

Stopes Road, Bolton

Specification for Consolidation of Mining Features by Drilling and Grouting



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Control Sheet

This report has been prepared for the sole benefit, use and information of VHE Construction Ltd. for the purposes set out in the instructions commissioning it. The liability of Van Elle Ltd in respect of the information contained in the report will not extend to any third party.

Prepared by	Conor White	Signed	Date
Approved by	Steve Bray	Signed	Date

1.0 Introduction

VHE Construction Ltd in their capacity as Main Contractor acting on behalf of the Harworth Estates Property Group Ltd have instructed Van Elle (VE) to produce a specification and design for the treatment of the known mineshafts within the site boundary.

1.1 Site Location and Description

The site address is Little Lever, Bolton, BL3 1NP. The site covers approximately 6 ha. The site is encompassed by residential areas to the north, south, east and west. A Site Location Plan can be found within Appendix 1. Within the site boundary there are 3No. known mineshafts varying in depth with the largest having a recorded depth of 262m bgl. The 3No. Mineshafts have been located and identified within previous phases of works undertaken/supervised by Hydrock. The areas adjacent to the mineshafts are to be no build zones and are intended to be used for public open space.

1.2 Summary of Previous Works Undertaken

1.2.1 – Shaft Reference 376407-006

The mineshaft was located during the service clearance works on site and as such no probe drilling was undertaken. The shaft is lined at the surface with a three-brick skin and was found to have an internal diameter of 2.90m. The Coal Authority records indicate that the mineshaft is 262m deep. The accurate coordinate for the mine shaft is 376348.333mE, 407592.727mN.

1.2.2 – Shaft Reference 376407-007

The mineshaft was located following 291 probe holes in close proximity to the recorded position of the mineshaft. One probe hole was advanced to 42m bgl however this could not continue further due to limitations of the equipment used. Thus, meaning the depth of the shaft is in excess of 42m bgl. The coal authority does not have records of the depth or construction of the mineshaft, however following further delineation of the mine shaft it is believed that the shaft is rectangular or oval in shape with a diameter of between 2.5m to 3.5m. The accurate coordinate for the mine shaft is 376367.595mE, 407559.113mN.

1.2.2 – Shaft Reference 376407-008

The mineshaft was located following 22 probe holes in close proximity to the recorded position of the mineshaft. One probe hole was advanced to 42m bgl however this could not continue further due to limitations of the equipment used. Thus, meaning the depth of the shaft is in excess of 42m bgl. The coal authority does not have records of the depth. Following further delineation of the mine shaft the diameter of the shaft was identified as being approximately 3m. The accurate coordinate for the mine shaft is E 376380.818, N 407524.433

1.3 Permissions

1.3.1 Coal Authority

A permit to treat the mineshafts will be obtained from the Coal Authority. A copy of the permit shall be kept on site by the foreman.

2.0 Specification

2.1 Design

During the tender stage of the works Van Elle Limited were instructed to carry out a design for the treatment of the three aforementioned mine shaft positions. The design of the treatment of the mineshafts is as follows, drill segmental 101mm casing to 100m below ground level or 5m past the base of the mineshaft if the base is encountered prior to 100m depth.

2.2 Supervision

A full time non-working foreman will be on site during the project, who will be responsible for ensuring the works comply with the specification. He will liaise with VE contract management staff on a weekly basis.

2.3 Drilling

Drilling will be carried out using rotary percussive drill rig, advancing 101mm segmental casing to 100m bgl or 5m past the base of the shaft. 2No. Treatment bores and 1No. Validation bore will be drilled within each mineshaft to the aforementioned depths. Rotary percussive drilling techniques will be used with water as the flushing medium. The rigs will be fitted with a fully interlocked guard, which will be operation at all times that drilling is being carried out. All drilling work will be undertaken from a fully designed shaft frame (design included in appendix 3)

2.3.1 - Drillers Daily Records

Driller's Daily Records should be submitted to the Engineer by 10am the next day.

Driller Daily Records will include the following information:

3. Project Title, number and location.
4. Stabilisation area reference.
5. Drill-hole number and date.
6. Specialist Contractor's name and address.
7. Plant in use and crew members; hours worked.
8. Method of drilling, flush medium, type and size of drilling bit.
9. Angle at which drillhole was drilled (vertical or degrees off-vertical). If off-vertical, position from which drill-hole was drilled and direction of drilling.
10. Type and diameter (id and od) of casing(s) used.
11. Diameter and depth of drill-hole at beginning and end of each working day or shift, if not completed within same.
12. Details and depth(s) of any flushing medium loss during drilling and action taken. Depth(s) at which flushing medium was regained.
13. Standing time, with reason, or time lost overcoming obstructions or access problems.
14. Details of any underground apparatus located.
15. Daily and cumulative meterage drilled.
16. Description of strata encountered; whether it is solid or broken. Depths (m bgl) of same.
17. Details and depths of any voids or cavities, soft drilling, evidence of workings (packed waste, Made Ground at depth, timber etc.).

20. Details and depths of any coal seam encountered, depths and condition (solid, broken, soft etc.).
21. Depth of completed drill-hole.
22. Details of ground mine gas monitoring, emissions of ground mine gas or 'foul air'. If any gas emissions occur above the exposure values detailed within the permit application will be recorded.
23. Details and depths of instructions or hard drilling within the Made Ground and Natural Superficial Deposits.

2.4 Grouting

2.4.1 Materials & Mix

Grout materials shall consist of Ordinary Portland Cement and Pulverise Fuel Ash, mixed at a ratio of 1:10 with a water solids ratio of no more than 40%. No thixotropic or thickening agents were added during agitation. OPC shall comply with BS12 and PFA shall be in accordance with BS 3892: part 2. Where voids are encountered in excess of 500mm, pea gravel will be introduced.

Grouting Records should be submitted to the Engineer daily. Grouting Records will include the following:-

1. Project Title, number and location.
2. Stabilisation area reference.
3. Drill-hole number and date.
4. Contractor's name and address.
5. Drill-hole depths.
6. Grout constituents and mix injected into each drill-hole.
7. Total daily and cumulative quantities of each constituent of grout mixes and grout totals.
8. Details of grouting pressures recorded and corresponding depths.
9. Details of any blockage and measures taken to unblock drill-hole.
10. Details of casing abandoned in drill-holes with appropriate reference numbers.
11. Records of flowmeter and bleed tests undertaken. Details of cubes sent for laboratory testing.
12. Details of materials delivered to site on a daily and cumulative basis.

2.4.2 Equipment

Grout will be batched on site using an electric 6T Mixer. Constituent materials shall be introduced by a loading shovel, and pumped to each bore using a Bauer HP-35e Material Pump. All plant shall be certified safe and maintained properly throughout the operation. When undertaking the mineshaft grouting works, if grout is being injected with no pressure showing on the dial for a volume in excess of 50m³, pea gravel will be introduced via a hopper and flushed using 10:1 PFA:OPC grout. Once a 'plug' has been formed, grouting will recommence as detailed within the RAMS

2.4.3 Water

A source of potable water will be sourced from a nearby wash out hydrant.

2.4.4 Testing

Grout cubes shall be taken twice weekly and tested at 7, 14 and 28 day intervals to achieve a minimum strength of 1N/mm² after 28 days.

The foreman shall ensure that mixes are tested twice daily for flow and once daily for bleed using a Colcrete type flowmeter and graduated beaker respectively. Flows should be with the range of 300-600mm and bleed should be no more than 2% by volume.

2.5 Testing

2.5.1 Validation holes

Validation holes will be drilled within each mineshaft across the site to validate the works. Grout will be injected under pressure in to the borehole and held for 2 minutes at 2 bar of pressure to prove the lack of permeability. The test shall be considered a pass where the pressure drops by no more than 10% for 2 minutes. Then, one string of casing will be withdrawn (2m) and the test will be repeated until the grout breaks surface. Drill and Grout records of test holes will be kept.

2.5.2 Gas testing

A gas monitor shall be used throughout the consolidation program to monitor for the presence of three harmful gases, carbon monoxide (CO), hydrogen sulphide (H₂S) and Methane (CH₄). Levels of airborne Oxygen (O₂) will also be monitored. The gas alarms have visible and aural alarms should concentrations of any of these gases touch pre-determined trigger levels. Records of the gas monitoring shall be kept.

3.0 Reporting

A completion report will be compiled within 28 days of the works being completed. The report will include drilling records, grouting records, testing records and an as-built location plan showing the location of the boreholes and any test holes carried out. It will also summarise total length drilled, and quantities of grout materials.

4.0 References

CIRIA Special Publication no 32 – Construction over Abandoned Mineworkings

Any SI Report made available to us and used for reference

Appendix 1

Sample Drilling & Grouting Records

Open Hole Drillers Log

Site:			Sheet:			of				
Rig:		Crew:			Date:					
Hours on Site:			Travelling Time:							
BH	Depth	Strata Description		BH	Depth	Strata Description				
Casing/Water Level Details										
BH	Casing		Water			Totals	BH	Drill	Case	Install
	Dia	Depth	Strike	Rise	Sealed	Today				
						Previous				
						To Date				
I confirm this is a true record. Van Elle operative name						Client's Name				
Drill hole Nos. checked Yes ☐ No ☐						Client's position				
Hole Depth checked Yes ☐ No ☐						Signature				
SIGNED						Dated				
Dated										

DAILY & ACCUMULATIVE GROUTING RETURN

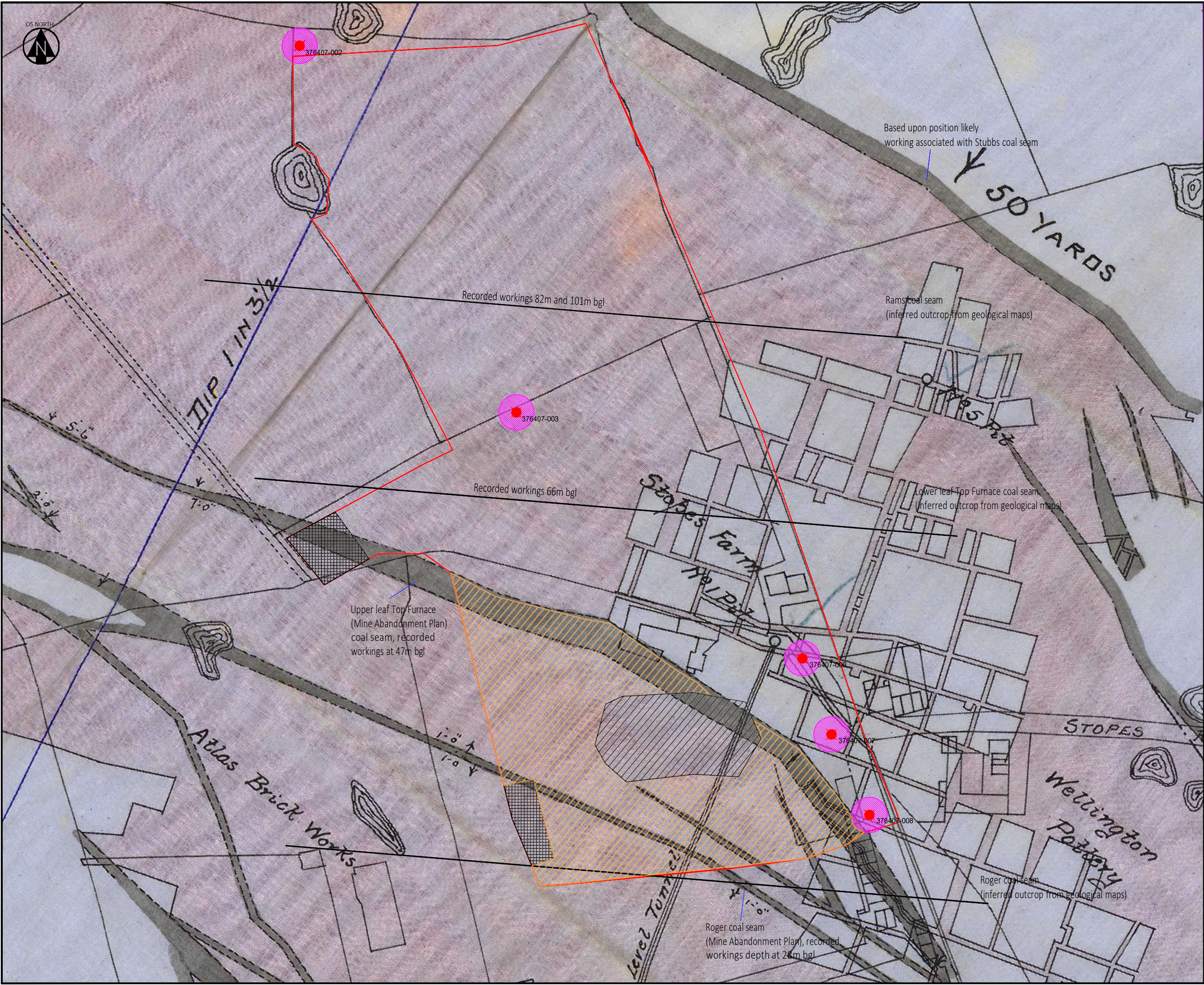
Job No. Client Site Address

.....

