Demolition, steel dismantling
& asbestos removal

BROWN&MASON

Design for Explosive Demolition

Site: Gelderland Central Power Station

Document No: **C2002/MM/D001**

Title: **Design for the Demolition of the Northern FGD Duct Support Structures using Controlled Explosives.**

Date: 25th February 2021

Document authorisation:

Designer	5.1.2e	Signature	25/02/21 Date
Checker	5.1.2e	Signature	25/02/21 Date

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Contents

1.0 CHANGE LOG

Rev	Date	By	Comment
-	25/02/2021	5.1.2e	Initial Issue

2.0 OBJECTIVE / PURPOSE OF CALCULATIONS

The purpose of the following calculations is to determine stability of both the reinforced concrete and structural steelwork duct support structures following the proposed alterations to facilitate its demolition with the aid of Controlled Explosives.

3.0 EXECUTIVE SUMMARY

The calculations confirm that the proposed alterations to the duct support structures do not adversely affect its stability and the attendant design drawings must be used to prepare the structure for demolition.

4.0 BASE DATA USED

1. 13022-4: Overzitch Vert. Doorsn as B-A^2-C^1-B^1-D-E-F-C^1-C^2.
2. 13023-4: Overzitch Vert. Doorsn as 1-1^1-1^2-1^3-2-2^3-???.
3. 77002-021-101: Foundatie Bilastingen.
4. 770.002-330-103: DuoFsnede Werk Luchleiding M2 TBV CTAVO.
5. 770.002-310-130: Gavo opstelling Doorsnede over as D.
6. 82 300-003-001: Centrale Gelderland Groep 13 Rookgasontzwavelng Lay out.
7. 82 300-003-105: Accord Voor Vitvoering.
8. Y77613: Outline Arrangement of 31GVAZ Gas Heater.
9. Site measurements.

5.0 DESIGN CODES / STANDARDS USED

1. NEN3851: 1973 – Technical Principles for the Design and Calculation of Building Structures. TGB 1972 – STEEL.
2. [redacted]
3. 5.1.2f

6.0 REFERENCES

1. [redacted] 5.1.2f

7.0 ASSUMPTION LOG

ASSUMPTION LOG			
Ref	**Date**	**By**	**Assumption**
A1	25/02/21	[redacted] 5.1.2e	The concrete density = 24kN/m^3.
A2	25/02/21		The steelwork density = 78.5kN/m^3.
A3	25/02/21		The concrete strength is 25N/mm^2.
A4	25/02/21		The structural steelwork assumed to be mild steel.

8.0 DESIGN INFORMATION

Building Age	The FGD system was built circa early 1980s.
General Loading Conditions	Gas Heater = 490 tonnes.
	Services – N/A.
	Wind loading conditions – basic wind speed 24.5m/s.
Material data	
Static coefficient of friction	0.5

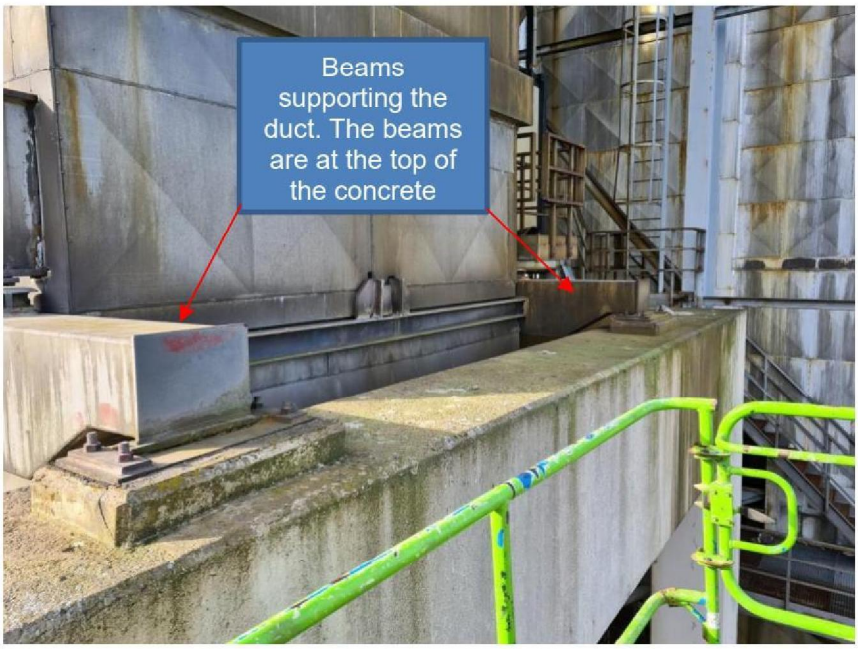


Photo 1 – Duct Support beams at the top of the concrete structure.

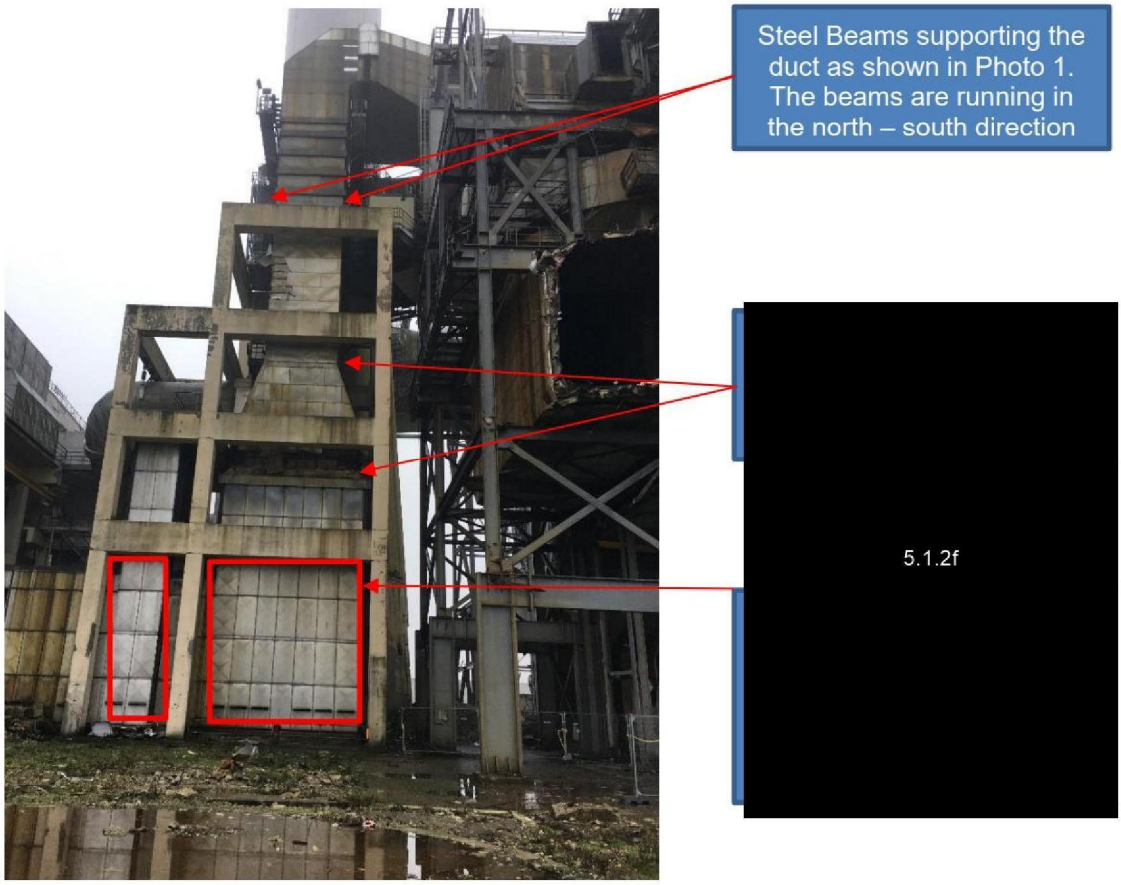


Photo 2 – Northern elevation of the Concrete Duct Support Structure.

