

Classification of Transformers and Generators.

Transformers can be classified on different basis, like types of construction, types of cooling etc. Transformers are sized to carry the peak running load of all busses connected to them. In addition, feeders to and from power transformers shall be rated to carry full current at the maximum rating.

The packaged combination of a diesel engine, an alternator, and various ancillary devices such as base, canopy, sound attenuation, control systems, circuit breakers, jacket water heaters, starting systems etc., is referred to as a Diesel Generating Set or a DG Set in short.

12th May 2021: Classification of Switchgear, construction, and power factor improvement.

7	Classification of Switchgear construction andpower factor improvement	Different types of Switchgear assembles	Power factor improvement

Topic details:

Classification of Switchgear construction and Power Factor Improvement.

Switchgear includes switching & protecting devices like fuses, switches, CTs, VTs, relays, circuit breakers, etc. This device allows operating devices like electrical equipment, generators, distributors, transmission lines, etc. Once the short circuit occurs within the power system, then a huge current will flow through the devices. So that the equipment can be damaged & the interruption will occur to the operators. To overcome this problem, it is used to detect the fault in the power system to protect humans and equipment.

There are three types of switch gears namely LV (Low voltage), MV (Medium voltage) and HV (High voltage) Switchgear.

17th May 2021: Detailing about UPS system and Busducts.

8	Detailing about UPS system andBusducts	Uninterruptible power supply system	Busducts of the system

Topic details:

Power distribution of UPS system and Busducts.

An uninterruptible power supply or uninterruptible power source (UPS) is an electrical apparatus that provides emergency power to a load when the input power source or mains power fails. It is a type of continual power system. UPS systems shall be two types:

- ACUPS–48V,110V,230VSinglephase&415Vthreephase
- DCUPS–24V48V,110V,220V

A sheet metal duct with aluminium or copper bus bars as conductor and used as are liable link for transferring power from one equipment to other at desired voltage levels, used as an alternate means for conducting electricity to cable bus and power cables. Bus ducts are classified into various types depending on its application they are:

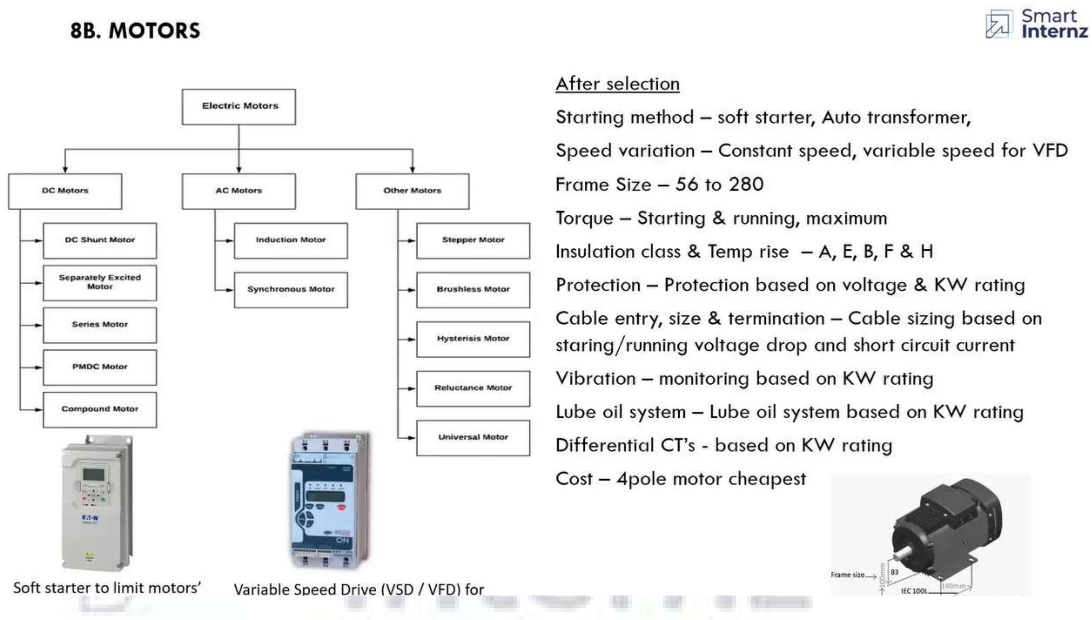
- Phase separated Busducts.
- Segregated phase busducts
- Non-segregated phase busducts

18th May 2021: Detailing about Earthing system and Lighting Protection.

9	Detailing about Motor Starters and Sizing of motors	Motor starters and drives	Sizing and selection of motors

Topic details:

Detailing about Motor Starter and Sizing of motors and their selection.



The principal function of a motor starter is to start and stop the respective motor connected withspecially designed electromechanical switches which are similar in some ways to relays. The main difference between a relay and a starter is that a starter has overload protection for the motor that is missing in a relay.

Different types of motor starters are as follows:

- Direct-On-Line Starter
- Rotor Resistance Starter
- Stator Resistance Starter
- Auto Transformer Starter

Motor Sizing

LV motors - based on driven equipment shaft power + 10 -15% margin to select nearest standard size.

MV Motors - based on driven equipment shaft power + 5 -10% margin and rounded off to nearest 10s.

Voltage: 0.18 to 160kW LV, 200 to 1800kW 3.3/6.6KV, >2000 11kV also depends on availability

19th May 2021: Describing about Earthing systems and Lighting Protection.

10	Describing aboutEarthing system and Lighting Protection.	Plant Earthing system	Lighting Protection materials

Topic details:

Describing about Earthing system and Lighting Protection.

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An **earthing system** or **grounding system** connects specific parts of an electric power system with the ground, typically the Earth's conductive surface, for safety and functional purposes. The choice of earthing system can affect the safety and electromagnetic compatibility of the installation. Regulations for earthing systems vary considerably among countries, though most follow the recommendations of the International Electrotechnical Commission. Regulations may identify special cases for earthing in mines, in patient care areas, or in hazardous areas of industrial plants.

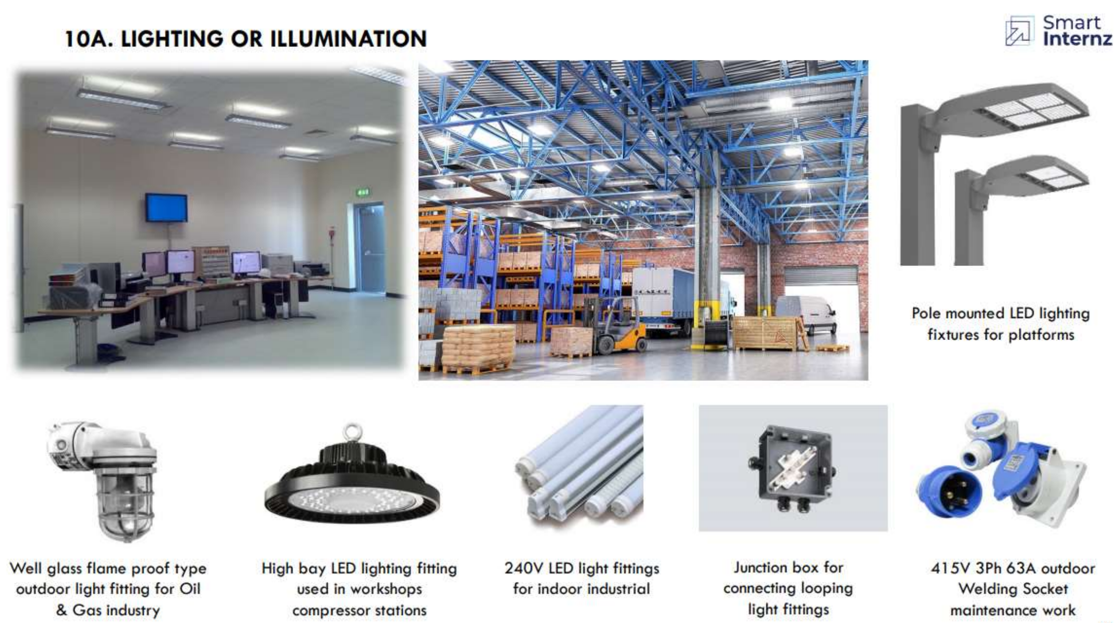
Inputs required: Lightning Protection calculations, Equipment layouts, Earthing layout.
Applicable Standards: IS 2309: Protection of buildings and allied structures against lightning,
IS 3043: Code of practice for earthing.
Deliverables: Lightning Protection Layouts, BOQ.
Installation details: Lightning arrestors, earth pits, earth flats.

