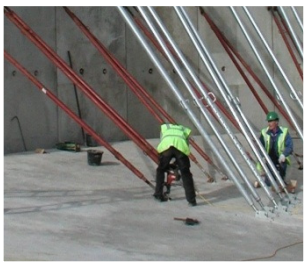
User Manual for AQUA - TANK









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User Manual

Project Ref. No.	430407
Project Title:	Biogas Plants - Nottingham
AQUA TANK type	N6000/41+2B/2 Digester 1,2
Tank Height	6030 mm
Client	Bio Dynamic UK Ltd.
Date	01.05.2017

Table of Contents

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Foreword

A Users' Manual provides details regarding technical features, design of the Aqua – Tank and requirements concerning exploitation of the structure.

Finally, this users manual containing general layout drawings of the built structure and Data Sheet of applied products.

1. Brief Description of the Structure

The Aqua-Tank wall consists of precast concrete panels made from reinforced concrete. The pre-cast concrete panels are installed as a polygon onto a cast-in-situ concrete base slab.

The precast concrete panels are provided with a number of PVC-ducts into which single strand tendons are threaded after erection of the panels. The strands are anchored in a special 'buttress' panel that forms part of the tank wall structure.

Specially profiled EPDM sealant strips are placed in the vertical panel joints in order to provide proper contact and a tight joint between the panels.

When the tensioning of the tendons is completed, a "ring beam seal" is cast from the outer side of the wall at the connection of the wall and the base-slab. As the base slab is provided with stirrups along the edge, and as the wall panels are positioned into a rebate (or have dowel bars protruding at the lower edge of their outer face), the seal will link the base-slab and the wall structurally and ensure the tightness of the wall/base joint.

2. Technical Specifications

The Aqua-Tank is constructed to comply with the main principles and intentions of "BS EN 1992 -1-1 Eurocode 2 "Design of concrete Structures and associated National Annexs".

2.1 Pre-cast concrete panels

The precast concrete panels are manufactured according to the "Aqua-Tank Quality Manual for Precast Concrete Panels" from materials with the following specification.

▪ **Concrete:**	For aggressive conditions classified as XC4, XF3, XA2 Concrete grade C35/45 (according to EN 206-1).
▪ **Reinforcement:**	Fabric: $f_{yk} \geq 500$ MPa (both mould-side and up-side). Bars: $f_{yk} \geq 500$ MPa (both mould-side and up-side). In addition, for vertically pre-stressed panels only: Bonded tendons: 0.5”, breaking load ≥ 164 kN.
▪ **Cover to reinforcement:**	Inside: min. 35 mm Outside: min. 35 mm
▪ **Surface Finish:**	**Internal (up-side):** Steel Float Finish (standard finish) **External (mould-side):** Fair Finish

Concrete should only be used in tanks for containing liquids with PH-values in a range from 6 to 8.

For liquid with a PH-range beyond 6-8 a suitable concrete surface protection coating should be used.

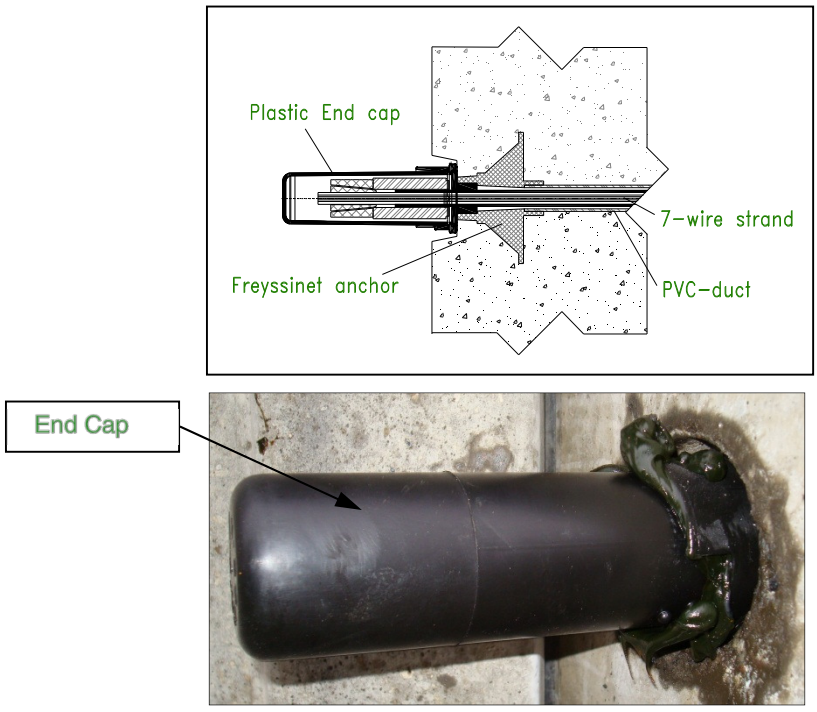
For this tank, please refer to Chapter 2.5.

2.2 Post-tensioning system

The post-tensioning system consists of un-bonded greased and plastic coated strands. The grease inhibits corrosion and prevents bond between the sheath and the strand. Each strand is individually anchored in an external anchorage house. The anchor is fully encapsulated against corrosion by post-injection of grease in to the external anchor house. The "easy-fix" end cap is grease filled, covering the strand end and the collet (see fig.1)

▪ **Un-bonded Strands:**	Conforms with BS 5896 15.3 mm/0.6" Standard Breaking Load ≥ 248 kN
▪ **Anchorage:**	Freyssinet anchors

***Figure 1**. External Anchoring House*



2.3 EPDM-sealing Strips

The vertical joint between the panels consist of a special EPDM Profile.

The Material conforms to EN681 – Elastomeric Seals – Materials requirements for pipe and joint seals used in water and drainage applications.

▪ **Hardness /shore:**	60
▪ **Profile width:**	80 mm
▪ **Profile thickness, uncompressed:**	14 mm
▪ **Profile thickness, compressed:**	~ 6 mm

2.4 HDPE lining

To provide the protection of concrete surface of Aqua-Tank walls from chemical and mechanical damage, precast panels (1 m from the tank top) are fabricated with cast in HDPE lining.
After Aqua tank installation, all joints of HDPE lining are extrude welded in order seal the joints in concrete panel and roof units.
For Product Specifications and Data Sheet of used product please refer to Appendix 2.

3. Basis of Design for the Aqua-Tank

The following information is the design basis for the Aqua-Tank.

3.1 Foundations

The design and construction of the foundations for the Aqua-Tanks must be capable of sustaining the loads imposed without excessive or differential settlement. It is assumed that the base slab will be constructed to within 10 mm of theoretical datum at its highest point under the Aqua-Tank panels and within +/- 20 mm in level.

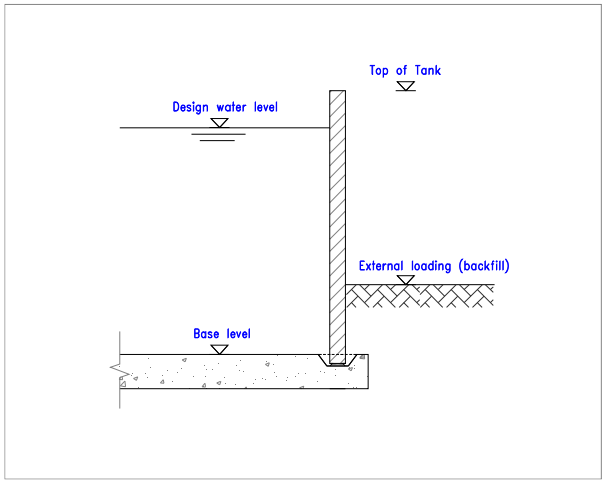
3.2 Design Loadings on the Wall Structure

During the design stage, the following parameter are used:

Liquid containing structures (see Fig.2):

▪ **Base level:**	0.000 m (Set by A-Consult)
▪ **Top of Tank:**	6.030 m
▪ **Operational internal loadings:**	SLS: Hydrostatic pressure (10.3 kN/ m³) to 5.7 m
▪ **Operational external loadings:**	3.0 m
▪ **Surcharge loadings:**	5 kN/m²

Figure 2. *Design levels scheme*



4. Backfilling of the Aqua-Tank Structure

The following operations are the standard recommendations **for tanks backfilling around only.** The recommendations are to be followed unless otherwise agreed in writing with A-Consult.

- Backfilling is not to be initiated before the installation of the Aqua-Tank is completed and the ring beam seal is properly cured.
- Backfilling should not be allowed if there is water in the excavation (external pressure on the base).
- The backfill material shall be free draining material (i.e. clay can not be used) with Dmax < 50 mm.
- The backfill must be placed in layers of 250-350 mm thick. Each layer is to be compacted before placing the next layer.
- The maximum variation of finished level of backfill is 1 metre. Any variations must be in the form of a gradual slope between levels - steps are not permitted.

5. Water Testing of the Aqua-Tank Structure

When a water test is carried out to test for liquid tightness of an Aqua-Tank the following procedure must be followed:

- Ensure that the ring beam seal has been cast minimum 7 days before test is started.
- (Water could be filled into the tank to a level of maximum ½ m above the base level 24 hours after the ring beam has been cast).
- Guidelines according to section nine in BS8007 stipulates a filling rate of not greater than 2 m in 24 hours, however subject to an assessment of the risk for settlement in the foundation for the structure, the initially filling rate could be increased.
- When first filled, the liquid level should be maintained by the addition of further liquid for a stabilising period while swelling of sealant materials, absorption and autogenous healing take place.
- After the stabilising period a 7 day test according to BS8007 is carried out.
- Satisfactory completion of the water test is based on the interpretation of the term”seepage” as being evidence of passing water only. The existence of damp marks on the surface of the concrete shall not be construed as”seepage”.

- Should the Aqua-Tank Structure not satisfy the 7 days test, then A-Consult should be contacted to carry out suitable remedial work. A-Consult to advise of curing time for any sealants or other materials used, the structure can then be refilled to the maximum level within 24 hour period from this time.

6. Periodical Inspections

To ensure a lifetime as long as possible and to prevent leaking, the tank should be inspected regularly with respect to integrity.

It is recommended that the Aqua-Tank is inspected each time the tank is emptied to check for the early signs of any damage. At least every 5 years in conjunction with emptying, the tank should be cleaned inside with high-pressure water cleaner. At the same time the following should be done.

- The surface of the tank wall – both inside and outside above ground – is inspected.
- Internal construction joint between the base and the wall is inspected.
- The plastic caps of above ground tendons in the buttress panels are removed to check that the protective corrosion grease around the anchors is intact.
- The HDPE lining welded joints should be inspected to check for sign of any damage/cracking.

If any damage during the inspection is found or suspicions arise during these inspections then A-Consult should be contacted immediately.

Regular inspection and restoration, if necessary, reduces the risk of comprehensive and expensive repair and eventual future damage.

The tank is never to be emptied below any external ground water level unless the tank has been explicitly designed for this load-case.

To discuss an inspections and maintenance service contract please contact A-Consult on 01777 249444.

7. Accidental Damage

If the Aqua-Tank is exposed to unintended influences such as collisions, fire or similar that might affect the structural integrity of the structure, A-Consult must be contacted to survey of the consequences.

8. Mechanical Equipment and Penetrations in the Tank Wall

The installation of any mixers, pumps or similar equipment onto the tank walls which were not advised during the structures initial design period *should not be undertaken without prior consultation with A-Consult.*

The Post drilling of precast panels for pipe connections or bolt fixings is permitted, however this work must be carried out with special attention being paid to the location of the post tensioning tendons within the structure, ensuring that the outer diameter of any hole/aperture is no less 75mm away from the outer diameter of any post tensioning tendons.

Consideration should also be given to location of fixing bolts when locating any drilling machine onto the precast panels. The same 75mm rule should be applied to any fixing bolts on the core drilling machine.

9. Precautions during winter

If the base slab is at least 300mm thick, done with a fairly good concrete quality, C35 and above, the risk of damage due to permafrost is insignificant.

If this is not the case and if the ground conditions, ground water level etc. are unknown, other precautions must be made to avoid damaging the concrete and the structure.

During periods of persistent frost, the Aqua-tank must not being emptied completely, especially not if the above mentioned conditions are unknown. In this case it is advisable to make sure that at least 0.5m water/liquid remains in the tank. If this is not possible, the concrete base must be protected against frost, for instance by covering it up with insulation material.

10. Decommissioning of the Aqua-Tank

10.1 Introduction

This method statement covers the decommissioning of a typical AQUA-TANK structure and forms the basis of a site specific Method Statement to be used by a competent demolition contractor.

10.2 References

All demolition work shall comply with the following:

BS5228 Noise control on construction and open sites.
BS6187 Code of Practice for demolition
GS29 Health & Safety in Demolition Work (Produced by HSE)
CDM The Construction (Design & Management) Regulations.

10.3 Documentation

The demolition contractor shall prepare the following documentation:

i. Detailed (Site Specific) Method Statement.
ii. Drawings of temporary works (for example, protective measures).
iii. Survey of any existing services.

10.4 Preliminary Procedures

i. A detailed examination (or survey) should be carried out of the demolition area. Sketches and photograph retained as necessary.

ii. Ensure all services affected by the demolition are removed, diverted and rendered completely safe at the outset.

10.5 Precautionary Measures

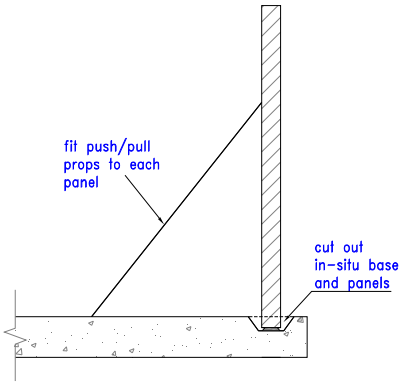
i. Prior to commencement ensure all relevant documentation is copied/submitted to all appropriate persons.

ii. Take measures to protect existing works from the demolition process (care of existing works).

iii. Materials arising from the demolition shall be recovered and recycled where possible; otherwise, it shall be removed from site and disposed of with an appropriate Waste Management Licence. The demolition contractor shall comply with legislation governing the state and the location of proposed tipping areas if carting way is to be sub-let.

10.6 Methodology

i. The tank is to be empty, cleaned and excavated where necessary before commencing work.
ii. Remove any mechanical equipment, channels, platforms, pipes etc.
iii. If coping beams exists, they should be disc cut at each panel joint.
iv. Push/pull props shall be installed between each panel and the tank floor (step 2).
v. Break or cut out in-situ concrete at base of precast wall units (step 3).



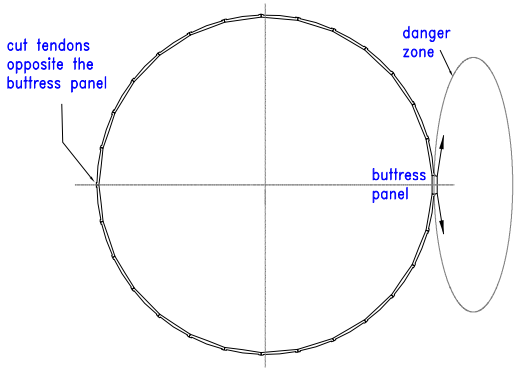
STEP 2,3

vi. As the tendons are cut, the sudden release in tension can lead to ejection of the cut strand at high velocity. Expect, that the tendon will eject up to 5 metre measured from the anchor point when stress is released. The area identified below, under step 4, shall therefore be emptied and cordoned off to prevent unauthorised access.

vii. Note that there is a small risk that the tendons are ejected beyond the danger zone identified below. To minimize the risk of damage to persons or property beyond the danger zone identified, it is a requirement that heavy rubber mats and/or energy absorbent screens are erected close to the buttress. The actual measures taken are the subject of a risk assessment by the demolition contractor to determine the final details of the protective measures, taking account of the site conditions prevailing at the time.

viii. Should a safety screen be considered to be necessary, such barrier can made from a 150 mm wide x 8 mm thick steel plate mounted over the cast in anchors on both sides of the buttress panel. Fix the plate centrally over the anchors, using M16/150 mm anchor bolts at 500 mm spacing to hold the plate in position.

ix. The tendons shall be cut opposite to the buttress panel (if the tank has more than one buttress panel, the tendons shall be cut between the buttresses), using a steel blade in a disc cutter. All cutting equipment and methods used shall be fully HSE compliant (Step 4).

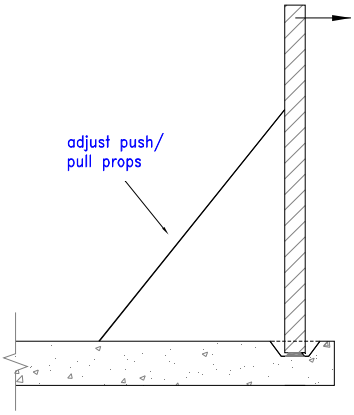


STEP 4

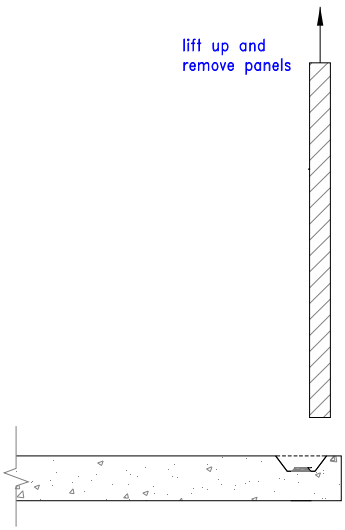
x. Adjust the push/pull props, so the top of each panel is moved out externally. The panels can then be removed by crane (step 5). Make sure, that no personnel is outside the tank wall, when the props are being adjusted outwards, as the panel in case of a failure in the anchor bolts is likely to fall out from the tank perimeter.

xi. Where possible, use the existing lifting inserts or drill holes though the panels and use pins for lifting. Make sure, that the lifting system used is fully designed to safely lift the weight of the precast panels (0.8 tonnes per metre length for 2.11 metre wide panels).

xii. The panels can be loaded onto lorries for re-erection, disposal or breaking up (step 6).