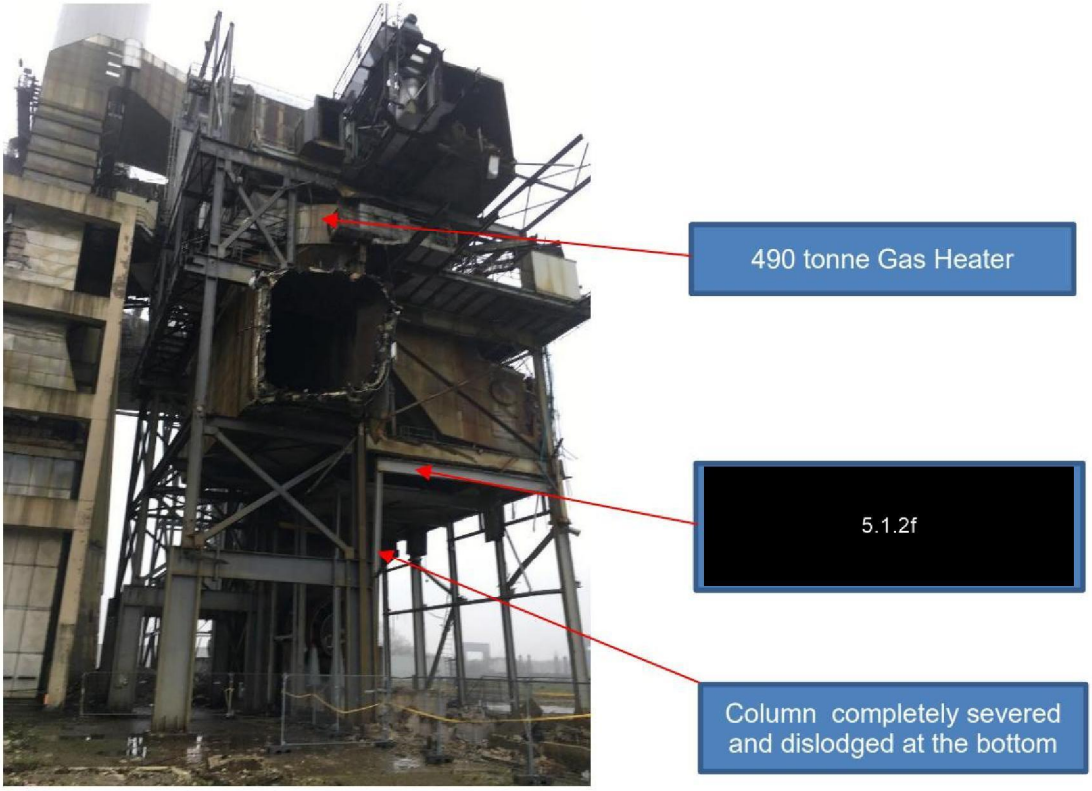


Photo 3 – Northern elevation of the Structural Steelwork Duct Support Structure.

9.0 CONDITION

The Northern FGD Duct Support Structures.

BAM have satisfied themselves of the condition of the duct support structures under consideration and the assessment is going to be undertaken on the basis that the concrete and reinforcement together with the structural steelwork have not suffered any deterioration.

A column at grid line 2D was noted as damaged from the previous demolition work. Both the column and the beam are no longer carrying any part of the ducts above. To ensure safety, the damaged column and beam will be carefully removed as part of the enabling works. The remaining structure will be assessed for stability.

A visual assessment of the structures was conducted on 02 & 03/02/2021.