20th May 2021: Lighting or illumination systems and calculations

11	Lighting or Illuminationsystems andCalculations	Lighting or illumination systems	Lighting calculations

Topic details:

Lighting or Illumination systems and Calculations.



Lighting or Illumination systems are designed based purpose, colour rendering, criticality.

Selection of type of lighting fittings shall be as follows:

- Lighting fittings shall be of energy efficient type.
- LED/HPMV lamps shall be generally used for outdoor plant lighting. HPSV lamps shall be used for street lighting and area lighting. Now a days most of the outdoor lighting are designed LED type lamps.
- LED / Fluorescent lamps shall be used for indoor lighting for non-process building and control room. All chemical handling facilities shall be provided with chemical resistant fixtures.
- All ballasts shall be with copper winding and capacitor for power factor improvement (to 0.95) shall be provided with fixtures as applicable.
- DC critical lighting shall employ incandescent lamps

21st May 2021: Lighting or illumination systems using DIALUX software.

12	Lighting or Illumination Using DIALUX software	Lighting or illumination systems	Operation of DIALUX software

Topic details:

Lighting or Illumination Calculations using DIALUX software.

11A. LIGHTING OR ILLUMINATION CALCULATIONS USING DIALUX SOFTWARE

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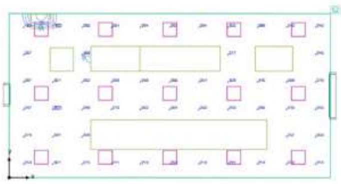
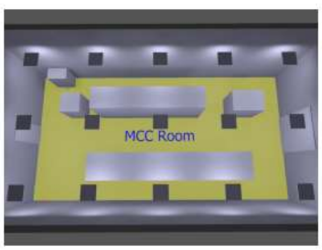
Indoor calculation results





Outdoor calculation results

Piperack

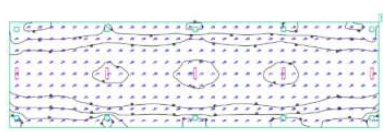
Luminaire list

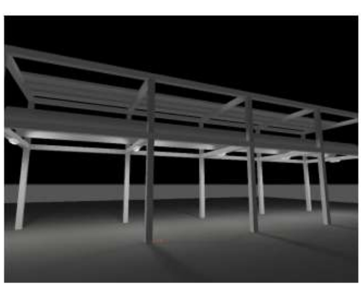
Φ_{total}	P_{total}	Luminous efficacy
15850 lm	360.0 W	44.0 lm/W

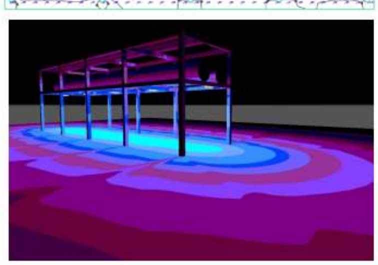
5	CEAG	12265881103	eLLK 92018/18 CG-S	72.0 W	3170 lm	44.0 lm/W

Piperack

Calculation surface





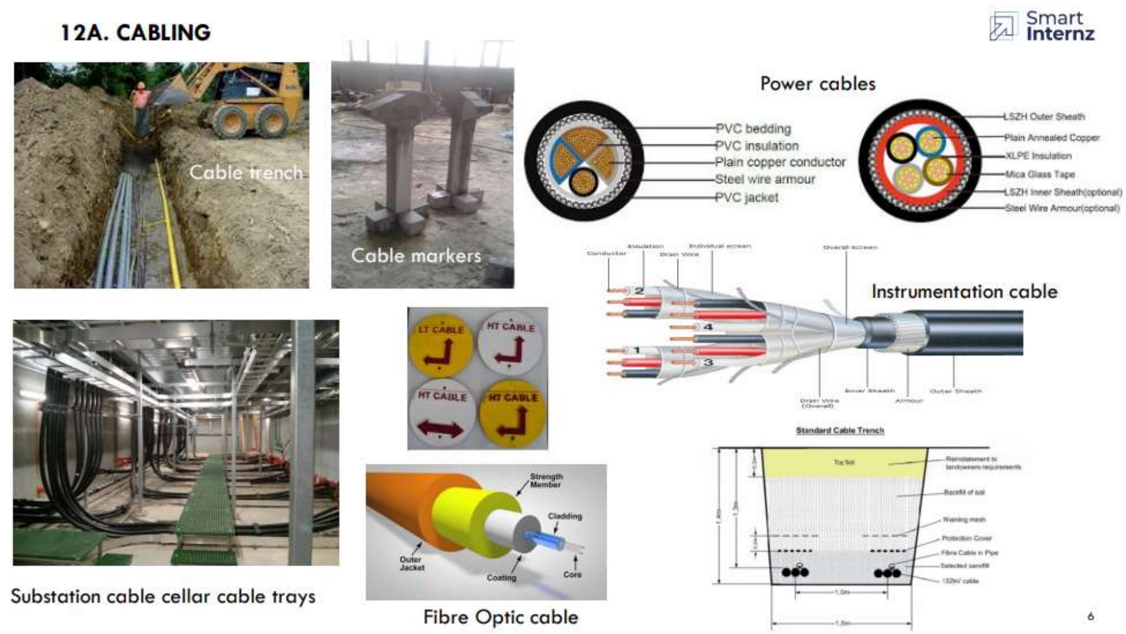


24th May 2021: Cabling and their calculations and types

13	Cabling and their types and calculations	Cabling calculations	Types of cabling materials

Topic details:

Cabling and their types and calculations.



Electrical cables must be properly supported to relieve mechanical stresses on the conductors and protected from harsh conditions such as abrasion which might degrade the insulation.

Cable trays shall be generally loaded 60 to 70% leaving space for future use. Underground cabling shall be done in concrete cable trenches with cable trays in paved areas and directly buried with mandatory gap of 300mm between different systems of cables.

The desired minimum depth of laying from ground surface to the top of cable is as follows:

Medium voltage cables: 750 to 900 mm.

High voltage cables: > 1000 mm.

Low voltage and control cables: 600 m.

Cables at road crossings: 1 m Cables at railway level crossings (measured from bottom of sleepers to the top of pipe): 1m.

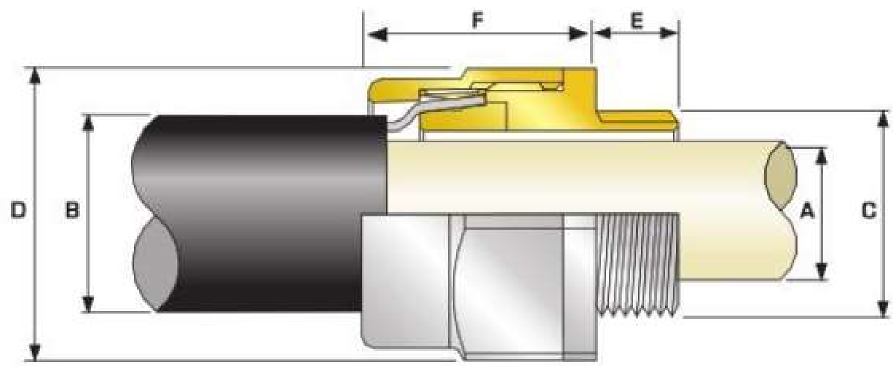
Installation details: cable trays with supports, cables, cable tags.

