	.PROCESS CALCULATIONS FOR 92 MLD STP AT UJJAIN							
1	DESIGN BASIS							
1.1	FLOW							
	Average Flow			=	92	MLD		
				=	3833.33	m3/hr		
				=	1.06	m3/s		
	Peak Factor			=	2			
	Peak Flow			=	184	MLD		
				=	7666.67	m3/hr		
				=	2.13	m3/s		
1.2	DESIGN QUALITY OF RAW SEWAGE							
	BOD5			=	100	mg/l		
	COD			=	250	mg/l		
	TSS			=	200	mg/l		
	TKN (as N)			=	20	mg/l		
	TP (as PO4)			=	5	mg/l		
1.3	DESIGN QUALITY OF TREATED SEWAGE							
	oBOD5 @ 20 C			≤	10	mg/l		
	COD			≤	50	mg/l		
	TSS			≤	10	mg/l		
	TN (as N)			≤	10	mg/l		
	TP (as PO4)			≤	2	mg/l		
2	RAW SEWAGE PUMPING STATION							
2.1	RECEIVING CHAMBER							
	No. of Units			=	1	No.		
	Design Flow			=	Peak Flow			
				=	184	MLD		
				=	7666.67	m3/hr		
				=	2.13	m3/sec		
	Hydraulic Retention Time (HRT) at Peak Flow			=	30	sec		
	Volume required			=	2.40 x 30			
				=	63.88888889	m3		
	Side Water Depth (SWD) provided			=	2.5	m		
	Width provided			=	6	m		
	Length provided			=	6	m		
	Freeboard provided			=	0.5	m		
	Volume provided			=	90	m3		
	Size of Receiving Chamber = 1 unit x 6 m x 6 m x 2.5 m							
2.2	COARSE SCREEN CHANNELS							
	No. of Mechanical (Working) Screens			=	2	Nos.		
	No. of Manual (Standby) Screens			=	1	Nos.		
	Total No. of Screens			=	3			
2.2.1	COARSE SCREEN CHANNEL: MECHANICAL							
	No. of Mechanical Screens			=	2	Nos.		
	Design Flow			=	Peak Flow			
				=	184	MLD		
				=	7666.67	m3/hr		
				=	2.13	m3/sec		
	Average Flow			=	92	MLD		
				=	3833.33	m3/hr		
				=	1.06	m3/sec		

	Design Flow in each Screen	=	2.13	m3/sec		
			2	No.		
		=	1.064814815	m3/sec		
	Average Flow in each Screen	=	1.06	m3/sec		
			2	No.		
		=	0.532407407	m3/sec		
	Maximum Velocity through Screen at PeakFlow	=	1.0	m/sec		
	Minimum Velocity through Screen at AverageFlow	=	0.6	m/sec		
	Clear Area of Opening through Screen at PeakFlow	=	1.064814815	m3/sec		
			1.0	m/sec		
		=	1.064814815	m2		
	Clear Area of Opening through Screen atAverage Flow	=	0.532407407	m3/sec		
			0.6	m/sec		
		=	0.887345679	m2		
	Considering maximum Area of Opening through Screen	=	1.064814815	m2		
	Clear Spacing of Bars	=	20	mm		
	Thickness of Bars	=	10	mm		
	Gross Area of Screen	=	1.197 x (20+10) / 20			
		=	1.597222222	m2		
	Assuming Depth of Screen Channel	=	1.6	m		
	Gross Width of Screen	=	1.796 / 1.6			
		=	0.998263889	m		
	No. of Bars	=	(Gross Width of Screen / Center to Center Spacing of Bars) - 1			
		=	(1.123 / ((20 + 10)/1000) - 1			
		=	32.27546296	Nos.		
	Say	=	33	Nos.		
