PREPARED FOR INFRASTRUCTURE COOK ISLANDS (ICI)
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ORIGINAL
BUILDINGS & STRUCTURES

Palmerston Is Cyclone Shelter – Detailed Design Stage

Structural Design Features Report

COMMERCIAL IN CONFIDENCE

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QUALITY ASSURANCE STATEMENT

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DOCUMENT REVISIONS

Issue	Date	Issue Details	Author	Checked	Approved
A	30/08/17	For comment	TD	SRG	SRG
B	29/09/17	Detailed Design Release	TD	SRG	SRG

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1 GENERAL

1.1 OBJECTIVE

The Design Features Report (DFR) is a detailed document defining the structure's design criteria and recording key decisions or outcomes. It outlines design loading, structural modelling assumptions, material properties, foundation requirements and design standards. The DFR also defines the calculation procedure and checking principles to be followed, providing a clear explanation of the full design.

1.2 SCOPE

The scope is in accordance with the Design Brief and Conditions of Engagement.

This report is for the detailed design of the project.

In general terms, the scope of work is as follows:

The structural design and detailing a cyclone shelter in Palmerston Island, part of the Cook Islands.

The use of building would classify as an Importance Level 4 (IL4) structure as per AS/NZS1170, as it will be used as post disaster support facility.

1.3 MEANS OF COMPLIANCE

The design of the structure is in compliance with the New Zealand Building Code (NZBC), Section B1. NZBC and AS/NZS1170 has been chosen as a general governing guide for the design of the structure for the building. The Cook Island Building Code (including proposed amendments) is also referred to ensure local considerations are taken into account.

The following standards have been used:

- AS/NZS1170 Structural Design Actions.
- NZS 3101 Concrete Structures Standard.
- NZS 3603:1993 Timber Structures Standard.
- NZS 3404:1997 Steel Structures Standard.
- NZS 4230: 2004 Design of Reinforced Concrete Masonry Structures.

1.4 ALTERNATIVE SOLUTIONS

The wind speed in Palmerston is designed in accordance with Australia standard, HB 212-2002. The design principal is still in accordance with NZS1170.2:2011. Refer to discussion in section 4.3.

Wave surge on the structure has been assessed using a guidance from a conference paper for a similar project. Refer to discussion in section 4.5.

1.5 STRUCTURAL DESIGN TEAM AND PROCESSES

Calibre have a policy of assigning the project to a design team who undertake the design with the support of a Technical Manager and a reviewer. The reviewer is a senior professional (CPEng or equivalent) who will review the design for verification of the design and validation of the principles. The object is to have the design progressively reviewed. The full design documents are then approved by a senior team leader as to the review verification processes having being followed and final validation of the design.

The design team comprised of:

- Structural Design Engineer – Steve Gaskin & Theo Dombroski, Structural Engineers
- Structural Draughtsperson – Gina Hunt, Structural Technician
- Reviewer – Nitin Dhavale, Senior Structural Engineer, (CPEng – Structural)
- Approver – Steve Gaskin, Project Manager, Senior Associate (CPEng – Civil/Structural)

2 THE STRUCTURE

2.1 GENERAL

The cyclone shelter was designed for both cyclone winds as well as storm wave surge. The structure has been designed to be still functional after an ultimate cyclone event.

The building is two stories with plan dimensions of approximately 10.0m x 16.0m and a hip roof with an apex height of 8.0m. The first floor of the building is raised nominally 800mm off the finished ground level to reduce wave and flooding issues. The lower storey has a concrete floor and masonry walls taken 700mm into the ground to mitigate likely scour of the building during storm surges.

The roof structure is constructed from site formed timber trusses, using bolted joints and spliced members.

The external cladding for the building will likely comprise of masonry block for the lower storey and upper storey.

The design life of the structures is 50 years.

2.2 GRAVITY STRUCTURE

The upper floor and roof structure of the building is supported by full height masonry columns. These columns are supported on a pad foundations 700mm below ground level.

The lower floor comprises of a ground bearing concrete slab, on fill material, with a masonry surround wall supported by strip footings.

The roof of the building comprises of a light steel roof, supported by timber purlins and a timber truss system fixed directly to the block walls and columns bellow.

2.3 LATERAL LOAD RESISITING STRUCTURE

We have identified that wind loads are the critical lateral load case for the building in Palmerston. Although earthquakes may be possible, it is considered that earthquake loads are insignificant compared to cyclones in this location.

Wave surge will have a significant loading to the lower floor of the building. Refer to section 4.5.

Lateral System – Upper Floor
The lateral bracing system reilies on masonry shear walls and full height cantilever masonry columns.

Lateral System – Lower Floor
The lower floor is braced by the ‘central core’ of the masonry block ablutions block and a moment resisting frame formed by the concrete masonry columns and concrete first floor beams.