STEP 5



STEP 6

This Aqua-Tank User Manual is prepared:

Date: _____01.05.2017_____

By: (print name)

_____Svetlana Volchek_____Title_____design engineer_____

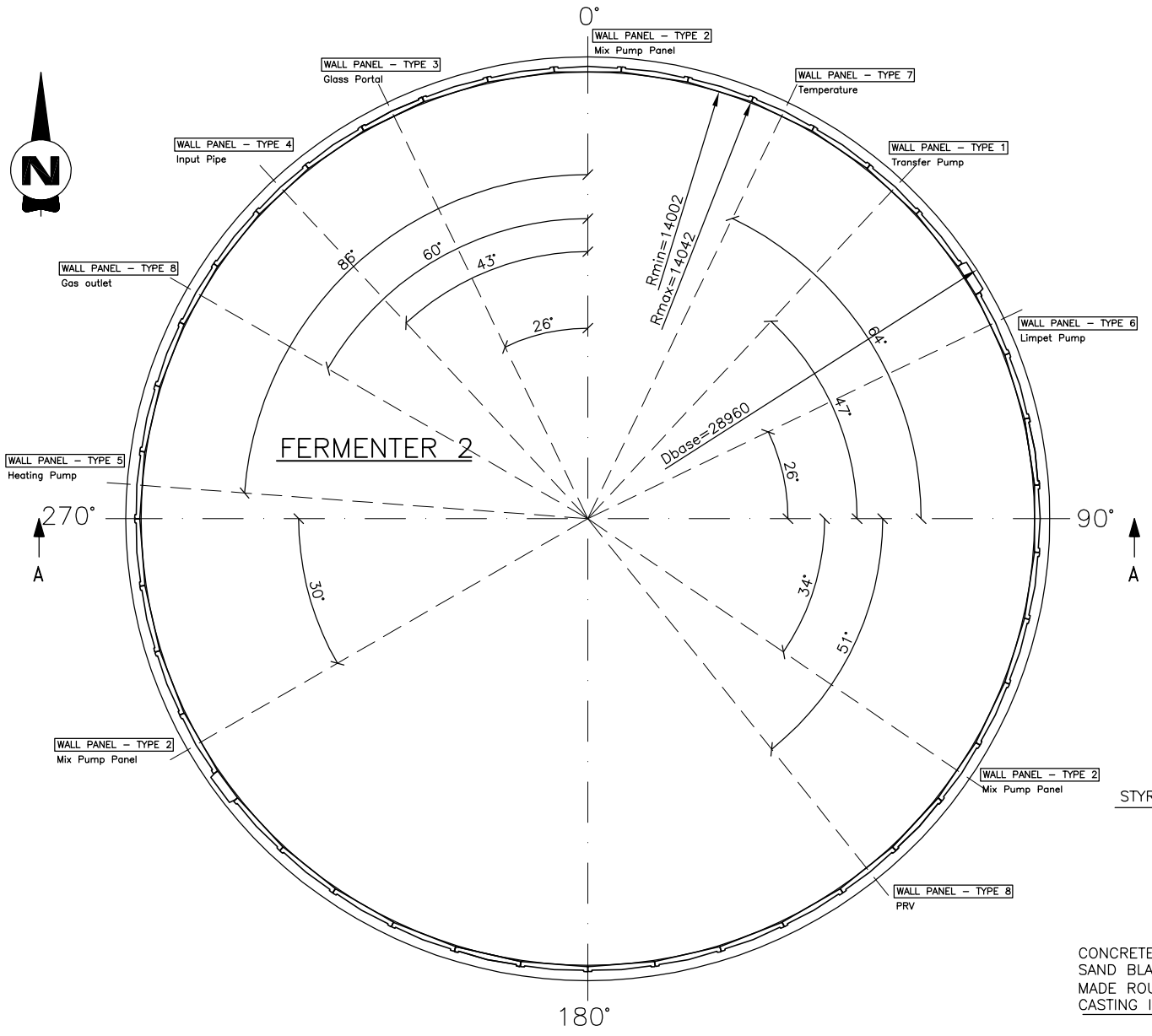
Signature:

_____SV_____

Appendix 1: General layout drawings

List of drawings:

DRAWING NO.	ITEM	ISSUE	DRAWING DATE
AQ430407-60-1011-2	General Layout Fermenter 2, Wall/base DETAILS	C	30.10.2013
AQ430407-60-1001-2	General Layout Primary Digester 1, Wall/base DETAILS	C	30.10.2013
AQ430407-60-1101-2	General Layout Wall Panel – STANDARD	C	16.01.2014
AQ430407-60-1102-2	General Layout Wall Panel – TYPE 1	E	16.01.2014
AQ430407-60-1103-2	General Layout Wall Panel – TYPE 2	C	16.01.2014
AQ430407-60-1104-2	Template details Wall Panel – TYPE 3	C	16.01.2014
AQ430407-60-1105-2	General Layout Wall Panel – TYPE 4	D	16.01.2014
AQ430407-60-1106-2	General Layout Wall Panel – TYPE 5	C	16.01.2014
AQ430407-60-1107-2	Template details Wall Panel – TYPE 6	C	16.01.2014
AQ430407-60-1108-2	General Layout Wall Panel – TYPE 7	D	16.01.2014
AQ430407-60-1109-2	General Layout Wall Panel – TYPE 8	D	16.01.2014
AQ430407-60-4101-2	General Layout BUTTRESS PANEL	C	29.01.2014



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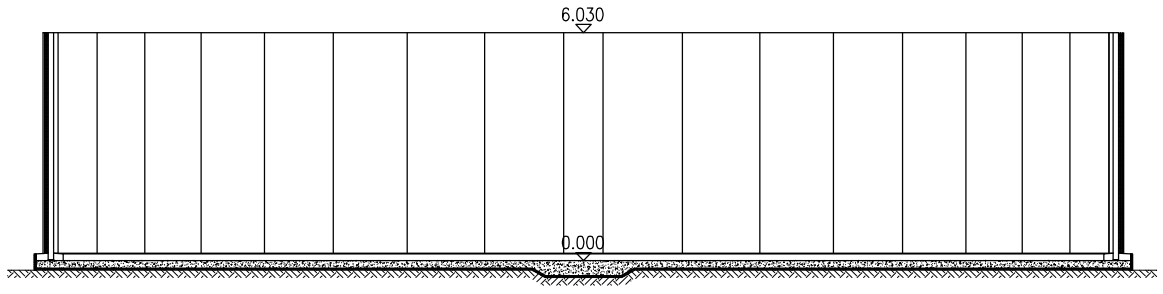

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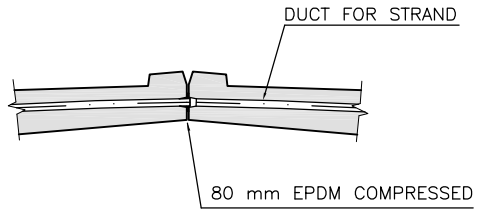
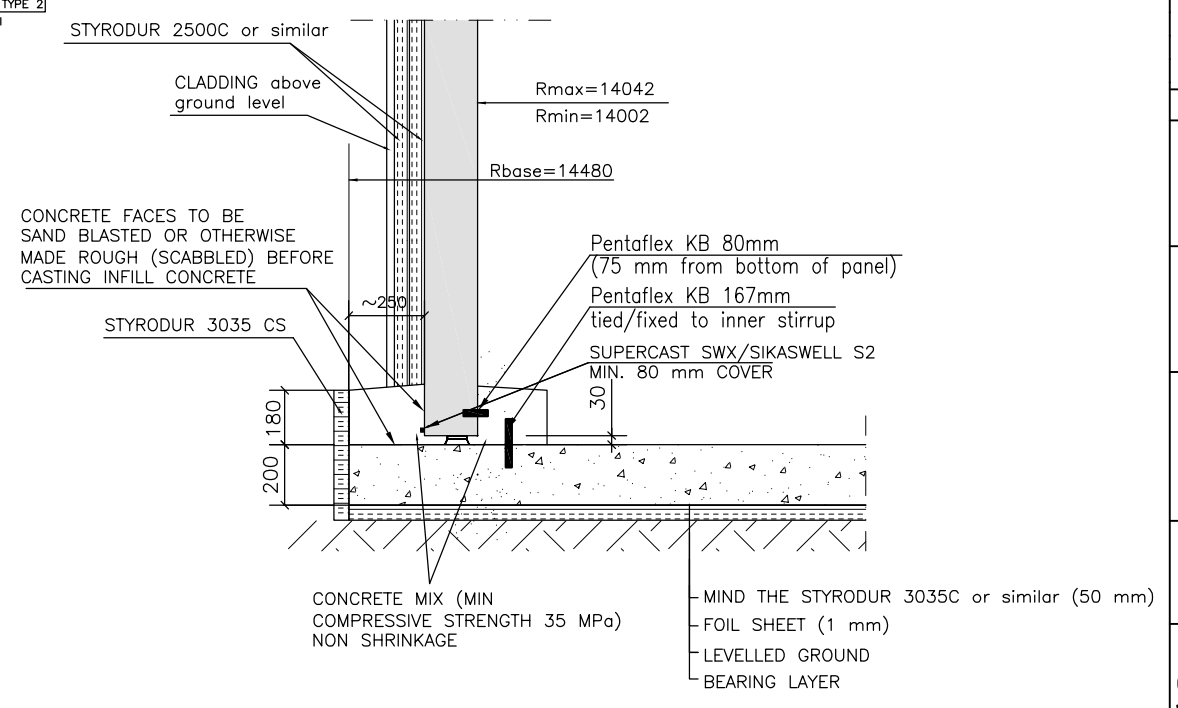


JOINT BETWEEN WALL PANELS
HORIZONTAL SECTION 1:25



JOINT BETWEEN WALL AND BASE
CONCRETE LAYOUT

NOTES:

1) ALL DIMENSIONS IN MILLIMETRES. NO DIMENSION IS TO BE SCALED FROM THE DRAWING.
2) CONCRETE: WALL/BASE JOINT C28/35(C35A)
3) CONCRETE: WALL PANELS: C35/45
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DRAWING STATUS
AS BUILT

ISSUE	DESCRIPTION	DATE	INIT.
C	TYPE 8, STATUS	29.01.2014	SV
B	WALL PANEL LOCATION	21.01.2014	SV
A	FIRST ISSUE	30.10.2013	SV

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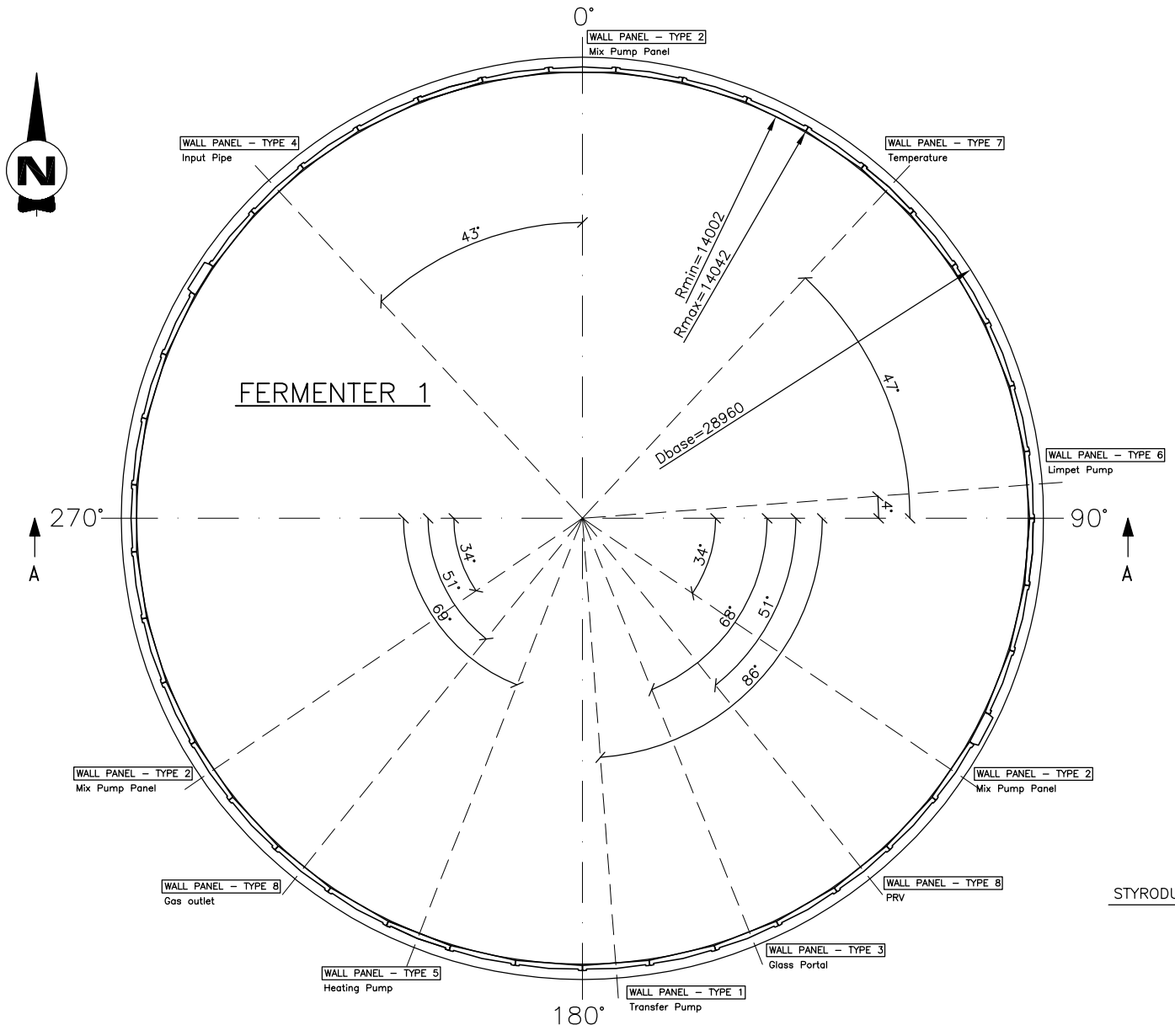

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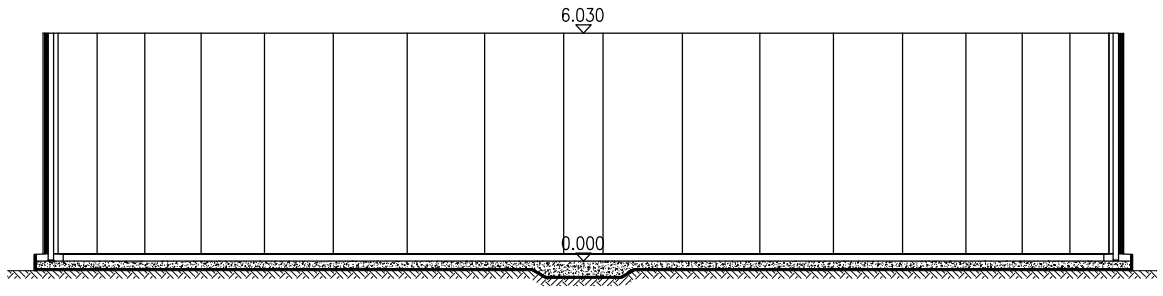

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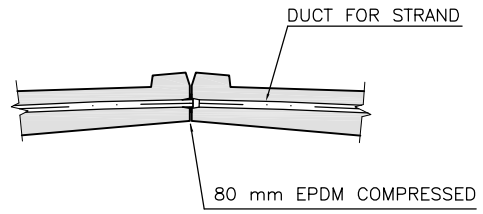

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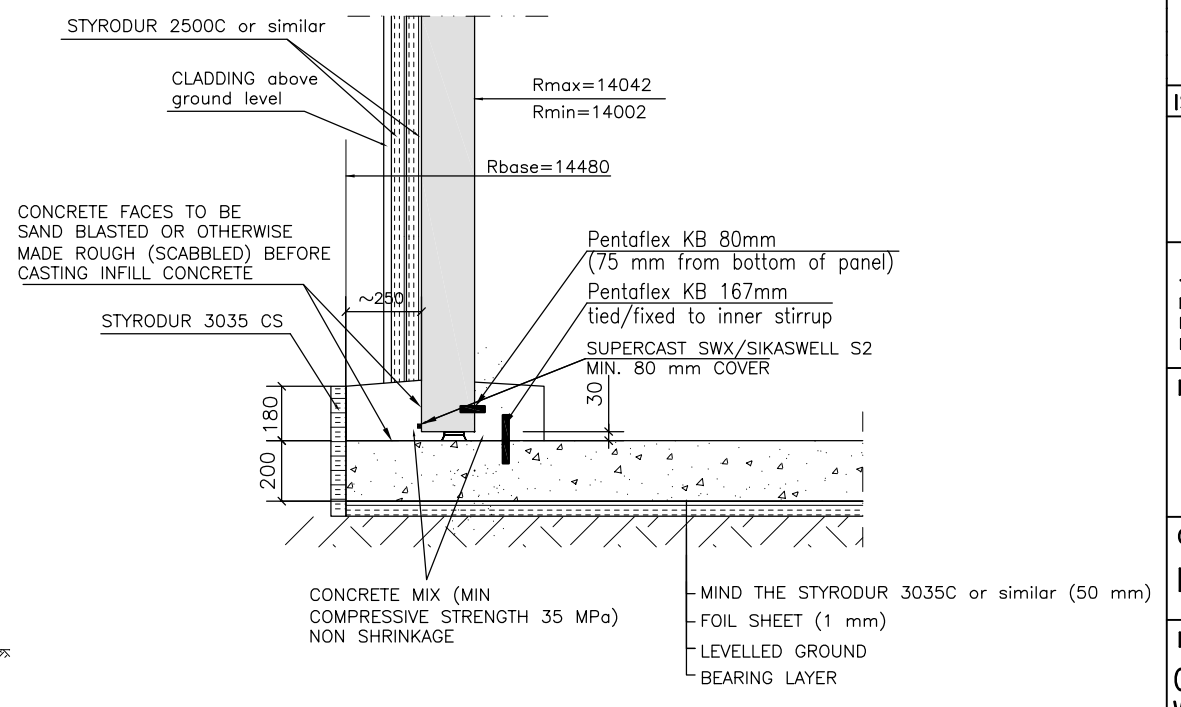