	Width of Screen provided	=	(Number of Bars+1) x Clear Spacing + (Number of Bars x Bar Thickness)			
		=	1010	mm		
	Say	=	1100	mm		
	Width of Side Frame provided	=	150	mm		
	Width of Screen Channel provided	=	1300	mm		
	Height of Blind Plate provided at bottom of the Screen	=	50	mm		
	Liquid Depth of Screen Channel provided	=	1650	mm		
	Length of Screen Channel provided	=	6000	mm		
	Freeboard provided	=	300	mm		
	Head Loss across Screen					
	Head Loss across Screen	=	0.0728 (V2 - v2)			
	V = Velocity through Screen at Peak Flow	=	Peak Flow through Screen Channel / Clear Area of Opening through Screen			
		=	1			
	v = Velocity in approach Channel at Peak Flow	=	Peak Flow through Screen Channel / Cross Sectional Area of Screen Channel			

		=	0.67			
	Head Loss across Screen at Peak Flow	=	0.040			
	Head Loss across Screen at 50% CloggedCondition					
	Velocity through Screen at 50% CloggedCondition at Peak Flow	=	1.918			
	Head Loss across screen at 50% CloggedCondition at Peak Flow	=	0.249			
		<	0.3	m/sec		OK
	Size of Mechanical Coarse Screens = 2 units x6 m x 1.4 m x 1.65 m					
2.2.2	COARSE SCREEN CHANNEL: MANUAL					
	No. of Manual Screen	=	1	No.		
	Design Flow	=	1/2Peak flow			
		=	92	MLD		
		=	3833.333333	m3/hr		
		=	1.06481	m3/sec		
	Average Flow	=	46	MLD		
		=	1916.667	m3/hr		
		=	0.532	m3/sec		
	Design Flow in each Screen	=	1.06481	m3/sec		
			1	No.		
		=	1.064814815	m3/sec		
	Average Flow in each Screen	=	0.532	m3/sec		
			1	No.		
		=	0.532407407	m3/sec		
	Maximum Velocity through Screen at PeakFlow	=	1.0	m/sec		
	Minimum Velocity through Screen at AverageFlow	=	0.6	m/sec		
	Clear Area of Opening through Screen forPeak Flow	=	1.064814815	m3/sec		
			1.0	m/sec		
		=	1.064814815	m2		
	Clear Area of Opening through Screen forAverage Flow	=	0.532407407	m3/sec		
			0.6	m/sec		
		=	0.887345679	m2		
	Considering maximum Area of Opening through Screen	=	1.064814815	m2		
	Clear Spacing of Bars	=	20	mm		
	Thickness of Bars	=	10	mm		
	Gross Area of Screen	=	1.197 x (20+10) / 20			
		=	1.597222222	m2		
	Assuming Depth of Screen Channel	=	1.65	m		
	Gross Width of Screen	=	0.968013468	m		
	No. of Bars	=	(Gross Width of Screen / Center to Center Spacing of Bars) - 1			
		=	(1.089 / ((20 + 10)/1000) - 1			
		=	31.2671156	Nos.		
	Say	=	32	Nos.		

	Width of Screen provided	=	(Number of Bars+1) x Clear Spacing + (Number of Bars x Bar Thickness)			
		=	(50+1) x 20 + (50 x 10)			
		=	980	mm		
	Say	=	980	mm		
	Width of Side Frame provided	=	50	mm		
	Width of Screen Channel	=	1080	mm		
	Liquid Depth of Screen Channel provided	=	1650	mm		
	Length of Screen Channel provided	=	6000	mm		
	Freeboard provided	=	300	mm		
	Head Loss across Screen					
	Head Loss across Screen	=	0.0728 (V2 - v2)			
	V = Velocity through Screen at Peak Flow	=	Peak Flow through Screen Channel / Clear Area of Opening through Screen			
		=	1			
	v = Velocity in approach Channel at Peak Flow	=	Peak Flow through Screen Channel / Cross			
	Head Loss across Screen at Peak Flow	=	0.667			
	Head Loss across Screen at 50% Clogged condition	=	3-4 m /km			
	Head Loss across Screen at 50% CloggedCondition					
	Velocity through Screen at 50% CloggedCondition at Peak Flow	=	1.532			
	Head Loss across screen at 50% CloggedCondition at Peak Flow	=	0.152			
		<	0.3	m/sec		OK
	Size of Manual Coarse Screens = 1 unit x 7 m x 1.7m x 1.65 m					
2.3	RAW SEWAGE SUMP (WET WELL) OF RAW SEWAGE PUMPING STATION					
	No. of Units	=	1	No.		