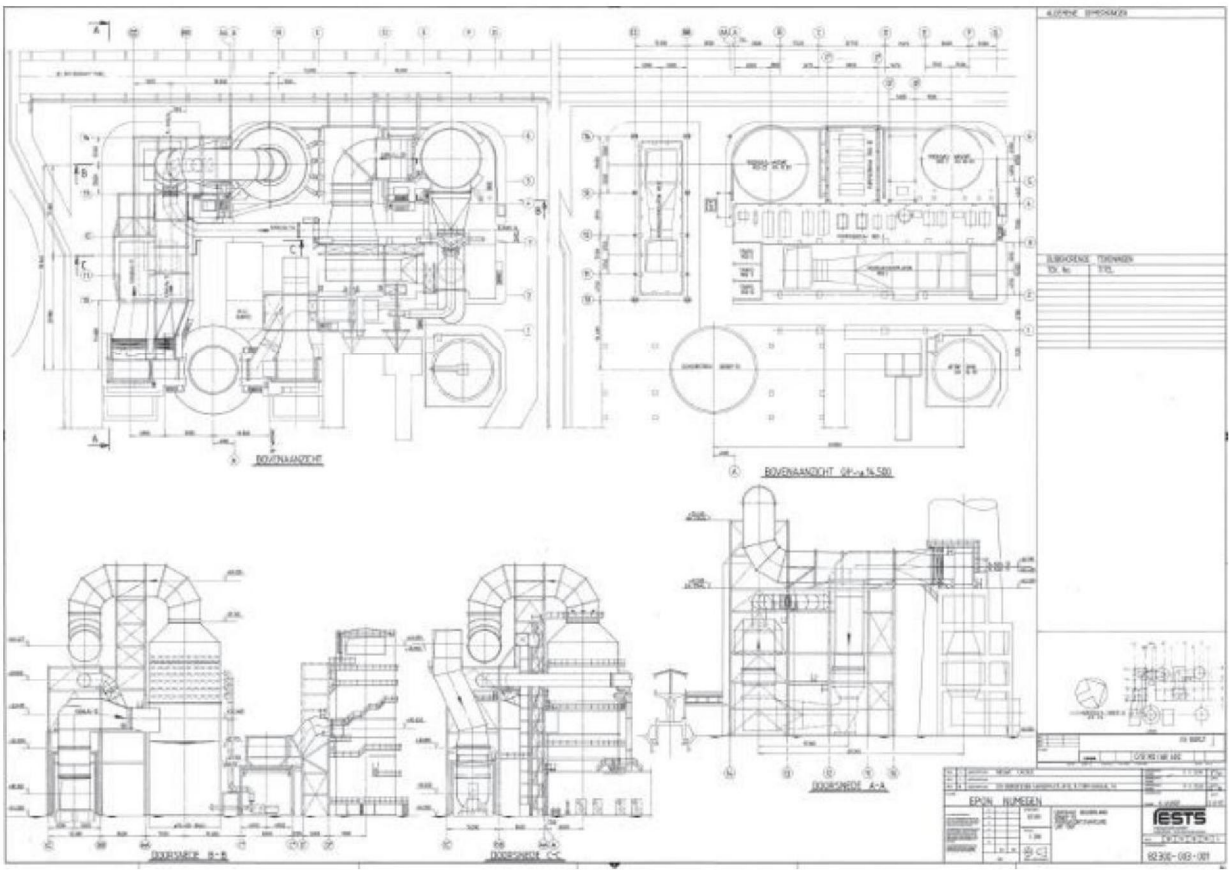
10.0 STRUCTURAL SUMMARY

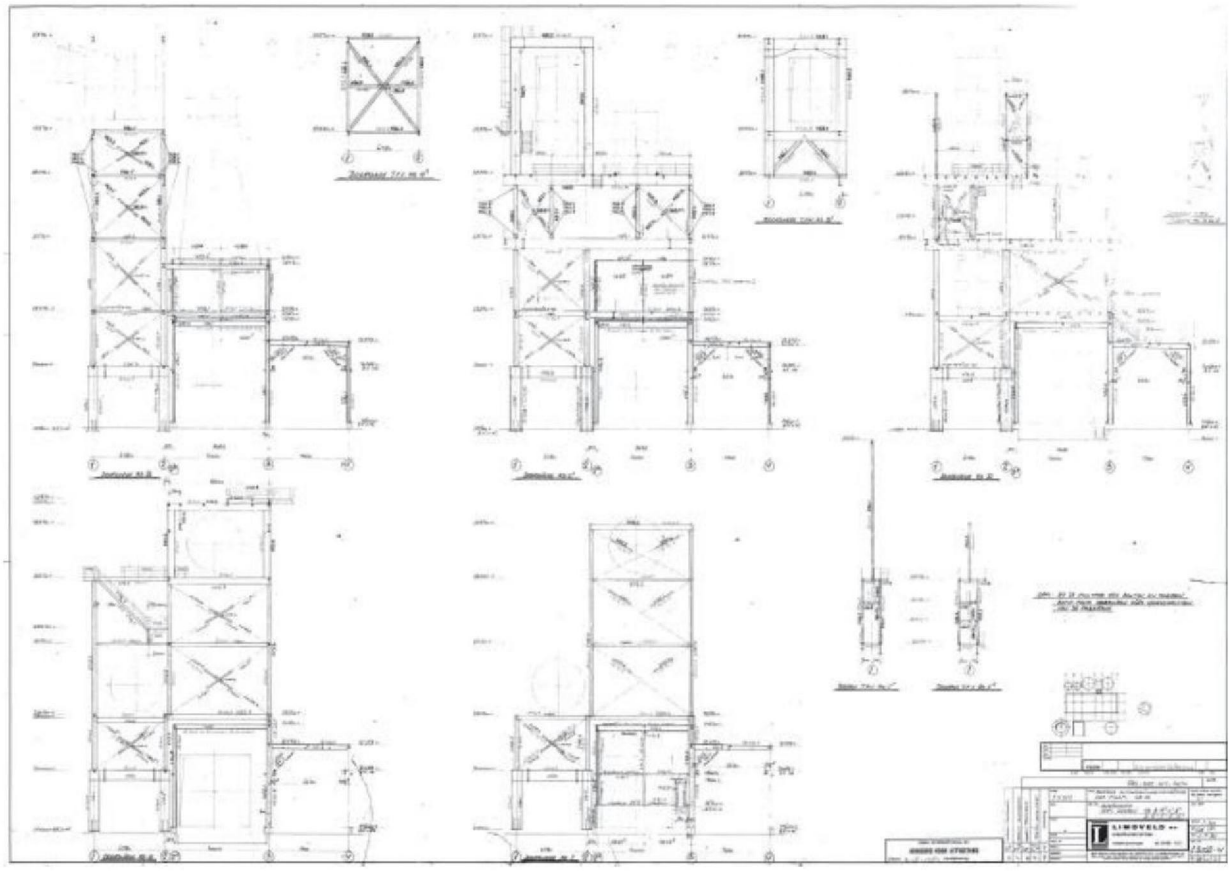
Concrete Structure.

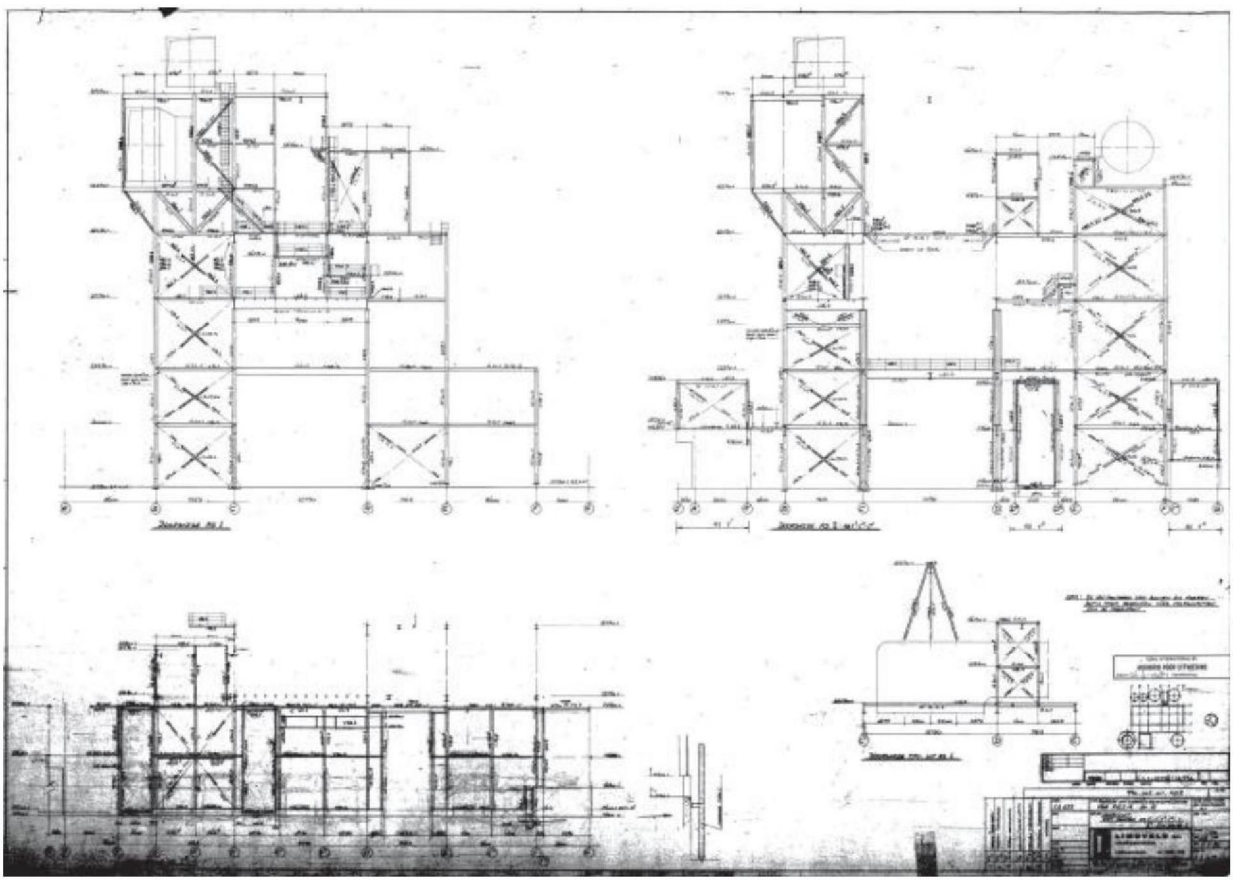
Plan area – approx. 10m x 14m.
6no. columns @ 800mm x 800mm.
Beam size – circa – 800mm x 1500mm deep.
Height – approx. 28m.

