LNA 458 PENNY LODGE

ENGINEERING REPORT

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C O N S U L T I N G E N G I N E E R S

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1. INTRODUCTION

This document is introductory discussion on the engineering design concepts for the new lodge development and how they might interface with the site and other development requirements. This report was prepared at time of submission of the environmental report to Local Authorities.

1.1 Purpose of the Report

The purpose of this report is to define in narrative form the CIVIL AND STRUCTURAL criteria for the development, the likely suite of materials, and the likely standards and procedures to be used in the design.

1.2 Scope

The scope of this report covers the conceptual design discussions for the lodge building cluster comprising the main lodge, pool sala and four accommodation units.

2. GENERAL PROJECT INFORMATION

The site is located in the Zululand Rhino Reserve, on the northern bank overlooking the Msunduzi River. The Lodge cluster is arranged along an outside bend of the river, some 8-10m above the river bed. The far side of the river forms the lower floodplain.

2.1 Topography

The site for the lodge cluster is fairly flat, and the buildings are to be positioned back from the top of the river bank in accordance with the requirements of the Geotechnical Engineers recommendations and the environmental requirements.

2.2 Geology and soil conditions

A Geotechnical Engineering investigation has been carried out by Drennan Maud (Pty) Ltd, dated 18 March 2016.

There is generally overlying alluvial and residual material occurring on the site and excavation is expected to be easy. These materials may be unstable and side wall collapse should be expected when excavating foundations.

Founding of the structures on shallow strip footings or column base foundations is likely to be possible. Both strip footings and column base footings will be taken into the stiff/dense subsoils that are likely to be either alluvial or residual basaltic soils, taken to a minimum depth of 1.2 m below the current ground level.

2.3 Ground Water

No groundwater is likely to occur where the lodge cluster site is proposed. However, during periods of high rainfall groundwater seepage may occur at the contact between the colluvial soils and the residual soils and underlying weathered bedrock.

2.4 Particular Building Guidelines of the Rhino Reserve

There is a set of regulations incorporating Building and Contractor regulations for development within the Reserve. It is noted that these are not expected to impact on the structural design for the buildings within the Architectural scheme as presented to date. Suffice to say that care and attention needs to be made in the conceptual design phase to economise, and act with sensitivity to the site location when decisions are made as to materials and methods of construction.

3. THE CONCEPTUAL ENGINEERING SCHEME

3.1 General Description of the Building Structures

The concept of the naked building structures can be described as a series of structural steel beam grillages, supported off either timber or steel columns, and braced utilising the timber stud/clad wall systems as structural shear walls.

Columns and shear walls will be connected onto concrete plinths and stub columns off the foundations.

As such the structures can be loosely described as composite steel and timber modularised frames.

Roofs will generally be sheeted with lightweight steel profiled roof sheeting.

Fenestration and sliding/folding glazed screens will be co-ordinated to be supported within the structural modularisation methodology.

The following features outline the intended design development outcomes:

- Steel and timber above ground, Concrete at and below ground
- " Touch the earth lightly"
- Utilise the timber clad walls which are themselves robust elements, as structural features to brace the buildings.
- Modularise a flat steel beam grillage to incorporate lines of fenestration in any direction and to support the sheeting rails.
- "Tipped" roof planes to support sheeting will be created by lifting the sheeting rail plane off the grillage
- Connection typologies will be developed with the Architect to create an aesthetic to the structural connections that allows adequate load transfer at all of the interfaces.

3.2 Pool Structure

It is envisaged that a structural box format will be used for the approach to the pool structure. This can be achieved either with a shuttered and cast wall system, or alternatively and reinforced infill masonry structural wall system. It is envisaged that the pool based will be a concrete raft scribed into the underlying basaltic soils.

3.3 Floors, Foundations and Reinforced Concrete

All columns will be supported off concrete pad footings designed in accordance with the ground pressure limitations recommended in the Geotechnical report.

Generally it is not anticipated that there will be significant concrete structure above ground level.

Where necessary, walls will be supported off reinforced concrete footings cast onto adequately compacted layer works.

Floors have been discussed as either of the following:

- Raised timber decks. These have the advantage of allowing underfloor reticulation of services.

- On grade concrete surface beds.

