

MODELING SYSTEM FOR THE RAPID CONSTRUCTION IN SYRIA

MODELOVACÍ SYSTÉM PRO RYCHLOU VÝSTAVBU V SÝRII

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Abstract

Prefabrication is a manufacturing process conducted at a specialized facility, in which various materials are joined to form a component part of the final installation. Prefabrication techniques have been progressively adopted in the construction industry in various countries [1]. The demand was at its peak in the early 1970s in Eastern and Western Europe for the construction of new towns. Worldwide, the highest precast levels in 1996 were located in Denmark (43%), the Netherlands (40%), Sweden and Germany (31%). In Asia, the precast levels in Japan and Singapore were about 15% and 8%, respectively, recently, the use of prefabrication is further encouraged to increase productivity and build ability [2]. In Syria too, the first residential project in Damascus: the establishment of 2400 housing units in the year (77-80). Except that the rate of construction pre-cast in Syria is still not exceed 2% of Building of reinforced concrete.

In order to participate in the reconstruction of Syria, after the destruction and devastation caused by the war over four years, this search evaluates successful international experiences in rapid construction technique, and modeled system that could serve the current Syrian reality. Introduction of this technology as a new method in the world of construction in Syria requires a good base, relying on the availability of the necessary raw materials and nearness of work site, as well as the need to replace old technology into modern technology, and analyzing the economic, social, environmental criteria, to make the decision about the best solution. Cost and time will form the most important indicators that will be analyzed and calculated, before the final model mode, in order to be able to use this system later in Syrian construction companies.

Keywords

Concrete; construction; pre-cast concrete; rapid construction

JEL Classification

L74, C60, D15

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1. Previous Studies

Prefabrication is a recent trend in the construction industry that it is in a safe and controlled environment [3]. Also prefabrication is applied in building construction to enhance productivity, improve quality, and cope with a shortage of skilled labor [1]. Still cost and time the most important criteria to choose the building method but also all the studies tend to identify the level of satisfaction of users [4]. In Iraq, Prefabrication experience could be a solution to the problem of increased reliance on mass production of housing and the provision of an execution time [5]. Most of the previous studies adopted as a methodology to review previous studies and conducting analysis of questionnaires and then through modeling and simulation [6]. In Catalonia by using MCDM building 3000 m² schools in only 14 months before then the design and construction process of a school center took 43 months[7].

In Iraq researcher reached to a typical Scale designed to integrate the advantages of two systems which globally using and put together their advantages in this scheme, which reduces the time and cost less than if carried out in the traditional way [8]. There is a need to establish holistic criteria to stimulate the suitable use of prefabrication for a given building project [9].

2. The importance of research

Syrian government has paid great attention to the process of reconstruction, and resettlement rapid construction technique in order to serve the stage post-war, also emphasized the need to link the executive bodies with researches carried out by the Syrian universities. It also seeks the Ministry of Housing and Urban Development, and the Ministry of Works in Syria to set up a special branch for rapid construction according to the latest technologies and international standards, and emphasizes the need to develop standards and models that meet the technical standards of rapid construction.

3. Problematic of research

- Destruction and devastation caused by the war on Syria and the trend towards reconstruction.
- Choose the rapid construction as a strategic solution to the crisis of the population in Syria.
- Expected return sync for the displaced to their houses.
- Lack of clarity towards knowledge of pre-casting construction among the citizens and workers in construction field.

4. Research Hypothesis

Some of the applications that would improve the performance of the rapid construction technology, including:

- Replacement the local technologies ancient to modern and sophisticated technologies.
- Increased production lines of prefabricated elements.
- Provide appropriate mechanisms for the transfer and lifting and installation of these elements.
- The processing of roads and infrastructure to withstand such large payloads.
- Management development and qualification of human resources.
- The development of contractual systems.

5. Research objectives

Propose a system for the rapid construction in Syria which contributes to resolving the issue of reconstruction.

6. Methodology

- Access to the latest scientific findings in the field of rapid construction. ☐ Develop evaluation criteria.
- Assessment of the Syrian reality in this area.
- Identify constraints and economic feasibility study of the strength ☐ Putting mathematical model for the rapid construction in Syria.
- Programming the model and submit it to the Syrian construction companies to take advantage of it in the next phase.