	Average Flow	=	92	MLD		
		=	3833.33	m3/hr		
		=	1.0648	m3/sec		
	Design Flow	=	Peak Flow			
		=	207	MLD		
		=	8625.00	m3/hr		
		=	2.3958	m3/sec		
	Hydraulic Retention Time (HRT) at Peak Flow	=	5	min		
	Volume required	=	718.75	m3		
		=				
	Hydraulic Retention Time (HRT) at AverageFlow	=	Volume / Average Flow			
		=	7.8125	min		
		<	30	min		OK
	Volume of Receiving Chamber (Inside WetWell)	=	0	m3		
	Total Volume of Wet Well	=	718.75	m3		
	Side Water Depth (SWD) provided	=	3.5	m		
	Plan Area of Wet Well	=	205.3571429	m2		
	Diameter of Sump required	=	16.1740983	m		
	Diameter of Sump provided	=	17	m		
	Freeboard provided	=	0.5	m		
	Volume of Sump provided	=	821.43	m3		
	Size of Wet Well = 1 unit x 17 m Dia x 3.5 m SWD					
2.4	RAW SEWAGE TRANSFER PUMPS					
	Present Average Flow (DWF)	=	4583	m3/hr		
	Half Present Average Flow (1/2 DWF)	=	2292	m3/hr		
	Present Peak Flow (WWF)	=	10313	m3/hr		
	Pump Capacity provided					
I	1 DWF: 3 Nos.	=	2063	m3/hr		

	No. of Working Pumps	=	5	No.		
	No. of Standby Pumps	=	2	No.		
	Head Provided	=	20	m		
3	PRIMARY TREATMENT UNITS					
3.1	INLET CHAMBER					
	No. of Units	=	1	No.		
	Design Flow	=	Peak Flow			
	Peak Flow	=	207	MLD		
		=	8625	m3/hr		
		=	2.40	m3/sec		
	Hydraulic Retention Time (HRT) at Peak Flow	=	30	sec		
	Volume required	=	2.4 x 30			
		=	71.875	m3		
	Side Water Depth (SWD) provided	=	2.5	m		
	Width provided	=	6	m		
	Length provided	=	6	m		
	Freeboard provided	=	0.5	m		
	Volume provided	=	90	m3		
	Size of Inlet Chamber = 1 unit x 6 m x 6m x 2.5 m					
3.2	FINE SCREEN CHANNELS					
	No. of Mechanical (Working) Screens	=	2	Nos.		
	No. of manual (Standby) Screens	=	1	Nos.		
	Total No. of Screens	=	3			
3.2.1	FINE SCREEN CHANNELS: MECHANICAL					
	No. of Mechanical Screens	=	2	Nos.		
	Design Flow	=	Peak Flow			
		=	207	MLD		
		=	8625	m3/hr		
		=	2.40	m3/sec		
	Average Flow	=	92	MLD		
		=	3833.33	m3/hr		
		=	1.0648	m3/sec		
	Design Flow in each Screen	=	2.40	m3/sec		
			2	No.		
		=	1.197916667	m3/sec		
	Average Flow in each Screen	=	1.0648	m3/sec		
			2	No.		
		=	0.532407407	m3/sec		
	Maximum Velocity through Screen at PeakFlow	=	1.0	m/sec		
	Minimum Velocity through Screen at AverageFlow	=	0.6	m/sec		
	Clear Area of Opening through Screen at PeakFlow	=	1.197916667	m3/sec		
			1.0	m/sec		
		=	1.197916667	m2		
	Clear Area of Opening through Screen atAverage Flow	=	0.532407407	m3/sec		
			0.6	m/sec		

				=	0.887345679	m2		
	Considering maximum Area of Opening through Screen			=	1.197916667	m2		
	Clear Spacing of Bars			=	6	mm		
	Thickness of Bars			=	2	mm		
	Gross Area of Screen			=	1.432 x (6+2) /6			
				=	1.597222222	m2		
	Assuming Depth of Screen Channel			=	1.5	m		
	Gross Width of Screen							
				=	1.064814815	m		
	No. of Bars			=	(Gross Width of Screen / Center to Center Spacing of Bars) - 1			
				=	(1.273 / ((6 + 2)/1000) - 1			
				=	132.1018519	Nos.		
	Say			=	133	Nos.		
