Study on the Storage and Transportation Optimization of Prefabrication Factory

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***Abstract*—Within the scope of construction supply chain, various uncertainties arising in the processing procedure lead to difficulties and impracticality in structural planning. As a result, consistency in individual job function and standardization of components of the production process, which is also known as "industrialized construction," become the major topic for discussion in the last few years. In order to achieve this objective, prefabrication production adopts the production method used by factory, so as to reduce numerous uncertainties arising during the processing procedure. It also attempts to standardize as many components as possible during the design stage. Under such a production environment, the production speed would be surely increased. However, contractors have to face the discrepancies between the site installation priorities and the factory production priorities. Subsequently, the issue of adopting a quality storage and transportation mechanism to act as a buffer within these processes becomes an important and prominent topic of concern. This study considers the behavioral pattern of the storage and transportation of the prefabrication factory, and then constructs an optimized pattern of prefabrication storage and transportation. Firstly, it proposes a concept of storage zoning to undergo the storage and allocation of every component. It would also consider the storage spaces available in the prefabrication factory, storage area outside the factory and jobsite, as well as the transport relationship among these storage areas. Considering the cost issue, usage cost of respective storage sites and the cost of component transportation would be the primary objectives of planning. Under such circumstances, and together with the strategic application of storage classification and allocation, the influence of different storage zoning strategies towards the whole transportation process is assessed, ensuring the best construction planning for the decision maker.**

***Index Terms*—industrialized construction, prefabrication storage and transportation, supply chain, optimization.**

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I. Introduction

A. Industrialized Construction — Prefabrication

Comparing with the environments of other industries, the environment of construction industry has too many uncertainties and industrial characteristics. There are many management means which can be applied by other industries to achieve the operation goals successfully, but always cannot be applied by construction industry due to its unique environment. For example, regarding the issue of supply chain management generally discussed in manufacturing industry, although construction industry can be categorized to a certain extent as manufacturing industry, considering the nature of the supply chain management problem, it is greatly different from manufacturing industry. Therefore, the means to standardize and industrialize the manufacturing procedures of construction industry has become a major issue over the management problem of construction industry.

The prefabrication of component reduces the uncertainties arising in the processing environment of a construction project, and also meets the needs of industrializing the process. Thus, prefabricated method is a construction method with its industrial characteristics being closest to those of manufacturing industry. It is also most suitable for application via the successful management methods of manufacturing industry, and for discussion of its operation strategies, production procedures, and distribution procedures etc., so as to promote the competitiveness of prefabrication industry.

B. Issue of Prefabrication

The manufacturing environment of general prefabrication factories was a problem most frequently analyzed and investigated by scholars. It mainly covered the production plan problems of the prefabrication factory, no matter such plans were related to component, material supply, or process simulation and analysis. Besides, there were relevant studies focusing on the investigation of consistency and standardization of component design during the design stage. However, from the analytic viewpoint of all the problems arising during the prefabrication, the working process of prefabrication can be divided into several stages, as shown in Figure 1 as follows:

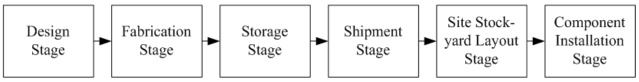

Fig. 1. Working Procedures of Prefabrication

Apart from the issues of design and production mentioned above, there are the issues of site stockyard layout and installation sequence, which primarily belong to the issue of jobsite-end scheduling, and cannot be completely controlled by the prefabrication factory. Here, it is found that in the whole production process, the issues of storage and transportation of the prefabrication factory are less studied and discussed. The main reasons are that these two issues have great variations, and they always have close relationship with practical environment. Nevertheless, the problems of storage and transportation are still the significant practical problems. Thus, this study would focus its investigation on the issues of storage and transportation inside the prefabrication factory.


Fig. 2. Storage of prefabrication factory

II. Introduction of the Issues of Storage and Transportation

A. Issue of Storage

Generally speaking, the issue of storage has to be considered in the production plan, so as to reflect the relationship between the production quantity of prefabricated components and the installation requirements of jobsite. However, in the general production plan models, only the item of quantity can describe the number of components being stored. Regarding the constraint of storage space, it is mostly constrained by the total quantity of component storage or the relationship between single component and total space. As to the calculation of cost, the quantity of component storage can be used for calculating the cost of storage of single component, so as to reflect the significance of the cost of storage toward the production plan model.

