Ørsted

Appendix 1: Pattern Book

Kittiwake Implementation & Monitoring Plan

Design Report

Hornsea Three

Kittiwake artificial nesting structure pattern book

May 2021

LDĀDESIGN

When the tarrock takes to air
from his western cliff,
he'll never look at land again –
his cloud-high soul adrift –
until he shrugs his shoulders clean
and shakes his heart awake:
the tarrock dips his wings in ink,
becomes a kittiwake,

and on the swell he finds a mate
to please his infant soul;
they scud beneath the firmament,
they fish above a shoal,
the sky itself their waking day,
the sea-swell is their rest,
until the blush of thrift on stone
calls them in to nest,

and by the samphire on a ledge,
the kelp-blotched eggs are laid.
Where there's scarce a place to perch
the chicks hatch unafraid,
in briny air amid the gales
where seething waters break,
and little Keltie, who is dead,
becomes a kittiwake.

Kittiwake, by Giles Watson

Contents

Version:	1.3
Version date:	October 13 2021
Comment	Final

This document has been prepared and checked in accordance with ISO 9001:2015

1.0 Introduction

The purpose this document is to act as a tool that can be used to inform the design of kittiwake artificial nesting structures (ANS) in any appropriate location, building on the ecological design principles developed by Orsted, NIRAS and WSP developed as part of the Hornsea Project Three Offshore Wind Farm (Hornsea Three). The criteria involved in the initial selection of the ANS sites is not covered in this document.

The intention is to create a live document that can be:

- used by designers of ANS;
- used to communicate ANS design approach to stakeholders as part of engagement and planning activities;
- updated in response to design development, research findings from Orsted ANS once installed or ANS research findings external to Hornsea Three.
- potentially shared with the wider public to communicate ANS design approach and Orsted's commitment to high quality environmental design.

1.1 Kittiwake - *Rissa tridactyla*

Kittiwakes are coastal gulls who spend the majority of their time out at sea, landing only on coastal cliffs to nest. The population of these gulls is continually declining, likely due to a lack of key food sources and kittiwakes therefore hold a red conservation status. There are currently 380,000 breeding pairs in the UK situated around various coastal regions of the country.

The birds are characterised by their 'dipped in ink' markings and are thought by many to be the most beautiful of all gulls. They have short black legs and when in flight no white can be seen on their black wing tips, setting them apart from other gull species. They have a short yellow beak and dark eyes with thin red edge markings.

Kittiwakes natural nesting habitats are steep coastal cliff ledges that are too narrow to be landed on by larger gull species. They build nest structures from a variety of materials, typically including mud to seaweed. Often, they can also be found nesting in built structures such as piers, offshore oil rigs and abandoned buildings. These structures often provide similar characteristics to the sea-cliff.

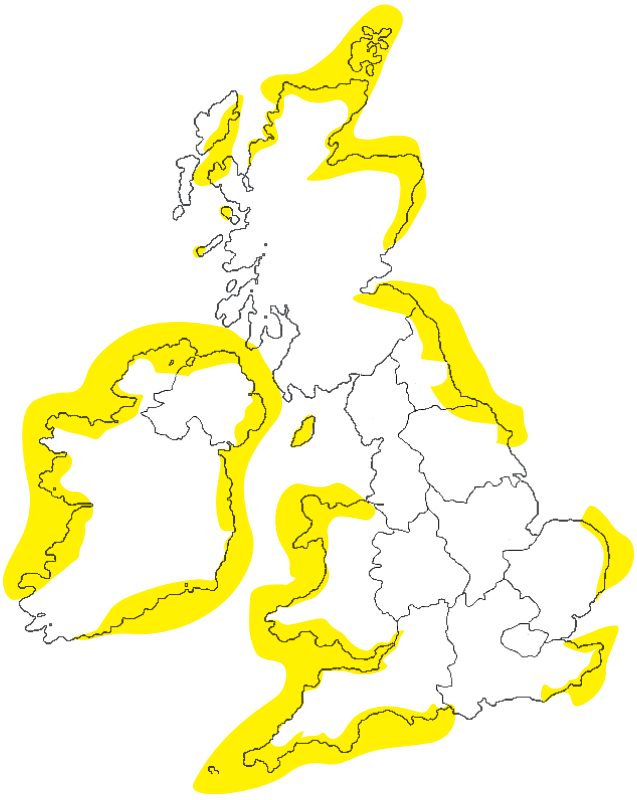
The birds generally lay two eggs during their breeding season from March to July and after fledging, the young birds stay at sea for 2-3 years before searching for a life long breeding colony.

Once a successful colony has been found, the birds will likely continue to return there annually. The average lifespan of a kittiwake is around 12 years.

Kittiwakes natural nesting habitat is on the medium to upper rocky sea cliff ledges and the built structures that kittiwakes nest on generally provide similar characteristics to the successful cliff ledge environments.

Typical features of the nesting habitats include:

- medium to high ledges, out of the splash zone of the sea;
- ledges with a slight overhang or ceiling to increase protection from predators;
- narrow ledges which are too small for larger gull species to land on;
- completely horizontal ledge surfaces are not necessarily essential as kittiwakes build nest structures up on top of the ledge surfaces;
- offshore oil rigs, abandoned buildings, railway and pier substructures can also provide small sheltered ledges which kittiwakes are attracted to;
- conditions that provide a degree of shelter and protection from wind, rain and direct sunlight are advantageous.



UK kittiwake colonies

2.0 The design patterns

The design of the ANS involves a range of complexities related to providing optimum ecological nesting conditions for kittiwakes and making ANS so they become a positive part of the varied landscapes within which they can be located.

Given all the ecological and landscape complexities when considering ANS design, a pattern language provides the ideal basis for establishing a design approach and applying design thinking that is:

- consistent;
- principled;
- flexible and adaptable in response to any ANS locations.

