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Resource Management Allocation of Construction Project Using Assignment and Transportation Problem

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ABSTRACT: Now a day resource allocation is the important aspect in construction project mainly in managing economy. There are various problem arises in construction industry due to resource planning and resource allocation. If any mistakes occurs during the construction of project while allocating resources or planning it may create various crises in the project. The resource management methods used in olden days cannot be used for now a day project because the technologies are improved and also the methods are differ from the olden day methods. While allocating resources proper care must be taken, if excess resources are allocated it may leads to excess budget. The resources used in construction project can be allocated by using certain software.

I. INTRODUCTION

“Cost and time factors are mainly important in construction field”. In managing these two factormainly depending on the selection of available resource and beneficial management. There are three important resources mainly used in construction industry, they are manpower, material, machinery. Only the proper allocation can be manage the whole construction project. If not proper allocation of resource can arise various lost due to excess of budget and project duration.

Construction industry is spread throughout the world and also fastest growing field. It consist of various department, each of the department can

place a crucial role in different section. In especially management department is occur main portion in construction field. Here many issues arise in this field due to poor allocation of resource, improper levelling, over duration and non-availability of resource.

The main task of project management can control the overall cost of project and properly manage the time. In every project different type of task will be executed day by day and also meet different problems. The main reason for create problem is over allocation and under allocation of resource. If over allocation means budgeted cost will high, if under allocation of resource means pauldron of resource it will make delay.

Resource allocation is the important manner for thriving of the project. Resource allocation includes the resource scheduling, resource levelling and etc. In widely CPM can be used to scheduling the project. The resource allocation can be done by PRIMAVERA software. This software is advanced software than MSP. This software mainly used for obtain the accurate result. It can manage the huge number of project at the same time.

To allocate resources various methods can be used, in this the transportation problem and assignment problem contains all the detail that required for allocating the resources. This problem can give the most accurate result on allocating resource. Assignment method mainly used to assign the proper resource to the project which is effectively. And the transportation problem principally used to identify the shortest path to purchasing the resource.

In this paper shows the resources were allocated in analytically and manually. When the resource allocation can be control the over allocation, it is the important task for construction manager. Here some resource re allocated and control the

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Visit: www.ijirset.com

Vol. 8, Issue 3, March 2019

cost. There are three residential building were taken to allocate the resource and finally compare the actually used resource cost and planned resource cost.

II. LITERATURE REVIEW

A study on optimization of resource for multiple projects by using PRIMAVERA, B.S.K. Reddy, S.K.Nagaraju(2018)

Here there are two projects were taken to allocate the resource for obtaining the optimization of resource.it can be done by two ways, one option is resource are individually levelled and another option is resources are combined levelled. The combined option is better than the individual option because it reduced the demand of resource by 5.65%.

Assignment problem and its extensions for construction project scheduling, PiotrJaskowski, Michal Tomlzak (2014)

The resources are allocated by assignment model it can help to the project managers in determining a strategy for crew or bids selection. In this classical model of assignment problem can control the overall cost and project time. Scheduling of work and allocation of resource are the major challenge for almost all construction work. In this paper mainly allocate the manpower resource to complete the work without delay.

III. METHODOLOGY

The methodology applied in this project is separated mainly in two phases. The required data are collected from the construction field. The critical path is obtained from the scheduled report by using primavera software. First phase of the project is resource allocation by using software and the second phase is resource allocation by using theoretical method. By using these methods the resource are minimized from the existing given data. Finally results obtained are concluded. Following flow chart diagram illustrates the phases.