HOLE REF.	DEPT H (M)	ANGLE/ PRESSURE	BRIEF LOG OF HOLE	QUANT OF GROUT (T)	OPC	PFA	SAND	PEA GRAVEL		CEMENT	PFA	SAND	PEA GRAVEL
									Today's Deliveries				
									Previous Deliveries				
									Total Deliveries				
									Total Used				
									Stock on Site				
									OPERATIVES ON SITE				
									REMARKS				
									I CONFIRM THIS IS A TRUE RECORD VAN ELLE OPERATIVE SIGNATURE CLIENTS SIGNATURE DATE				
	TOTAL HOLES GROUTED TODAY		TODAY'S TOTAL GROUT										
	PREVIOUS TOTAL		PREVIOUS TOTAL										
	TOTAL TODATE		TOTAL GROUTING										

Appendix 2

Site Plan



KEY

Approximate Site Boundary

Approximate Mine Shaft Locations from CA report 51002283067001

8m departure from current location (CIRIA C758-2019)

Approximate location of Refuse Heap 1891-1955

Approximate location of encroachment of Deep Fill from unlicensed opencast

Higher density of intrusive rotary works required due to potential for shallow coal workings

- NOTES
1. All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.

2. This drawing is to be read in conjunction with all relevant Engineers' and Service Engineers' drawings and specifications.

3. This drawing has been based on the following drawings and information:
Topographical Survey Reference 55335_01 dated 18-03-20.
Mine Abandonment Plan referenced 5419/8.

4. Although the coordinates from the Coal Authority Report show the location of disused mine shaft 376407-002 to be offsite due the potential for departures (as per CIRIA C758-2019) is must be assumed to be onsite.

5. Ground investigation required in the form of trial trenching to confirm the existing on site mine entry conditions and to determine any requirement for treatment with reference to the proposed development layout. Geophysical surveys could be considered to enable targeting of trial trenches/trial pits, should it be deemed achievable by a specialist geophysics contractor.

6. Confirmation of the extent of recorded shallow mineworkings in the Roger and upper leaf of the Top Furnace coal seam; including the absence/presence of unrecorded workings associated with Roger, Rams and upper and lower leaf of the Top Furnace seam.

7. Recommended that a greater density of intrusive rotary boreholes are undertaken in the southern section of the site where risk posed by shallow worked seams is higher than the centre and north.

8. Rotary boreholes undertaken in the south of the site to extend to 40m bgl to confirm the presence/absence of Roger and to confirm workings associated with the upper leaf of the Top Furnace are not present.

9. Investigations need to confirm the presence/absence of deep fill encroaching onto the west of the site associated possible unlicensed open cast mining shown to have occurred to the west. Ground investigation needs to confirm the extent, geotechnical and geochemical properties of possible remaining fill associated with the refuse heap onsite between 1891 and 1955.

POL1	FIRST ISSUE					
	RS	20/05/20	MC	20/05/20	MC	20/05/20
REV.	REVISION NOTES/COMMENTS					
	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
Hydrock			 4 Lakeside Festival Way Stoke-on-Trent ST1 5RY t: +44(0) 1782 261919 e: stoke@hydrock.com or visit www.hydrock.com			
CLIENT						
HARWORTH ESTATES PROPERTY GROUP LTD						
PROJECT						
STOPES ROAD						
TITLE						
COAL MINING CONSTRAINTS PLAN						
HYDROCK PROJECT NO. C-15220-C				SCALE @ A3 1:650		
PURPOSE OF ISSUE SUITABLE FOR INFORMATION					STATUS S2	
DRAWING NO. (PROJECT CODE-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER) 15220-HYD-XX-XX-DR-GE-1003					REVISION P01	

Appendix 3

Shaft Frame

Design



CALCULATION SHEET

Project: RIG SHAFT SUPPORT FRAME

Title: RIG SHAFT SUPPORT FRAME CALCULATIONS

Customer: VAN ELLE LTD

JOB NO: 6325-01

REVISION: CC1

PREPARED BY: MD

CHECKED BY: MAC

DATE: 16.03.2021

PAGE 1 OF 9

1. Description:

Revision:

REV	DATE	DESCRIPTION	DES	CHK
CC0	16/03/21	FIRST ISSUE	MD	MAC

Aim:

Calculations of steel members under rig + splice connection design.

Loadings:

This structure has been designed in accordance with the following guidance:

- BS EN 1990 - Basis of structural design;
- BS EN 1991-1-1 - General Actions-Densities self weight, imposed loads for buildings;
- BS EN 1993-1-1 - Design of steel structures - General rules and rules for buildings;

2. Loads:

Safety factors: $\gamma_G := 1.35$ $\gamma_Q := 1.5$

Rig type: **Casagrande SPAC6**

Track bearing length: $L := 2.28\text{m}$

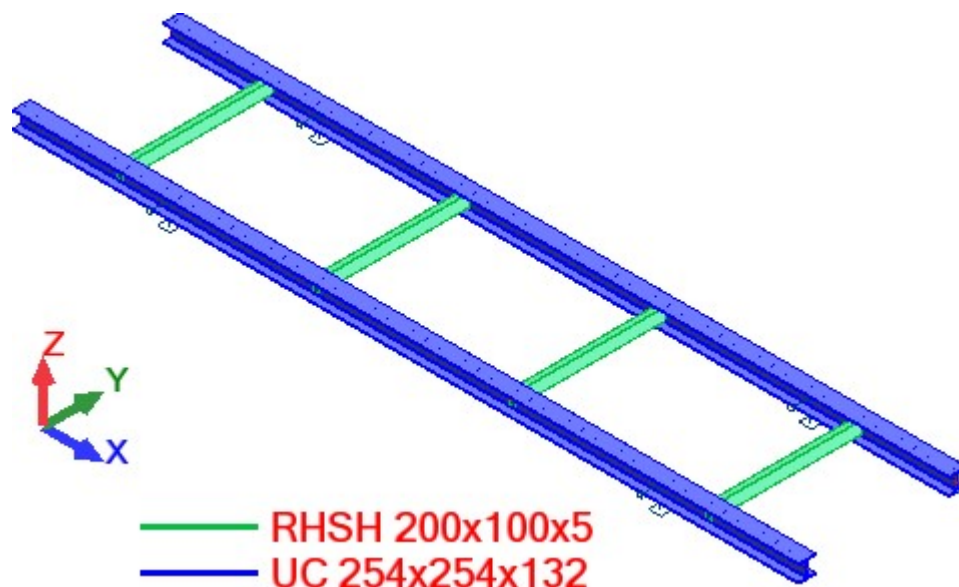
Track bearing width: $B := 0.4\text{m}$

Data sheet with loads for each situation was given by customer (datasheet attached at the end of calculations). Summary of design situation + loads shown below:

	Equivalent track length	Track width	Pressure	Equivalent force
1. Standing	$L_1 := 2.039\text{m}$	$B_1 := B = 0.4\text{m}$	$q_1 := 73\text{kPa}$	$F_1 := q_1 \cdot L_1 \cdot B_1 = 59.539\text{kN}$
2. Travelling	$L_2 := 1.58\text{m}$	$B_2 := B = 0.4\text{m}$	$q_2 := 110\text{kPa}$	$F_2 := q_2 \cdot L_2 \cdot B_2 = 69.52\text{kN}$
3. Handling	$L_3 := 1.387\text{m}$	$B_3 := B = 0.4\text{m}$	$q_3 := 114\text{kPa}$	$F_3 := q_3 \cdot L_3 \cdot B_3 = 63.247\text{kN}$
4. Penetrating	$L_4 := 0.282\text{m}$	$B_4 := B = 0.4\text{m}$	$q_4 := 240\text{kPa}$	$F_4 := q_4 \cdot L_4 \cdot B_4 = 27.072\text{kN}$
5. Extracting	$L_5 := 1.165\text{m}$	$B_5 := B = 0.4\text{m}$	$q_5 := 150\text{kPa}$	$F_5 := q_5 \cdot L_5 \cdot B_5 = 69.9\text{kN}$

As shown above design cases No. 2 & 5 are decisive here and are taken to further analysis.

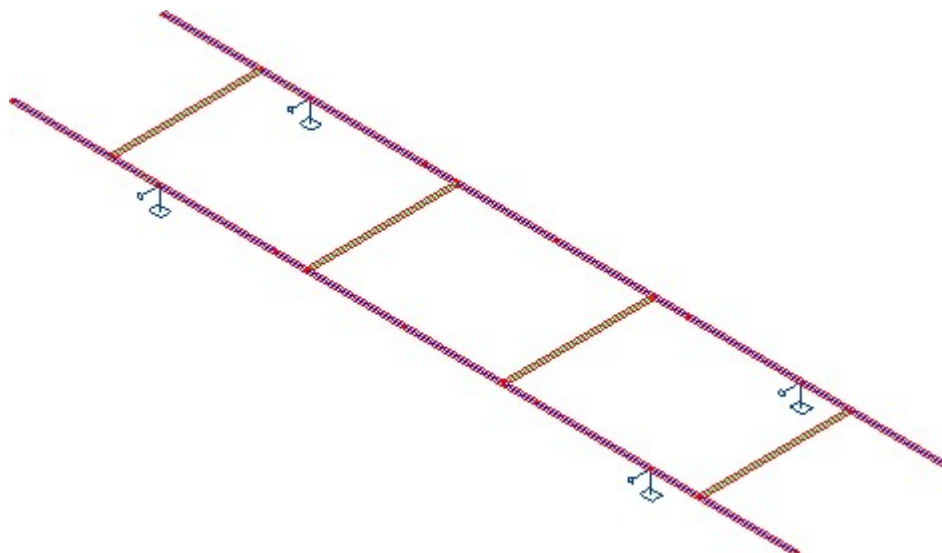
3. Static analysis



3D analytical model of steel structure

Load cases (loads shown in [kN]):

DL1 - Self weight of structure



LL1 - Rig load - Travelling case 1



CALCULATION SHEET

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Title: RIG SHAFT SUPPORT FRAME CALCULATIONS