Lateral System – Floor/Roof Diaphragm
The roof of the building will be braced by a ply diaphragm in the ceiling. This is supplemented by stainless steel strapping across the roof trusses. The first floor will be well-nailed plywood floor that will provide at suitable diaphragm.

3 SOIL CONDITIONS

3.1 DESCRIPTION OF SITE SOIL CONDITIONS

Geotechnical information about Palmerston Island is not available and suitably conservative design approach is needed.

What is known is that the island is coral atoll overlain with sand.

3.2 SOIL DESIGN VALUES

3.2.1 ULTIMATE SOIL STRENGTHS

The report states that the allowable bearing capacity for design purposes is 50kPa under working load conditions or a dependable bearing capacity of 100kPa for ultimate limit state design loads.

3.2.2 STRENGTH REDUCTION FACTORS

Ultimate limit state strength reduction factors: $\phi = 0.5$.

4 DESIGN LOADS

4.1 GENERAL

For the use of the shelter with a post disaster function, the structure would classify as an Importance Level 4 (IL4) as per AS/NZS1170.

4.2 IMPOSED LOADS

4.2.1 GRAVITY LOADS

The table below summarizes all vertical loads including both superimposed dead and live loads.

In all cases, a minimum superimposed dead load of 0.75kPa is applied unless noted otherwise (to allow for service and fittings etc.).

Table 4-1: Imposed Gravity Loads.

Level/Area	Use	Live Load (kPa)	Superimposed Dead Load (kPa)
Ground Floor		3.0	0.75
First Floor	Office and communal area (subject to overcrowding)	5.0	0.75
Staircase and surrounding first floor area	Staircase	5.0	0.75
Roof	Only maintenance	0.25kPa or 1.4kN	0.5

Level/Area	Use	Live Load (kPa)	Superimposed Dead Load (kPa)
Ceiling	Maintenance/ storage of Bunks	2.0Kpa or 1.4kN	0.5KPa

4.3 WIND LOADS

4.3.1 WIND LOADING HAS BEEN TAKEN IN ACCORDANCE WITH AS/NZS1170.2:2002 AND HB 212- 2002. SITE WIND SPEED PROFILE

The wind speed is designed as per HB 212- 2002 Design Wind Speeds for the Asia-Pacific Region, Standards Australia. Palmerston falls within region IV-V which encounters strong typhoons/typical cyclones.

A wind speed of 93 m/s (330 kph) has been adopted.

The standard recommends 74.4m/s wind speed for 1 in 2,500 event for an IL4 structure (50 years design life) for region IV wind, or 91.0m/s for region V winds. The calculations for the wind speeds are as follows:

V_R:	122-104x2500^-0.1=74.4 m/s or 156-142x2500^-0.1 = 91.0
M_d, wind direction multiplier:	1 any direction
Terrain category:	1.5
Height, z:	7m
$M_{z,cat}$, terrain multiplier:	1.0
M_s, shielding multiplier:	1.0
M_t, topographic multiplier:	1.0
Wind pressure (ULS):	4.15 kPa (Max windward), 2.08kPa (Max leeward)
Wind pressure (SLS):	1.35kPa (windward), 0.68kPa (leeward)
Wind pressure on roof (ULS)	2.49kPa (uplift), 2.70kPa (downwards) Excluding local pressure factors.
Wind pressure on roof (SLS)	0.81kPa (uplift), 0.88kPa (downwards) Excluding local pressure factors.

This has also been verified using a proprietary computer programme called check wind. Location coordinates of the island were used and recommended design wind speeds noted as follows:

Building Importance Level 3:	93m/s (using Tc = 1.5)
Building Importance Level 4:	99m/s (using Tc = 1.5)

Noting the historic wind speeds (see 4.3.2 below) in the region, and possible over-estimation of the of the check wind calculations. A moderate level of reduction has been made to the extreme loading of 99m/s.

4.3.2 HISTORIC RECORD REVIEW

A review of historic wind records, provided by Beca , as part of the review of the Cook Island building codes gives some wind speeds for Palmerston and surrounding islands.

The highest recording wind speed for Palmerston Island was 165kmh (cyclone Ima, 1985), or the highest wind speed recorded by surrounding islands was Nassau which was 230kmh (cyclone Percy, 2005). These wind speed were sustained 10min recordings, which need to be factored to design 3 second gust wind speed.

Using Table 1.1 Recommended wind speed conversion factors for tropical cyclone conditions, from World Meteorological Organization, Guidelines For Converting Between Various Wind Averaging Periods In Tropical Cyclone Conditions, October 2008. A conversion factor to 3 second gust is taken at 1.30.

This gives the three second gust speed likely for each of these highest recordings as:

Palmerston Island (1985)	60m/s
Nassau (2005)	83m/s

4.3.3 WIND PRESSURE & WIND SPEEDS

Wind Pressure for the building is as follows:

Table 4-2: Directional Site Wind Speeds & Pressures.

