

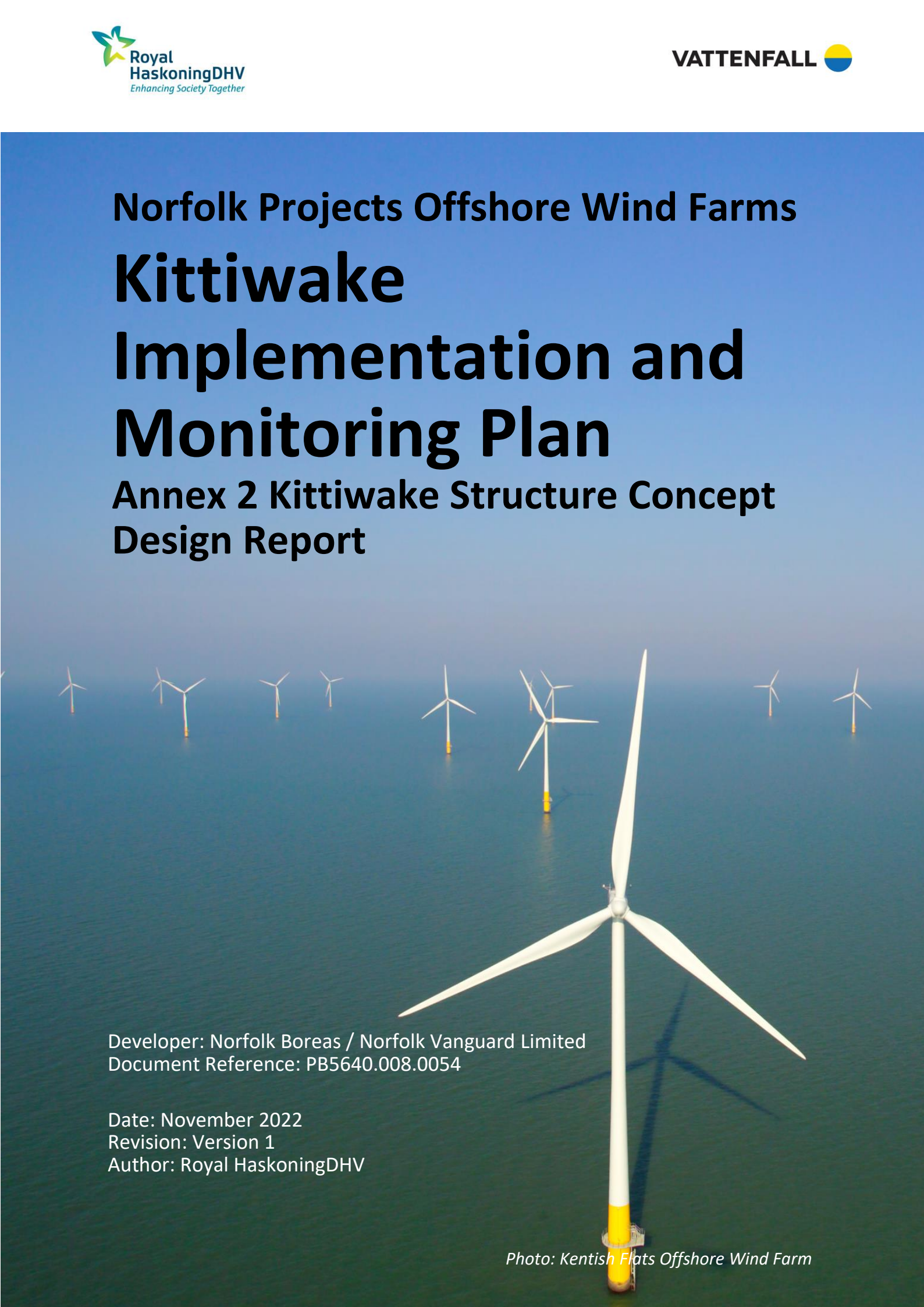
Norfolk Projects Offshore Wind Farms Kittiwake Implementation and Monitoring Plan

Annex 2 Kittiwake Structure Concept Design Report

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REPORT

Kittiwake Artificial Nesting Sites - Concept Designs

Client: Vattenfall


Reference: PB5640-RHD-KZ-XX-RP-C-0002

Status: A2/P02

Date: 01 April 2021

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Classification

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1 Introduction

1.1 Background

Vattenfall (the Client) has appointed Royal HaskoningDHV (RHDHV) to provide concept designs for a Kittiwake artificial nesting site to be built at or near the Port of Lowestoft. Two structural forms are proposed – a wall type structure and a tower type structure. The Client and RHDHV have developed design requirements, which are outlined in the Basis of Design (PB5640-RHD-KZ-XX-RP-Z-0001 P01).

2 Concept Designs

2.1 Common Items

2.1.1 Shelving

The shelves shall be securely connected to the structure. The shelves shall be placed on the exterior / one side of the structure to allow access from the rear for maintenance and to reduce disturbance from the public. It is noted that shelves exposed to southern directions are likely to have reduced nesting due to exposure to sunlight, therefore careful consideration of orientation is required.

An option appraisal of the shelving materials is carried out in Table 2-1.

Table 2-1: Shelving Material Option Appraisal

| Material | Advantages | Disadvantages |
|----------|---|---|
| GRP | <ul style="list-style-type: none"> Low heat conduction Very light Easy to install and replace | <ul style="list-style-type: none"> Environmental microplastics are a widespread concern. |
| Timber | <ul style="list-style-type: none"> Low heat conduction Natural material can be sustainably sourced Light Easy to install and replace | <ul style="list-style-type: none"> Timber shelves may require periodic replacement. |
| Steel | <ul style="list-style-type: none"> More durable Easy to install and replace | <ul style="list-style-type: none"> Steel conducts heat easily and may result in undesirable surface temperatures. The conditions on the shelves may accelerate corrosion where protective coatings have broken down. Replacement of the shelves may require lifting equipment. |
| Concrete | <ul style="list-style-type: none"> Low heat conduction More durable. Conditions on the shelves are unlikely to accelerate the degradation of the material. | <ul style="list-style-type: none"> Replacement of the shelves would require lifting equipment. Reinforced concrete shelves may have to be thick to meet durability requirements Replacement may be difficult due to weight |

Timber shelves have been chosen as the most suitable for this concept design. The timber may need to be treated depending on the chosen wood type to protect from environmental conditions. Should the shelves need to be replaced, this work shall be done outside of the kittiwakes breeding season.

2.1.2 Security

A fence shall be installed around the perimeter of the structure to as far as possible prevent access from the public and mammalian predators such as foxes. The fence shall be at least 2m high and detailed to as far as possible prevent access from foxes from above and below (i.e. and overhang and continuation of the fence underground).

2.2 Concept 1: Reinforced Concrete Wall

The wall shall be formed from readily available prefabricated precast concrete retaining wall sections. These are available from multiple manufacturers and examples using Bison products are shown. This solution is modular, allowing for relatively easy handling and installation due to the preformed lifting points. The standard wall sections can be adapted to allow fixings for the shelving units to be incorporated.

