Centrale di San Filippo del Mela

Progetto definitivo per l'installazione di un nuovo ciclo combinato a gas

Note di calcolo – Fondazioni minori

APPLICA

A2A/DGE/BGT/GEN/ING

LISTA DI DISTRIBUZIONE

A2A/DGE/BGT/GEN/ING
AEF/AMD/ISF

ORDINE DEGLI INGEGNERI DELLA PROVINCIA DI MILANO
DOTT.ING. COLETTI PAOLO ALBERTO
Sez.A Settori:
a) Civile e ambientale
b) Industriale
c) dell' Informazione
n° A 30355

ORDINE DEGLI INGEGNERI DELLA PROVINCIA DI MILANO
DOTT. ING. MORGERA DANIELE
Sez.A Settori:
a) civile e ambientale
b) industriale
c) dell'informazione
n° A 30863

a2a energiefuture

LOGO E CODIFICA DEL FORNITORE

TECHINT
Engineering & Construction

0421-TITA-C-CA-000-008

EMISSIONE					
1	10/12/2019	FU = Per Uso	C. Bettoni	D. Morgera	P. Coletti
0	27/11/2019	FA = Per Approvazione	L. Agostino	C. Bettoni	G. Ricci
REV	DATA	DESCRIZIONE	REDAZIONE	VERIFICA	APPROVAZIONE

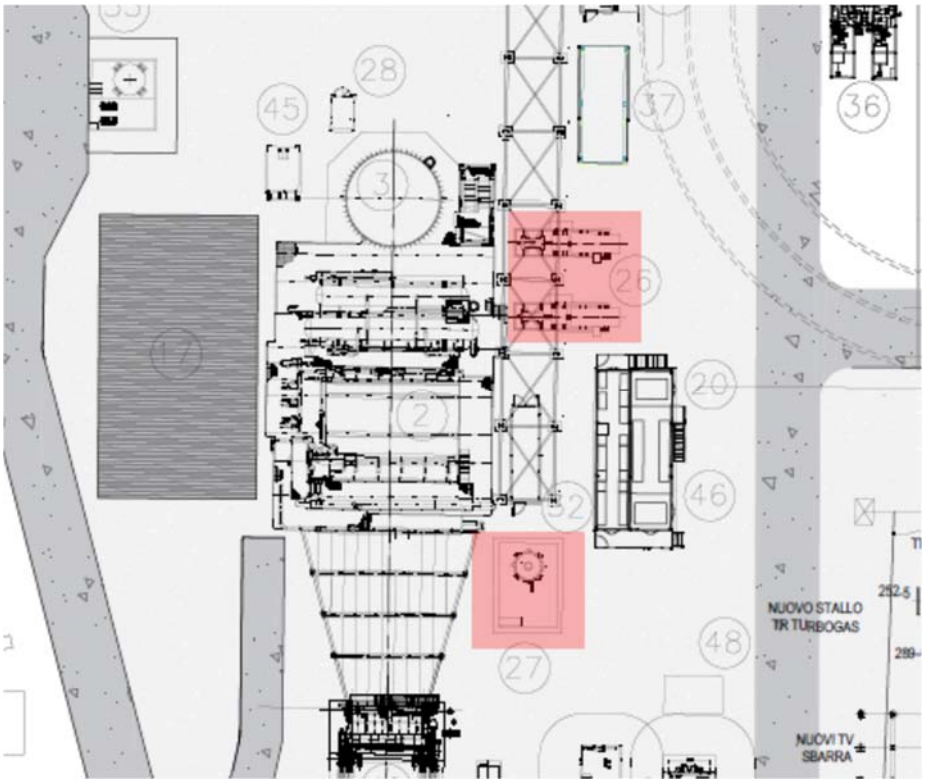
- Il documento approvato e firmato in originale è depositato presso l'archivio tecnico della S.O.-

INDICE

1 SCOPO

Lo scopo di applicazione del presente documento consiste nella definizione delle fondazioni relative a:

1. Pompe alimento;
2. Vasche.



Sono state fatte considerazioni di buona pratica in base ad ipotesi ed alcuni standard Techint.

La progettazione di tutti gli elementi in base ai codici e alle norme applicabili rimane a carico del fornitore EPC.