Customer: VAN ELLE LTD

JOB NO: 6325-01

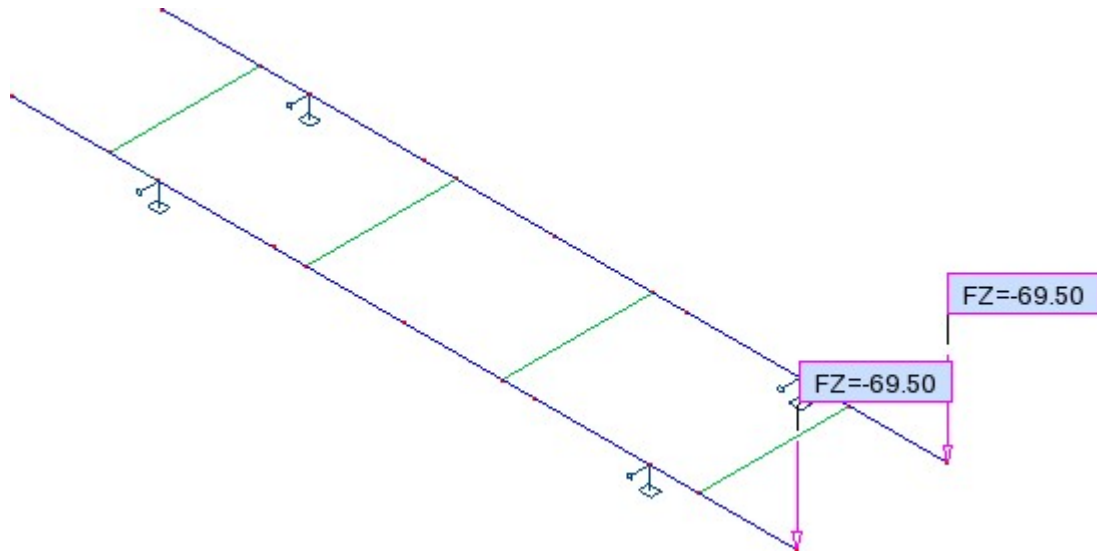
REVISION: CC1

PREPARED BY: MD

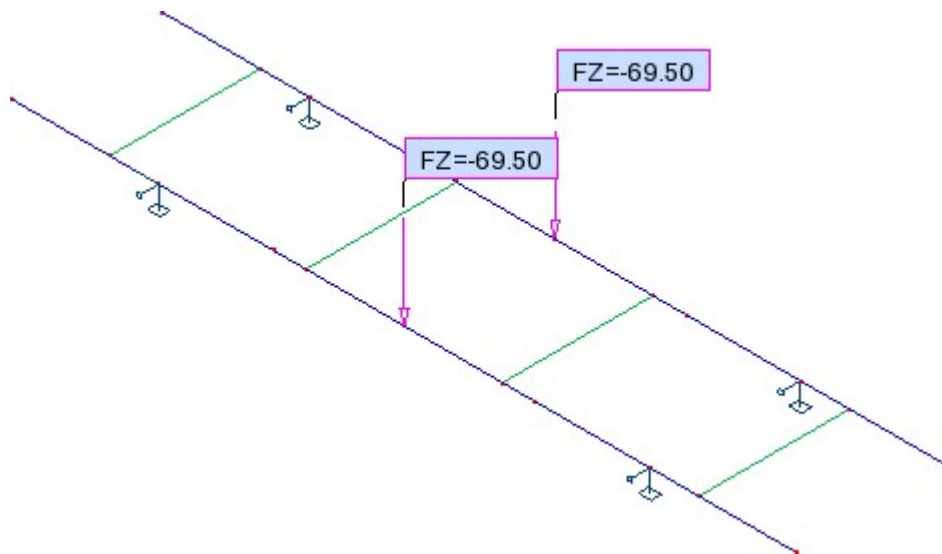
CHECKED BY: MAC

DATE: 16.03.2021

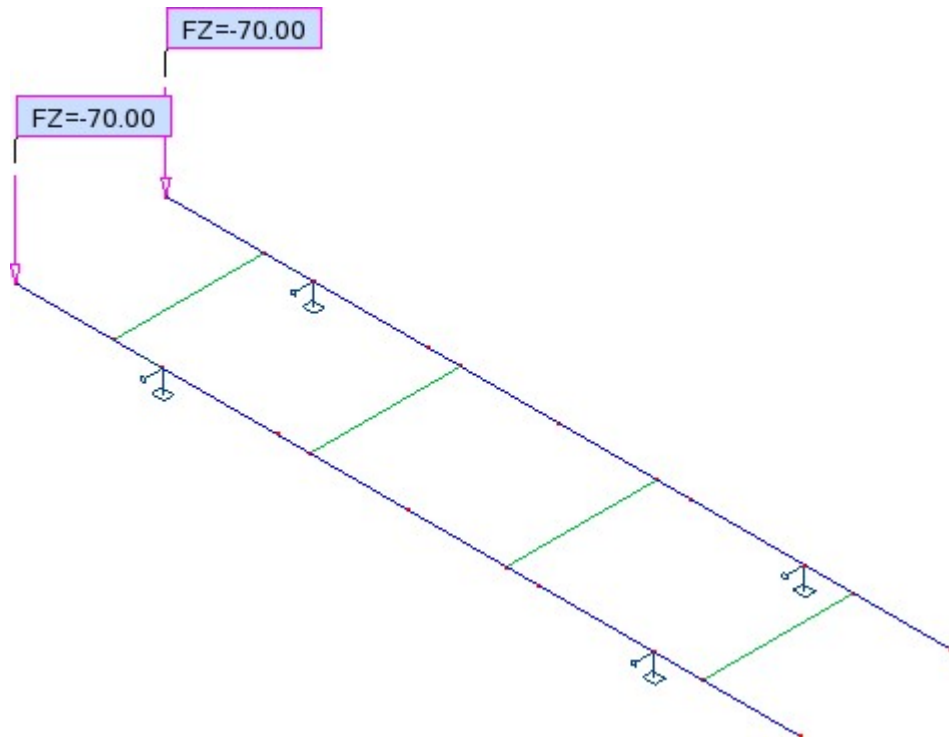
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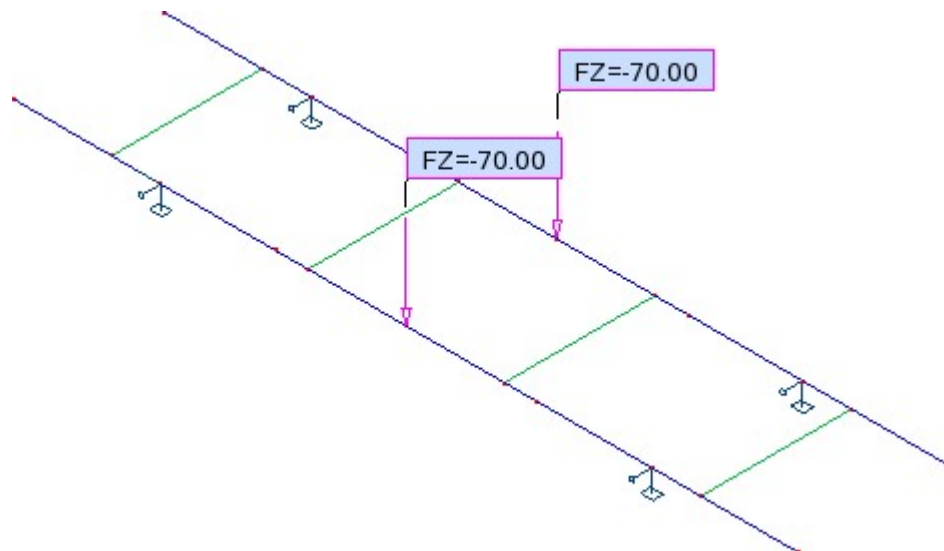
LL2 - Rig load - Travelling case 2



LL3 - Rig load - Extracting case 1

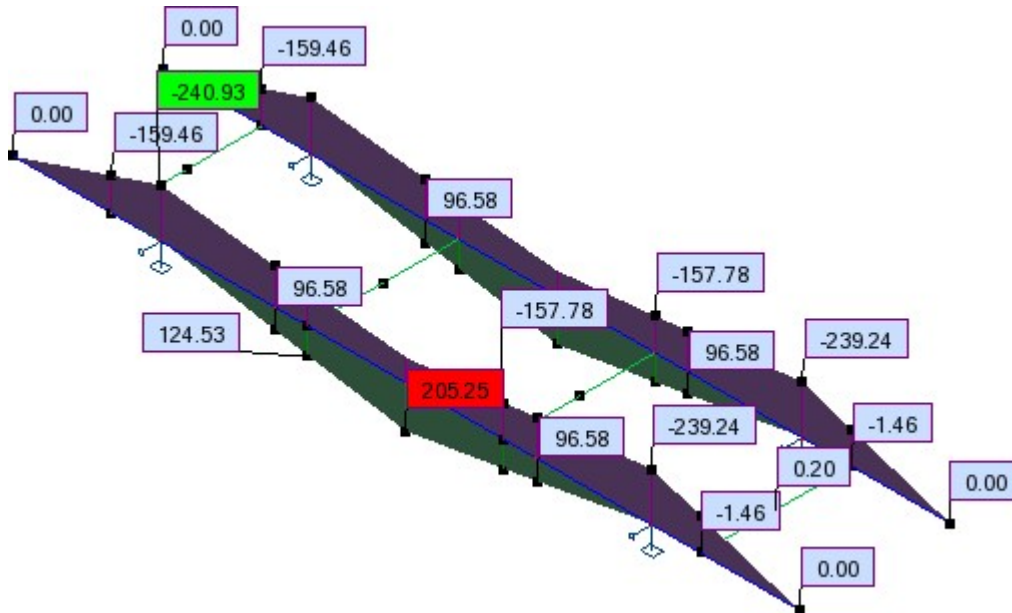


LL4 - Rig load - Extracting case 2

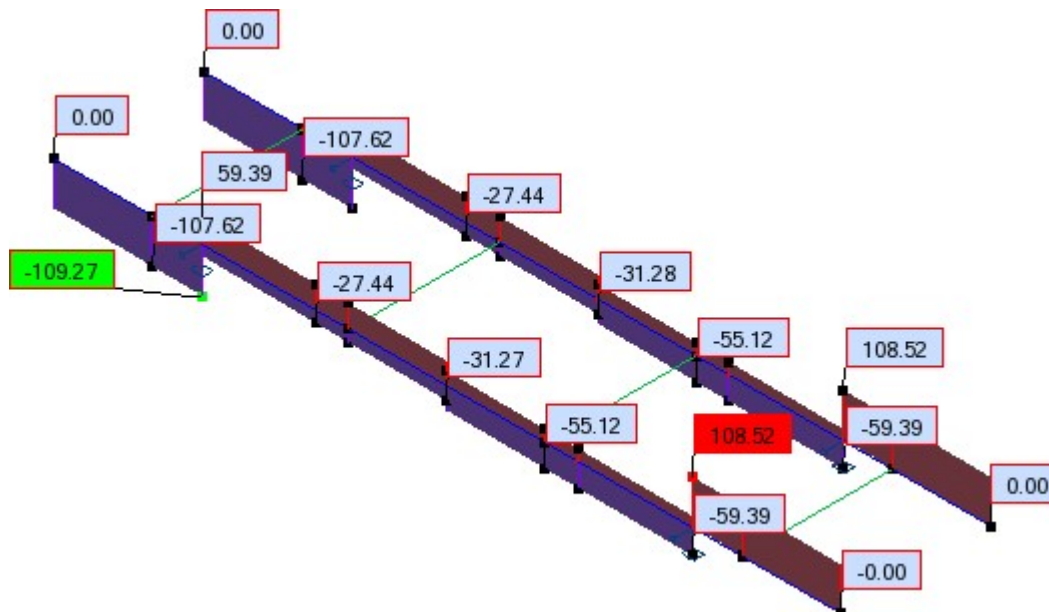


3.1 Internal forces

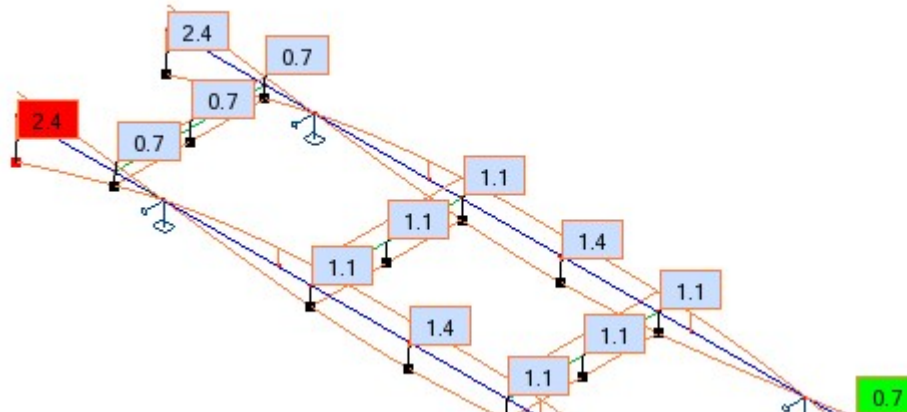
My - bending moments [kNm]