Nevertheless, there are so many issues that most of the production plan models may neglect in practice, for example, the pile-up and shake-out ways of component, the transportation of component from production area to storage area, allocation of components in multiple storage zones, and different types of component etc. All of these are the problems always faced by the prefabrication factory during practical operation.

Speaking solely of the problem of storage, storage is identified by most of the related studies as a problem of 2-dimensional or 3-dimensional spatial allocation. These studies firstly presume the size and form of the storage component, and locate a better storage place from the space. In most of the practical storage problems, there are of course some simpler components, such as beam and column, which can be planned by this way. But similarly, there are some other forms of components, such as wallslab and floorslab, which cannot be expressed likewise because the difference in size and form among slabs would create difficulties to storage. Besides, several situations that are commonly found in practice should also be considered: (1) different sizes of components; (2) limitation of vertical loading of ground; (3) safe distance between components; and (4) different ways of storage, such as vertical storage and horizontal storage.

From the practical point of view, storage does not simply stress the placing of component. The most common problem of the prefabrication factory is the search of the "right" component.

A good environment for production planning has to take the continuous flow of production into consideration. It implies that during the production of components by mold, the components of the same model number should be continuously produced as much as possible, so as to reduce the costs of labor and time spent on the change of mold. Therefore, it is common to see the related storage measure that storage is conducted according to the types of components, or the components of the same form are piled up in the same storage space after allocation. On the one hand, repeated piling can be undergone according to the production process, whereas on the other, the components of larger size can also be stored. Contrarily, a good scheduling of jobsite is to lift all the required components to a fixed point smoothly according to the relative position of every component in the jobsite and the installation sequence. The mixed installation of beam and column is a common example of this way. Here, it is known that there is a conflict between the sequence of production in factory and the sequence of installation in jobsite. The existence of storage mechanism is just a buffer between them.

When the degree of component standardization is not satisfying or the required production quantity is not sufficient enough, mixed storage of components of different sizes becomes a common and inevitable solution. Once the required component is placed beneath other components, additional resources of labor and crane have to be spent to move the components. In terms of the size of prefabricated component, this is just an increase of the cost of second handling, as well as a time and labor-consuming task.

B. Issue of Transportation

Transportation cost is one which has always been neglected in the issue of optimization of prefabrication. Generally speaking, the transportation of components can be made possible by two ways: one is the transportation of component within the same site by means of the crane of prefabrication factory or jobsite, and the other is the transportation of component between different sites by means of truck. In practice, the crane for component transportation within the same site is owned by the prefabrication factory and jobsite, but the truck is mostly rented. Hence, the calculation of transportation cost can also be divided into site equipment fee and truck rental fee. Plant equipment fee mostly belongs to a long-term purchase of asset. It can be included in site use fee. As to transportation fee of truck, not only the transportation distance should be considered, but the weight of component is also a major parameter in calculating cost.

When the component storage space of the prefabrication factory is insufficient, storage at a foreign place is a common alternative. It refers that the prefabrication factory has to look for other storage place to store the components which cannot be stored in the prefabrication factory and jobsite. Thus, transportation cost is not just limited to the cost of component transportation from the prefabrication factory to jobsite, but may also include the extra expense of storage cost at foreign place and site rental fee.

III. Model of Storage-Transportation Optimization

According to the practical situations and problems of component storage and transportation of the prefabrication factory, this study defines a mechanism of optimization model which employs the concept of basic zoning and minimization of total cost to conduct storage and transportation of prefabricated component. The related definition and assumption are explained in the following sections:

A. Zoning of Components

In this study, the zoning of components is the basic structure. It means that no matter what storage method the planner employs, it has to classify the components according to their characteristics. For example, traditional component storage is done according to the types of components, so the components of same type have to be placed together in the same zone unit. On the contrary, the installation sequence of jobsite can also be adopted. It refers to the zoning of components on one floor or in one construction zone unit.