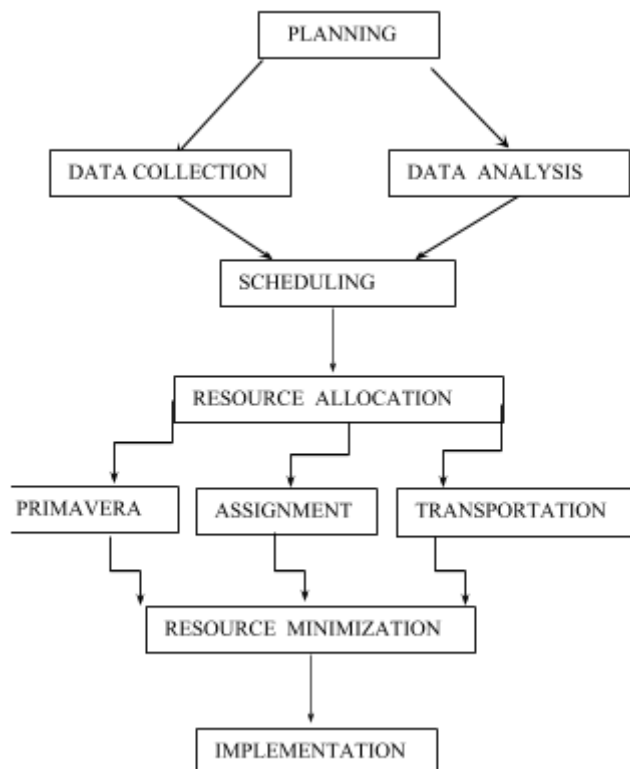


Fig-1. Methodology flowchart

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 3, March 2019

3.1 PLANNING

The preliminary planning for the project can help to properly flow to the entire project without fault. The several journals have been collected and which are explain different aspects that are relevant to the aim of study.

3.2 DATA COLLECTION

The required data is collected from various construction companies. Data collection is important for correlating the different data and then using in working with primavera software. The gathering data from the field is done with frequency visit. In this project collected data about resource and scheduling details.

3.3 DATA ANALYSIS

The data from the industry was analysed and allocate the resource with their activity. The activities were scheduled using Primavera software and proper allocation of resource can be done by assignment and transportation problem.

3.4 SCHEDULING OF ACTIVITY

After collecting all the work details from the related areas andpreparing the schedule by Primavera software. It is help to allocate the activity and resource allocation with their relations. The software can easily identify the longest critical duration of the project which make help to avoid exceed duration.

3.5 ALLOCATION OF RESOURCE

After scheduling process the resource table is prepared and it assigned to all activities. Resource calculation mainly depended on quantity of activity. As a result of resource allocation is able to determine the unwanted resource in the project and also reduced that for a continuous flow of work. The resource allocation can be done by two ways, one is allocation by software and another one is theoretical allocation. In this paper resource allocation is done by two theoretical methods that are assignment and transportation problems.

3.6 RESOURCE MINIMIZATION

The proper allocation and planning can reduced over allocation of resource. Assignment method can help to assign correct resource to correct job which can reduced excess amount spent to the project and also transportation problem can help to identify the shortest route to purchase the resource for control the transportation cost.

IV. PROJECT DETAILS

Details of project A

Project type : residential building
Project location :Parvathipuram
Number of floor : G+1
Area of project : 2000Sq.ft
Project cost : 33 Lakh

Details of project B

Project type : residential building
Project location :Thuckalay
Number of floor : G+1
Area of project : 2380Sq.ft
Project cost : 39Lakh

Details of project C

Project type : residential building
Project location :Pathmanabapuram
Number of floor : G+1