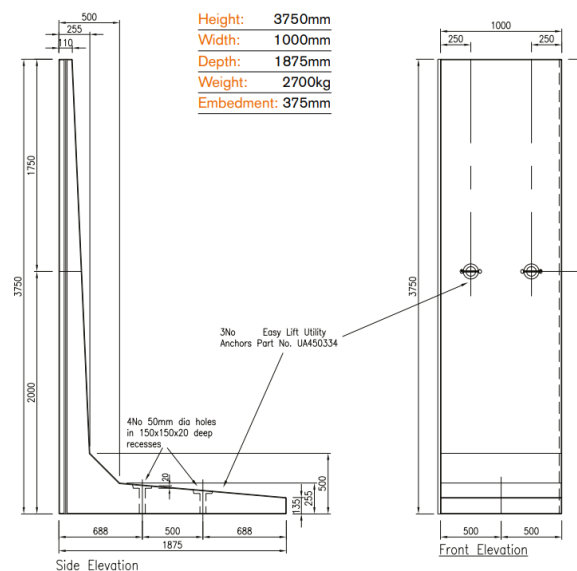


Figure 2-1: Side and front elevation of precast concrete wall

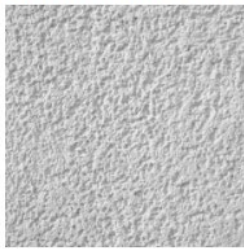
To meet the requirement for rear access to the shelving, each retaining wall shall be spaced to have a gap of 0.5m between each upright. This space would be filled by hinged timber panels attached to the wall that will swing open for ease of access, the panels will be securely locked preventing access from the public. The shelving will be placed on the “outside” of the retaining wall, i.e. the side to the left of the L shape in Figure 2-1. The shelves shall span the gaps between the modules.

Using an off the shelf product, the height of the wall can be selected up to 3.75m, with the chosen dimensions shown in Figure 2-1. The bottom shelf shall be 2m from ground level, meaning the top 1.75m can be fitted with shelves. Assuming a shelf thickness of 0.05m, this wall section can hold up to four shelves resulting in an 26m long wall to accommodate at least 200 kittiwake pairs. As each section is 1m wide, 17 modules are required. Due to the total height of the wall, a mobile access tower scaffold will be required to carry out maintenance.

Should the chosen site be within a harbour, the wall units could be placed flush with the edge of the jetty deck, depending upon restrictions from harbour features or furniture such as cope, bollards or mooring equipment. This may be more appealing to the kittiwakes as access to the shelving by predators would be restricted.

The wall can have an aesthetic finish cast into the concrete to minimise visual impact. A selection of these finishes are shown in Figure 2-2.

ROUGH & TEXTURED FINISHES:



Marne

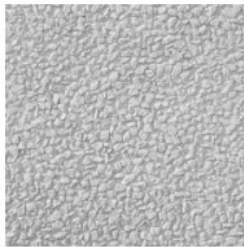


Red River

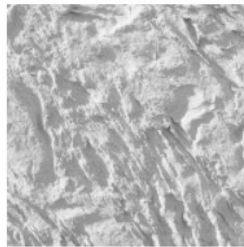


Lausitz

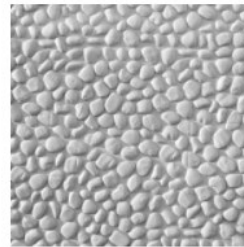
STONE & ROCK FINISHES:



Mosel



Cheyanne

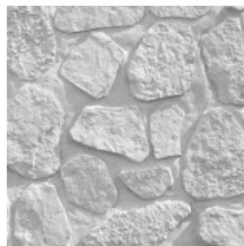


Romanche

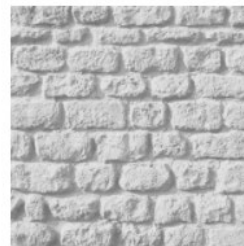
BRICK & MASONRY FINISHES:



Brabant



La-reunion



Mayenne

Figure 2-2: Concrete Wall Finishes

Depending on the final installation location the wall may be connected to a foundation using holding down bolts or partially buried to resist wind loading preventing it from overturning or sliding.

2.3 Concept 2: Tower Type Structure

This concept is a tower type structure with a cabin installed at the top that will accommodate kittiwakes on shelves

The structure uses a prefabricated steel triangular tower that can be delivered in sections, assembled on-site and attached to a concrete foundation using holding down bolts. The tower should have an approximate length of 2.5m and height of 4.5m. The tower shall have two platforms at 2m and 4.2m from ground, this will allow maintenance personal to work safely at these two locations.

The access cabin that the shelves are installed on shall be triangular in plan (see Figure 2-3) and constructed from timber. The cabin will be installed at 2m from the base of the tower, meaning the bottom shelf shall be at least 2m from the ground. The cabin shall be prefabricated and delivered to the site in panels that can be easily assembled – a small crane will be required to lift the cabin onto the tower. This triangular shape of the cabin has been proposed as this should mean that two out of three faces will be exposed to less direct sunlight. Having one side facing South and the other two sides facing North-East and North-West. This has been proposed over a four-sided cabin as this design would mean at least two faces will always be exposed to direct sunlight throughout the year.

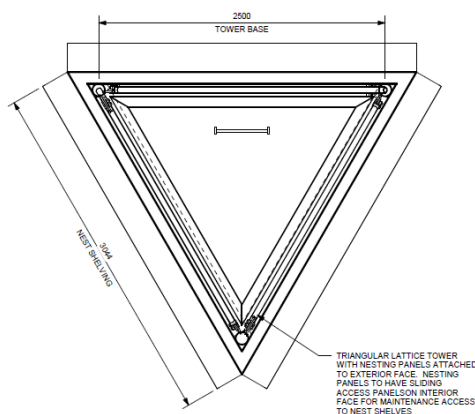


Figure 2-3 – Plan Elevation

Using the number of breeding pairs and space requirements, an optimal size for the cabin has been identified. The dimensions for the cabin shall have a width of 5m and a height of 3.6m, allowing 12 shelves that can accommodate 10 kittiwakes per shelf (see Figure 2-4). These dimensions will allow safe access within the cabin to perform maintenance. The approximate maximum number of pairs was calculated as 300 pairs and assumes two sides at full capacity and one side at 50% capacity.

It has been advised by the client that gaining access to each shelf from the rear is less intrusive. To allow for this, a sliding hatch type system will be installed to the back of each shelf that will allow access from the inside of the cabin. This has the benefit that it should remove the requirement for a MEWP to access the shelving (as in other notable designs such as the Gateshead kittiwake tower). This is likely to be very intrusive to the kittiwakes and requires access, planning and space for a large piece of machinery.

