PROTOTYPE DESIGN FOR A PHARMACEUTICAL INTERMEDIATE WAREHOUSE

STRUCTURE DETAILED DESIGN PROJECT DESCRIPTION

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1 INTRODUCTION

The present report refers to the Prototype Structural Design for the Construction of a Pharmaceutical Intermediate Warehouse. The project includes the following buildings:

- Building 1 ï Pharmaceutical Warehouse
- Building 2 ï Toxic and Famable Products Warehouse
- Building 3 ï Workshop and Maintenance
- Building 4 ï Engine Room
- Building 5 ï Guardhouse
- Building 6 ï Waste Disposal
- Building 7 ï Elevated Reservoir

The structural plans were designed to meet the architectural requirements imposed, but the compatibility of this specialty should be verified in case of any change to the architectural project before its execution.

2 LAWS AND REGULATIONS

For the projectôs structural design the following laws and regulations were used:

- EUROCODE 2 ï Design of Concrete Structures
- EUROCODE 3 ï Design of Steel Structures
- EUROCODE 4 ï Design of Concrete and Steel Composite Strctures
- EUROCODE 8 ï Design of Structures for Earthquake Resistance

3 SOIL CHARACTERISTICS

Since this is a prototype project, there isnôt any geotechnical study as the location for its implementation is unknown. Therefore, tle soil bearing capacity was assumed to be 0,15 MPa for the calculation of the foundations.

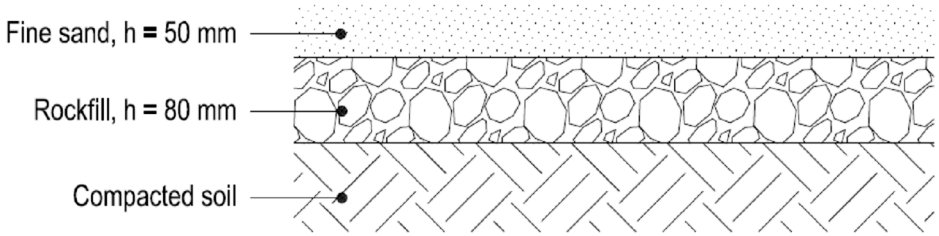
It is recommended that a geotechnical study be carried out at the sites prior to project construction so that the soil quality is improved if it has a load capacity of less than 0,15 MPa, replacing the existing soils with a fill of thickness equal to twice the height of the footing.

4 BASE OF FOUNDATIONS AND PAVEMENT

For all buildings it was considered pad footings and foundation beams.

The base of the foundation lays over a layer of 50 mm of fine sand followed by 80 mm of rockfill e bellow it a well compacted soil.

The pavement slabs, like the foundations, is laid on a layer of 50 mm of fine sand followed by 80 mm of rockfill and bellow it the landfill properly compacted.



Both foundations and pavement slabs are protected by a waterproof plastic membrane of 250 microns.

5 LOADS

Dead loads, live loads and wind loads were taken into account for all buildings. The earthquake load was taken into account only while designing the Building 1.

5.1 Dead Loads

The following dead loads are referred to all buildings (where applicable):

- Soil on the foundation ï 16,0 kN/m^2
- Screed (average thickness 0,04 m) ï 0,84 kN/m^2
- Floor covering ï 0,04 kN/m^2
- Masonry ï 13,0 kN/m^3
- Roof steel sheets IBR 0,8 mm ï 0,10 kN/m^2

5.2 Live Loads

The following live loads are referred to all buildings (where applicable):

- Pavement floor (with the exception of the pharmaceutical warehouse) ï 3,0 kN/ m^2
- Pavement floor of the pharmaceutical warehouse ï 7,5 kN/ m^2
- Water (reservoir) ï 10,0 kN/m^3
- Roof (steel sheets) ï 0,30 kN/m^2
- Inaccessible Roof (slab) ï 1,0 kN/m^2
- Fork lifts (pharmaceutical warehouse) ï 63 kN/wheel
- Racks (pharmaceutical warehouse) ï 60 kN/support
- Generator (engine room) ï 14 kN

5.3 Wind Loads

The wind load applied to all buildings is equivalent to a wind speed of 42,3 m/s.

5.4 Earthquake Load

The earthquake load was calculated according to Eurocode 8 using the following parameters:

- Terrain C (Deep deposits of compacted sand or moderately compacted sand, gravel or hard clay with thickness varying from dozens of metres to many hundreds of metres);
- Earthquake type 1;
- Earthquake in direction X and Y.

6 STRUCTURAL MATERIALS

6.1 Reinforced Concrete

Concrete B25 (C20 / 25), fck = 20MPa, ɔc = 1.50 shall be used for all structures including foundations.