2 PARAMETRI DI PROGETTAZIONE

2.1 DOCUMENTI DI RIFERIMENTO

NORMATIVE

1 Decreto ministeriale 17 gennaio 2018 - AGGIORNAMENTO "Norme tecniche per le costruzioni".

2 Circolare 21 gennaio 2019, nr. 7 - "Istruzioni per l'applicazione dell'aggiornamento delle Norme tecniche per le costruzioni".

3 UNI EN 1992-1: Eurocodice 2 – Progettazione delle strutture di calcestruzzo - Parte 1-1: Regole generali e regole per gli edifici

RELAZIONI E SPECIFICHE TECNICHE

4	SFP-RTC-100004-CCGT-00	Relazione Sismica
5	SFP-RTC-100005-CCGT-00	Relazione Geotecnica

2.2 SOFTWARES

→ SAP2000 v19.2.1
→ MathCAD v14

2.3 MATERIALI

2.3.1 ACCIAIO STRUTTURALE

S275

→ f_{yk} = 275 N/mm^2
→ f_{tk} = 370-530 N/mm^2
→ E_s = 2.1×10^5 N/mm^2

2.3.2 CALCESTRUZZO

C 35/45

• resistenza caratteristica cilindrica	f_{ck} =	35	MPa
• resistenza caratteristica cubica	R_{ck} =	45	MPa
• resistenza media a compressione	f_{cm} =	43	MPa
• resistenza media a trazione	f_{ctm} =	3.20	MPa
• modulo di elasticità secante	E_{cm} =	34077	MPa