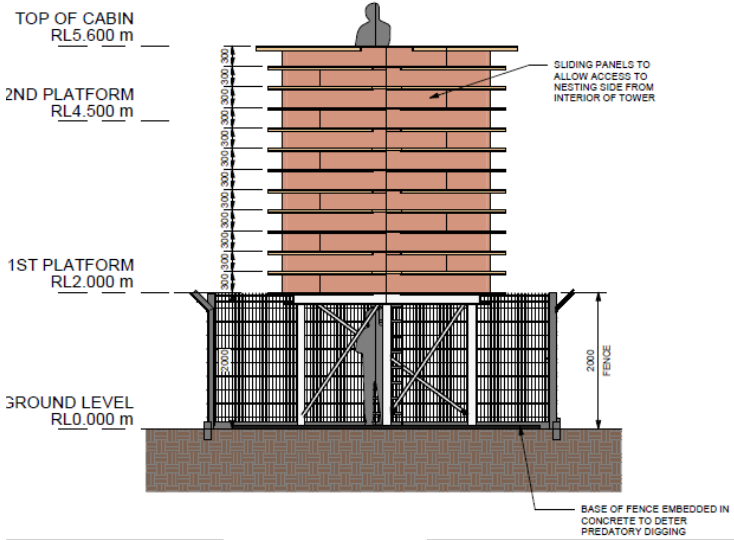


Figure 2-4 – Side Elevation Showing Shelving

Appendix

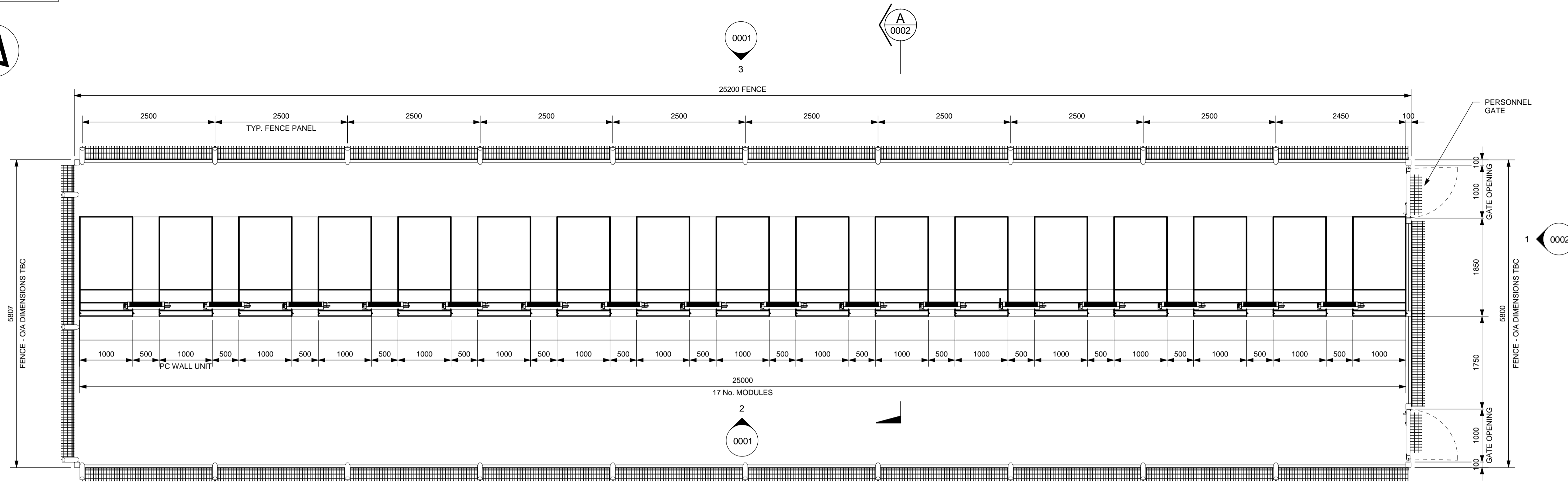
Concept Design

Kittiwake Hotel

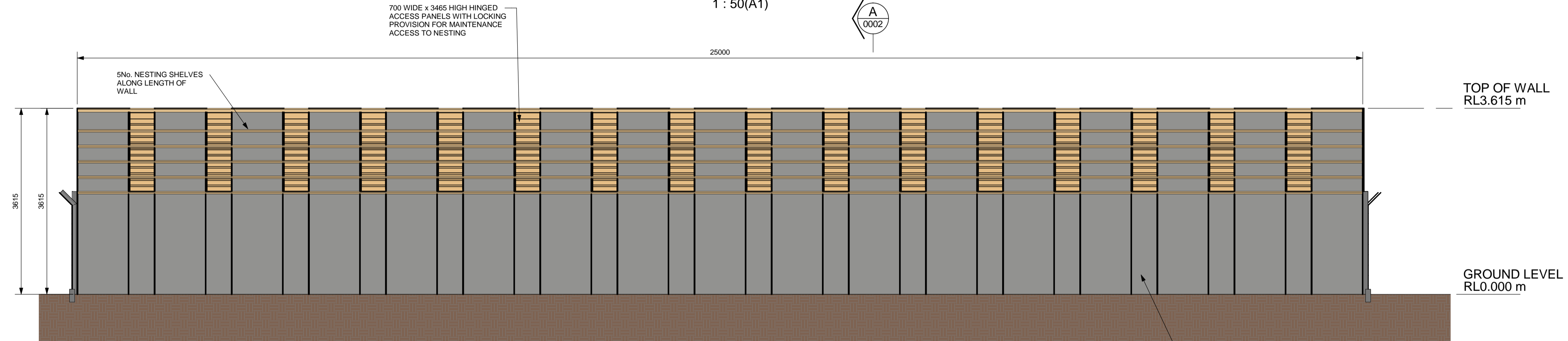


A1 Drawings

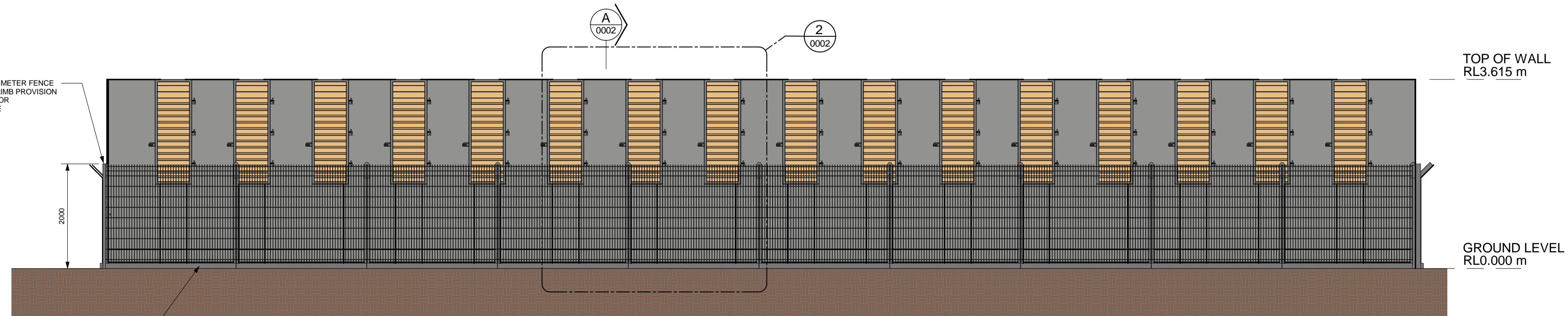
ORIENTATION OF NESTING TO BE IN A NORTHEASTERLY DIRECTION



PLAN ON KITTIWAKE WALL
1: 50(A1)



ELEVATION 2
1: 50 (A1) 0001
REAR ELEVATION OF KITTIWAKE WALL



ELEVATION 3
1: 50 (A1) 0001
FRONT ELEVATION OF KITTIWAKE WALL

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE
2. ALL MATERIALS & WORKMANSHIP WILL BE AS DEFINED IN THE SPECIFICATION UNLESS NOTED OTHERWISE

PRELIMINARY

NOT FOR CONSTRUCTION

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|-----|----------|----------------|----|-----|-----|
| P1 | 04/03/20 | CONCEPT DESIGN | AS | HB | TH |
| REV | DATE | DESCRIPTION | BY | CHK | APP |

