

EARNED VALUE ANALYSIS FOR A CONSTRUCTION PROJECT

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ABSTRACT

Cost over-runs and time over-runs are prevalent in most of the projects carried out in developing nations such as India. There may be multiple reasons for these overruns. In order to reduce them, there should be efficient use of the construction softwares available in the market. This paper emphasises the use of these softwares to reduce these issues by the use of a scientific technique called earned value analysis. Earned Value Analysis is an industry standard method of measuring a project's progress at any given point of time, forecasting its completion date and final cost, analysing variances in the schedule and budget as the project proceeds. It is a method for measuring project performance, it indicates how much of the budget should have been spent, in view of the amount of work done and the baseline cost for the task, assignment and resources. The analysis helps in finding out the deviations both in cost as well as in time i.e. schedule variance and cost variance. This paper emphasizes on the use of this techniques in modern softwares such as Microsoft Project and Oracle Primavera P6 in order to exercise better management over the project.

Keywords: Earned Value, Variance, Schedule, Baseline

1.0 INTRODUCTION

1.1 Cost variances

Cost variance is computed by comparing actual cost of work performed (ACWP) with the budgeted cost of work performed (BCWP).

$$\text{Cost variance} = \text{BCWP} - \text{ACWP} \quad (1)$$

1.2 Over-run and Under-run

If the cost variance is positive, then the project has a cost under-run, i.e. the cost incurred is less than the planned or budgeted cost. If the cost variance is negative, then there is a cost over-run, i.e. the cost incurred is more than the planned or budgeted cost. When the cost variance is zero, the project is proceeding according to the budgeted cost.

Cost overrun and cost under-run are usually expressed in percentage. These can be represented graphically. Each point of cross over-run (or under-run) is derived using the following relationship.

$$\text{Cost over-run (or under-run)} = \frac{100(\text{BCWP}-\text{ACWP})}{(\text{BCWP})} \quad (2)$$

1.2 Schedule variance

Schedule variance is computed by comparing budgeted cost of work performed (BCWP) with the budgeted cost of work scheduled (BCWS). Although the name indicates schedule, it has to reflect somewhere in terms of cost, hence it is indicated in INR.

$$\text{Schedule variance (SV)} = \text{BCWP} - \text{BCWS} \quad (3)$$

If schedule variance is positive, then the project is ahead of its planned cost in terms of the schedule, i.e. earned value of the work performed is higher than the planned or scheduled earned value. If schedule variance is negative, then the project is behind its planned cost in terms of the schedule i.e. earned value of work performed is less than the planned or scheduled earned value. When schedule variance is zero, the project is proceeding according to the planned schedule. When project is behind schedule, there is a time overrun. Similarly, there is a time under-run, if project is ahead of schedule. Time overrun (or under-run) is equal to the period the project is behind or ahead of the schedule. Time overruns and time under-runs are usually expressed in terms of units of time, say month.

1.3 The Earned Value Chart

One way of measuring overall performance is by using an aggregate performance measure called Earned Value. A serious difficulty with comparing actual expenditures against budgeted or baseline is that the comparison fails to take into account the amount of work accomplished relative to the cost incurred. The earned value of work performed (value completed) for those tasks in progress is found by multiplying the estimated percent completion for each task by the planned cost for that task, the answer is the amount that should have been spent on the task till that point. The basic terms used are as follows:

- EV - Earned Value: budgeted cost of work performed
- AC - Actual cost: Actual Cost of work performed
- PV - Planned Value: budgeted cost of work scheduled
- ST - Scheduled time for work performed
- AT - Actual time of work performed
- EV - AC = Cost variance (CV, overrun is negative) (4)
- EV - PV = Schedule variance (SV, late is negative) (5)
- ST - AT = Time variance (TV, delay is negative) (6)

If the earned value chart shows a cost overrun or performance under run, the project manager must figure out what to do to get the schedule back on track. Options may include borrowing resources, or holding a meeting of project team members to suggest solutions, or notifying the client that the project may be late or over budget.

- Variances are also formulated as ratios rather than differences
- Cost Performance Index (CPI) = EV/AC (7)
- Schedule Performance Index (SPI) = EV/PV (8)
- Time Performance Index (TPI) = ST/AT (9)
- Use of ratios is particularly helpful when comparing the performance of several projects.

1.3 Corrective actions

In case of time over-run, we have to review the schedule of activities, re-examine their inter-dependencies, explore the possibilities of crashing the activities in critical path, by increasing/re-allocating available resources, draw revised schedule in an attempt to minimize the slippage. This has to be a continuous process rather than a onetime correction.

In case of cost over-run, we review the planned/budgeted cost estimates to complete the project and possibilities of cost reduction by crashing/decompression of activities, postponing allocation of resources to non-critical activities to the extent possible, reduction in resources considered redundant and other feasible means. In real life situations, we are sometimes confronted with the problem of matching the schedule with limited resources, e.g. manpower, funds, etc. In such a case we reallocate resources to activities, in order of priority, most critical activity getting the top priority in the matter. The attempt would be to redistribute the resources without incurring time over-run. If impossible, we would try to keep it to the least possible value.

2.0 CASE STUDY

This is a bridge constructed on Pune-Solapur Highway at Saswad Phata Pune. The main purpose of constructing this bridge is that to remove or to reduce the traffic load from the existing highway. The overall construction cost of this bridge is Rupees 25 crores. There are a total of two flyovers, one is from Pune to Saswad and another is from Saswad to Pune. There are 27 piers for Pune to Saswad and 9 piers for Saswad to Pune. The span of piers varies from 25m to 30m. The approach length of Pune to Saswad flyover is 80m. The total approach length of Saswad to Pune is 106m. The total vertical clearance for Pune to Saswad flyover is 5m. Every pier foundation has four piles of 1.2m diameter and 7.5m to 10m deep to carry a heavy load. The construction is done in various phases as follows:

Phase 1-A Construction of Pune to Saswad (P27-P14)

Phase 1-B Construction of Saswad to Pune (P1-P10)

Phase 2 Construction of Slip roads Saswad to Pune 285m Approach

Phase 3-A Construction of Pune to Saswad (P14-P10)

Phase 3-B Construction Pune to Saswad (P9-P1)

Pune Municipal Corporation is the Owner, S.N. Bhohe and Associates Private Limited are the consultants and J. Kumar Infraproject Private Limited is the contractors.