This model assumes that the quantity of components available for storage in each zone, including the mixed storage of components of different types, is already known. Then there is a close relationship between the quantity of component storage in a zone and the basic supposition of the zone. Based on these two zoning methods, some simple explanations are made as follows:

1) Zoning completely according to components

Taking the size or nature of component as the basis of zoning, the components of the same nature are stored in one zone. As mentioned above, within the same storage space, this storage method can offer greater quantity of component storage, and the calculation of storage area is easier. Taking beam and column for example, the pile-up limit of general prefabrication factories is 2 layers only, and the loading per square meter cannot exceed 5 tons. It means that the piling up of 2 layers is the major limit. Therefore, the area occupied for zoning can be taken as an example for calculation as follows:

Required area of zone = Limit of quantity of component storage of a zone × (length of component × width of component) ÷ 2

The planning can be based on the total required quantity of components of a project, or the required area for the maximum quantity of component storage during the planning period. Not only the abovementioned formula can be used to calculate the required area, planner should also judge the storage situation, add in an amplified parameter according to experience, and consider other required area, such as aisle, in the storage process.

2) Mixed Storage by Installation Sequence

Mixed storage mainly acts as the buffer between production sequence and installation sequence. Although it is quite hard to estimate the storage area of this part directly, the user has to calculate it according to the logical relationship of storage.

However, different types of components or different pile-up methods may result in different areas in calculation. Over this point, the study does not presume any limitation, so as to increase the flexibility in practical situations. Therefore, the user has to consider how to plan the storage method, and estimate the required area in the storage process.

B. Allocation of Zones

According to the above zoning way of components, this study further carries out zone allocation at different storages sites based on the zone units. It is used as a basis for checking the component storage and utility of each storage site. The allocation of zones is shown in Figure 2 as follows:

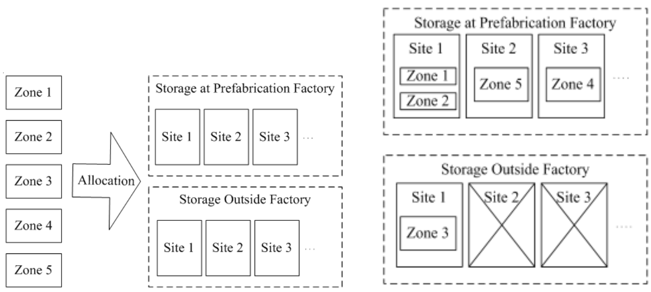

Fig. 3. Illustration of the Relationship among Zones and Storage Sites

C. Storage-Transportation Optimization Model

This study suggests the provision of an optimization mechanism for the handling of component between the existing storage space of prefabrication factory and different storage space, provided that the supply and demand are known. The chart of the model is conceived as follows:

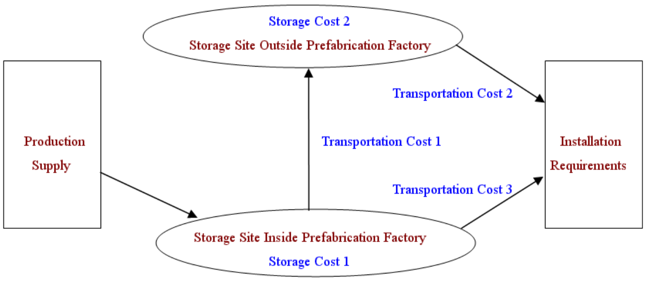

Fig. 4. Cost Classification Chart of the Model

Objective functions：

Minimize $Total\_Cost = IC + TC$ (1)

Where,

$$IC = \sum_{i=1}^{np} UP_i * PCS_i + \sum_{i=1}^{ni} UI_i * ICS_i \quad (2)$$

$$TC = \sum_{i=1}^{ns}\sum_{j=1}^{ns}\sum_{k=1}^{ct}\sum_{l=1}^{p} TSQ_{i,j,k,l} * (TC1_k + TC2_k) + \sum_{i=1}^{ct}\sum_{j=1}^{p} D_{ij} * TC3_j - \sum_{i=1}^{ns}\sum_{j=1}^{ns}\sum_{k=1}^{ct}\sum_{l=1}^{p} TSQ_{i,j,k,l} * TC3_k \quad (3)$$