REVISIONS

CLIENT



PROJECT
KITTIWAKE ARTIFICIAL NESTING SITES

TITLE
PRECAST CONCRETE WALL CONCEPT - PLAN & ELEVATIONS

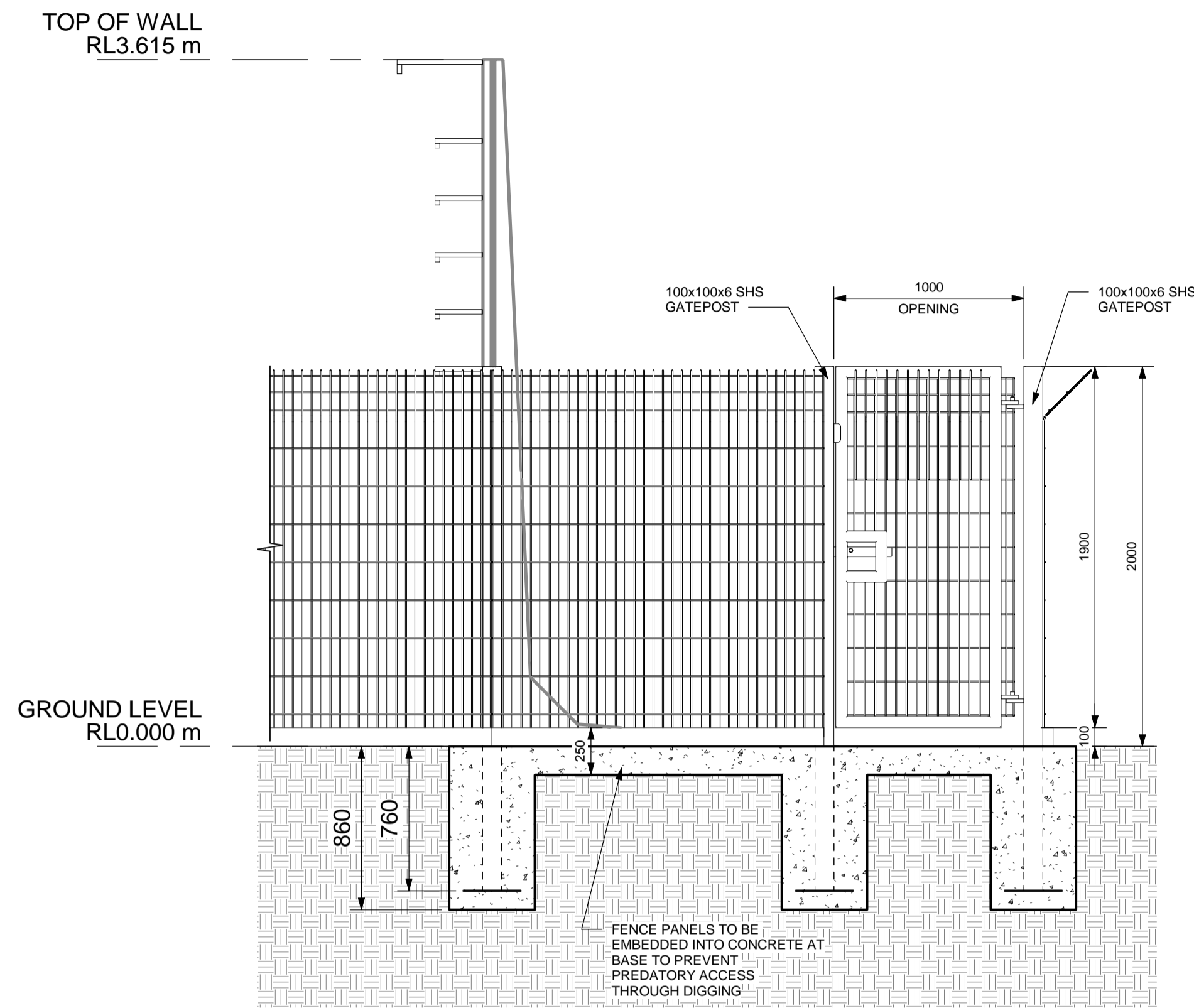
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Website: www.royalhaskoningdhv.com