	Width of Screen provided			=	(Number of Bars+1) x Clear Spacing + (Number of Bars x Bar Thickness)			
				=	(159+1) x 6 + (159 x 2)			
				=	1278	mm		
	Say			=	1300	mm		
	Width of Side Frame provioded			=	150	mm		
	Width of Screen Channel provided			=	1600	mm		
	Height of Blind Plate at Bottom of Screen provided			=	50	mm		
	Liquid Depth of Screen Channel provided			=	1550	mm		
	Length of Screen Channel provided			=	8000	mm		
	Freeboard provided			=	300	mm		
	Head Loss across Screen							
	Head Loss across Screen			=	0.0728 (V2 - v2)			
	V = Velocity through Screen at Peak Flow			=	Peak Flow through Screen Channel / Clear Area of Opening through Screen			
				=	0.979			
	v = Velocity in approach Channel at Peak Flow			=	Peak Flow through Screen Channel / Cross Sectional Area of Screen Channel			
				=	0.578			
	Head Loss across Screen at Peak Flow			=	0.046			
	Head Loss across Screen at 50% CloggedCondition							
	Velocity through Screen at 50% CloggedCondition at Peak Flow			=	1.959			
	Head Loss across screen at 50% CloggedCondition at Peak Flow			=	0.255			
				<	0.3	m/sec		OK
	Size of Mechanical Fine Screens = 2 units x 8 m x 1.6 m x 1.55 m							
3.2.2	FINE SCREEN CHANNELS: MANUAL							
	No. of Manual Screen			=	1	No.		
	Design Flow			=	1/2Peak Flow			
				=	103.5	MLD		
				=	4312.5	m3/hr		
				=	1.197916667	m3/sec		
	Average Flow			=	46	MLD		
				=	1916.666667	m3/hr		
				=	0.532407407	m3/sec		
	Design Flow in each Screen			=	1.197916667	m3/sec		
					1	No.		
				=	1.197916667	m3/sec		

	Average Flow in each Screen	=	0.532407407	m3/sec		
			1	No.		
		=	0.532407407	m3/sec		
	Maximum Velocity through Screen at PeakFlow	=	1.0	m/sec		
	Minimum Velocity through Screen at AverageFlow	=	0.6	m/sec		
	Clear Area of Opening through Screen forPeak Flow	=	1.197916667	m3/sec		
			1.0	m/sec		
		=	1.197916667	m2		
	Clear Area of Opening through Screen forAverage Flow	=	0.532407407	m3/sec		
			0.6	m/sec		
		=	0.887345679	m2		
	Considering maximum Area of Opening through Screen	=	1.197916667	m2		
	Clear Spacing of Bars	=	10	mm		
	Thickness of Bars	=	3	mm		
	Gross Area of Screen	=	1.432 x (10+3) / 10			
		=	1.557291667	m2		
	Assuming Depth of Screen Channel	=	1.55	m		
	Gross Width of Screen	=	1.004704301	m		
	No. of Bars	=	(Gross Width of Screen / Center to Center			
		=	(1.201 / ((10 +3)/1000) - 1			
		=	76.28494624	Nos.		
	Say	=	77	Nos.		
	Width of Screen provided	=	(Number of Bars+1) x Clear Spacing + (Number of Bars x Bar Thickness)			
		=	(113+1) x 10 + (113 x 3)			
		=	1011	mm		
	Say	=	1011	mm		
	Width of Side Frame provided	=	50	mm		
	Width of Screen Channel	=	1600	mm		
	Width of Screen Channel Provided	=	1600			
	Liquid Depth of Screen Channel provided	=	1550	mm		
	Length of Screen Channel provided	=	8000	mm		
	Freeboard provided	=	300	mm		
	Head Loss across Screen					
	Head Loss across Screen	=	0.0728 (V2 - v2)			
	V = Velocity through Screen at Peak Flow	=	Peak Flow through Screen Channel / Clear Area of Opening through Screen			
		=	0.751			
	v = Velocity in approach Channel at Peak Flow	=	Peak Flow through Screen Channel / Cross Sectional Area of Screen Channel			
	Head Loss across Screen at Peak Flow	=	0.578			
	Head Loss across Screen at 50% Clogged condition	=	0.017			
	Head Loss across Screen at 50% CloggedCondition					
	Velocity through Screen at 50% CloggedCondition at Peak Flow	=	1.502			
	Head Loss across screen at 50% CloggedCondition at Peak Flow	=	0.140			