Constraints:

1) Judging the positions of zones: Storage zones to be located inside or outside the prefabrication factory

$$\forall i \quad M * UP_i \geq \sum_{j=1}^{ns}\sum_{k=1}^{p} SLP_{j,i,k} \quad i \in np \quad (4)$$

$$\forall i \quad M * UP_i \geq \sum_{j=1}^{ns}\sum_{k=1}^{p} SLI_{j,i,k} \quad i \in ni \quad (5)$$

2) Zone allocation limit 1: Each zone cannot be located at more than two sites.

$$\forall ij \quad (\sum_{k=1}^{np} SLP_{i,j,k} + \sum_{k=1}^{ni} SLI_{i,j,k}) \leq 1 \quad i \in ns, j \in p \quad (6)$$

3) Zone allocation limitation 2: No movement should be made after zoning and positioning.

$$\forall i, j, k \quad SLP_{i,j,k} \geq SLP_{i,j,k-1} \quad i \in ns, j \in np, k \in p \quad (7)$$

$$\forall i, j, k \quad SLI_{i,j,k} \geq SLI_{i,j,k-1} \quad i \in ns, j \in ni, k \in p \quad (8)$$

4) Limit of area for use: Limit of area in each storage zone inside and outside the factory

$$\forall i, j \quad PA_i \geq \sum_{k=1}^{ns} (SLP_{k,i,j} * SA_j) \quad i \in np, j \in p \quad (9)$$

$$\forall i, j \quad IA_i \geq \sum_{k=1}^{ns} (SLI_{k,i,j} * SA_j) \quad i \in ni, j \in p \quad (10)$$

5) Limit of acquisition of supplied component: Only when the zone is inside the prefabrication factory can the component be acquired via production.

$$\forall i, j, k \quad \sum_{l=1}^{np} SLP_{i,l,k} \geq SS_{i,j,k} \quad i \in ns, j \in ct, k \in p \quad (11)$$

6) Inventory control upon termination: Upon termination of a project, the inventory of components is allowed to be left only when storage zone is inside the factory.

$$\forall i, j \quad \sum_{k=1}^{np} M * SLP_{i,l,p} \geq IS_{i,j,p} \quad i \in ns, j \in ct \quad (12)$$

7) Quantity of supply to zones: Quantity of products to be supplied to different zones

$$\forall i, j \quad \sum_{k=1}^{ns} SS_{k,i,j} = SC_{i,j} \quad i \in ct, j \in p \quad (13)$$

8) Initial inventory of zone: Quantity of initial inventory in each zone

$$\forall i, j \quad IS_{i,j,0} = OIS_{i,j} \quad i \in ns, j \in ct \quad (14)$$

9) Daily inventory: Quantity of components stored in each zone every day

$$\forall i, j, k \quad IS_{i,j,k} = IS_{i,j,k-1} + SS_{i,j,k} + \sum_{l=1}^{ns} TSQ_{l,i,j,k} - \sum_{l=1}^{ns} TSQ_{i,l,j,k} - TWQ_{i,j,k} - \sum_{l=1}^{ns} TSQ_{i,l,j,k} - TWQ_{i,j,k} - TWQ_{i,j,k} \quad i \in ns, j \in ct, k \in p \quad (15)$$

10) Limit of zone storage: Limit of components stored in each zone

$$\forall i, j, k \quad IS_{i,j,k} \leq MSQ_{i,k} \quad i \in ns, j \in ct, k \in p \quad (16)$$

11) Initial inventory of jobsite: Quantity of components at the jobsite at the beginning of the plan

$$\forall i \quad IW_{i,0} = OIW_i \quad i \in ct \quad (17)$$

12) Daily inventory of jobsite: Quantity of components stored in jobsite

$$\forall i, j \quad IW_{i,j} = IW_{i,j-1} + \sum_{k=1}^{ns} TQW_{k,i,j} - D_{i,j} \quad i \in ct, j \in p \quad (18)$$