Figure 1: Layout of Gadital Bridge, Hadapsar



Figure 2: 3D model of the Gadital Bridge, Hadapsar

2.1 Scheduling of the bridge project

The activities for the given project are entered, their resources are allocated and duration of the activities is entered. After feeding the tasks, sub –tasks, durations and predecessors, schedule structure is generated. Bar chart shows the required units and quantities of resources assigned to the activities. Necessary Resource levelling and crashing may be done to get the optimal solution of the given project. The initial schedule structure is prepared (Figure 3), from which the Earned Value table is found (Figure 4). By analysing the table, If SV is negative ($PV > EV$), it means that the project is behind schedule and hence the project needs to be crashed (Figure 5). If CV is negative ($AC > PV$), it means that the actual cost of work is more than what was planned and hence smoothening is done by increasing the duration and using resources to their optimum level, thereby saving out on money (Figure 6).

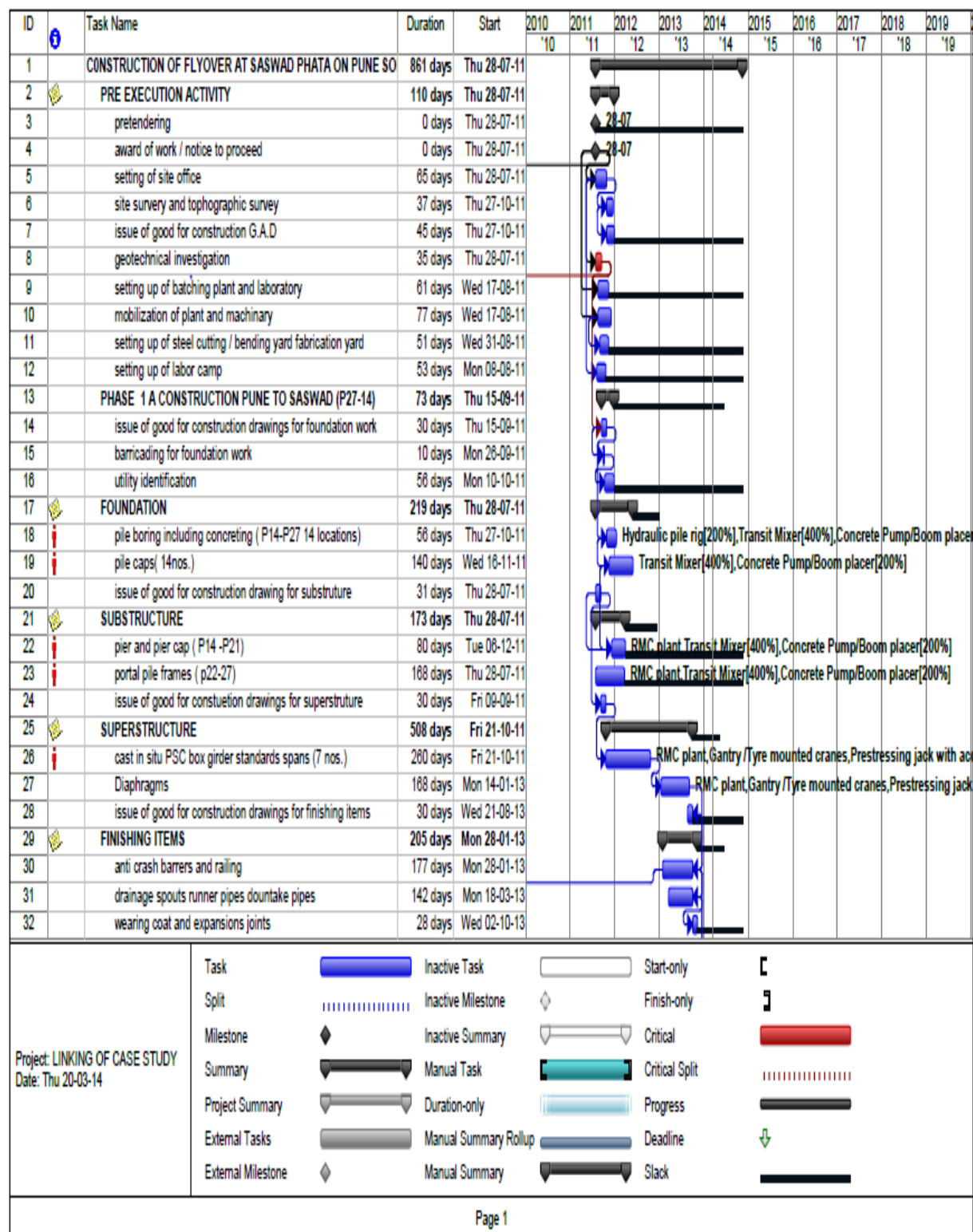
3.0 RESULTS

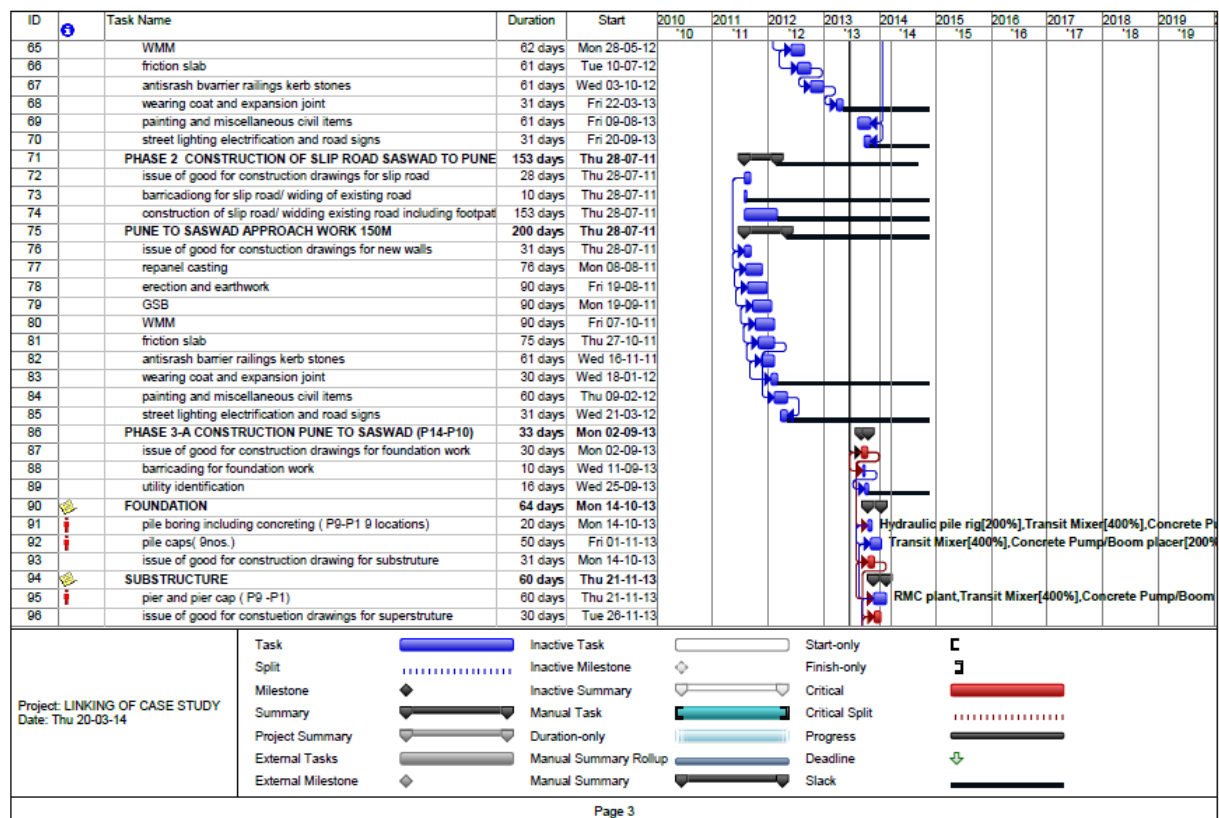
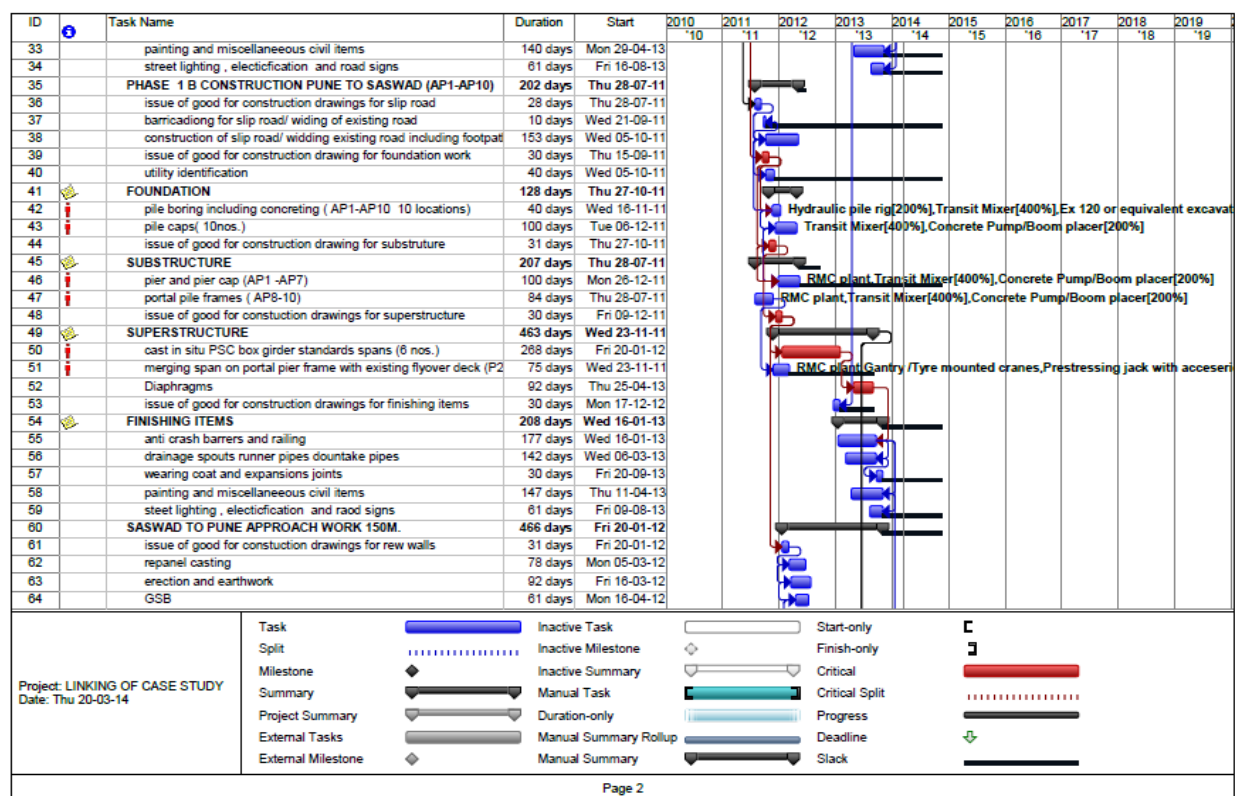
Initial Duration of Construction of Gadital Bridge = 861 days (Ref. fig. 3)

Complete Crashed Duration of Construction (When SV is –ve) = 775 days (high cost) (Ref fig.5)

Smoothened Duration of Construction (When CV is +ve) = 1185 days (low cost)

(Ref fig.6). Hence depending upon the values of the SV and CV, corrective action may be taken. The optimal solution is to be found out by the experience of the project manager, by smoothening the resources at suitable occasions and crashing activities where needed. Project tracking needs to be done continuously in order to carry out the earned value analysis. Schedule structure is as shown in the figures below.





