INFLUENCE FLEXIBILITY TECHNOLOGIES CONSTRUCTION ON PROCESS INDUTRIALIZATION AND ROBOTICS IN CONSTRUCTION

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Abstract: In this work, we will present an original classification of building technologies being used for high-rise building facilities. For suchlike building technology presentation, we will define flexibility of technology as a substantial criterion for application of industrialization and robotics to them and present process optimization for difference kind construction technologies with use in south-east Europe.

1. Introduction

Flexibility of various building technologies understands a possibility of a comprehensives architectural expression within them. A basic function of flexibility of building technologies is to be able to surmount any kind of solutions of architectural high-rise building facilities beginning from classical building to the technology of installing finished apartments having been industrially made and installed the spot as finished units.

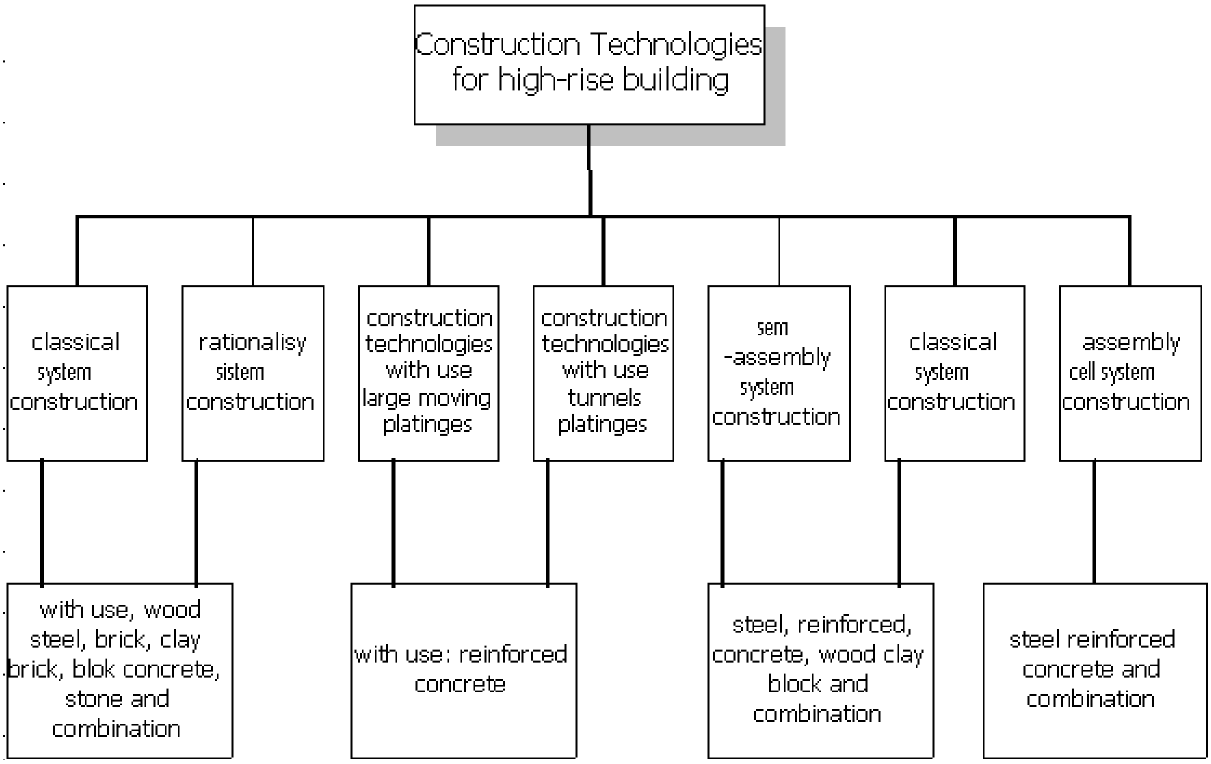
in that respect, we will determine flexibility of characteristic building technologies. According to the degree of flexibility considered characteristic building technologies of high-rise facilities as the simplest criteria and some other important elements of these technologies (building velocity, building price and other elements), we will present a possibility of optimization of these technologies.