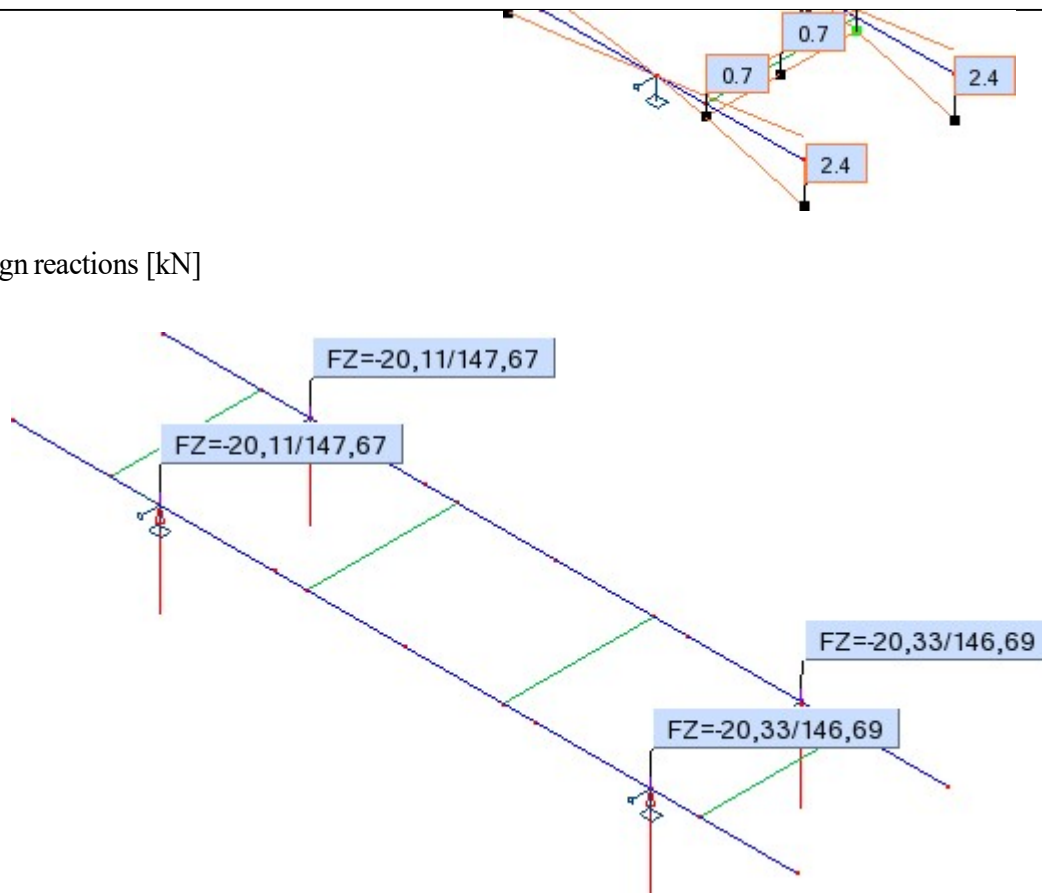
Vz - shear forces [kN]



Deformations [cm]

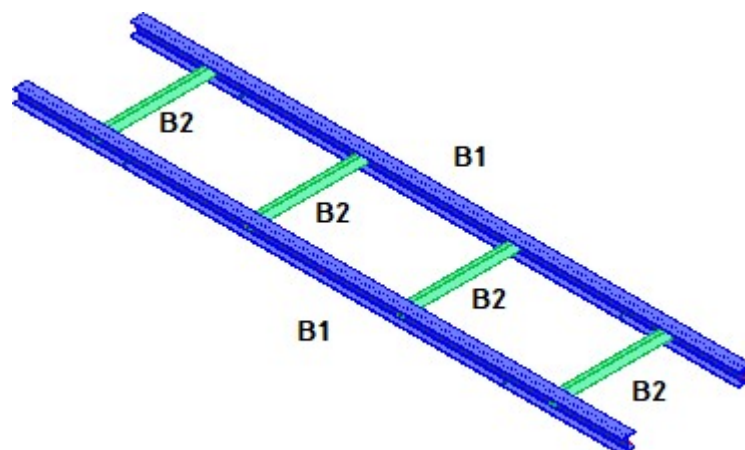


Design reactions [kN]



3.2 Dimensioning of steel members

Scheme with beam/columns numbered for calculations:



Dimensioning was held for the most unfavour positions.

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Primary beams B1**CODE:** EN 1993-1, Eurocode 3: Design of steel structures.**ANALYSIS TYPE:** Member Verification**CODE GROUP:****MEMBER:** 1 Beam_1
m**POINT:** 3**COORDINATE:** x = 0.19 L = 2.25**LOADS:**

Governing Load Case: 8 KOMB3 1*1.35+4*1.50

MATERIAL:S 275 (S 275) $f_y = 275.00$ MPa**SECTION PARAMETERS: UC 254x254x132**

h=27.6 cm

gM0=1.00

gM1=1.00

b=26.1 cm

Ay=137.35 cm²Az=46.08 cm²Ax=168.00 cm²

tw=1.5 cm

Iy=22530.00 cm⁴Iz=7531.00 cm⁴Ix=319.00 cm⁴

tf=2.5 cm

Wply=1869.00 cm³Wplz=878.00 cm³**INTERNAL FORCES AND CAPACITIES:**

My,Ed = -240.93 kN*m

My,pl,Rd = 513.98 kN*m

My,c,Rd = 513.98 kN*m

Vz,Ed = -109.27 kN

Vz,c,Rd = 731.61 kN

Mb,Rd = 377.74 kN*m

Class of section = 1

**LATERAL BUCKLING PARAMETERS:**

z = 1.00

Mcrc = 544.81 kN*m

Curve,LT - b

XLT = 0.72

Lcr,low=12.00 m

Lam_LT = 0.97

fi,LT = 0.95

XLT,mod = 0.73

BUCKLING PARAMETERS:

About y axis:



About z axis:

VERIFICATION FORMULAS:**Section strength check:**

My,Ed/My,c,Rd = 0.47 < 1.00 (6.2.5.(1))

Vz,Ed/Vz,c,Rd = 0.15 < 1.00 (6.2.6.(1))

Global stability check of member:

My,Ed/Mb,Rd = 0.64 < 1.00 (6.3.2.1.(1))

LIMIT DISPLACEMENTS**Deflections**

uy = 0.0 cm < uy max = L/200.00 = 6.0 cm

Verified

Governing Load Case: 13 KOMB4ch (1+5)*1.00

uz = 2.9 cm < uz max = L/200.00 = 6.0 cm

Verified

Governing Load Case: 12 KOMB3ch (1+4)*1.00



Displacements Not analyzed

Section OK !!!**Secondary beams B2**

Beams were designed for stabilising force:

Primary beam high:

h := 27.6cm



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Flange thickness:

$$t_f := 2.5 \text{ cm}$$

Equivalent high of beam:

$$h_{eq} := h - t_f = 251 \text{ mm}$$

Maximum design bending moment on primary beams:

$$M_{y.Ed} := 241 \text{ kN}\cdot\text{m}$$

Equivalent normal force on primary beam flange:

$$F_{x.eq.Ed} := \frac{M_{y.Ed}}{h_{eq}} = 960.159 \text{ kN}$$

Stabilizing force - 2% of equivalent normal force

$$F_{x.Ed.stab} := 0.02 \cdot F_{x.eq.Ed} = 19.203 \text{ kN}$$

STEEL DESIGN

CODE: EN 1993-1, Eurocode 3: Design of steel structures.

ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 7 Prêt_7

POINT:

COORDINATE:

LOADS:

Governing Load Case: Manual

MATERIAL:

S 275 (S 275) $f_y = 275.00 \text{ MPa}$



SECTION PARAMETERS: RSH 200x100x5

$h = 20.0 \text{ cm}$

$b = 10.0 \text{ cm}$

$t_w = 0.5 \text{ cm}$

$t_f = 0.5 \text{ cm}$

$gM0 = 1.00$

$A_y = 9.57 \text{ cm}^2$

$I_y = 1495.00 \text{ cm}^4$

$W_{ely} = 149.50 \text{ cm}^3$

$gM1 = 1.00$

$A_z = 19.13 \text{ cm}^2$

$I_z = 505.00 \text{ cm}^4$

$W_{elz} = 101.00 \text{ cm}^3$

$A_x = 28.70 \text{ cm}^2$

$I_x = 1204.00 \text{ cm}^4$

INTERNAL FORCES AND CAPACITIES:

$N_{Ed} = 20.00 \text{ kN}$

$M_{y,Ed} = 0.20 \text{ kN}\cdot\text{m}$

$N_{c,Rd} = 789.25 \text{ kN}$

$M_{y,Ed,max} = 0.20 \text{ kN}\cdot\text{m}$

$N_{b,Rd} = 692.66 \text{ kN}$

$M_{y,c,Rd} = 41.11 \text{ kN}\cdot\text{m}$

Class of section = 3



LATERAL BUCKLING PARAMETERS:

BUCKLING PARAMETERS:



About y axis:

$L_y = 2.30 \text{ m}$

$L_{cr,y} = 2.30 \text{ m}$

$\lambda_{my} = 31.87$

$\lambda_{my} = 0.37$

$\chi_y = 0.96$

$\kappa_{yy} = 0.91$



About z axis:

$L_z = 2.30 \text{ m}$

$L_{cr,z} = 2.30 \text{ m}$

$\lambda_{mz} = 54.83$

$\lambda_{mz} = 0.63$

$\chi_z = 0.88$

$\kappa_{zy} = 0.00$

VERIFICATION FORMULAS:

Section strength check:

$M_{y,Ed}/M_{y,c,Rd} = 0.00 < 1.00$ (6.2.5.(1))

$N_{Ed}/N_{c,Rd} + M_{y,Ed}/M_{y,c,Rd} = 0.03 < 1.00$ (6.2.1.(7))

Global stability check of member:

$\lambda_{my} = 31.87 < \lambda_{my,max} = 210.00$ $\lambda_{mz} = 54.83 < \lambda_{mz,max} = 210.00$ STABLE

$N_{Ed}/(\chi_y \cdot N_{c,Rd}/gM1) + \kappa_{yy} \cdot M_{y,Ed,max}/(XLT \cdot M_{y,Rd}/gM1) = 0.03 < 1.00$ (6.3.3.(4))

$N_{Ed}/(\chi_z \cdot N_{c,Rd}/gM1) + \kappa_{zy} \cdot M_{y,Ed,max}/(XLT \cdot M_{y,Rd}/gM1) = 0.03 < 1.00$ (6.3.3.(4))

Section OK !!!



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Title: RIG SHAFT SUPPORT FRAME CALCULATIONS

Customer: VAN ELLE LTD

JOB NO: 6325-01

REVISION: CC1

PREPARED BY: MD

CHECKED BY: MAC

DATE: 16.03.2021

PAGE 9 OF 9

4. Connection design:

Splice connection design attached as appendix at the end of file.
Splices devided 12m long beam into 3No. 4m long parts.