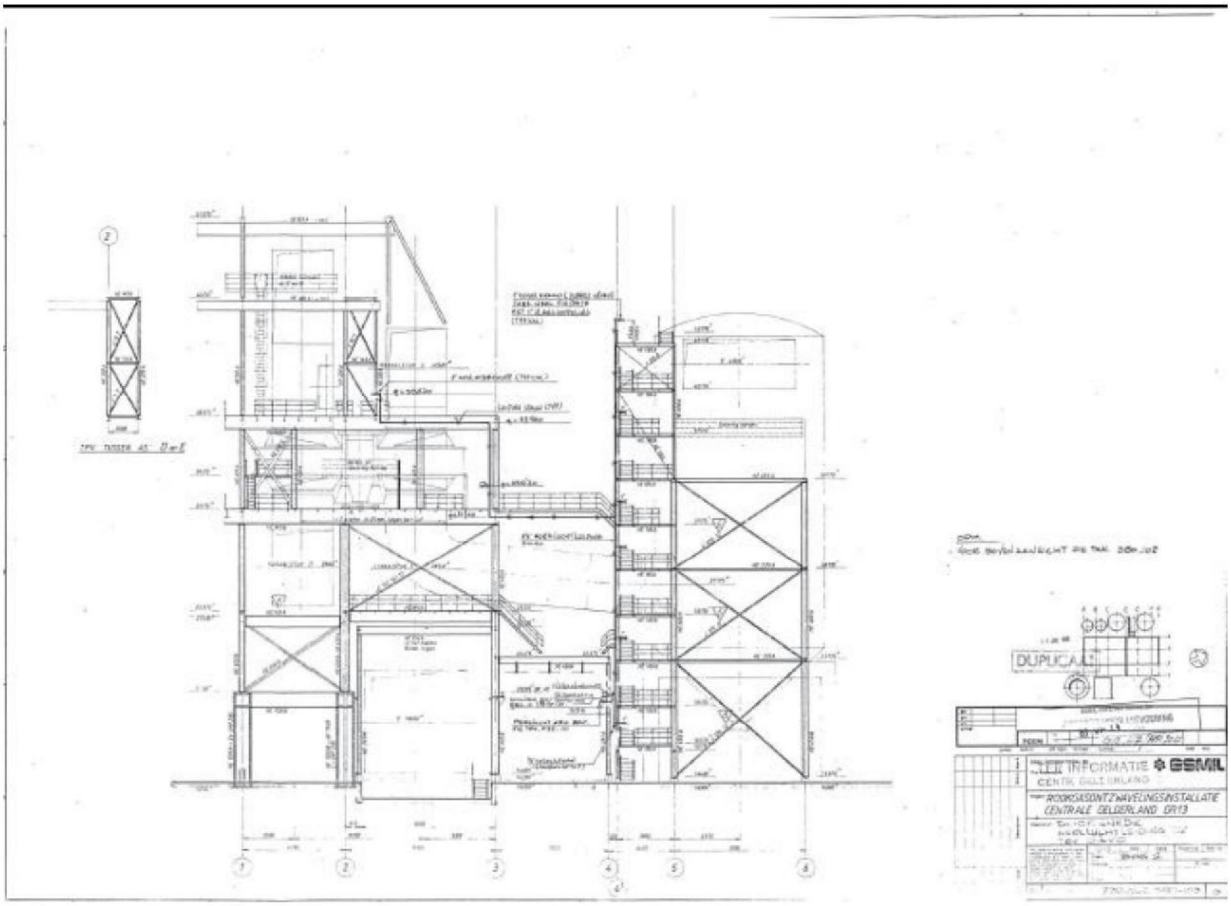
Structural Steelwork Structure.

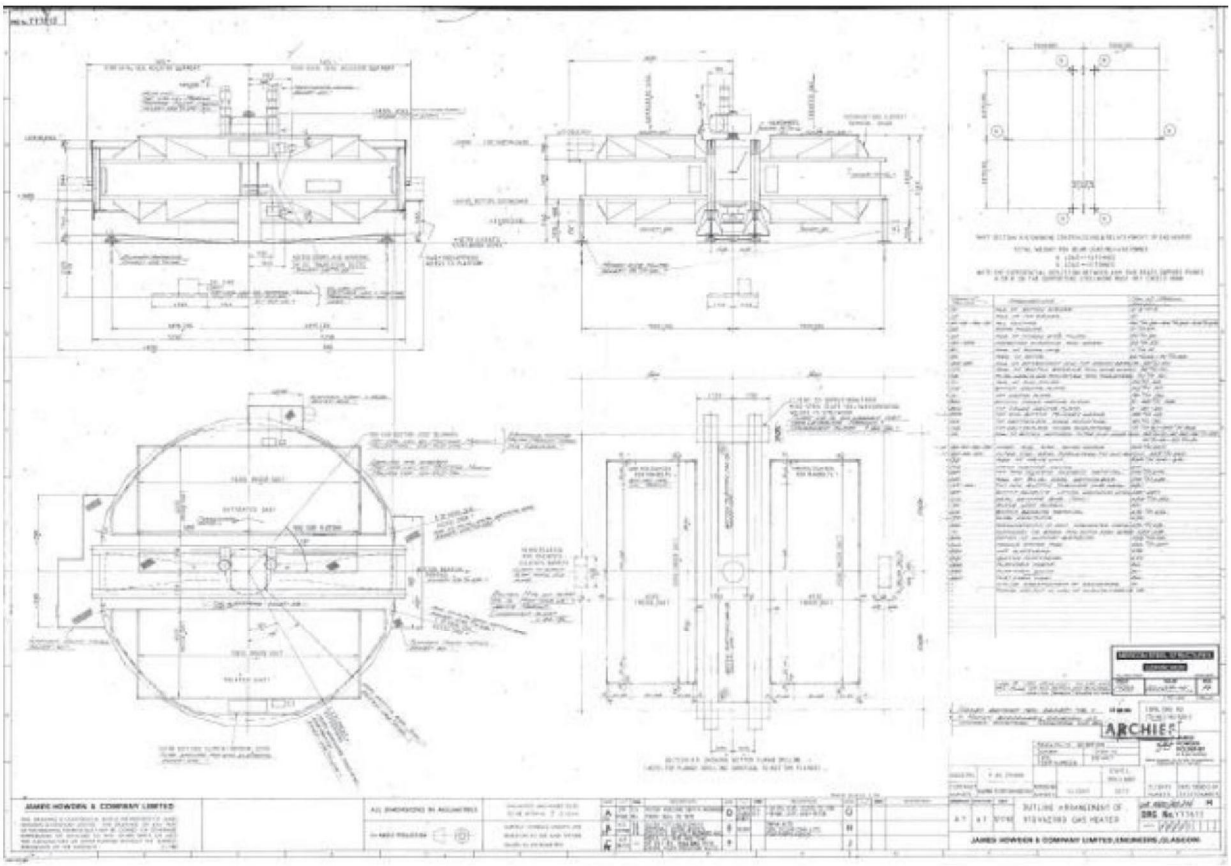
Plan footprint size – 16.78m x 20.275m
Approx. height of structure = 37.570m
Approx. height to top of highest duct = 45m
Duct size – varies. Average 5m x 5m











11.0 DESIGN PHILOSOPHY

1. Demolition phasing.

   Both the concrete duct supporting structure and the structural steelwork supporting structures will be blown down northwards simultaneously in one event.

2. Demolition Strategy.

   The structures will be prepared as shown on the drawings. 5.1.2f

   5.1.2f

   On the structural steelwork structure, there is not robust horizontal connectivity between the sections between grid lines B to C and C to D.

   5.1.2f

3. Structural Checks.

   The global stability and stresses of the respective structures will be checked in their respective pre-weakened states.

   For the concrete structure, the global stability will be checked in the south to north direction and for the structural steelwork structure in the east to west direction.

   By inspection, the effect of drilling the staggered blind holes on the concrete support structure leading columns will not materially reduce the concrete compressive capacity. No reinforcement bars will be cut during the drilling process and as a result the full tensile capacity is retained. No further checks will be made with respect to this.

12.0 CALCULATIONS

[redacted]

5.1.2f

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	Project: Gelderland Central Power Station			**Job Ref.:** C2002
	Part of Structure: Northern FGD Duct Support Structures..			**Sheet No./rev.:**
	Calc. by: 5.1.2e	**Date:** 25/02/21	**App'd by:** 5.1.2e	**Date:** 25/02/21

Ref.	Calculations	Output

SECTION PROPERTIES' CALCULATIONS.