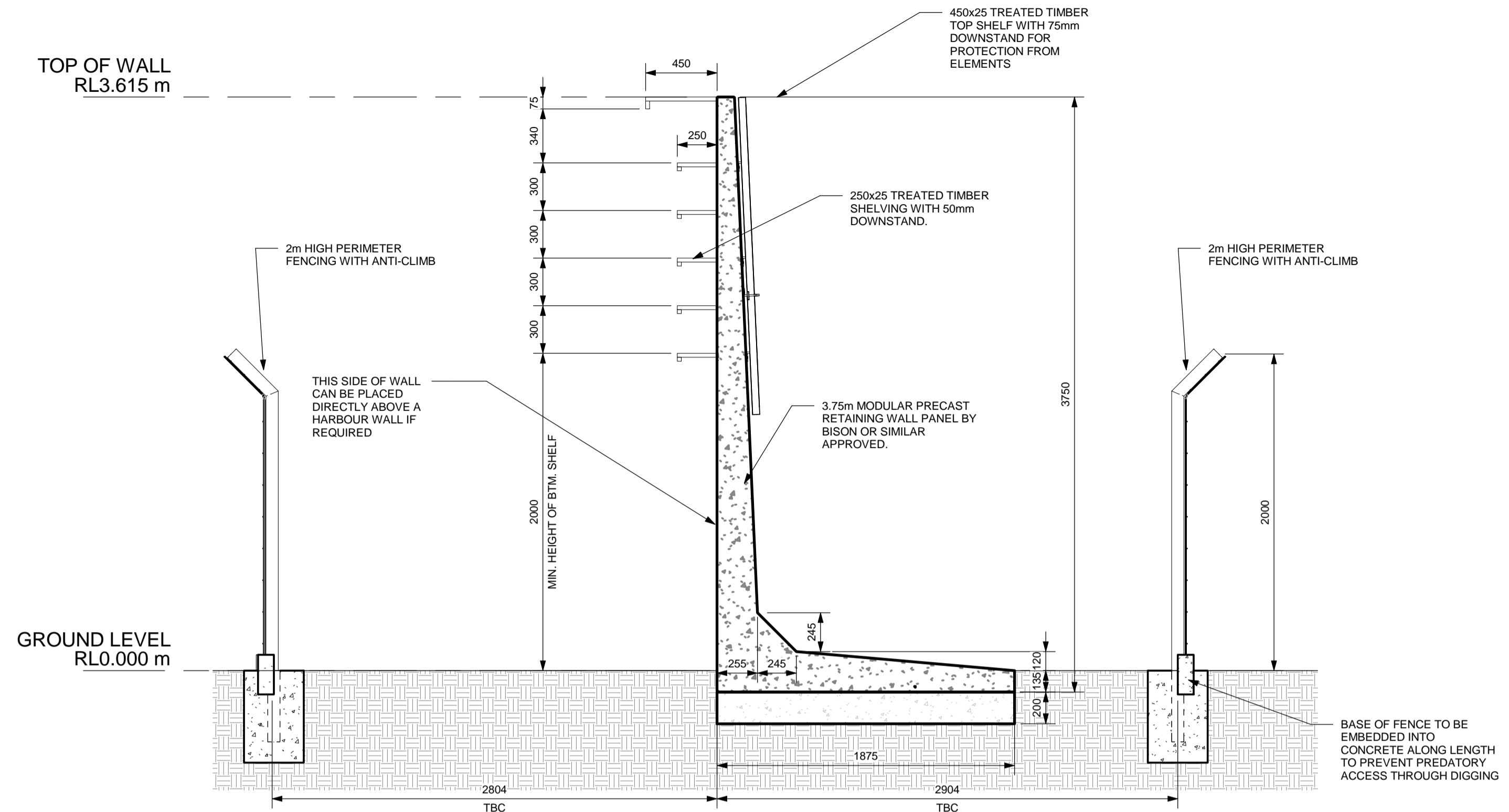
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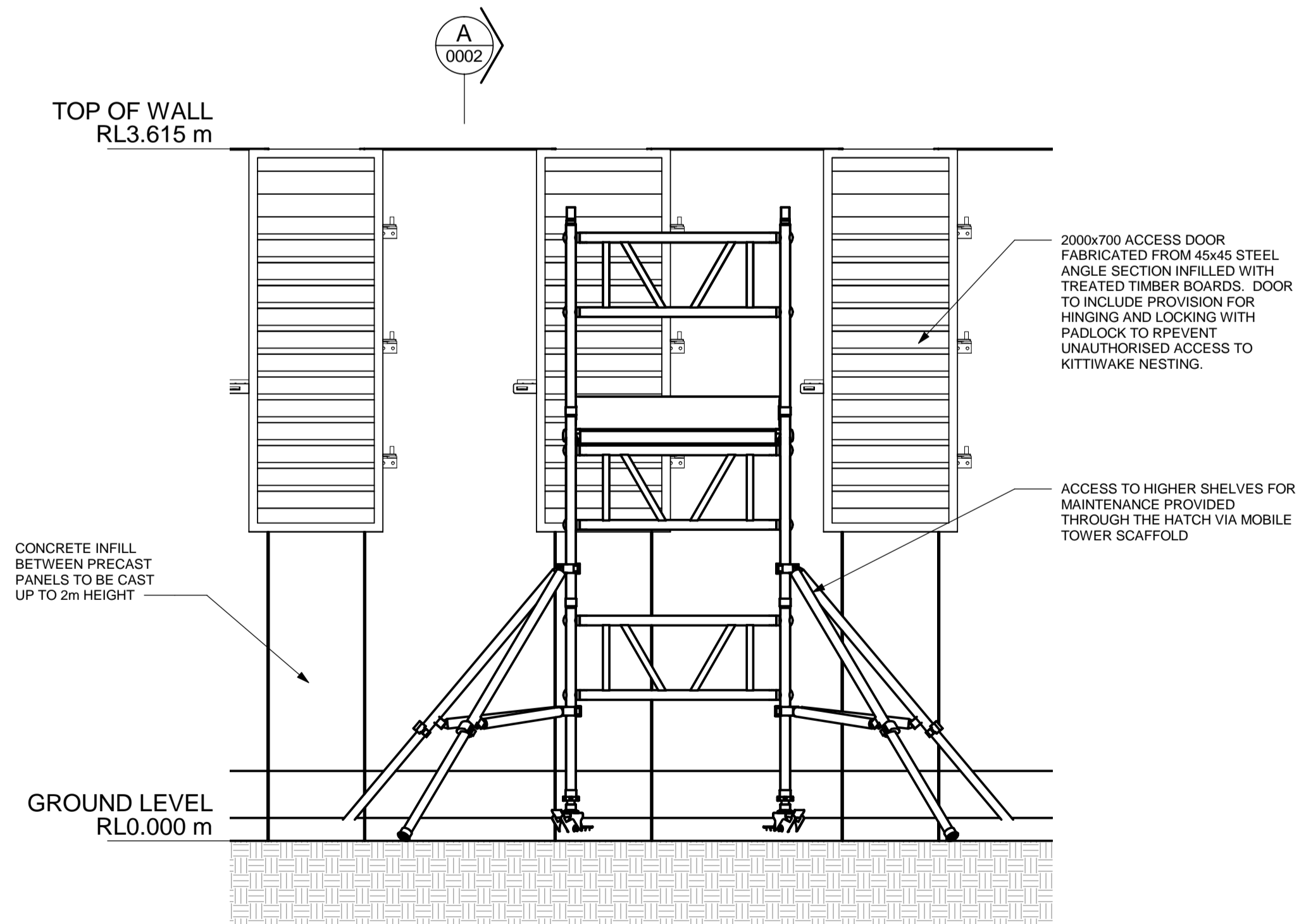
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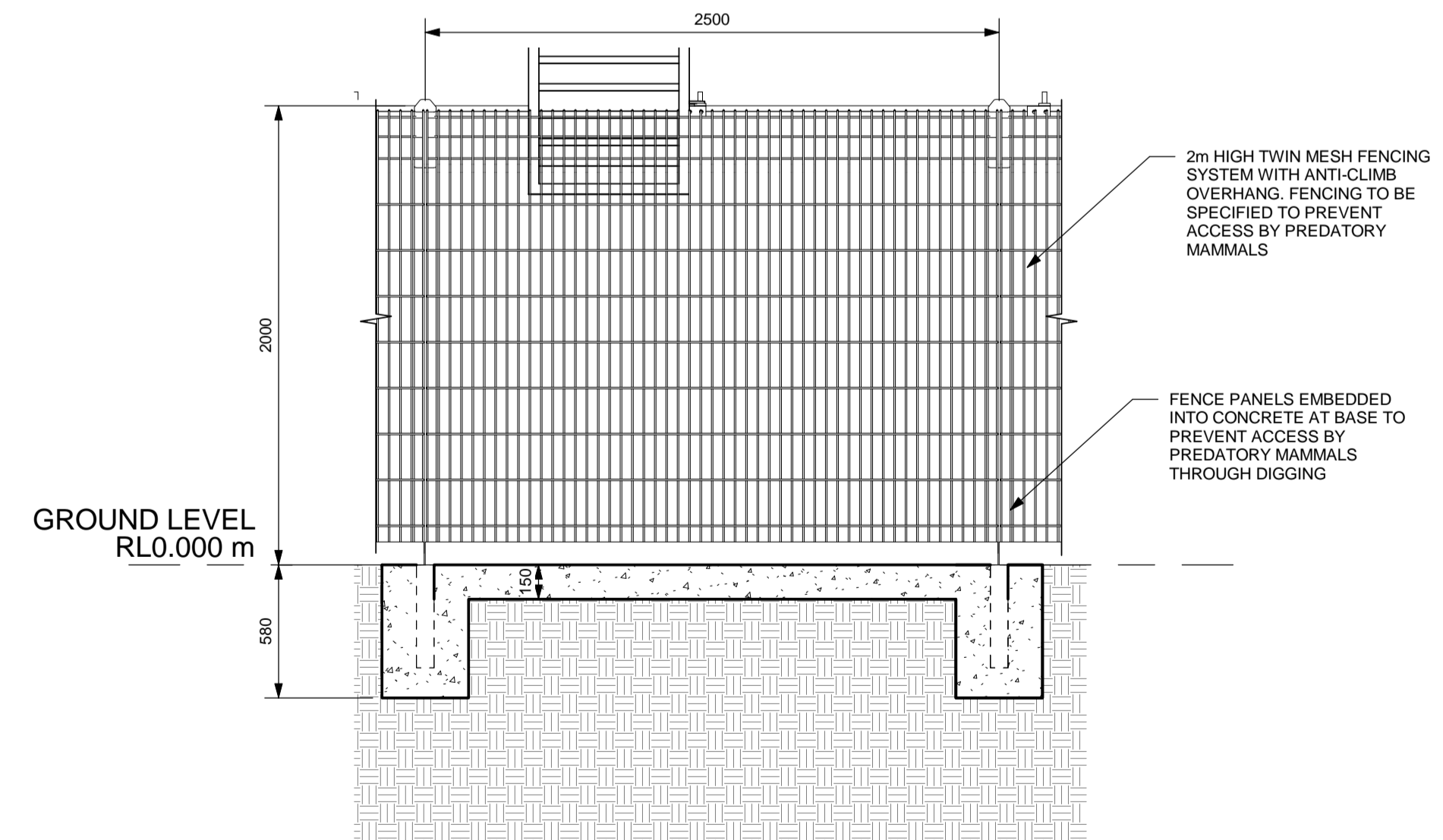
ELEVATION 1
1 : 25 (A1) 0001
ELEVATION ON PERSONNEL GATE