		<	0.3	m/sec		OK
	Size of Manual Fine Screens = 1 unit x 8 m x 1.6 m x 1.55 m					
3.3	GRIT CHAMBERS					

	No. of Working Units	=	2	Mechanical
	No. of Standby Units	=	0	Manual
	Total No. of Units	=	2	Nos
3.3.1	GRIT CHAMBER: MECHANICAL			
	No. of Mechanical Grit Chamber	=	2	
	Design Flow	=	Peak Flow	
	Peak Flow	=	184	MLD
		=	184000	m3/day
		=	7666.666667	m3/hr
		=	2.12962963	m3/sec
	Design Flow to each Grit Chamber	=		
		=	92000	m3/day
		=	3833.333333	m3/hr
		=	1.064814815	m3/sec
	According to "Manual on Sewerage & Sewage Treatment" published by Central Public Health and Environmental Engineering Organisation (CPHEEO),			
	Surface Overflow Rate for 0.15 mm dia. Particle Size with Specific G	=	1555	m3/m2/day
	Considering Design Overflow Rate	=	960	m3/m2/day
	Area of Grit Chamber required	=	123750	m3/day
			960	m3/m2/day
		=	128.91	m2
	Square Side of Grit Chamber required	=	128.91	
		=	11.35	m
	Length of Chamber provided	=	11.5	m
	Width of Chamber provided	=	11.5	m
	Hydraulic Retention Time (HRT) in GritChamber at Peak Flow	=	60	sec
	Volume of Grit Chamber required	=	1.432 x 60	
		=	85.938	m3
	Depth required in Grit Chamber	=	85.938 / (11.5 x11.5)	
		=	0.65	m
	Say	=	0.65	m
	Grit Storage Depth	=	0.25	m
	Total Liquid Depth required	=	0.9	m
	Total Liquid Depth provided	=	0.9	
	Freeboard provided	=	0.3	m
	Size of Grit Chambers = 2 units x 11.5m x 11.5 m x 0.9 m			
4	PROCESS DESIGN FOR SBR BASINS			
4.1	TREATMENT SEQUENCE			
A	Sewage to be treated in a day	=	92000	m3
B	Time for "Fill & Aerate" phase provided	=	2	hrs
C	Time for "Settle" phase provided	=	1	hrs
D	Time for "Decant" phase provided	=	1	hrs
E	Total Cycle Time provided = B + C + D	=	4	hrs
F	No. of Cycles provided per Basin per day= 24 / E	=	6	Nos.
G	Aeration Time provided per Basin per day= B x F	=	12	hrs
H	No. of Basins under "Fill" simultaneously	=	3	Nos.

I	No. of Basins under "Aerate" simultaneously	=	3	Nos.		
J	No. of Basins under "Decant" simultaneously	=	2	Nos.		
K	Flow Rate = A / 24	=	3833.333333	m3/hr		
L	Flow Rate to each Basin = K / H	=	1277.777778	m3/hr		
4.2	BASIN SIZING					
A	Volume of Sewage to be treated in day	=	92000	m3/day		
B	Inlet BOD	=	100	mg/l		
C	MLSS considered	=	4300	mg/l		
D	MLVSS = MLSS x 0.7	=	3010	mg/l		
E	F/M considered	=	0.08			
F	Total Volume of Aeration Basins required= (A x B) / (D x E)	=	38205.98	m3		
G	No. of Basins provided	=	6	Nos.		
H	Volume required per Basin = F / G	=	6367.663344	m3		
I	Side Water Depth (SWD) provided	=	5.5	m		
J	Width provided	=	31.0	m		
K	Length required	=	37.3	m		
L	Length provided	=	38.0	m		
M	Volume provided = I x J x L	=	6479	m3		
N	Total Volume provided = M x G	=	38874	m3		
O	Freeboard provided	=	0.5	m		
P	Total Depth provided = I + O	=	6	m		
Q	Hydraulic Retention Time (HRT) provided= N x 24 / A	=	10.14	hrs		
R	Solids Retention Time (SRT) provided = (N x C) / (Excess Sludge x 1000)	=	55.53428571	days		
S	Recirculation Ratio provided	=	25%	Flow per		
T	Feed Flow to each Basin	=	1277.777778	m3/hr		
U	Recirculation Flow required = T x S	=	319.4444444	m3/hr		
V	Capacity of Return Activated Sludge (RAS) Pump provided	=	320	m3/hr		
	Size of SBR Basins = 6 units x 61.7 m x 31 m x 5.5 m					
4.3	SELECTOR ZONE					
A	Design Flow = Feed Flow + Recirculation Flow	=	1597.222222	m3/hr		
B	Hydraulic Retention Time HRT) provided atDesign Flow	=	55	min		
C	Volume required = (A x B) / 60	=	1464.12037	m3		
D	No. of Sub-Compartments provided per Basin	=	6	No.		