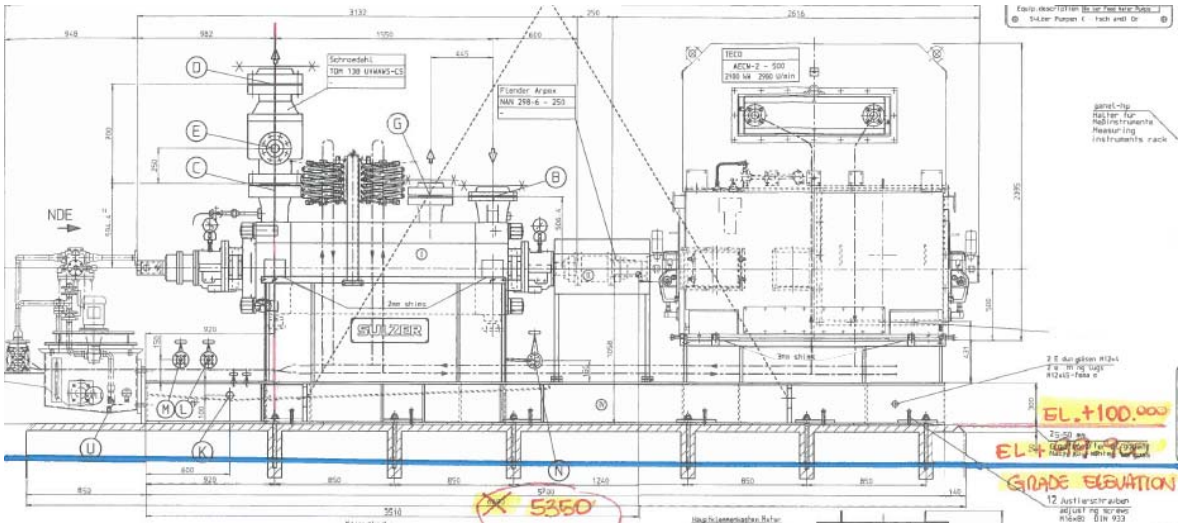
2.3.3 ACCIAIO D'ARMATURA

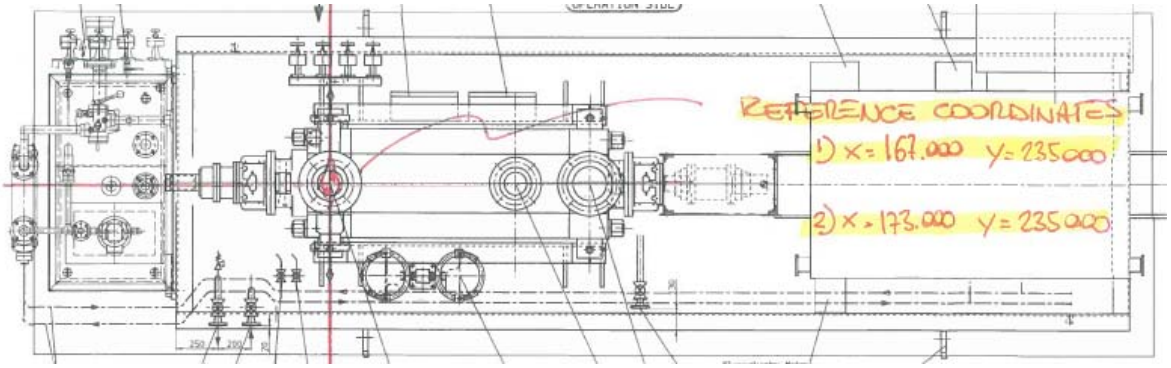
B450C

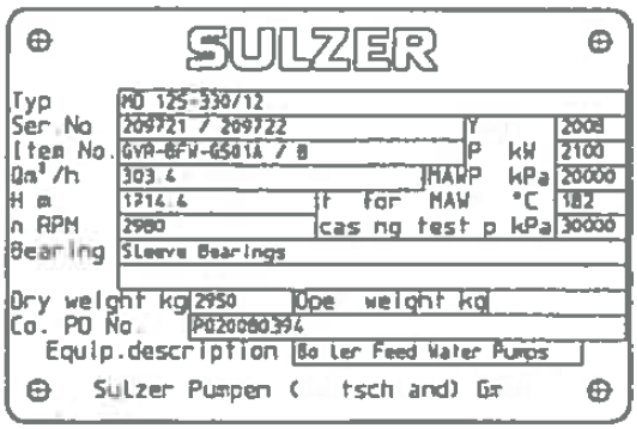
→ f_{yk} = 450 N/mm^2
→ f_{tk} = 540 N/mm^2
→ E_s= 2.1×10^5 N/mm^2

3 POMPE ALIMENTO

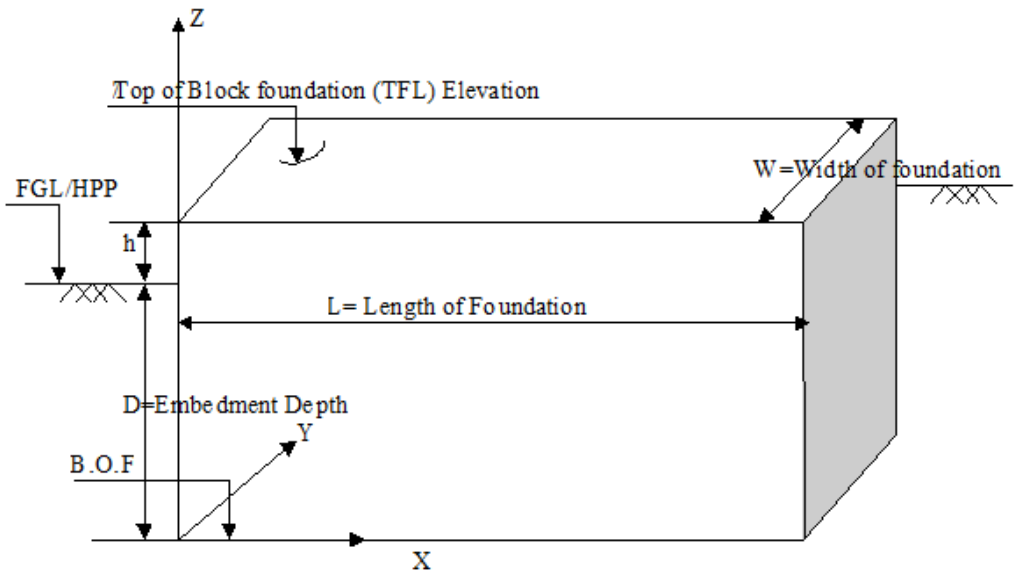
Dato che in questa fase di progetto non sono disponibili i disegni del venditore né i carichi della pompa, sono stati utilizzati i dati del fornitore (i carichi e la geometria) relativi a pompe simili di progetti già realizzati.