SECTION A
1 : 25 (A1) 0001
SECTION A-A THROUGH KITTIWAKE WALL



ELEVATION 2
1 : 25 (A1) 0001
HINGED ACCESS DOOR DETAIL



DETAIL 3
1 : 25 (A1) 0001
TYPICAL FENCE PANEL DETAIL

NOTES:

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PRELIMINARY

NOT FOR CONSTRUCTION

| REV | DATE | DESCRIPTION | AS | HB | TH |
|-----|----------|----------------|----|-----|-----|
| P1 | 04/03/20 | CONCEPT DESIGN | AS | HB | TH |
| | | | BY | CHK | APP |

REVISIONS

CLIENT



PROJECT
KITTIWAKE ARTIFICIAL NESTING SITES

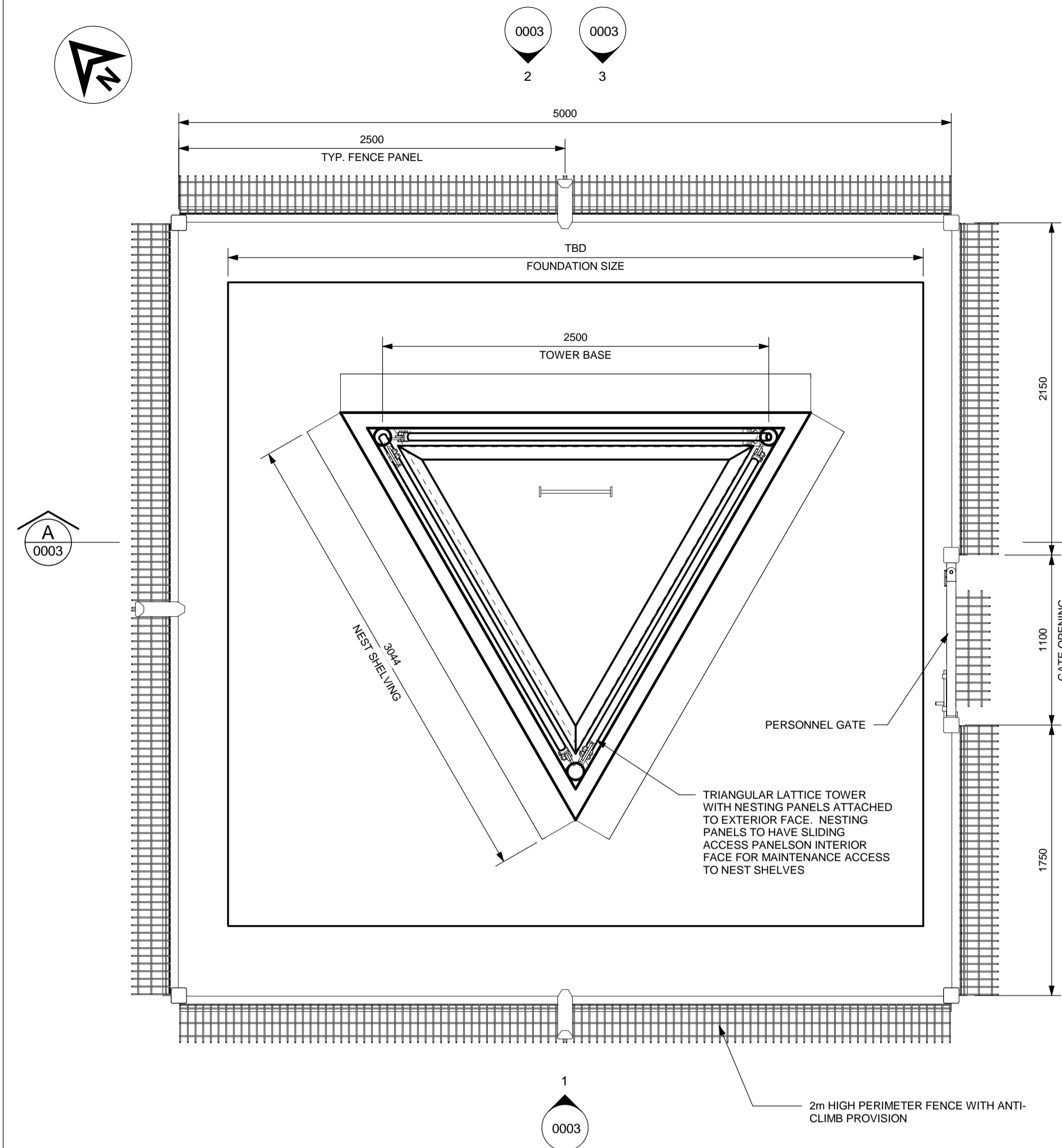
TITLE
PRECAST CONCRETE WALL CONCEPT - SECTIONS & DETAILS

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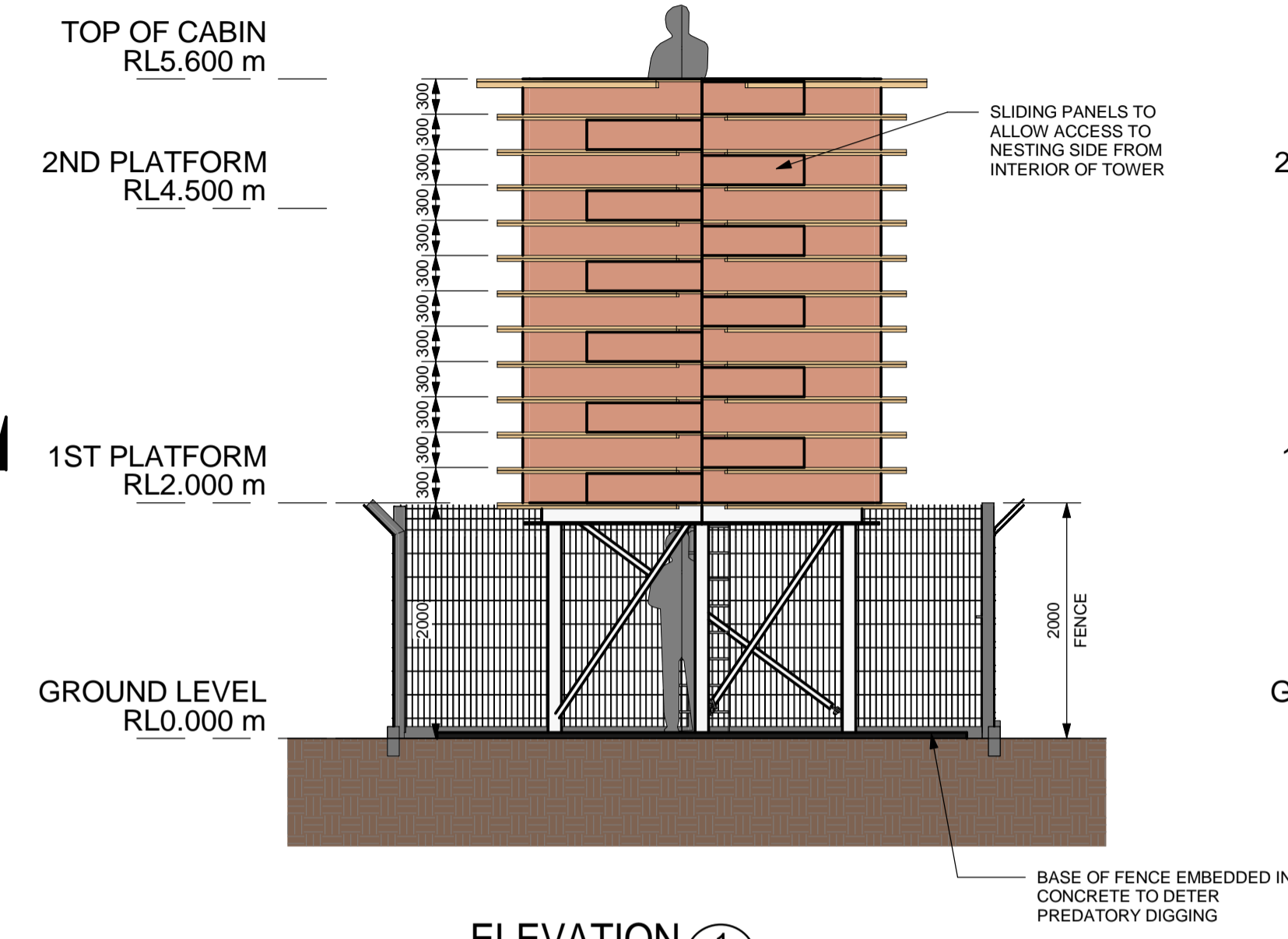


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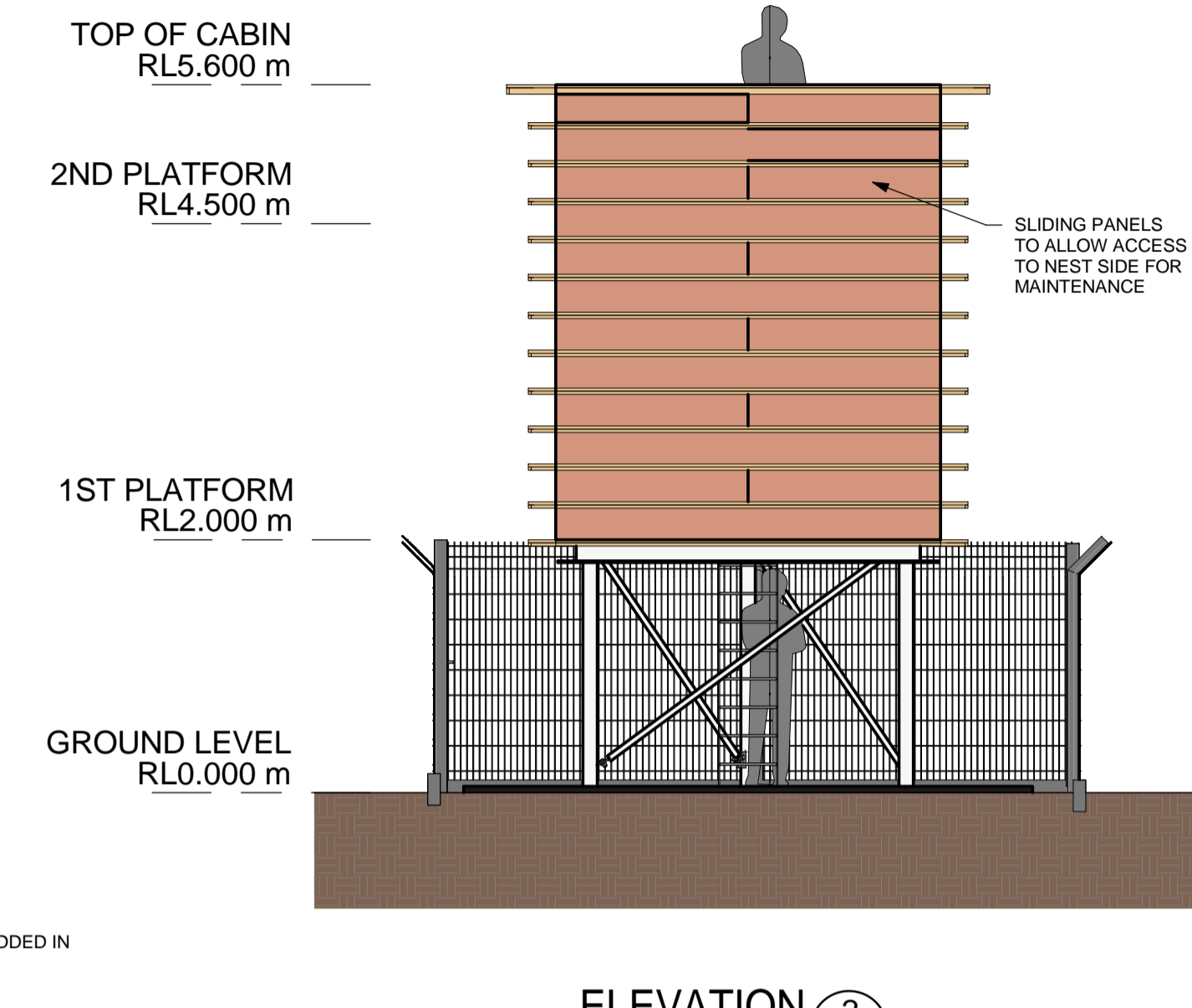
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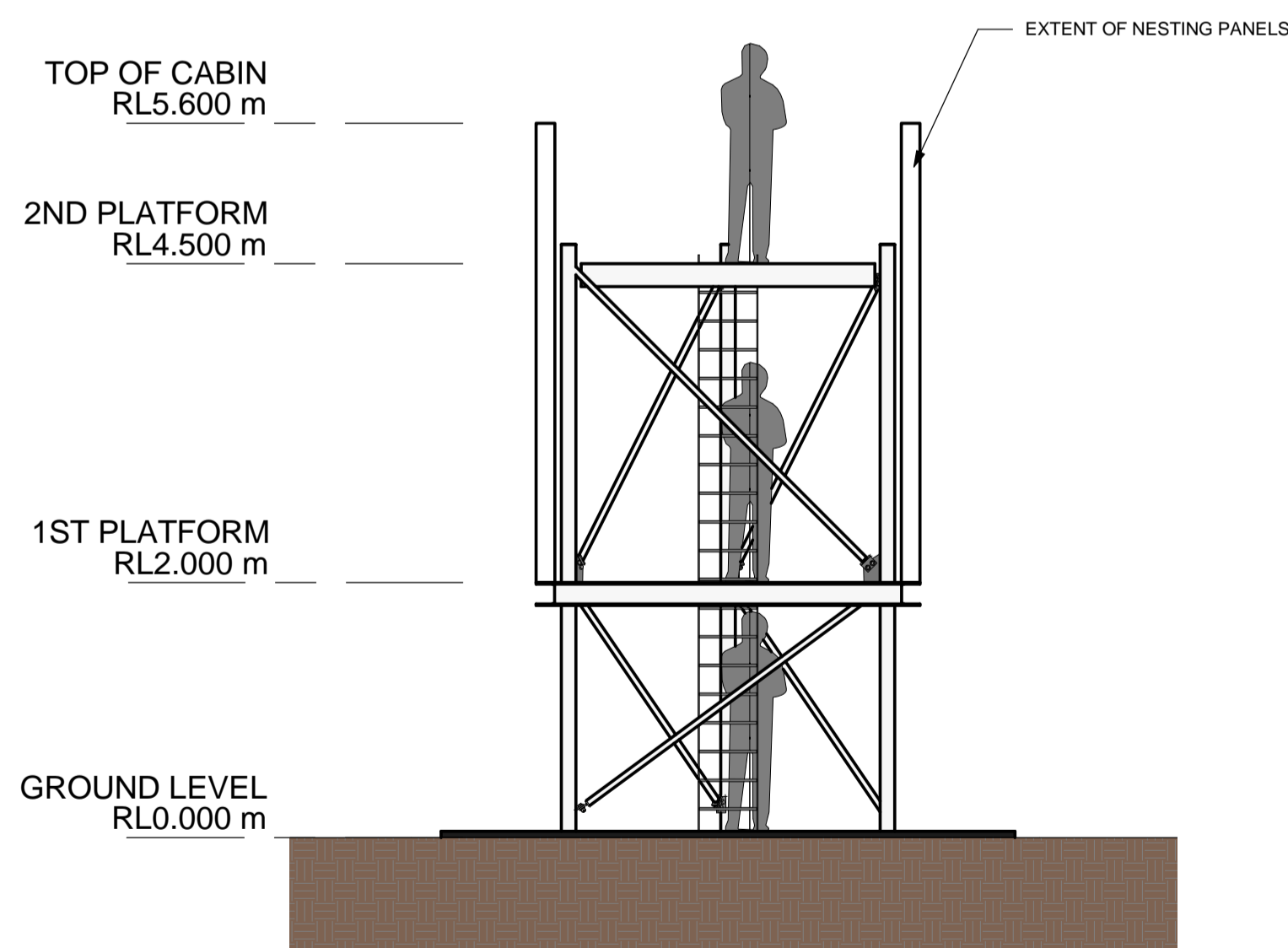
PLAN ON KITTIWAKE NESTING TOWER
1 : 25(A1)