Note: Standard sections will be calculated automatically by the analysis software.

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[redacted]

5.1.2f

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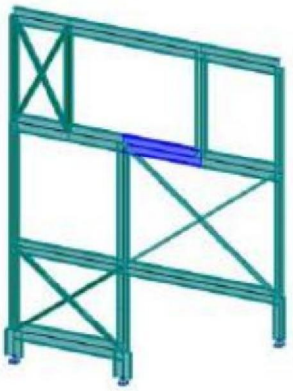
Ref.	**Calculations**	**Output**

[redacted]

5.1.2f

Structure view



Nodes

Node	X (m)	Z (m)	Support code	Support
1	0.0	0.0	xxf	Pinned
2	0.0	1.50		
3	0.0	4.00		
4	0.0	6.50		
5	0.0	13.70		
6	0.0	19.90		
7	1.73	16.80		
8	3.45	19.90		
9	3.45	13.70		
10	3.45	4.00		
11	6.90	13.70		
12	6.90	6.50		
13	6.90	4.00		
14	6.90	1.50		
15	6.90	0.0	xxf	Pinned
16	11.85	19.90		
17	11.85	13.70		
18	11.85	10.10		
19	16.80	19.90		
20	16.80	13.70		
21	16.80	6.50		
22	16.80	4.00	xxf	Pinned

Loads

	Case	Load type	List
	1	self-weight	1to8 12to26 2
	1	uniform load	15to17
	1	uniform load	22
	1	nodal force	6
	1	nodal force	5
	1	nodal force	20
	1	nodal force	4
	1	nodal force	12
	1	nodal force	21
	1	bar force	19
	1	bar force	20

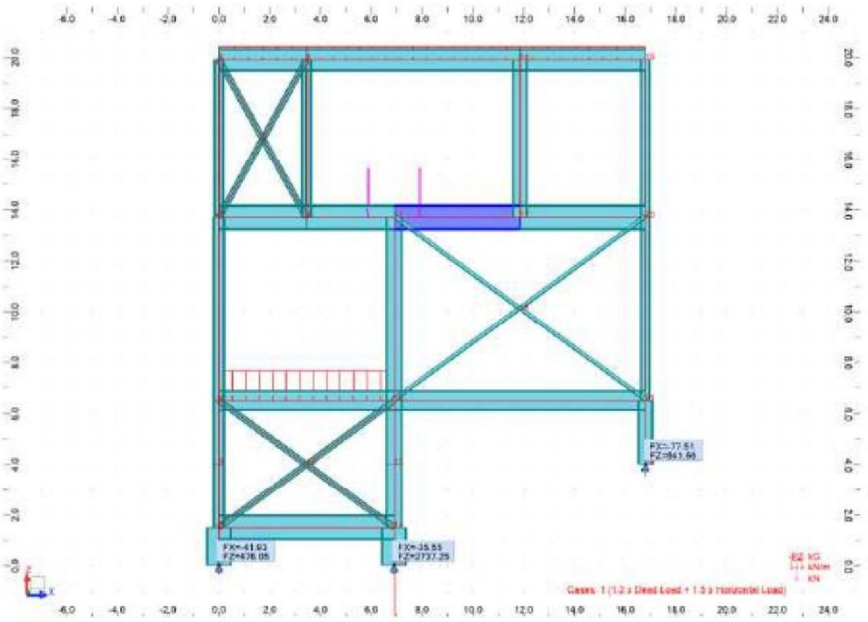
Load values	
	PZ Negative Factor=1.00
	PZ=-12.00(kN/m)
	PZ=-28.00(kN/m)
	FX=100.00(kN)
	FX=40.00(kN) FZ=-65.00(kN)
	FZ=-65.00(kN)
	FX=15.00(kN)
	FZ=-175.00(kN)
	FZ=-80.00(kN)
	FZ=-1400.00(kN) X=0.71 relative
	FZ=-1400.00(kN) X=0.20 relative

reactions: values

in the coordinate system: global - Case: 1 (1.2 x Dead Load + 1.5 x H

Node/Case	FX (kN)	FZ (kN)	MY (kNm)
1/ 1	-41.93	476.05	-0.00
15/ 1	-35.55	2737.25	-0.00
22/ 1	-77.51	641.66	0.00
Case 1	1.2 x Dead Load + 1.5 x Horizontal Load		
Sum of val.	-155.00	3854.96	-0.00
Sum of reac.	-155.00	3854.96	-29976.94
Sum of forc.	155.00	-3854.96	29976.94
Check val.	-0.00	-0.00	0.00
Precision	5.50437e-14	3.22081e-29	

View - Reaction forces(kN), Cases: 1 (1.2 x Dead Load + 1.5 x Horizontal Load)

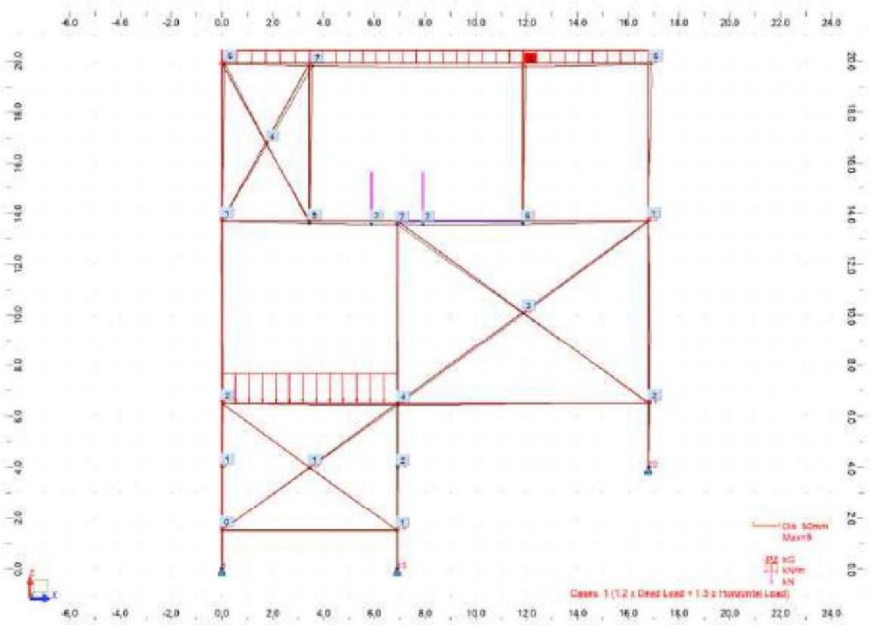


displacements: values

- Case: 1 (1.2 x Dead Load + 1.5 x Horizontal Load)

Node/Case	UX (mm)	UZ (mm)	RY (Rad)
1/ 1	0.0	0.0	0.000
2/ 1	0	-0	0.000
3/ 1	1	-0	0.000
4/ 1	1	-1	0.001
5/ 1	-0	-1	0.001
6/ 1	6	-1	0.001
7/ 1	3	-3	0.001
8/ 1	6	-5	0.001
9/ 1	-0	-5	0.001
10/ 1	1	-1	0.000
11/ 1	-0	-7	0.000
12/ 1	2	-3	-0.000
13/ 1	1	-2	0.000
14/ 1	0	-1	0.000
15/ 1	0.0	0.0	0.000
16/ 1	5	-6	-0.000
17/ 1	0	-6	-0.001
18/ 1	1	-3	-0.000
19/ 1	5	-1	-0.001
20/ 1	0	-1	-0.001
21/ 1	2	-0	0.000
22/ 1	0.0	0.0	0.001

