FACULTY OF MECHANICAL AND CIVIL ENGINEERING
IN KRALJEVO
UNIVERSITY OF KRAGUJEVAC

The Eighth Triennial
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# HEAVY MACHINERY HM 2014

## Proceedings

ZLATIBOR, SERBIA
June 25 - June 28 2014

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# Reconstruction of Warehouse System in Pharmaceutical Industry

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*The paper presents the way how reconstruction of existing warehouse system in pharmaceutical industry was done. The main goal of reconstruction was increasing of storage capacity and design of new material handling system. New designed warehouse system introduces rack pallet system and adequate material handling devices. In this way technological function parameters of warehouse system are improved.*

**Keywords: Warehouse, Material handling, Reconstruction**

## 1. INTRODUCTION

Whole area of the factory for drug production is located near town Kovin in lowland part of Serbia. Factory area is surrounded by agricultural land. Within factory area, shown on Figure 1, warehouse is situated in the south part near by access roads and gates. This factory warehouse will be analysed in this paper. [1]

Physically factory warehouse system is situated in two separate buildings mutually connected with corridor (objects 1 and 2 on Figure 1). Warehouse buildings are the same with dimensions 48×13×6.35 m (L×W×H). The existing warehouse is connected with production facilities by internal roads.

The main focus of the study presented in this paper is reconstruction of existing warehouse system and design of new material flow in warehouse system. Main goals of reconstruction were to: enlarge storage capacity by introducing rack pallet system and to select appropriate material handling and storage devices.

Side goal of warehouse reconstruction was to design system for monitoring, gathering, processing and archiving temperature and humidity of data. Due to geographical position of warehouse, region meteorological characteristic, construction and technical characteristic of objects as well as specific properties of stored goods, continuous monitoring and observance of temperature and humidity (microclimate) in required limits within whole warehouse system is necessary during the whole year. For optimal observance of microclimate parameters in warehouse system, it is necessary to install sensors for temperature and humidity monitoring on several places within warehouse system - characteristic spots. [2]

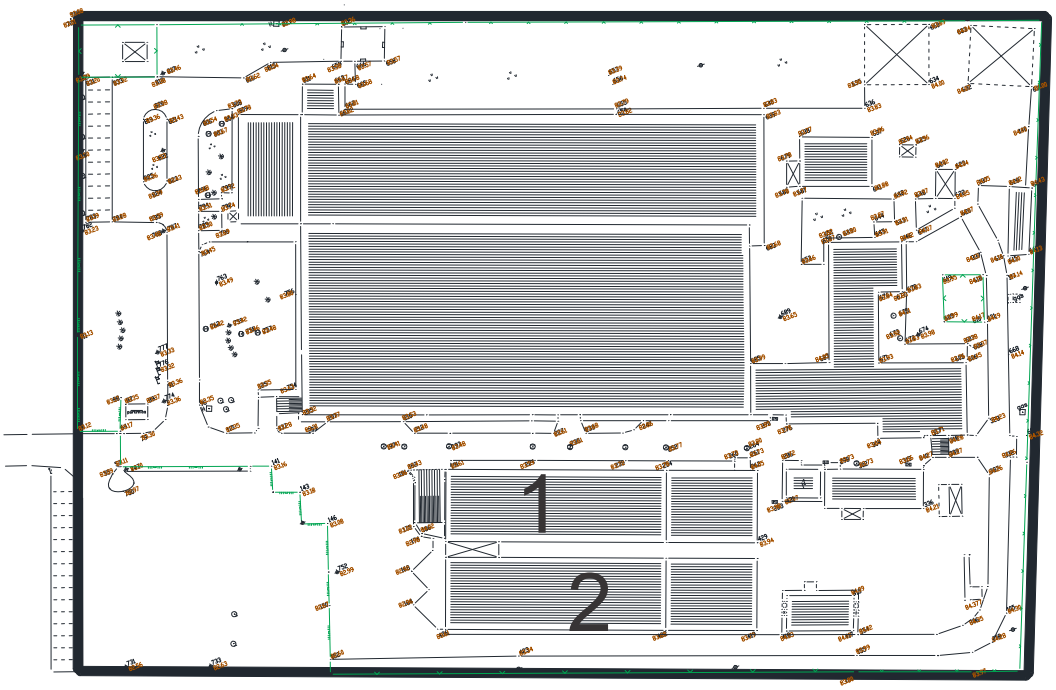


*Figure 1: Factory layout*

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## 2. EXISTING SITUATION

Goods that are stored in factory warehouse system are: raw materials, final goods, packaging, auxiliary material characteristic for pharmaceutical industry.