25th May 2021: Cabling calculations and Cable gland selection.

14	Cabling calculations and cable gland selection	Cabling calculations	Cable gland selection

Topic details:

Cable sizing calculation and cable gland selection.



Cable Gland Selection Table

Refer to illustration at the top of the page.

Cable Gland Size	Available Entry Threads "C" (Alternate Metric Thread Lengths Available)		Cable Bedding Diameter "A"	Overall Cable Diameter "B"	Armour Range		Across Flats "D"	Across Corners "D"	Protrusion Length "F"
	Metric	Thread Length (Metric) "E"	Max	Max	Min	Max	Max	Max	
20S16	M20	10.0	8.7	13.2	0.8	1.25	24.0	26.4	35.2
20S	M20	10.0	11.7	15.9	0.8	1.25	24.0	26.4	32.2
20	M20	10.0	14.0	20.9	0.8	1.25	30.5	33.6	30.6
25	M25	10.0	20.0	26.2	1.25	1.6	36.0	39.6	36.4
32	M32	10.0	26.3	33.9	1.6	2.0	46.0	50.6	32.6
40	M40	15.0	32.2	40.4	1.6	2.0	55.0	60.5	36.6
50S	M50	15.0	38.2	46.7	2.0	2.5	60.0	66.0	39.6
50	M50	15.0	44.1	53.1	2.0	2.5	70.1	77.1	39.1
63S	M63	15.0	50.0	59.4	2.0	2.5	75.0	82.5	52.0
63	M63	15.0	56.0	65.9	2.0	2.5	80.0	88.0	49.8
75S	M75	15.0	62.0	72.1	2.0	2.5	90.0	99.0	63.7
75	M75	15.0	68.0	78.5	2.5	3.0	100.0	110.0	57.3
90	M90	24.0	80.0	90.4	3.15	4.0	114.3	125.7	66.6

Cable glands are mechanical cable entry devices and can be constructed from metallic or non -metallic materials. Cable glands are used on all types of electrical power, control, instrumentation, data and telecommunications cables. They are used as a sealing and termination device to ensure that the characteristics of the enclosure which the cable enters can be maintained adequately.

28^{th} May 2021: Load calculations and Transformer sizing calculations.

15	Load calculations and TR calculations	Load calculations	TR calculations

Topic details:

List of electrical load calculations.

ELECTRICAL LOAD CALCULATIONS LV MCC

Sl. No.	Equipment No.	Equipment Description	Breaker Rating (A)	Breaker Type	Breaker No. of Poles	ELCB Rating (mA)	Absorbed Load [A] kW	Motor / Load Rating [B] kW	Load Factor [A] / [B] [C] decimal	Efficiency at Load Factor [C] [D] decimal	Power Factor at Load Factor [C] cos φ	kW = [A] / [D] Continuous kW	Continuous kVAR	Consumed Load Intermittent kW	Intermittent kVAR	kVAR = kW x tan φ Stand-by kW	Stand-by kVAR	Remarks
1	PU2315	Silica filter feed pump					14.34	15.00	0.96	0.85	0.73	16.87	15.79					
2	PU 2314-A	Absorbesnt/Neutral oil pump (W)					4.16	4.70	0.89	0.85	0.73	4.9	4.6					
3	PU 2314 -B	Absorbesnt/Neutral oil pump (S)					3.58	3.70	0.97	0.85	0.73					4.2	3.9	
4	PU2305	Feed Pump (Seperator)					14.47	15.00	0.96	0.85	0.73	17.0	15.9					
5	MX2305	MIXER (W)					14.58	15.00	0.97	0.85	0.73	17.2	16.1					
6	MX 2308	MIXER (S)					14.58	15.00	0.97	0.85	0.73					17.2	16.1	
7	BW2313	Blower					6.27	7.50	0.84	0.85	0.73	7.4	6.9					
8	Rotary valve	TK 2313B (I)					0.61	0.75	0.81	0.85	0.73			0.7	0.7			
9	SC2314	Screw conveyor (I)					1.41	1.50	0.94	0.85	0.73			1.66	1.55			
10	AG 2324A	Citric acid tan agitator (W)					1.05	1.10	0.95	0.85	0.73	1.24	1.16					
11	AG 2324B	Citric acid tank agitator (S)					1.05	1.10	0.95	0.85	0.73					1.2	1.2	
12	AG 2305	Citric oil rection vessol agitator					3.84	4.70	0.82	0.85	0.73	4.52	4.23					
13	AG 2309	Lye oil reaction vessel agitator					1.39	1.50	0.93	0.85	0.73	1.64	1.53					
14	AG 2310	Lye oil reaction vessel agitator					1.39	1.50	0.93	0.85	0.73	1.64	1.53					
15	AG 2314	Soap Adsorbant Tank Agitator					2.44	3.00	0.81	0.85	0.73	2.87	2.69					

Maximum of normal running plant load : (Est. x%E + y%F)	75.9 kW	71.1 kVAR	sqrt (kW² +kVAR²) =	104.0 kVA	TOTAL	75.21	70.42	2.38	2.22	22.60	21.16
Peak Load : (Est. x%E + y%F + z%G)	78.2 kW	73.2 kVAR	sqrt (kW² +kVAR²) =	107.1 kVA	kVA	103.03		3.26		30.96	

Assumptions

1) Load factor, Efficiency and Power factor.

Load Rating (kW)	Efficiency	Power factor
<= 20	0.85	0.73
> 20 - <= 45	0.91	0.78
> 45 - < 150	0.93	0.82
>= 150	0.94	0.91

2) Coincidence factors x= 1.0, y= 0.3, and z=0.1 considered for contnious, intermittent and standby load.

Calculation for Transformer Capacity

1.0 Example of calculation for Transformer Capacity

1.1 Calculation for consumed load

Consumed loads used for this example are as follows :

	kW	kVar	kVA	
a. Continuous load	75.21	70.4	103.03	--- (i)
b. Intermittent load / Diversity Factor	2.38	2.2	3.25	--- (ii)
c. Stand-by load required as consumed load	22.6	21.2	30.96	--- (iii)
Max. Consumed load = ((i) + 30% (ii) + 10% (iii)) =	78.2	73.2	107.10	
Future expansion load (20% capacity)	15.6	14.6	21.42	
Total Load =	93.8	87.8	128.52	

1.2 Calculation for 3.3kV / 0.433 kV transformer capacity

Max. Consumed load	=	107.1	kVA
Spare capacity	=	21.4	kVA
Required capacity	=	128.5	kVA
Transformer rated capacity	=	150	kVA

1.3 Voltage regulation check

During starting or reacceleration of max. capacity motor (3400 kW) , while all the other loads running , the voltage regulation is as follows :

P_T = 150 KVA (%Z)= 4 & Ratio X/R = 1.5 (refer table)

Hence , **%R** = = 2.219 %

%X = = 3.33 %

P_M = 15 KW having (K = 6 & C = 1 & Cos θ – 0.73 & Eff. η – 0.85 & Cos θs – 0.25

P_S = = 145.04 KVA

Cos $θ_S$ = 0.25 ,Corresponding to Angle $θ_s$ = 75.522 Degrees for which Sin $θ_s$ = 0.97

P_B = 113.49 KVA & PB in KW is = 96.466 & P_B in Kvar = 59.784 ∴ Cos $θ_B$ = 0.850

Cos $θ_B$ = 0.85 ,Corresponding to Angle $θ_s$ = 31.788 Degrees, for which Sin $θ_s$ = 0.53

P_{CP} = = 132.73 KW

P_{CQ} = = 200.22 KVAR

P_C = = 240.22 KVA

Cos $θ_C$ = = 0.5525 , where as Sin $θ_C$ = 0.833

Voltage Regulation ε = 6.4 % Selected Transformer rating is adequate.