APPENDIX A – SPLICE CONNECTION DESIGN

Material

Steel

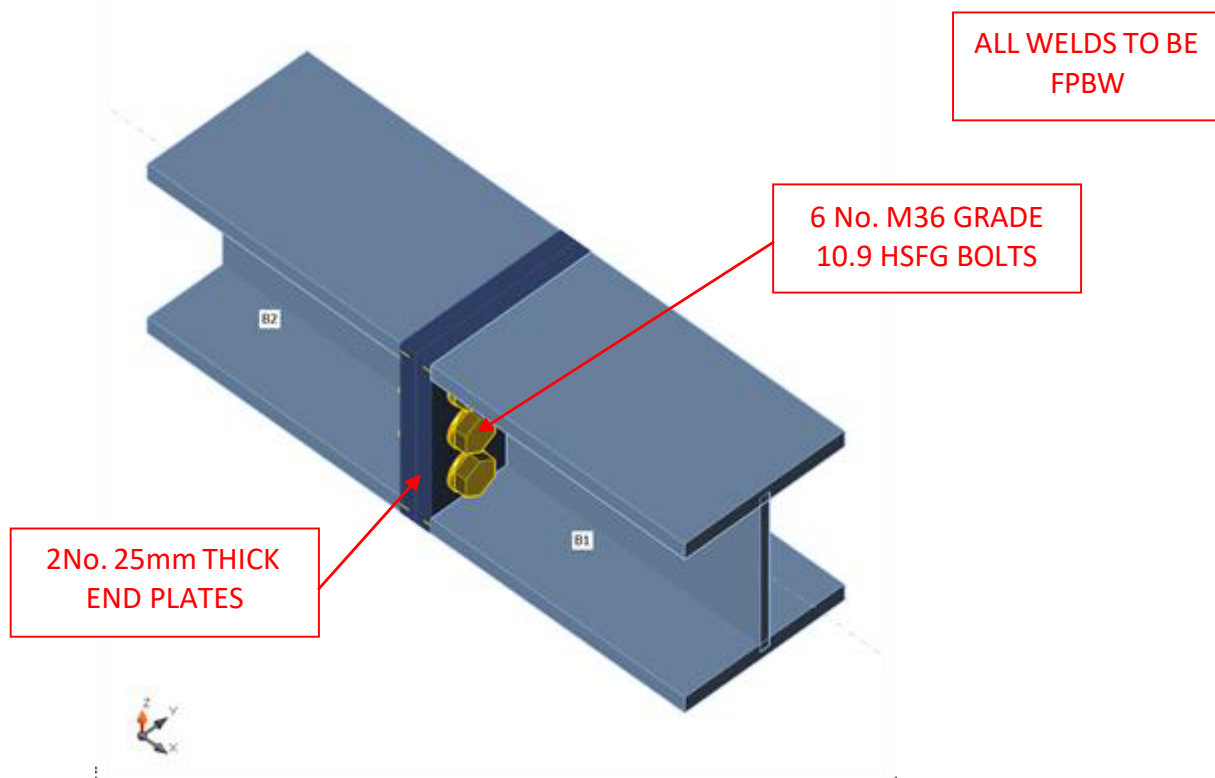
S 275

Project item Splice connection Design

Name Splice connection
Description Splice connection
Analysis Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B1	2 - UC 254 x 254 x 132	0,0	0,0	0,0	0	0	0	Node
B2	2 - UC 254 x 254 x 132	180,0	0,0	0,0	0	0	0	Node



Cross-sections

Name	Material
2 - UC 254 x 254 x 132	S 275

Bolts

Name	Bolt assembly	Diameter [mm]	f_u [MPa]	Gross area [mm ²]
M30 10.9	M30 10.9	30	1000,0	707

Load effects (equilibrium not required)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	0,0	0,0	-70,0	0,0	-200,0	0,0

Check

Summary

Name	Value	Status
Analysis	100,0%	OK
Plates	0,9 < 5%	OK
Preloaded bolts	98,9 < 100%	OK
Buckling	Not calculated	

Plates

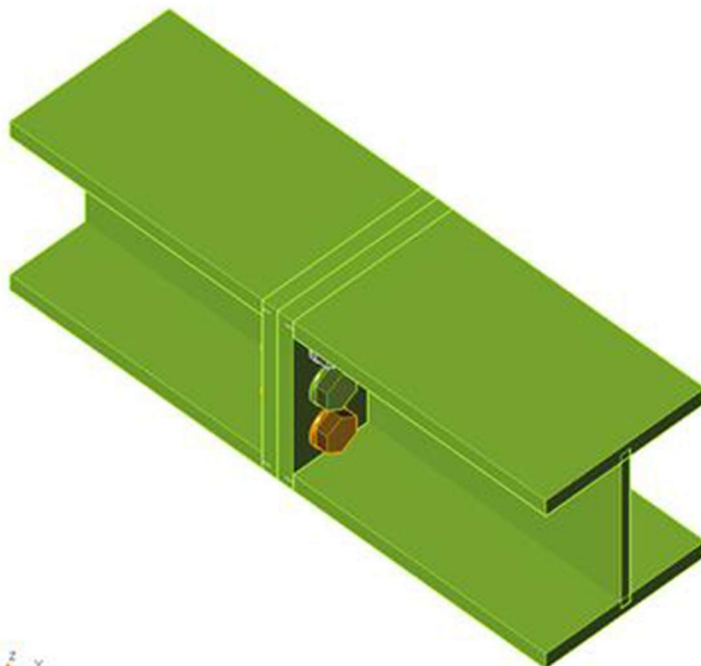
Name	Thickness [mm]	Loads	σ_{Ed} [MPa]	ϵ_{Pl} [%]	Status
B1-bfl 1	25,3	LE1	275,6	0,3	OK
B1-tfl 1	25,3	LE1	275,0	0,0	OK
B1-w 1	15,3	LE1	275,1	0,0	OK
B2-bfl 1	25,3	LE1	275,5	0,2	OK
B2-tfl 1	25,3	LE1	275,1	0,0	OK
B2-w 1	15,3	LE1	275,1	0,0	OK
PP1a	25,0	LE1	276,8	0,9	OK
PP1b	25,0	LE1	276,8	0,9	OK

Design data

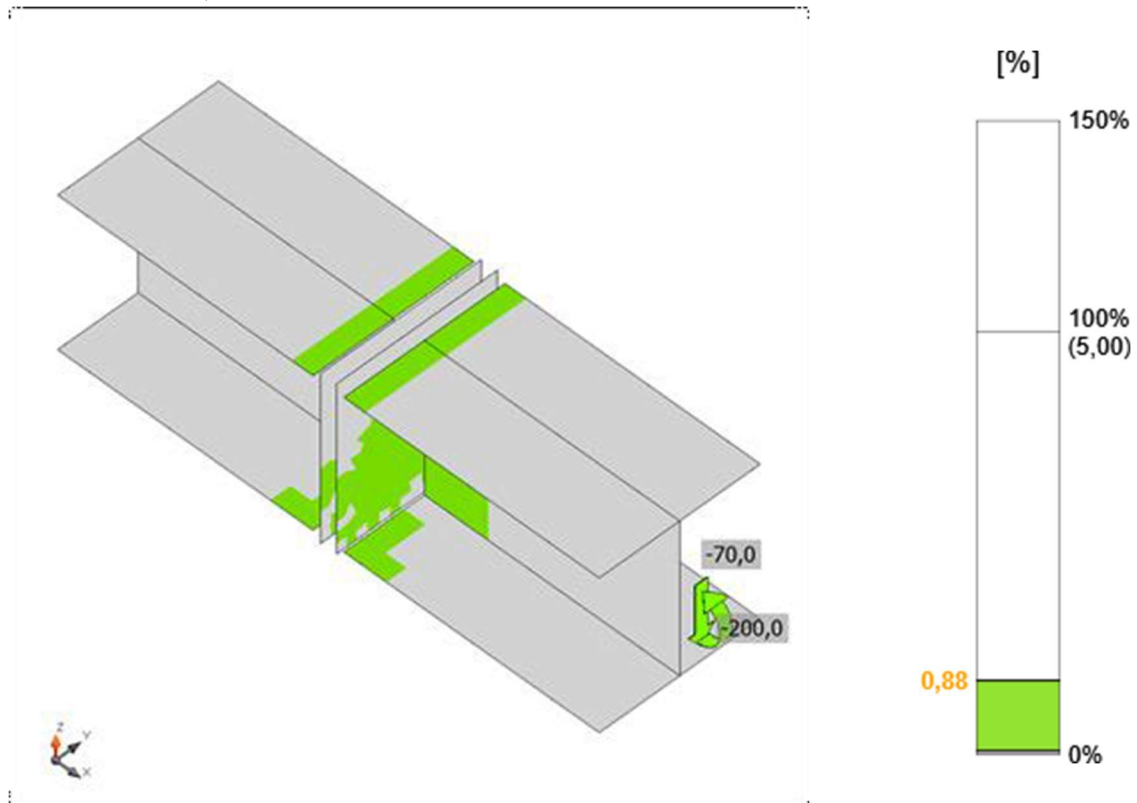
Material	f_y [MPa]	ϵ_{lim} [%]
S 275	275,0	5,0

Symbol explanation

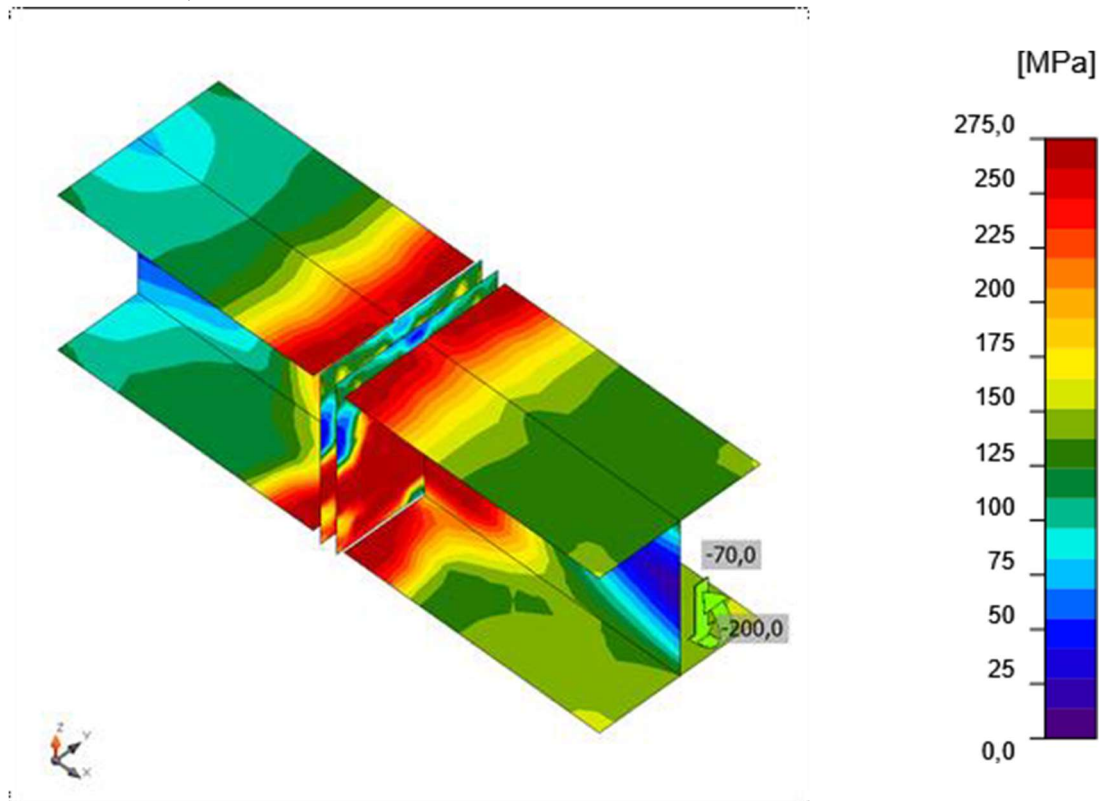
- ϵ_{Pl} Strain
- σ_{Ed} Eq. stress
- f_y Yield strength
- ϵ_{lim} Limit of plastic strain



Overall check, LE1

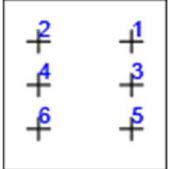


Strain check, LE1



Equivalent stress, LE1

Preloaded bolts

	Name	Bolt assembly	Loads	$F_{t,Ed}$ [kN]	V [kN]	$B_{p,Rd}$ [kN]	$F_{t,Rd}$ [kN]	$F_{s,Rd}$ [kN]	U_t [%]	U_s [%]	Status
	B1	M30 10.9 - 1	LE1	83,4	12,5	854,1	403,9	78,2	20,6	15,9	OK
	B2	M30 10.9 - 1	LE1	81,4	13,2	854,1	403,9	78,6	20,2	16,8	OK
	B3	M30 10.9 - 1	LE1	295,1	10,2	854,1	403,9	37,6	73,1	27,0	OK
	B4	M30 10.9 - 1	LE1	285,7	9,4	854,1	403,9	39,4	70,7	23,8	OK
	B5	M30 10.9 - 1	LE1	398,6	13,4	854,1	403,9	17,7	98,7	75,4	OK
	B6	M30 10.9 - 1	LE1	399,5	14,4	854,1	403,9	17,6	98,9	82,2	OK

Symbol explanation

- $F_{t,Rd}$ Bolt tension resistance EN 1993-1-8 tab. 3.4
 $F_{t,Ed}$ Tension force
 $B_{p,Rd}$ Punching shear resistance
 V Resultant of shear forces V_y , V_z in bolt
 $F_{v,Rd}$ Bolt shear resistance EN 1993-1-8 table 3.4
 $F_{b,Rd}$ Plate bearing resistance EN 1993-1-8 tab. 3.4
 $F_{s,Rd}$ Design slip resistance EN 1993-1-8 chapter 3.9
 F_{pc} Pretension force
 U_t Utilization in tension
 U_s Utilization in shear

Welds (Maximal value used, plastic redistribution recommended)

Item	Edge	Throat th. [mm]	Length [mm]	Loads	$\sigma_{w,Ed}$ [MPa]	$\sigma_{\perp}$ [MPa]	$\tau_{\parallel}$ [MPa]	$\tau_{\perp}$ [MPa]	U_t [%]	Status
PP1a	B1-bfl 1	25,0	261	LE1						OK
PP1a	B1-tfl 1	25,0	261	LE1						OK
PP1a	B1-w 1	15,3	251	LE1						OK
PP1b	B2-bfl 1	25,0	261	LE1						OK
PP1b	B2-tfl 1	25,0	261	LE1						OK
PP1b	B2-w 1	15,3	251	LE1						OK

Design data

	β_w [-]	$\sigma_{w,Rd}$ [MPa]	0.9σ [MPa]
S 275	0,85	404,7	309,6

Symbol explanation

- $\sigma_{w,Ed}$ Equivalent stress
 $\sigma_{w,Rd}$ Equivalent stress resistance
 $\sigma_{\perp}$ Perpendicular stress
 $\tau_{\parallel}$ Shear stress parallel to weld axis
 $\tau_{\perp}$ Shear stress perpendicular to weld axis
 0.9σ Perpendicular stress resistance - $0.9 \cdot f_u / \gamma_{M2}$
 β_w Corelation factor EN 1993-1-8 tab. 4.1
 U_t Utilization
 U_{tc} Weld capacity utilization

Buckling

Buckling analysis was not calculated.