Raw materials, auxiliary material and packaging are transported to warehouse system (factory), using means of road transport (trucks, lorry). Dimensions and types of packaging of those goods are different (standard and non-standard) and they are stored in original delivery packaging (packed by producer). Delivery of goods is in one shift.

Production in the pharmaceutical factory is performed in the production facilities situated next to warehouse system. The production is organised in two shifts, when needed even on Saturdays and Sundays). Production outcome of final goods per months is not uniform.

Delivery of final goods to warehouse system is done from daily production buffers by forklift trucks in one shift.

Raw material and existing assortment of final goods requires storage temperature in interval of 10°C÷20°C and humidity in interval of 0÷50% during the whole year.

### 2.1. Size and Orientation

Pages should have A4 (210x297 mm) format and portrait orientation. Top and bottom margins of the page should be 2 cm, while inside and outside borders should be 1.5 cm.

## 3. NEW WAREHOUSE TECHNOLOGY DESIGN

On the basis of: available storage space, optimal number of pallet places, analysis of goods which are to be stored and goods technological properties warehouse system is organized as: [1]

Part 1 (object 1) – raw material warehouse, which is designed for keeping bulk raw materials and auxiliary materials. Also in this object, quarantine for raw material as well as private custom warehouse is situated. Goods in this part of warehouse system are stored in racks.

Part 1 (object 1) consists of three technological parts. The capacities of technological parts are:

- 480 pallet places – for powder raw materials and auxiliary materials,
- 24 pallet places – raw materials quarantine,
- 72 pallet places – private custom storage, and
- 110 shelf places – separate part with extra entrance used mainly for spare parts.

Part 2 (object 2) - final goods warehouse, is designed for keeping final goods and packaging in racks. Some of goods in this part of warehouse system are packed in metal containers and crates and are stored on the floor - block system.

Capacity of the factory warehouse system is 1312 pallet places in racks and 56 places in block system.

Part 2 (object 2) also consists of three technological parts. The capacities of technological parts are:

- 512 pallet places – for final goods storage,
- 104 pallet places – for sample storage,
- 120 pallet places – for elastomer storage in racks, and
- 56 block places – for elastomer storage in block.

Receiving - shipping area (object 1) is equipped with twin I/O roll doors and inclining ramp as a connection with outdoor transport roads. This part is designed as I/O for people and transport devices. Beside this area there is a passage - connection between object 1 and 2 used by people and transport devices.

All technological parts in the warehouse system are connected with adequate transport paths which fulfils technical requests of chosen transport devices.

Acceptance, manipulation, storage of pallets in the warehouse together with order picking and distribution of final goods pallets is done by electric fork lift trucks and hand pallet trucks.

Racks in the whole warehouse system (object 1 and 2) consist of modules which can accept two or three euro pallets (1200×800×145 mm) per module, with four levels in height. Maximal load of one pallet place is 1000 kg. Layout and look of racks in warehouse are shown on Figures 2a, 2b and 2c. Technical dimensions of racks and rack modules are shown on Figure 3. Basic rack module of length 2700 mm, can accept three standard pallets (1200× 800 mm) or two non-standard pallets, while basic rack module of length 1800 mm, can accept two standard pallets (1200×800 mm) or one non-standard pallet. [3]

All double racks are equipped with protection poles and protection metal plate between them. Single racks are protected only with angular metal poles. Protection is placed in front of all racks towards the main transport path.

All double racks are equipped, up to the third level, with metal stops which prevent pallet shearing from horizontal beam. Fourth level on all racks is equipped with metal mesh deck which prevent possible drop of pallets, pallets shearing and pallet break. All metal mesh decks on fourth level have the same load capacity as horizontal beams i.e. 1000 kg per pallet place.

The rack which is designed for raw materials quarantine is equipped with metal wired doors. Purpose of those doors is to enable access to raw materials in quarantine only to authorised persons.