13) Limit of jobsite storage: Limit of components stored in jobsite

$$\forall i,j \quad IW_{i,j} \le MWQ_i \qquad i \in ct, k \in p \tag{19}$$

14) Finally, jobsite is not allowed to have any inventory left.

$$\forall i \quad IW_{i,p} = 0 \qquad i \in ct \tag{20}$$

15) Zone Transportation Limit 1: Transportation of components within jobsite is not allowed.

$$\forall i,j,k, \quad TSQ_{i,i,j,k} = 0 \quad i \in ns, j \in ct, k \in p \tag{21}$$

16) Zone Transportation Limit 2: The storage zones outside the factory are not allowed to transport components to other zones.

$$\forall i,j \quad \sum_{k=1}^{np} SLP_{i,k,j} * M \ge \sum_{k=1}^{ns}\sum_{l=1}^{ct} TSQ_{i,k,l,j} \quad i \in ns, j \in p \tag{22}$$

17) Zone Transportation Limit 3: The storage zones inside the factory are not allowed to accept any components transported from zones.

$$\forall i,j \quad \sum_{k=1}^{ni} SLI_{i,k,j} * M \ge \sum_{k=1}^{ns}\sum_{l=1}^{ct} TSQ_{k,i,l,j} \quad i \in ns, j \in p \tag{23}$$

The codes for the above objective functions and constraints are shown in Table 1 and Table 2 The codes in Table 1 are the variables or variable matrices to be determined in the model, whereas the codes in Table 2 are the parameters or parameter matrices to be entered in the model. The related variables and parameters of the model are positive integers.

TABLE I
Variables Used in the Model

Total Cost	Total cost
IC	Inventory cost
TC	Transportation cost
UP_i	Variable (0,1) for the use of area (i) of storage inside factory
UI_i	Variable (0,1) for the use of area (i) of storage outside factory
$TSQ_{i,j,k,l}$	Quantity of components k transported from zone i to zone j on the p[th] day
$SLP_{i,j,k}$	Variable (0,1) for the use of area (i) of storage inside factory in zone j on the k[th] day
$SLI_{i,j,k}$	Variable (0,1) for the use of area (i) of storage outside factory in zone j on the k[th] day
$SS_{i,j,k}$	Quantity of components j acquired from production zone to zone i on the k[th] day
$IS_{i,j,k}$	Quantity of components j stored in zone i on the k[th] day
$IW_{i,j}$	Quantity of components j stored in jobsite on the i[th] day
$TWQ_{i,j,k}$	Quantity of components j transported from zone i to jobsite on the k[th] day

TABLE II
Parameters Used in the Model

np	Area of storage zones inside the factory
ni	Area of storage zones outside the factory
ns	Area of zone
ct	Quantity of types of components
p	Planned number of days of a period
PCS_i	Cost of zone i inside the factory
ICS_i	Cost of zone I outside the factory
$TC1_i$	Transportation cost of component i in storage zones inside and outside the factory
$TC2_i$	Transportation cost of component i from storage zone outside the factory to jobsite
$TC3_i$	Transportation cost of component i from storage zone inside the factory to jobsite
D_{ij}	Quantity of required component i for jobsite on the j[th] day
M	Value of extremely great positive integer
SA_i	Required storage area in zone i
PA_i	Limit of area of zone i inside the factory
IA_i	Limit of area of zone i outside the factory
period	Last day of planned period
$SC_{i,j}$	Quantity of components i produced on the j[th] day
$OIS_{i,j}$	Quantity of components j stored in zone i at the beginning of the plan
$MSQ_{i,j}$	Limit of maximum quantity of components j stored in zone i
OIW_i	Quantity of components i stored in jobsite at the beginning of the plan
MWQ_i	Limit of quantity of components i stored in jobsite

D. Solving Tool

The optimization model developed by this study belongs to a subject of integer programming (IP) so that it can be solved by the general mathematical programming tools. Since the variable belongs to discrete-type variable, it can also be solved by constraint programming (CP) technique. This study uses ILOP OPL program to integrate the interfaces. The solving technique contains mathematical programming (CPLEX) and CP, which are the tools for the establishment and solution of the model.