$V_{sit,\beta}$, for site direction	Direction	SLS	ULS
m/s		m/s / kPa	m/s / kPa
93	Any	54 / 1.69	93 / 5.19

4.3.4 PARTS OF STRUCTURE

Pressure coefficients are used in accordance with NZS1170.2:2011 to give design wind pressures.

Typical wind pressure coefficients used are:

Table 4-3: Wind Pressure Coefficients.

	Max	Min
Internal, Cp,i	0	-0.3
Wall Cp,e, windward (W)	0.7	0.7
Wall Cp,e, leeward (L)	-0.5	-0.5
Wall Cp,e, side (S)	-0.2	-0.65
Roof Cp,e, upwind (U)	0.35	-0.4
Roof Cp,e, downwind (D)	-0.6	-0.6
Roof Cp,e, crosswind (R)	-0.6	-0.6

4.3.5 GLAZING

Wind loads for glazing to be in accordance with the NZ Building Code and NZS4223:1985, Code of practice for glazing in buildings. The design wind zone is 93 m/s (5.2kPa).

4.4 SEISMIC LOADS

4.4.1 SITE PARAMETERS

Palmerston is not in a highly seismically active area. The nearest Solomon Islands tectonic plate boundary (Pacific Plate and Indo-Australian Plate) is about 1,000km away from Palmerston sourced from Office for the Coordination of Humanitarian Affairs (OCHA). Wind action is expected to dominate the design of the building and further research has not been carried out into the seismic requirements of the island.

4.5 WAVE ACTIONS

During storms wave surge action is expected to inundate the low lying island. These wave action will have significant effect on the loading of the ground floor structures.

There is no standard design codes for the design of storm and tsunami wave action in Palmerston. We have carried out some research and the here are the founding:

The design of the wave action is in accordance with The Design of Cyclone Shelters for Low- Lying Islands, Gregory Szakats, Coasts & Ports Australasian Conference 2003.

Discussion of wave and water levels during previous inundations of the island indicate approximately 1.0m of water (waist height) flooded the majority of the island, while residents sheltered on the highest areas of the island.

An adopted wave height is taken as 1.8m, justified as follows:

The base of reduced level (RL=0) is at mean sea level (MSL). The designed wave height of 3500mm (to be fully confirmed) is applied from the mean high water spring (MHWS) which is at RL=0.5mm. The ground level is at RL= 2.2m and the maximum designed wave height is at RL=4.0m which is 1.8m above ground.

The building height to ground floor has been set at 800mm above ground level, or an RL of 3.0m MSL. This means the wave impact onto the building strucuture and walls on the lower level will be 1.0m high.

There are two load combinations:

Case 1:
Apply the hydrostatic pressure (triangular distribution with 10kPa per meter depth) and the dynamic pressure, 15.4kPa (uniform width depth) over the full wave height.

Case 2:
Apply the hydrostatic pressure and dynamic pressure over 50% of the wave height and apply debris impact loads at 300mm below water surface. The debris impact loads consist of 14kN impact load from floating log and debris plus 14kN for the body of water carried with it (28kN total).

Along with impact actions from waves scour from wave is considered. Slab edges around the building are taken to 700mm below ground level to guard against wave scour undermining foundations.

4.6 CONSTRUCTION LOADS

Due to the likely construction approach for the building by manual labour, no construction loads have been considered.

4.7 LOAD COMBINATIONS

The load combinations used for ULS design are;

- 1.35G
- 1.2G, 1.5Q
- 1.2G, Wu, ψcQ
- 0.9G, Wu
- 1.2G, Wave action
- G,2% Stability Load, ψcQ

4.8 RESILIENCE

The building has been designed with resilience, and it expected that the collapse design strength is in excess of 150% of the ULS design, equivalent to a return period of 2,500 years.

5 SERVICEABILITY CRITERIA

5.1 WIND DEFLECTIONS

Particular elements are designed to the recommended serviceability deflection limits of AS/NZS1170.0:2002, Table C1. SLS 1 is 1/25, and SLS 2 is 1/250 (governs).

5.2 GRAVITY DEFLECTIONS

Particular elements are designed to the recommended serviceability deflection limits of AS/NZS1170.0:2002, Table C1.

6 DESIGN LIFE FOR DURABILITY

6.1 DESIGN LIFE

Foundations: 50 years Superstructure: 50 years

Note: Non-structural elements and cladding specification are as for B2 and are not covered by this design features report.

6.2 DURABILITY PROVISIONS

Durability provisions are achieved by:

ACCEPTABLE SOLUTIONS B2/AS1

- Reinforced Concrete: NZS3101:1995 Part 1 Section 5 is an acceptable solution for durability with durability requirements met through covers equal to or in excess of the requirements of the standard.
- Timber: NZS3602:2003 Part 1 is an acceptable solution for meeting durability through treatment in accordance with the standard.
- Light Timber Framing Structures: NZS 604:1999 is an acceptable solution for meeting durability requirements of buildings within its scope and includes framing and metal fixings.