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 3, March 2019

Area of project : 2200Sq.ft
Project cost : 37 Lakh

V. WORKING WITH PRIMAVERA

5.1 PRIMAVERA RESULT FOR BUILDING A

Activity ID	Activity Name	Original Duration	Remaining Duration	Schedule %	Start	Finish	Res...	Budgeted Total	Total Float
A	SURVEY	1	1	0%	07-Mar-19	07-Mar-19	ENGL...	Rs613	0
C	EXCAVATION1	2	2	0%	08-Mar-19	11-Mar-19	ENGL...	Rs1,924	2
D	SAND FILLING FOR FOUNDATION	2	2	0%	08-Mar-19	11-Mar-19	SUP...	Rs1,737	0
B	SITE CLEARANCE	1	1	0%	08-Mar-19	08-Mar-19	SUP...	Rs2,237	3
E	BASEMENT CONCRETING	2	2	0%	11-Mar-19	12-Mar-19	SUP...	Rs18,163	7
F	FORMWORK	3	3	0%	11-Mar-19	13-Mar-19	SUP...	Rs100,863	3
I	G COLUMN CONSTRUCTION	4	4	0%	12-Mar-19	15-Mar-19	SUP...	Rs20,913	9
J	WALL CONSTRUCTION	7	7	0%	12-Mar-19	20-Mar-19	SUP...	Rs6,963	0
G	G BEAM CONSTRUCTION	2	2	0%	13-Mar-19	14-Mar-19	SUP...	Rs30,413	2
H	G SLAB CONSTRUCTION	3	3	0%	13-Mar-19	15-Mar-19	SUP...	Rs18,863	9
K	REMOVING FORMWORK	3	3	0%	13-Mar-19	15-Mar-19	LAB...	Rs738	7
L	STAIR CONSTRUCTION	4	4	0%	15-Mar-19	20-Mar-19	SUP...	Rs212,813	2
M	F.F FORMWORK	2	2	0%	18-Mar-19	19-Mar-19	LAB...	Rs50,738	9
N	F.F BEAM CONSTRUCTION	2	2	0%	18-Mar-19	19-Mar-19	SUP...	Rs19,463	10
O	F.F SLAB CONSTRUCTION	3	3	0%	18-Mar-19	20-Mar-19	LAB...	Rs18,063	9
X	SANITARY WORK	4	4	0%	18-Mar-19	21-Mar-19	CER...	Rs25,874	10
Y	PLUMBING	5	5	0%	18-Mar-19	22-Mar-19	PIPE...	Rs15,525	7
T	RAILING	3	3	0%	20-Mar-19	22-Mar-19	STE...	Rs10,650	9
P	F.F COLUMN CONSTRUCTION	5	5	0%	21-Mar-19	27-Mar-19	SUP...	Rs19,163	0
S	STAIR CONSTRUCTION	2	2	0%	21-Mar-19	22-Mar-19	SUP...	Rs15,963	9
U	DOOR INSTALLATION	5	5	0%	21-Mar-19	27-Mar-19	W/O...	Rs54,392	2
V	WINDOW INSTALLATION	4	4	0%	21-Mar-19	26-Mar-19	W/O...	Rs50,863	3
W	ELECTRICAL WORK	4	4	0%	21-Mar-19	26-Mar-19	Elect...	Rs43,644	3
Z	TILING	6	6	0%	25-Mar-19	01-Apr-19	LAB...	Rs100,863	7
Q	WALL CONSTRUCTION	6	6	0%	28-Mar-19	04-Apr-19	SUP...	Rs7,663	0
R	REMOVING FORMWORK	2	2	0%	28-Mar-19	29-Mar-19	LAB...	Rs925	4
Z1	PLASTERING	8	8	0%	28-Mar-19	08-Apr-19	SUP...	Rs6,650	2
Z2	WHITE WASHING	4	4	0%	05-Apr-19	10-Apr-19	Paint...	Rs4,983	0
Z3	PAINTING	9	9	0%	11-Apr-19	23-Apr-19	Paint...	Rs81,548	0
Z4	LAND SCAPING	3	3	0%	24-Apr-19	26-Apr-19	LAB...	Rs825	0