Bill of material

Manufacturing operations

Name	Plates [mm]	Shape	Nr.	Welds [mm]	Length [mm]	Bolts	Nr.
PP1	P25,0x261,3-276,3 (S 275)		1	Bevel: a = 25,0 Bevel: a = 15,3	1045,2 502,0	M30 10.9	6
	P25,0x261,3-276,3 (S 275)		1				

Welds

Type	Material	Throat thickness [mm]	Leg size [mm]	Length [mm]
Bevel	S 275	25,0	35,4	1045,2
Bevel	S 275	15,3	21,6	502,0

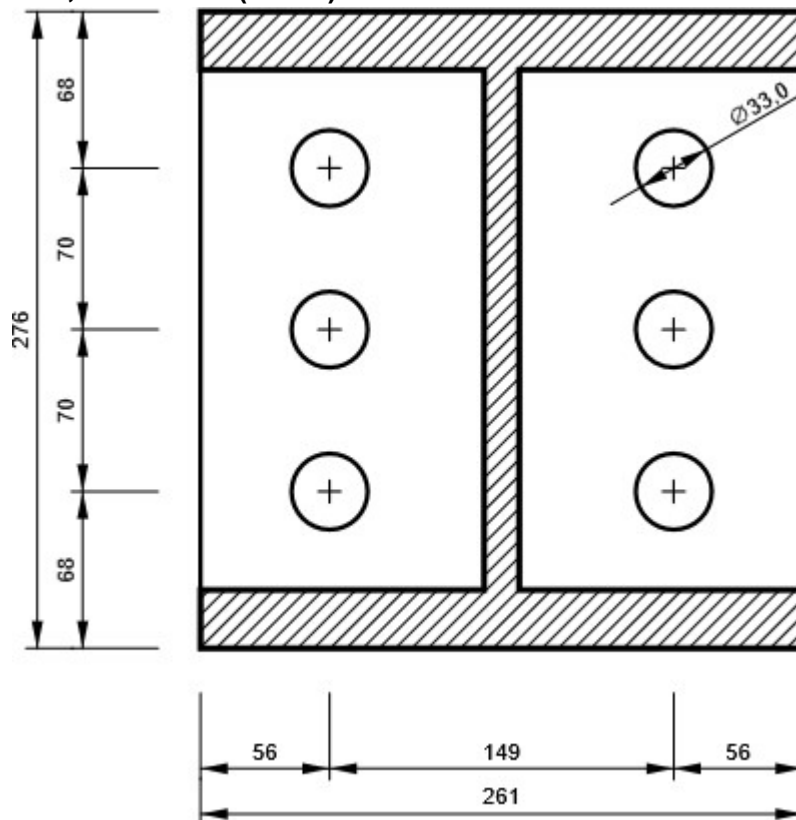
Bolts

Name	Grip length [mm]	Count
M30 10.9	50	6

Drawing

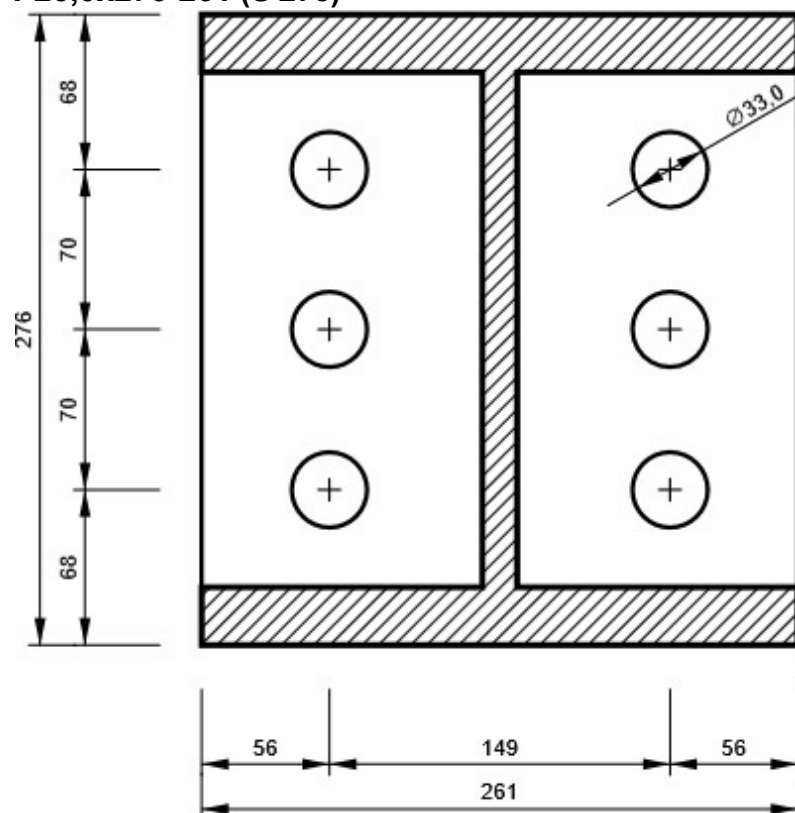
PP1 - 1

P25,0x276-261 (S 275)



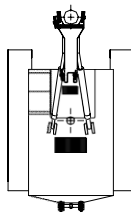
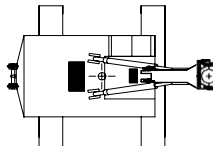
PP1 - 2

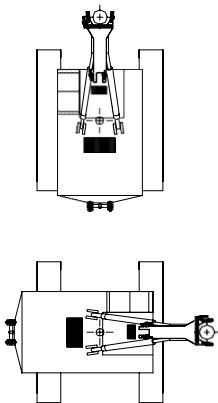
P25,0x276-261 (S 275)



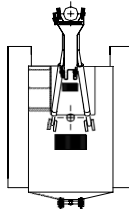
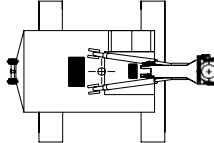
The user of this spreadsheet shall input data into the relevant yellow boxes on this worksheet and on all of the other relevant worksheets

Note: The disclaimer on the first worksheet applies to all tables in this workbook			
Rig Manufacturer :		CASAGRANDE SPA	Rig Type : C6 sn. C6_US_1439
Operation mode:		Micropiles - W.R. 3,09 m	
Completed by:	Ing. D. Verona	18/07/2016	Checked by: Ing. G. Peressini
Main Components :			
	Item	Mass (kg)	Moment arm (m)
UPPER WORKS			0,00
	Mast Assembly + cathead + winch+ + articulation + clamps	4850	2,19
			0,00
			0,00
			0,00
	safety cages/guards	250	3,09
			0,00
LOWER WORKS			0,00
	Upperstructure + undercarriage + + pump NG530 + lubricator	8010	-1,22
			0,00
			0,00
			0,00
ROPE / KELLY / CHAIN SUSPENDED EQUIPMENT	Rotary T20 + casing driver + swivel tools (augers, rods,...)	890	3,09
	rods	200	3,09
			0,00
	input to use properly the spreadsheet	0	0,00
COUNT.			0,00
			0,00
			0,00
OTHER	None	0	0,00
			0,00
			0,00
Main Components Totals			
UPPER WORKS		5100	2,23
LOWER WORKS		8010	-1,22
ROPE / KELLY / CHAIN SUSPENDED EQUIPMENT		1090	3,09
COUNTERWEIGHT		0	0,00
OTHER		0	0,00
TOTAL		14200	0,35
Tracks			
Track bearing length (m)		2,28	
Track pad width (m)		0,4	
Distance between centrelines of tracks (m)		1,85	
Front Foot Pads			
Pad Bearing Area (m²)		0,29	Actual Dimensions stabilizers 2 x 240 x 600
Pad Maximum Loading (kN)		100,00	Actual Shape rectangular
Pad Moment Arm (m)		1,68	
Rear Foot Pads			
Pad Bearing Area (m²)		0,14	Actual Dimensions dia 300mm
Pad Maximum Loading (kN)		100,00	Actual Shape circular
Pad Moment Arm (m)		-1,70	
Forces			
Maximum Extraction Force (kN)		85,00	
Maximum Penetration Force (kN)		85,00	
Maximum Auxillary Force (kN)		20,00	Auxillary Force Moment Arm (m) 3,13
Note: The disclaimer on the first worksheet applies to all tables in this workbook		 Notes No limits on working practice INPUT PAGE for STANDING - TRAVELLING - HANDING and PENETRATING	

CASAGRANDE SPA		Weight (kg) / Load (kgf)	Distance to CL rotation (m)	Horizontal moment (kNm)	 		Mode : Micropiles - W.R. 3,09 m										Standing		Transformation from triangular or trapezoidal to an equivalent rectangular pressure distribution under track maintaining the load centroid	
C6_US_1439							Relative Angle - Upper Body and Tracks (degrees)	Bearing pressure at front of L.H. track (kN/m^2)	Bearing pressure at rear of L.H. track (kN/m^2)	Bearing pressure at front of R.H. track (kN/m^2)	Bearing pressure at rear of R.H. track (kN/m^2)	Max Track loading dimensions		Equivalent Bearing L (m)	Q (KPa)					
		ecc (m)	Bearing Len. (m)																	
Lower Works	8010	-1,221	-96																	
Counterweight	0	0,000	0																	
Upper Works	5100	2,231	112																	
Other	0	0,000	0																	
Rope / Kelly / Chain Suspended	1090	3,090	33																	
Machine Weight (kg)		14200	0,350	49																
				Force (kN)	Max. (kN)	Foot Pad Area (m2)														
Auxiliary Line (kgf)		0	3,125	0	0,00		20,00													
Net Extraction Force (kgf)		0	3,090	0	0,00		85,00													
Net Penetration Force (kgf)		0	3,090	0	0,00	85,00														
Front Foot Pads Loading (kgf)		-2090	1,680	-34	20,50	100,00	0,288	Front Foot Pads Equivalent Length (m)and Bearing Pressure (kN/m^2)						0,720		71				
Rear Foot Pads Loading (kgf)		0	-1,700	0	0,00	100,00	0,140	Rear Foot Pads Equivalent Length (m)and Bearing Pressure (kN/m^2)						0.350		0				
Others		0	0,000	0	Track Bearing Length (m)															
Track Total Loading (kgf)		12110	0,120	14	Track Width Centres (m)															
				Track pad width (m)																

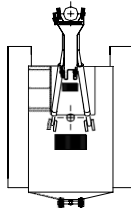
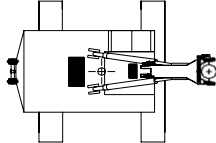


Auxiliary Line Force OK
 Extraction Force OK
 Penetration Force OK
 Front Foot Pad Force OK
 Rear Foot Pad Force OK