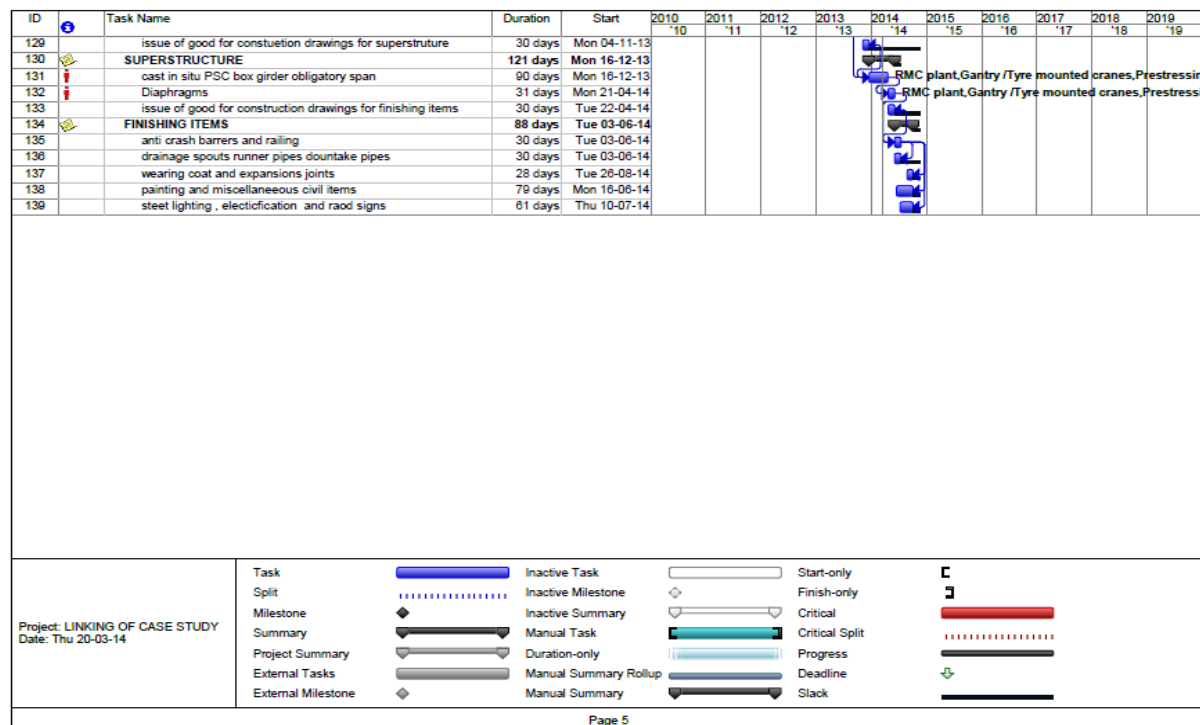
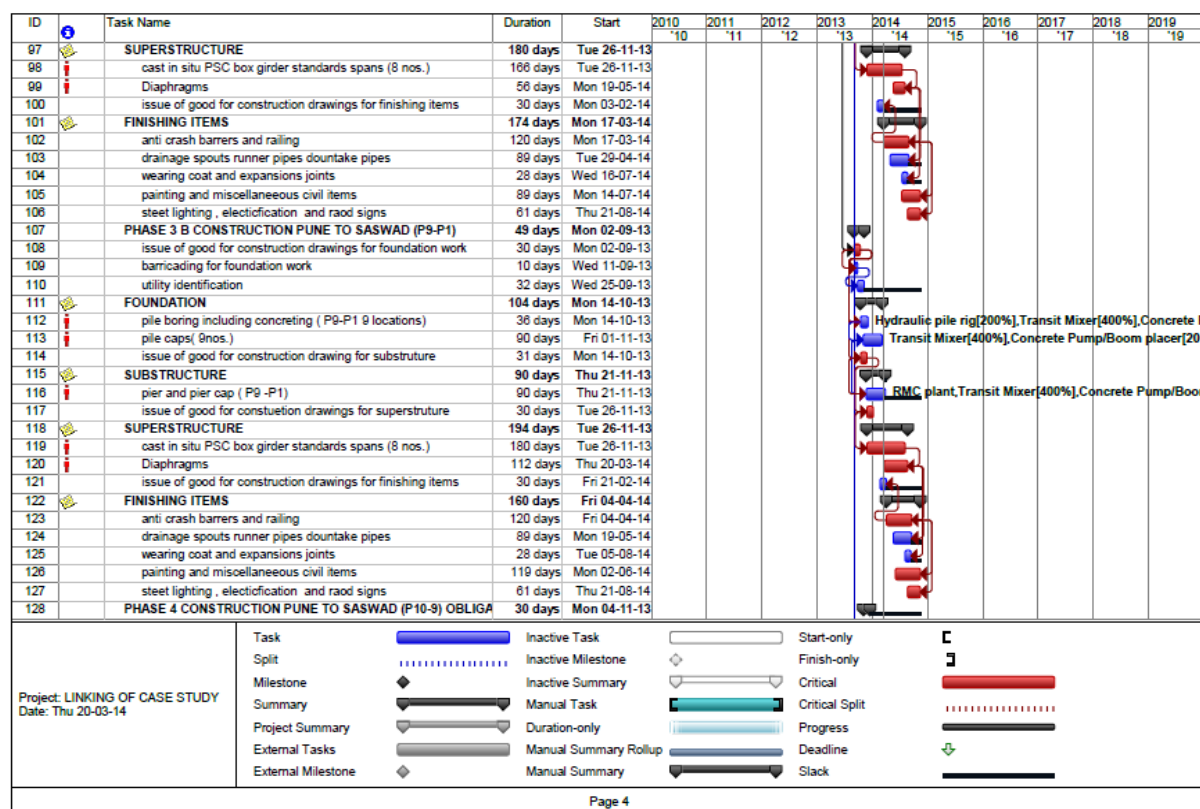


FIGURE 3: Initial schedule of the Gadital Bridge

**Earned Value Analysis For A Construction Project, Anuj Dubey, Journal Impact Factor (2015): 9.1215
(Calculated by GISI) www.jifactor.com**