According to new designed solution Part 1 (object 1) of warehouse system is equipped with six four level height double racks with capacity of 20 pallet places per level. Racks consist of four modules with three pallet places and four modules with two pallet places. These racks are used for storage of powder raw materials, auxiliary and packaging materials. For raw materials quarantine one four level height single rack with eight pallet places per level is designed. Rack consists of two modules with three pallet places and one module with two pallet places. This rack is equipped with metal wired door, painted in red colour, which can be locked.

Private custom storage, situated in Object 1, is equipped with two single four level height racks with capacity of 9 pallet places per level. Racks consist of three modules with three pallets. Private custom storage is placed in separate in room with two passing through doors.

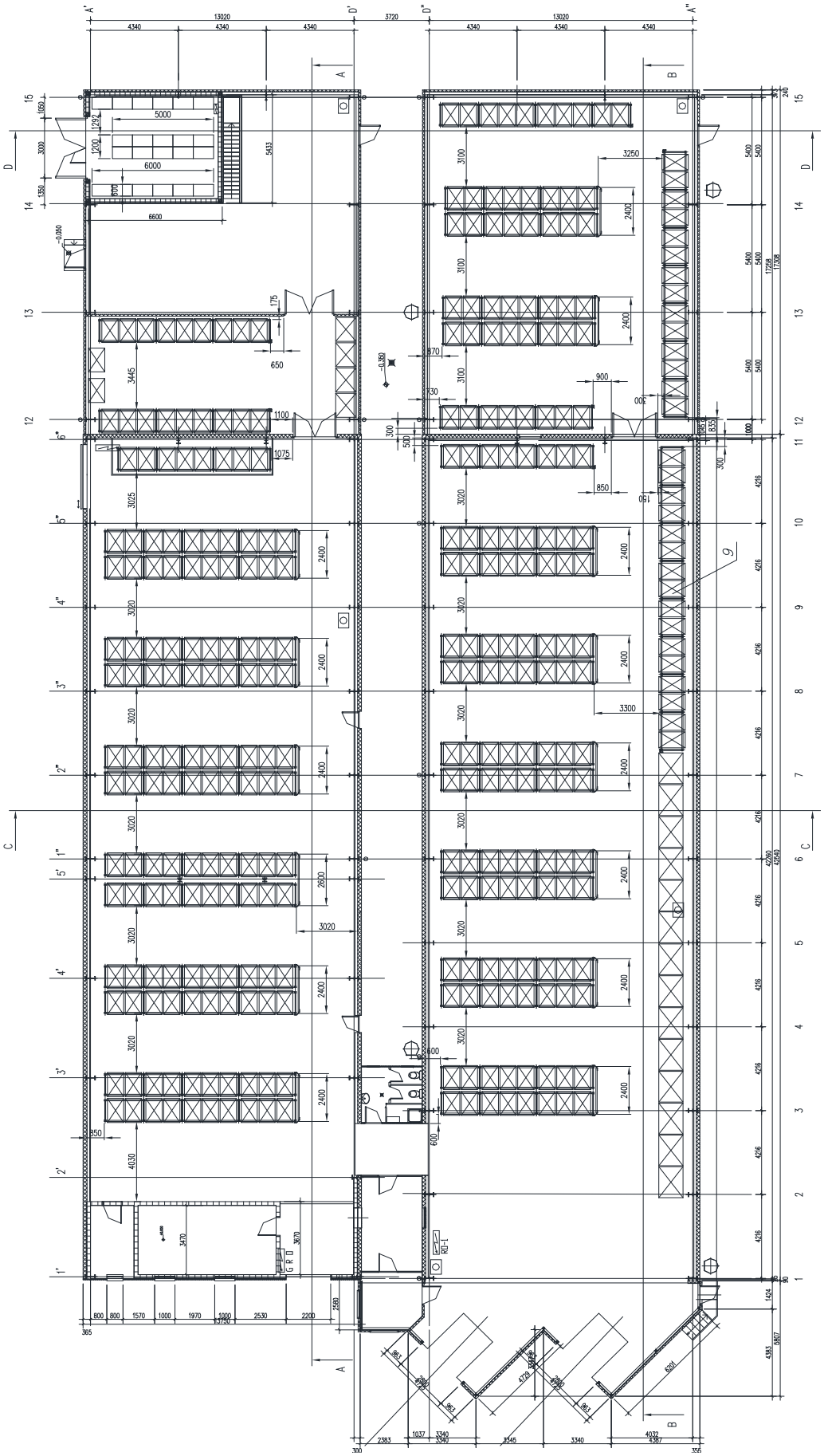

*Figure 2a: Warehouse layout*

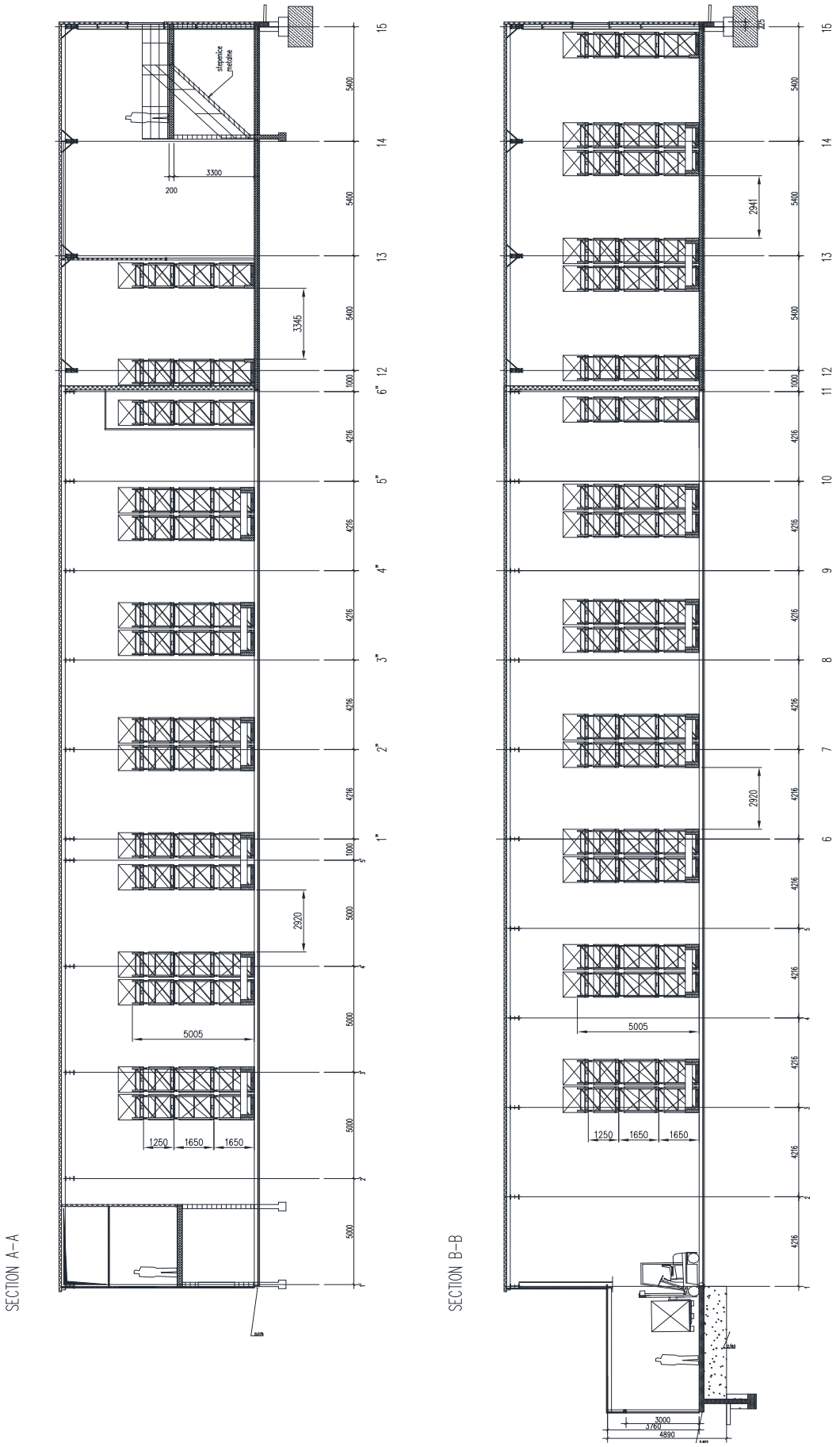