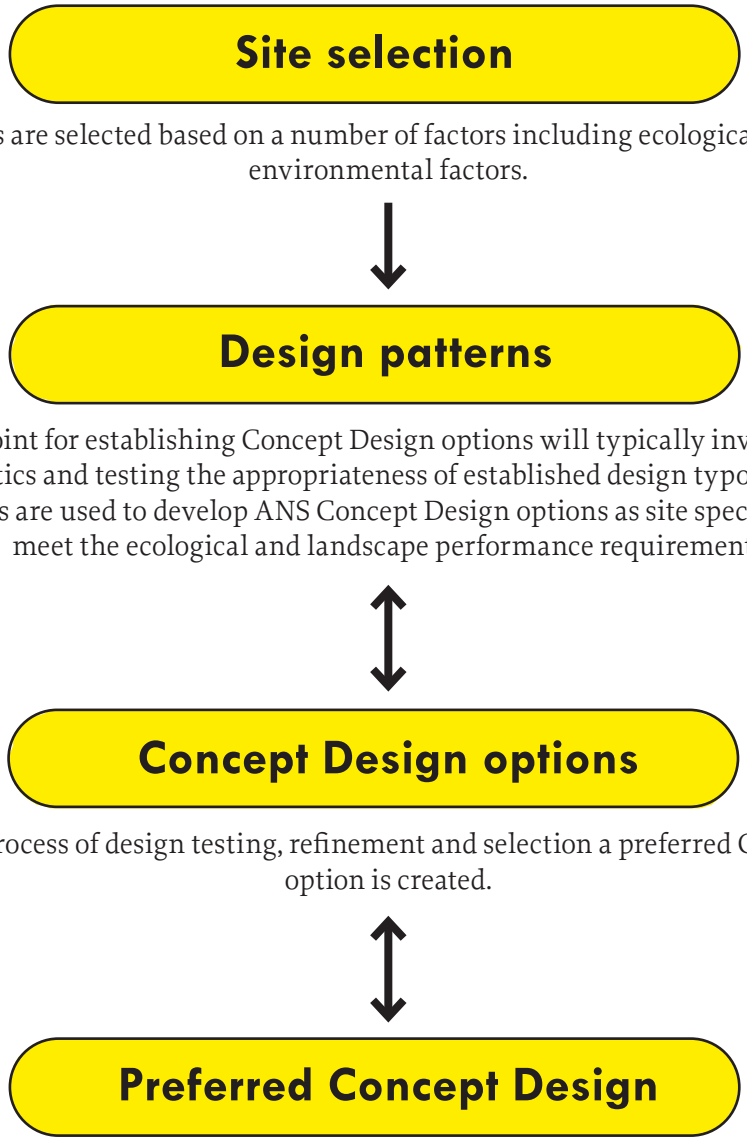
The pattern language provides a set of timeless solutions that can be applied in a diversity of ways that address the opportunities and challenges of the ANS design. This provides an approach that is flexible, enduring and capable of adapting to future changes.

Patterns provide the units of this language and these are kittiwake and landscape-centred, derived from the universal ecological requirements for successful nesting conditions and the unique qualities of place particular to each ANS location. The pattern book provides a tool that will allow the creation of ANS with optimised nesting conditions as well as ANS that have an optimised fit within any landscape they are located.

The pattern language comprises a set of twenty eight interrelated design patterns shaped around ecological and landscape design requirements.

The patterns are used for design but they are equally useful to communicate the ANS approach to stakeholders as part of a transparent and easy to understand process. Over time, findings from ANS once installed and in use can inform the refinement of existing design patterns or the creation of new patterns.

2.1 Design process



2.2 The design patterns

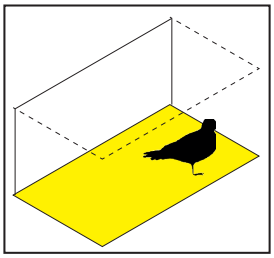
A set of 28 interrelated design patterns have been created that will form the basis for ANS design approach in any appropriate location.

Patterns 01 - 18 provide ecological performance requirements with patterns 19 - 28 providing landscape performance requirements for the ANS.

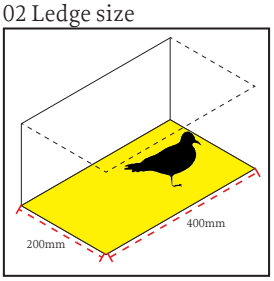
The ecological patterns are concerned with the creation of successful nesting conditions and the ability to monitor and potentially adapt the ANS over time in response to research findings or changes in environmental conditions such a sea level rise.

The landscape patterns are concerned with the appropriate contextual integration of ANS within the landscapes they are located and key considerations in terms of their functional performance including durability, maintenance and sustainability.

