# Research on Integrated Management Method of BIM Isomerous Data for Engineering Construction Period

**Yan Li[a], Zhao Junjie[b]**

Henan Water Resources and Hydropower School, Zhoukou, Henan, 466000 China

[a,b]277082430@qq.com

**Keywords:** engineering construction period; BIM isomerous data; integrated management method

**Abstract:** Information management measures of digitized and informationalized construction project provide space to solve these kinds of problems, at present, technology measure with best application effect is BIM technology. This paper makes research on integrated management method of BIM isomerous data for engineering construction period.

## 1. Introduction

With the development of science and technology, acceleration in urbanization, as well as improvement of people's living standard and quality of life, people start having higher and higher requirements such as function, appearance and comfort degree etc of buildings, which causes buildings have more and more functions. People apply BIM technology into project construction and management process to make effective control on engineering construction quality, which is favorable to achieve overall target of project. This paper makes research on integrated management method of BIM isomerous method for engineering construction period.

## 2. Construction schedule has DAG model and heterogeneous resources system model

This paper uses BIM data base to derive road constriction schedule and relevant resources data as well as converts it into DAG model and heterogeneous system model, and then calls MCEFT algorithm to make optimization on target problem.

### 2.1 DAG model of construction schedule

In this paper, road construction schedule source data of building engineering project is derived from BIM data, schedule is composed of a series of construction tasks, and these tasks have corresponding constraint relations among them. Corresponding construction schedule DAG model contains 2 kinds of basic elements: node and edge, it can be indicated by DAG＝(T,E). Of which, all task nodes are indicated by T＝(t1,t2,…,t|T|), including start node, terminate node, actual task node and virtual time node. Start indicates the beginning of the whole construction project, it has no precursor node, in order not to lose generality, this paper sets start time of Start as 0, Exit represents the end of the whole project and it has no descendant node. Actual task node corresponds to a series of construction tasks in source data of construction schedule, virtual time node occupies none actual resource group. The edge in DAG model indicates constraint relation among task nodes, this constraint relation corresponds to execution sequence of tasks in construction process, it can be indicated by E＝｛(es,e)i｜i＝1,2,3,…,｜E｜｝, of which, (Es,e)i is one edge between task node ts and te. Example of construction schedule DAG model is indicated by figure 1.

  DOI: 10.25236/icscbd.2018.025

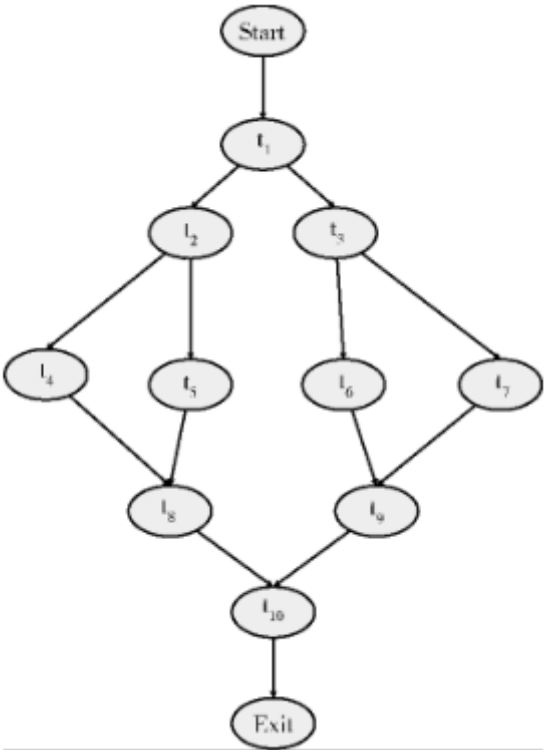


Figure 1 DAG model

### 2.2 Heterogeneous resources system model

Heterogeneous resource system model of road construction schedule is manually constructed according to relevant resource group data, model example is indicated by table 1. This model indicates execution time of each task node in construction schedule DAG model under condition of different resource group distribution. Heterogeneous resource system model can be exampled by table 1. Longitudinal coordinates ti∈(t1,t2,…,t丨T丨)corresponds to one task node of construction schedule in figure 2, horizontal ordinate ri∈R＝｛ri丨i＝1,2,3,…,丨R丨｝indicates one resource group in resource group set R in system. One coordinate element (ti,rj)in heterogeneous resource system model can be indicated by EcCostrj(ti), which means execution time(if ti is time node of StArt or Exit or virtual time node, it calculates rj=0) of task node ti under condition of resource distribution group rj. Only when task is executed, this resource group can be distributed the next task (task is independently executed and resource group can not be taken up). AreW(ti) means the average execution expenditures, it can be calculated by the following formula.