IV. Solutions of Case

A. Input Data

In order to verify the accuracy of the model, the researchers explain the solution by using a small case study. The data includes such environmental parameters as production supply, jobsite demand and zoning, as shown in Table 3 as follows:

TABLE III
Related Input Parameters of a Case Study

Parameter	Value	Parameter	Value
np	2	PCS_i	[30000,30000]
ni	3	ICS_i	[100000,50000,30000]
ns	3	SA_i	[2000,2500,2500]
ct	3	PA_i	[2500,2500]
p	7	IA_i	[5000,3000,2000]
$OIS_{i,j}$	[0,0,0], [0,0,0], [0,0,0]	MWQ_i	[10,10,10]
OIW_i	[0,0,0]	D_{ij}	[0,0,0,0,0,0,10], [0,0,0,0,0,0,0], [0,0,0,0,0,0,30]
$MSQ_{i,j}$	[0,0,30], [0,0,30], [0,0,30]	$SC_{i,j}$	[0,0,0,10,0,0,0], [0,0,0,0,0,0,0], [20,20,20,10,10,0,0]
$TC1_i$	[60,60,70]	$TC3_i$	[350,350,450]
$TC2_i$	[350,350,450]		

B. Output Results

The solutions for the above input parameters are as follows:

- The total cost was $107,700.
- The total storage cost was $90,000.

- The transportation cost was $17,700.
- Regarding the use of storage site, sites 1 and 2 inside the prefabrication factory were used. Due to inadequate area of the site, site 3 outside the factory had to be rented.
- Regarding the use of zones:
  (1) Zone 1 was allocated to site 3 outside the factory, and started storing components as from the next day.
  (2) Zone 2 was allocated to site 1 inside the factory, and started storing components as from the first day.
  (3) Zone 3 was allocated to site 2 inside the factory, and started storing components as from the first day.
- Being situated in the prefabrication factory, zones 2 and 3 could accept the supply of components produced. On the 2nd, 3rd, 4th and 5th day, the quantity of type-3 components acquired in zone 2 was 10 per day. On the 3rd and 4th day, the quantity of type-1 components acquired in zone 3 was 10 per day. On the 1st, 2nd and 3rd day, the quantity of type-3 components acquired was 20, 10 and 10 respectively.
- As to the quantity of components stored in each zone, zone 3 once acquired 10 type-1 components. Since the jobsite had storage space, these components were directly transported to the jobsite on that day. The storage situations of type-3 components in different zones were as follows:
  (1) From the 1st to the 7th day, the storage quantity of zone 1 was [0,0,10,10,10,10,10,0]. Since zone 1 was located outside the prefabrication plant, it could not store component upon termination of planning period, and the site had to be returned.
  (2) From the 1st to the 7th day, the storage quantity of zone 2 was [0,0,0,10,20,30,30,20].
  (3) From the 1st to the 7th day, the storage quantity of zone 3 was [0,10,20,30,30,30,30,30].
- Regarding the storage situation of jobsite, as from the 4th day, the storage quantity of type-1 components was 10 per day, and the installation was completed on the 7th day. As to type-3 component, from the 1st to the 7th day, the storage quantity was 10 per day. For the rest of the demand, the components were directly installed from zone 1 and zone 2 to the jobsite respectively on that day. Thus, no storage quantity was recorded.
- The situation of the transportation of components from each zone to the jobsite was as follows:
  (1) Zone 1 transported 10 type-3 components to the jobsite for installation only on the 7th day.
  (2) Zone 2 transported 10 type-3 components to the jobsite for installation on the 7th day.
  (3) Zone 3 transported 10 type-3 components to the jobsite on the 1st day, and 10 type-1 components to the jobsite on the 4th day for storage.
- As to the transportation among zones, zone 2 transported 10 type-3 components to zone 1 only on the 2nd day.