7. Results details

7.1. Case study

Portable hotel is built using one of the rapid construction techniques (pre-cast concrete technology). Construction consists of two parts: Each section consists of two floors:

- The downstairs consists of 8 apartments with an area of 30 square meters for each one. Total area of the floor $8 * 30 * 2 = 480$ square meters.
- Upstairs consists of 4 apartments with an area of 50 square meters for each one. Total area of the floor $4 * 50 * 2 = 400$ square meters. The cost per square meter of the building (the structure) = 30,000 square meters in Syrian pounds. The cost per square meter of the building (with cladding) = 40,000 square meters in Syrian pounds.



Fig. 1: The portable hotel.



Fig. 2: Prefabricated elements.

7. 2. Building schedule and composition of the activities using DH method (Dynamický harmonogram)

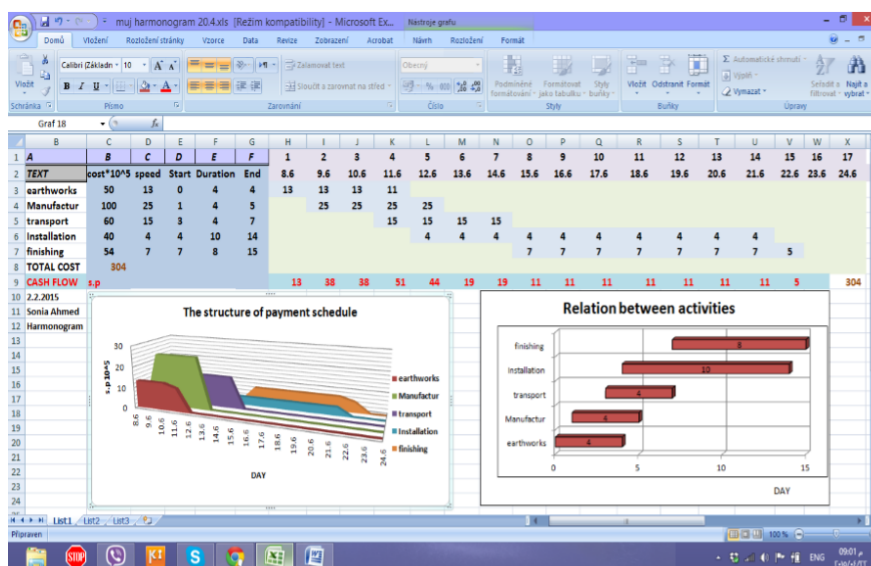
There are 5 activities: A1: earthworks, A2: manufacture, A3: transport, A4: installation, A5: finishing. Scheduling is based on the cost and speed of production, taking compatibility between

individual activities. Relationship between the activities is given as allows technical and organizational conditions of the activities, it makes the schedule faster and easier. There is more than one possibility in designing this relation, and this gives us the ability to analysis the variables and taking the decision.

7. 2. 1. Building schedule and composition of the activities:

Table (1) Helps in calculating the resource requirements and the formation of the payment schedule (cash -flow), and therefore know the necessary financial resources within the suitable time. Figure (3) shows the necessary financial resources during the life of the project.

Tab. 1: Building schedule and composition of the activities.



Source: Own calculations.

The schedule gives great flexibility, in terms of the expected change, and there is a possibility to deal with the change (in the cost or duration of individual activity or production speed), and also the possibility of dealing with any new activity may be added later, and its relation with previous activities. In this project we have the case of early payments, and we need to lend this money from bank, we could calculate the durations, the longer loan, the higher overall cost will be paid by the owner. All resulting values can be represented in the figure (4), the bottom line represents the second row of the table, a financing needs. The lower line represents the second row of the table, a financing needs. The upper line represents the total requirements without the introduction of the time factor, the middle line is the total value of the resource needs without the introduction of the time factor.

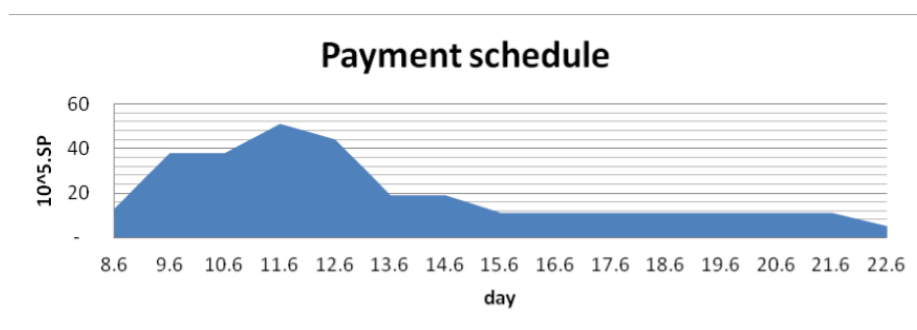


Fig. 3: Payment schedule. Source: Own calculations.