29th May 2021: DG set calculations.

16	DG set calculations

Topic details:

Transformer and DG set calculations, types, sizing, or selections.

	Rated Volatge	415	KV
	Power factor (CosØ)	0.73	Avg
	Efficiency	0.85	Avg
	Total operating load on DG set in kVA at 0.73 power factor	**75.9**	
	Largest motor to start in the sequence - load in KW	15	KW
	Running kVA of last motor (CosØ= 0.91)	24	KVA
	Starting current ratio of motor	6	(Considering starting method as Soft starter)
	Starting KVA of the largest motor (Running kVA of last motor X Starting current ratio of motor)	**145**	KVA
	Base load of DG set in KVA (Total operating load in kVA – Running kVA of last motor)	**52**	KVA
A	**Continous operation under load -P1**		
	Capacity of DG set based on continuous operation under load P1	**52**	**KVA**
B	**Transient Voltage dip during starting of Last motor P2**		
	Total momentary load in KVA (Starting KVA of the last motor+Base load of DG set in KVA	197	KVA
	Subtransient Reactance of Generator (Xd'')	7.91%	(Assumed)
	Transient Reactance of Generator (Xd')	10.065%	(Assumed)
	Xd''' =(Xd''+Xd')/2	0.089875	
	Transient Voltage Dip	15%	(Max)
	Transient Voltage dip during Soft starter starting of Last motor P2 = Total momentary load in KVA x Xd''' x (1-Transient Voltage (Transient Voltage	**100**	**KVA**
C	**Overload capacity P3**		
	Capacity of DG set required considering overload capacity		
	Total momentary load in KVA	197	KVA
	overcurrent capacity of DG (K) (Ref: IS/IEC 60034-1, Clause 9.3.2)	150%	
	Capacity of DG set required considering overload capacity (P3) = Total momentary load in KVA / overcurrent capacity of DG (K)	**131**	**KVA**
	Considering the last value amongst P1, P2 and P3		
	Continous operation under load -P1	52	KVA
	Transient Voltage dip during Soft starter starting of Last motor P2	100	KVA
	Overload capacity P3	131	KVA
	Considering the last value amongst P1, P2 and P3	**131**	**KVA**

2nd June 2021: Calculations of Earthing and Lighting protection.

17	Calculation of Earthing and Lighting protectioncalculations	Earthing calculations	Lighting protection calculation

Topic details:

Calculation of Earthing and Lighting protection calculations

Maximum line-to-ground fault in kA for 1 sec	16	
Earthing material (Earth rod & earth strip)	GI	
Depth of earth flat burrial in meter	0.5	
Average depth / length of Earth rod in meters	3.5	
Soil resistivity Ω-meter	17	
Ambient temperature in deg C	45	
Plot dimensions (earth grid) L x B in meters	60	120
Number of earth rods in nos.	6	

Rr - Earth Electrode resistance	
Grid resistance can be calculated using Eq. 55 of IEEE 80	
$$R_r = \frac{\rho}{2 \times \pi \times n_r \times L_r}\left\{ l_n\left[\frac{4 \times L_r}{b}\right] - 1 + \frac{2 \times k_1 \times L_r}{\sqrt{A}}\left(\sqrt{n_r} - 1\right)^2 \right\}$$	
ρ - Soil resistivity in Ω-meter, 16.96	17
n - No of earth electrodes	6
Lr - Length of earth electrode in meter	3.5
b - Diameter of earth electrode in meter	0.020
k1 - co-efficient	1
A - Area of grid in square metre	7200
Rr - Earth Electrode resistance	7.32925

5th June 2021: Cable sizing and cable tray sizing calculations.

18	Cable sizing and cable tray sizingcalculations	Cable sizing calculations	Cable tray calculation

Topic details:

Cable sizinssg and cable tray sizing calculations for LV cables and MV/HV cables.

S.NO.	Description	Equipment No.	Description	Consumed Load KW	Load Rating KW	Voltage (V)	No. of ph	Full Load Current (A)	Motor Starting Current (A)	Load P.F. Running	SIN Φ Running	Motor P.F Staring	SIN Φ Staring	Type	No. of Runs	No. of Cores	Size (mm2)	Current Rating (A)	Derating factor k1	Derating factor k2	Derating factor k3	Derating factor k4	Overal Deratin factor k
3	LV MCC	PU2315	Silica filter feed pump	14.34	15.00	415	3	24.9	149.63	0.8	0.6	0.8	0.5	2	1	4.0	10	66	0.98	0.9	1	1	0.882
4	LV MCC	PU 2314-A	Absorbesnt/Neutral oil pump (W)	4.16	4.70	415	3	7.2	43.41	0.8	0.6	0.8	0.5	2	1	4.0	2.5	28	0.98	0.9	1	1	0.882
5	LV MCC	PU 2314 -B	Absorbesnt/Neutral oil pump (S)	3.58	3.70	415	3	6.2	37.35	0.8	0.6	0.8	0.5	2	1	4.0	2.5	28	0.98	0.9	1	1	0.882
6	LV MCC	PU2305	Feed Pump (Seperator)	14.47	15.00	415	3	25.2	150.99	0.8	0.6	0.8	0.5	2	1	4.0	10	66	0.98	0.9	1	1	0.882
7	LV MCC	MX2305	MIXER (W)	14.58	15.00	415	3	25.4	152.13	0.8	0.6	0.8	0.5	2	1	4.0	10	66	0.98	0.9	1	1	0.882
8	LV MCC	MX 2308	MIXER (S)	14.58	15.00	415	3	25.4	152.13	0.8	0.6	0.8	0.5	2	1	4.0	10	66	0.98	0.9	1	1	0.882
9	LV MCC	BW2313	Blower	6.27	7.50	415	3	10.9	65.42	0.8	0.6	0.8	0.5	2	1	4.0	10	66	0.98	0.9	1	1	0.882
10	LV MCC	Rotary valve	TK 2313B (I)	0.61	0.75	415	3	1.1	6.36	0.8	0.6	0.8	0.5	2	1	4.0	2.5	28	0.98	0.9	1	1	0.882
11	LV MCC	SC2314	Screw conveyor (I)	1.41	1.50	415	3	2.5	14.71	0.8	0.6	0.8	0.5	2	1	4.0	6	51	0.98	0.9	1	1	0.882
12	LV MCC	AG 2324A	Citric acid tan agitator (W)	1.05	1.10	415	3	1.8	10.96	0.8	0.6	0.8	0.5	2	1	4.0	2.5	28	0.98	0.9	1	1	0.882
13	LV MCC	AG 2324B	Citric acid tank agitator (S)	1.05	1.10	415	3	1.8	10.96	0.8	0.6	0.8	0.5	2	1	4.0	6	51	0.98	0.9	1	1	0.882
14	LV MCC	AG 2305	Citric oil rection vessol agitator	3.84	4.70	415	3	6.7	40.07	0.8	0.6	0.8	0.5	2	1	4.0	6	51	0.98	0.9	1	1	0.882
15	LV MCC	AG 2309	Lye oil reaction vessel agitator	1.39	1.50	415	3	2.4	14.50	0.8	0.6	0.8	0.5	2	1	4.0	25	122	0.98	0.9	1	1	0.882
16	LV MCC	AG 2310	Lye oil reaction vessel agitator	1.39	1.50	415	3	2.4	14.50	0.8	0.6	0.8	0.5	2	1	4.0	2.5	28	0.98	0.9	1	1	0.882
17	LV MCC	AG 2314	Soap Adsorbant Tank Agitator	2.44	3.00	415	3	4.2	25.46	0.8	0.6	0.8	0.5	2	1	4.0	2.5	28	0.98	0.9	1	1	0.882