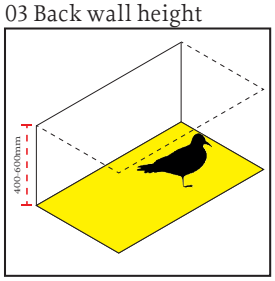
01 Structure



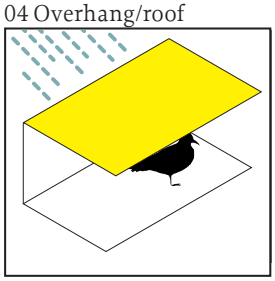
02 Ledge size



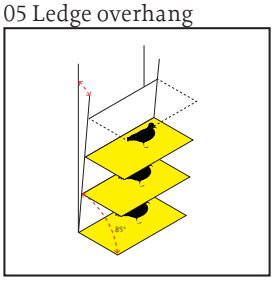
03 Back wall height



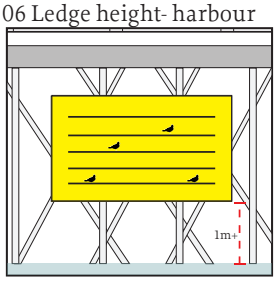
04 Overhang/roof



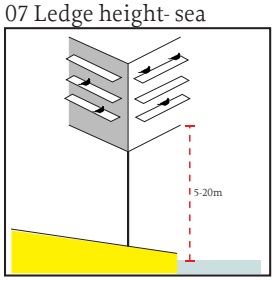
05 Ledge overhang



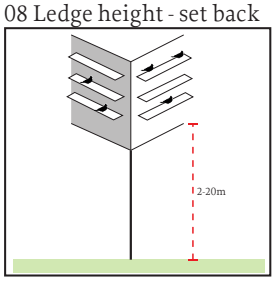
06 Ledge height- harbour



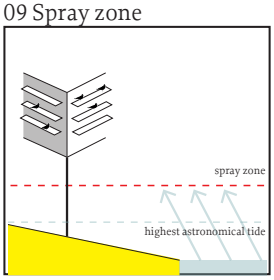
07 Ledge height- sea



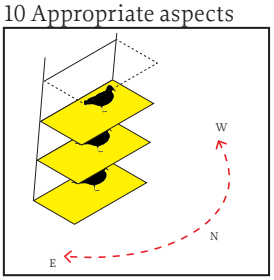
08 Ledge height - set back



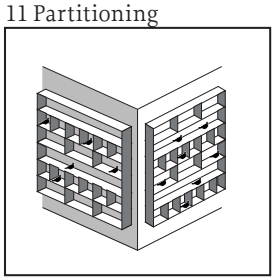
09 Spray zone



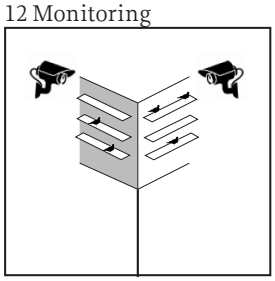
10 Appropriate aspects



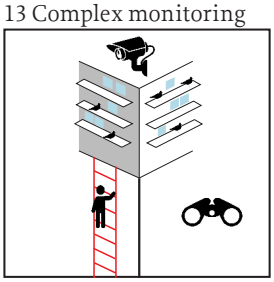
11 Partitioning



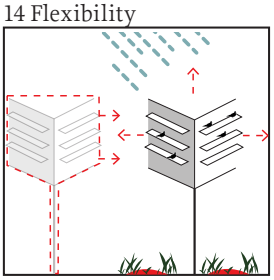
12 Monitoring



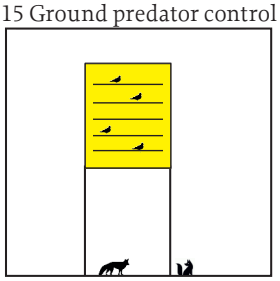
13 Complex monitoring



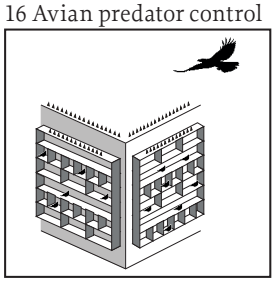
14 Flexibility



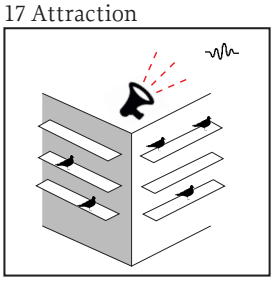
15 Ground predator control



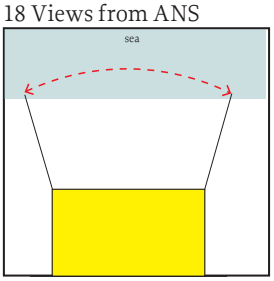
16 Avian predator control



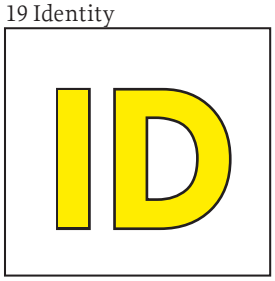
17 Attraction



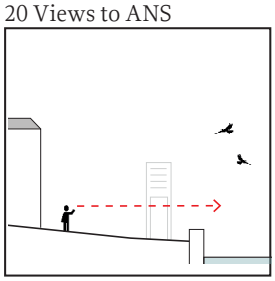
18 Views from ANS



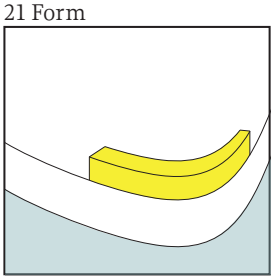
19 Identity



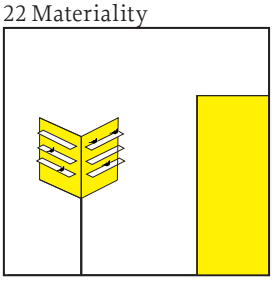
20 Views to ANS



21 Form

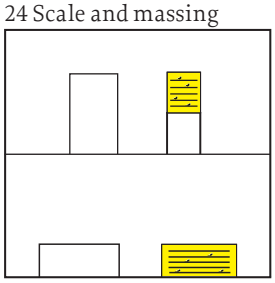


22 Materiality

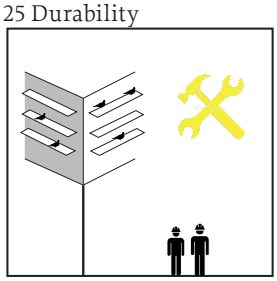


23 Neighbouring uses

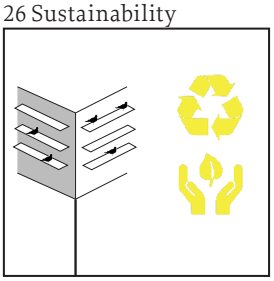
24 Scale and massing



25 Durability

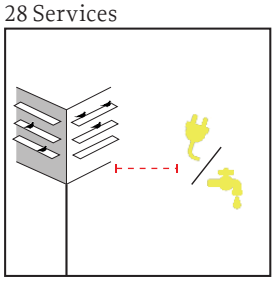


26 Sustainability

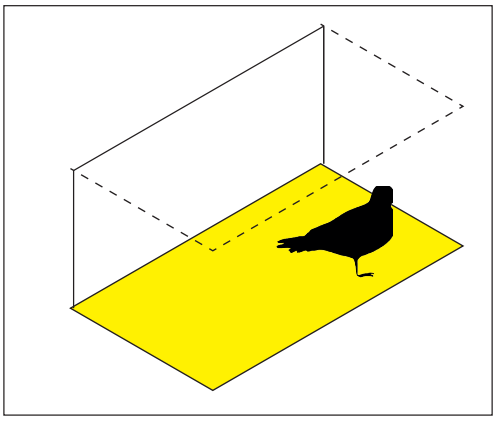


27 Access

28 Services

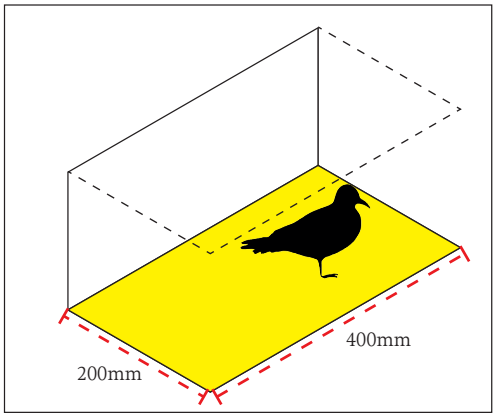


01 Structure



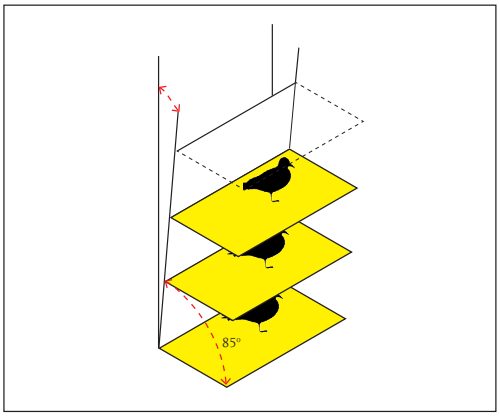
Essential: a high and steep sided structure with a near vertical back wall and narrow horizontal ledges.