Difference between the two total values with and without the time factor is not great in our example as a small, but give the indication of the importance of this factor and its impact more will appear in the larger projects.

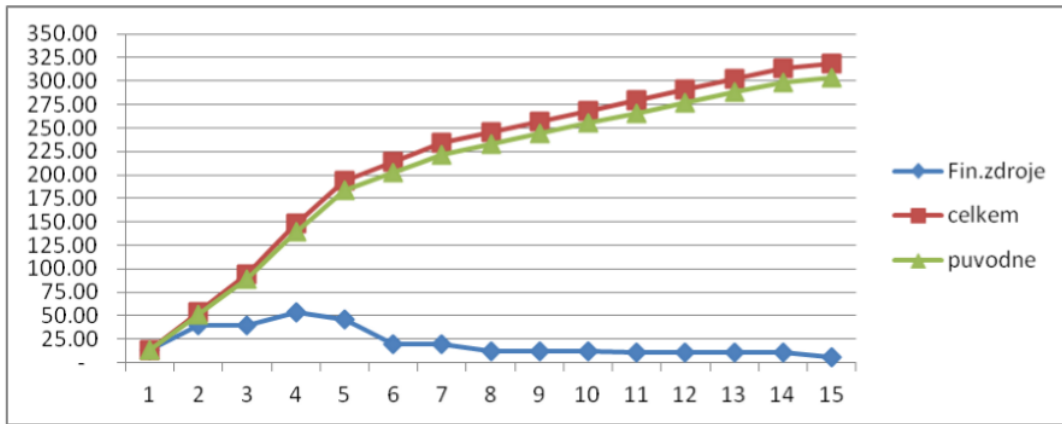


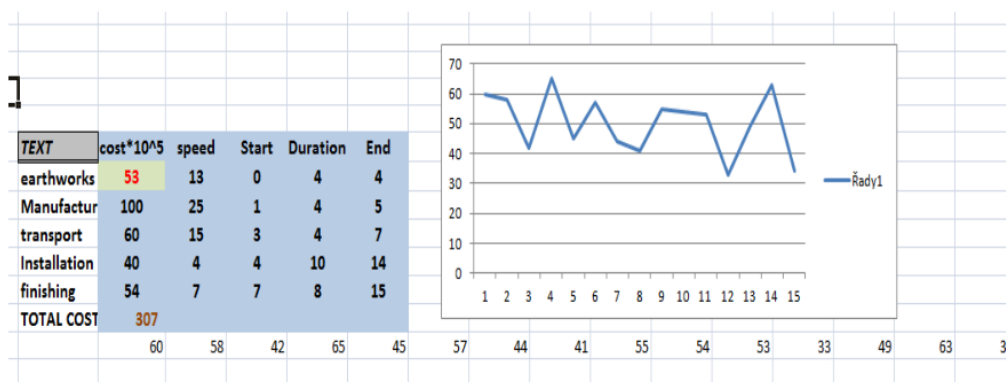
Fig. 4: Needed financial resources with the effect of time and without. Source: Own calculations.

7. 2. 2. Risk in preparing the schedules

Inputting risks to input parameters of calculating tables using random numbers, Provides many and different results in the case of risk, generating a new value of risk gives us an idea about the final period of the project, and the relationship between the beginning and end of each activity, which helps management in decision-making about the best solution. Figure (6) show the Inputting risks to input parameters of calculating tables.

7. 2. 3. Sensitivity analysis

Using sensitivity analysis is figuring out how to change the input effect on the result, the output from the formula. It is thus a process of changing the values in cells to see how these changes will affect the output of the formulas in the worksheet. Shown in Figure (7) the positive relationship between increased volume of activity (manufacturing), and increase the total duration of the project. Where we have shown an increase of about 15%. As for the speed of production, in the figure (8) an inverse relationship, where the low-speed give an excess total duration.



Source: Own calculations.