ID	Task Name	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	AC (ACWP)	SV	CV	EAC	BAC	VAC
1	CONSTRUCTION OF FLYOVER	₹ 0.00	₹ 0.00	₹ 85,238,887.82	₹ 0.00	₹ 85,238,887.82	₹ 378,598,974.00	₹ 0.00	₹ 378,598,974.00
2	PRE EXECUTION ACTIVITY	₹ 0.00	₹ 0.00	₹ 2,144,812.00	₹ 0.00	₹ 2,144,812.00	₹ 2,144,812.00	₹ 0.00	₹ 2,144,812.00
3	pretendering	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
4	award of work / notice to	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
5	setting of site office	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
6	site survey and topogra	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
7	Issue of good for construc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
8	geotechnical investigation	₹ 0.00	₹ 0.00	₹ 360,000.00	₹ 0.00	₹ 360,000.00	₹ 360,000.00	₹ 0.00	₹ 360,000.00
9	setting up of batching plant	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
10	mobilization of plant and	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
11	setting up of steel cutting	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
12	setting up of labor camp	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
13	PHASE 1 A CONSTRUCTIO	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
14	Issue of good for construc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
15	barricading for foundation	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
16	utility identification	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
17	FOUNDATION	₹ 0.00	₹ 0.00	₹ 13,498,830.98	₹ 0.00	₹ 13,498,830.98	₹ 19,012,438.00	₹ 0.00	₹ 19,012,438.00
18	pile boring including conc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
19	pile caps(14nos.)	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
20	Issue of good for construc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
21	SUBSTRUCTURE	₹ 0.00	₹ 0.00	₹ 4,317,508.49	₹ 0.00	₹ 4,317,508.49	₹ 13,083,353.00	₹ 0.00	₹ 13,083,353.00
22	pier and pier cap (P14 -P	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
23	portal pile frames (p22-2'	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
24	Issue of good for construc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
25	SUPERSTRUCTURE	₹ 0.00	₹ 0.00	₹ 6,197,418.00	₹ 0.00	₹ 6,197,418.00	₹ 30,987,090.00	₹ 0.00	₹ 30,987,090.00
26	cast in situ PSC box girde	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
27	Diaphragms	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
28	Issue of good for construc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
29	FINISHING ITEMS	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 25,222,404.00	₹ 0.00	₹ 25,222,404.00
30	anti crash barriers and rail	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
31	drainage spouts runner pi	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 350,700.00	₹ 0.00	₹ 350,700.00
32	wearing coat and expansi	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 4,015,575.00	₹ 0.00	₹ 4,015,575.00
33	painting and miscellaneec	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 6,107,262.00	₹ 0.00	₹ 6,107,262.00
34	street lighting , electrica	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 2,137,665.00	₹ 0.00	₹ 2,137,665.00
35	PHASE 1 B CONSTRUCTIO	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
36	Issue of good for construc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
37	barricading for slip road/	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
38	construction of slip road/	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
39	Issue of good for construc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
40	utility identification	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
41	FOUNDATION	₹ 0.00	₹ 0.00	₹ 14,839,577.28	₹ 0.00	₹ 14,839,577.28	₹ 19,012,438.00	₹ 0.00	₹ 19,012,438.00

Page 1

ID	Task Name	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	AC (ACWP)	SV	CV	EAC	BAC	VAC
42	pile boring including conc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
43	pile caps(10nos.)	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
44	Issue of good for construc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
45	SUBSTRUCTURE	₹ 0.00	₹ 0.00	₹ 9,812,514.79	₹ 0.00	₹ 9,812,514.79	₹ 13,083,353.00	₹ 0.00	₹ 13,083,353.00
46	pier and pier cap (AP1 -A	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
47	portal pile frames (AP8-1	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
48	Issue of good for construc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
49	SUPERSTRUCTURE	₹ 0.00	₹ 0.00	₹ 8,507,288.90	₹ 0.00	₹ 8,507,288.90	₹ 30,987,090.00	₹ 0.00	₹ 30,987,090.00
50	cast in situ PSC box girde	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
51	merging span on portal pi	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
52	Diaphragms	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
53	Issue of good for construc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
54	FINISHING ITEMS	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 12,611,202.00	₹ 0.00	₹ 12,611,202.00
55	anti crash barriers and rail	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
56	drainage spouts runner pi	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
57	wearing coat and expansi	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
58	painting and miscellaneec	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
59	street lighting , electrica	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
60	SASWAD TO PUNE APPRO	₹ 0.00	₹ 0.00	₹ 436,863.40	₹ 0.00	₹ 436,863.40	₹ 8,793,268.00	₹ 0.00	₹ 8,793,268.00
61	Issue of good for construc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
62	repanel casting	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
63	erection and earthwork	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
64	GSE	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
65	WMM	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
66	friction slab	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
67	antislash barrier railings	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
68	wearing coat and expansi	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
69	painting and miscellaneec	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
70	street lighting electrica	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
71	PHASE 2 CONSTRUCTIO	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
72	Issue of good for construc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
73	barricading for slip road/	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
74	construction of slip road/	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
75	PUNE TO SASWAD APPRO	₹ 0.00	₹ 0.00	₹ 7,685,275.84	₹ 0.00	₹ 7,685,275.84	₹ 8,793,268.00	₹ 0.00	₹ 8,793,268.00
76	Issue of good for construc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
77	repanel casting	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
78	erection and earthwork	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
79	GSE	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
80	WMM	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
81	friction slab	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
82	antislash barrier railings	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00