Table 1 Heterogeneous resource system model (unit: 10 days)

| Construction task | r1 | r2 | r3 |
|---|---|---|---|
| t1 | 7 | 8 | 9 |
| t2 | 11 | 14 | 17 |
| t3 | 12 | 15 | 18 |
| t4 | 10 | 8 | 12 |
| t5 | 5 | 7 | 6 |
| t6 | 9 | 7 | 5 |
| t7 | 6 | 8 | 7 |
| t8 | 14 | 12 | 10 |
| t9 | 10 | 8 | 6 |
| t10 | 11 | 13 | 15 |

Considering heterogeneous degree of heterogeneous model has many kinds of quantization modes, this paper designs parameter TRR in the test stage to make quantization on heterogeneous

degree of model.

### 2.3 Mathematical modeling of construction schedule dispatch

After completing construction schedule DAG model and heterogeneous resource system model, it realizes construction schedule sub-package and dispatch target problem of this model, which is to solve overall execution time(it sets as makespan) construction schedule according to existing task dispatch sequence.

Set DAG model includes ｜T｜task nodes, heterogeneous resource system includes R resource groups. Task dispatch sequence is (t1,t2,…,t｜T｜),s＝(r1,r2,..,r｜T｜)is resource distribution sequence solution of all tasks, its elements respectively indicate the distributed resource group of each element in (t1,t2,…,t｜T｜). It sets task node with the highest dispatch degree as ti, and distributes resource group rj, then the earliest start time is indicated by formula (2). Of which, TAVAil(rj)indicates time of resources group rj to execute task tj, TrEAdy(ti)indicates ready time of tj, it is respectively calculated by formula(3) and formula(4). In the formula, E x Ec(rj)indicates task set executed by all resource group rj, TAFTimE(tk)indicates actual execution time of tk, prED(ti) indicates precursor node set. Under condition distributing resource group rj, if ti uses non-occupy method to process, then the earliest completion time of ti can be indicated by formula(5), of which, EcCostrj(ti)indicates execution time expenditure of task ti by using resource group rj. Under condition of distribution resource group rj, if node ti is executed, then gives value of TEFTimE(ti,rj)to TAFTimE(ti). Overall completion time of construction schedule(mAkEspAn)equals to completion time of tExit, please refer to formula(6).

TESTimE(ti,rj)＝mA x ｛TAVAil(rj),TrEAdy(ti)｝(2)

TAVAil(rj)＝mA x tk∈E x Ec(rj) ｛TAFTimE(tk)｝;if ti is StArt or Exit ir virtual time node, TAVAil(rj)＝0(3)

TrEAdy(ti)＝mA x tk∈prEd(ti) ｛TAFTimE(tk)｝;if ti is StArt,TrEAdy(ti,rj)＝0(4)

TEFTimE(ti,rj)＝TESTimE(ti,rj)＋EcCostrj(ti)(5)

mAkEspAn＝mA x ti∈T ｛TAFTimE(ti)｝＝TAFTimE(tExit)(6)

### 2.4 Mathmatical modeling of construction schedule dispatch

It uses BIM modeling tool Revit to construct one steel structure model, which is indicated by figure 2. According to analysis steps, it is derived into! FC formatted file, which is ifc file, it adopts IFC3x3 standard. It is further based on IFC analysis structure of IFCOpenShell, and it uses C-freeS coding to operate corresponding C++ program and read ifc file under windows system, it designates file output content and gets corresponding OBJ file and MTL file, which is .obj .file and obj.mtl. File. It uses avaScript language to make OBJ file analysis program, it combines with WebGL technology and HT MLS, and finally forms 2 files, which are html and js file, and it uses Web browser to realize 3-D display of BIM model, which is indicted by figure 3.