LT CABLES

CABLE TRAY: FROM		LT-4		TO	LT-5				
Sr. No.	Cable Route (From-To)	Type & Cable Size	Size of Cable (mm2)	No. of Cable	Overall Diameter of each Cable (mm)	Sum of Cable OD (mm)	Self Weight of Cable (Kg/Mt)	Total Weight of Cable (Kg/Mt)	Remarks
1	LV MCC	4	10	1	18	**18**	3.95	**0.9**	
2	PU2315- VFD	4	10	1	18	**18**	0.37	**0.9**	
3	PU2315- VFD	5	1.5	1	15	**15**	3.95	**0.4**	
4	LV MCC	4	2.5	1	16	**16**	0.37	**0.5**	
5	LV MCC	5	1.5	1	15	**15**	3.95	**0.4**	
6	LV MCC	4	2.5	1	16	**16**	0.37	**0.5**	
7	PU 2314 -B- VFD	4	2.5	1	16	**16**	0.9	**0.5**	
8	PU 2314 -B- VFD	5	1.5	1	15	**15**	0.9	**0.4**	
9	LV MCC	4	10	1	18	**18**	2.9	**0.9**	
10	PU2305- VFD	4	10	1	18	**18**	1.2	**0.9**	
11	PU2305- VFD	5	1.5	1	15	**15**	1.2	**0.4**	
12	LV MCC	4	10	1	18	**18**	1.2	**0.9**	
13	LV MCC	5	1.5	1	15	**15**	1.45	**0.4**	
14	LV MCC	4	10	1	18	**18**	2	**0.9**	
15	LV MCC	5	1.5	1	15	**15**	2.4	**0.4**	
16	LV MCC	4	10	1	18	**18**	2.4	**0.9**	
17	BW2313- VFD	4	10	1	18	**18**	0.85	**0.9**	
18	BW2313- VFD	5	1.5	1	15	**15**	0.85	**0.4**	
19	LV MCC	4	2.5	1	16	**16**	0.85	**0.5**	
20	LV MCC	5	1.5	1	15	**15**	1	**0.4**	
21	LV MCC	4	6	1	18	**18**	0.85	**0.7**	
	Total			**21**		**346**	**33.91**	**13.1**	

Calculation			Result		
Maximum Cable Diameter:	18	mm	Selected Cable Tray width:	O.K	
Consider Spare Capacity of Cable Tray:	30%		Selected Cable Tray Depth:	O.K	
Distance between each Cable:	0	mm	Selectrd Cable Tray Weight:	O.K	Including Spare Capacity
Calculated Width of Cable Tray:	450	mm	Selected Cable Tray Size:	O.K	Including Spare Capacity
Calculated Area of Cable Tray:	8096	Sq.mm			
No of Layer of Cables in Cable Tray:	2		Required Cable Tray Size:	300 x 50	mm
Selected No of Cable Tray:	1	Nos.	Required Nos of Cable Tray:	1	No
Selected Cable Tray Width:	300	mm	Required Cable Tray Weight:	150.00	Kg/Meter/Tray
Selected Cable Tray Depth:	50	mm	Type of Cable Tray:	Ladder	
Selected Cable Tray Weight Capacity:	150	Kg/Meter			
Type of Cable Tray:	Ladder		Cable Tray Width Area Remar	25%	
Total Area of Cable Tray:	15000	Sq.mm	Cable Tray Area Remaning:	46%	

Conclusion

We have been taught many aspects of engineering activities during the EPC stages for all electrical and related other disciplines also.

Feedback

Smart Bridge

Smart bridge conduct summer internships, workshops, debates, hackathons, technical sessions etc. Its main motive is to bridge the gap between academy and industry.

Method of conducting program.

Online platform (Zoom). Although it was online we had been explained all the concepts clearly through slides. Some software was introduced which is very much required for industry.

Program highlights

Interaction of the trainer with students is very nice. Assignments make us understand better about the concepts, its limitations and calculations.

Material

The day wise material was provided for us daily and we can access our classes in website which is very helpful for us.

Benefits

We had a great opportunity to interact with the industry expert. It made us familiar with the industry environment.

Through this program we came to know how industry works and what are the tasks of every department to complete a project.

Assignment-1

ELECTRICAL LOAD CALCULATIONS LV MCC

Sl. No.	Equipment No.	Equipment Description	Breaker Rating	Breaker Type	Breaker No. of Poles	ELCB Rating	Absorbed Load [A]	Motor / Load Rating [B]	Load Factor [A] / [B] [C]	Efficiency at Load Factor [C] [D]	Power Factor at Load Factor [C]	Consumed Load (kW = [A] / [D]; kVAR = kW x tan φ): Continuous		Intermittent		Stand-by		Remarks
			A			mA	kW	kW	decimal	decimal	cos φ	kW	kVAR	kW	kVAR	kW	kVAR	
1	PU2315	Silica filter feed pump					14.34	15.00	0.96	0.85	0.73	16.87	15.79					
2	PU 2314-A	Absorbesnt/Neutral oil pump (W)					4.16	4.70	0.89	0.85	0.73	4.9	4.6					
3	PU 2314 -B	Absorbesnt/Neutral oil pump (S)					3.58	3.70	0.97	0.85	0.73					4.2	3.9	
4	PU2305	Feed Pump (Seperator)					14.47	15.00	0.96	0.85	0.73	17.0	15.9					
5	MX2305	MIXER (W)					14.58	15.00	0.97	0.85	0.73	17.2	16.1					
6	MX 2308	MIXER (S)					14.58	15.00	0.97	0.85	0.73					17.2	16.1	
7	BW2313	Blower					6.27	7.50	0.84	0.85	0.73	7.4	6.9					
8	Rotary valve	TK 2313B (I)					0.61	0.75	0.81	0.85	0.73			0.7	0.7			
9	SC2314	Screw conveyor (I)					1.41	1.50	0.94	0.85	0.73			1.66	1.55			
10	AG 2324A	Citric acid tan agitator (W)					1.05	1.10	0.95	0.85	0.73	1.24	1.16					
11	AG 2324B	Citric acid tank agitator (S)					1.05	1.10	0.95	0.85	0.73					1.2	1.2	
12	AG 2305	Citric oil rection vessol agitator					3.84	4.70	0.82	0.85	0.73	4.52	4.23					
13	AG 2309	Lye oil reaction vessel agitator					1.39	1.50	0.93	0.85	0.73	1.64	1.53					
14	AG 2310	Lye oil reaction vessel agitator					1.39	1.50	0.93	0.85	0.73	1.64	1.53					
15	AG 2314	Soap Adsorbant Tank Agitator					2.44	3.00	0.81	0.85	0.73	2.87	2.69					

	Continuous kW	Continuous kVAR	Intermittent kW	Intermittent kVAR	Stand-by kW	Stand-by kVAR
TOTAL	75.21	70.42	2.38	2.22	22.60	21.16
kVA	103.03		3.26		30.96	

Maximum of normal running plant load : (Est. x%E + y%F)	75.9 kW	71.1 kVAR	sqrt (kW^2 +$kVAR^2$) = 104.0 kVA
Peak Load : (Est. x%E + y%F + z%G)	78.2 kW	73.2 kVAR	sqrt (kW^2 +$kVAR^2$) = 107.1 kVA

Assumptions

1) Load factor, Efficiency and Power factor.