*Figure 2b: Warehouse layout - Sections A-A & B-B*

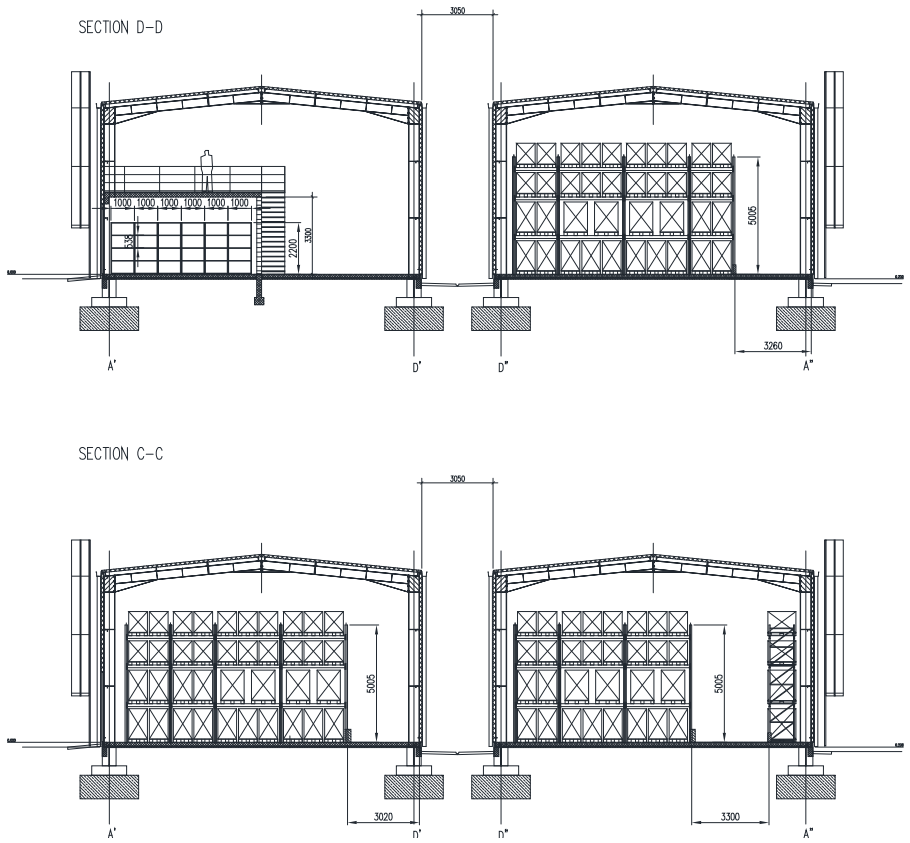


*Figure 2c: Warehouse layout - Sections C-C & D-D*

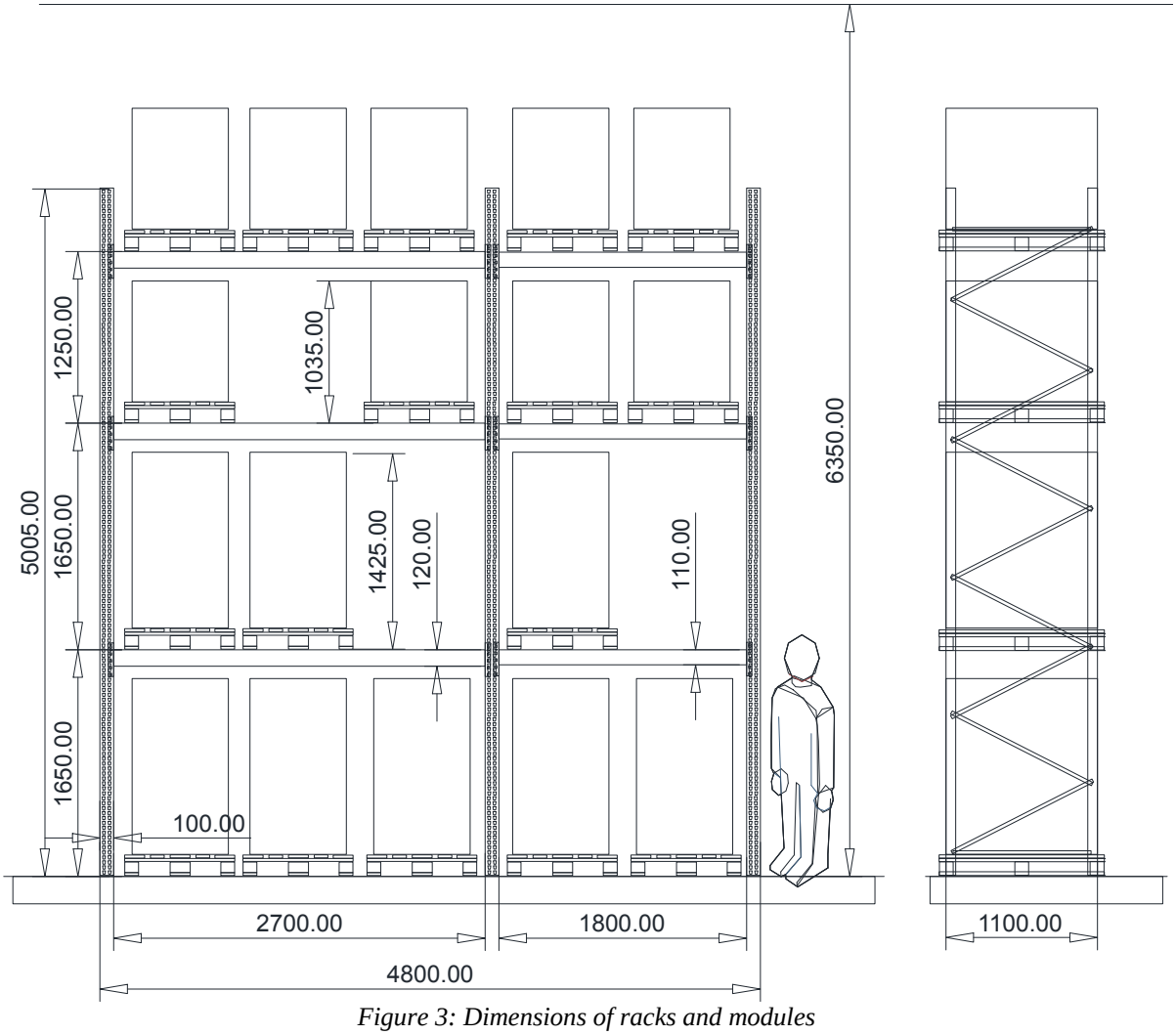


*Figure 3: Dimensions of racks and modules*

Separate part of the warehouse which has extra outside entrance is located at the corner of Object 1. It is equipped with shelf racks. In this separate part there are two single shelf racks with six modules which dimensions are 1000×600 mm (L×W) and load capacity 100 kg per module, with total shelf rack height of 2200 mm. In this part of warehouse there is also one double shelf rack with ten modules which dimensions are 1000×600 mm (L×W) and load capacity 100 kg per module, with total shelf rack height of 2200 mm. Shelf racks are used for storage of spare parts and small consumable material.

According to new designed solution in Part 2 (object 2) of warehouse system two loading bays with industrial doors, dock levellers and dock shelters are predicted. Lading bays are used for acceptance of raw materials and shipment of final goods.