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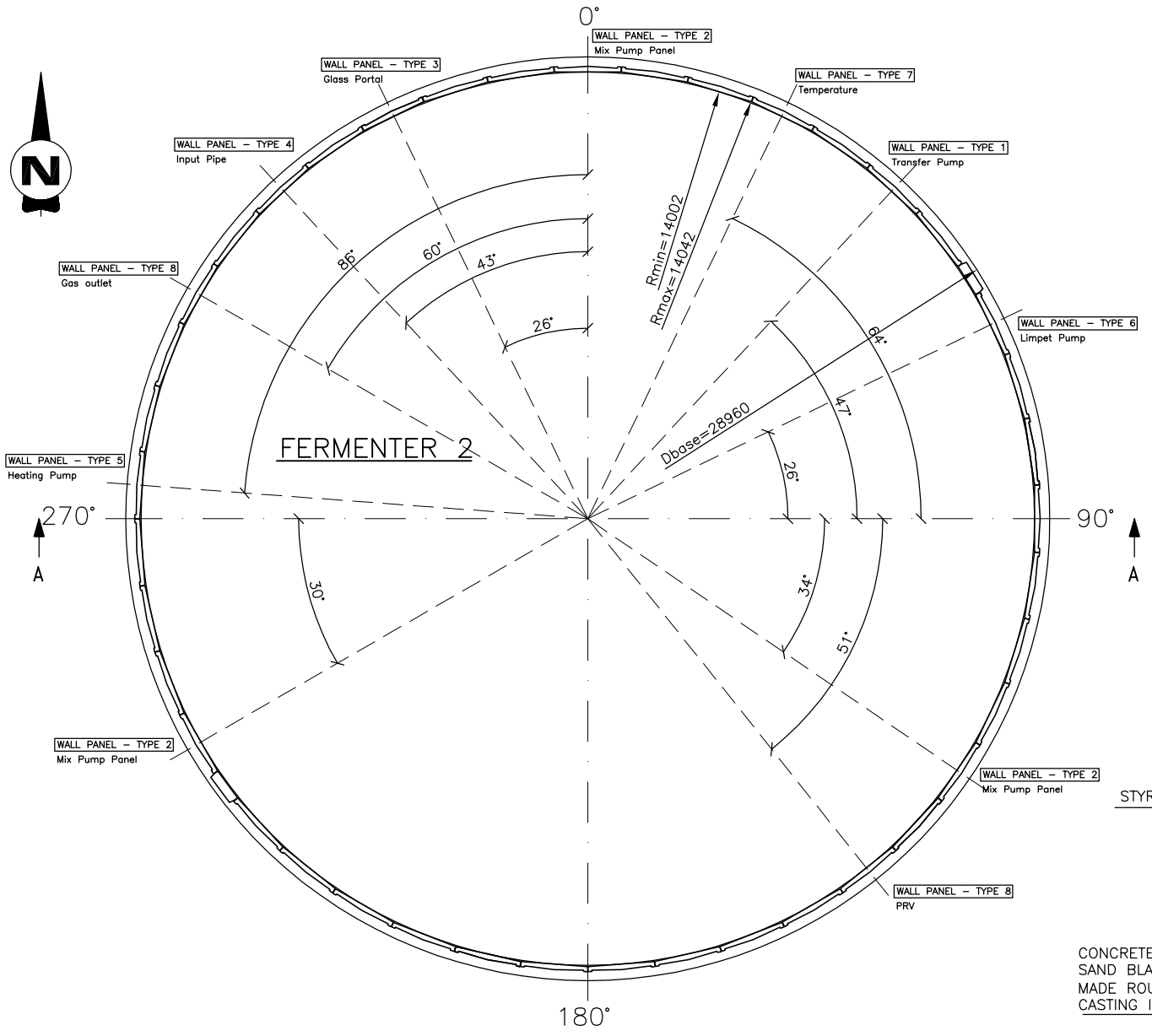

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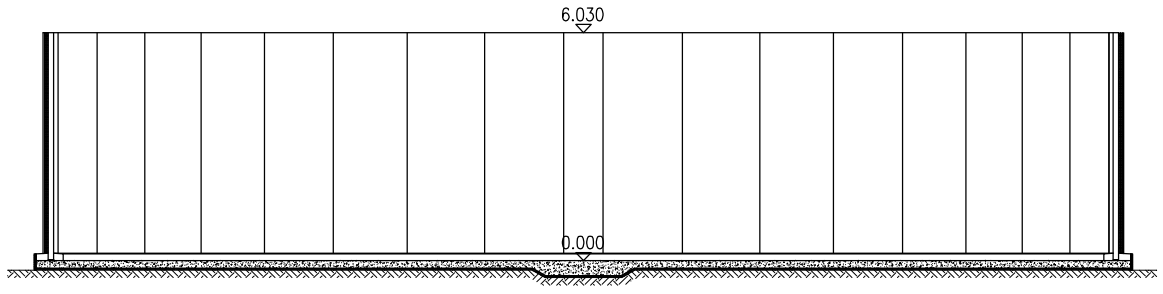

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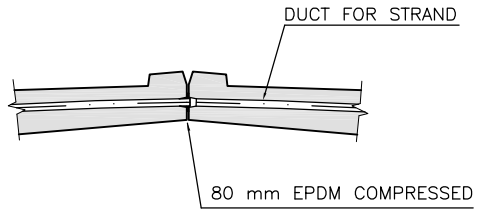

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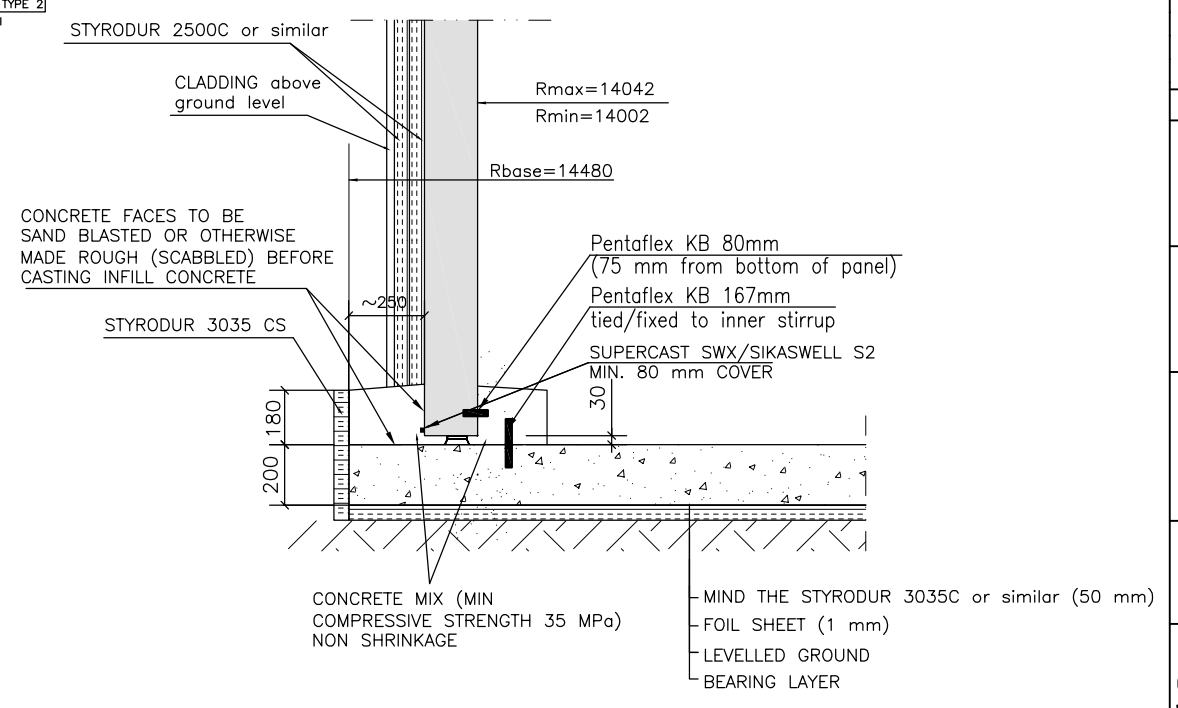

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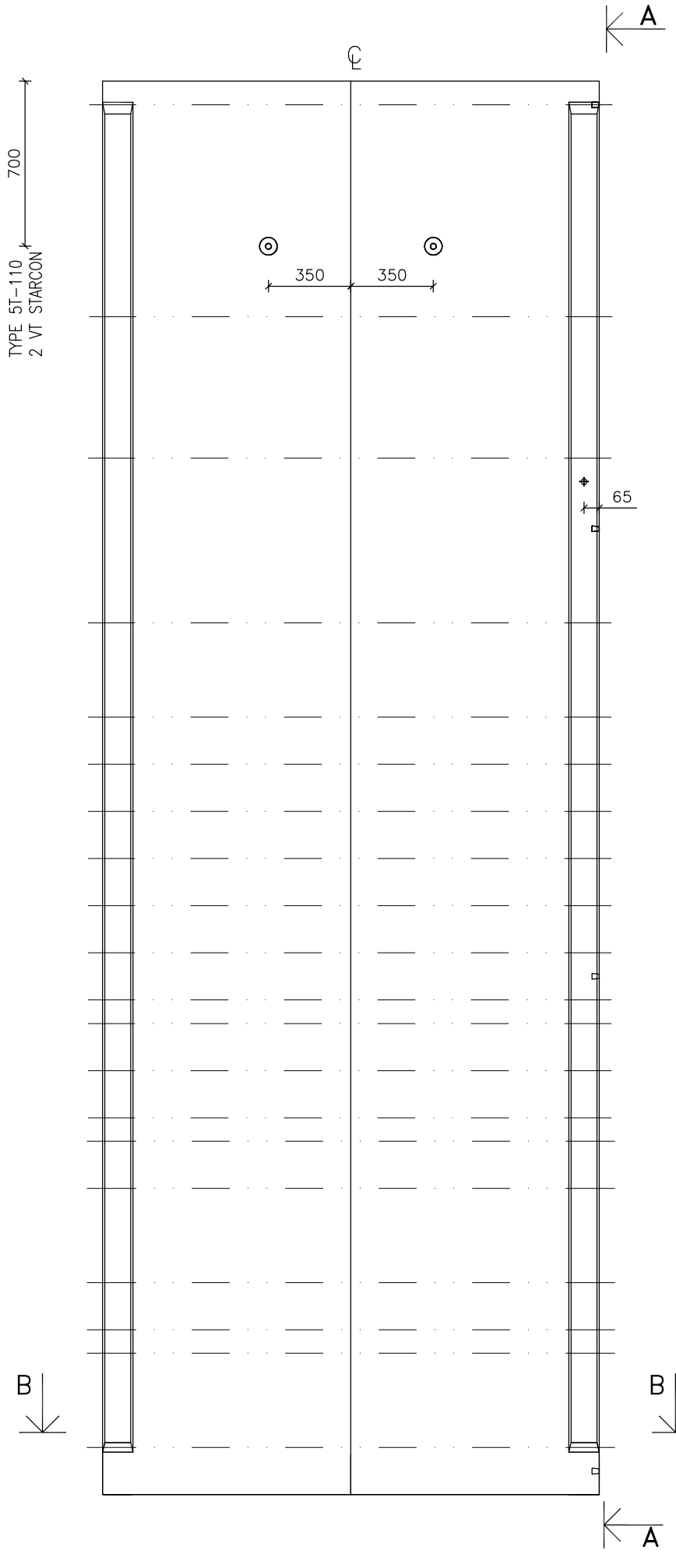
PROJECT
Biogas Plant – Nottingham
Primary Digester 2

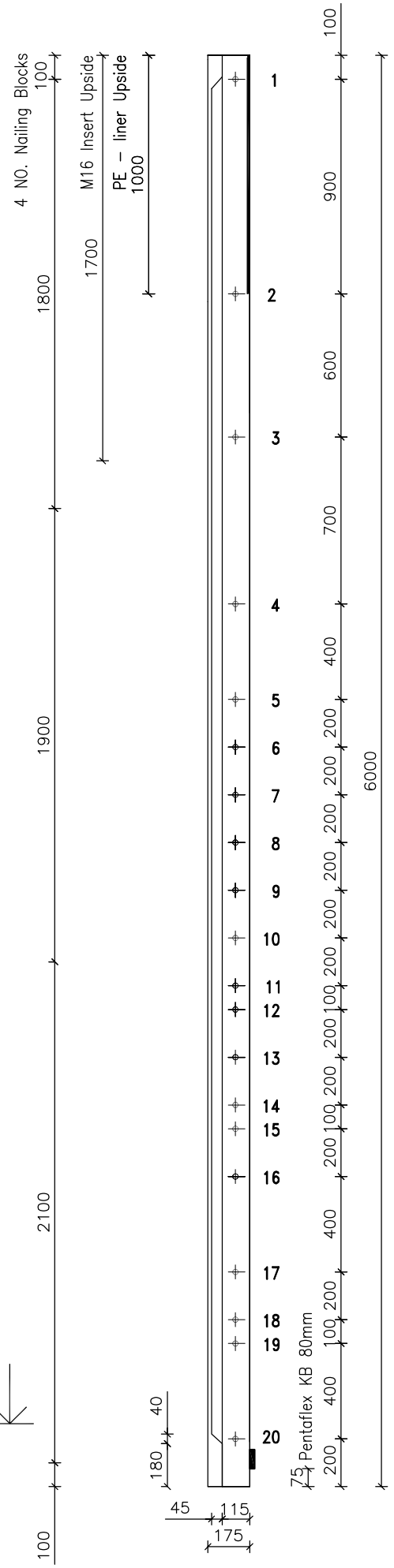
CLIENT
Bio Dynamic UK Ltd.

DRAWING DESCRIPTION
GENERAL LAYOUT
WALL PANEL LOCATION
TYPE N6000/41+2B/2

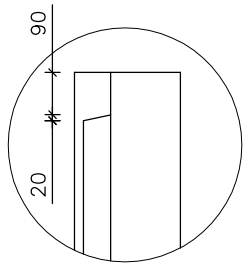
DRAWN:	CHECKED:	SCALE (A3):
SV	SØ	1:200
REF. NO.:	DATE:	STATUS:
430407	30.10.2013	01
DRAWING NO.:		ISSUE:
AQ430407–60–1011–2		C

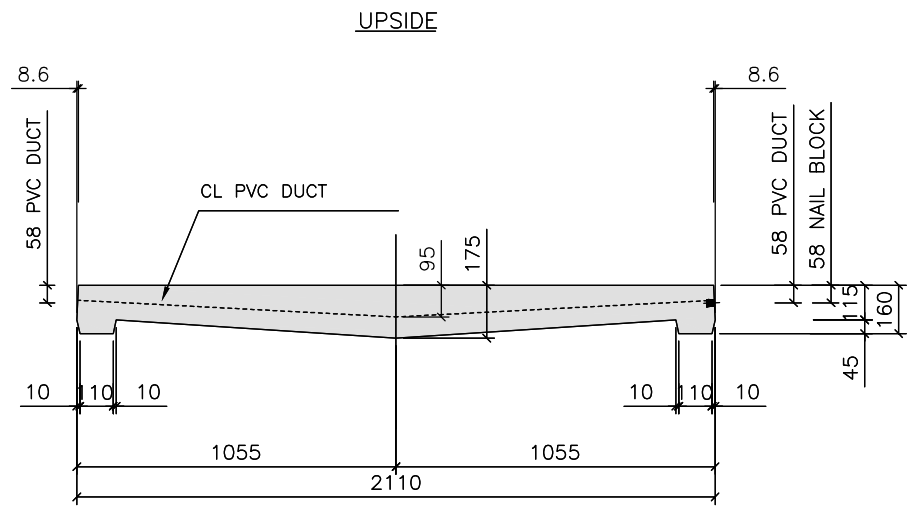


ELEVATION (FORMSIDE) 1:25



SECTION A-A





SECTION B-B 1:25

NOTES:

1) ALL DIMENSIONS IN MILLIMETRES. NO DIMENSION IS TO BE SCALED FROM THE DRAWING.
2) DUCTS: Ø23/25 mm PVC-TUBES
3) STRANDS: 15.3 mm STANDARD PE-SHEATED & GREASE-IMPREGNATED TENDON (BS5896/3).
4) SURFACE FINISH: FORMSIDE: FAIR; UPSIDE: STEEL FLOATED
5) CONCRETE: WALL PANEL: C35/45
6) EXPOSURE CLASS: XC4, XF3, XA2
7) PLEASE ALLOW min.75 mm DISTANCE FROM POST BORE-HOLE TO CENTER LINE OF TENDON.