Palmerston has an aggressive environment due to humidity, salt laden air and high UV levels. Additional performance of the structure to achieve design life requires additional measures that have been incorporated into the design such as:

- H3.2-H5 Timber (tantalised rather than borate) used throughout.
- 60mm minimum cover to all reinforcing steel.
- Aluminium Roofing
- Stainless steel fixings

7 FIRE SAFETY DESIGN REPORT INCLUSIONS

7.1 FIRE RESISTANCE RATINGS

The fire approach for the building is yet to be finalised. We have currently adopted 60 minute fire rating to all structural members and flooring systems.

7.2 STRUCTURAL REQUIREMENTS

8 SAFETY IN DESIGN

8.1 ULTIMATE LIMIT STATE DAMAGE AND REPAIR

The building has been designed to remain elastic under designed wind loads.

8.2 SERVICEABILITY LIMIT STATE DEFLETIONS

The building has been designed within acceptable deflection limits as set out in table C1 of AS/NZS1170.0. There are minor services and secondary structures, cladding systems or other items attached to the buildings that are likely to be affected.

8.3 EXCAVATIONS AND FOUNDATIONS, GROUND PENETRATION ETC.

All services on and adjacent to the site shall be identified from service providers, existing plans and topographical survey including underground service location scanning.

8.4 AREAS FOR MAINTENANCE, MOVEMENT JOINTS ETC.

There are no specific movement joints or other items that will require specific maintenance.

8.5 CONSTRUCTION REQUIREMENTS, LOADING, PROPPING ETC.

Most of the construction material will be shipped from New Zealand or Australia through 40' (11.8m x 2.3m x 2.3m) containers which limit the length and size of members that can be transported.

8.6 SAFETY SYSTEMS, ROOF AND FAÇADE FALL ARREST

A roof fall arrest system has been eliminated from the requirements. Improper use of the system carries higher risk due to the lack of training available in Palmerston.

9 SUSTAINABILITY

9.1 RECYCLED MATERIALS

Due to the limitation of appropriate supplies within Palmerston, the use of recycled materials will be limited.

10 DESIGN REVIEW

10.1 REVIEW

All drawings will be sent to ICI for approval, and distribution to the local authorities.

Table 10-1: Drawing Lists.

Discipline	Consultants Name	Drawing Numbers	Issue Date
Structural	Calibre Group	S000-S009 Rev A	30.09.17
Architectural	Fahrensohn Architect Ltd		30.09.17

11 SOFTWARE

The following computer applications were used for the design:

Table 11-1: Software used in Design:

Analysis Type	Software Used	Archive Files
Frame analysis	Microstran	###
General spreadsheet design	Excel	###

12 DRAWING AND SPECIFICATION NOTES

The purpose of this section is to ensure that the design requirements are included in the drawings or the specification.

12.1 DESIGN LOADS

Refer to Section 4 DESIGN LOADS.

12.2 FIRE RATING REQUIREMENTS

Refer to Section 7.1 Fire Resistance Ratings.

12.3 PROPPING REQUIREMENTS

All suspended beams, floors and formwork supporting concrete shall be propped for a minimum of 14 days.

12.4 MATERIAL PROPERTIES (TYPICAL)

Refer to technical specification for detail.

13 PROPRIETARY SYSTEMS

13.1 MANUFACTURER DESIGN REQUIREMENTS

APPENDICES

APPENDIX A CHECK WIND – SITE DESIGN WIND SPEEDS

----- BUILDING DATA -----

ORIENTATION:	0.0°
ROOF:	GABLE
GUTTER HEIGHT:	8.00 m
SPAN:	10.00 m
LENGTH:	10.00 m
ROOF SLOPE (α):	5.0°
BASE RL:	0.00 m
AVERAGE HEIGHT (h):	8.22 m

----- SITE DATA -----

LOCATION

LATITUDE:	-18.057131
LONGITUDE:	-163.190703
ELEVATION:	0.00 m

DESIGN

REFERENCE:	AS/NZS 1170
IMPORTANCE LEVEL:	4
LIFE:	50 YEARS

WIND

REGION:	D
ULTIMATE ARI:	2000 YEARS
ULTIMATE VR:	99 m/s
SERVICEABILITY VR:	53 m/s

DIRECTION MULTIPLIER (Md)

• Calculated for Region D as per AS/NZS 1170.2 Section 3.3 [7].

WIND	Md
N	0.95
NE	0.95
E	0.95
SE	0.95
S	0.95
SW	0.95
W	0.95
NW	0.95

TERRAIN/HEIGHT MULTIPLIER (Mz,cat)

• Calculated as per AS/NZS 1170.2 Section 4.2.2 [7] and varies with height.

• Averaging can be utilised within CHECKWIND using the Terrain/Height Multiplier wizard under the "SITE" tab.