Load Rating (kW)	Efficiency	Power factor
<= 20	0.85	0.73
> 20 - <= 45	0.91	0.78
> 45 - < 150	0.93	0.82
>= 150	0.94	0.91

2) Coincidence factors x= 1.0, y= 0.3, and z=0.1 considered for contnious, intermittent and standby load.

Assignment-2

Calculation for Transformer Capacity

1.0 Example of calculation for Transformer Capacity

1.1 Calculation for consumed load

Consumed loads used for this example are as follows :

	kW	kVar	kVA	
a. Continuous load	75.21	70.4	103.03	--- (i)
b. Intermittent load / Diversity Factor	2.38	2.2	3.25	--- (ii)
c. Stand-by load required as consumed load	22.6	21.2	30.96	--- (iii)
Max. Consumed load = ((i) + 30% (ii) + 10% (iii)) =	78.2	73.2	107.10	
Future expansion load (20% capacity)	15.6	14.6	21.42	
Total Load =	93.8	87.8	128.52	

1.2 Calculation for 3.3kV / 0.433 kV transformer capacity

Max. Consumed load	=	107.1	kVA
Spare capacity	=	21.4	kVA
Required capacity	=	128.5	kVA
Transformer rated capacity	=	150	kVA

1.3 Voltage regulation check

During starting or reacceleration of max. capacity motor (3400 kW) , while all the other loads running , the voltage regulation is as follows :

P_T = 150 KVA (%Z)= 4 & Ratio X/R = 1.5 (refer table)

Hence , **%R** = = 2.219 %

%X = = 3.33 %

P_M = 15 KW having (K = 6 & C = 1 & Cos θ = 0.73 & Eff.η = 0.85 & Cos Θs = 0.25

P_S = = 145.044 KVA

Cos θ_S = 0.25 ,Corresponding to Angle θ_s = 75.5225 Degrees for which Sin θ_s = 0.97

P_B = 113.489 KVA & PB in KW is = 96.4657 & P_B in Kvar = 59.784 ∴ Cos θ_B = 0.850

Cos θ_B = 0.85 ,Corresponding to Angle θ_s = 31.7883 Degrees, for which Sin θ_s = 0.53

P_{CP} = = 132.727 KW

P_{CQ} = = 200.223 KVAR

P_C = = 240.22 KVA

Cos θ_C = = 0.55252 , where as Sin θ_C = 0.833

Voltage Regulation ε = 6.4 % Selected Transformer rating is adequate.

Result: During starting of max. capacity motor, while all other loads are running , the voltage regulation at Transformer secondary terminals shall be approx. 6.4% which meets the criteria to maintain less than 15% voltage regulation.

1.4 Selection of rated capacity

Hence 150kVA Transformer rating selected.

Assignment-3

DG SIZING CALCULATIONS			
	Design Data		
	Rated Volatge	415	KV
	Power factor (CosØ)	0.73	Avg
	Efficiency	0.85	Avg
	Total operating load on DG set in kVA at 0.73 power factor	**75.9**	
	Largest motor to start in the sequence - load in KW	15	KW
	Running kVA of last motor (CosØ= 0.91)	24	KVA
	Starting current ratio of motor	6	(Considering starting method as Soft starter)
	Starting KVA of the largest motor (Running kVA of last motor X Starting current ratio of motor)	**145**	KVA
	Base load of DG set in KVA (Total operating load in kVA – Running kVA of last motor)	**52**	KVA
A	**Continous operation under load -P1**		
	Capacity of DG set based on continuous operation under load P1	**52**	**KVA**
B	**Transient Voltage dip during starting of Last motor P2**		
	Total momentary load in KVA	197	KVA
	(Starting KVA of the last motor+Base load of DG set in KVA		
	Subtransient Reactance of Generator (Xd'')	7.91%	(Assumed)
	Transient Reactance of Generator (Xd')	10.065%	(Assumed)
	Xd''' =(Xd"+Xd')/2	0.089875	
	Transient Voltage Dip	15%	(Max)
	Transient Voltage dip during Soft starter starting of Last motor P2 = Total momentary load in KVA x Xd''' x <u>(1-Transient Voltage Dip)</u> (Transient Voltage Dip)	**100**	**KVA**
C	**Overload capacity P3**		
	Capacity of DG set required considering overload capacity		
	Total momentary load in KVA	197	KVA
	overcurrent capacity of DG (K) (Ref: IS/IEC 60034-1, Clause 9.3.2)	150%	
	Capacity of DG set required considering overload capacity (P3) = <u>Total momentary load in KVA</u> overcurrent capacity of DG (K)	**131**	**KVA**
	Considering the last value amongst P1, P2 and P3		
	Continous operation under load -P1	52	KVA
	Transient Voltage dip during Soft starter starting of Last motor P2	100	KVA
	Overload capacity P3	131	KVA
	Considering the last value amongst P1, P2 and P3	**131**	**KVA**
	Hence, Existing Generator 131 KVA is adequate to cater the loads as per re-scheduled loads		
	NOTE:VOLTAGE DIP CONSIDERED - 15%		

Assignment-4
Earthing Calculations

IEEE
Std 80-2000 — IEEE GUIDE FOR SAFETY

Table 1—Material constants

Description	Material conductivity (%)	α_r factor at 20 °C (1/°C)	K_o at 0 °C (0 °C)	Fusing[a] temperature T_m (°C)	ρ_r 20 °C (μΩ·cm)	TCAP thermal capacity [J/(cm³·°C)]
Copper, annealed soft-drawn	100.0	0.003 93	234	1083	1.72	3.42
Copper, commercial hard-drawn	97.0	0.003 81	242	1084	1.78	3.42
Copper-clad steel wire	40.0	0.003 78	245	1084	4.40	3.85
Copper-clad steel wire	30.0	0.003 78	245	1084	5.86	3.85
Copper-clad steel rod[b]	20.0	0.003 78	245	1084	8.62	3.85
Aluminum, EC grade	61.0	0.004 03	228	657	2.86	2.56
Aluminum, 5005 alloy	53.5	0.003 53	263	652	3.22	2.60
Aluminum, 6201 alloy	52.5	0.003 47	268	654	3.28	2.60
Aluminum-clad steel wire	20.3	0.003 60	258	657	8.48	3.58
Steel, 1020	10.8	0.001 60	605	1510	15.90	3.28
Stainless-clad steel rod[c]	9.8	0.001 60	605	1400	17.50	4.44
Zinc-coated steel rod	8.6	0.003 20	293	419	20.10	3.93
Stainless steel, 304	2.4	0.001 30	749	1400	72.00	4.03

[a]From ASTM standards.
[b]Copper-clad steel rods based on 0.254 mm (0.010 in) copper thickness.
[c]Stainless-clad steel rod based on 0.508 mm (0.020 in) No. 304 stainless steel thickness over No. 1020 steel core.