PANEL TYPE	WEIGHT APPROX. [KG]
WALL PANEL - STANDARD	4508
BUTTRESS PANEL	4412

DRAWING STATUS
AS BUILT

ISSUE	DESCRIPTION	DATE	INIT.
C	1 m PE linier, tendon location	04.02.2014	SV
B	STATUS	29.01.2014	SV
A	FIRST ISSUE	16.01.2014	SV

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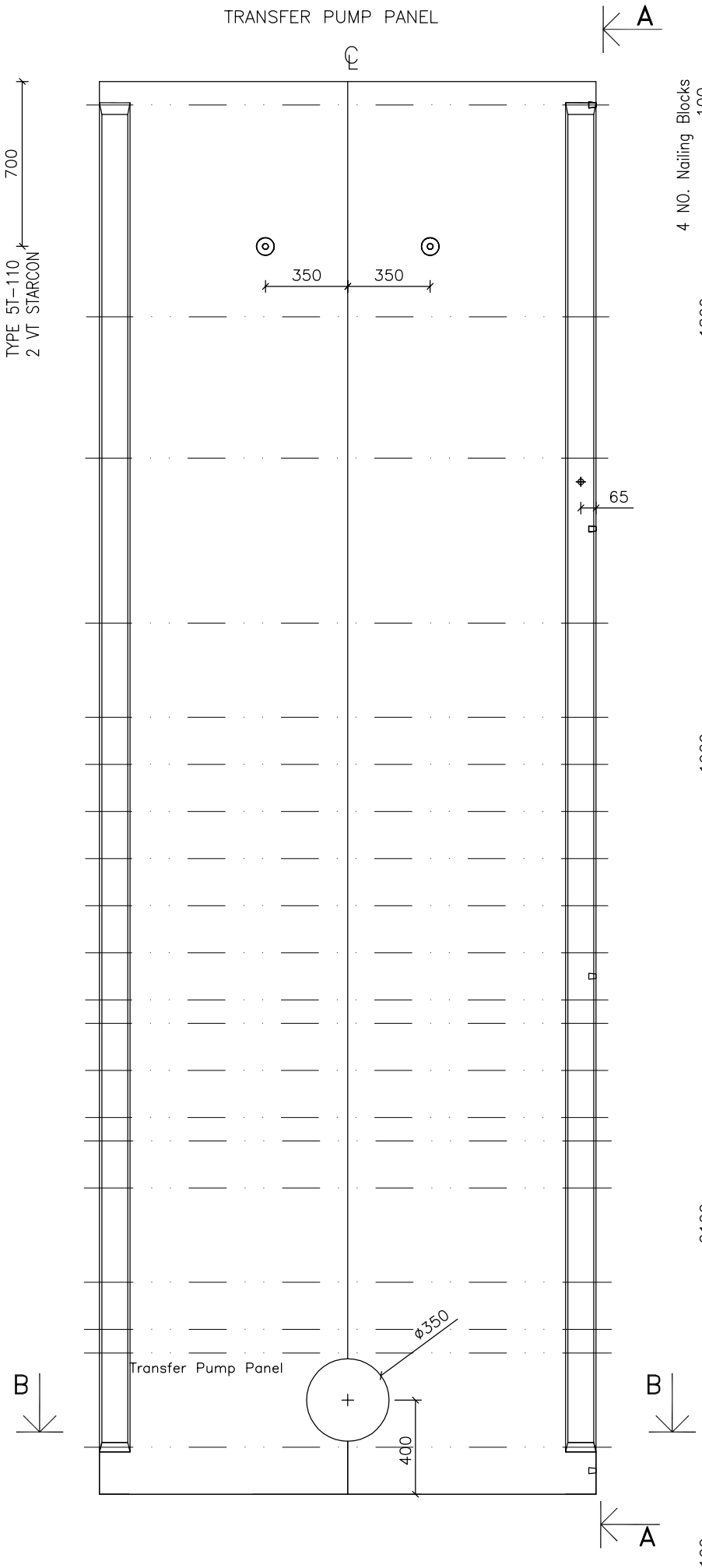
PROJECT
Biogas Plants - Nottingham

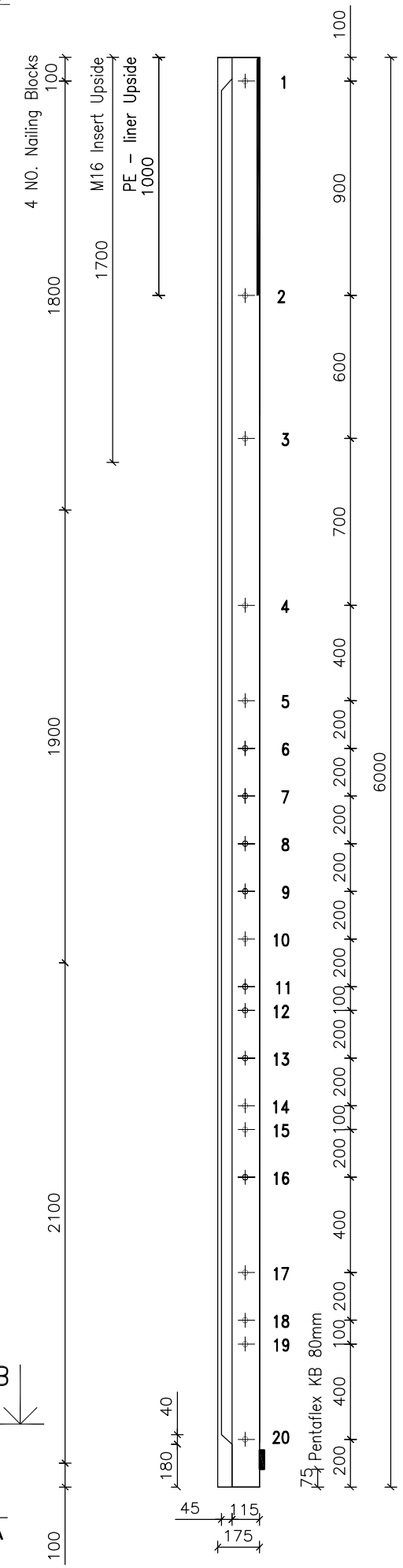
CLIENT
Bio Dynamic UK Ltd.

DRAWING DESCRIPTION
CONCRETE LAYOUT
WALL PANEL - STANDARD
TYPE N6000/41+2B/2

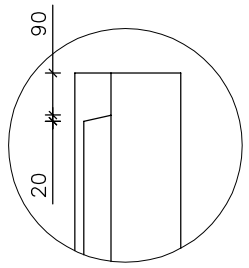
DRAWN:	CHECKED:	SCALE (A3):
SV	SØ	1:25
REF. NO.:	DATE:	STATUS:
430407	16.01.2014	01
DRAWING NO.:		ISSUE:
AQ430407-60-1101-2		C

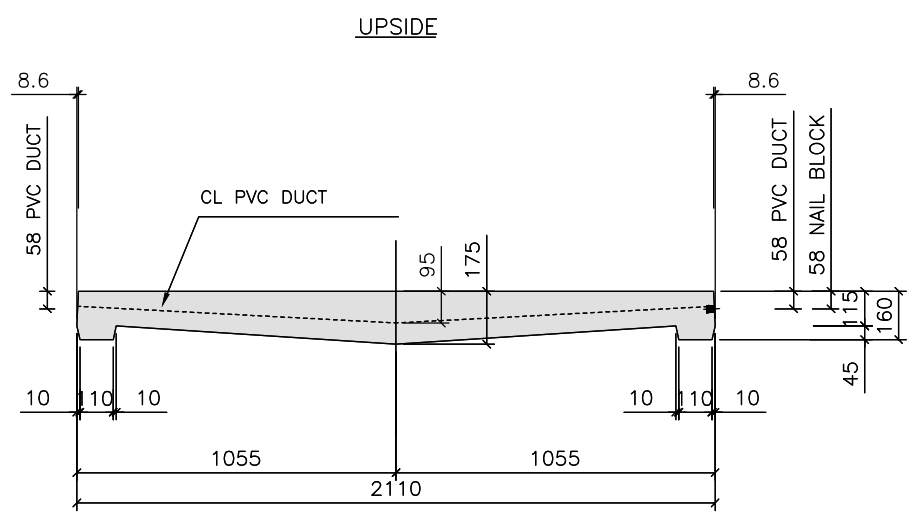


ELEVATION (FORMSIDE) 1:25



SECTION A-A





SECTION B-B 1:25

NOTES:

1) ALL DIMENSIONS IN MILLIMETRES. NO DIMENSION IS TO BE SCALED FROM THE DRAWING.
2) DUCTS: Ø23/25 mm PVC-TUBES
3) STRANDS: 15.3 mm STANDARD PE-SHEATED & GREASE-IMPREGNATED TENDON (BS5896/3).
4) SURFACE FINISH: FORMSIDE: FAIR; UPSIDE: STEEL FLOATED
5) CONCRETE: WALL PANEL: C35/45
6) EXPOSURE CLASS: XC4, XF3, XA2
7) PLEASE ALLOW min.75 mm DISTANCE FROM POST BORE-HOLE TO CENTER LINE OF TENDON.

PANEL TYPE	WEIGHT APPROX. [KG]
WALL PANEL - STANDARD	4508
BUTTRESS PANEL	4412

DRAWING STATUS
AS BUILT

ISSUE	DESCRIPTION	DATE	INIT.
C	1 m PE linier, tendon location	04.02.2014	SV
B	STATUS	29.01.2014	SV
A	FIRST ISSUE	16.01.2014	SV

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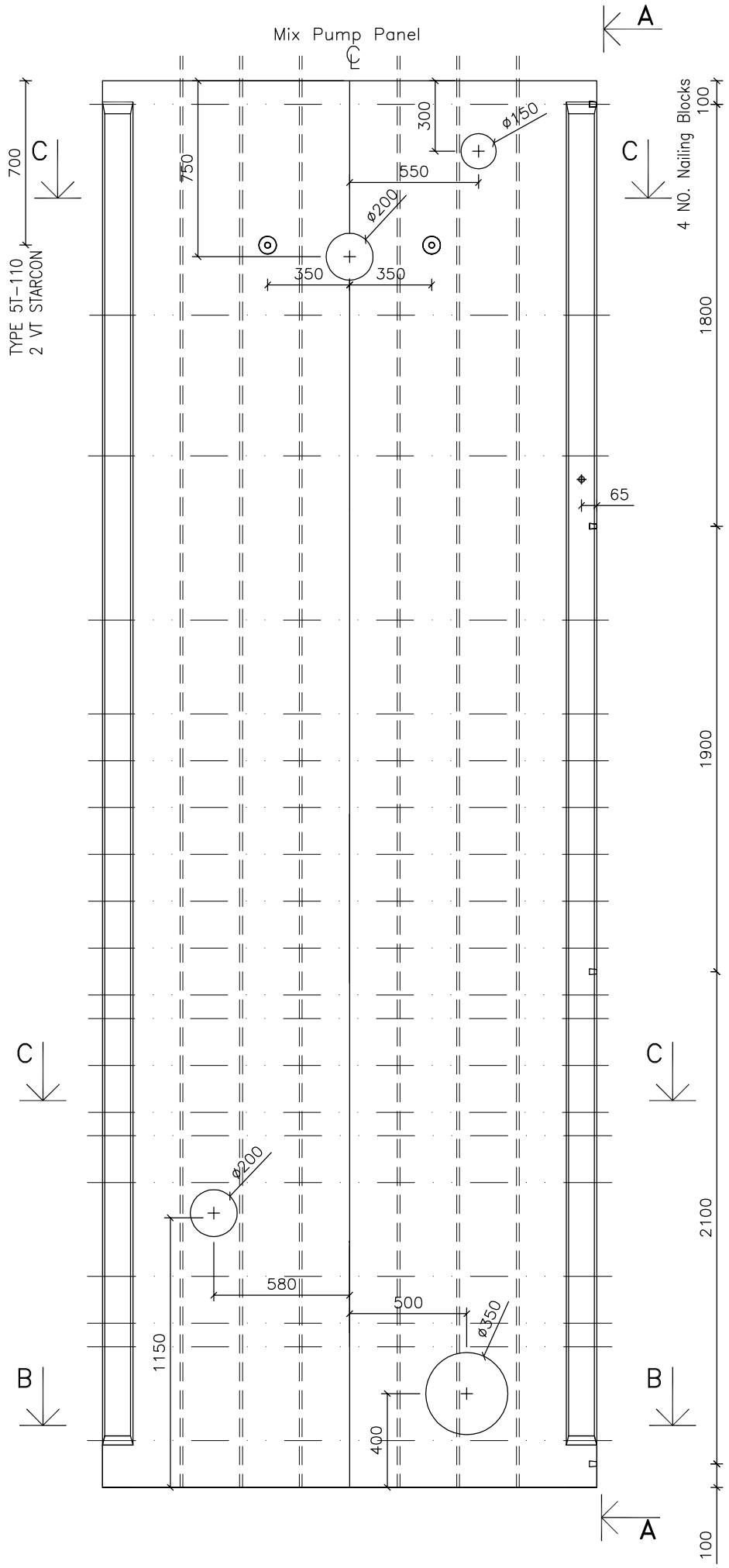
PROJECT
Biogas Plants - Nottingham

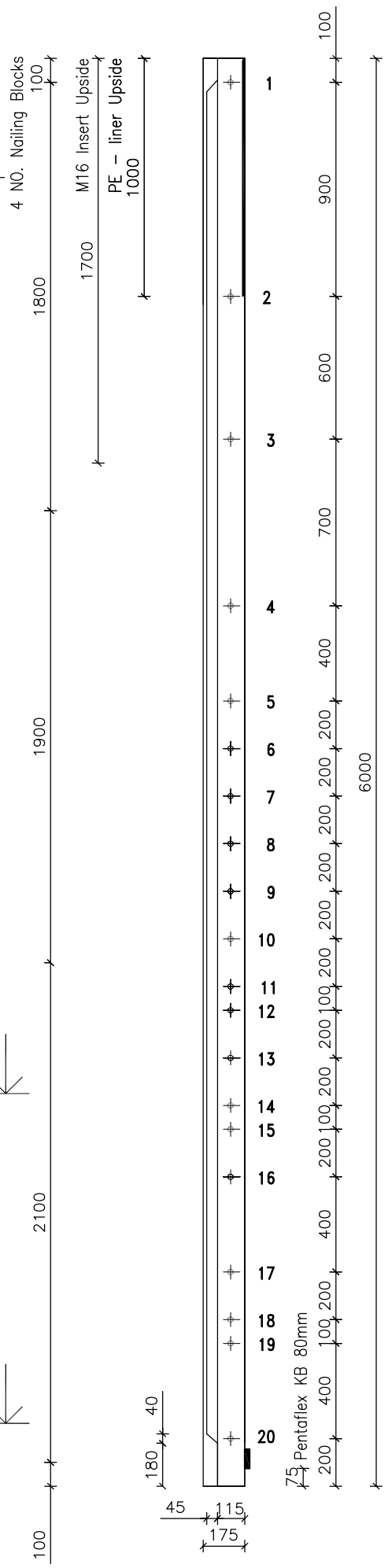
CLIENT
Bio Dynamic UK Ltd.

DRAWING DESCRIPTION
CONCRETE LAYOUT
WALL PANEL - TYPE 1
TYPE N6000/41+2B/2

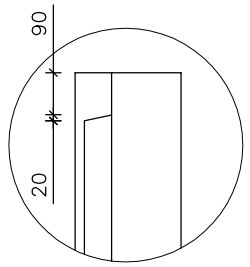
DRAWN:	CHECKED:	SCALE (A3):
SV	SØ	1:25
REF. NO.:	DATE:	STATUS:
430407	16.01.2014	01
DRAWING NO.:		ISSUE:
AQ430407-60-1102-2		C

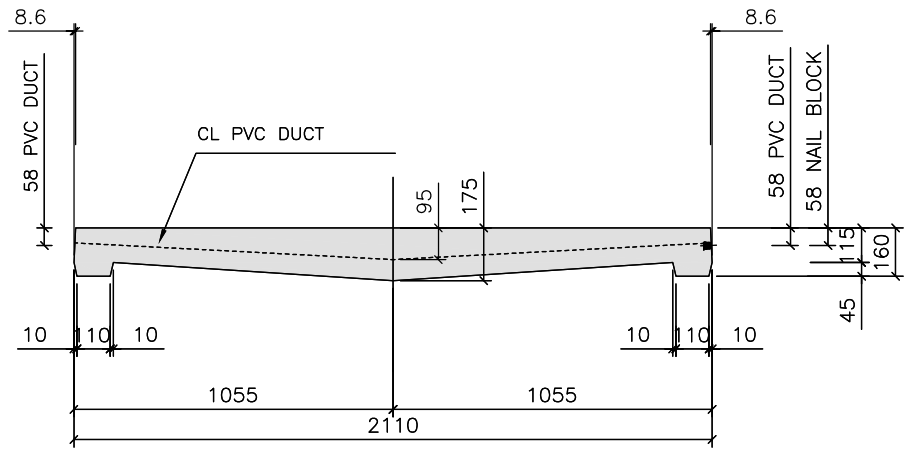


ELEVATION (FORMSIDE) 1:25



SECTION A-A





SECTION B-B 1:25

NOTES:

1) ALL DIMENSIONS IN MILLIMETRES. NO DIMENSION IS TO BE SCALED FROM THE DRAWING.
2) DUCTS: Ø23/25 mm PVC-TUBES
3) STRANDS: 15.3 mm STANDARD PE-SHEATED & GREASE-IMPREGNATED TENDON (BS5896/3).
4) SURFACE FINISH: FORMSIDE: FAIR; UPSIDE: STEEL FLOATED
5) CONCRETE: WALL PANEL: C35/45
6) EXPOSURE CLASS: XC4, XF3, XA2
7) PLEASE ALLOW min.75 mm DISTANCE FROM POST BORE-HOLE TO CENTER LINE OF TENDON.