WIND	ZONE 1	ZONE 2	ZONE 3	ZONE 4	TC	Mz,cat
N	664.37 m / TC 1.5	-	-	-	1.5000	1.0315
NE	664.37 m / TC 1.5	-	-	-	1.5000	1.0315
E	664.37 m / TC 1.5	-	-	-	1.5000	1.0315
SE	664.37 m / TC 1.5	-	-	-	1.5000	1.0315
S	664.37 m / TC 1.5	-	-	-	1.5000	1.0315
SW	664.37 m / TC 1.5	-	-	-	1.5000	1.0315
W	664.37 m / TC 1.5	-	-	-	1.5000	1.0315
NW	664.37 m / TC 1.5	-	-	-	1.5000	1.0315

SHIELDING MULTIPLIER (Ms)

• Calculated as per AS/NZS 1170.2 Section 4.3 [7] and varies with height.

NORTH WIND: Ms = 1.0000 (SLOPE: 0.0000)

NORTH EAST WIND: Ms = 1.0000 (SLOPE: 0.0000)

EAST WIND: Ms = 1.0000 (SLOPE: 0.0000)

SOUTH EAST WIND: Ms = 1.0000 (SLOPE: 0.0000)

SOUTH WIND: Ms = 1.0000 (SLOPE: 0.0000)

SOUTH WEST WIND: Ms = 1.0000 (SLOPE: 0.0000)

WEST WIND: Ms = 1.0000 (SLOPE: 0.0000)

NORTH WEST WIND: Ms = 1.0000 (SLOPE: 0.0000)

TOPOGRAPHIC MULTIPLIER (Mt)

• Calculated as per AS/NZS 1170.2 Section 4.4 [7] and varies with height.

• Site located outside lee zones as per AS/NZS 1170.2 Section 4.4.3 [7].

WIND	TOPOGRAPHY	H	Lu	x	Mh	Mt
N	FLAT	-	-	-	1.0000	1.0000
NE	FLAT	-	-	-	1.0000	1.0000
E	FLAT	-	-	-	1.0000	1.0000
SE	FLAT	-	-	-	1.0000	1.0000
S	FLAT	-	-	-	1.0000	1.0000
SW	FLAT	-	-	-	1.0000	1.0000
W	FLAT	-	-	-	1.0000	1.0000
NW	FLAT	-	-	-	1.0000	1.0000

----- ANALYSIS -----

LOAD CASE 1: Ultimate Wind

NORTH WIND

RL	Md	TC	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qsit,β
8.22 m	0.95	1.5000	1.0315	0	-	-	1.0000	1.0000	97.01 m/s	5.6469 kPa
7.40 m	0.95	1.5000	1.0183	0	-	-	1.0000	1.0000	95.78 m/s	5.5038 kPa
6.57 m	0.95	1.5000	1.0052	0	-	-	1.0000	1.0000	94.54 m/s	5.3626 kPa
5.75 m	0.95	1.5000	0.9920	0	-	-	1.0000	1.0000	93.30 m/s	5.2232 kPa
4.93 m	0.95	1.5000	0.9790	0	-	-	1.0000	1.0000	92.07 m/s	5.0864 kPa
4.11 m	0.95	1.5000	0.9666	0	-	-	1.0000	1.0000	90.91 m/s	4.9591 kPa
3.29 m	0.95	1.5000	0.9543	0	-	-	1.0000	1.0000	89.75 m/s	4.8334 kPa
2.47 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
1.64 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
0.82 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
0.00 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa

NORTH EAST WIND

RL	Md	TC	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qsit,β
8.22 m	0.95	1.5000	1.0315	0	-	-	1.0000	1.0000	97.01 m/s	5.6469 kPa
7.40 m	0.95	1.5000	1.0183	0	-	-	1.0000	1.0000	95.78 m/s	5.5038 kPa
6.57 m	0.95	1.5000	1.0052	0	-	-	1.0000	1.0000	94.54 m/s	5.3626 kPa
5.75 m	0.95	1.5000	0.9920	0	-	-	1.0000	1.0000	93.30 m/s	5.2232 kPa
4.93 m	0.95	1.5000	0.9790	0	-	-	1.0000	1.0000	92.07 m/s	5.0864 kPa
4.11 m	0.95	1.5000	0.9666	0	-	-	1.0000	1.0000	90.91 m/s	4.9591 kPa
3.29 m	0.95	1.5000	0.9543	0	-	-	1.0000	1.0000	89.75 m/s	4.8334 kPa
2.47 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
1.64 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
0.82 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
0.00 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa

EAST WIND

RL	Md	TC	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qsit,β
8.22 m	0.95	1.5000	1.0315	0	-	-	1.0000	1.0000	97.01 m/s	5.6469 kPa
7.40 m	0.95	1.5000	1.0183	0	-	-	1.0000	1.0000	95.78 m/s	5.5038 kPa
6.57 m	0.95	1.5000	1.0052	0	-	-	1.0000	1.0000	94.54 m/s	5.3626 kPa
5.75 m	0.95	1.5000	0.9920	0	-	-	1.0000	1.0000	93.30 m/s	5.2232 kPa
4.93 m	0.95	1.5000	0.9790	0	-	-	1.0000	1.0000	92.07 m/s	5.0864 kPa
4.11 m	0.95	1.5000	0.9666	0	-	-	1.0000	1.0000	90.91 m/s	4.9591 kPa
3.29 m	0.95	1.5000	0.9543	0	-	-	1.0000	1.0000	89.75 m/s	4.8334 kPa
2.47 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
1.64 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
0.82 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
0.00 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa

SOUTH EAST WIND

RL	Md	TC	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qsit,β
8.22 m	0.95	1.5000	1.0315	0	-	-	1.0000	1.0000	97.01 m/s	5.6469 kPa
7.40 m	0.95	1.5000	1.0183	0	-	-	1.0000	1.0000	95.78 m/s	5.5038 kPa
6.57 m	0.95	1.5000	1.0052	0	-	-	1.0000	1.0000	94.54 m/s	5.3626 kPa
5.75 m	0.95	1.5000	0.9920	0	-	-	1.0000	1.0000	93.30 m/s	5.2232 kPa
4.93 m	0.95	1.5000	0.9790	0	-	-	1.0000	1.0000	92.07 m/s	5.0864 kPa
4.11 m	0.95	1.5000	0.9666	0	-	-	1.0000	1.0000	90.91 m/s	4.9591 kPa
3.29 m	0.95	1.5000	0.9543	0	-	-	1.0000	1.0000	89.75 m/s	4.8334 kPa
2.47 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
1.64 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
0.82 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
0.00 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa

SOUTH WIND

RL	Md	TC	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qsit,β
8.22 m	0.95	1.5000	1.0315	0	-	-	1.0000	1.0000	97.01 m/s	5.6469 kPa
7.40 m	0.95	1.5000	1.0183	0	-	-	1.0000	1.0000	95.78 m/s	5.5038 kPa
6.57 m	0.95	1.5000	1.0052	0	-	-	1.0000	1.0000	94.54 m/s	5.3626 kPa
5.75 m	0.95	1.5000	0.9920	0	-	-	1.0000	1.0000	93.30 m/s	5.2232 kPa
4.93 m	0.95	1.5000	0.9790	0	-	-	1.0000	1.0000	92.07 m/s	5.0864 kPa
4.11 m	0.95	1.5000	0.9666	0	-	-	1.0000	1.0000	90.91 m/s	4.9591 kPa
3.29 m	0.95	1.5000	0.9543	0	-	-	1.0000	1.0000	89.75 m/s	4.8334 kPa
2.47 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
1.64 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
0.82 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
0.00 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa

SOUTH WEST WIND

RL	Md	TC	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qsit,β
8.22 m	0.95	1.5000	1.0315	0	-	-	1.0000	1.0000	97.01 m/s	5.6469 kPa
7.40 m	0.95	1.5000	1.0183	0	-	-	1.0000	1.0000	95.78 m/s	5.5038 kPa
6.57 m	0.95	1.5000	1.0052	0	-	-	1.0000	1.0000	94.54 m/s	5.3626 kPa
5.75 m	0.95	1.5000	0.9920	0	-	-	1.0000	1.0000	93.30 m/s	5.2232 kPa
4.93 m	0.95	1.5000	0.9790	0	-	-	1.0000	1.0000	92.07 m/s	5.0864 kPa
4.11 m	0.95	1.5000	0.9666	0	-	-	1.0000	1.0000	90.91 m/s	4.9591 kPa
3.29 m	0.95	1.5000	0.9543	0	-	-	1.0000	1.0000	89.75 m/s	4.8334 kPa
2.47 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
1.64 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
0.82 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
0.00 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa

WEST WIND

RL	Md	TC	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qsit,β
8.22 m	0.95	1.5000	1.0315	0	-	-	1.0000	1.0000	97.01 m/s	5.6469 kPa
7.40 m	0.95	1.5000	1.0183	0	-	-	1.0000	1.0000	95.78 m/s	5.5038 kPa
6.57 m	0.95	1.5000	1.0052	0	-	-	1.0000	1.0000	94.54 m/s	5.3626 kPa
5.75 m	0.95	1.5000	0.9920	0	-	-	1.0000	1.0000	93.30 m/s	5.2232 kPa
4.93 m	0.95	1.5000	0.9790	0	-	-	1.0000	1.0000	92.07 m/s	5.0864 kPa
4.11 m	0.95	1.5000	0.9666	0	-	-	1.0000	1.0000	90.91 m/s	4.9591 kPa
3.29 m	0.95	1.5000	0.9543	0	-	-	1.0000	1.0000	89.75 m/s	4.8334 kPa
2.47 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
1.64 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
0.82 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa

0.00 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa

NORTH WEST WIND

RL	Md	TC	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qsit,β
8.22 m	0.95	1.5000	1.0315	0	-	-	1.0000	1.0000	97.01 m/s	5.6469 kPa
7.40 m	0.95	1.5000	1.0183	0	-	-	1.0000	1.0000	95.78 m/s	5.5038 kPa
6.57 m	0.95	1.5000	1.0052	0	-	-	1.0000	1.0000	94.54 m/s	5.3626 kPa
5.75 m	0.95	1.5000	0.9920	0	-	-	1.0000	1.0000	93.30 m/s	5.2232 kPa
4.93 m	0.95	1.5000	0.9790	0	-	-	1.0000	1.0000	92.07 m/s	5.0864 kPa
4.11 m	0.95	1.5000	0.9666	0	-	-	1.0000	1.0000	90.91 m/s	4.9591 kPa
3.29 m	0.95	1.5000	0.9543	0	-	-	1.0000	1.0000	89.75 m/s	4.8334 kPa
2.47 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
1.64 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
0.82 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa
0.00 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	89.35 m/s	4.7898 kPa

LOAD CASE 2: Serviceability Wind

NORTH WIND

RL	Md	TC	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qsit,β
8.22 m	0.95	1.5000	1.0315	0	-	-	1.0000	1.0000	51.94 m/s	1.6184 kPa
7.40 m	0.95	1.5000	1.0183	0	-	-	1.0000	1.0000	51.27 m/s	1.5774 kPa
6.57 m	0.95	1.5000	1.0052	0	-	-	1.0000	1.0000	50.61 m/s	1.5369 kPa
5.75 m	0.95	1.5000	0.9920	0	-	-	1.0000	1.0000	49.95 m/s	1.4970 kPa
4.93 m	0.95	1.5000	0.9790	0	-	-	1.0000	1.0000	49.29 m/s	1.4578 kPa
4.11 m	0.95	1.5000	0.9666	0	-	-	1.0000	1.0000	48.67 m/s	1.4213 kPa
3.29 m	0.95	1.5000	0.9543	0	-	-	1.0000	1.0000	48.05 m/s	1.3853 kPa
2.47 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
1.64 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
0.82 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
0.00 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa

NORTH EAST WIND

RL	Md	TC	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qsit,β
8.22 m	0.95	1.5000	1.0315	0	-	-	1.0000	1.0000	51.94 m/s	1.6184 kPa
7.40 m	0.95	1.5000	1.0183	0	-	-	1.0000	1.0000	51.27 m/s	1.5774 kPa
6.57 m	0.95	1.5000	1.0052	0	-	-	1.0000	1.0000	50.61 m/s	1.5369 kPa
5.75 m	0.95	1.5000	0.9920	0	-	-	1.0000	1.0000	49.95 m/s	1.4970 kPa
4.93 m	0.95	1.5000	0.9790	0	-	-	1.0000	1.0000	49.29 m/s	1.4578 kPa
4.11 m	0.95	1.5000	0.9666	0	-	-	1.0000	1.0000	48.67 m/s	1.4213 kPa
3.29 m	0.95	1.5000	0.9543	0	-	-	1.0000	1.0000	48.05 m/s	1.3853 kPa
2.47 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
1.64 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
0.82 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
0.00 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa

EAST WIND

RL	Md	TC	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qsit,β
8.22 m	0.95	1.5000	1.0315	0	-	-	1.0000	1.0000	51.94 m/s	1.6184 kPa
7.40 m	0.95	1.5000	1.0183	0	-	-	1.0000	1.0000	51.27 m/s	1.5774 kPa
6.57 m	0.95	1.5000	1.0052	0	-	-	1.0000	1.0000	50.61 m/s	1.5369 kPa
5.75 m	0.95	1.5000	0.9920	0	-	-	1.0000	1.0000	49.95 m/s	1.4970 kPa
4.93 m	0.95	1.5000	0.9790	0	-	-	1.0000	1.0000	49.29 m/s	1.4578 kPa
4.11 m	0.95	1.5000	0.9666	0	-	-	1.0000	1.0000	48.67 m/s	1.4213 kPa
3.29 m	0.95	1.5000	0.9543	0	-	-	1.0000	1.0000	48.05 m/s	1.3853 kPa
2.47 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
1.64 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
0.82 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
0.00 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa

SOUTH EAST WIND

RL	Md	TC	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qsit,β
8.22 m	0.95	1.5000	1.0315	0	-	-	1.0000	1.0000	51.94 m/s	1.6184 kPa
7.40 m	0.95	1.5000	1.0183	0	-	-	1.0000	1.0000	51.27 m/s	1.5774 kPa
6.57 m	0.95	1.5000	1.0052	0	-	-	1.0000	1.0000	50.61 m/s	1.5369 kPa
5.75 m	0.95	1.5000	0.9920	0	-	-	1.0000	1.0000	49.95 m/s	1.4970 kPa
4.93 m	0.95	1.5000	0.9790	0	-	-	1.0000	1.0000	49.29 m/s	1.4578 kPa
4.11 m	0.95	1.5000	0.9666	0	-	-	1.0000	1.0000	48.67 m/s	1.4213 kPa
3.29 m	0.95	1.5000	0.9543	0	-	-	1.0000	1.0000	48.05 m/s	1.3853 kPa
2.47 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
1.64 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
0.82 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
0.00 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa

SOUTH WIND

RL	Md	TC	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qsit,β
8.22 m	0.95	1.5000	1.0315	0	-	-	1.0000	1.0000	51.94 m/s	1.6184 kPa
7.40 m	0.95	1.5000	1.0183	0	-	-	1.0000	1.0000	51.27 m/s	1.5774 kPa
6.57 m	0.95	1.5000	1.0052	0	-	-	1.0000	1.0000	50.61 m/s	1.5369 kPa
5.75 m	0.95	1.5000	0.9920	0	-	-	1.0000	1.0000	49.95 m/s	1.4970 kPa
4.93 m	0.95	1.5000	0.9790	0	-	-	1.0000	1.0000	49.29 m/s	1.4578 kPa
4.11 m	0.95	1.5000	0.9666	0	-	-	1.0000	1.0000	48.67 m/s	1.4213 kPa
3.29 m	0.95	1.5000	0.9543	0	-	-	1.0000	1.0000	48.05 m/s	1.3853 kPa
2.47 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
1.64 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
0.82 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
0.00 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa

SOUTH WEST WIND

RL	Md	TC	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qsit,β
8.22 m	0.95	1.5000	1.0315	0	-	-	1.0000	1.0000	51.94 m/s	1.6184 kPa
7.40 m	0.95	1.5000	1.0183	0	-	-	1.0000	1.0000	51.27 m/s	1.5774 kPa
6.57 m	0.95	1.5000	1.0052	0	-	-	1.0000	1.0000	50.61 m/s	1.5369 kPa
5.75 m	0.95	1.5000	0.9920	0	-	-	1.0000	1.0000	49.95 m/s	1.4970 kPa
4.93 m	0.95	1.5000	0.9790	0	-	-	1.0000	1.0000	49.29 m/s	1.4578 kPa
4.11 m	0.95	1.5000	0.9666	0	-	-	1.0000	1.0000	48.67 m/s	1.4213 kPa

3.29 m	0.95	1.5000	0.9543	0	-	-	1.0000	1.0000	48.05 m/s	1.3853 kPa
2.47 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
1.64 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
0.82 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
0.00 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa

WEST WIND

RL	Md	TC	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qsit,β
8.22 m	0.95	1.5000	1.0315	0	-	-	1.0000	1.0000	51.94 m/s	1.6184 kPa
7.40 m	0.95	1.5000	1.0183	0	-	-	1.0000	1.0000	51.27 m/s	1.5774 kPa
6.57 m	0.95	1.5000	1.0052	0	-	-	1.0000	1.0000	50.61 m/s	1.5369 kPa
5.75 m	0.95	1.5000	0.9920	0	-	-	1.0000	1.0000	49.95 m/s	1.4970 kPa
4.93 m	0.95	1.5000	0.9790	0	-	-	1.0000	1.0000	49.29 m/s	1.4578 kPa
4.11 m	0.95	1.5000	0.9666	0	-	-	1.0000	1.0000	48.67 m/s	1.4213 kPa
3.29 m	0.95	1.5000	0.9543	0	-	-	1.0000	1.0000	48.05 m/s	1.3853 kPa
2.47 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
1.64 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
0.82 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
0.00 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa

NORTH WEST WIND

RL	Md	TC	Mz,cat	ns	hs	bs	Ms	Mt	Vsit,β	qsit,β
8.22 m	0.95	1.5000	1.0315	0	-	-	1.0000	1.0000	51.94 m/s	1.6184 kPa
7.40 m	0.95	1.5000	1.0183	0	-	-	1.0000	1.0000	51.27 m/s	1.5774 kPa
6.57 m	0.95	1.5000	1.0052	0	-	-	1.0000	1.0000	50.61 m/s	1.5369 kPa
5.75 m	0.95	1.5000	0.9920	0	-	-	1.0000	1.0000	49.95 m/s	1.4970 kPa
4.93 m	0.95	1.5000	0.9790	0	-	-	1.0000	1.0000	49.29 m/s	1.4578 kPa
4.11 m	0.95	1.5000	0.9666	0	-	-	1.0000	1.0000	48.67 m/s	1.4213 kPa
3.29 m	0.95	1.5000	0.9543	0	-	-	1.0000	1.0000	48.05 m/s	1.3853 kPa
2.47 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
1.64 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
0.82 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa
0.00 m	0.95	1.5000	0.9500	0	-	-	1.0000	1.0000	47.83 m/s	1.3728 kPa

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