View - Deformation, Cases: 1 (1.2 x Dead Load + 1.5 x Horizontal Load)



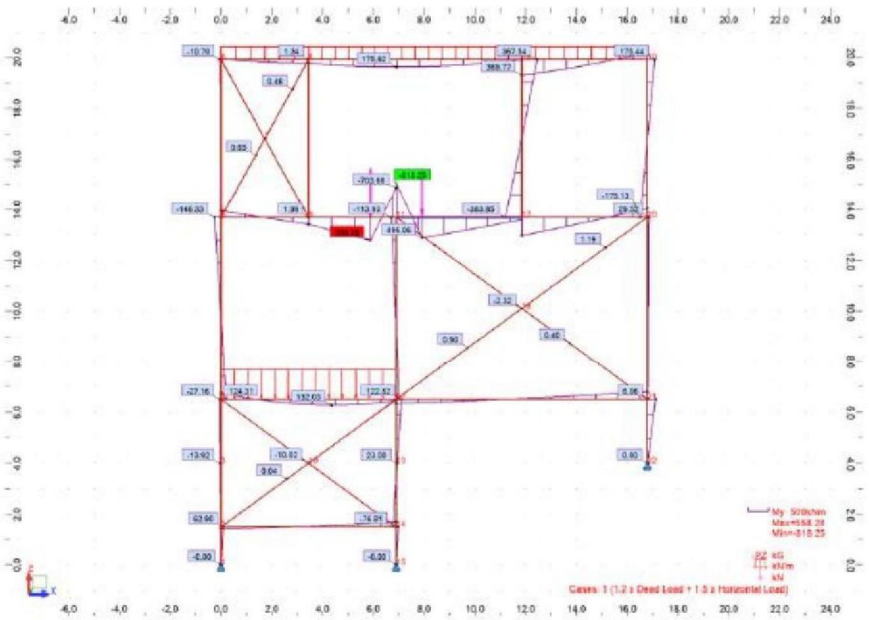
forces: values

- Case: 1 (1.2 x Dead Load + 1.5 x Horizontal Load)

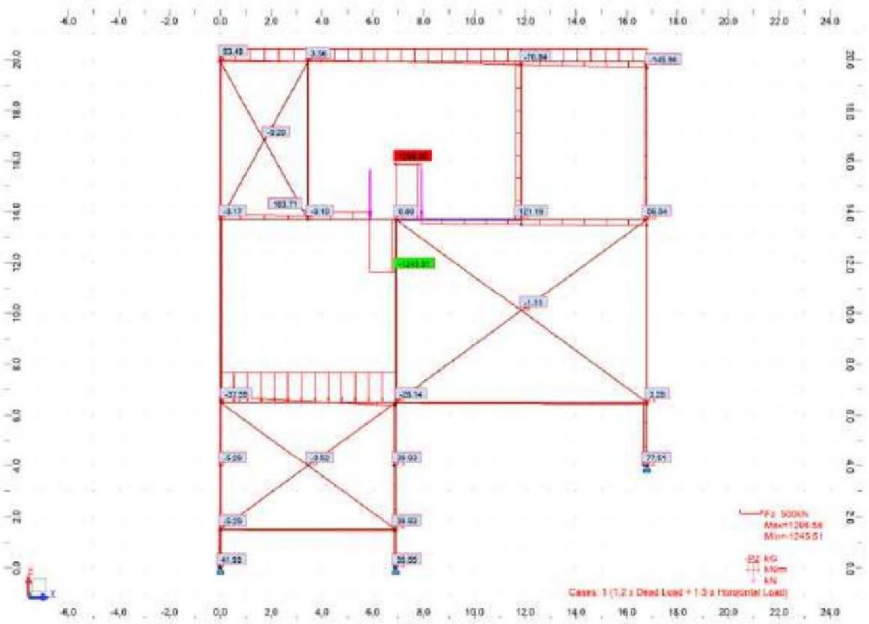
Bar/Node/Case	FX (kN)	FZ (kN)	MY (kNm)
1/ 1/	476.05	41.93	-0.00
1/ 2/	472.05	41.93	62.90
2/ 2/	416.89	-5.29	-0.69
2/ 3/	412.69	-5.29	-13.92
3/ 3/	412.69	-5.29	-13.92
3/ 4/	408.50	-5.29	-27.16
4/ 4/	374.24	-37.59	124.31
4/ 5/	362.15	-37.59	-146.33
5/ 5/	112.14	-3.17	8.96
5/ 6/	104.54	-3.17	-10.70
6/ 9/	-25.64	-0.10	1.99
6/ 8/	-33.23	-0.10	1.34
7/ 21/	364.45	3.26	6.06
7/ 20/	355.63	3.26	29.52
8/ 20/	153.55	56.54	-175.13
8/ 19/	145.96	56.54	175.44
12/ 15/	2737.25	35.55	-0.00
12/ 14/	2733.25	35.55	53.33
13/ 17/	7.31	121.19	-383.85
13/ 16/	-3.48	121.19	367.54
14/ 22/	641.66	77.51	0.00
14/ 21/	636.46	77.51	193.78
15/ 6/	132.44	53.49	-13.23
15/ 8/	132.44	3.56	85.18
16/ 8/	177.74	50.72	86.73
16/ 16/	177.74	-70.84	2.23
17/ 16/	56.54	-74.33	369.77
17/ 19/	56.54	-145.96	-175.44
18/ 5/	27.23	98.53	-154.76
18/ 9/	27.23	89.31	169.27
19/ 9/	-0.15	163.71	167.47
19/ 11/	-0.15	-1245.51	-703.66
20/ 11/	-176.20	1296.56	-818.25
20/ 17/	-176.20	-116.66	57.66
21/ 17/	-55.01	-123.97	441.51
21/ 20/	-55.01	-137.20	-204.88
22/ 4/	-150.63	131.79	-155.49
22/ 12/	-150.63	-76.61	34.88
23/ 12/	-132.85	-17.57	96.79
23/ 21/	-132.85	-39.37	-185.08
24/ 2/	-143.87	-16.75	65.96
24/ 14/	-143.87	-38.00	-122.94
25/ 5/	98.52	0.82	-0.53
25/ 7/	96.69	-0.20	0.58
26/ 7/	94.06	0.62	-0.19
26/ 8/	92.23	-0.40	0.21
28/ 6/	-58.85	-0.75	2.52
28/ 7/	-57.01	-1.77	-1.95
29/ 7/	-57.70	0.90	-1.18
29/ 9/	-55.87	-0.13	0.19

Bar/Node/Case	FX (kN)	FZ (kN)	MY (kNm)
30/ 2/	120.45	1.52	-2.38
30/ 10/	118.97	-0.52	-0.25
31/ 10/	116.14	6.07	-10.02
31/ 12/	114.66	4.03	11.51
32/ 4/	165.20	-0.74	4.03
32/ 10/	166.68	-2.78	-3.48
33/ 10/	173.82	-2.15	6.30
33/ 14/	175.30	-4.19	-7.21
34/ 12/	9.33	1.55	-1.87
34/ 18/	7.39	-1.11	-0.52
35/ 18/	3.40	1.75	-2.32
35/ 20/	1.46	-0.92	0.23
36/ 11/	249.43	0.80	0.65
36/ 18/	251.37	-1.87	-2.64
37/ 18/	255.33	1.04	-0.84
37/ 21/	257.27	-1.63	-2.64
38/ 14/	2588.99	39.93	-76.81
38/ 13/	2584.33	39.93	23.00
39/ 13/	2584.33	39.93	23.00
39/ 12/	2579.67	39.93	122.82
40/ 12/	2409.43	-26.14	74.27
40/ 11/	2396.01	-26.14	-113.93

