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SERIAL AND PARALLEL CONNECTION OF ACTIVITIES FOR ESTABLISHMENT OF A DYNAMIC PLAN OF CONSTRUCTION OF AN RC BUILDING

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ABSTRACT

The presented topic is in the area of organization of construction. It has increasingly been highlighted and applied in the construction of any structure in the construction industry, allowing the achieving of a greater cost effectiveness and efficiency of resources, time and money. This is possible to be achieved by making a dynamic plan (gantogram) for which there are a number of softwares, but previously, it is of a great importance to study all the conditions that will be included in the realization. A residential eight storey building has been considered. For this building, certain aspects of organization have been studied and the dynamics of engagement of resources (gantogram) in the course of time as well as the dynamics of activities to be done for the entire building have been presented by use of Microsoft Office Project.

INTRODUCTION

Dynamics of construction and dynamic planning of construction were prepared for a residential structure with a rectangular plan proportioned 18 m x 24 m, with total area of 432m2 at plan and a total of 8 storeys (B+GF+6). The modules in both directions are 6 m each, 4 modules in one and 3 modules in the other direction. The structural system represents a mixed system composed from reinforced concrete frames and reinforced concrete walls. The structural elements are proportioned as follows:

- Reinforced concrete columns 65/65 cm along the entire height
- Reinforced concrete beams 65/55 cm
- Cross reinforced floor slab – 18 cm
- Reinforced concrete walls for the staircase – 25 cm, basement and elevator core – 20 cm
- Foundation structure – foundation truss with a height of 120 cm and width of foundation beam of 85 cm, with a slab having a thickness of 25 cm and width of up to 220 cm – designed for bearing capacity of soil of 200 Kpa.
- Roof structure as a wood structure with a couple roof covered with plasticized sheet metal.

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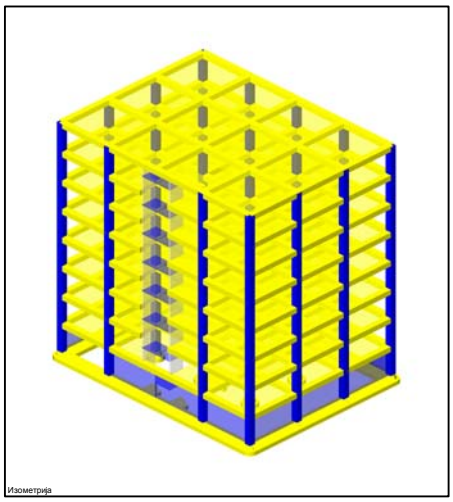

Figure 1. 3d model in Radimpex Tower 6

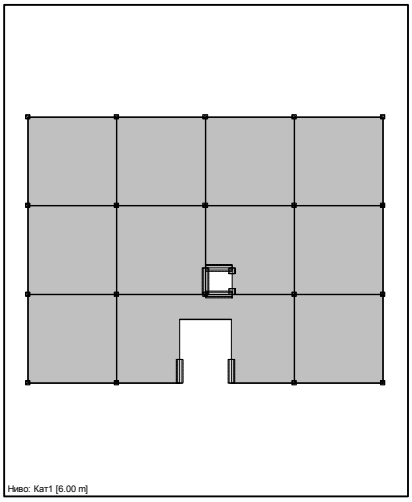

Figure 2. Plan of the first floor

The residential structure consists of 35 flats, 5 flats at each storey. The storey height of each storey is 3 m. The total height of the structure is 24 m. 12 parking places are anticipated for the basement. The structure is represented in the Radimpex Tower 6 software package.

TECHNOLOGY OF CONSTRUCTION

The construction starts with the preparation works involving completion of all administrative works, provision of all necessary consents and accomplishment of all necessary projects. The initial activity as to the preparation of the construction site is its enclosure. The fence will be constructed of sheet metal plates fixed by previously tamped steel profiles at corresponding distance, with necessary elements for maintenance of the fence stability. Once the construction site is enclosed, the terrain is cleaned and the facilities constituting the economy part are established. The enclosed construction site is indicated by a board with the image of the structure, reading the investors and the contractors, the number and date of approval of construction, the title of the authorized authority and the deadline for the completion of the structure. The preparation works end by staking and marking of the terrain after which the main construction works are to begin.