PANEL TYPE	WEIGHT APPROX. [KG]
WALL PANEL - STANDARD	4508
BUTTRESS PANEL	4412

DRAWING STATUS

AS BUILT

ISSUE	DESCRIPTION	DATE	INIT.
C	1 m PE linier, tendon location	04.02.2014	SV
B	STATUS	29.01.2014	SV
A	FIRST ISSUE	16.01.2014	SV

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PROJECT

Biogas Plants - Nottingham

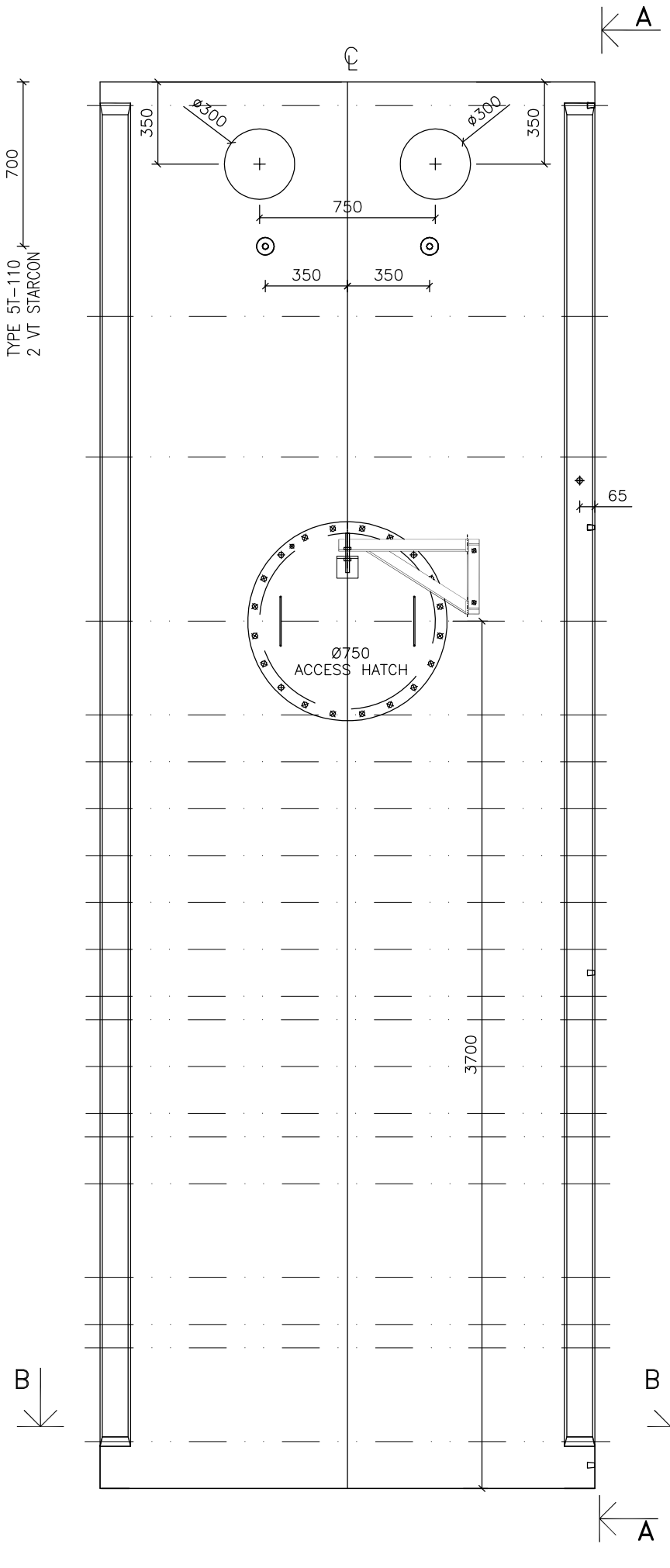
CLIENT

Bio Dynamic UK Ltd.

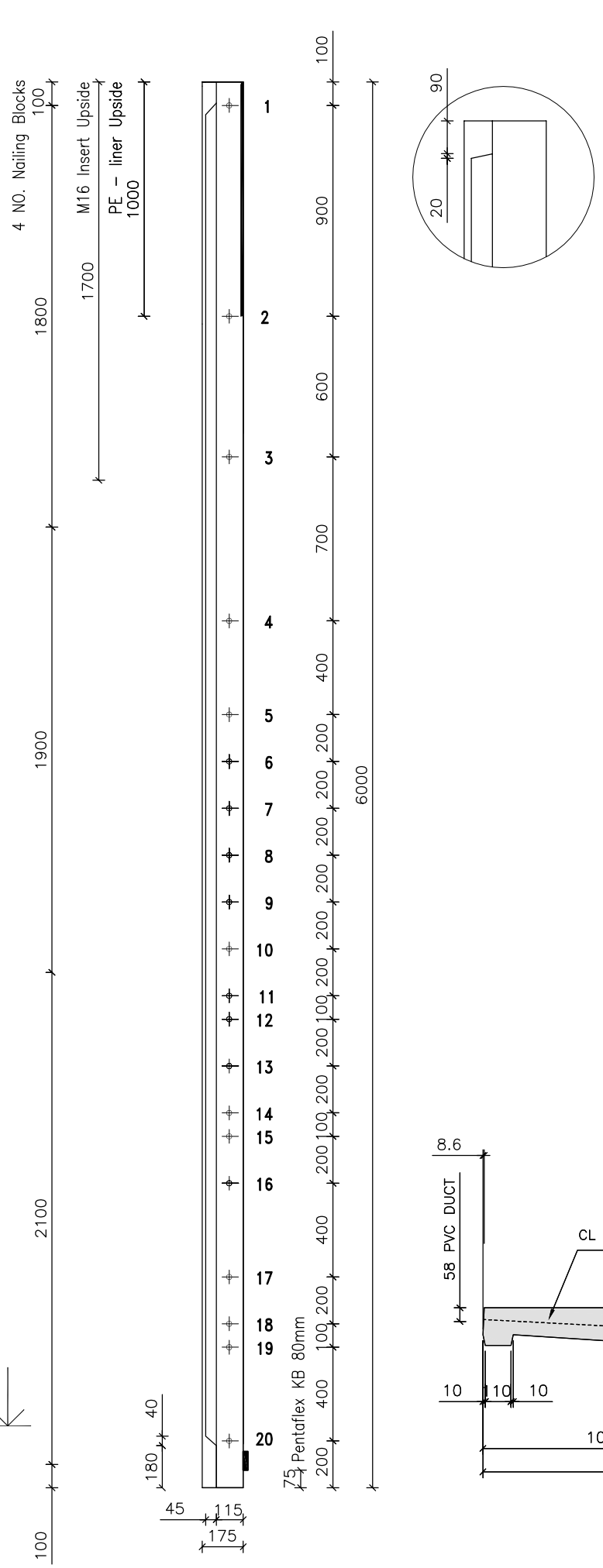
DRAWING DESCRIPTION

CONCRETE LAYOUT
WALL PANEL - TYPE 2
TYPE N6000/41+2B/2

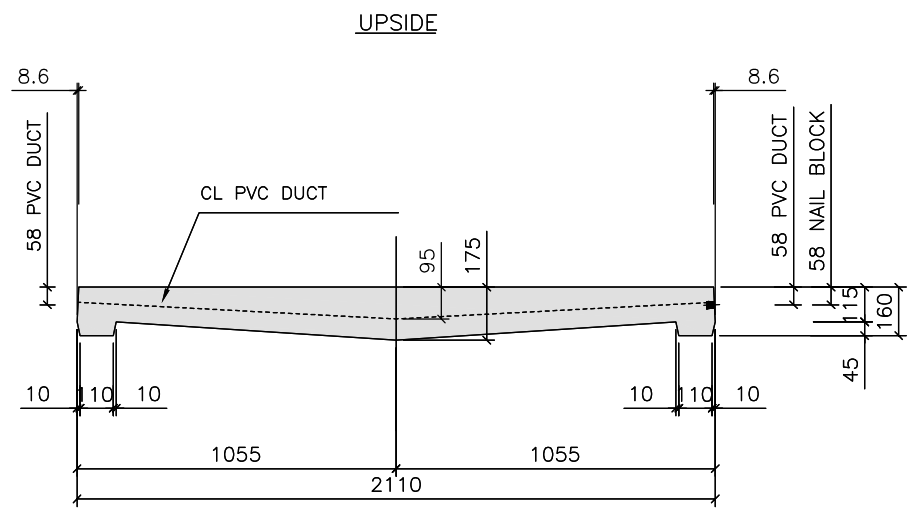
DRAWN:	CHECKED:	SCALE (A3):
SV	SØ	1:25
REF. NO.:	DATE:	STATUS:
430407	16.01.2014	01
DRAWING NO.:		ISSUE:
AQ430407-60-1103-2		C



ELEVATION (FORMSIDE) 1:25



SECTION A-A



SECTION B-B 1:25

NOTES:

1) ALL DIMENSIONS IN MILLIMETRES. NO DIMENSION IS TO BE SCALED FROM THE DRAWING.
2) DUCTS: Ø23/25 mm PVC-TUBES
3) STRANDS: 15.3 mm STANDARD PE-SHEATED & GREASE-IMPREGNATED TENDON (BS5896/3).
4) SURFACE FINISH: FORMSIDE: FAIR; UPSIDE: STEEL FLOATED
5) CONCRETE: WALL PANEL: C35/45
6) EXPOSURE CLASS: XC4, XF3, XA2
7) PLEASE ALLOW min.75 mm DISTANCE FROM POST BORE-HOLE TO CENTER LINE OF TENDON.

PANEL TYPE	WEIGHT APPROX. [KG]
WALL PANEL - STANDARD	4508
BUTTRESS PANEL	4412

DRAWING STATUS
AS BUILT

ISSUE	DESCRIPTION	DATE	INIT.
C	1 m PE linier, tendon/hatch location	04.02.2014	SV
B	STATUS	29.01.2014	SV
A	FIRST ISSUE	16.01.2014	SV

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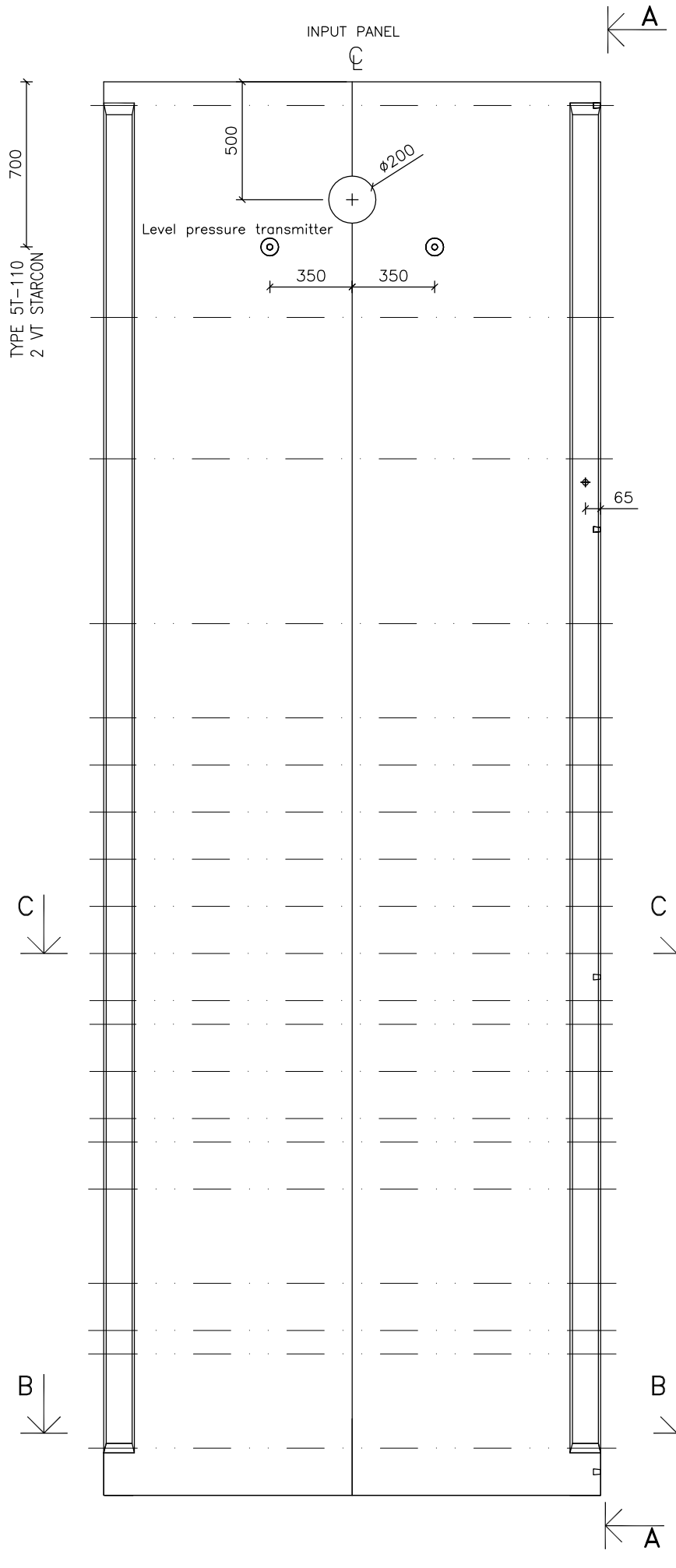
PROJECT
Biogas Plants - Nottingham

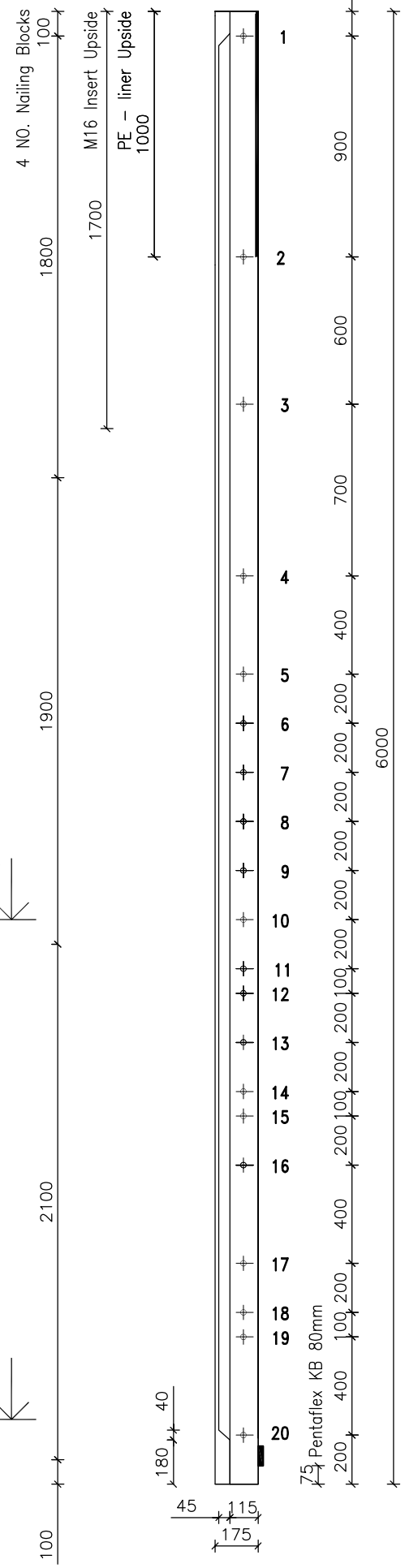
CLIENT
Bio Dynamic UK Ltd.

DRAWING DESCRIPTION
CONCRETE LAYOUT
WALL PANEL - TYPE 3
TYPE N6000/41+2B/2

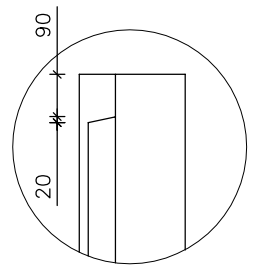
DRAWN:	CHECKED:	SCALE (A3):
SV	SØ	1:25
REF. NO.:	DATE:	STATUS:
430407	16.01.2014	01
DRAWING NO.:		ISSUE:
AQ430407-60-1104-2		C

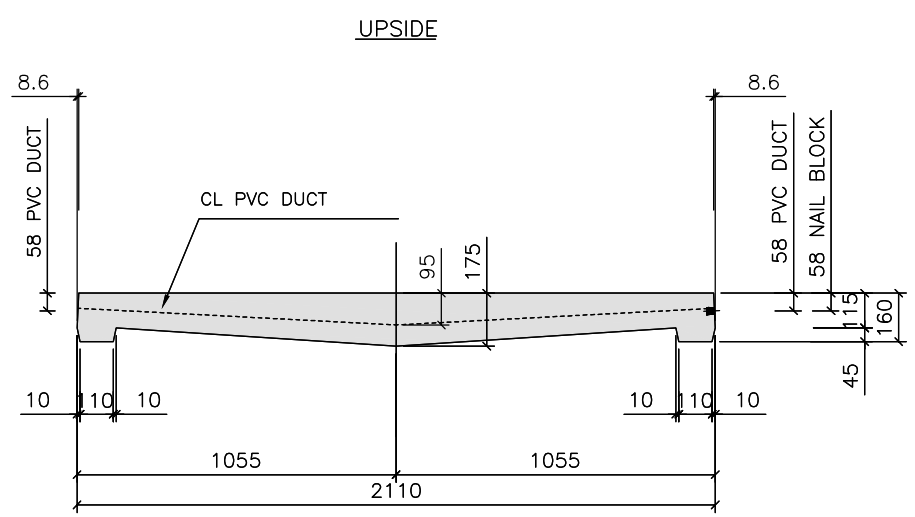


ELEVATION (FORMSIDE) 1:25



SECTION A–A





SECTION B–B 1:25

NOTES:

1) ALL DIMENSIONS IN MILLIMETRES. NO DIMENSION IS TO BE SCALED FROM THE DRAWING.
2) DUCTS: Ø23/25 mm PVC–TUBES
3) STRANDS: 15.3 mm STANDARD PE–SHEATED & GREASE–IMPREGNATED TENDON (BS5896/3).
4) SURFACE FINISH: FORMSIDE: FAIR; UPSIDE: STEEL FLOATED
5) CONCRETE: WALL PANEL: C35/45
6) EXPOSURE CLASS: XC4, XF3, XA2
7) PLEASE ALLOW min.75 mm DISTANCE FROM POST BORE–HOLE TO CENTER LINE OF TENDON.