View - MY, Cases: 1 (1.2 x Dead Load + 1.5 x Horizontal Load)



View - FZ, Cases: 1 (1.2 x Dead Load + 1.5 x Horizontal Load)



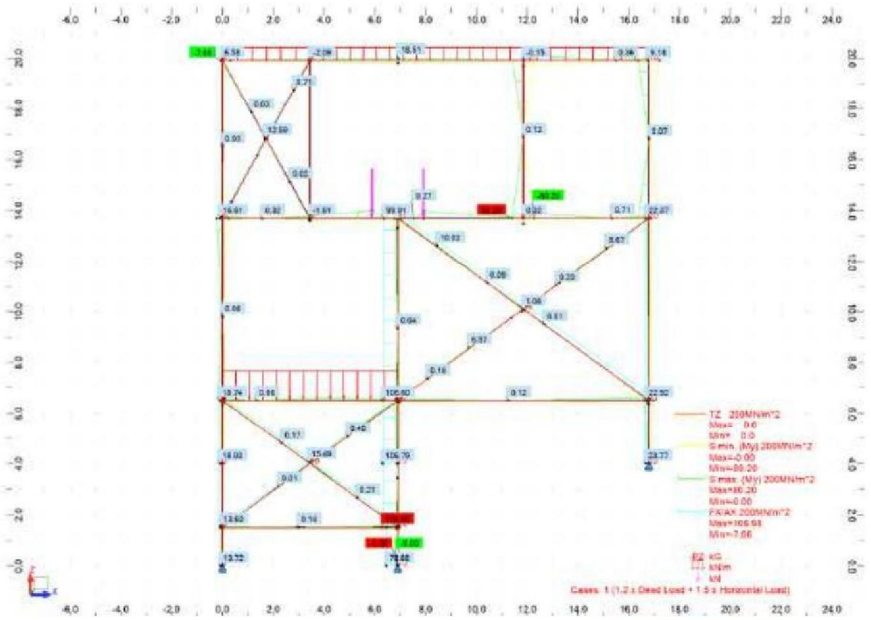
stresses: values

- Case: 1 (1.2 x Dead Load + 1.5 x Horizontal Load)

Bar/Node/Case	S max (MPa)	S min (MPa)	S max(My) (MPa)	S min(My) (MPa)
1/ 1/	13.72	13.72	0.00	-0.00
1/ 2/	19.23	7.98	5.62	-5.62
2/ 2/	19.32	18.93	0.19	-0.19
2/ 3/	22.85	15.01	3.92	-3.92
3/ 3/	22.85	15.01	3.92	-3.92
3/ 4/	26.39	11.09	7.65	-7.65
4/ 4/	52.18	-17.84	35.01	-35.01
4/ 5/	57.82	-24.60	41.21	-41.21
5/ 5/	10.93	3.18	3.87	-3.87
5/ 6/	11.21	1.94	4.63	-4.63
6/ 9/	-0.75	-2.47	0.86	-0.86
6/ 8/	-1.51	-2.67	0.58	-0.58
7/ 21/	25.54	20.30	2.62	-2.62
7/ 20/	35.14	9.59	12.77	-12.77
8/ 20/	85.43	-66.11	75.77	-75.77
8/ 19/	85.09	-66.73	75.91	-75.91
12/ 15/	78.88	78.88	-0.00	-0.00
12/ 14/	83.53	74.00	4.77	-4.77
13/ 17/	80.52	-79.87	80.20	-80.20
13/ 16/	76.63	-76.94	76.79	-76.79
14/ 22/	23.77	23.77	0.00	-0.00
14/ 21/	57.57	-10.42	34.00	-34.00
15/ 6/	5.52	2.73	1.39	-1.39
15/ 8/	13.11	-4.85	8.98	-8.98
16/ 8/	14.68	-3.61	9.14	-9.14
16/ 16/	5.77	5.30	0.24	-0.24
17/ 16/	40.74	-37.22	38.98	-38.98
17/ 19/	20.26	-16.73	18.50	-18.50
18/ 5/	14.62	-13.05	13.83	-13.83
18/ 9/	15.91	-14.34	15.13	-15.13
19/ 9/	14.96	-14.97	14.97	-14.97
19/ 11/	62.89	-62.90	62.90	-62.90
20/ 11/	68.06	-78.22	73.14	-73.14
20/ 17/	0.08	-10.23	5.15	-5.15
21/ 17/	37.88	-41.05	39.46	-39.46
21/ 20/	16.73	-19.90	18.31	-18.31
22/ 4/	14.98	-25.51	20.24	-20.24
22/ 12/	-0.73	-9.81	4.54	-4.54
23/ 12/	7.96	-17.25	12.60	-12.60
23/ 21/	19.45	-28.74	24.10	-24.10
24/ 2/	1.52	-8.71	5.12	-5.12
24/ 14/	5.94	-13.13	9.53	-9.53
25/ 5/	13.61	12.05	0.78	-0.78
25/ 7/	13.45	11.73	0.86	-0.86
26/ 7/	12.53	11.97	0.28	-0.28
26/ 8/	12.31	11.70	0.30	-0.30
28/ 6/	-3.92	-11.40	3.74	-3.74
28/ 7/	-4.54	-10.31	2.88	-2.88
29/ 7/	-5.77	-9.26	1.74	-1.74
29/ 9/	-6.99	-7.55	0.28	-0.28

Bar/Node/Case	S max (MPa)	S min (MPa)	S max(My) (MPa)	S min(My) (MPa)
30/ 2/	19.20	12.16	3.52	-3.52
30/ 10/	15.86	15.12	0.37	-0.37
31/ 10/	29.97	0.28	14.85	-14.85
31/ 12/	31.97	-2.11	17.04	-17.04
32/ 4/	27.48	15.54	5.97	-5.97
32/ 10/	26.85	16.55	5.15	-5.15
33/ 10/	31.96	13.30	9.33	-9.33
33/ 14/	33.50	12.15	10.68	-10.68
34/ 12/	6.50	-12.21	5.16	-13.55
34/ 18/	2.49	-2.69	1.43	-3.75
35/ 18/	6.90	-16.33	6.41	-16.82
35/ 20/	1.86	-0.42	1.65	-0.63
36/ 11/	40.38	33.82	4.75	-1.81
36/ 18/	43.21	16.76	7.30	-19.15
37/ 18/	38.80	30.39	2.32	-6.09
37/ 21/	44.06	17.59	7.31	-19.17
38/ 14/	121.01	92.95	14.03	-14.03
38/ 13/	110.99	102.59	4.20	-4.20
39/ 13/	110.99	102.59	4.20	-4.20
39/ 12/	129.03	84.17	22.43	-22.43
40/ 12/	113.13	86.00	13.57	-13.57
40/ 11/	119.82	78.20	20.81	-20.81

View - S max(My),S min(My),Fx/Ax,TZ, Cases: 1 (1.2 x Dead Load + 1.5 x Horizontal Load)



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	Project: Gelderland Central Power Station				**Job Ref.:** C2002
	Part of Structure: Northern FGD Duct Support Structures..				**Sheet No./rev.:**
	Calc. by: 5.1.2e	**Date:** 25/02/21	**App'd by:** 5.1.2e	**Date:** 25/02/21	
Ref.	**Calculations**				**Output**

5.1.2f

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	Project: Gelderland Central Power Station				**Job Ref.:** C2002
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	Calc. by: 5.1.2e	**Date:** 25/02/21	**App'd by:** 5.1.2e	**Date:** 25/02/21	

Ref.	**Calculations**	**Output**

[redacted]

5.1.2f

13.0 DESIGN CONCLUSION SUMMARY

Having concluded our design calculations we can confirm that the FGD Duct Support Structures remain stable in their temporary state following the proposed alterations to aid their felling with the aid of controlled explosives.