In Part 2 (Object 2) of warehouse system on the right side near to passage - connection between object 1 and 2 there is area for fork lift battery charger, while on the left side towards the loading bays there is a stretch wrap packing machine installed.

Technological equipment in Part 2 (Object 2) of warehouse system consists of eight four level height double racks with capacity of 16 pallet places per level. Racks consist of four modules with three pallet places and two modules with two pallet places. These racks are used for storage of final goods and production samples.

This part also contains five single racks. Two four level height single rack with two modules with three pallet places and one module with two pallet places are used for storage of final goods. One four level height single rack with two modules with three pallet places and two modules with two pallet places is used for sample storage.

One four level height single rack with seven modules with two pallet places and one four level height single rack with eight modules with two pallet places are used for storage of elastomer packed on non-standard pallets.

## 4. CONCLUSION

The reconstruction of existing warehouse system and design of new material flow system in the warehouse was accomplished by introducing rack pallet system with appropriate material handling and storage devices. New designed rack pallet system, increased storage capacity i.e. number of pallets that can be stored in the warehouse system. Introduced new material handling devices (side fork lift trucks, loading bays etc.) enabled quicker and safer pallet manipulation in the warehouse system. Applied design solutions leads to better technological function parameters of warehouse system such as: simplest and shortest transport paths in warehouse, shorter fork lift truck cycle time, faster loading/unloading of pallets etc.

Also, original solution for observance of microclimate parameters (temperature and humidity) is developed and implemented in the warehouse system.

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