PANEL TYPE	WEIGHT APPROX. [KG]
WALL PANEL – STANDARD	4508
BUTTRESS PANEL	4412

DRAWING STATUS
AS BUILT

ISSUE	DESCRIPTION	DATE	INIT.
C	1 m PE linier, tendon location	04.02.2014	SV
B	STATUS	29.01.2014	SV
A	FIRST ISSUE	16.01.2014	SV

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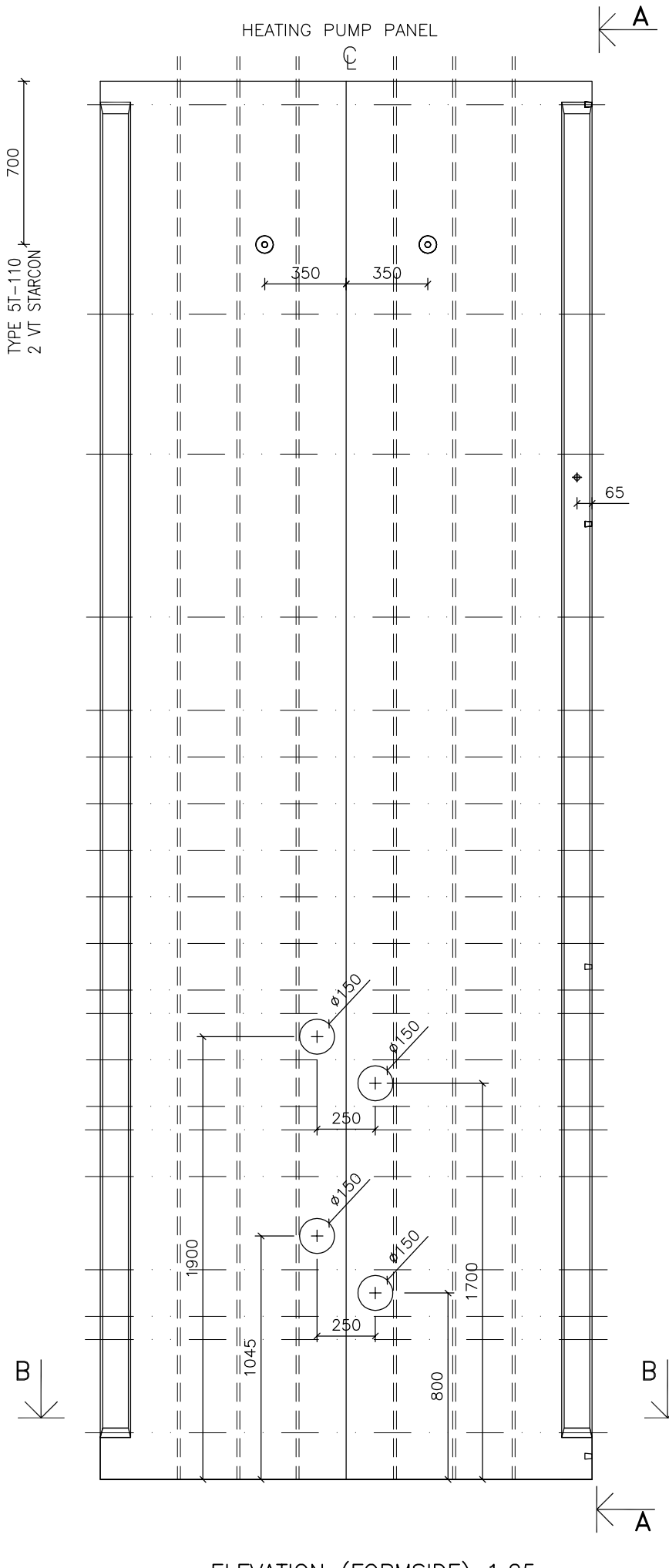
PROJECT
Biogas Plants – Nottingham

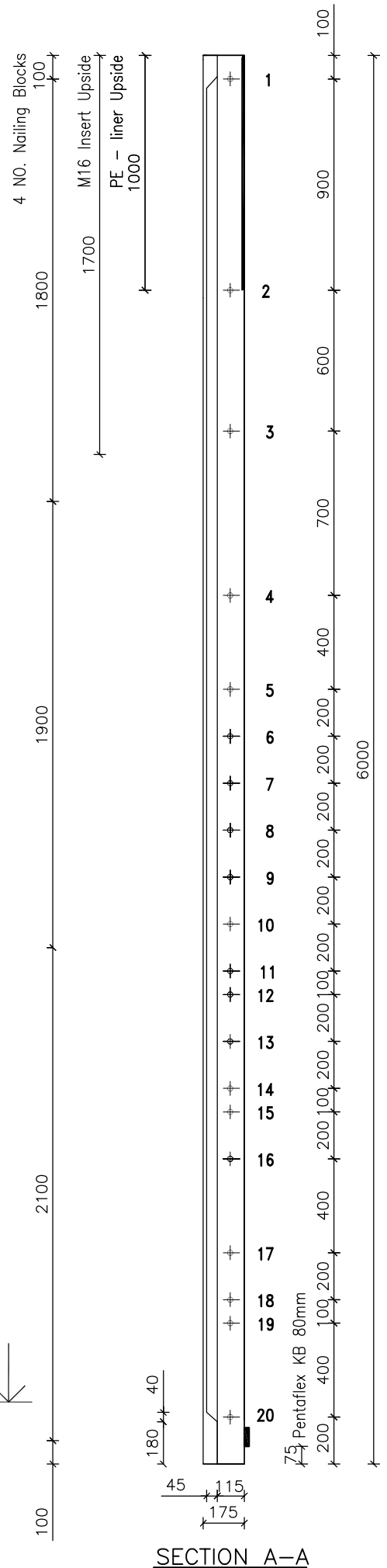
CLIENT
Bio Dynamic UK Ltd.

DRAWING DESCRIPTION
CONCRETE LAYOUT
WALL PANEL – TYPE 4
TYPE N6000/41+2B/2

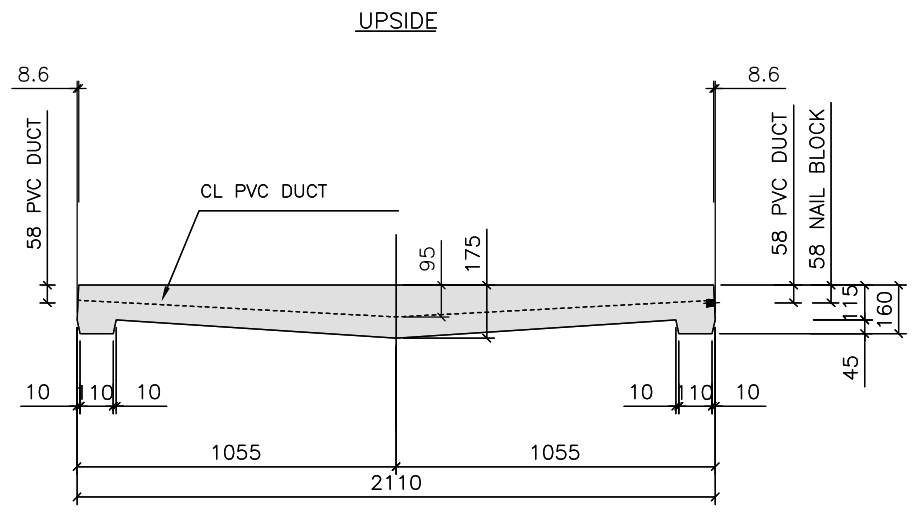
DRAWN:	CHECKED:	SCALE (A3):
SV	SØ	1:25
REF. NO.:	DATE:	STATUS:
430407	16.01.2014	01
DRAWING NO.:		ISSUE:
AQ430407–60–1105–2		C



ELEVATION (FORMSIDE) 1:25



SECTION A-A



SECTION B-B 1:25

NOTES:

1) ALL DIMENSIONS IN MILLIMETRES. NO DIMENSION IS TO BE SCALED FROM THE DRAWING.
2) DUCTS: Ø23/25 mm PVC-TUBES
3) STRANDS: 15.3 mm STANDARD PE-SHEATED & GREASE-IMPREGNATED TENDON (BS5896/3).
4) SURFACE FINISH: FORMSIDE: FAIR; UPSIDE: STEEL FLOATED
5) CONCRETE: WALL PANEL: C35/45
6) EXPOSURE CLASS: XC4, XF3, XA2
7) PLEASE ALLOW min.75 mm DISTANCE FROM POST BORE-HOLE TO CENTER LINE OF TENDON.

PANEL TYPE	WEIGHT APPROX. [KG]
WALL PANEL - STANDARD	4508
BUTTRESS PANEL	4412

DRAWING STATUS

AS BUILT

ISSUE	DESCRIPTION	DATE	INIT.
C	1 m PE linier, tendon location	04.02.2014	SV
B	STATUS	29.01.2014	SV
A	FIRST ISSUE	16.01.2014	SV

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PROJECT

Biogas Plants - Nottingham

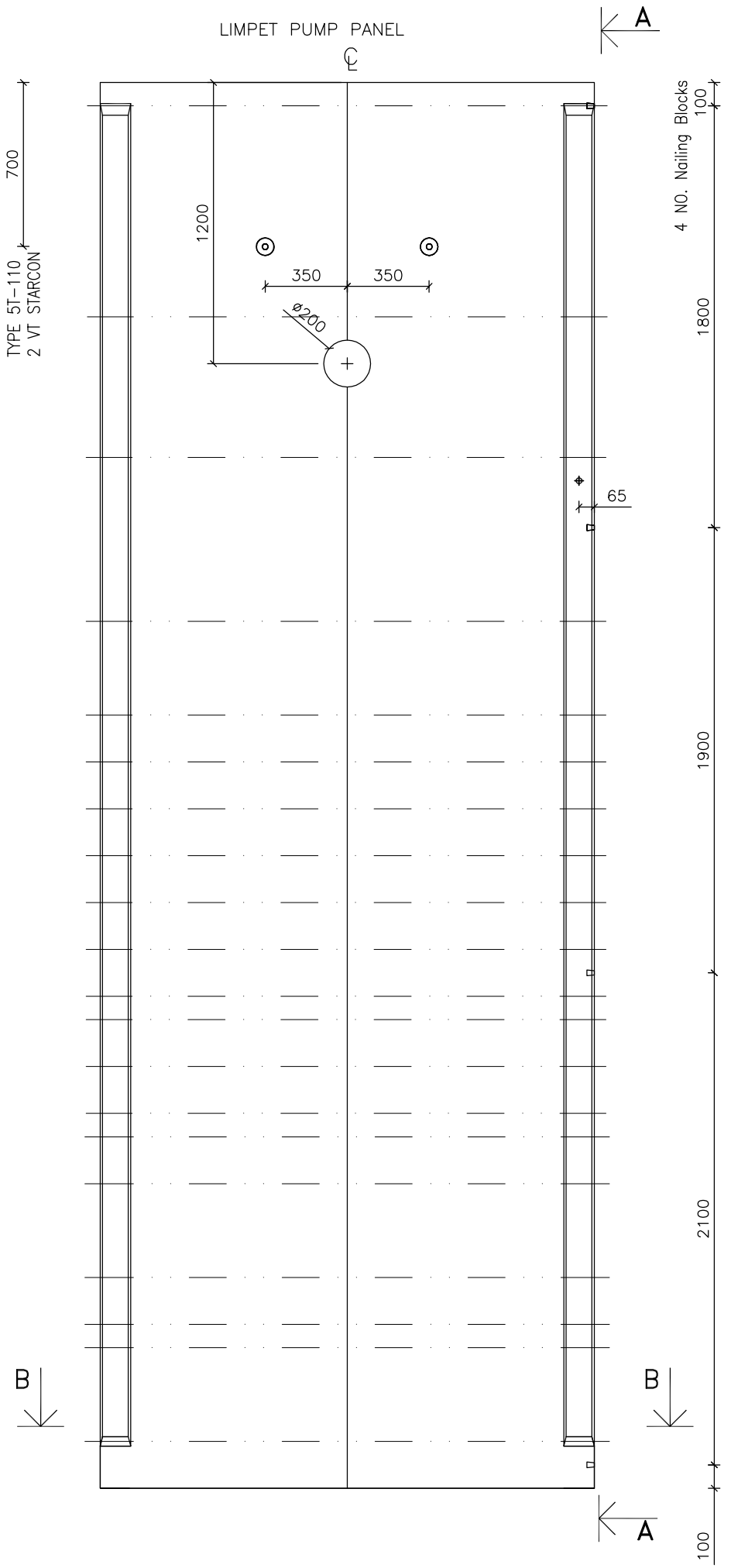
CLIENT

Bio Dynamic UK Ltd.

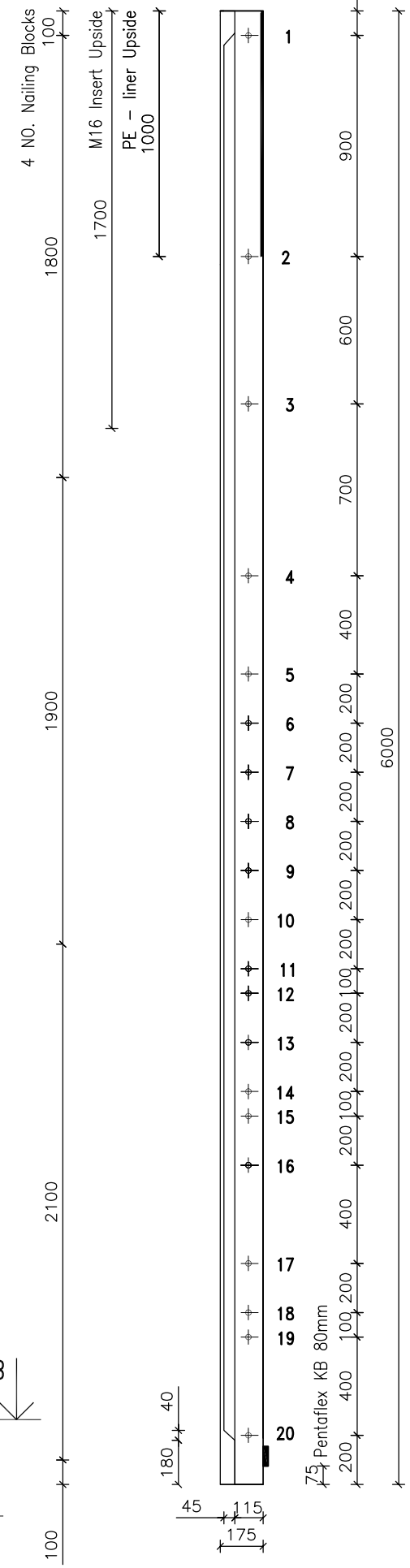
DRAWING DESCRIPTION

CONCRETE LAYOUT
WALL PANEL - TYPE 5
TYPE N6000/41+2B/2

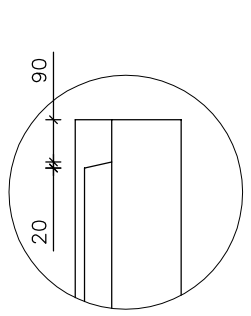
DRAWN:	CHECKED:	SCALE (A3):
SV	SØ	1:25
REF. NO.:	DATE:	STATUS:
430407	16.01.2014	01
DRAWING NO.:		ISSUE:
AQ430407-60-1106-2		C

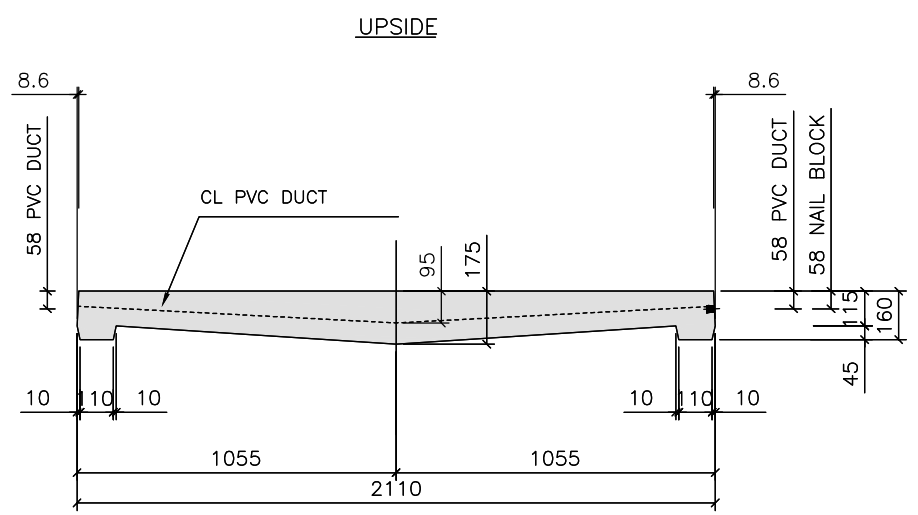


ELEVATION (FORMSIDE) 1:25



SECTION A–A





SECTION B–B 1:25

NOTES:

1) ALL DIMENSIONS IN MILLIMETRES. NO DIMENSION IS TO BE SCALED FROM THE DRAWING.
2) DUCTS: Ø23/25 mm PVC-TUBES
3) STRANDS: 15.3 mm STANDARD PE-SHEATED & GREASE-IMPREGNATED TENDON (BS5896/3).
4) SURFACE FINISH: FORMSIDE: FAIR; UPSIDE: STEEL FLOATED
5) CONCRETE: WALL PANEL: C35/45
6) EXPOSURE CLASS: XC4, XF3, XA2
7) PLEASE ALLOW min.75 mm DISTANCE FROM POST BORE-HOLE TO CENTER LINE OF TENDON.