3.4 Earthworks

Due to the sensitive nature of the area to be developed, very limited earthworks, consisting mainly of localised levelling is envisaged. The geotechnical report indicates that excavation to a depth of 3m is expected to be easy and as such the limited earthworks could potentially be undertaken using manual labour rather than mechanical equipment.

It is noted that a new gravel road passing over the dam wall is indicated on the architectural layouts. This would be designed as a cambered gravel road as per Draft TRH 20 The Structural Design, Construction and Maintenance of Unpaved Roads. Side drains will be used where natural dispersion of surface water is disrupted, as the concentration of stormwater is the root cause of erosion. The side drains should run parallel to the road, collecting the surface water from the pavement and shoulders and removing it through mitre drains (or turnouts) as far from the road as practically possible, where it can soak into the ground or flow into a natural drainage course without influencing the road structure. The distance between mitre drains (which need not necessarily always be associated with sidedrains) depends on their grade with a smaller spacing on flat grades and greater spacing (not far enough to cause excessive flow velocities) between them on steeper grades. The principle is to place the mitre drains at intervals which avoid ponding adjacent to the road but not far apart enough to allow the build-up of high concentrations and flow velocities which lead to scouring. The width of mitre banks should generally be 1 to 1,5 metres. The importance of the road surface being raised above the surrounding area is obvious. When the surrounding area is higher than the road surface, the road becomes the drain during periods of heavy rainfall and rapidly becomes deformed or even impassable if the water soaks in.

3.5 Bulk Water

The source of potable water will be from an existing borehole off site which will be pumped to an elevated tank and gravity fed to the lodge complex. It has been confirmed by the Rhino Reserve Management that the borehole delivers 4100 litres per hour consistently based on a flow test carried out by management this year.

3.6 Storm Water

The design intent is to create landscaping commensurate with the existing bushland and there is no intention to create berms or other such natural features which would change the natural stormwater runoff in open areas.

Open timber decks are intended to be open jointed such that the rainwater runoff simply drains onto the ground below and drains away naturally or percolates into the ground.

Stormwater management is therefore limited to:

- The water draining off the roof structures. There are no gutters on the roofs, which are monopitched towards back of house and allow a sufficient overhang from the building walls to allow for runoff from the roof to fall directly onto the ground.
- At the ground line zone strip that will be situated under the roof edge, the Architectural treatment will be such that the landacsaping can accept this runoff without degradation or erosion and the rainwater will be allowed to fall

away from the building without concentration into the natural soils surrounding the lodge complex

- Any areas that require concentrated collection of storwater as a result of design development, or for example, pool backwashing procedures, there will be a subsoil piped and dedicated routing for such runoff which will terminate at the adjacent Msunduzi River where it can discharge through a headwall system complete with flow reducing splitter blocks and reno mattresses.

3.7 Sewer

As indicated in the DMP Geotechnical Assessment of the 18th March 2016, the most practical means of waste water disposal is a sub-surface system in the form of a septic tank and soakaway. It is envisaged that each unit will discharge waste water via a gravity system to a septic tank from where the effluent will drain to a suitably designed and sized French drain soakaway system and evapotranspiration area.

3.8 Solid Waste

Solid waste will be collected in bins in a dedicated bin areas at back of house of the lodge complex and the workshop area. Bins will be colour coded and solid waste sorted to separate tins, glass, food and items that can be burnt. Smaller bins at the lodge area and large wheely bins at the workshop area.

The binned solid waste will then be collected by the Reserve Management team in a tractor with a trailer or on the back of a Land Cruiser pick up. Frequency of collection will relate to the occupancy at the lodge.

Tins and glass will be dropped in Mkuze Refuse area by the Reserve Management whenever the bins at the workshop are full - the refuse area is based North East of the Mkuze town on the road to Jozini; it is a municipal site; or picked up by members of the local community for recycling. - occasionally members of the community will contact lodges to see if they have tins or bottles available for collection.

Food/ paper is burnt will be burnt on site by Reserve Management - burnt in a dug out pit near the workshop area. This will be supervised by senior management. Where possible organic waste will be separated for use in the development of a compost heap which will be utelised in the gardens at the lodge and the staff accommodation.