Fig-2.Activity chart for building A

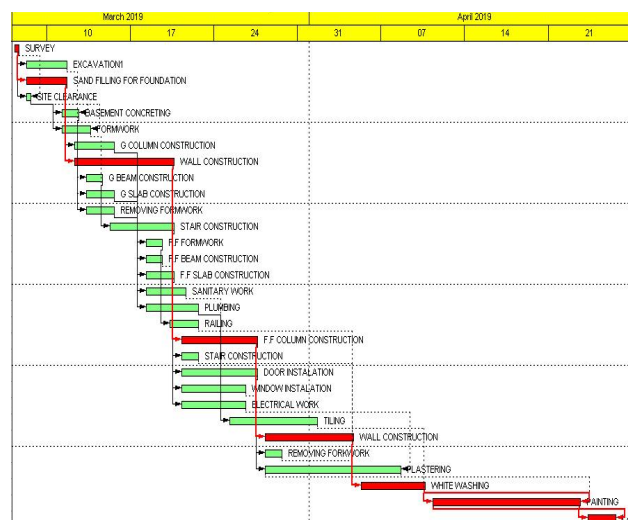


Fig-3.Gantt chart for building A

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

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Vol. 8, Issue 3, March 2019

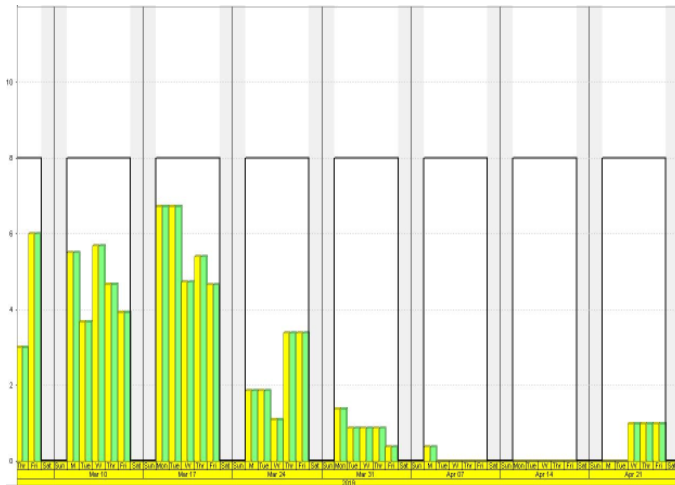


Fig-4.Resource usage profile for building A

Table-1.Resource detail for building A

Resource Type	Resource Name	Qty	Cost
Manpower	Unskilled labour	8	500/d
	Skilled labour	5	700/d
	Mason	6	850/d
	Carpenter	5	850/d
	Painter	5	700/d
	Filter	4	500/d
Material	Hollow block	58000nos	1340000
	Cement (sanker:opc43)	750bag	288750
	Sand + Msand	50load	330000
Machine	Concrete mixer	1	600/h
	JCB	1	800/h

5.2 PRIMAVERA RESULT FOR BUILDING B

Activity ID	Activity Name	Original Duration	Remaining Duration	Progress %	Start	Finish	Res...	Budgeted Total Cost	Total Float
A	SITE CLEARANCE	2	2	0%	22-Feb-19	25-Feb-19	ENGL...	Rs1,687	0
B	EXCAVATION FOR FOUNDATION	6	6	0%	22-Feb-19	01-Mar-19	SUP...	Rs17,463	15
C	SAND FILLING	1	1	0%	26-Feb-19	26-Feb-19	SUP...	Rs1,299	2
D	BASEMENT CONCRETING	3	3	0%	26-Feb-19	28-Feb-19	ENGL...	Rs48,613	0
D1	FORMWORK	5	5	0%	01-Mar-19	07-Mar-19	LAB...	Rs50,050	20
E	GROUND BEAM CONST	6	6	0%	26-Feb-19	05-Mar-19	ENGL...	Rs48,150	1
F	G.F SLAB CONST	2	2	0%	01-Mar-19	04-Mar-19	ENGL...	Rs16,900	0
G	G.F COLUMN CONST	5	5	0%	01-Mar-19	07-Mar-19	ENGL...	Rs47,650	6
H	G.F WALL CONST	5	5	0%	01-Mar-19	07-Mar-19	SUP...	Rs24,263	25
I	G.F STAIR CONST	3	3	0%	04-Mar-19	06-Mar-19	SUP...	Rs2,931	15
II	REMOVING FORMWORK	3	3	0%	08-Mar-19	12-Mar-19	LAB...	Rs662	25
J	FF COLUMN CONST	3	3	0%	05-Mar-19	07-Mar-19	SUP...	Rs16,213	3
K	FF BEAM CONST	6	6	0%	05-Mar-19	12-Mar-19	SUP...	Rs7,713	0
L	FF WALL CONST	2	2	0%	06-Mar-19	07-Mar-19	SUP...	Rs19,813	3
L1	REMOVING FORMWORK	2	2	0%	13-Mar-19	14-Mar-19	LAB...	Rs737	23
M	FF SLAB CONST	4	4	0%	06-Mar-19	11-Mar-19	SUP...	Rs19,263	1
N	STAIR CONST	3	3	0%	07-Mar-19	11-Mar-19	ENGL...	Rs7,600	15
O	CURTAIN WALL CONST	8	8	0%	07-Mar-19	16-Mar-19	ORA...	Rs100,860	15
P	RAILING INST	2	2	0%	06-Mar-19	11-Mar-19	SUP...	Rs17,463	6
Q	DOOR INSTALLATION	5	5	0%	12-Mar-19	18-Mar-19	SUP...	Rs21,012	1
Q1	WINDOW INSTALLATION	6	6	0%	19-Mar-19	26-Mar-19	LAB...	Rs50,737	15
R	ELECTRICAL WIRING INST	3	3	0%	12-Mar-19	14-Mar-19	SUP...	Rs21,050	6
S	PLUMBING WORK	8	8	0%	13-Mar-19	22-Mar-19	SUP...	Rs12,763	0
T	SANITARY FITTING	10	10	0%	19-Mar-19	01-Apr-19	SUP...	Rs50,063	1
U	TILING	5	5	0%	15-Mar-19	21-Mar-19	SUP...	Rs863	7
U1	ARCHITECTURE WORK	6	6	0%	22-Mar-19	29-Mar-19	LAB...	Rs15,112	12
V	PLASTERING	6	6	0%	25-Mar-19	01-Apr-19	Plum...	Rs5,514	0
W	WHITE WASHING	8	8	0%	02-Apr-19	11-Apr-19	LAB...	Rs6,363	1
X	PAINING	9	9	0%	02-Apr-19	12-Apr-19	Paint...	Rs28,677	0
Y	LAND SCAPING	2	2	0%	15-Apr-19	16-Apr-19	SUP...	Rs7,600	0