The attendant drawings to be strictly adhered to during the alterations process.

14.0 Appendix

1. Designers Risk Assessment
2. Design Drawings – C2002/D001/DWG000 - 007.

Appendix 1

Designers Risk Assessment

Hazard/Risk Assessment

Hazard	Hazard Sub Category	Persons at Risk	Initial Risk Rating			Control Measures	Residual Risk Rating		
			S	L	RR		S	L	RR
Disproportionate Collapse caused by accidental loading or erroneous cuts.	a. Plant b. Personnel	BAM Contractors Others	3 3 3	3 3 3	9 9 9	All plant movement to be controlled and not come closer than 2m from the works (columns and beams) once the structural weakening begins. MEWPs may be exceptions. However, MEWPs should be operated by experienced and authorised personnel only. All cuts to be marked and verified before cuts are made.	3 3 3	1 1 1	3 3 3
'Cut' locations which are not readily accessible.	a. Some columns proposed cut locations are not reachable from ground level.	BAM Contractors Others	3 3 3	3 1 1	9 3 3	A safe system of access and egress to be established before any work begins. Suitable fall arrest system to be provided.	3 3 3	1 1 1	3 3 3
Gust wind speed exceeding 40m/s.		BAM Contractors Others	3 3 3	3 3 3	9 9 9	Wind speed monitoring should be undertaken during the structural weakening and all subsequent operations undertaken within the drop zone, leading to the blowdown. All operations to be stopped and the premises vacated immediately should the limit be exceeded.	3 3 3	1 1 1	3 3 3
Snow Loading during pre-weakening.	The duct support structures have not been assessed for snow loading	BAM Contractors Others	3 3 3	3 3 3	9 9 9	Work should be stopped should snow fall exceeding 100mm (though not anticipated during spring) occur after pre-weakening commences. Any exceedance of the snow fall limit should be communicated to the Designer to facilitate further assessments before work proceeds.	3 3 3	1 1 1	3 3 3
Unexpected duct expansion joints on the vertical section of the duct within the concrete support structure.	The duct is supported at the top of the concrete structure and the risk arises when the bottom section of the duct is being removed.	BAM Contractors Others	3 3 3	3 3 3	9 9 9	The presence or otherwise of expansion joints should be verified on the concrete structure vertical duct between ground level and the top. The section of the duct between the ground level and the topmost expansion joint found should be removed as part of the enabling works.	3 3 3	1 1 1	3 3 3

Severity			**Likelihood**		
1 – Minor accident (First Aid)	2 – Major accident (RIDDOR)	3 – Fatality	**1** - Low	**2** – Medium	**3** – High

Risk Rating & Control & Monitoring Protocols

1-2: Work may proceed in accordance with Brown and Masons policy and procedures	3-4: Work may proceed providing stringent control measures have been implemented (e.g. permit to work, monitoring, etc.)	**6-9:** The work cannot commence until alternative method of work or additional control measures implemented

Appendix 2

Design Drawings – C2002/D001/DWG000 - 007.

Deze pagina's zijn reeds openbaar of niet openbaar. Voor de reden verwijzen wij u naar het woo-besluit en de inventarislijst.

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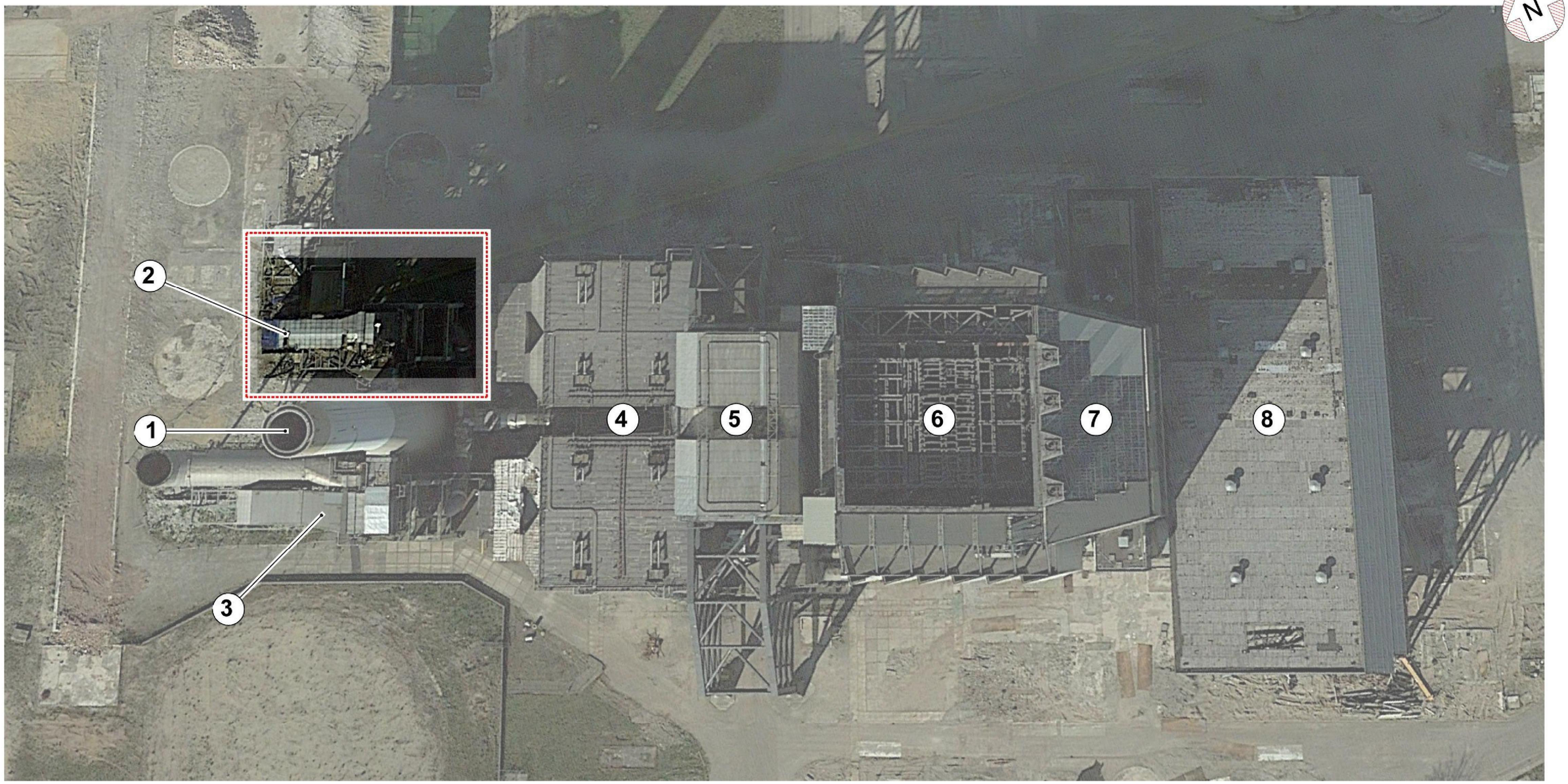

Site Key Plan	
1	Chimney
2	Northern FGD Duct Support
3	Southern FGD Duct Support
4	Precips
5	CG13 Denox
6	Boiler House
7	DA & Bunker Bay
8	Turbine Hall

Rev	Date	Description	By

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Site	Drawing Number		
Central Gelderland Power Plant Hollandiaweg 11, 6541 BL Nijmegen	C2002 / D001 / DWG001		
	Date	Scale	
Title	25-02-2021	N.T.S.	
Northern FGD Duct Support Site Key Plan	Designed / Drawn: 5.1.2e	Size: A3	Rev

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