02 Ledge size



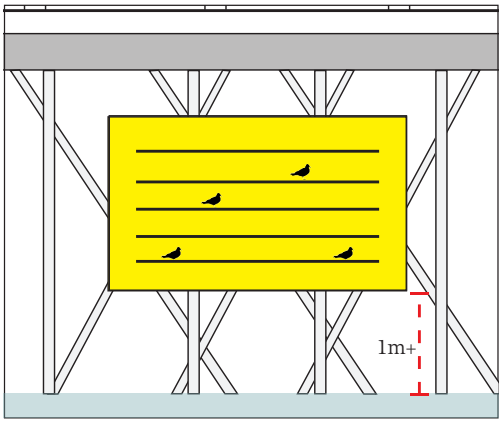
Essential: adequate ledge dimensions: horizontal ledges 200mm width; length per pair from 300mm (working length 400 mm).

05 Creating ledge overhang



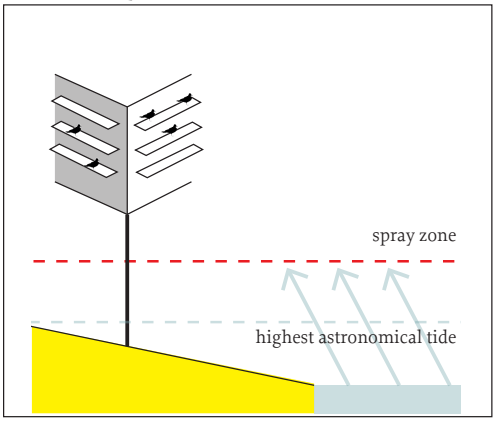
Optimising success: vertical wall designed to create nesting ledge overhangs sufficient to minimise lower ledge fouling by droppings and potential for reducing avian predation risk.

06 Ledge height - harbourside



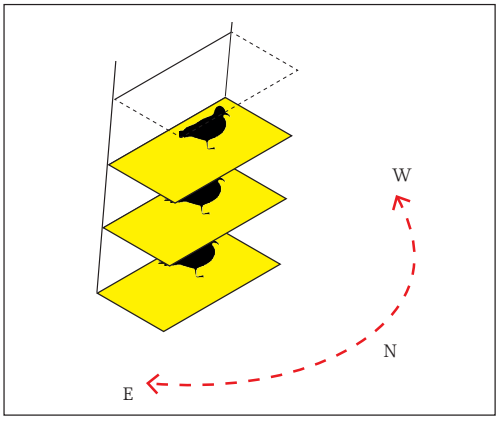
Essential: minimum height if at harbourside waterfront location. 1 m + above wave height/ splash zone of HAT , predicted for 2050 accommodating for sea level rise (in > 50 years).

09 Spray zone



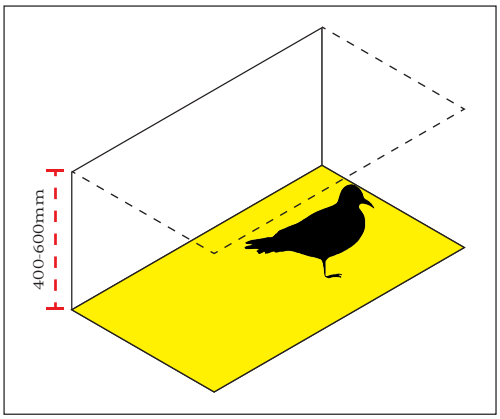
Essential: nesting ledges located above the level of highest astronomical tide and beyond the reach of wave action.

10 Appropriate aspects



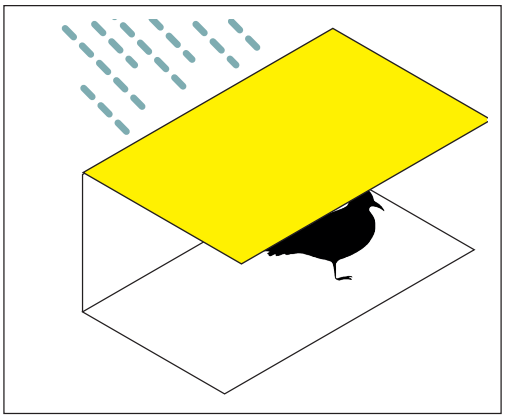
Essential: majority of nesting ledges should not be south-facing. If this is not possible, ledges should be facing multiple aspects. Shelter from prevailing wind may also need consideration.

03 Back wall height



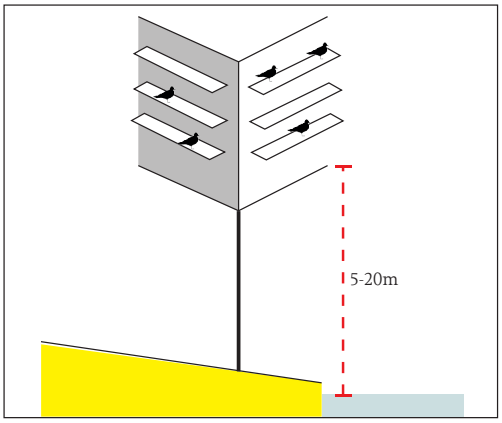
Essential: height between ledges at a minimum of 400 mm and maximum of 600 mm.

04 Overhang / Roof



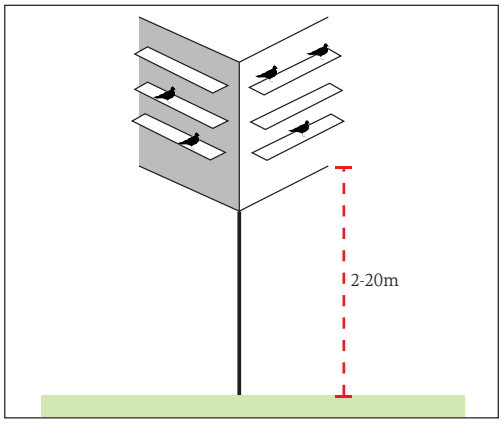
Optimising success: overhang / roof to help protect against weather conditions and additional predator deterrent. Roof pitch in excess of 25 degrees can be used to deter nesting.

07 Ledge height - exposed sea frontage



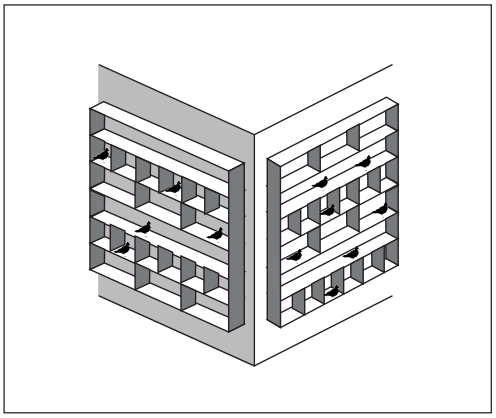
Essential: minimum height if at exposed waterfront location. 5-20 m (above HAT site dependent;) above wave height/ splash zone of HAT predicted for 2050, accommodating for sea level rise (in > 50 years).