E	Side Water Depth (SWD) provided	=	5.5	m		
F	Length provided	=	31	m		
G	Width required = C / (F x E)	=	8.587216249	m		
H	Width provided	=	9	m		
I	Volume provided = F x H x E	=	1534.5	m3		
4.4	ACTUAL OXYGEN REQUIREMENT (AOR) CALCULATIONS					
A	Volume of Sewage to be treated in day	=	92000	m3		
B	Inlet BOD5	=	100	mg/l		
C	Outlet BOD5	=	10	mg/l		
D	BOD5 removed = C - D	=	90	mg/l		
E	BOD5 removed in a day = A x D / 1000	=	8280	Kg/day		
F	O2 required for oxidation of BOD	=	1.2	Kg/Kg BOD		
G	O2 required for oxidation of BOD = E x F	=	9936	Kg/day		
H	Inlet TKN	=	20	mg/l		
I	Outlet NH3-N	=	1	mg/l		
J	Nitrogen assimilated during oxidation of BOD= D x 5%	=	4.5	mg/l		
K	NH3-N nitrified in a day = H - I - J	=	14.5	mg/l		
L	NH3-N nitrified in a day = A x K / 1000	=	1334	Kg/day		
M	O2 required for nitrification of NH3-N	=	4.56	Kg/NH3-N		
N	O2 required for nitrification of NH3-N = L x M	=	6083.04	Kg/day		II

O	NO3-N generated assuming 75% nitrification of NH3-N = K x 75%			=	10.875	mg/l		
P	Outlet NO3-N			=	3	mg/l		
Q	NO3-N that is denitrified= O – P			=	7.875	Kg/day		
R	Amount of NO3-N that is denitrified= A x Q / 1000			=	724.5	Kg/day		
S	O2 credit during de-nitrification of NO3-N			=	2.86	Kg/Kg NO3-		
T	O2 credit available during de-nitrification				6,548	Kg/day		III
W	Total O2 required including O2 credit during de-nitrification = G + N – T				9471.04	Kg/day		
4.5	**STANDARD OXYGEN REQUIREMENT (SOR) CALCULATIONS**							
A	Actual Oxygen Transfer Rate (AOTR) under field conditions			=	9471.04	Kg/day		
B	As per Equation 5-55, Pg No 429, Wastewater Engineering - Treatment and Reuse, Metcalf & Eddy….. Standard Oxygen Transfer Rate (SOTR) in Tap Water at 200 C and Zero Dissolved Oxygen:							
	AOTR ÷ [((βC'S,T,H – CL) ÷ CS,20) x 1.024(T – 20)x α x F]							
	Where,							
	AOTR = Actual Oxygen Transfer Rate under field conditions			=	9471.04	Kg/day		
	As per Pg No 429, Wastewater Engineering - Treatment and Reuse, Metcalf & Eddy….. C' : Average Dissolved Oxygen Saturation Concentration in Clean Water in Aeration Tank at Temperature 'T' and Altitude 'H' S,T,H = CS,T,H x (1/2) x ((Pd / Patm,H)+Ot/21))							
T = Field Temperature		=	27					
H = Altitude of Site		=	527					
	As per Equation B-2, Pg No 1738, Wastewater Engineering - Treatment and Reuse, Metcalf &Eddy….. C = Oxygen Saturation Concentration in Clean Water at Temperature 'T' and Altitude 'H': CS,T,HS,T,H = CS,T x exp(-(g x M x (zb - za)) / (R x T))							
	C = Oxygen Saturation Concentration in Clean Water at Temperature 'T'			=		mg/l		
g = Acceleration due to Grav		=	9.81 m/s2					
M = Mole of Air		=	28.97 Kg/Kg-					
zb = Elevation (Altitude 'H')		=	527			m		
za = Elevation (Altitude Zero		=	0			m		
R = Universal Gas Constant		=	8,314			Nm/Kg-mole.K		
T = Temperature		=	300.15			Kelvin		
Hence, CS,T,H		=	7.76			mg/l		
As per Equation B-2, Pg No 1738, Wastewater Engineering - Treatment and Reuse, Metcalf & Eddy….. Patm,H = PaS,T,H – CL) ÷ C x exp(-(g x M x (zS,20b) x 1.024 - za(T – 20))) / (R x T))								
Pa = Pressure at Zero Altitu		=						
g = Acceleration due to Grav		=	9.81					
M = Mole of Air		=	28.97					
	zb = Elevation (Altitude 'H')			=	527	m		
	za = Elevation (Altitude Zero)			=	0	m		
	R = Universal Gas Constant			=	8,314	Nm/Kg-mole.K		
	T = Temperature			=	300.15	Kelvin		
	Hence, Patm,H			=	9.54			
	Pd = Pressure at the Depth of Air Release= Patm,H + Effective Aerat			=	13.59	mWC		
	Ot = Percentage Oxygen Concentration leavingTank			=	19.00			18 - 20
	Hence, C'S,T,H			=	9.03	mg/l		
	CL: Operating Oxygen Concentration			=	2	mg/l		
	CS,20: Dissolved Oxygen Saturation Concentration in Clean Water a			=	9.08	mg/l		Table D, Ap
	α: Oxygen Transfer Correction Factor			=	0.65			
	β: Salinity - Surface Tension Correction Factor			=	0.95			
	F: Fouling Factor			=	0.9			
	Hene, SOTR			=	87,369	Kg/day		
C	No. of Basins			=	6	Nos.		