CASAGRANDE SPA C6_US_1439		Weight (kg) / Load (kgf)	Distance to CL rotation (m)	Horizontal moment (kNm)	 			Mode : Micropiles - W.R. 3,09 m							Travelling		Transformation from triangular or trapizoidal to an equivalent rectangular pressure distribution under track maintaining the load centroid	
								Relative Angle - Upper Body and Tracks (degrees)	Bearing pressure at front of L.H. track (kN/m^2)	Bearing pressure at rear of L.H. track (kN/m^2)	Bearing pressure at front of R.H. track (kN/m^2)	Bearing pressure at rear of R.H. track (kN/m^2)	Max Track loading dimensions		Equivalent Bearing			
Lower Works		8010	-1,221	-96														
Counterweight		0	0,000	0														
Upper Works		5100	2,231	112														
Other		0	0,000	0														
Rope / Kelly / Chain Suspended		1090	3,090	33														
Machine Weight (kg)		14200	0,350	49														
					Force (kN)	Max. (kN)												
Auxiliary Line (kgf)		0	3,125	0	0,00	20,00	Foot Pad Area (m2)											
Net Extraction Force (kgf)		0	3,090	0	0,00	85,00												
Net Penetration Force (kgf)		0	3,090	0	0,00	85,00												
Front Foot Pads Loading (kgf)		0	1,680	0	0,00	100,00	0,288	Front Foot Pads Equivalent Length (m)and Bearing Pressure (kN/m^2)							0,720	0		
Rear Foot Pads Loading (kgf)		0	-1,700	0	0,00	100,00	0,140	Rear Foot Pads Equivalent Length (m)and Bearing Pressure (kN/m^2)							0,350	0		
Others		0	0,000	0	Track Bearing Length (m)		2,280	Maximum Equivalent Design Values							1,580	110		
Track Total Loading (kgf)		14200	0,350	49	Track Width Centres (m)		1,850											
					Track pad width (m)		0,400								BRE LOAD CASE (1 or 2)		1	

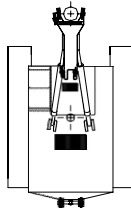
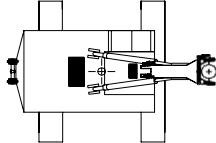


Auxiliary Line Force OK
 Extraction Force OK
 Penetration Force OK
 Front Foot Pad Force OK
 Rear Foot Pad Force OK

CASAGRANDE SPA		Weight (kg) / Load (kgf)	Distance to CL rotation (m)	Horizontal moment (kNm)	 		Mode : Micropiles - W.R. 3,09 m							Handling		Transformation from triangular or trapizoidal to an equivalent rectangular pressure distribution under track maintaining the load centroid	
C6_US_1439												Max Track loading dimensions		Equivalent Bearing			
Relative Angle - Upper Body and Tracks (degrees)	Bearing pressure at front of L.H. track (kN/m^2)	Bearing pressure at rear of L.H. track (kN/m^2)	Bearing pressure at front of R.H. track (kN/m^2)	Bearing pressure at rear of R.H. track (kN/m^2)					L (m)	Q (KPa)							
							ecc (m)	Bearing Len. (m)									
Lower Works	8010	-1,221	-96														
Counterweight	0	0,000	0														
Upper Works	5100	2,231	112														
Other	0	0,000	0														
Rope / Kelly / Chain Suspended	1090	3,090	33														
Machine Weight (kg)		14200	0,350	49													
				Force (kN)	Max. (kN)												
Auxiliary Line (kgf)	2039	3,125	63	20,00	20,00	Foot Pad Area (m2)											
Net Extraction Force (kgf)	0	3,090	0	0,00	85,00												
Net Penetration Force (kgf)	0	3,090	0	0,00	85,00												
Front Foot Pads Loading (kgf)	-3313	1,680	-55	32,50	100,00	0,288	Front Foot Pads Equivalent Length (m)and Bearing Pressure (kN/m^2)						0,720	113			
Rear Foot Pads Loading (kgf)	0	-1,700	0	0,00	100,00	0,140	Rear Foot Pads Equivalent Length (m)and Bearing Pressure (kN/m^2)						0,350	0			
Others	0	0,000	0	Track Bearing Length (m)		2,280	Maximum Equivalent Design Values						1,387	114			
Track Total Loading (kgf)		12926	0,447	57	Track Width Centres (m)		BRE LOAD CASE (1 or 2)						1				
				Track pad width (m)		0,400											



Auxiliary Line Force OK
Extraction Force OK
Penetration Force OK
Front Foot Pad Force OK
Rear Foot Pad Force OK

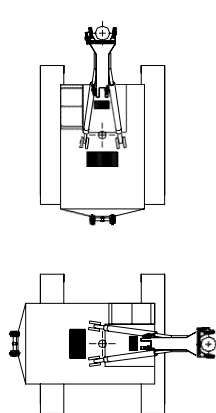
CASAGRANDE SPA		Weight (kg) / Load (kgf)	Distance to CL rotation (m)	Horizontal moment (kNm)	 			Mode : Micropiles - W.R. 3,09 m Penetrating							Transformation from triangular or trapizoidal to an equivalent rectangular pressure distribution under track maintaining the load centroid	
C6_US_1439								Relative Angle - Upper Body and Tracks (degrees)	Bearing pressure at front of L.H. track (kN/m^2)	Bearing pressure at rear of L.H. track (kN/m^2)	Bearing pressure at front of R.H. track (kN/m^2)	Bearing pressure at rear of R.H. track (kN/m^2)	Max Track loading dimensions			
		ecc (m)	Bearing Len. (m)	L (m)	Q (KPa)											
Lower Works	8010	-1,221	-96		0	320	0	320	-0,999	0,423	0,282	240				
Counterweight	0	0,000	0		0	320	0	320	-0,999	0,423	0,282	240				
Upper Works	5100	2,231	112		0	320	0	320	-0,999	0,423	0,282	240				
Other	0	0,000	0		0	320	0	320	-0,999	0,423	0,282	240				
Rope / Kelly / Chain Suspended	1090	3,090	33		0	320	0	320	-0,999	0,423	0,282	240				
Machine Weight (kg)		14200	0,350	49		0	0	320	0	320	-0,999	0,423	0,282	240		
				Force (kN)	Max. (kN)		0	0	320	0	320	-0,999	0,423	0,282	240	
Auxiliary Line (kgf)	0	3,125	0	0,00	20,00	Foot Pad Area (m2)	0	0	320	0	320	-0,999	0,423	0,282	240	
Net Extraction Force (kgf)	0	3,090	0	0,00	85,00		0	0	320	0	320	-0,999	0,423	0,282	240	
Net Penetration Force (kgf)	-5269	3,090	-160	41,00	85,00		0	0	320	0	320	-0,999	0,423	0,282	240	
Front Foot Pads Loading (kgf)	0	1,680	0	0,00	100,00	0,288	Front Foot Pads Equivalent Length (m)and Bearing Pressure (kN/m^2)					0,720	0			
Rear Foot Pads Loading (kgf)	-3415	-1,700	57	33,50	100,00	0,140	Rear Foot Pads Equivalent Length (m)and Bearing Pressure (kN/m^2)					0,350	239			
Others	0	0,000	0	Track Bearing Length (m)		2,280	Maximum Equivalent Design Values					0,282	240			
Track Total Loading (kgf)		5516	-0,999	-54	Track Width Centres (m)		1,850						BRE LOAD CASE (1 or 2)		2	
				Track pad width (m)		0,400										

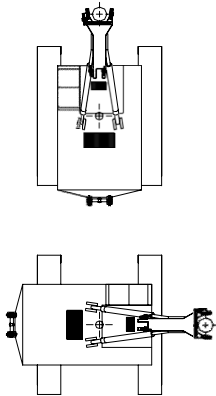


Auxiliary Line Force OK
 Extraction Force OK
 Penetration Force OK
 Front Foot Pad Force OK
 Rear Foot Pad Force OK