In line with these researches, we will try to give a critical approach to an impact of the building technology selection in the application of industrialization and robotics to them. Within the same context, it will be analyses necessary activities in order to increase a degree of industrialization and robotics over analyses technologies while a flexibility coefficient at the same time will not be decreased.

We will give a specific example for building technology according to our research and experience, where by increasing flexibility would prove that we do not have a trend of decreasing industrial building on empiric basis. Technologies used to be applied with a high degree of industrialization have been applied less recently for their possibilities are not sufficiently expressed. According to this research and our experience, it should be given an over live of a perspective go application of industrialization and robotics at various building technologies of high-rise facilities, particularly having in mind that this part go Europe, for the last fifteen years, has undergone comprehensive changes.

2. CLASSIFICATION BUILDING TECHNOLOGIES

Classification building technologies for high-rise building faculties, we will present original building technologies.



3. FLEXIBILITY AS A BASIC PARAMETER OF ARCHITECTURAL RESEARCH

Technology flexibility of constructions is its capability to be used in realization of various architectural solutions of high-rise facilities. That's a question of universality of technology.

Here it is noted that with technology the higher level of industrialization and pre-fabrication and installation the lower coefficient of flexibility, that is to say, an architect's capability to achieve various architectural solutions. Therefore, these technologies required special design bureaus in order to achieve a high quality solution. These technologies mostly were used for larger and continuing volume of construction tending to decrease. Mainly reduced possibility of architectural expression, respectively reduction of flexibility of these construction technologies is a result of space limits of components production in all three coordinates. Consequently, here, necessity for increase of the level of technology flexibility as a basic precondition for better architectural expression collides with an initiative of industrialization and robotics in construction industry. Industrial production, pre-fabrication, robotics require high classification and modeling thus rising a question where is the optimum between these two opposite aims.

In order to analyze this problem in details we made research in technology flexibility of construction of high-rise facilities mainly used here. Research of these technologies started from an assumption that classical construction technology provides comprehensive expression and that a system of cell technology (with a complete industrial produced units) provides the lowest architectural expression. In that respect, depending on a capability of technologies to define space architecturally and in three-dimension, it has been determined exactly a level of flexibility as a basic parameter of representation of industrialization and robotics within them. Therefore, detailed research of industrialization and pre-fabrication and flexibility of technologies mainly used here, have been made.

We will further on present multi-criterion optimization of different construction technologies where, with variations of major coefficient of the level of industrialization and flexibility, it is likely to determine optimal version satisfying both of these parameters.

4. POSSIBILITY OF OPTIMIZATION OF DIFFERENT CONSTRUCTION TECHNOLOGIES OF HIGH RISE FACILITIES

As a comprehensive method for optimization of different construction technologies, we suggest multi-criterion optimization where it is likely to carry out an extensive ranking of selection of optimum technologies. Multi-criterion optimization is a complex process of finding out solutions in more phases and more levels of decision-making. A basic lay out of actions and phases of decision-making are given in illustration No. 1

4.1 Mathematical modeling of a multi-criterion optimization problem

Solving this type of assignment is a part of a multi-criterion optimization problem for non-dynamics systems and is formed in the following way: min F(x), max F(x), $x \in X$, where F(x) is a vector criterion function which components are individual criterion functions:

$F(x) = f1(x), f2(x), f3(x), f4(x), f5(x)$,

Usually the following criterion functions are selected:

f1(x) - consumption of time per m2 net surface

f2(x)- value of materials per m2 net surface

f3(x)- level of industrialization and robotics

f4(x)- velocity of facility construction

f5(x)- flexibility

f6(x)- total costs per m2 net surface

f7(x)- consumption of energy for production of building materials being used for construction processes, etc.

$X1\ X2\ X3\ X4 \in X$ - is a group of various variants

A method of a compromise programming and compromise ranking is chosen for establishing optimum solutions. This method is very much applicable when there is a matrix of individual criterion functions for each variant.

Rarely, one solution maximizes all criterion functions parallels. In event that we do not have this case, we will use a concept of ideal solution, respectively "ideal" point as a referring point in space of criterion function.

If f = min f1(x), and = 1,2..., n optimum solution by i-criterion, then FT = (f1T, f2T,..., faT) is an ideal solution of multi-criterion optimization. If there is xTΣ and C for which F(xT) = FT , it is required and XT = x1T x2T - ... - xT, and then xT can be adopted as an optimum solution of the assignment.