D	Standard O2 required at Field Conditions perBasin= B / C			=	1578.506667	Kg/day/Bas in		

E	Top Water Level (TWL) in SBR Basins	=	5.5	m	
F	Bottom Water Level (BWL) in SBR Basins	=	3.1	m	
G	Aeration Depth	=	4.3	m	
H	Height at which Diffusers are kept	=	0.25	m	
I	Effective Aeration Depth = G - H	=	4.05	m	
J	SOTE for the above Effective Aeration Depth	=	25.25	%	
K	Fraction of O2 in Air	=	23.18	%	
L	Specific Gravity of Air at Standard Condition	=	1.293		
M	Air required at Field Conditions per Basin= D / (J x K x L)	=	20858.02009	Nm3/day/Basin	
N	Hours of Aeration per Basin per day	=	12	hr/day/Bas	
O	Air required per hour per Basin = M / N	=	1738.168341	Nm3/hr/Ba sin	
P	No. of Operating Air Blowers per Basin	=	3	Nos.	
Q	Capacity of Air Blowers required = O / P	=	579.389447	Nm3/hr	
R	Capacity of Air Blowers provided	=	5,500	Nm3/hr	
S	Number of Basins per set of Air Blowers	=	2	Nos.	
T	Number of Basins	=	6	Nos.	
U	Number of Operating Air Blowers = P x T / S	=	9	Nos.	
V	Number of Standby Air Blowers(50% of Working Air Blowers)	=	3	Nos.	
4.6	SLUDGE WASTING				
A	Specific Sludge Yield	=	0.81	Kg/Kg BODremoved	
B	BOD removed	=	8280	Kg/day	
C	Excess Sludge to be wasted = B x A	=	6706.8	Kg/day	
D	No. of Basins provided	=	6	Nos.	
E	Sludge to be Wasted per Basin = C / D	=	1117.8	Kg/day	
F	No. of Cycles	=	8	Cycles/day/ Basin	
G	Sludge to be Wasted per Cycle per Basin = E / F	=	139.725	Kg/day	
H	Solids Consistency in the Wasted Sludge	=	0.80%		
I	Volume of Sludge to be Wasted per Cycle perBasin = G / (H x 1000)	=	17.465625	m3	
J	Considering Running Time pf SurplusActivated Sludge (SAS) Pump p	=	10	min	
K	Capacity of SAS Pump required= (I x 60) / J	=	104.79375	m3/hr	
L	Capacity of SAS Pump provided	=	105	m3/hr	
5	DISINFECTION SYSTEM				
5.1	CHLORINE CONTACT TANK				
	No. of Units	=	1	No.	
	Design Flow	=	Average Flow or Decant Flow whichever ismore		
	Average Flow	=	3833.33	m3/hr	
	Decant Flow	=	1916.67	m3/hr	
	Hydraulic Retention Time at Average Flow	=	30	min	
	Volume of Chlorine Contact Tank required	=	958.3333333	m3	
	Side Water Depth (SWD) provided	=	3.5	m	
	Width provided	=	8	m	
	Length required	=	34.22619048	m	
	Length provided	=	35	m	
	Volume provided	=	980	m3	
	Freeboard provided	=	0.5	m	
	Size of Chlorination Tank = 1 unit x 35 m x 8m x 3.5 m				
5.2	CHLORINATORS				
	Design Flow	=	Average Flow or Decant Flow whichever ismore		
	Average Flow	=	3833.33	m3/hr	
	Decant Flow	=	1916.67	m3/hr	
	Design Chlorine Dosage (Max)	=	4	mg/l	
	Quantity of Chlorine required	=	7.67	Kg/hr	
	No. of Working Chlorinator provided	=	1	No.	