As for the cover to reinforcement, 50 mm for the foundations and buried elements and 30 mm for columns, beams and slabs.

6.2 Steel Bars

Steel bars A400; fyk = 400 MPa; ɔs = 1.15 shall be used for all reinforced concrete elements.

6.3 Steel Sections

Steel Fe360 shall be used for all buildings that have a steel structure. The dimensions of all steel elements must be checked on site before its manufacture.

7 STRUCTURAL DESIGN

For the analysis and design of the Building 1 structure, the software used was Robot Structural Analysis 2017. For the remaining buildings, CYPECAD Version 2017 was used. Both programs were used in compliance with the Eurocodes.

7.1 Description of the Structures

Building 1 ï Pharmaceutical Warehouse

The pharmaceutical warehouse building is made of steel frames in castellated profiles with a transverse span of 5,0 m and longitudinal span of 40,0 m, the roof has two slopes of 10º and has IBR steel sheets of 0.8 mm thickness. The office is located on the left hand side and is made of reinforced concrete columns, beams and slabs. The roof area of the steel frames is calculated to withstand a live load of 0,3 kN/m^2, the pavement floor was calculated to withstand the load of a forklift type FL3 (63 kN) and the maximum load of the pallets (60 kN). The side of building allocated to the office was calculated to withstand an liveload of 1,0 kN/m^2 on the roof slab and 3,0 kN/m^2 on the first floor and on the floor slab. The foundations of the steel frames are made

of pad footings connected by foundation beams, in the office area there is a foundation slab, the walls up to the pavement floor are made of reinforced concrete with 18 cm thickness. The wind load and the earthquake load were taken into account throughout the whole building.

Building 2 ï Toxic and Famable Products Warehouse

The toxic and flammable products warehouse building is composed of non-equidistant steel frames (2,9m ï 5,0m), the roof has two slopes of 10º and IBR roof steel sheets 0.8mm thickness. The side facades of the building are made of masonry. The building was calculated to withstand a live load of 3,0 kN/m^2 on the pavement and the roof is considered ordinary with a live load of 0,3 kN/m^2. Although it is a low rise building, the wind load was considered and for both suction and pressure. The foundations are pad footings connected by foundation beams.

Building 3 ï Workshop and Maintenance

The workshop and maintenance building is made of equidistant steel frames (5,0 m), the roof has two slopes of 10° and has 0.8 mm thick IBR steel sheets. The side facades of the building are made of masonry. The building was calculated to withstand a live load of 3,0 kN/m^2 on the pavement and the roof is considered ordinary with a live load of 0,3 kN/m^2. Although it is a low rise building, the wind load was considered and for both suction and pressure. The foundations are pad footings connected by foundation beams.

Building 4 ï Engine Room

The engine room building has a simple reinforced concrete structure of columns, beams and slabs. The floor supports a live load of 3.0 kN/m^2 and a point load of 14 kN allocated to the generator which is placed on a reinforced concrete base on the pavement floor. The roof is not accessible with a live load of 1,0 kN/m^2. The wind load was also considered. The foundations are pad footings connected by foundation beams.

Building 5 ï Guardhouse

The guardhouse building, similar to the engine room, has a simple, reinforced concrete structure made of columns, beams and slabs. As the guardhouse is a small building and without special conditions, the pavement floor supports a live load of 3,0 kN/m^2 and the roof is not accessible with a live load of 1,0 kN/m^2. The foundations are pad footings connected by foundation beams.

Building 6 ï Waste Disposal

The waste disposal building has a composite structure made of with concrete frames and a steel roof structure with IBR steel sheets of 0,8 mm of thickness. The floor supports a live load of 3,0 kN/m^2 and the

roof is considered ordinary with a live load of 3,0 kN/m^2. The wind load was also considered. The foundations are pad footings connected by foundation beams.

Building 7 ï Elevated Reservoir

The elevated reservoir building consists of a pump house and two reservoirs, one underground and the other one elevated.

The structure is reinforced concrete with 0,35m thick slab foundation 2,50m below ground level. The reservoir walls and 4 columns that support the elevated reservoir at 13,15m from the ground level (base of the reservoir) rise from the foundation slab. The columns are locked by beams of 0,25x0,30 in 3 levels.

When calculating taking into account the wind load, the structure was analyzed as having both reservoirs empty in order to obtain the worst case scenario. When calculating the load of the structure on the foundation, it was analyzed with the 2 filled reservoirs assuming a live load of the water equivalent to 10 kN/m^3.

The foundation slab should be laid on a layer of fine sand of 50mm followed by a layer of 80mm of rockfill and beneath it a well compacted soil.

Maputo, November 24th 2017

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