		Masse Mass [kg]	Masse der rot. Teile Mass of rot. parts [kg]	Massenträgheitsmoment Mass moment of inertia J [kgm²]
I	PUMP	~2950	-	2.659
II	COUPLING	75	56.5	0.584
III	MOTOR	≈7000	1300	24
IV	BASEPLATE without grout	~2725	-	-
V	AUTOMATIC RECIRCULATING CHECK VALVE	444	-	-
VI	ACCESSORIES	≈270	-	-
VII	STRAINER	-	-	-
VIII	OIL SUPPLY UNIT	≈500	-	-
	Transport weight	≈13564	-	-
	on site: concrete filled-in baseplate	≈5220		
	Total weight ≈	21259		



Inputs .....

Density of concrete	$\gamma_c := 24.5 \frac{kN}{m^3}$	
Top of Foundation,	TFL := 0.05m	
Highest Point of Paving/Finished Grade,	HPP := 0.00m	
Lowest Point of Paving/Finished Grade,	LPP := 0.00m	[Lowest point of Paving = 99.800m]
Embedment depth of foundation from LPP	D := 1.5m	[the remaining shall be covered with structured Fill]
Top of founation from LPP	h := TFL − LPP	h = 0.05 m
Centrel Line of shaft Elevation,	E_{shaft} := 1.058m	

- For pedestal weight calculation dimension related to pedestal.

Pedestal dimension for Pump & Motor baseframe

Lenght of pedestal along x axis $L_{ped} := 10m$ $L_{ped} = 10\,m$

Width of pedestal along y axis $B_{ped} := 3m$ $B_{ped} = 3\cdot m$

Height of pedestal $h_{ped} := 0.5m$ $h_{ped} = 0.5\,m$

Weight of pedestal P1 $P1_{weight} := h_{ped}\cdot B_{ped}\cdot L_{ped}\cdot \gamma_c$ $P1_{weight} = 367.5\cdot kN$

- For footing weight calculation dimension related to footing.

Plan dimension of the foundation

Lenght of foundation along x axis $L_f := 10m$ $L_f = 10\cdot m$

Width of foundation along y axis $B_f := 4m$ $B_f = 4\cdot m$

Height of footing $h_f := 1.m$ $h_f = 1\,m$

Weight of footing P2 $P2_{weight} := h_f\cdot B_f\cdot L_f\cdot \gamma_c$ $P2_{weight} = 980\cdot kN$

$j := 1..2$

$P := \left(\left(P1_{weight}\ \ P2_{weight}\right)\right)^T$ $P = \begin{pmatrix} 367.5 \\ 980 \end{pmatrix}\cdot kN$

Check 1 Rocking Stability

Check for Rocking Resistance (as per Section 2.4.3 of PIP REIE 686-1996, Chapter 4)

$B_{min} := 1.5\cdot\left(E_{shaft} + h + D\right)$ $B_{min} = 3.912\,m$

$$Check\_rock := \begin{cases} \text{"Width Adequate"} & \text{if } B_{min} \le B_f \\ \text{"Increase Width"} & \text{otherwise} \end{cases}$$

$Check\_rock = \text{"Width Adequate"}$

Check 2 Thickness of the foundation

$$Check\_thick := \begin{cases} \text{"Depth Adequate"} & \text{if } \left[\left(0.6 + \frac{L_f}{30m}\right)m \le \left(h_f + h_{ped}\right)\right] \wedge \max\left(L_f, B_f\right) \le 10\left(\left(h_f + h_{ped}\right)\right) \\ \text{"Increase Depth"} & \text{otherwise} \end{cases}$$

$Check\_thick = \text{"Depth Adequate"}$

Check 3 Mass Ratio

Check 3 Check for Mass Ratio [(as per Section 2.4.2 of PIP REIE 686-1996, Chapter 4)

The pump-driver-set type is Centrifugal type so weight of block concrete foundation shall be 3 times the weight of machine train. (including weight of machine base plate including piping supported on it.)

Total weight of machine train including piping weight

$P_{Machinetrain} := 212.6kN$ $P_{Machinetrain} = 213 \cdot kN$ $P_{Machinetrain} = 21679.16669 \cdot kgf$