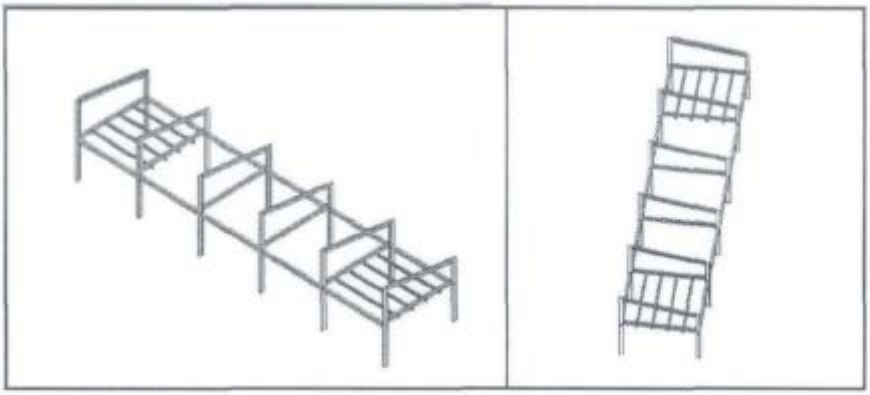

Figure 2 Revit model of steel structure

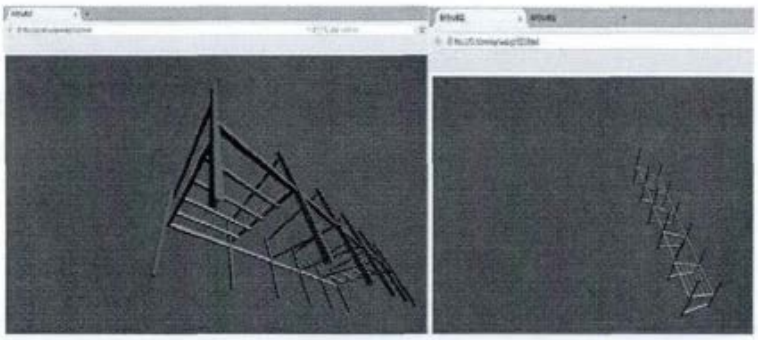

Figure 3 Browser interface displays BIM model

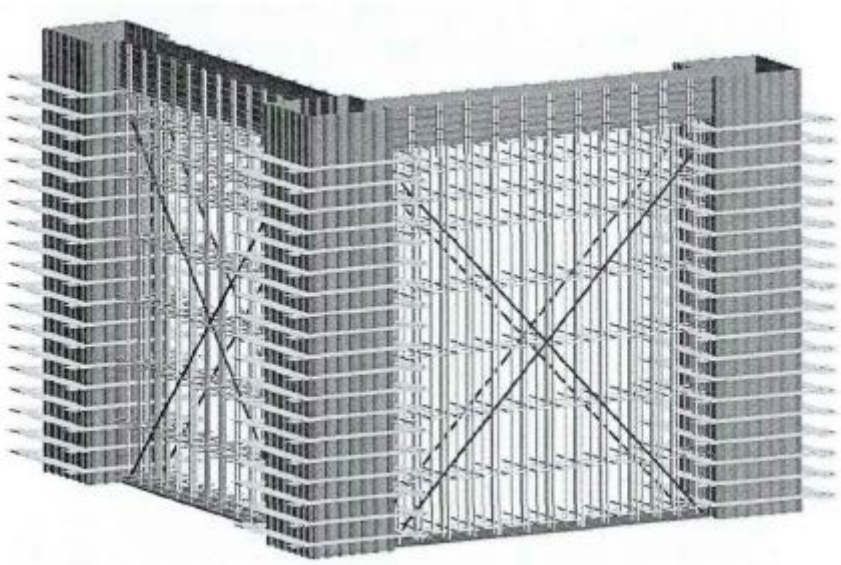

Figure 4 Reinforcement and optimization plan of wall column framework

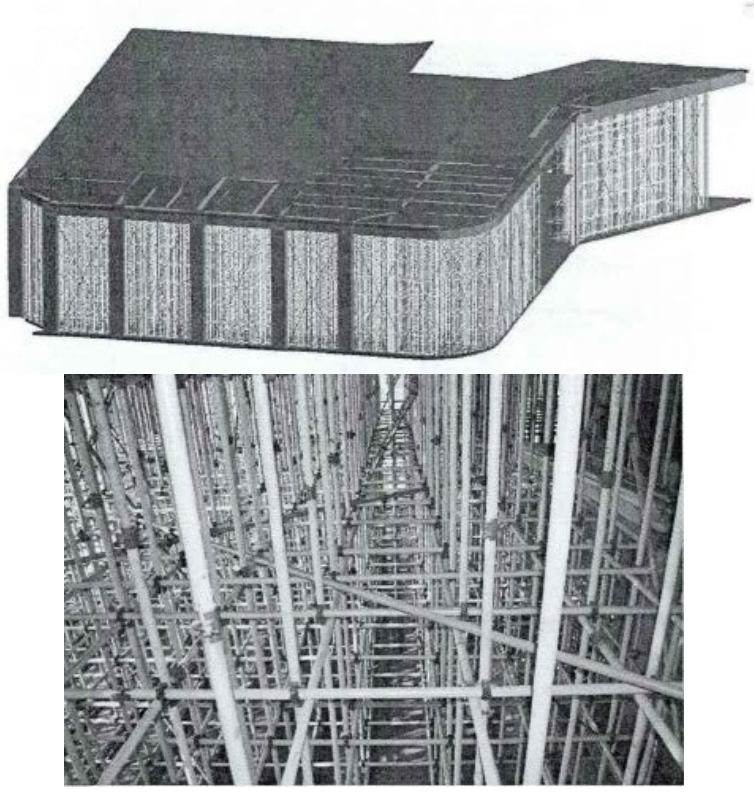

Figure 5 High support model optimization plan and site scene pictures

## 3. Integrated management method analysis of isomerous data for engineering construction period

With the universal application of BIM technology, it appears a plenty of software tools related to BIM technology in domestic and foreign building market, plenty of software support can obviously enhance construction efficiency of building construction project, but meanwhile plenty of BIM data appears, in details, different users complete BIM data and information transmission and interaction between equipment terminal and server.

According to different system support of user terminal, network framework model can be divided into C/S framework and B/S framework. Integrated management platform for construction period is based on B/S framework, it adopts H2 Database, it is one open-source database. It integrates every kind of Web technology in data presentation level, such as HTMLS, WebGL, ActiveX technology etc. In data application level, which is user level, it can use Ajax technology to enhance interactive experience of users and enhance interaction efficiency. The detailed technology summary is indicated by the following table:

Table 2 Technology summary and comparison table

| technology support | traditional integrated management platform | integrated management platform of this paper |
|---|---|---|
| platform framework | C/S framework | B/S framework |
| data maintenance | software system updating and maintenance of user terminal(high cost, low efficiency) | server maintenance(low cost, high efficiency) |