Figure 3. Technology of construction

The main construction works start with the earth works, i.e, wide mechanical earth excavation that is performed by an excavator, whereas the transport – the hauling of the earth is done by a truck. The wide mechanical excavation shall be done down to the level of 3 m below the terrain surface from which point, a narrow excavation will start to be made mechanically and manually for the purpose of establishment of the foundation structure. Application and tamping of gravel below the foundation

structure is the next activity. Then, lean concrete is applied to serve as a base for the formworking of the foundation structure as well as reinforcement and concreting with dismounting of the formwork. From the already constructed foundation structure, RC columns and RC walls in the basement part are reinforced by their formworking, concreting and dismounting of the formwork. Below the floor slab, lean concrete is applied with a thickness of 7 cm and hydro-insulation of the floor slab is made. Then formworking, reinforcement, concreting and removal of formwork is done for this slab. This creates conditions for the construction of the first floor structure in the basement that is previously formworked, reinforced and concreted while the removal of its formwork will be done after a time interval of 12 days and will be followed by formworking of the floor structure at the ground floor. This process of construction is carried out up to the 6^{th} storey, with removal of the formwork of slab structure at the 6^{th} floor followed by construction of the timber roof structure with the roof cover structure.

The first to be built are the facade walls and then the inner walls of the structure and the chimney area are built followed by placement of the installations pertaining to the first phase, including electricity, water supply, sewerage, ventilation and central heating. Once this activity is done, the inner walls of all storeys, starting from the ground floor upwards, are plastered. Cement set is applied on all storeys after previous plastering and doors and windows are incorporated within the entire structure. Next, two activities are performed simultaneously, namely the construction of the façade with 8 cm polystyrene in a corresponding coloured mortar and application of the finishing layer of mortar on the inner part of the walls and the ceilings. With the accomplishment of these activities, there start the activities for floors of the structure – a floor of ceramic plates, parquet and granite plates for the staircase area. The sanitary installations are carried out for each storey separately by which there starts the second phase of installations for connection with the end users. Then, there starts the ground floor arrangement, the construction of access ramps with a corresponding base, the placement of rails on the staircase and the balconies and finally inner and external cleaning. This being done, the structure is ready for technical acceptance.

TECHNICAL CONDITIONS FOR REALIZATION OF THE STRUCTURE

The technology of construction starts with division of the activities into 4 categories:

- Previous works
- Preparatory works
- Main construction works
- Finishing works

Figure 4. Main construction works

Previous works include research and development of analysis and collection of information on the conditions of the location where the building will be built that have an impact on the construction of the building, which impose the very need for survey of the terrain. Other conditions included in this category include the following:

- Conditions for use of labor force
- Conditions for supply of material and energy
- Conditions for use of machinery and equipment
- Conditions for the performance of the works

Analyzing all these conditions, one can obtain a clear insight into the mode in which the works anticipated for construction of the building will be done as well as the capacity of the company appointed as Contractor. The latter, first of all, refers to the capacity of the company for realization of the works, i.e., labour force (number and qualification), mechanisation and equipment (types of machines and equipment) by which are defined the own initial possibilities of the company and are analyzed the conditions and the resources necessary for use of subcontractors.

Preparatory works include construction of a temporary structure – a construction site that will be of a temporary character and will enable conditions for accelerated construction and organization (this construction site is anticipated to house a wardrobe, a storehouse for materials and equipment, premises for preparation of materials and offices.) This will create conditions for beginning of the main construction works (earth works, reinforced concrete works, roof construction, building and plastering). In the end, the finishing works are carried out.