Weight of concrete foundation and pedestals

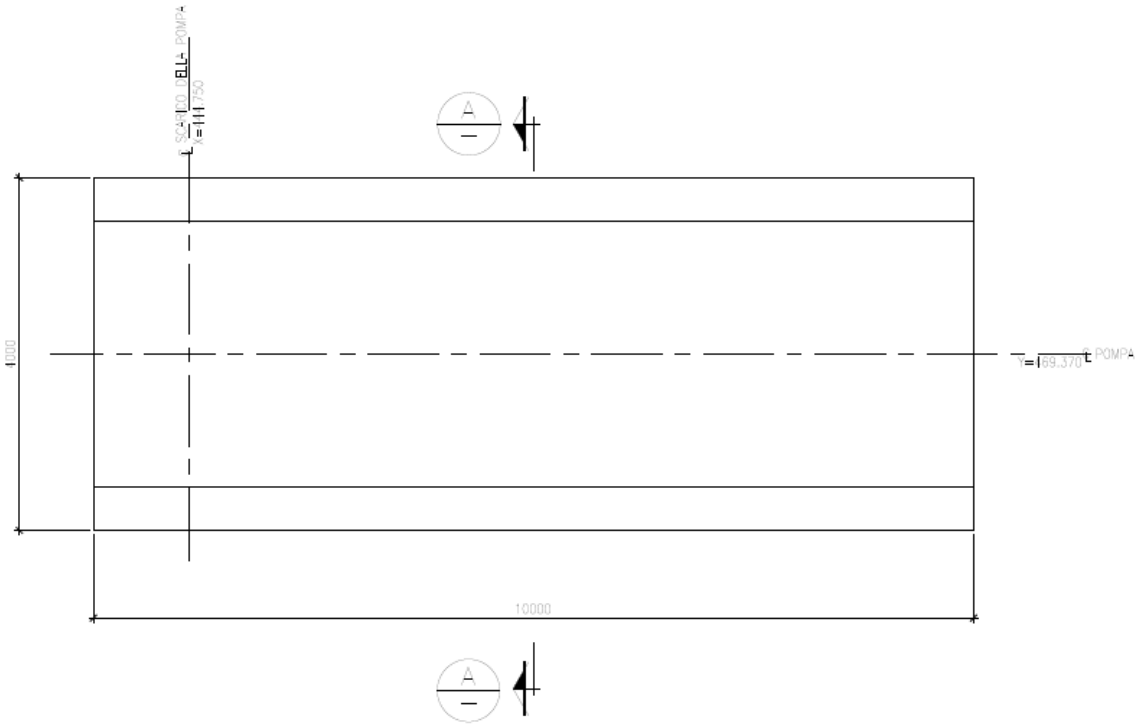
$P_{weightfdnped} := \sum_{j=1}^{2} P_j$ $P_{weightfdnped} = 1348 \cdot kN$

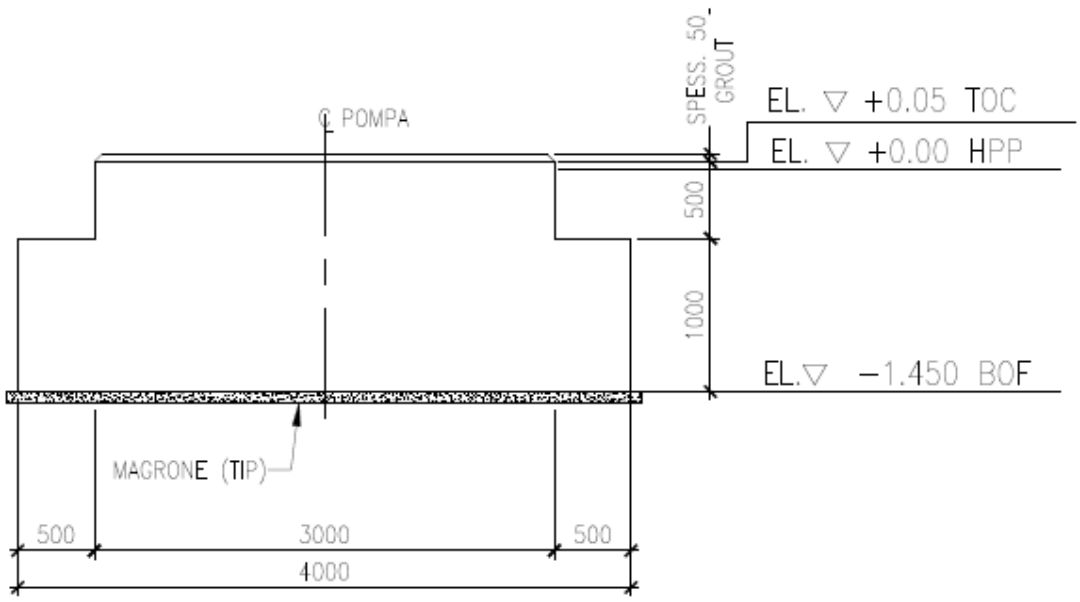
c := ""Centrifugal Machine"