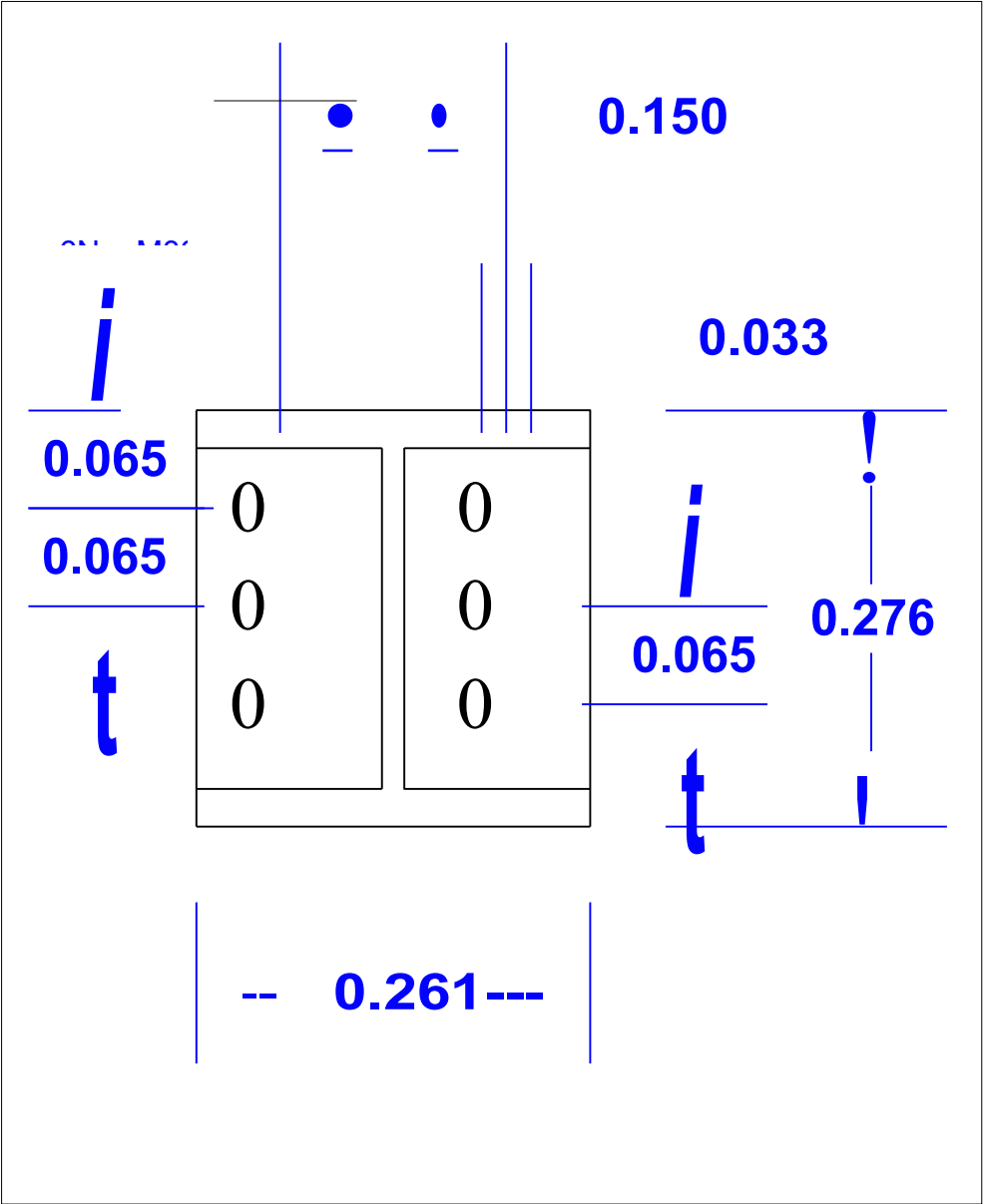
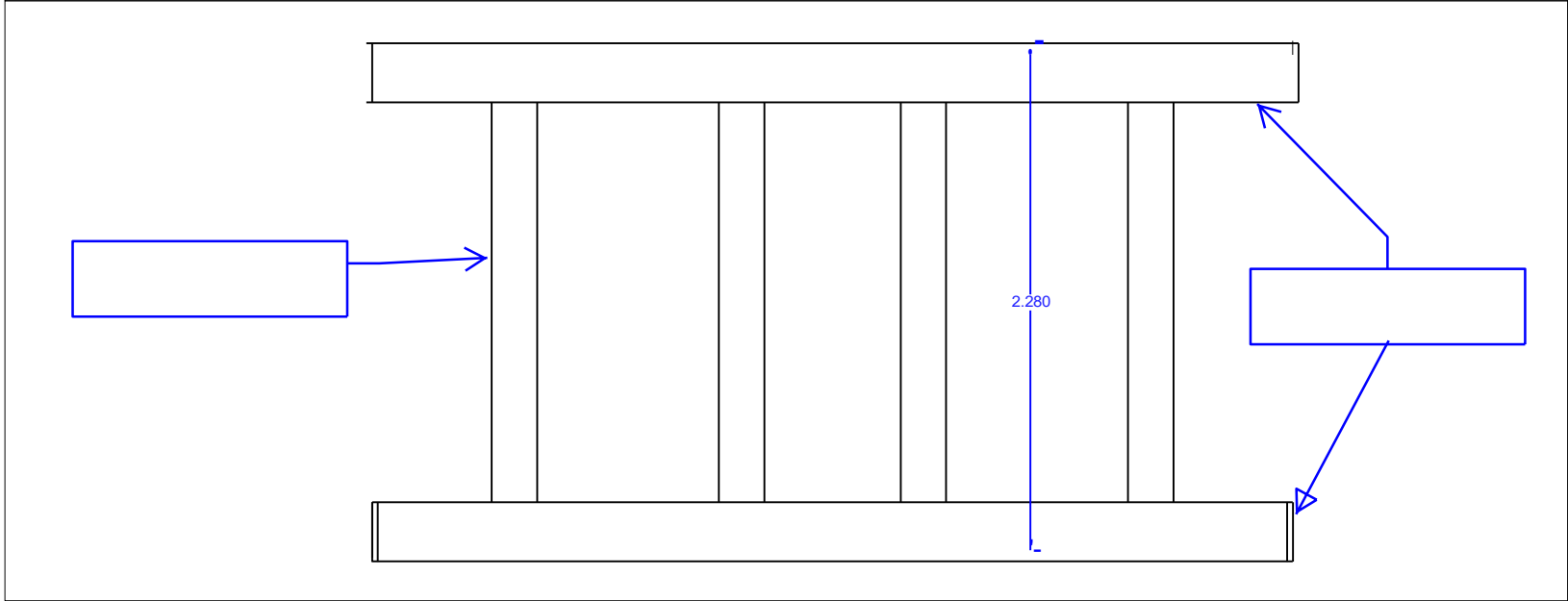
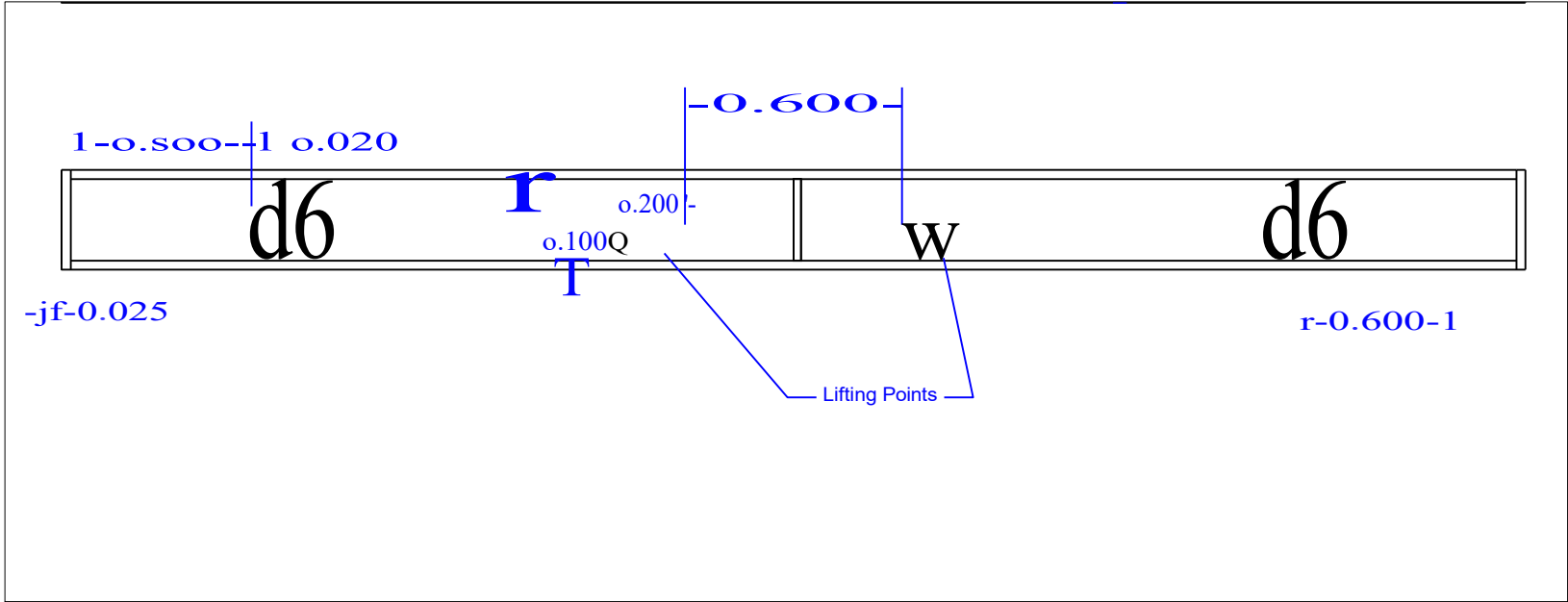
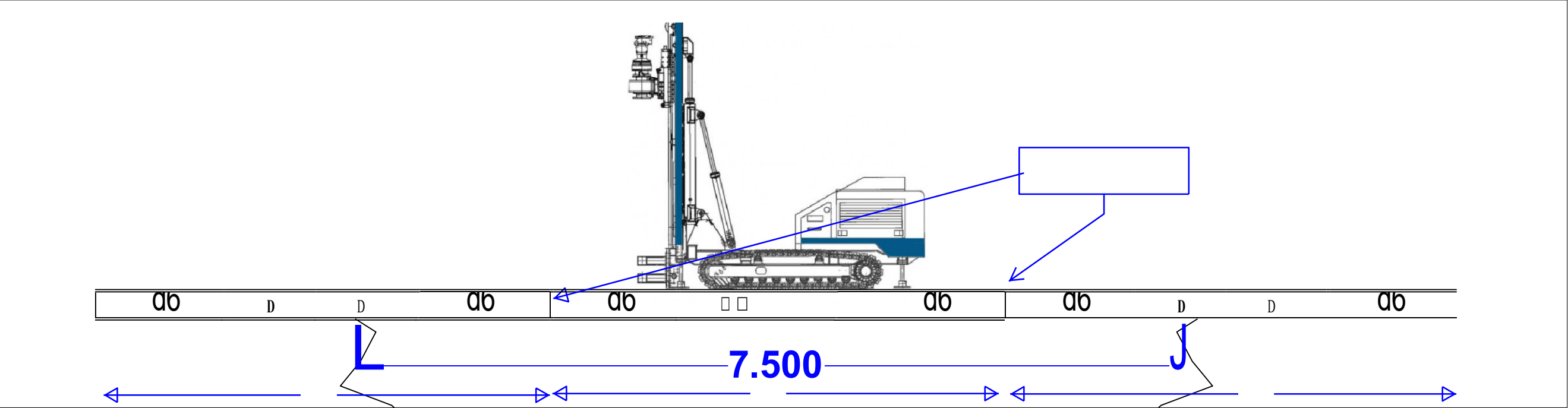
with current circular shape dia 300mm

Note: The disclaimer on the first worksheet applies to all tables in this workbook				
Rig Manufacturer :		CASAGRANDE SPA	Rig Type :	C6 sn. C6_US_1439
		Operation mode:	Micropiles - W.R. 3,09 m	
Completed by:	Ing. D. Verona	18/07/2016	Checked by:	Ing. G. Peressini
Main Components :				
	Item	Mass (kg)	Moment arm (m)	Moment (kNm)
UPPER WORKS				0,00
	Mast Assembly + cathead + winch+	4850	2,19	104,05
	+ articulation + clamps			0,00
				0,00
				0,00
	safety cages/guards	250	3,09	7,58
				0,00
LOWER WORKS				0,00
	Upperstructure + undercarriage +	8010	-1,22	-95,94
	+ pump NG530 + lubricator			0,00
				0,00
				0,00
ROPE / KELLY / CHAIN / SUSPENDED EQUIPMENT	Rotary T20 + casing driver + swivel	890	3,09	26,98
	tools (augers,rods...)			0,00
	rods	200	3,09	6,06
				0,00
	input to use properly the spreadsheet	0	0,00	0,00
COUNT.				0,00
				0,00
				0,00
OTHER	None	0	0,00	0,00
				0,00
				0,00
Main Components Totals				
UPPER WORKS		5100	2,23	111,63
LOWER WORKS		8010	-1,22	-95,94
ROPE / KELLY / CHAIN SUSPENDED EQUIPMENT		1090	3,09	33,04
COUNTERWEIGHT		0	0,00	0,00
OTHER		0	0,00	0,00
TOTAL		14200	0,35	48,73
Tracks				
Track bearing length (m)		2,28		
Track pad width (m)		0,4		
Distance between centrelines of tracks (m)		1,85		
Front Foot Pads				
Pad Bearing Area (m²)		0,50	Actual Dimensions	shape 350 x 370
Pad Maximum Loading (kN)		100,00	Actual Shape	rectangular
Pad Moment Arm (m)		2,71		
Rear Foot Pads				
Pad Bearing Area (m²)		0,14	Actual Dimensions	dia 300mm
Pad Maximum Loading (kN)		100,00	Actual Shape	circular
Pad Moment Arm (m)		-1,70		
Forces				
Maximum Extraction Force (kN)		85,00		
Maximum Penetration Force (kN)		85,00		
Maximum Auxillary Force (kN)		20,00	Auxillary Force Moment Arm (m)	3,13
Note: The disclaimer on the first worksheet applies to all tables in this workbook			Notes	
			No limits on working practice INPUT PAGE for EXTRACTING	

CASAGRANDE SPA		Weight (kg) / Load (kgf)	Distance to CL rotation (m)	Horizontal moment (kNm)				Mode : Micropiles - W.R. 3,09 m Extracting							Transformation from triangular or trapizoidal to an equivalent rectangular pressure distribution under track maintaining the load centriod		
C6_US_1439								Relative Angle - Upper Body and Tracks (degrees)	Bearing pressure at front of L.H. track (kN/m^2)	Bearing pressure at rear of L.H. track (kN/m^2)	Bearing pressure at front of R.H. track (kN/m^2)	Bearing pressure at rear of R.H. track (kN/m^2)	Max Track loading dimensions				Equivalent Bearing
Lower Works		8010	-1,221	-96													
Counterweight		0	0,000	0													
Upper Works		5100	2,231	112													
Other		0	0,000	0													
Rope / Kelly / Chain Suspended		1090	3,090	33													
Machine Weight (kg)		14200	0,350	49													
					Force (kN)	Max. (kN)											
Auxiliary Line (kgf)		0	3,125	0	0,00	20,00	Foot Pad Area (m2)										
Net Extraction Force (kgf)		7575	3,090	230	85,00	85,00											
Net Penetration Force (kgf)		0	3,090	0	0,00	85,00											
Front Foot Pads Loading (kgf)		-7543	2,710	-201	74,00	100,00	0,500	Front Foot Pads Equivalent Length (m)and Bearing Pressure (kN/m^2)						1,250	148		
Rear Foot Pads Loading (kgf)		0	-1,700	0	0,00	100,00	0,140	Rear Foot Pads Equivalent Length (m)and Bearing Pressure (kN/m^2)						0,350	0		
Others		0	0,000	0	Track Bearing Length (m)		2,280	Maximum Equivalent Design Values						1,165	150		
Track Total Loading (kgf)		14231	0,557	78	Track Width Centres (m)		1,850							BRE LOAD CASE (1 or 2)		2	
					Track pad width (m)		0,400										



Auxiliary Line Force OK
Extraction Force OK
Penetration Force OK
Front Foot Pad Force OK
Rear Foot Pad Force OK



Van Elle

- Notes
1. Frame suitable for a Cassagrande C6 drilling rig only.
 2. Max free span of frame: 7.5m
 3. Ground support to base of frame and access to and from frame provided by others
 4. Edge protection by others.