Fig-5.Activity chart for building B

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

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Vol. 8, Issue 3, March 2019

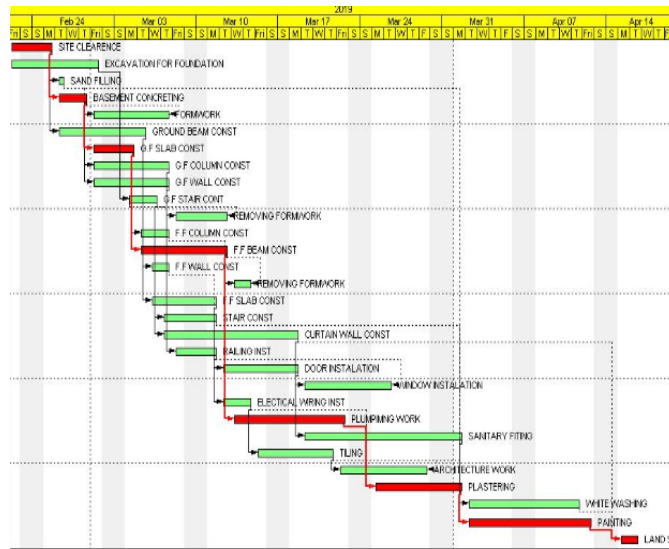


Fig-6.Gantt chart for building B

Resource Type	Resource Name	Quantity	Cost
Manpower	Unskilled Labour	5	500/d
	Skilled Labour	5	700/d
	Mason	5	850/d
	Carpenter	5	850/d
	Painter	5	700/d
	Filter	2	500/d
Material	Brick	95000nos	760000
	Cement (Ramco:opc53)	795bag	298125
	River sand	54load	432000
Machine	Concrete Mixer	1	600/h
	JCB	1	800/h