$$Ratio := \begin{cases} 5 & \text{if } c = \text{"Reciprocating Machine"} \\ 3 & \text{otherwise} \end{cases} \qquad \frac{P_{weightfdnped}}{P_{Machinetrain}} = 6.338$$

$$Conclusion := \text{if}\left(\frac{P_{weightfdnped}}{P_{Machinetrain}} > Ratio, \text{"Weight of foundation is ok"}, \text{"Increase the weight of foundation"}\right)$$

Conclusion = "Weight of foundation is ok"





SEZIONE A–A

SCALA 1:50

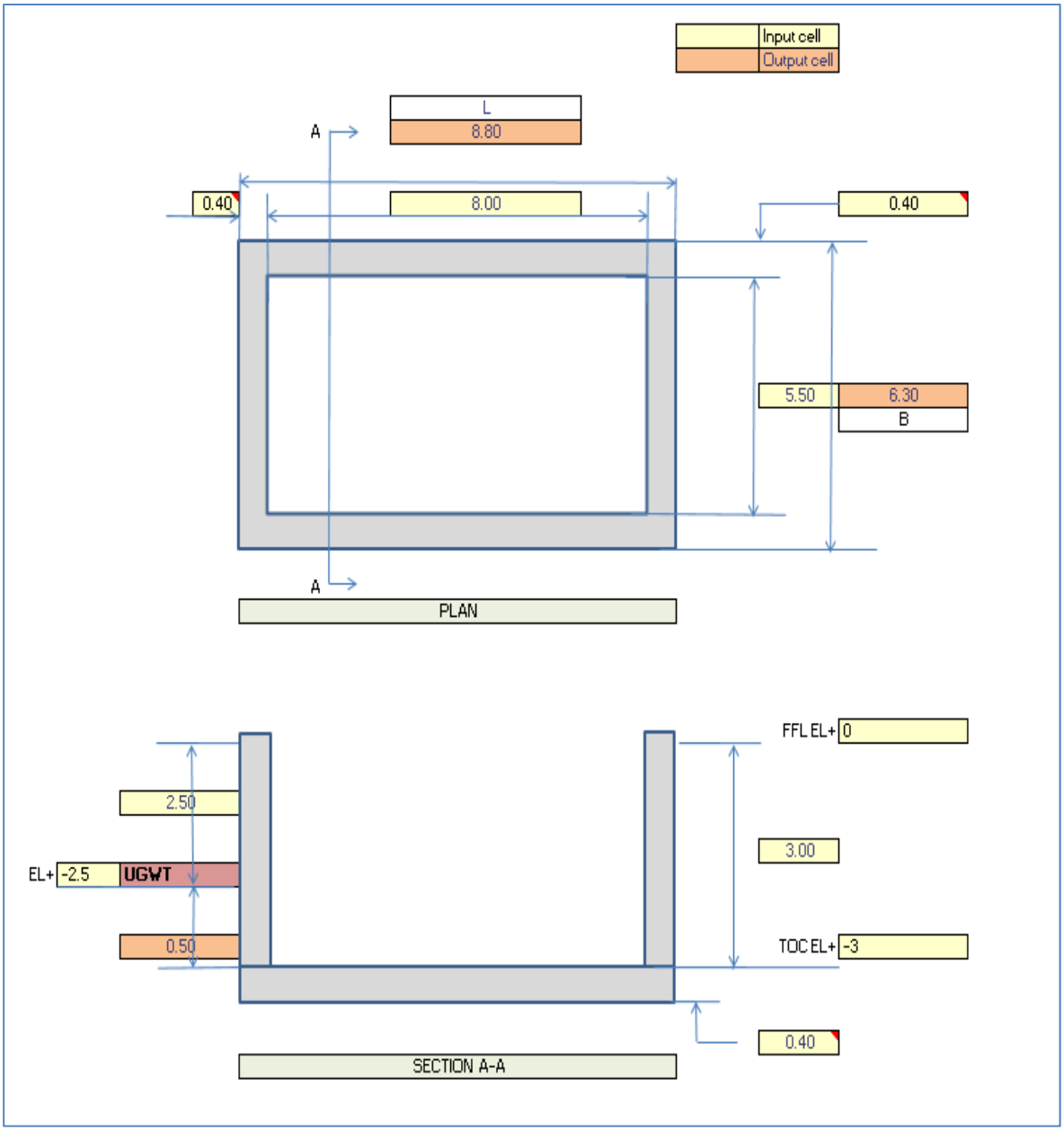
4 VASCHE

1. Vasca Blow Down (8.8m x 6.3m x 3.7m).
2. Pozzetti pompe estrazione del condensato (profondità di 1,6m).
3. Vasca di lavaggio/risciacquo (5.1m x 4.7m x 4.35m).

Il dimensionamento strutturale delle vasche viene definito in base a diverse verifiche di stabilità e di progettazione (galleggiamento, capacità portante e scorrimento).

Il calcolo riportato è eseguito per la Vasca 1.

4.1 VASCA BLOW-DOWN



PARAMETERS				
STRUCTUTRAL MATERIAL PARAMETERS				
Concrete strength, f`c	=		30.00	MPa
Reinforced concrete density	=		25.00	KN/m³
Steel grade, fy	=		420.00	MPa
shear strength reduction factor,Ø	=		0.75	
flexure strength reduction factor,Ø	=		0.90	
cover	=		50.00	mm
permissible crack width for liquid retaining structure	=		0.10	mm
permissible crack width for conc. In contact with earth	=		0.30	mm
F.O.S. against overturr =	1.50	For LC # 1		

SOIL AND WATER PARAMETERS			
Soil density, ps	=	18.00	KN/m³
Angle of Internal Friction	=	30°	
Active earth pressure co-eff, Ka	=	**0.33**	
S.B.C.	=	**306.00**	KN/m²
Pressure Diagram For Load case -1			
		3.00	
		30.00	