08 Ledge height - set back



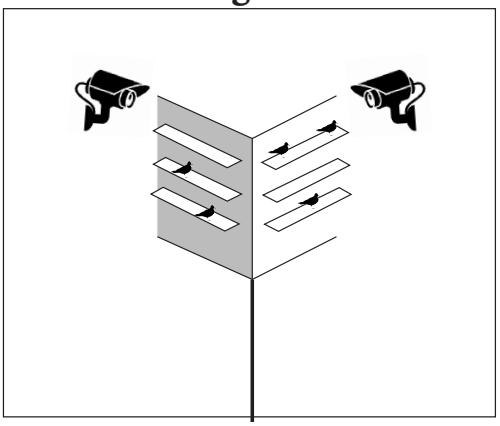
Essential: minimum height if set back from water depends on anticipated disturbance likelihood. Restricted human access - 2m+, low disturbance - 3-4m+. high disturbance - 10-20m. Shelving high enough for direct line of sight/flight to water.

11 Partitioning



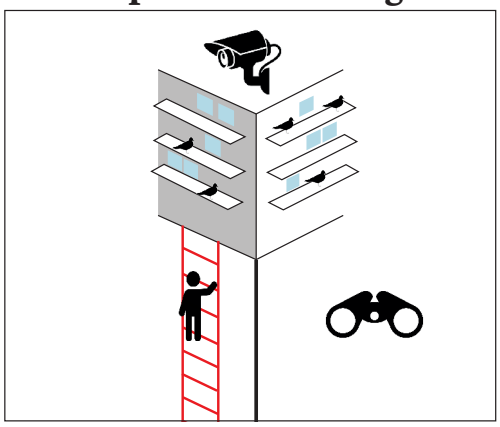
Optimising success: walls/partitions between groups of nests. To facilitate an experimental design, each structure should have alternating rows with and without compartments. The order of alternation should be different on adjacent faces. Design should allow for easy addition/removal of partitions.

12 Monitoring



Optimising success: include capacity for remote monitoring devices e.g. cameras to provide coverage of all available ledges at a sufficiently high resolution to monitor individual nests including chicks and eggs to be inspected.

13 Complex monitoring



Optimising success: complex monitoring features to be included as required:

a) Internal access.

b) Enclosed structures where the personnel monitoring within would be hidden from view, including to birds flying above and therefore minimising any disturbance.

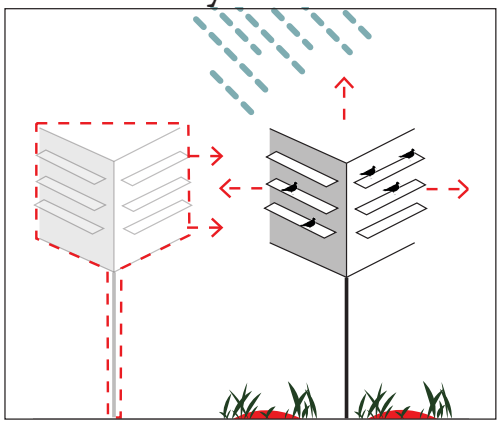
c) Either with hatches to allow access from behind/within the structure to individual nests by ornithologists undertaking monitoring works.

d) And / or one-way glass to allow observations to be made from interior/ back of structure.

e) Capacity for additional monitoring equipment to be accommodated within/on the structure

f) Welfare facilities.

14 Flexibility



Essential (a,d), optimising success (b, c, e): capacity for the structure to be modified to facilitate adaptive management design features after they have been operational for 4+ years. These may include:

a) Extension of structure to facilitate further nesting spaces.

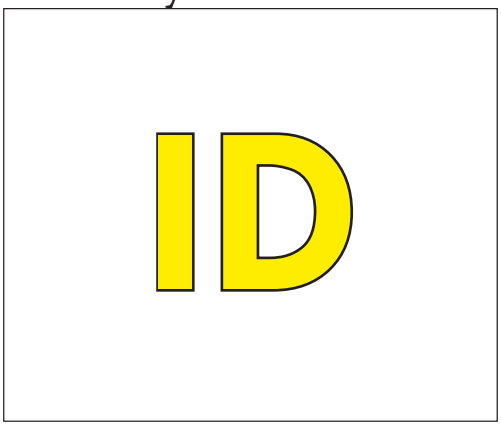
b) Relocation of nesting structure.

c) Additional protection from elements e.g. wind/weather shield location points.

d) Enhanced predator deterrent e.g. straightforward roof and fencing, including opportunities to add avian predator deterrents.

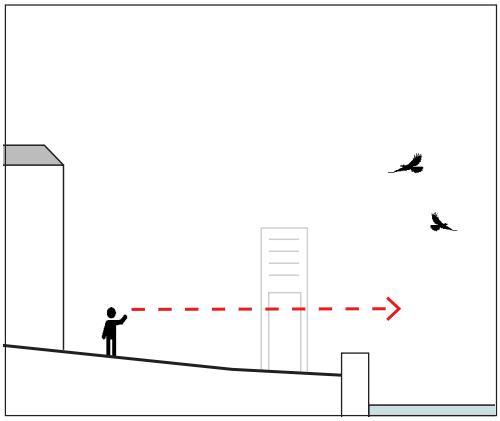
e) Provision of nesting material, such as seaweed. This would require additional protected space around or under the structure.

19 Identity



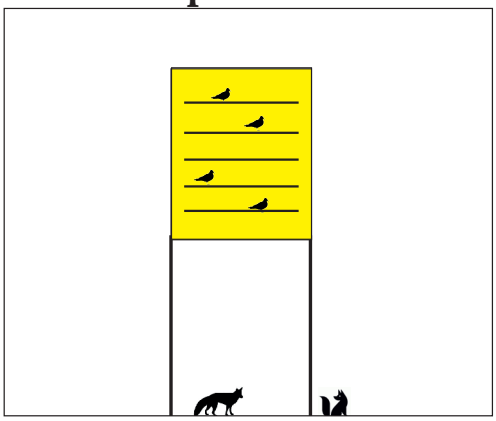
Essential: the ANS design must be contextually driven, responsive to landscape setting qualities and make a positive contribution to local identity, ensuring the ANS becomes a part of the landscape within which it is situated.

20 Views to ANS



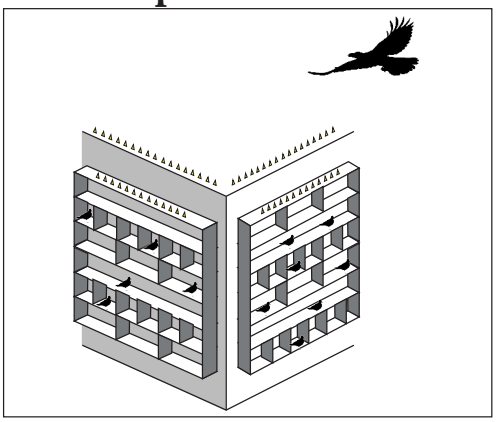
Essential: locate the ANS to avoid detriment to key views and support legibility.