	3	
Maximum line-to-ground fault in kA for 1 sec	16	
Earthing material (Earth rod & earth strip)	GI	
Depth of earth flat burrial in meter	0.5	
Average depth / length of Earth rod in meters	3.5	
Soil resistivity Ω-meter	17	
Ambient temperature in deg C	45	
Plot dimensions (earth grid) L x B in meters	60,	120
Number of earth rods in nos.	6	

Earth electrode sizing:
Ac - Required conductor cross section in sq.mm

$$I_{lg} = A_c x \sqrt{\left[\frac{TCAPx10^{-4}}{t_c x \alpha_r x \rho_r}\right]} xl_n \left[\frac{K_0 + T_m}{K_0 + T_a}\right]$$

αr - Thermal co-efficient of resistivity, at 20 oC	0.0032
ρr - Resistivity of ground conductor at 20 oC	20.10
Ta - Ambient Temperature is °C	50
$I_{l\text{-}g}$ - RMS fault current in kA = 50 KA	14
tc - Short circuit current duration sec	1
Thermal capacity factor, TCAP J/(cm3.oC)	3.93
Tm - Maximum allowable temperature for copper conductor, in oC	419
K0 - Factor at oC	293
The data taken from IEEE 80-2000, Clause 11.3, Table-1 for clad steel rod:	
14 = Ac *	0.123
Ac - Required conductor cross section in sq.mm	114
Earth rod dia in mm	12
Earth rod dia (including 25% corrosion allowance) in mm	15

Earth flat sizing:
Ac - Required conductor cross section in sq.mm

$$I_{lg} = A_c x \sqrt{\left[\frac{TCAPx10^{-4}}{t_c x \alpha_r x \rho_r}\right]} xl_n \left[\frac{K_0 + T_m}{K_0 + T_a}\right]$$

αr - Thermal co-efficient of resistivity, at 20 oC	0.0032
ρr - Resistivity of ground conductor at 20 oC	20.10
Ta - Ambient Temperature is °C	50
$I_{l\text{-}g}$ - RMS fault current in kA = 50 KA	14
tc - Short circuit current duration sec	1
Thermal capacity factor, TCAP J/(cm3.oC)	3.93
Tm - Maximum allowable temperature for copper conductor, in oC	419
K0 - Factor at oC	293
The data taken from IEEE 80-2000, Clause 11.3, Table-1 for clad steel rod:	
14 = Ac *	0.123
Ac - Required conductor cross section in sq.mm	114
Earth flat area in mm	12
Earth flat area (including 25% corrosion allowance) in mm	15
Selected flat size W * Thk in sq mm	20

Rg - Grid resistance
Grid resistance can be calculated using Eq. 52 of IEEE 80

$$R_g = \rho \left\{\frac{1}{L} + \frac{1}{\sqrt{20 \ x \ A}}\left[1 + \frac{1}{1 + h \sqrt{20 \ /A}}\right]\right\}$$

ρ - Soil resistivity in Ω-meter=	17
L - Total buried length of ground conductor in meter	#VALUE!
h - Depth of burial in meter	0.5
A - Grid area in sq. meter	#VALUE!
Rg - Grid resistance	#VALUE!

Rr - Earth Electrode resistance
Grid resistance can be calculated using Eq. 55 of IEEE 80

$$R_r = \frac{\rho}{2 \ x \ \pi \ x \ n_r \ x \ L_r}\left\{l_n\left[\frac{4 \ x \ L_r}{b}\right] - 1 + \frac{2 \ x \ k_1 \ x \ L_r}{\sqrt{A}}\left(\sqrt{n_r} - 1\right)^2\right\}$$

ρ - Soil resistivity in Ω-meter, 16.96	17
n - No of earth electrodes	6
Lr - Length of earth electrode in meter	3.5
b - Diameter of earth electrode in meter	0.020
k1 - co-efficient	1
A - Area of grid in square metre	#VALUE!
Rr - Earth Electrode resistance	#VALUE!

Grounding system resistance
Grounding system resistance can be calculated using equation 53 of IEEE 80 as follows:

$$R_s = \frac{R_g \ x \ R_2 - R_m^2}{R_g + R_2 - 2R_m}$$

R_m - Mutual ground resistance between the group of ground conductors, R_g and group of electrodes, R_r in Ω. Neglected R_m, since this is for homogenous soil

Rs - Total earthing system resistance #VALUE! Ohms

The calculated resistance grounding system is less than the allowable 1 Ω value.

Assignment-5

Lightning Protection Calculations

3

Location	Visakhapatnam
Building	Concrete, Hospital
Type of Building	Flat Roofs (a)
Building Length (L)	20
Building breadth (W)	9
Building Height (H)	8

Risk Factor Calculation

1 Collection Area (A_c)

A_c = (L*W) + (2*L*H) + (2*W*H) + (3.14*H*H)

844.96

2 Probability of Being Struck (P)

P = $A_c * N_g * 10^{-6}$

0.000929456

3 Overall weighing factor

a) Use of structure (A)	=	1.7
b) Type of construction (B)	=	0.4
c) Contents or consequential effects (C)	=	1.7
d) Degree of isolation (D)	=	1.0
e) Type of country (E)	=	0.3
Wo - Overall weighing factor	=	A * B * C * D * E
	=	0.347

4 Overall Risk Factor

Po = P * Wo

Po = 0.000322335

Pa 10^{-5}

As per clause no. 9.7 of BS- 6651, suggested acceptable risk factor (Po) has been taken as 10^{-5}

Since Po > Pa lightning protection required.

5 Air Terminations

Perimeter of the building = 2(L+W)

= 58 Mts.

6 Down Conductors

Perimeter of building	=	58	Mts.
No. of down conductors based on perimeter	=	3	Nos.

Hence 3 nos. of Down conductors have been selected.

Size of Down conductor = 20 X 2.5 mm Galvanized Steel Strip

(As per BS6651, lightning currents have very short duration, therefore thermal factors are of little consequence in deciding the cross-section of the conductor. The minimum size of Down conductors - 20mm X 2.5 mm Galvanized Steel Strip)