Mostly, this does not belong to a permissible group, thus, a solution is being sought to be the closest to ideal in space of criterion function. A solution the closest to the ideal is called a compromise solution.

Due to extensive presentation of mathematical modeling of multi-theoretical optimization and limitations of this work, we are not able to show in details a mathematical process of modeling. In case of interests for details about investigation of this problem, there are apart from detailed lay out of mathematical model, in literature under the number (3), the examples of multi-criterion optimization of different construction technologies mainly used here.

We will present here characteristic construction technologies for process optimization

Table num. 1 Variantes characteristic construction technologies

A1	Traditional technology construction
A2	*Rationality – traditional technology construction*
A3	*Technology use for column and beamers traditional technology construction for mezzanines large moving plantings*
A4	*Technology use for columns and beams traditional technology construction for mezzanines system ''OMNIA''*
A5	*Technology use for columns and beams specific moving plantings for mezzanines large moving plantings*
A6	*Technology use for columns and beams specific moving plantings for mezzanines system ''OMNIA''*
A7	*Technology use for production R.C: panels specific small moving plantings for mezzanines system ''OMNIA''*
A8	*Technology use production R.C. panels large moving plantings for mezzanines system ''OMNIA''*
A9	*Technology use for production R.C: panels specific small moving plantings for mezzanines large moving plantings*
A10	*Technology use for production R.C. panels large moving plantings for mezzanines large moving plantings*
A11	*Assembly frame system with prefabricate production elements*
A12	*Assembly R.C: panels system with prefabricate production panels*
A13	*Technology use specific tunnel plantings*
A14	*Assembly cell system with prefabricate production cells*

In this research, fourteen different construction technologies have been analyzed mainly being represented here and seven criterion functions indicated in the foregoing chapter.

For extensive analyses of compromise ranking, we will sort out an influence and flexibility on selection of optimum construction technology.

Increasing criterion function of flexibility from 0,2 up to 0,3 (Enclosure D, Table D3) an order of variants on a ranking list is not changed up to sixth position. Variants A14 and A12, however, descend from the seventh and eight position to 12 changing positions of other variants in the second part of the Table.

Further increase of criterion function from 0,3 to 0,4, a variant A2 goes to the second position instead of a variant A7. It is important to notify that variants A14 and A12 come to the last and before the last position on the list. In addition, a variant A13 descends from the fifth to the seventh position and a variant A1 changes the last position to the 12 positions.

By increase of criterion function from 0,4 to 0,5, a variant A2 comes to the first position and a variant A1 ascend from the 12 right to third position, and variants A10 and A13 from the eight and seventh positions descend to the 12 and 13 positions. A descend of variants A7, A8 and A9 is also recorded though slight as well as a slight ascend of variants A3, A5, A4 and A6.

5. FINAL ANALYSES

Construction industry is a specific activity where each facility is being built on a different site, and in principle, in various periods of time and with different architectural solutions, as on one site it is possible only to build one building and each personality is for itself and therefore intends to build a unique facility.

There is question - what will be the courses of industrialization and robotics progress and what will be their effects to the construction technologies progress? In view of the said extensive research it can be ascertained that an optimum solution depends on trend of value of the coefficients of criterion functions. In this concrete case, if it is taken into consideration an effect of selection of construction technologies to the process of industrialization and robotics through possibility of realization of various architectural solutions, it can be clearly concluded that in case that we want to have our construction technologies very flexible, an optimum solution are technologies of type A2 (rationalized construction technologies) where basic constructive elements can be carried out in traditional and rational manner, and all other constructive elements, functional, interior elements and other elements produced and installed on the site.

According to our point of view of this problem, perspective of construction technologies progress is creating such industrial systems where necessary works will be carried out on the site and all other works by prefabricating of industrial produced elements. In that context, a substantial effect is a selection of construction technology to the perspective of industrialization and robotics progress here, particularly when taken in consideration a small scope of mass construction and larger scope of individual construction.

Finally, I would add that a greater perspective of application of industrialization and robotics is in preparation of the realization of the facilities than in its direct realization.

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