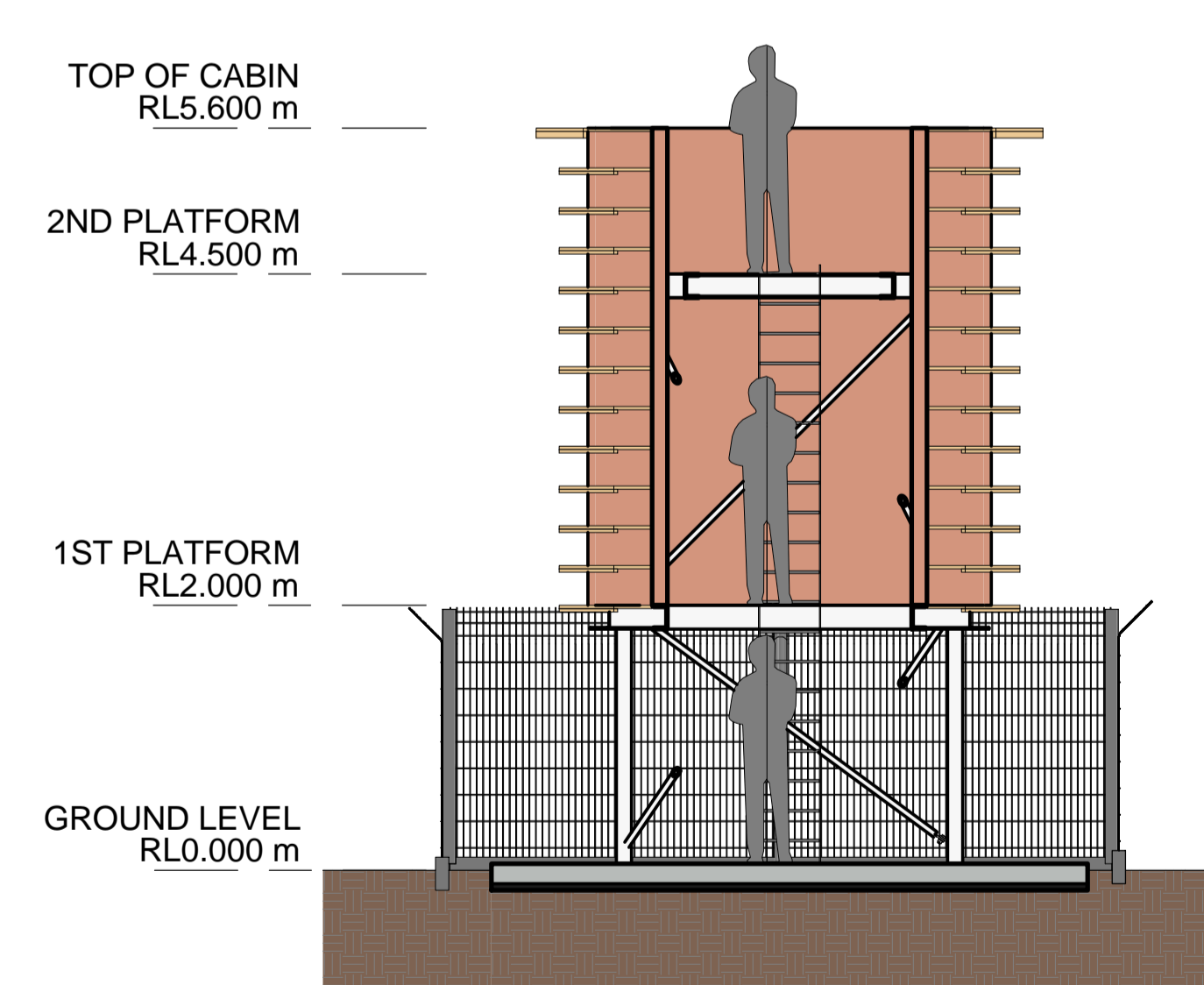
ELEVATION 1
1 : 50 (A1) 0003
FRONT ELEVATION OF KITTIWAKE WALL



ELEVATION 2
1 : 50 (A1) 0003
REAR ELEVATION OF KITTIWAKE WALL



ELEVATION 3
1 : 50 (A1) 0003
ELEVATION ON STEEL LATTICE TOWER



SECTION A
1 : 50 (A1) 0003

NOTES:

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| P1 | 04/03/20 | CONCEPT DESIGN | AS | HB | TH |
| REV | DATE | DESCRIPTION | BY | CHK | APP |

REVISIONS

CLIENT



PROJECT
KITTIWAKE ARTIFICIAL NESTING SITES

TITLE
KITTIWAKE TOWER CONCEPT - PLAN, ELEVATIONS & SECTION



| | | | | | |
|-------------|----------------------------|-------------|--------------|----------|----|
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