15 Ground predator control



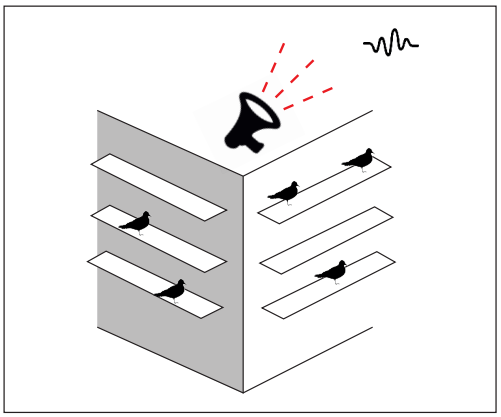
Essential: inaccessible / non climbable to ground predators such as foxes and rats; additional anti-predation features may be required such as fences / barriers but any features must be integrated with ANS design and context.

16 Avian predator control



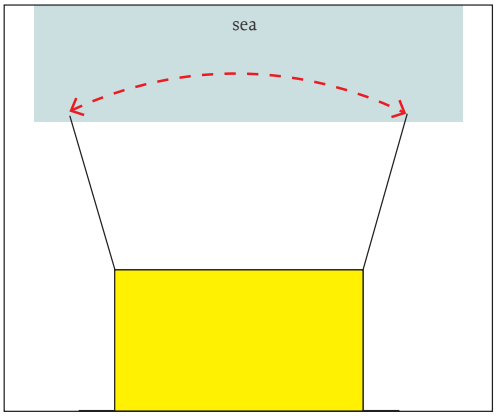
Essential: inaccessible to avian predators with special attention paid to top of ANS and nesting ledge depths; additional anti-predation features may be required but any features must be integrated with ANS design and context.

17 Attraction



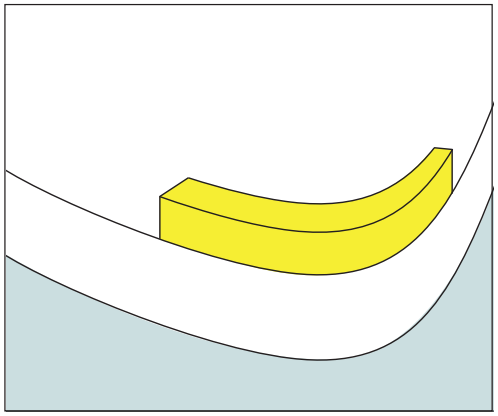
Essential: capacity for addition of decoy nests/birds and audio systems to play kittiwake calls to attract birds. These items will no longer be required once the colony is inhabited, so they should be removable or concealed within the design.

18 View from ANS



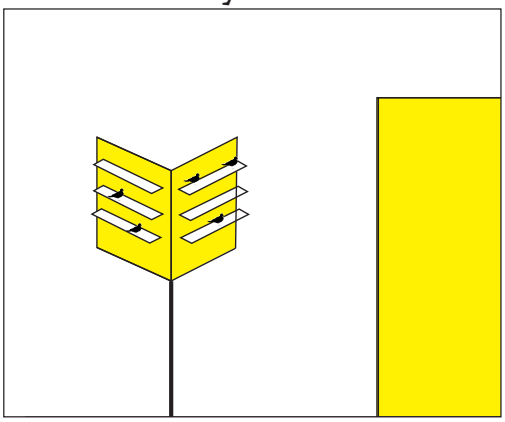
Essential: a location close to water, facing out to sea (i.e. nest adjacent to / above harbour waters / sea).

21 Form



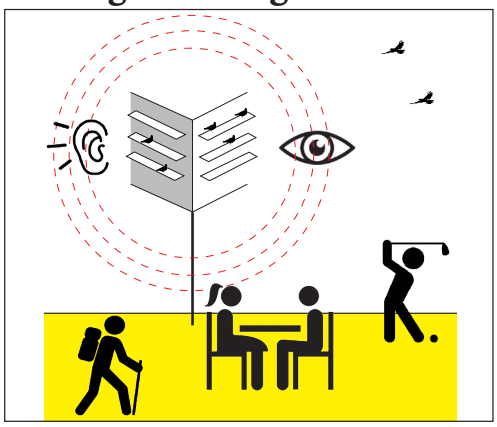
Essential: the ANS must adopt a form driven by the contextual characteristics. of the site.

22 Materiality



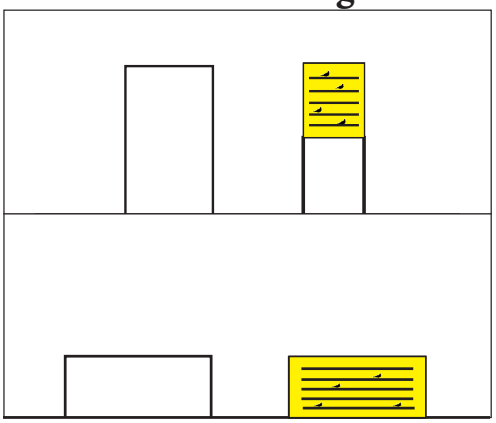
Essential: the ANS must use materials that are responsive to local contextual identity and informed by successful kittiwake nesting conditions.

23 Neighbouring uses



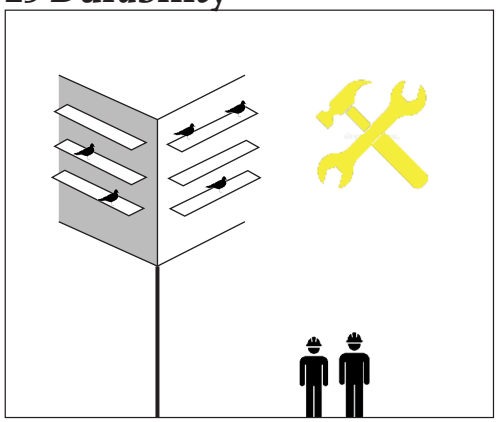
Essential: locate the ANS to avoid potential visual and noise conflict issues between the ANS, neighbouring uses and vice versa.

24 Scale and massing



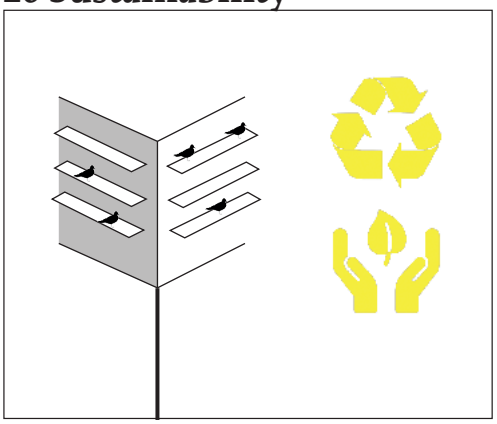
Essential: the size and shape of the ANS must be responsive and appropriate to the landscape setting within which they are located.