Table-2.Resource detail for building B

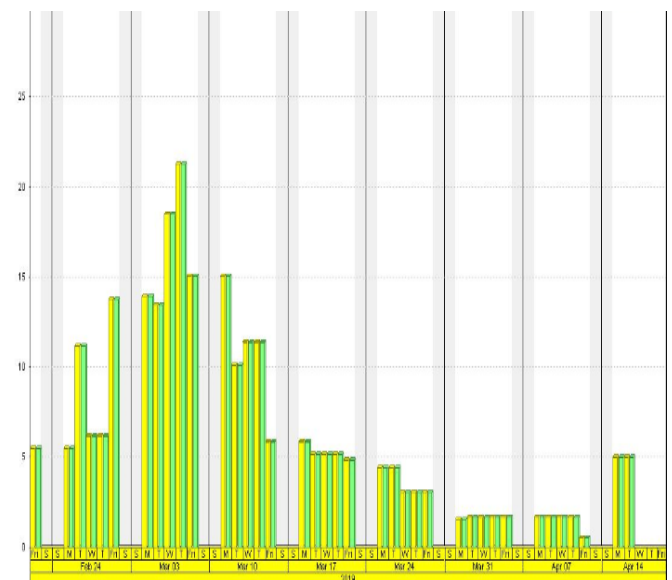


Fig-7.Resource usage profile for building B

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

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Vol. 8, Issue 3, March 2019

5.3 PRIMAVERA RESULT FOR BUILDING C

Activity ID	Activity Name	Original Duration	Remaining Duration	Schedule %	Start	Finish	Res.	Budgeted Total Cost	Total Float
A1000	SITE CLEARANCE	2	2	0%	22-Feb-19	25-Feb-19	ENGL...	Rs2,524	0
A1010	EXCAVATION	3	3	0%	26-Feb-19	28-Feb-19	ENGL...	Rs2,424	2
A1020	REINFORCED INSTALATION	4	4	0%	26-Feb-19	01-Mar-19	ENGL...	Rs11,237	3
A1030	PILE FILING	5	5	0%	26-Feb-19	04-Mar-19	LAB...	Rs5,925	0
A1040	PILE CAP CONSTRUCTION	4	4	0%	01-Mar-19	06-Mar-19	SUP...	Rs6,662	12
A1050	FORMWORK	2	2	0%	01-Mar-19	04-Mar-19	LAB...	Rs50,925	2
A1060	G BEAM CONSTRUCTION	6	6	0%	04-Mar-19	11-Mar-19	ENGL...	Rs31,750	6
A1070	G FLOOR SLAB CONSTRUCTION	7	7	0%	04-Mar-19	12-Mar-19	SUP...	Rs17,362	3
A1080	G COLUMN CONSTRUCTION	9	9	0%	05-Mar-19	15-Mar-19	SUP...	Rs19,800	0
A1090	REMOVING FORMWORK	2	2	0%	05-Mar-19	06-Mar-19	LAB...	Rs825	10
A1100	WALL CONSTRUCTION	10	10	0%	05-Mar-19	16-Mar-19	LAB...	Rs11,725	2
A1110	G STAIR CONSTRUCTION	5	5	0%	05-Mar-19	11-Mar-19	LAB...	Rs69,125	7
A1120	F F FORMWORK	2	2	0%	05-Mar-19	06-Mar-19	LAB...	Rs50,925	10
A1130	F F SLAB CONSTRUCTION	5	5	0%	07-Mar-19	13-Mar-19	SUP...	Rs17,800	12
A1140	F F BEAM CONSTRUCTION	6	6	0%	12-Mar-19	19-Mar-19	SUP...	Rs17,100	8
A1150	F F COLUMN CONSTRUCTION	7	7	0%	12-Mar-19	20-Mar-19	SUP...	Rs20,150	6
A1160	F F WALL CONSTRUCTION	9	9	0%	13-Mar-19	25-Mar-19	SUP...	Rs9,062	3
A1170	F F STAIR CONSTRUCTION	4	4	0%	13-Mar-19	18-Mar-19	SUP...	Rs17,950	8
A1180	REMOVING FORMWORK	2	2	0%	13-Mar-19	14-Mar-19	LAB...	Rs1,025	10
A1190	RALING	8	8	0%	18-Mar-19	27-Mar-19	HEL...	Rs11,025	0
A1200	SANITARY WWORK	5	5	0%	07-Mar-19	13-Mar-19	PIPE...	Rs31,847	10
A1210	ELECTRICAL WORK	7	7	0%	19-Mar-19	27-Mar-19	Elect...	Rs11,677	2
A1220	DOOR INSTALATION	5	5	0%	20-Mar-19	26-Mar-19	Carp...	s2,038.63	8
A1230	WINDOW INSTALATION	6	6	0%	21-Mar-19	28-Mar-19	WID...	Rs53,864	6
A1240	PLUMBING WWORK	4	4	0%	26-Mar-19	29-Mar-19	Plum...	Rs23,053	3
A1250	TLING WWORK	5	5	0%	28-Mar-19	03-Apr-19	ORA...	s100,850	0
A1260	PLASTERING	9	9	0%	28-Mar-19	09-Apr-19	LAB...	Rs5,925	2
A1270	WHITE WASHING	4	4	0%	29-Mar-19	03-Apr-19	Paint...	Rs82,433	6
A1280	PAINING	6	6	0%	04-Apr-19	11-Apr-19	Paint...	Rs79,677	0
A1290	LAND SCAPING	3	3	0%	12-Apr-19	16-Apr-19	LAB...	Rs2,725	0