	Capacity of Chlorinator required	=	7.67	Kg/hr	

	Capacity of Chlorinator provided	=	8.00	Kg/hr		
	No. of Standby Chlorinator provided	=	1	No.		
	Quantity of Chlorine required	=	276	Kg/day		
	Considering Storage Period as	=	30	days		
	Quantity of Chlorine required	=	8280	Kg		
	Available Capacity of one Chlorine Tonner	=	928	Kg		
	No. of Chlorine Tonners required	=	8.922413793	Nos.		
	Say	=	9	Nos.		
	No. of Chlorine Tonners in use at any time	=	1	Nos.		
	Total No. of Chlorine Tonners provided	=	10	Nos.		
6	SLUDGE HANDLING SYSTEM					
6.1	CENTRIFUGE FEED SUMP					
	Quantity of Sludge to be wasted from SBR Basins	=	6706.8	Kg/day		
	Total Sludge generated	=	6706.8	Kg/day		
	Solids Consistency of Waste Sludge considered	=	0.8%			
	Volume of Sludge to be wasted in a day	=	6706.8 / (0.008 x 1000)			
		=	838.35	m3/day		
		=	34.93	m3/hr		
	Hydraulic Retention Time (HRT) provided inSludge Sump	=	6.00	hrs		
	Volume of Sludge Sump required	=	209.5875	m3		
	Side Water Depth (SWD) provided	=	3.5	m		
	Width provided	=	7	m		
	Length provided	=	9.00	m		
	Volume provided	=	220.5	m3		
	Freeboard provided	=	0.5	m		
	Size of Centrifuge Feed Pump = 1 unit x 9 m x 7 m x 3.5 m					
6.2	SLUDGE SUMP AIR BLOWERS					
	Volume of Sludge Sump provided	=	220.5	m3		
	Design Air Agitation Rate	=	1.2	m3/hr/m3		
	Air required for mixing	=	264.6	m3/hr		
	Number of Working Air Blower considered	=	1	No.		
	Capacity of each Air Blower required	=	264.6	m3/hr		
	Capacity of each Air Blower provided	=	265	m3/hr		
	Number of Standby Air Blower provided	=	1	No.		
	Head provided	=	0.4	Kg/cm2		
6.3	CENTRIFUGE & CENTRIFUGE FEED PUMPS					
	Volume of Sludge to be fed to Centrifuge in a day	=	838.35	m3/day		
	No. of Operating Hours of Centrifuge considered	=	18			
	Capacity of Centrifuge required	=	46.575			
	No. of Working Centrifuge considered	=	4	Nos.		
	Capacity of each Centrifuge required	=	11.64375	m3/hr		
	Capacity of each Centrifuge provided	=	12	m3/hr		
	No. of Standby Centrifuge provided	=	1	No.		
	Capacity of Centrifuge Feed Pump provided	=	12	m3/hr		
	No. of Working Centrifuge Feed Pump provided	=	4	Nos.		
	No. of Standby Centrifuge Feed Pump provided	=	1	No.		
	Head provided	=	15	mWC		
6.4	POLYELECTROLYTE DOSING SYSTEM					
	Quantity of Sludge to be dewatered in a day	=	6706.8	Kg/day		
	Design Polyelectrolyte Dosage (Max)	=	1.50	Kg/Ton ofDry Solids		
	Quantity of Polyelectrolyte required	=	32.54	Kg/day		
	Design Strength of Polyelectrolyte Solution	=	0.1%			
	Volume of Polyelectrolyte Solution	=	32.54 / (0.001 x1000)			
		=	32.54	m3		
	No. of Dosing Tanks provided	=	2	Nos.		

	Volume of each Dosing Tank required			=	16.27	m3		
	Side Water Depth (SWD) provided			=	2	m		
	Length/Width required			=	2.85	m		
	Length/Width offered			=	2.85	m		
	Volume provided			=	16.27	m3		
	Freeboard provided			=	0.5	m		
	Size of Dosing Tanks = 2 units x 2.9 m x 2.9 m x 2.0 m							
	No. of Working Polyelectrolyte Dosing Pump provided			=	6	Nos.		
	Capacity of each Polyelectrolyte Dosing Pump required			=	Total Volume of Polyelectrolyte Solution / (No. of Dosing Pumps x No. of Hours of			
				=	32.54 / (6 x 18)			
				=	0.301	m3/hr		
				=	301	LPH		
	Capacity of each Polyelectrolyte Dosing Pump provided			=	410	LPH		
	No. of Standby Polyelectrolyte Dosing Pump provided			=	1	No.		