25 Durability



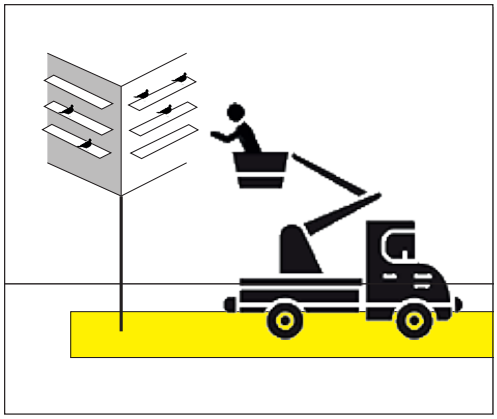
Essential: the ANS must be made to stand the test of time in the coastal conditions with associated low maintenance requirements.

26 Sustainability



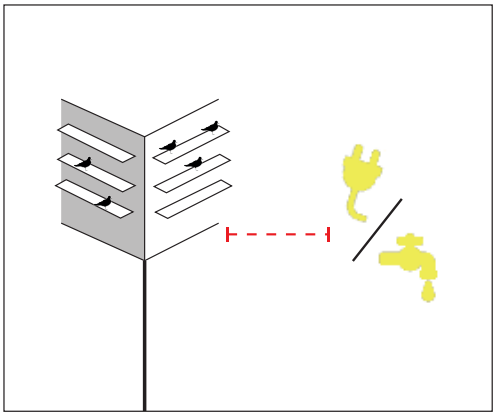
Essential: design and construction of the ANS must embed a sustainable approach throughout the process.

27 Access



Essential: access arrangements to the ANS must be considered for people and potential vehicles related to construction, ongoing visits and maintenance. Special attention must be given to safety of any access requirements, especially those at height.

28 Services



Essential: connectivity requirements for ANS features such as monitoring, audio or welfare facilities need special consideration in light of potential locations. Battery / solar power for instance may be required.

3.0 Precedents and lessons learned

A series of precedent studies were carried out by NIRAS looking at purpose made artificial nesting sites for kittiwakes that have been successful. A brief summary of the study sites is included here with lessons learned as a point of reference when considering the design of ANS.

Once constructed and in use, the Hornsea Three ANS can be added to existing precedents in the pattern book along with any new precedents external to the Hornsea Three project. Given that there are generally a lack of ANS precedents that have been evaluated with regard to successful and unsuccessful characteristics; there is an opportunity for the Hornsea Three project to make a valuable contribution in this respect.

NIRAS work concluded that kittiwakes show no preference for purpose-built artificial versus non-purpose-built artificial structures and that new kittiwake recruits take to artificial sites faster than established breeders. If designed correctly and in the right location, an artificial structure should have every chance of success in supporting a kittiwake colony.

Tyne Kittiwake Tower

Inland tower structure constructed of timber nesting and metal support legs.

Outcomes to date:

- Successful breeding on all sides, particularly north east / north west facing.
- Clay decoys successfully used to attract birds at outset.
- There have been some issues with avian predation from crows.
- The structure is not close to full capacity.

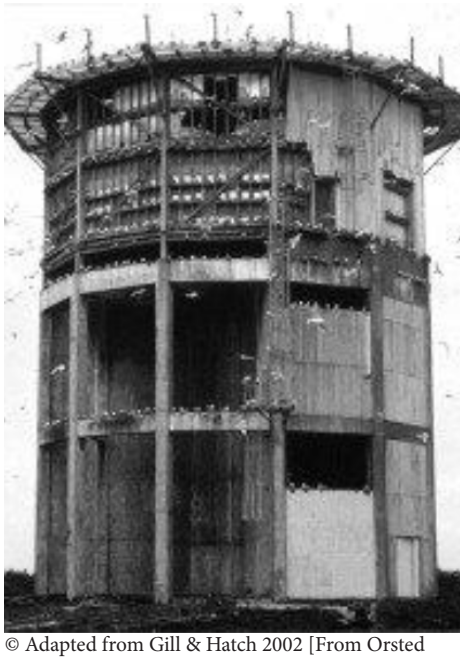
© Les Hulls Geograph.co.uk [From Orsted Ecological evidence document]

Middleton Island Seabird Tower, Alaska

Modified, decommissioned radar tower. Additional food is supplied during nesting season and monitoring opportunities are provided from inside the structure.

Outcomes to date:

- All sides occupied.
- Max recorded 400 pairs.
- Considered to probably be the best kittiwake ANS precedent.



© Adapted from Gill & Hatch 2002 [From Orsted Ecological evidence document]

Lowestoft Wall, Suffolk

Concrete wall with ledges at entrance to fishing harbour. Accessible by foot to the rear.

Outcomes to date:

- North / north west facing sides are well occupied.
- Predation issues with larger gull species on top shelves and foxes on the lower shelves.
- Despite many nests being present in various years, no chicks were raised.

© M Swindells [From Orsted Ecological evidence document]

Mumble Shelves, Swansea

Wooden shelves attached onto an existing pier structure. Placed as temporary compensation whilst renovation work was taking place on the pier.

Outcomes to date:

- 76 nests reported in 2013.
- Birds initially tried to use original nests but gradually moved across to the purpose built shelves.

© Nilfanion Wikimedia UK [From Orsted Ecological evidence document]

Boulogne Wall, France

Concrete wall with discreet compartments on top of a sea wall in an industrial port. Built as compensation for the demolition of a nearby building where kittiwakes were nesting.

Outcomes to date:

- In 2017, there were 155 nests with chicks.

© J M Sauvage [From Orsted Ecological evidence document]

4.0 Artificial nesting structure typologies

Orsted, NIRAS and WSP initially identified a number of potential design typologies for the ANS including:

- simple shelves attached to an existing structure (discounted as inappropriate for Orsted's ANS);
- purpose built tower;
- purpose built wall;
- modified wall to allow access to nests for monitoring e.g. hatches / one way glass;
- purpose built tower or structure with internal access for nest monitoring.

The typologies have associated differences in terms of:

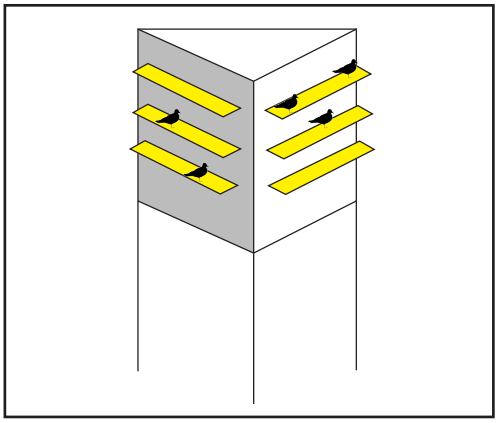
- monitoring and research potential;
- complexity of design;
- size of structure footprint;
- potential fit within the landscape setting;
- financial cost.