Page 2

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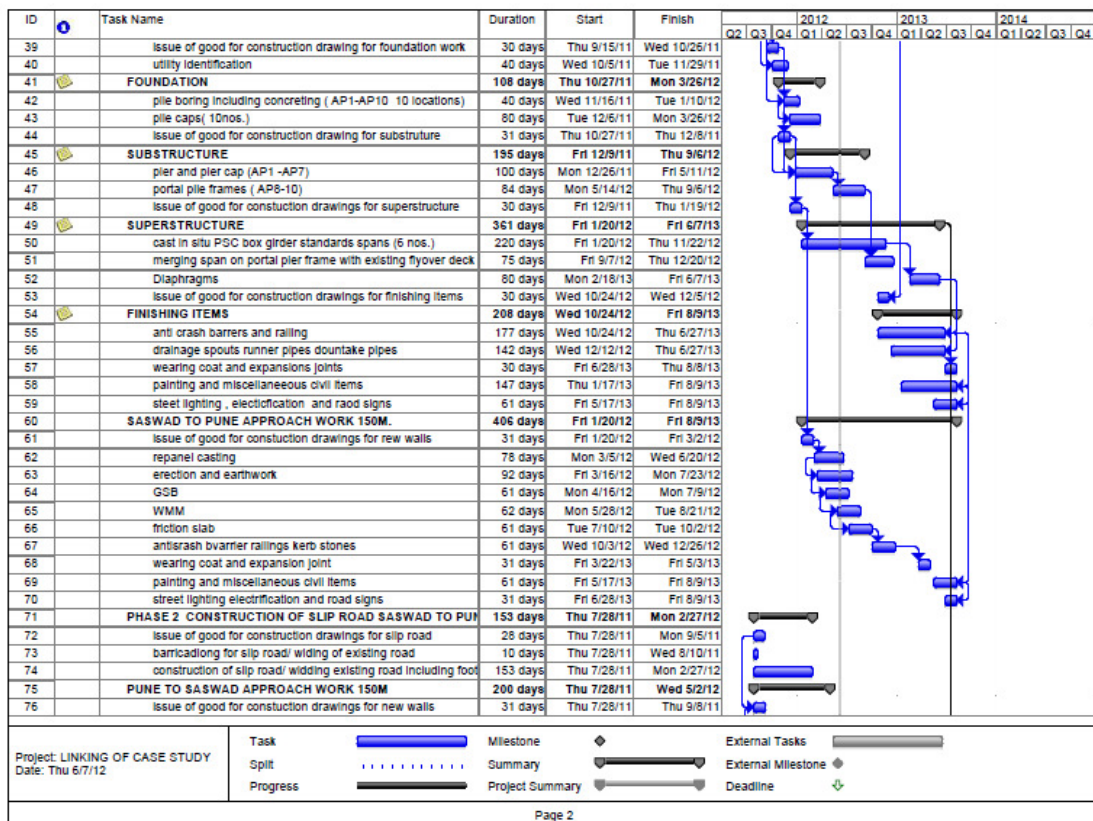
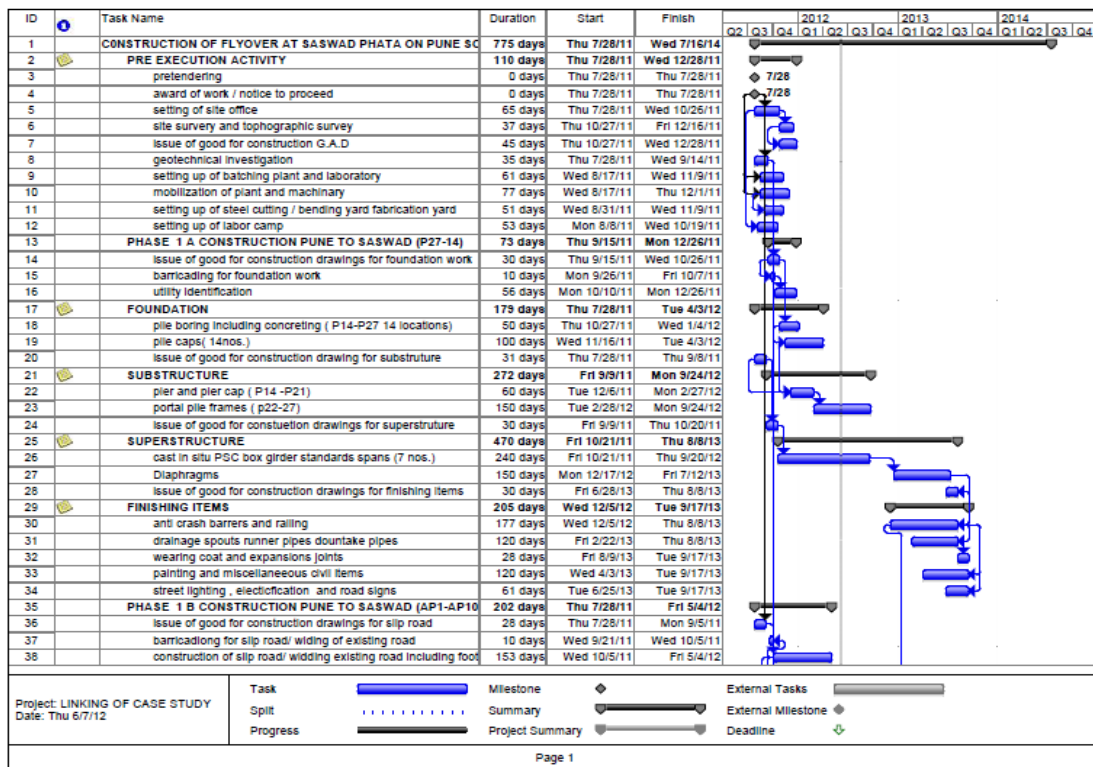
ID	Task Name	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	AC (ACWP)	SV	CV	EAC	BAC	VAC
83	wearing coat and expansi	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
84	painting and miscellaneou	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
85	street lighting electrificati	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
86	PHASE 3-A CONSTRUCTIO	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
87	Issue of good for construc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
88	barricading for foundation	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
89	utility identification	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
90	FOUNDATION	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 19,012,438.00	₹ 0.00	₹ -19,012,438.00
91	pile boring including conc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
92	pile caps(9nos.)	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
93	Issue of good for construc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
94	SUBSTRUCTURE	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 13,083,353.00	₹ 0.00	₹ -13,083,353.00
95	pier and pier cap (P9 -P1	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
96	Issue of good for constue	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
97	SUPERSTRUCTURE	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 30,987,090.00	₹ 0.00	₹ -30,987,090.00
98	cast in situ PSC box girde	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
99	Diaphragms	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
100	Issue of good for construc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
101	FINISHING ITEMS	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 12,611,202.00	₹ 0.00	₹ -12,611,202.00
102	anti crash barriers and rail	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
103	drainage spouts runner pi	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
104	wearing coat and expansi	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
105	painting and miscellaneec	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
106	steel lighting , electrificati	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
107	PHASE 3 B CONSTRUCTIO	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
108	Issue of good for construc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
109	barricading for foundation	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
110	utility identification	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
111	FOUNDATION	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 19,012,438.00	₹ 0.00	₹ -19,012,438.00
112	pile boring including conc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
113	pile caps(9nos.)	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
114	Issue of good for construc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
115	SUBSTRUCTURE	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 13,083,353.00	₹ 0.00	₹ -13,083,353.00
116	pier and pier cap (P9 -P1	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
117	Issue of good for constue	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
118	SUPERSTRUCTURE	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 30,987,090.00	₹ 0.00	₹ -30,987,090.00
119	cast in situ PSC box girde	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
120	Diaphragms	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
121	Issue of good for construc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
122	FINISHING ITEMS	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 12,611,202.00	₹ 0.00	₹ -12,611,202.00
123	anti crash barriers and rail	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00