Assignment-6

Cable Sizing Calculations

S.NO.	Description	Equipment No.	Description	Consumed Load KW	Load Rating KW	Voltage (V)	No. of ph	Full Load Current (A)	Motor Starting Current (A)	Load P.F. Running	SIN Φ Running	Motor P.F Staring	SIN Φ Staring	Type	No. of Runs	No. of Cores	Size (mm2)	Current Rating (A)	Derating factor k1	Derating factor k2	Derating factor k3	Derating factor k4	Overall Derating factor k	Derated Current (A)	Cable Length (M)	Cable Resistance (Ohms/kM)	Cable Reactance (Ohms/kM)	Voltage drop (Running) (V)	Voltage drop (Running) (%)	Voltage drop (Starting) (V)	Voltage drop (starting) (%)	Cable size result	OD of Cable (mm)	Gland size
3	LV MCC	PU2315	Silica filter feed pump	14.34	15.00	415	3	24.9	149.63	0.8	0.6	0.8	0.5	2	1	4.0	10	66	0.98	0.9	1	1	0.882	58.2	95	2.3400	0.0852	7.89	1.90	47.14	11.36	OK	18	20
4	LV MCC	PU 2314-A	Absorbesnt/Neutral oil pump (W)	4.16	4.70	415	3	7.2	43.41	0.8	0.6	0.8	0.5	2	1	4.0	2.5	28	0.98	0.9	1	1	0.882	24.7	95	9.4800	0.1007	9.10	2.19	54.53	13.14	OK	16	20s
5	LV MCC	PU 2314 -B	Absorbesnt/Neutral oil pump (S)	3.58	3.70	415	3	6.2	37.35	0.8	0.6	0.8	0.5	2	1	4.0	2.5	28	0.98	0.9	1	1	0.882	24.7	60	9.4800	0.1007	4.95	1.19	29.64	7.14	OK	16	20s
6	LV MCC	PU2305	Feed Pump (Seperator)	14.47	15.00	415	3	25.2	150.99	0.8	0.6	0.8	0.5	2	1	4.0	10	66	0.98	0.9	1	1	0.882	58.2	85	2.3400	0.0852	7.12	1.72	42.56	10.25	OK	18	20s
7	LV MCC	MX2305	MIXER (W)	14.58	15.00	415	3	25.4	152.13	0.8	0.6	0.8	0.5	2	1	4.0	10	66	0.98	0.9	1	1	0.882	58.2	75	2.3400	0.0852	6.33	1.53	37.84	9.12	OK	18	20s
8	LV MCC	MX 2308	MIXER (S)	14.58	15.00	415	3	25.4	152.13	0.8	0.6	0.8	0.5	2	1	4.0	10	66	0.98	0.9	1	1	0.882	58.2	105	2.3400	0.0852	8.87	2.14	52.97	12.76	OK	18	20s
9	LV MCC	BW2313	Blower	6.27	7.50	415	3	10.9	65.42	0.8	0.6	0.8	0.5	2	1	4.0	10	66	0.98	0.9	1	1	0.882	58.2	100	2.3400	0.0852	3.63	0.88	21.69	5.23	OK	18	20s
10	LV MCC	Rotary valve	TK 2313B (I)	0.61	0.75	415	3	1.1	6.36	0.8	0.6	0.8	0.5	2	1	4.0	2.5	28	0.98	0.9	1	1	0.882	24.7	100	9.4800	0.1007	1.40	0.34	8.42	2.03	OK	16	20s
11	LV MCC	SC2314	Screw conveyor (I)	1.41	1.50	415	3	2.5	14.71	0.8	0.6	0.8	0.5	2	1	4.0	6	51	0.98	0.9	1	1	0.882	45.0	75	3.9400	0.0902	1.02	0.25	6.11	1.47	OK	18	20
12	LV MCC	AG 2324A	Citric acid tan agitator (W)	1.05	1.10	415	3	1.8	10.96	0.8	0.6	0.8	0.5	2	1	4.0	2.5	28	0.98	0.9	1	1	0.882	24.7	110	9.4800	0.1007	2.66	0.64	15.94	3.84	OK	16	20s
13	LV MCC	AG 2324B	Citric acid tank agitator (S)	1.05	1.10	415	3	1.8	10.96	0.8	0.6	0.8	0.5	2	1	4.0	6	51	0.98	0.9	1	1	0.882	45.0	75	3.9400	0.0902	0.76	0.18	4.55	1.10	OK	18	20
14	LV MCC	AG 2305	Citric oil rection vessol agitator	3.84	4.70	415	3	6.7	40.07	0.8	0.6	0.8	0.5	2	1	4.0	6	51	0.98	0.9	1	1	0.882	45.0	105	3.9400	0.0902	3.89	0.94	23.30	5.61	OK	18	20
15	LV MCC	AG 2309	Lye oil reaction vessel agitator	1.39	1.50	415	3	2.4	14.50	0.8	0.6	0.8	0.5	2	1	4.0	25	122	0.98	0.9	1	1	0.882	107.6	85	0.9300	0.0816	0.28	0.07	1.68	0.40	OK	22	32
16	LV MCC	AG 2310	Lye oil reaction vessel agitator	1.39	1.50	415	3	2.4	14.50	0.8	0.6	0.8	0.5	2	1	4.0	2.5	28	0.98	0.9	1	1	0.882	24.7	95	9.4800	0.1007	3.04	0.73	18.22	4.39	OK	16	20s
17	LV MCC	AG 2314	Soap Adsorbant Tank Agitator	2.44	3.00	415	3	4.2	25.46	0.8	0.6	0.8	0.5	2	1	4.0	2.5	28	0.98	0.9	1	1	0.882	24.7	65	9.4800	0.1007	3.65	0.88	21.88	5.27	OK	16	20s

Basis:

1. Overall derating factor k = k1 x k2 x k3 x k4
   - K1=Rating factor for variation in air/ground temperature
   - K2=Rating factor for depth of laying
   - K3=Rating factor for spacing between two circuits
   - K4=Rating factor for variation in thermal resistivity of the soil
2. LT Motors : Running Voltage Drop = 3%, Starting Voltage Drop = 15%
3. Cable type:
   - TYPE 1: Al Conductor, XLPE Insulated, Armoured, PVC outer sheathed
   - TYPE 2: Cu Conductor, XLPE Insulated, Armoured, PVC outer sheathed
4. Effect of Frequency Variation ± 5%
5. Combined Effect of Voltage & Frequency Variation ±10%

ASSIGNMENT-7
Cable Tray Sizing

LT CABLES

CABLE TRAY: FROM		LT-4		TO	LT-5				
Sr. No.	**Cable Route (From-To)**	**Type & Cable Size**	**Size of Cable (mm2)**	**No. of Cable**	**Overall Diameter of each Cable (mm)**	**Sum of Cable OD (mm)**	**Self Weight of Cable (Kg/Mt)**	**Total Weight of Cable (Kg/Mt)**	**Remarks**
1	LV MCC	4	10	1	18	**18**	3.95	**0.9**	
2	PU2315- VFD	4	10	1	18	**18**	0.37	**0.9**	
3	PU2315- VFD	5	1.5	1	15	**15**	3.95	**0.4**	
4	LV MCC	4	2.5	1	16	**16**	0.37	**0.5**	
5	LV MCC	5	1.5	1	15	**15**	3.95	**0.4**	
6	LV MCC	4	2.5	1	16	**16**	0.37	**0.5**	
7	PU 2314 -B- VFD	4	2.5	1	16	**16**	0.9	**0.5**	
8	PU 2314 -B- VFD	5	1.5	1	15	**15**	0.9	**0.4**	
9	LV MCC	4	10	1	18	**18**	2.9	**0.9**	
10	PU2305- VFD	4	10	1	18	**18**	1.2	**0.9**	
11	PU2305- VFD	5	1.5	1	15	**15**	1.2	**0.4**	
12	LV MCC	4	10	1	18	**18**	1.2	**0.9**	
13	LV MCC	5	1.5	1	15	**15**	1.45	**0.4**	
14	LV MCC	4	10	1	18	**18**	2	**0.9**	
15	LV MCC	5	1.5	1	15	**15**	2.4	**0.4**	
16	LV MCC	4	10	1	18	**18**	2.4	**0.9**	
17	BW2313- VFD	4	10	1	18	**18**	0.85	**0.9**	
18	BW2313- VFD	5	1.5	1	15	**15**	0.85	**0.4**	
19	LV MCC	4	2.5	1	16	**16**	0.85	**0.5**	
20	LV MCC	5	1.5	1	15	**15**	1	**0.4**	
21	LV MCC	4	6	1	18	**18**	0.85	**0.7**	
Total				**21**		**346**	**33.91**	**13.1**	

Calculation

Maximum Cable Diameter:	**18**	**mm**
Consider Spare Capacity of Cable Tray:	**30%**	
Distance between each Cable:	**0**	**mm**
Calculated Width of Cable Tray:	**450**	**mm**
Calculated Area of Cable Tray:	**8096**	**Sq.mm**
No of Layer of Cables in Cable Tray:	**2**	
Selected No of Cable Tray:	**1**	**Nos.**
Selected Cable Tray Width:	**300**	**mm**
Selected Cable Tray Depth:	**50**	**mm**
Selected Cable Tray Weight Capacity:	**150**	**Kg/Meter**
Type of Cable Tray:	**Ladder**	
Total Area of Cable Tray:	**15000**	**Sq.mm**

Result

Selected Cable Tray width:	**O.K**	
Selected Cable Tray Depth:	**O.K**	
Selectrd Cable Tray Weight:	**O.K**	**Including Spare Capacity**
Selected Cable Tray Size:	**O.K**	**Including Spare Capacity**
Required Cable Tray Size:	**300 x 50**	**mm**
Required Nos of Cable Tray:	**1**	**No**
Required Cable Tray Weight:	**150.00**	**Kg/Meter/Tray**
Type of Cable Tray:	**Ladder**	
Cable Tray Width Area Remaning	**25%**	
Cable Tray Area Remaning:	**46%**	