Fig-8.Activity chart for building C

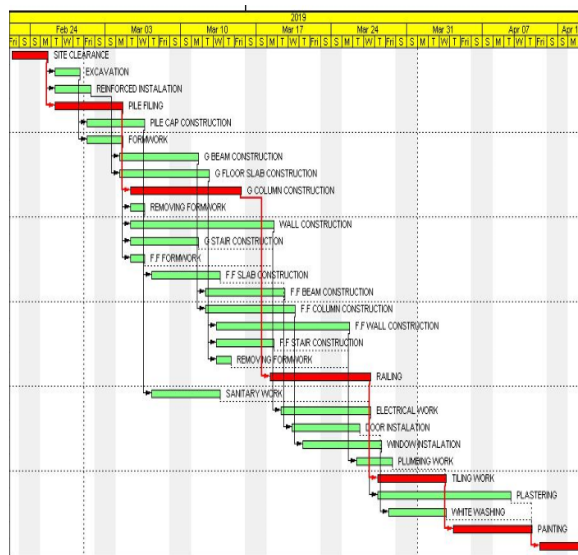


Fig-9.Gantt chart for building C

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

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Vol. 8, Issue 3, March 2019

Resource Type	Resource Name	Qty	Cost
Manpower	Unskilled labour	4	500/d
	Skilled labour	4	700/d
	Mason	4	850/d
	Carpenter	3	850/d
	Painter	3	700/d
	Filter	2	500/d
	Material	Solid block	55000nos
Cement (ramco:opc43)		775bag	290625
MSand		52load	270400
Machine	Concrete mixer	1	600/h
	JCB	1	800/h

Table-3.Resource detail for building C

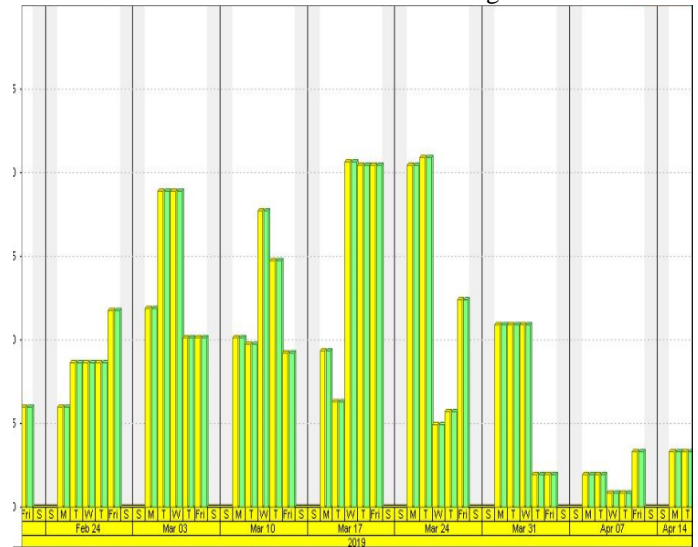


Fig-10.Resource usage profile for building C

VI. RESULT AND DISCUSION

Resource Details	Actual used resource			Assigned Resource			Actual resource cost	Assigned resource cost	Reduced cost
	A	B	C	A	B	C			
Material (block)	hollow block	brick	solid block	Solid Block	brick	Hollow block	3475000	3210000	265000
Material (cement)	Sanker (opc43)	Ramco (opc53)	Ramco (opc43)	Ramco (opc53)	Ramco (opc43)	Sanker (opc43)	889425	889000	423
Material (sand)	Sand+ M sand	River sand	M sand	River Sand	M sand	Sand + M sand	1032400	1024000	8400
Man power	Crew 2 (33no)	Crew3 (27no)	Crew1 (20no)	Crew1 (20no)	Crew2 (33no)	Crew3 (27no)	387000	380000	7000
Machine (excavation)	JCB	JCB	JCB	JCB	JCB	JCB	8000	8000	-

Table-4.Comparison of resource cost

VII. CONCLUSION

Essentially comparison between the actually used resource and assigned used resource is to create some variance. The allocation resource is used by primavera, assignment method and transportation method. The data collection from three buildings where used different types of resource without allocation. After allocation of resource of these building by assignment and transportation problem which generates some difference on resource usage and also the total cost of the project. In assignment problem and transportation problem can help to assign right choice to right



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place. In that way the resources are allocated and cost are minimized. This way of allocation total resource cost is reduced up to 25%.

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