The whole process of solution finding took 0.46 seconds only. It implies that despite the complicatedness of constraints, which contained 594 constraints and 523 variables, the model could still obtain optimized results. Regarding the presetting of optimization technology, the search strategies of constraint programming adopted standard search method, and the variable branching process adopted depth prioritizing method. The solving screen of the model is shown in Figure 4 below:

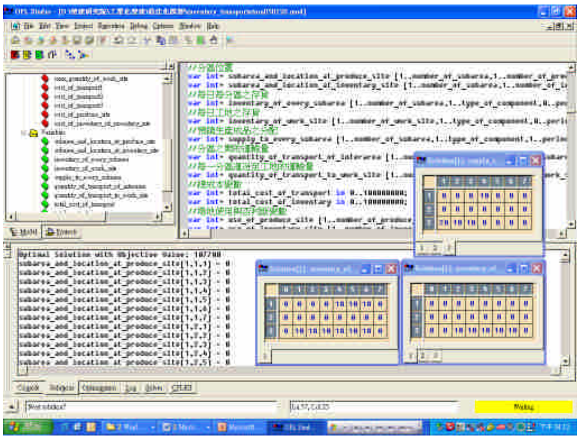

Fig. 5. Screen of Solving by ILOP OPL

V. Description on Practical Application

Based on the research results, some descriptions on the practical application in future are provided as follows:

A. *Efficiency of Solving*

Although the case test at the present stage can rapidly find out the solution, in future we may possibly face the extension of period and the increased types of components, which shall seriously affect the efficiency of solving of the whole model. This will be an important point for further studies in future. The production period of general prefabrication factories is mostly one to four months, and the relative working days are about 100 days. Hence, the effects may be limited. But if the types of components are complicated and multiple, and the quantity of components in general projects may be in thousands, then standardization cannot effectively work on the types and size of components. It may cause a low efficiency to the solving of model, and affect the workability of planning a model. Such a case may also happen in other optimization models of prefabricated production, which may result in poor efficiency of model production. Therefore, only high standardization of the prefabricated component can help acquire effective planning results.

B. *Combination of Production Models*

There are quite a number of optimization models of prefabricated production. Nevertheless, no matter the optimization models developed by this study or other production models, they are the best solutions of zones in terms of the operation of prefabrication factory. As mentioned above, the production plan and storage plan of component is a question of balance. How to combine these two parts to form an optimization model effectively shall be the major direction of future studies.

C. Suggestions of Practical Zoning

Although the viewpoint of zoning established in this study is applicable to different kinds of classification (installation according to types and sites), the main purpose of zoning is to apply zoning to the mixed storage mechanism of components. Only the implementation of zoning according to the installation sequence of jobsite can the problems of repeated movement and handling be decreased during the searching and storing of component. However, how to build up a storage method that can offer convenience for storing and searching component? This study proposes a storage matrix as shown in Figure 5 below:

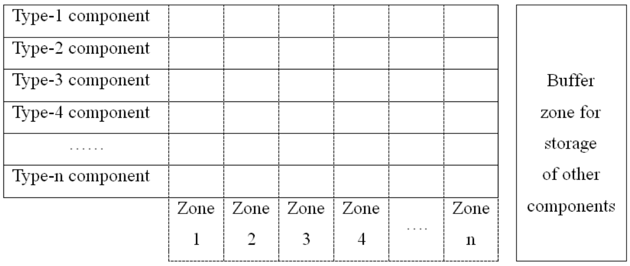

Fig. 6. Illustration of Mixed Storage Zoning

The thinking logic of this model is to take such storage method as the direction. It not only can match the convenience of component storage, but also can move component from the zone to the jobsite sequentially, solving the problem of search for component.

VI. Discussions and Suggestions

According to the storage and transportation environment of the components of prefabrication factory, the following research results are derived:

1) An optimization model is established in consideration of the total storage and transportation costs.
2) A component storage mechanism is built up based on the concept of storage zoning, and the flexibility of practical planning can be preserved.
3) It is suggested that zoning-oriented mixed storage mechanism of component can be developed in future.

Focusing on these research results, the following suggestions are made:

1) Establish an optimization model that combines with production, so as to achieve the result of general planning of prefabrication factory.
2) Focusing on practical cases, further verification and application can be conducted.
3) Decision-making optimization system of prefabrication factory can be further developed to meet the practical needs.

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