The typologies provide the starting point for considering the most appropriate options for a specific site in consideration of the ecological and landscape patterns. Once initial ANS typologies have been identified, Concept Design options can then be generated and through a process of testing, refinement and selection, a preferred Concept Design option can be created.

The typologies therefore provide the starting point for ANS design that will be subsequently shaped in response to the site specific application of the ecological and landscape design patterns. It is possible through the design process that new ANS typologies could be identified and these can be added to the existing typology collection in the pattern book.

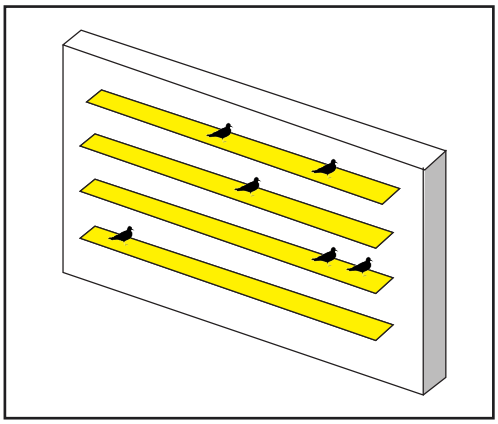
Purpose built tower

- Can be placed almost anywhere and is flexible in size and form.
- Limited options for incorporating access to the tower.
- Shape could vary.
- Versatile for relocation.



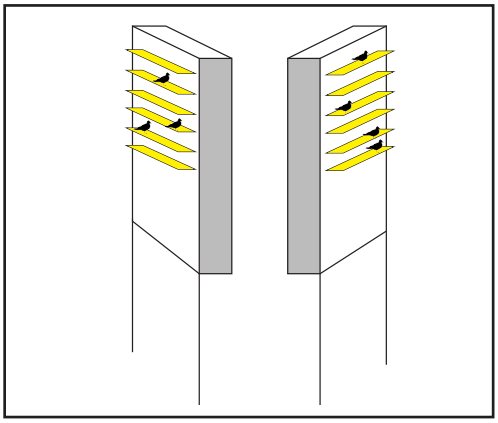
Purpose built wall

- A practical approach at waterfront locations.
- The lack of height on this option could lead to predation issues.
- Permanent, immovable design.
- Monitoring opportunity could be limited.



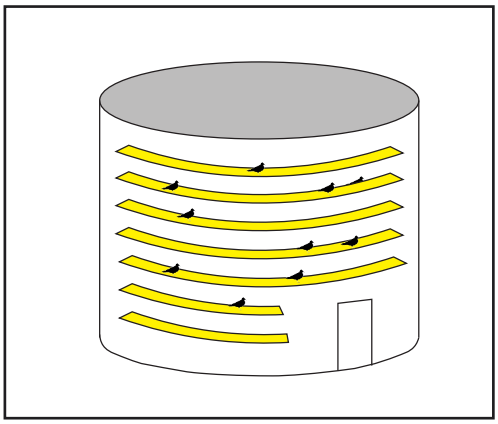
Modified wall structure

- Can fit in small constrained areas.
- Flexible in size and form.
- Potential opportunity for monitoring from the back of the walls.
- Less foundation work required compared to a purpose built building typology.



Purpose built building

- Most complex option and could have location limitations.
- Offers greatest opportunity for monitoring and access.
- May require avian predator deterrents.
- Design approach flexible in complexity and form.
- Would require a larger footprint and foundations than other typology options.



5.0 References

Information and research

- NIRAS, 2021, Hornsea 3 Kittiwake Compensation : OOEG meeting 2
- Orsted, 2020. Hornsea Project Three, Offshore Wind farm, Response to the Secretary of State's Minded to Approve Letter Annex 2 to Appendix 2: Kittiwake Artificial Nest Provisioning: Ecological Evidence
- Orsted, 2021. Hornsea Three Kittiwake Compensation. Design Principles
- Orsted, 2020, Hornsea 3 OOEG briefing note, ORSTED
- April OOEG Briefing Note - Appendix A (WSP Overview of Typical ANS developed)
- Orsted, 2020. Response to the Secretary of State's Minded to Approve Letter Annex 2 to Appendix 2: Kittiwake Artificial Nest Provisioning: Ecological Evidence. [online] Orsted. Available at: ‹https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010080/EN010080-003241-HOW03_30Sep_Appendix_2_Annex_2%20Ecological%20Evidence%20(06543000_A)%20combined%20(06543760_A).pdf›
- Scottish Wildlife Trust. 2021. Kittiwake. [online] Available at: ‹https://scottishwildlifetrust.org.uk/species/kittiwake/›
- The RSPB. 2021. Kittiwake Bird Facts | Rissa Tridactyla - The RSPB. [online] Available at: ‹https://www.rspb.org.uk/birds-and-wildlife/wildlife-guides/bird-a-z/kittiwake/›

Images

- All images of precedent Kittiwake nesting structures are adapted from Orsted, 2020. Hornsea Project Three, Offshore Wind farm, Response to the Secretary of State's Minded to Approve Letter Annex 2 to Appendix 2: Kittiwake Artificial Nest Provisioning: Ecological Evidence. Copyright/credit under each image.

Poem

- Watson, G., 2013. Kittiwake. [online] Available at: ‹https://www.flickr.com/photos/29320962@N07/8378090766›

London
New Fetter Place
8-10 New Fetter Lane
London EC4A 1AZ
United Kingdom
+44 (0) 20 7467 1470

Bristol
Studio 4B
36 King Street
Bristol BS1 4DZ
United Kingdom
+44 (0) 117 203 3628

Cambridge
17A Sturton Street
Cambridge CB1 2SN
United Kingdom
+44 (0) 1223 949054

Exeter
Kings Wharf, The Quay
Exeter EX2 4AN
United Kingdom
+44 (0) 1392 260 430

Glasgow
Sovereign House
158 West Regent Street
Glasgow G2 4RL
United Kingdom
+44 (0) 1412 229 780

Manchester
Beehive Lofts
Beehive Mill
Jersey Street
Manchester M4 6JG
United Kingdom
+44 (0) 161 359 5684

Oxford
Worton Rectory Park
Oxford OX29 4SX
United Kingdom
+44 (0) 1865 887050

Peterborough
17 Minster Precincts
Peterborough PE1 1XX
United Kingdom
+44 (0) 1733 310 471

LDA Design Consulting Ltd
Registered No: 09312403
17 Minster Precincts, Peterborough PE1 1XX

LDA Design is a ISO 9001 / ISO 14001 accredited company