4. DESIGN STANDARDS AND SOURCES OF REFERENCE

4.1 Statutory regulations and Bye-Laws

Reference is made to the Zululand Rhino Reserve building guideline document

4.2 Statutory regulations and Bye-Laws

SANS 10160: 2008
Basis of structural design and actions for buildings and industrial structures.
Parts 1 to 8

SANS 10100-1 Ed.2.2
The structural use of concrete Part 1: Design

SANS 10100-2

The structural use of concrete Part 2: Materials and execution of work

SANS 10144-1995
Detailing of steel reinforcement for concrete

SANS 10162-1: 1993
The limit states design of hot rolled steelwork

SABS 0164 Part 1-1980
The structural use of masonry Part 1: Unreinforced masonry walling

SANS 2001-CS1:2005
Construction works Part CS1: Structural steelwork

SANS 0163-1:1994
The Structural use of Timber

4.3 Other Sources of Reference

Geotechnical Report

Compiled by Drennan Maud (Pty)Ltd, Durban head office, reference 31366, dated 18 March 2016.

Waste Water Disposal Report
Compiled by Drennan Maud (Pty)Ltd, Durban head office, reference 31366, dated 26 May 2016

Environmental report
Preliminary assessment carried out by iDM Consultants dated 20 March 2016.

5. IMPOSED CONDITIONS

5.1 Design Loadings

The following loads should be used in the preliminary design calculations. As the various load categories develop and are finalized these loads will be revised during design development to reflect the reality of the structure.

5.1.1 Structure Self Weight

The self-weight of all structural elements will be calculated in accordance with the relevant material densities and to the particular geometry denoted on the structural drawings, and will exclude any applied finishes, claddings and partitions.

5.1.2 Imposed Dead and Live loadings

Live load reductions will be calculated in accordance with the requirements of SANS 10160.

- Reinforced concrete roofs to be schemed for the following imposed loads

- 250kg/m2 for screed and finishes (50mm stone + 75mm screed)
- 35kg/m2 for services and ceilings
- 50kg/m2 for imposed live loading (inaccessible roof)

- Sheeted structural steelwork roofs to be schemed for the following imposed loads

- 20kg/m2 for ceilings
- 15kg/m2 for suspended services in the roof space
- 25kg/m2 for imposed live loading (inaccessible roof)

5.1.3 Imposed Wind Loading

- Wind loading pressures to be calculated using the provisions of *SANS 10160 Part3 : Wind Actions*

5.2 Other Performance Requirements

5.2.1 Building Design Life

The indicative design working life of the building would be considered appropriate as 50 years. This is not necessarily an indication of the service life, but will be used as the design norm for design code applications.

5.2.2 Durability

The levels of exposure of the reinforced concrete structures are deemed to be:

- Externally exposed faces, such as vertical faces of slab edges, open slab soffits, external beams and the like, the level of exposure is MODERATE

- Internal faces, generally considered to be 'indoors' and not exposed to external weather conditions, the level of exposure is MILD-MODERATE.

5.2.3 Fire Resistance Periods

All structural reinforced concrete elements will be sized to achieve a 2 hour fire rating.

5.3 Construction Implications

5.3.1 Construction tolerances

It will be assumed that the building structures will generally be constructed to degree of accuracy II (SANS 1200)

6. MATERIALS

6.1 Structural Materials

6.1.1 Concrete

Design grades:

Blinding	-	10 MPa / 19mm
Ground beams and footings	-	25 MPa / 19mm
Retaining walls	-	25 MPa / 19mm
Surface beds	-	25 MPa / 19mm

Columns	-	25 MPa / 19mm
Suspended Slabs & Beams	-	25 Mpa / 19mm

6.1.2 Steel

All structural steelwork will be executed in accordance with the following standardised specifications, with variations and additions as listed in Portion II of this specification.

SANS 2001 – CS1:2005 Structural Steelwork
SANS 1067 -1984: Welding in steel structures

Design grades:

- Hot rolled sections SANS 50025-2-S355 JR
- Hot rolled Structural Tubing – EN 10219 Grade S355
- Hot rolled plate SANS 50025-2-S355 JR
- Cold rolled sections Yield stress 200MPa
  Tensile strength 365MPa

6.1.3 Timber (structural grade)

Timber will be sourced as the design develops, whereas the intention is to engage with champions of the timber industry to source and ascertain availability of timber types and suitability for the conditions.

END OF REPORT

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