DYNAMICS OF CONSTRUCTION ACCORDING TO A NETWORK PLAN MODEL

The dynamic plan shows the dynamics of engagement of resources in the course of time and for this structure, a gantogramme will be used as the most common technique of planning whereat the time is shown on the abscissa, while the activities are shown on the ordinates. Each activity is marked by a segment whose length is equal to its time duration. For the establishment of the dynamic plan, the following previous information has been used for the elaboration of the gantogramme:

Defined are seven groups of workers who have the ability to perform several activities:

- Group 1- preparation, earth works, reinforced concrete works, wood roof structure and roof covering works, masonry works , installation works of the first phase and plastering)
- Group 2 - doors and windows
- Group 3 - facade works and finishing coat of plaster
- Group 4 - floors - parquet , ceramic tiles and granite tiles
- Group 5 - sanitary installation phase 2, fences of stairs and terraces
- Group 6 – installation of elevator
- Group 7 – ground floor arrangement with internal and external cleaning

The method of organization involves activation of 177 activities whose relationship is seen in the network plan and the mode of performance of the construction is defined through a technology of construction which is, in fact, limited in the dynamic plan – gantogram, by a time interval. The correlations among the groups of activities and workers are defined in the gantogram.

Date of start of construction is 24.02.2014.

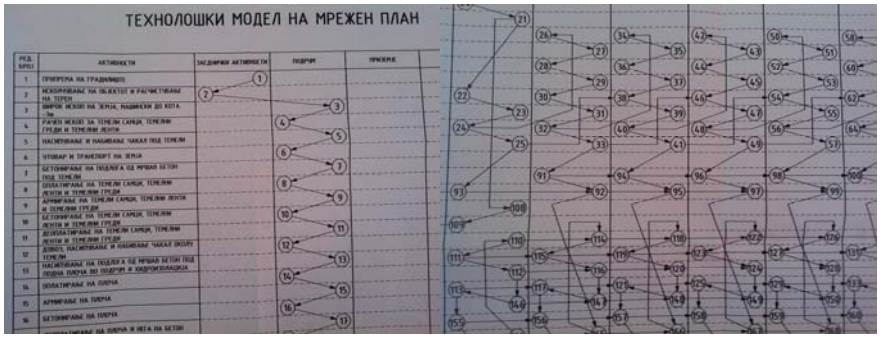

Figure 5. Technical model of the network plan

MICROSOFT OFFICE PROJECT – GANTOGRAM

After definition of the network plan procedure, the next step is the elaboration of the dynamic plan – gantogram by use of the Microsoft Office Project software package which will enable the obtaining of:

- The dead line for the completion of the structure – if it is started on 24.02.2014 according to the dynamic plan, it will be completed on 02.10.2015, or approximately for 19 months

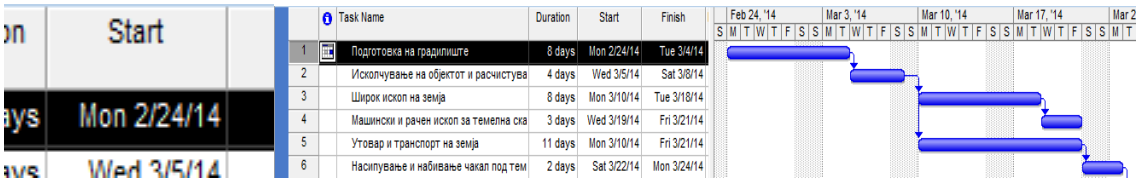

Figure 6. Start of the dinamic plan

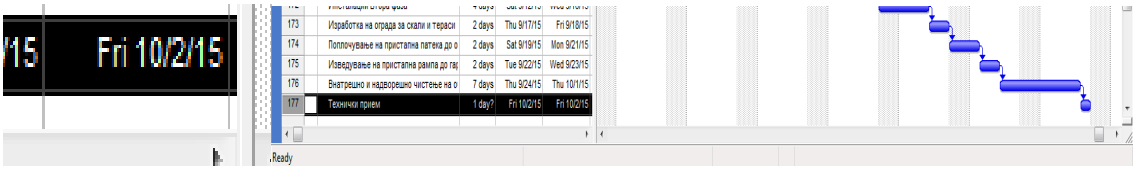

Figure 7. Finalization of the dynamic plan

- An insight into the activities to be realized within each time period;
- Possibilities for correction that are directly transferred from terrain to Microsoft Office Project that automatically displaces the time intervals and prolongs the dead line for completion of the structure.