| data interaction and storage | interaction and storage form of data form based on system support(strong limitation) | data interaction and storage framework(universal application, realize remote synchronous interaction) based on IFC towards Web |
| visualization | software system | website visualization technology based on WebGL or ActiveX technology |
| Data asynchronous transmission and optimization | None | Ajax technology |
| new technology application | None | HTML.5. Web GIS, coordinate transformation technology |

## 4. Conclusions

This paper applies BIM technology into cost control of construction project, which solves problems such as difficulty in information sharing, low coordination degree and refining degree, as well as low work efficiency in cost control; it makes up defect of cost control in traditional construction project through BIM technology. It uses BIM technology and BIM-cost control information management platform to make cost control and enhance work efficiency of cost control from aspects such as resources, engineering change, visa claim, and multiple calculation contrast etc.

## References

[1] Chen Yuan, Li Hongxi. Research on BIM Coordination Work Platform Theory Framework Based on Portable Computer [J]. Construction Technology, 2015, 44(18):40-43.

[2] Chen Ming. Research on BIM Application Technology in Road Engineering [J]. Western Transportation Science and Technology, 2018(04):165-170.

[3] Wang Junqing, Lei Longfe, Zhang Dongchao, Guo Kailei, Ding Jie Effective Application of BIM Technology in Cost Control of Electromechanical Installation Engineering. [J]. Building Material and Decoration, 2018(39):172-173.

[4] Zhang Huanhuan, Cai Ning, Jiang Yuyi, Tan Liwei, Yi Weifeng. BIM Road Construction Progress Optimization Method towards Heterogeneous Resource and Environment [J]. Computer Engineering and Design, 2016, 37(04):1042-1050.

[5] Zhang Shourui, Li Lin. Application of BIM Technology in Distributed Photovoltaic Power Generation Project Construction Management [J]. City Construction Theory Research (electronic version), 2018(23):32.