PANEL TYPE	WEIGHT APPROX. [KG]
WALL PANEL – STANDARD	4508
BUTTRESS PANEL	4412

DRAWING STATUS
AS BUILT

ISSUE	DESCRIPTION	DATE	INIT.
C	1 m PE linier, tendon location	04.02.2014	SV
B	STATUS	29.01.2014	SV
A	FIRST ISSUE	16.01.2014	SV

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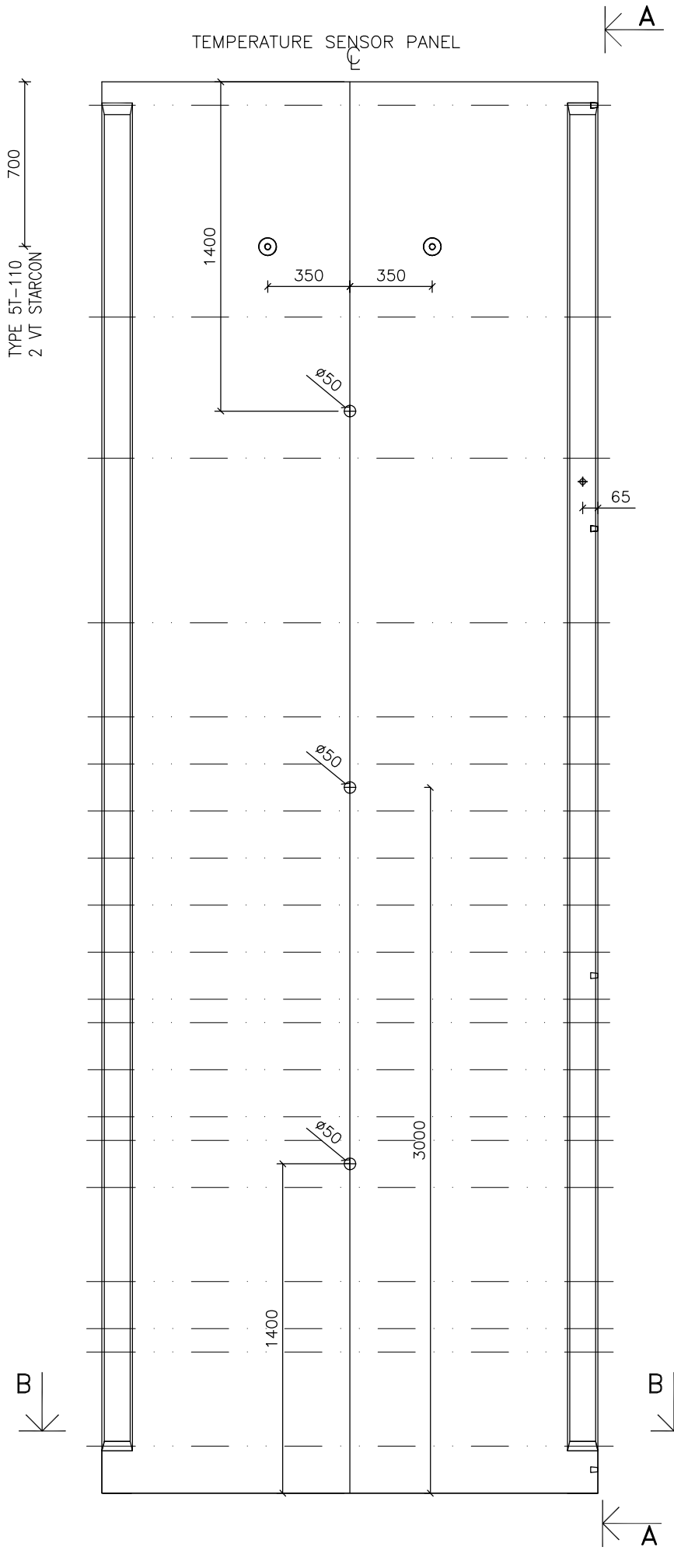
PROJECT
Biogas Plants – Nottingham

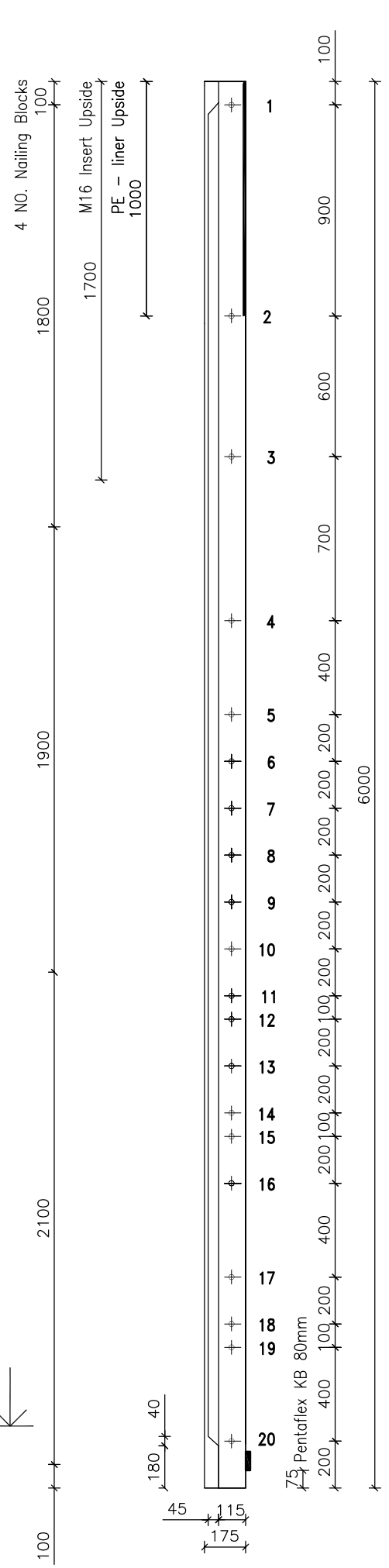
CLIENT
Bio Dynamic UK Ltd.

DRAWING DESCRIPTION
CONCRETE LAYOUT
WALL PANEL – TYPE 6
TYPE N6000/41+2B/2

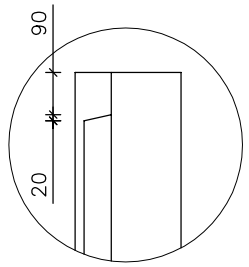
DRAWN:	CHECKED:	SCALE (A3):
SV	SØ	1:25
REF. NO.:	DATE:	STATUS:
430407	16.01.2014	01
DRAWING NO.:		ISSUE:
AQ430407-60-1107-2		C

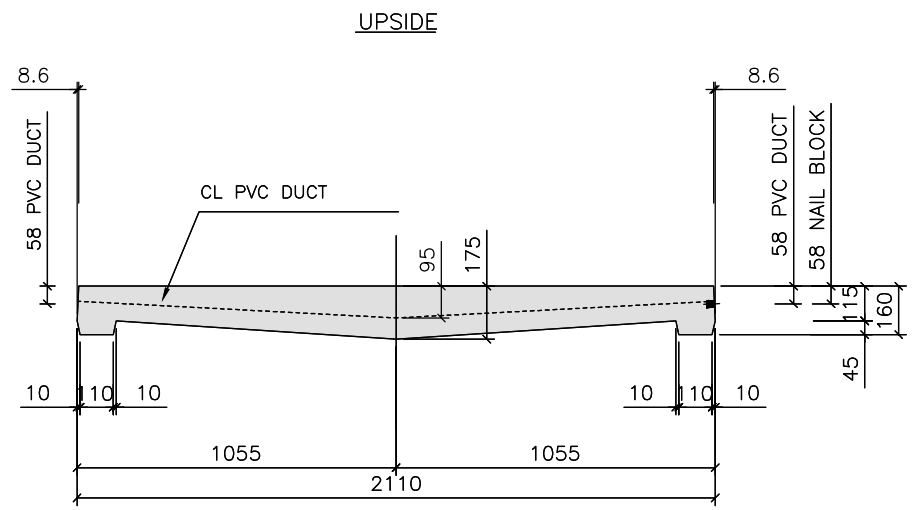


ELEVATION (FORMSIDE) 1:25



SECTION A–A





SECTION B–B 1:25

NOTES:

1) ALL DIMENSIONS IN MILLIMETRES. NO DIMENSION IS TO BE SCALED FROM THE DRAWING.
2) DUCTS: Ø23/25 mm PVC-TUBES
3) STRANDS: 15.3 mm STANDARD PE-SHEATED & GREASE-IMPREGNATED TENDON (BS5896/3).
4) SURFACE FINISH: FORMSIDE: FAIR; UPSIDE: STEEL FLOATED
5) CONCRETE: WALL PANEL: C35/45
6) EXPOSURE CLASS: XC4, XF3, XA2
7) PLEASE ALLOW min.75 mm DISTANCE FROM POST BORE-HOLE TO CENTER LINE OF TENDON.

PANEL TYPE	WEIGHT APPROX. [KG]
WALL PANEL – STANDARD	4508
BUTTRESS PANEL	4412

DRAWING STATUS
AS BUILT

ISSUE	DESCRIPTION	DATE	INIT.
C	1 m PE linier, tendon location	04.02.2014	SV
B	STATUS	29.01.2014	SV
A	FIRST ISSUE	16.01.2014	SV

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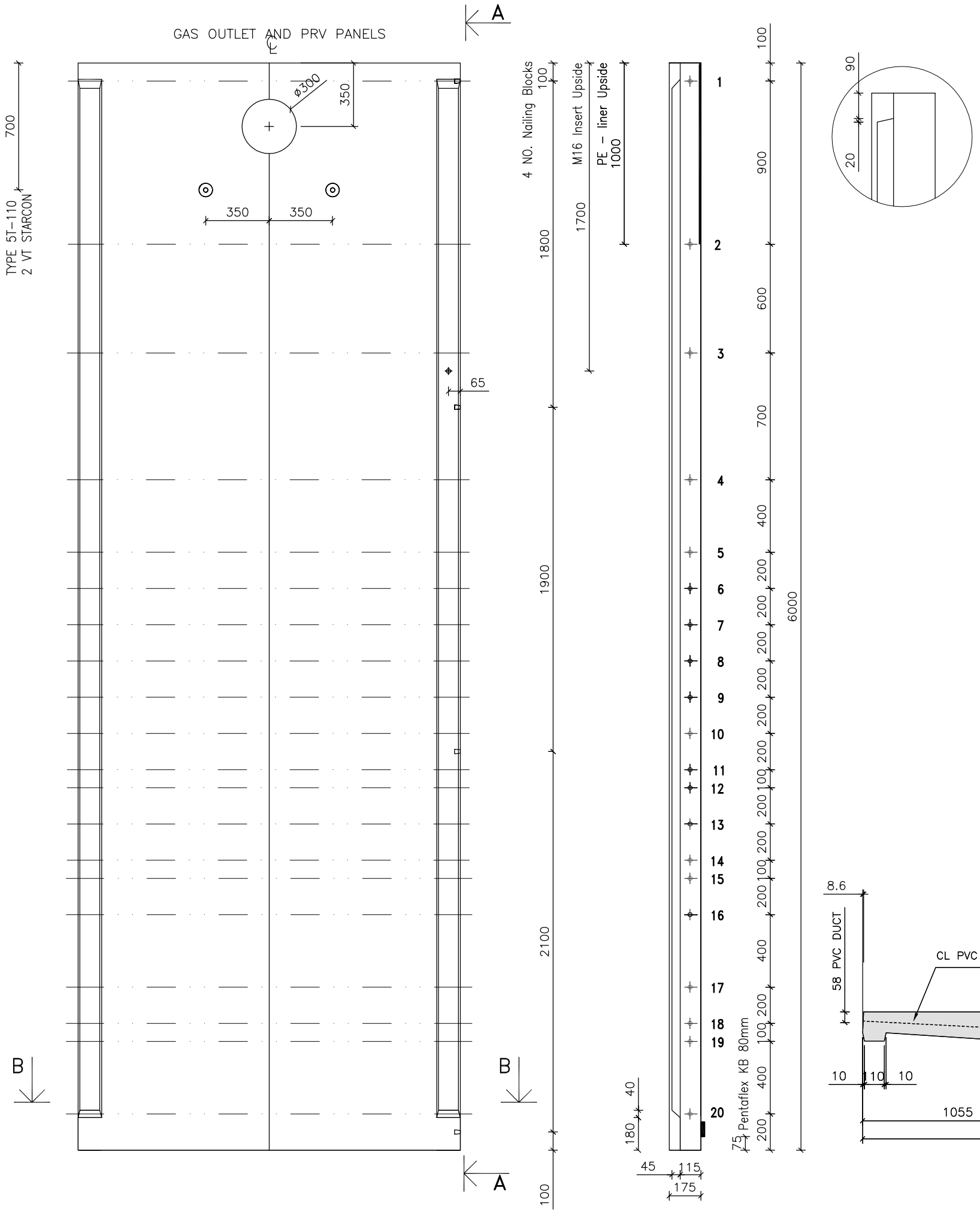
INTERNET: www.aconsult.dk
E-mail: info@aconsult.dk

PROJECT
Biogas Plants – Nottingham

CLIENT
Bio Dynamic UK Ltd.

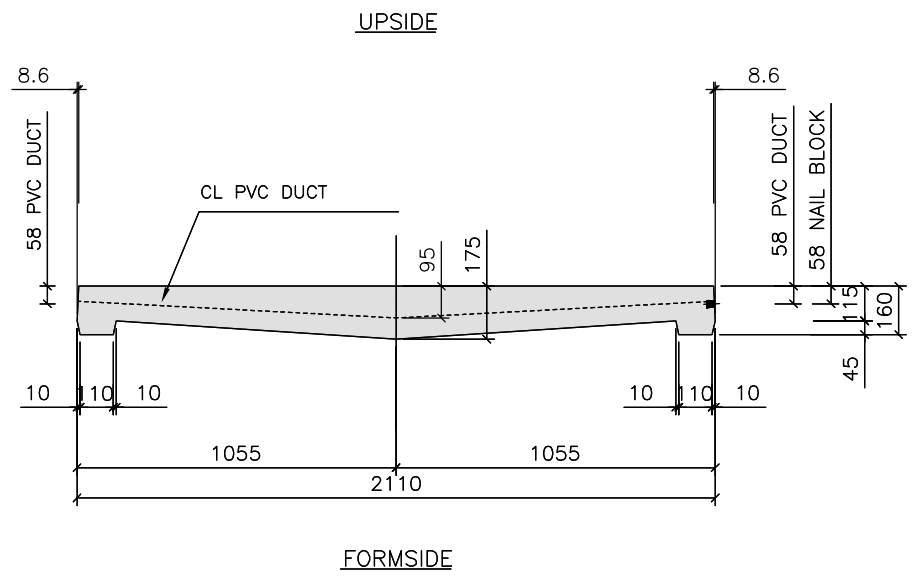
DRAWING DESCRIPTION
CONCRETE LAYOUT
WALL PANEL – TYPE 7
TYPE N6000/41+2B/2

DRAWN:	CHECKED:	SCALE (A3):
SV	SØ	1:25
REF. NO.:	DATE:	STATUS:
430407	16.01.2014	01
DRAWING NO.:		ISSUE:
AQ430407-60-1108-2		C



ELEVATION (FORMSIDE) 1:25

SECTION A–A



SECTION B–B 1:25

NOTES:

1) ALL DIMENSIONS IN MILLIMETRES. NO DIMENSION IS TO BE SCALED FROM THE DRAWING.
2) DUCTS: Ø23/25 mm PVC–TUBES
3) STRANDS: 15.3 mm STANDARD PE–SHEATED & GREASE–IMPREGNATED TENDON (BS5896/3).
4) SURFACE FINISH: FORMSIDE: FAIR; UPSIDE: STEEL FLOATED
5) CONCRETE: WALL PANEL: C35/45
6) EXPOSURE CLASS: XC4, XF3, XA2
7) PLEASE ALLOW min.75 mm DISTANCE FROM POST BORE–HOLE TO CENTER LINE OF TENDON.

PANEL TYPE	WEIGHT APPROX. [KG]
WALL PANEL – STANDARD	4508
BUTTRESS PANEL	4412

DRAWING STATUS

AS BUILT

ISSUE	DESCRIPTION	DATE	INIT.
C	1 m PE linier, tendon location	04.02.2014	SV
B	STATUS	29.01.2014	SV
A	FIRST ISSUE	16.01.2014	SV

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PROJECT

Biogas Plants – Nottingham

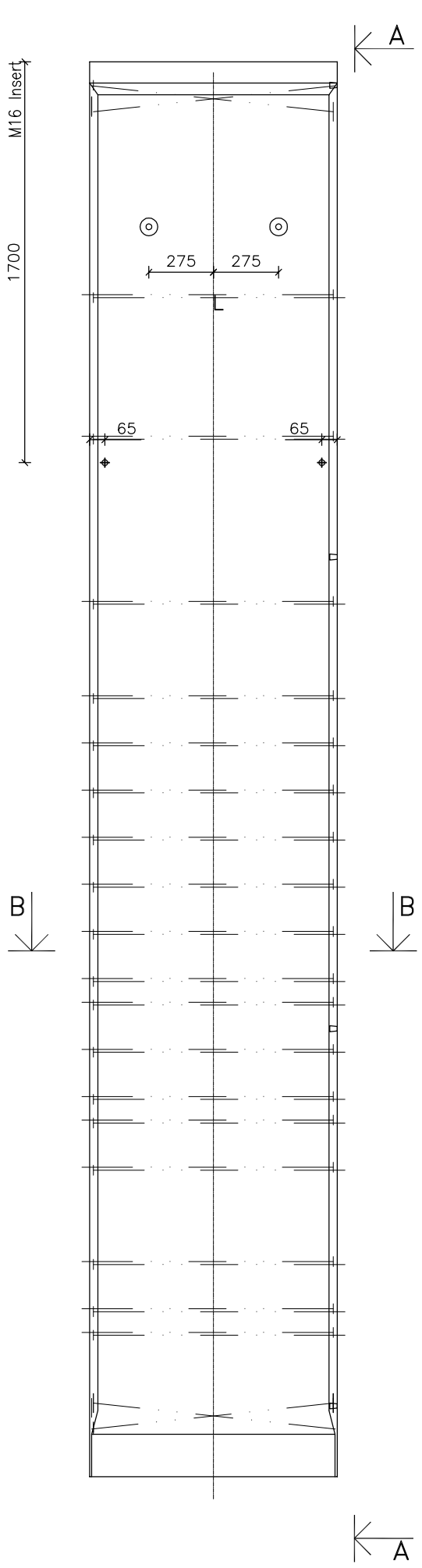
CLIENT

Bio Dynamic UK Ltd.