Water Density	=	**10.00**	KN/m³
Pressure at bottom of wall due to water	=	**30.00**	KN/m²
Moment Due to water pressure = 1/2 x 20 x 2 x 1		**15.00**	KN-m
Reaction due to water pressure = 1/2 x 20 x 2		**20.00**	KN
Pressure Diagram For Load case -2			
		2.50	
		0.50	
		15	
		8	
		23	
Pressure at bottom of wall due to soil	=	**15.00**	KN/m²
Pressure at bottom of wall due to Soil + submerged soil	=	**23.00**	KN/m²
Moment Due to soil pressure = 1/2 x 8.31 x 1.39 x ((1.39/3) + 0.61)		**27.21**	KN-m
+ (8.31 x 0.61 x 0.61/2) + (1/2 x 9.84 x 0.61 x (0.61/3)		**27.21**	
Reaction due to sol pressure = (1/2 x 8.31 x 1.39)			
+ (8.31 x 0.61) + (1/2 x 9.84 x 0.61)		**28.25**	KN

LOAD COMBINATIONS			
SERVICE LOAD For Base Pressure (max. pressure & uplift) & Stability Checks			
LC # 1 : 1.0D + 1.0H or 1.0D+1.0F	Dead	1.00	
	Fluid Pr.	1.00	
	Earth Pr.	1.00	
FACTORED LOAD For Concrete (Strength) Design			
LC # 2 : 1.4D + 1.4F	Dead	1.40	
	Fluid Pr.	1.40	
LC # 3 : 1.2D + 1.6H or 1.2D+1.2F	Dead	1.20	
	Fluid Pr.	1.20	
	Earth Pr.	1.60	

LC # 1 : 1.0D + 1.0H or 1.0D+1.0F			
BEARING PRESSURE CHECK			
Self wt of walls	=	858	kN
Self wt of top slab	=	0	kN
Self wt of bottom slab	=	554.4	kN
Weight of Fluid inside	=	1320	kN
Total Vertical Load	=	2732.4	kN
Base Area	=	55.44	m^2
Bearing Pressure	=	49.3	kN/m^2
Allowable Bearing Pressure	<	105.00	kN/m^2
		SAFE AGAINST BEARING	
LC # 1 : 1.0D + 1.0H or 1.0D+1.0F			
BUOYANCY CHECK			
Self wt of tank	=	1412.4	kN
Submerged volume of tank	=	49.90	m^3
Force due to buoyancy	=	498.96	kN
Check for Buoyancy		SAFE AGAINST BUOYANCY	