Fig. 6: Inputting risks to input parameters of calculating tables using random numbers.

But this does not give a solution to the problem, but can take advantage of this information in the preparation stage of the project, and offers. then reorganizing operations, where we get the best alternative in early.

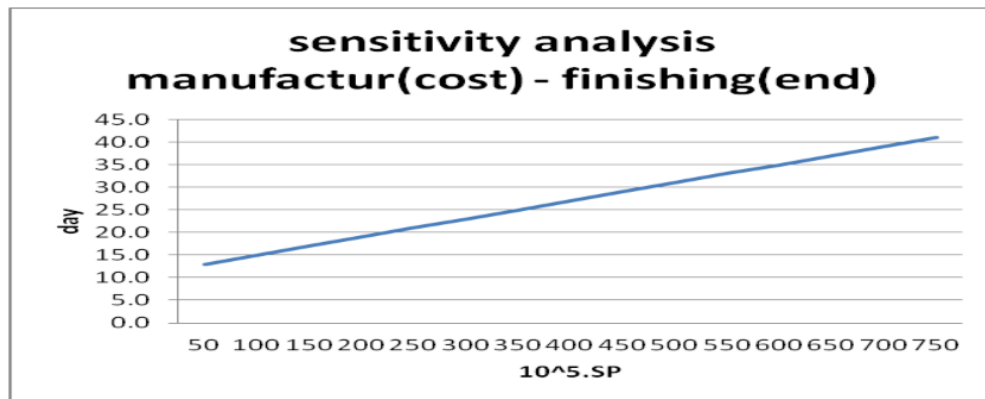


Fig. 7: Sensitivity analysis manufacture (cost) – finishing (end). Source: Own calculations.

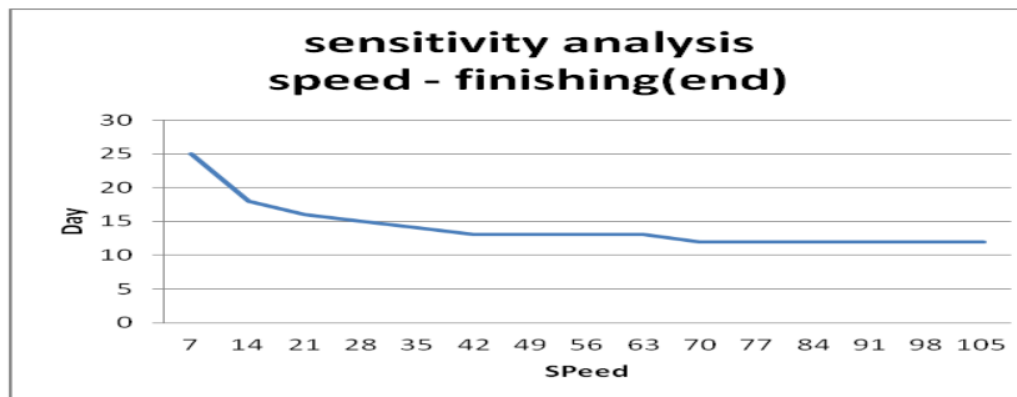


Fig. 8: Sensitivity analysis speed – finishing (end). Source: Own calculations.

8. Conclusion

Using schedules offers a lot of flexibility through relationships formed between different activities [10]. In this case, the allowable relationships between activities has formatted (technical and organizational), and then the distribution of work on the overall duration of the project size to get the financial resources that are needed daily, and drawing the cash flow. After this, was the analysis that can give at each stage a clear vision for the management about the possibility of intervention to make the decision and choose the best alternative. That scheduling gives the possibility of periodic monitoring of the progress of activities, through a stop at a control moment, and through calculating could know the extent of achievement of each activity and thus adjust the delay to preserve the final period of the project. It can also through enter the expected impact of risk giving an idea to the owner during the negotiations and conflict resolution to see the impact of each risk and the possibility to accept or reject the solutions offered by contractor. Sensitivity analysis also helps the administration, in the comparison between alternative options and decision-making and provides useful information before contracting where you can switch the order of technology and organizational processes during the preparation of quotations, and thus provide the best technical bid. By comparison with previous research analyzed through different statistical programs [11], show us the flexibility and significant results provided by the HD method , and therefore the decision was

made in the application of this method during the analysis down to the data that will help in the formation of the desired model.

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