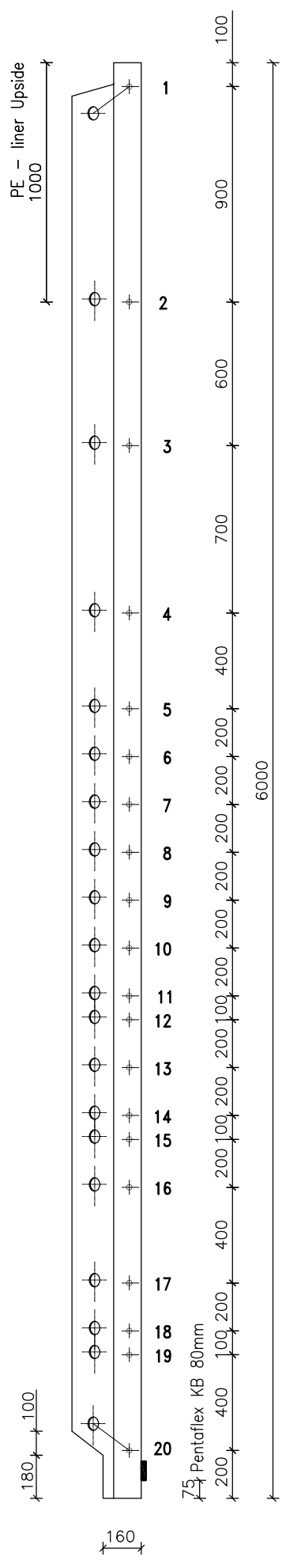
DRAWING DESCRIPTION

CONCRETE LAYOUT
WALL PANEL – TYPE 8
TYPE N6000/41+2B/2

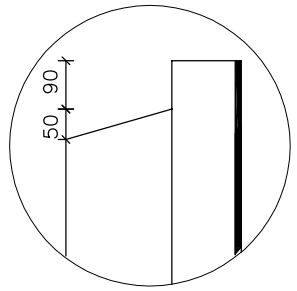
DRAWN:	CHECKED:	SCALE (A3):
SV	SØ	1:25
REF. NO.:	DATE:	STATUS:
430407	16.01.2014	01
DRAWING NO.:		ISSUE:
AQ430407–60–1109–2		C

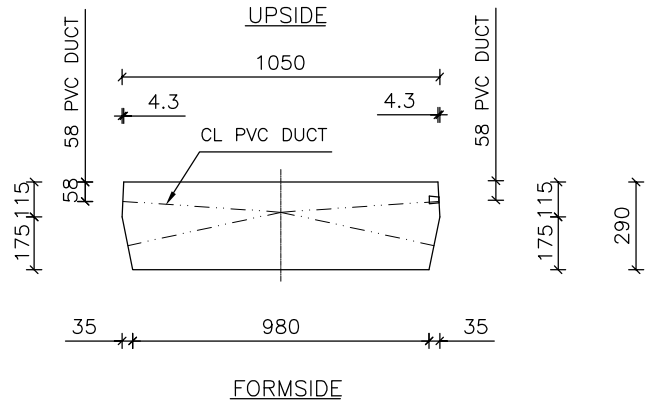


ELEVATION 1:25



SECTION A-A 1:25





SECTION B-B 1:25

NOTES:

1) ALL DIMENSIONS IN MILLIMETRES. NO DIMENSION IS TO BE SCALED FROM THE DRAWING.
2) DUCTS: Ø23/25 mm PVC-TUBES
3) STRANDS: 15.3 mm STANDARD PE-SHEATED & GREASE-IMPREGNATED TENDON (BS5896/3).
4) SURFACE FINISH: FORMSIDE: FAIR; UPSIDE: STEEL FLOATED
5) CONCRETE: WALL PANEL: C35/45
6) EXPOSURE CLASS: XC4, XF3, XA2
7) PLEASE ALLOW min.75 mm DISTANCE FROM POST BORE-HOLE TO CENTER LINE OF TENDON.

PANEL TYPE	WEIGHT APPROX. [KG]
WALL PANEL - STANDARD	4508
BUTTRESS PANEL	4412

DRAWING STATUS
AS BUILT

ISSUE	DESCRIPTION	DATE	INIT.
C	1 m PE linier, tendon location	04.02.2014	SV
B	SMIG	29.01.2014	SV
A	FIRST ISSUE	29.01.2014	SV

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PROJECT
Biogas Plants - Nottingham

CLIENT
Bio Dynamic UK Ltd.

DRAWING DESCRIPTION
CONCRETE LAYOUT
BUTTRESS PANEL
TYPE N6000/41+2B/2

DRAWN:	CHECKED:	SCALE (A3):
SV	SØ	1:25
REF. NO.:	DATE:	STATUS:
430407	29.01.2014	01
DRAWING NO.:		ISSUE:
AQ430407-60-4101-2		C

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Technical Data 2205

Carbofix (AKS)

Manufactured of High Density Polyethylene (HDPE)

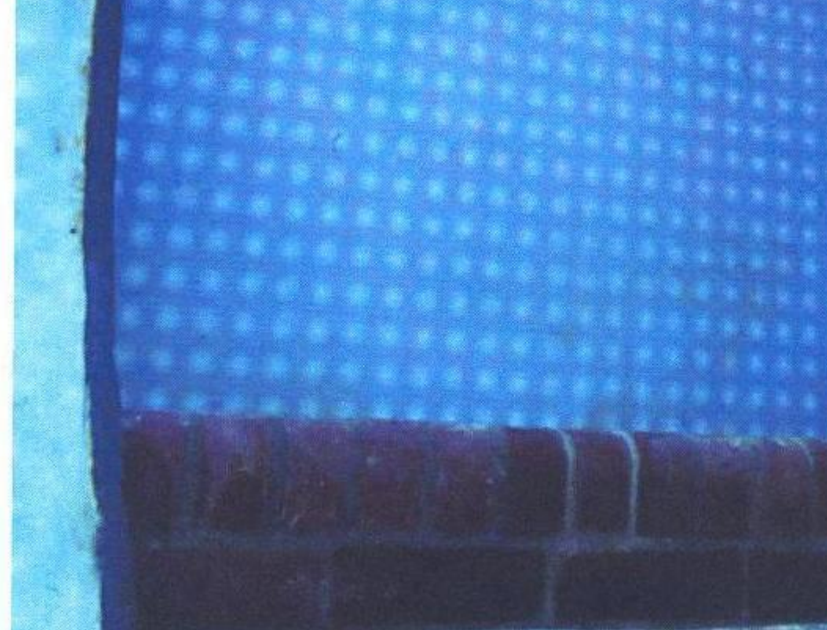
Date: 03.01.2011

Thickness from 2.0 to 5.0 mm (excluding length of knobs)

Properties	Test Method	Unit	Value
Thickness variance	ASTM D 5199	%	± 15%
Density	ASTM D 505 / D 792	g/cm³	0,945
Shore D	ISO 868	D	56
Melt Flow Rate	ASTM D 1238 Cond. P 190/5	g/10 min	<1,0
Melt Flow Rate	ASTM D 1238 Cond. E 190/2,16	g/10 min	<0,2
Carbon black content	ASTM D 1603	%	2 - 3
Carbon black dispersion	ASTM D 5596	Category	Cat 1 - 2
Length of knobs (nom)		mm	12
Knobs per m²		knobs / m²	1230
Tensile strength at yield	ASTM D 6693-4	MPA	> 15
Elongation at yield		%	> 9
Tensile strength at break		MPA	> 25
Elongation at break		%	600
Dimensional stability after warm storage 1h/100°C	ASTM D 1204	%	< 2

Sewage pipe system completely lined with mechanically anchored thermoplastic materials. Steuler also offers special design solutions to integrate coatings and brick linings.

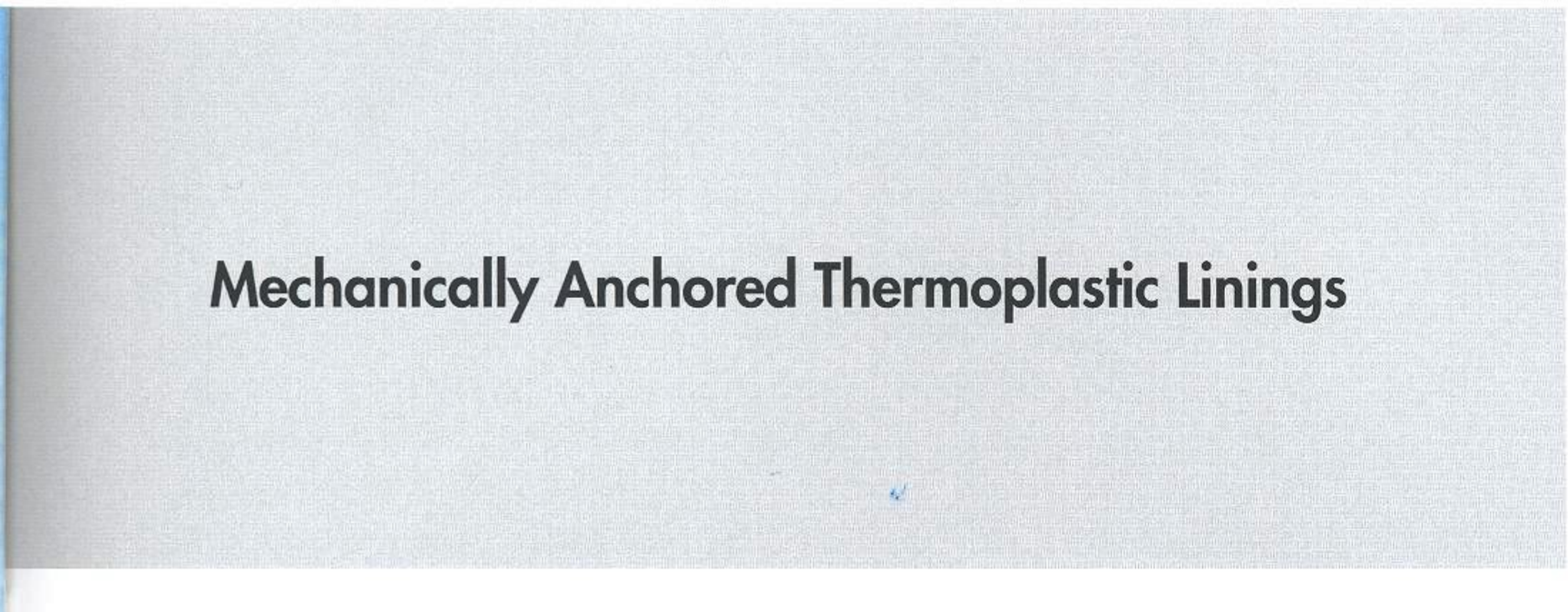
Prefabricated Bekaplast™ Double Wall containers for the buried installation of process tanks.



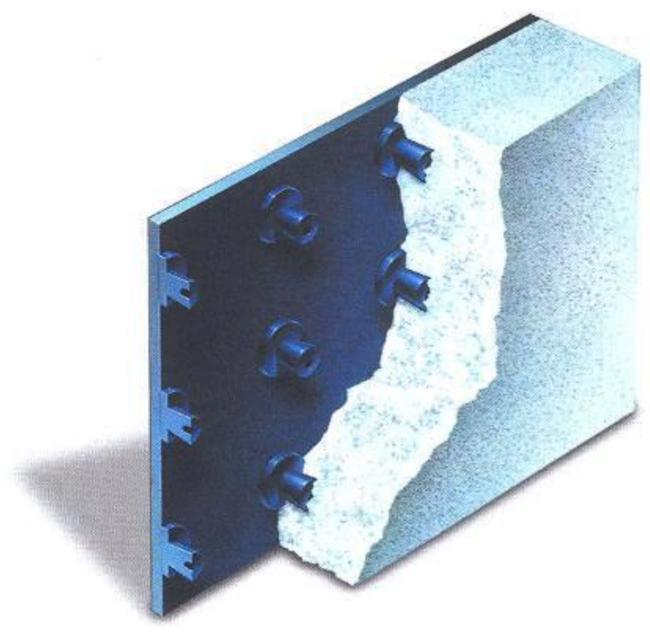
Tübbing-prefabricated unit with Ankerplast™ lining.

Steuler also installs Bekaplast™ as concrete scrubber linings in flue gas desulphurisation plants.

Owing to the defined number and patented form of the Bekaplast™ anchor stubs anchored in the concrete, stresses induced by the different thermal expansion properties of concrete and plastic are safely and reliably contained.



Mechanically Anchored Thermoplastic Linings



With the introduction of mechanically anchored thermoplastic lining systems, Steuler has considerably expanded the selection of materials in the field of industrial corrosion protection. The interlocking of a thermoplastic lining, which is highly resistant to chemical and corrosive attack with concrete, a material that can withstand extreme static loads, brings about an ideal synergic combination of stability, reliability and durability.

The Bekaplast™ lining system developed and patented by Steuler is capable of containing the different expansion properties of these materials safely and reliably. This system has a successful track record of over 30 years both in the chemical industry and municipal wastewater facilities.

Based on this design, Steuler has developed a broad range of different lining systems for specific fields of application. Foremost among these is Bekaplast™ DWS, the world's first double-wall lining system that is firmly welded together and force-locked with the concrete.

Thermoplastics have excellent chemical resistance, can be subjected to mechanical loads and are also impervious to biogenic corrosion. Welded to form a gas- and waterproof surface, the smooth, anti-adhesive finish offers very little friction and prevents incrustations. These lining systems are easy to install, can be tested reproducibly and, if damaged, can also be repaired easily.

The materials utilised, i.e. polyethylene (PE-HD), polypropylene (PP), polyvinylidene fluoride (PVDF), or polyvinyl chloride (PVC) are available in various thicknesses and additional material grades, such as electrically conductive, UV-stabilised or slip-resistant. Cat ladders, pump sumps, pipe connections, channel constructions and detailed system solutions complete the varied lining program.

Bekaplast™ PE-HD has been issued a building regulation approval by the DIBt for use as a sealing system in secondary containments for storing liquids that are hazardous to water.

Bekaplast™ *for wastewater, reaction and process tanks, absorption towers, wastewater systems, electrolysis cells*

Bekaplast™ DWS Double Wall System

Bekaplast™ Secondary containments with building regulation approval (DIBt-certified)

Lining 400™ *for municipal wastewater systems, shafts and tanks*

Ankerplast™ *for Tübbing components in municipal wastewater systems as well as other prefabricated concrete units*

Bolted Lining™ *– Thermoplastic systems that are bolted to the substrate by means of anchor studs for retrofit lining and re-lining applications to steel and concrete structures*

Stable mechanical bond between concrete and plastic lining

Highly resistant to biogenic corrosion and chemicals

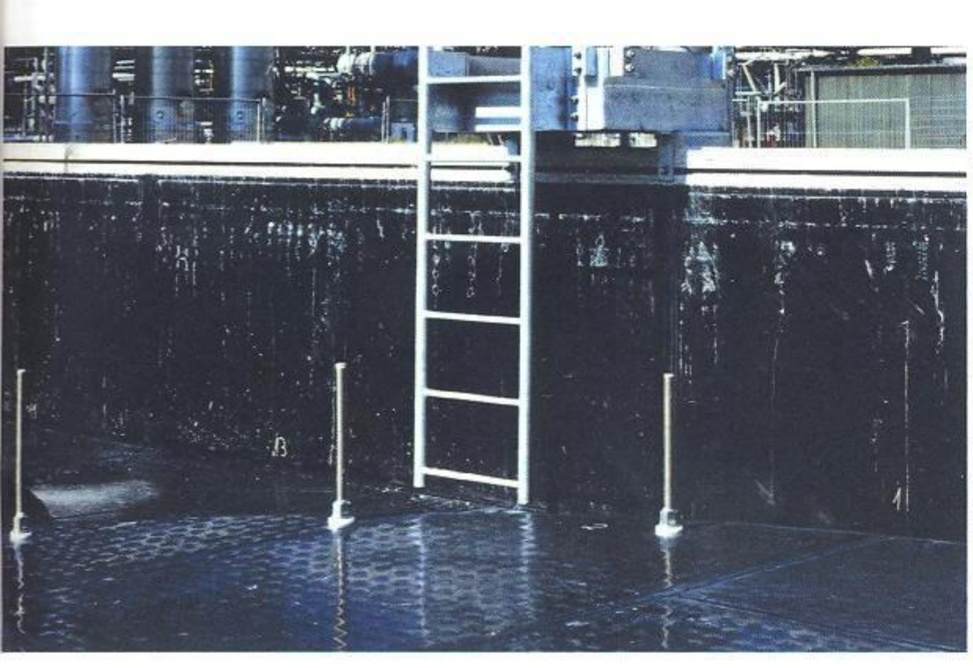
Smooth, anti-adhesive surface

Physiologically harmless material qualities

Cracks in the concrete are securely bridged

Verifiable gas-proof and watertight welding, easy to repair

Easy handling and installation



Secondary containment with building regulation approval (DIBt-Test Certificate) in a petrochemical plant.

Storage tank retrofitted with a bolted-on thermoplastic lining – Bolted Lining™ System.