The input parameters for the working time are considered such that each day of the week is a working day with the exception of Sunday. The working time is from 8 to 17 h with a break of one hour between 12 and 13 h.

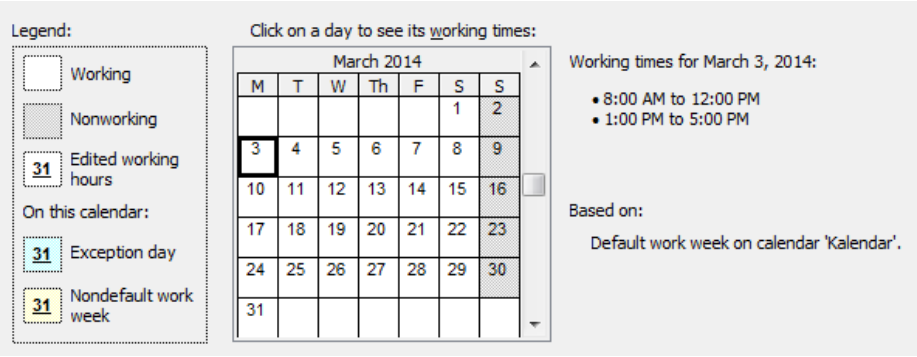

Figure 8. Definition of working time

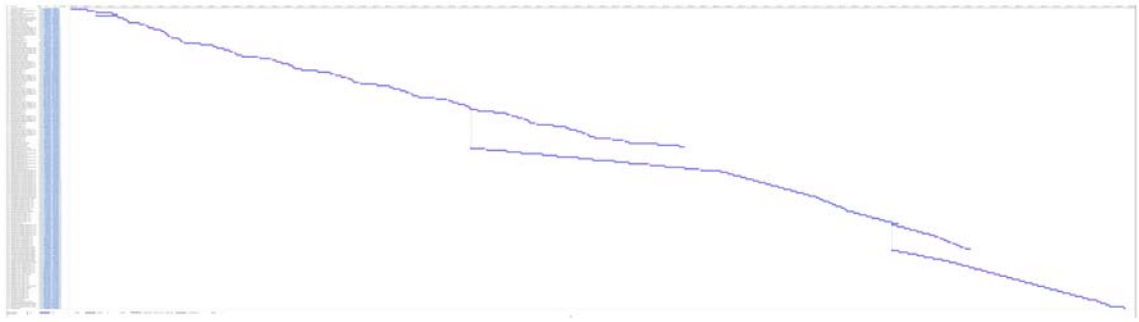

Figure 9. Gantogram

The construction starts with the performance of the preparation works, earth works, reinforced concrete works, works on the timber roof structure that are connected serially and together form the main branch of the gantogram. Branching of this branch begins with the completion of formwork removal from RC columns and RC walls at the fourth flour and beginning with formwork removal from slabs, beams and stairs at the third floor and starts with building of the walls at the ground floor and further, along the elevation of the building. Then there follow the installations, plastering, concrete surface, installation of doors and windows and with their installation, there is branched another branch that begins with the placement of the final plaster cover and further preparation of floors, sanitary works, installations of the second phase, fences for staircases and terraces, access road to the structure, access ramp, inner and outer cleaning and technical admission.

CONCLUSION

Through the organization of construction of this residential structure, the process of construction is represented. Without organization, i.e., elaboration of dynamic plans, this process would be quite undefined and irrational. The elaboration of a dynamic plan necessitates knowledge of a number of types of resources and their capacities. Greater knowledge of these resources enables more detailed elaboration of the gantogramme and the highest level of its accuracy. The Microsoft Office Project provides excellent graphic illustration of the gantorgramme and enables its correction in each time interval without disturbance of further distribution of activities. The time segments with represented activities to be executed can be separated as local parts and used in each local time period.

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