Page 3

ID	Task Name	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	AC (ACWP)	SV	CV	EAC	BAC	VAC
124	drainage spouts runner pi	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
125	wearing coat and expansi	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
126	painting and miscellaneec	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
127	steel lighting , electrificati	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
128	PHASE 4 CONSTRUCTION	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
129	Issue of good for constue	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
130	SUPERSTRUCTURE	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 30,987,090.00	₹ 0.00	₹ -30,987,090.00
131	cast in situ PSC box girde	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
132	Diaphragms	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
133	Issue of good for construc	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
134	FINISHING ITEMS	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 12,611,202.00	₹ 0.00	₹ -12,611,202.00
135	anti crash barriers and rail	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
136	drainage spouts runner pi	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
137	wearing coat and expansi	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
138	painting and miscellaneec	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
139	steel lighting , electrificati	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00

Page 4

FIGURE 4: Earned Value Table of the Gadital Bridge



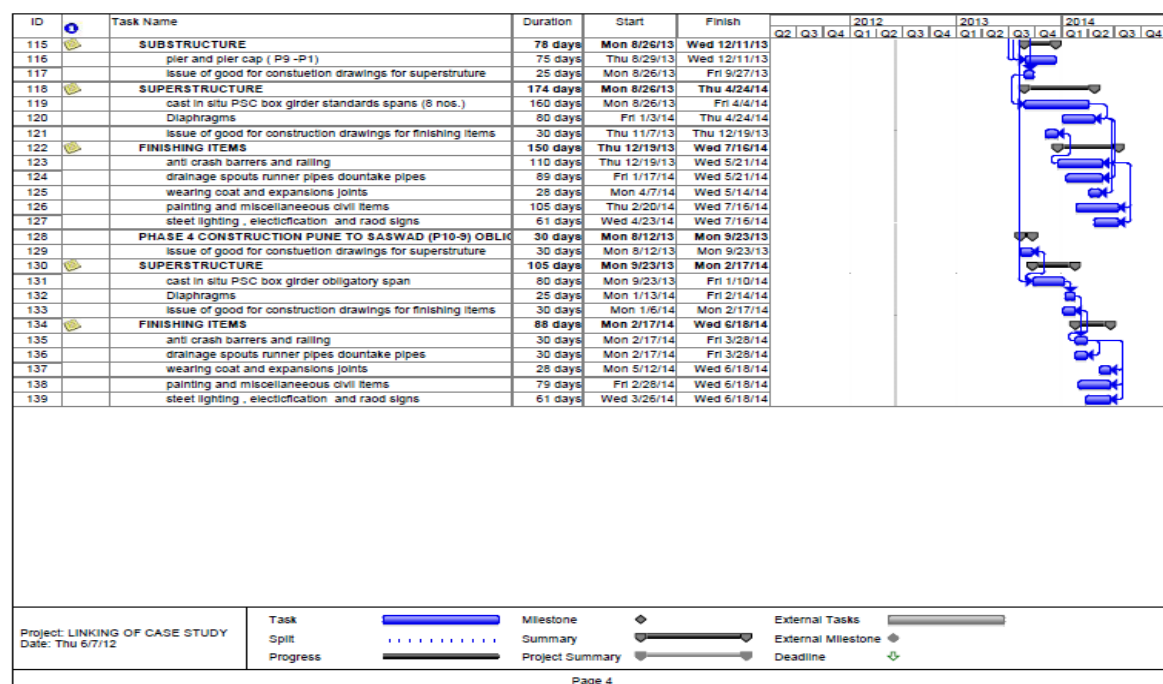
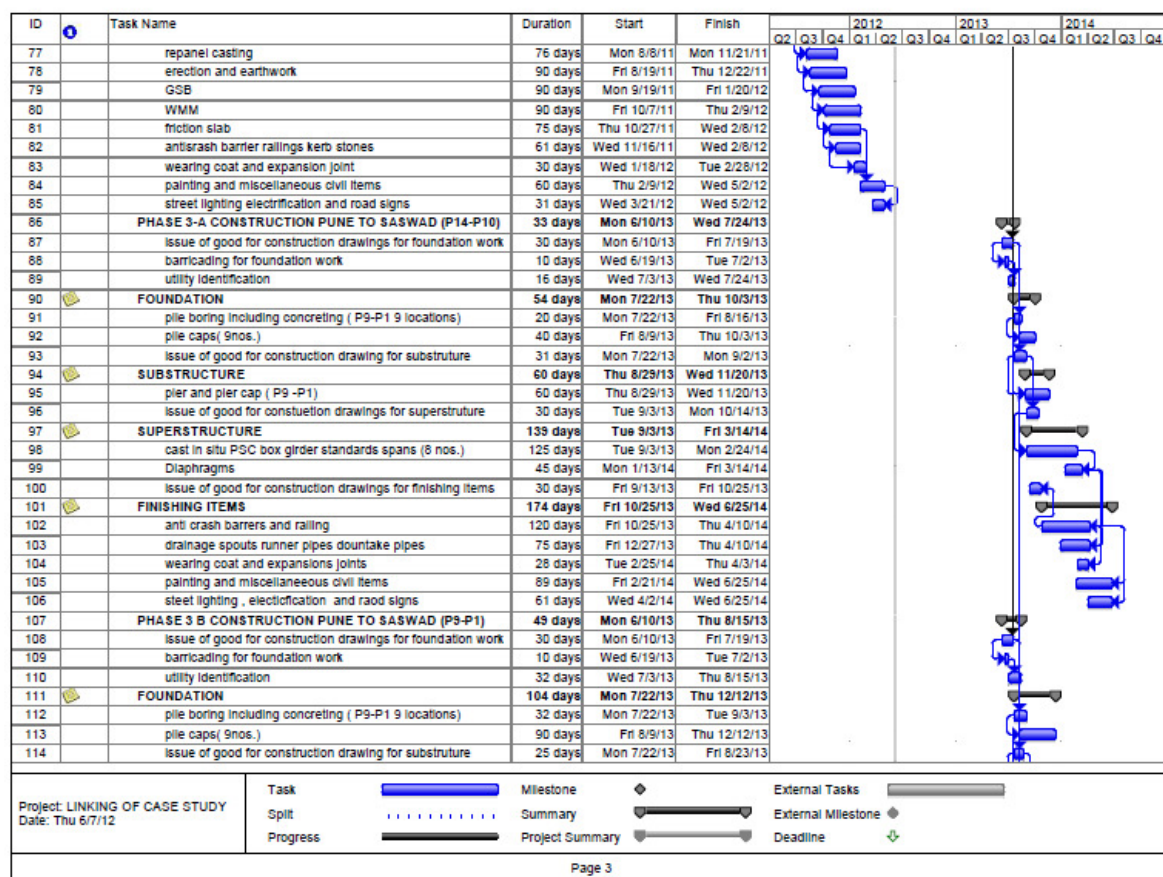
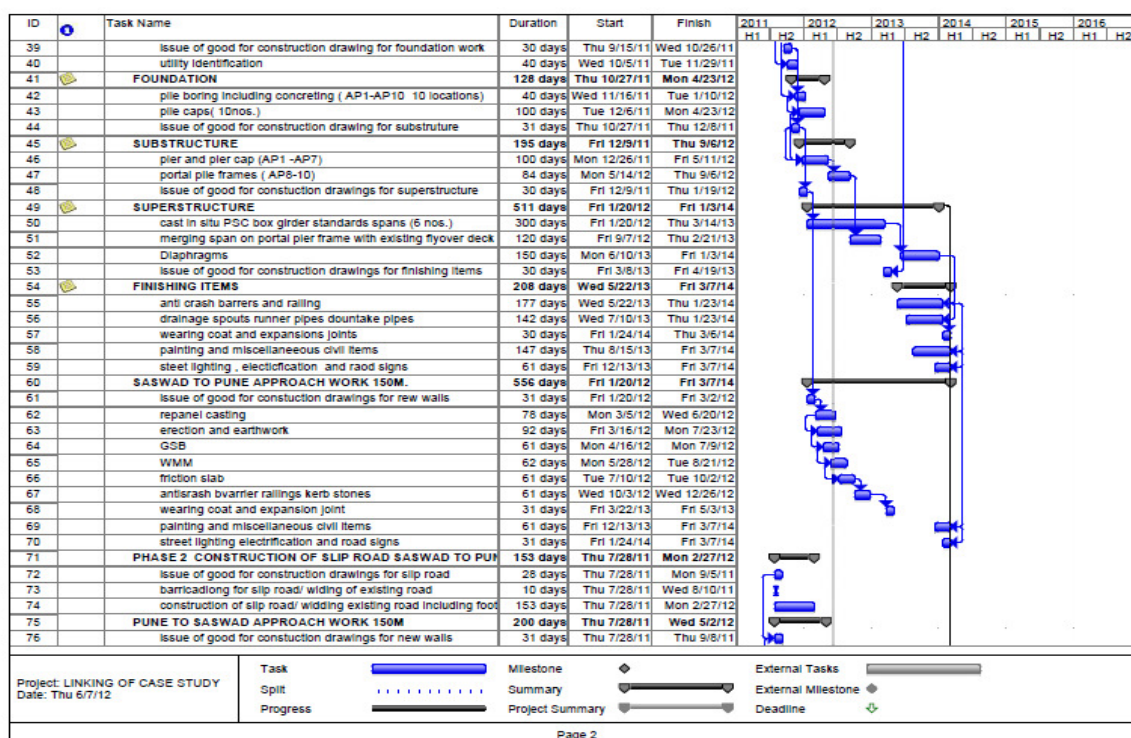
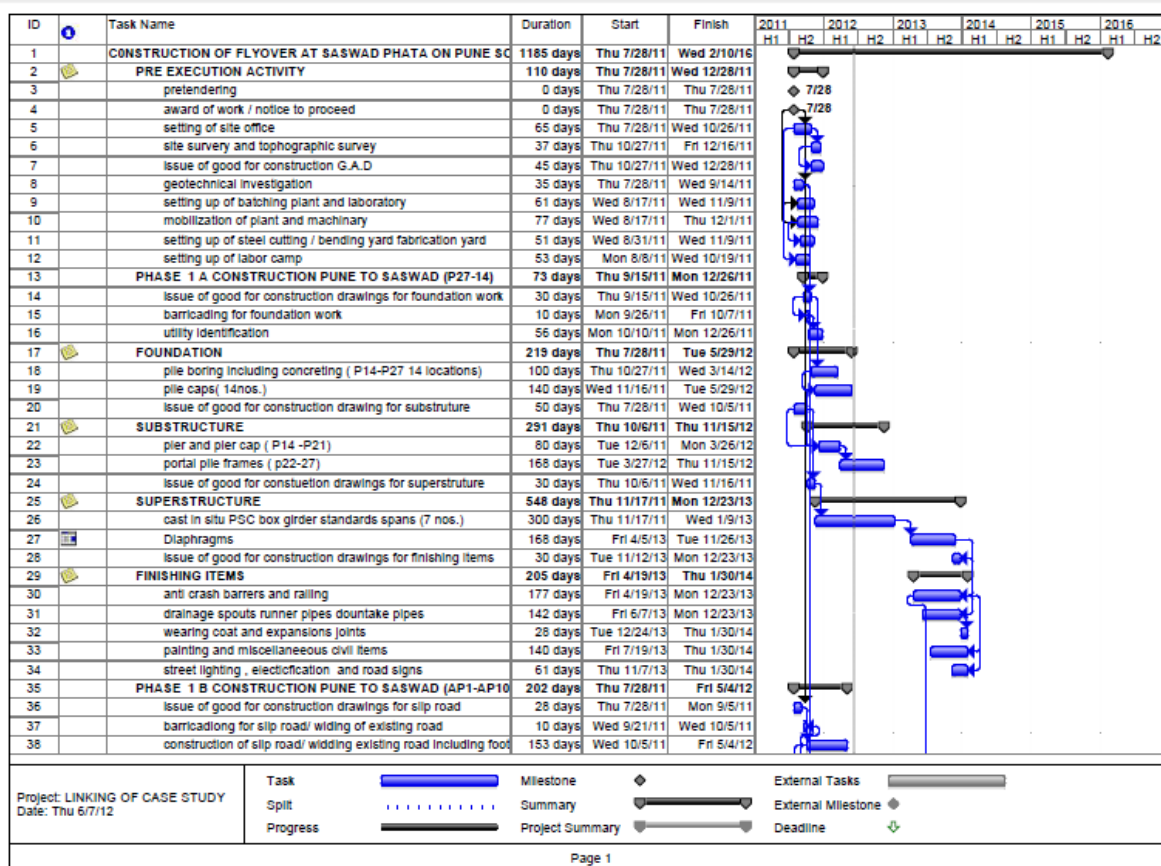


Figure 5: Crashed Schedule of the Bridge Project

**Earned Value Analysis For A Construction Project, Anuj Dubey, Journal Impact Factor (2015): 9.1215
(Calculated by GIS) www.jifactor.com**



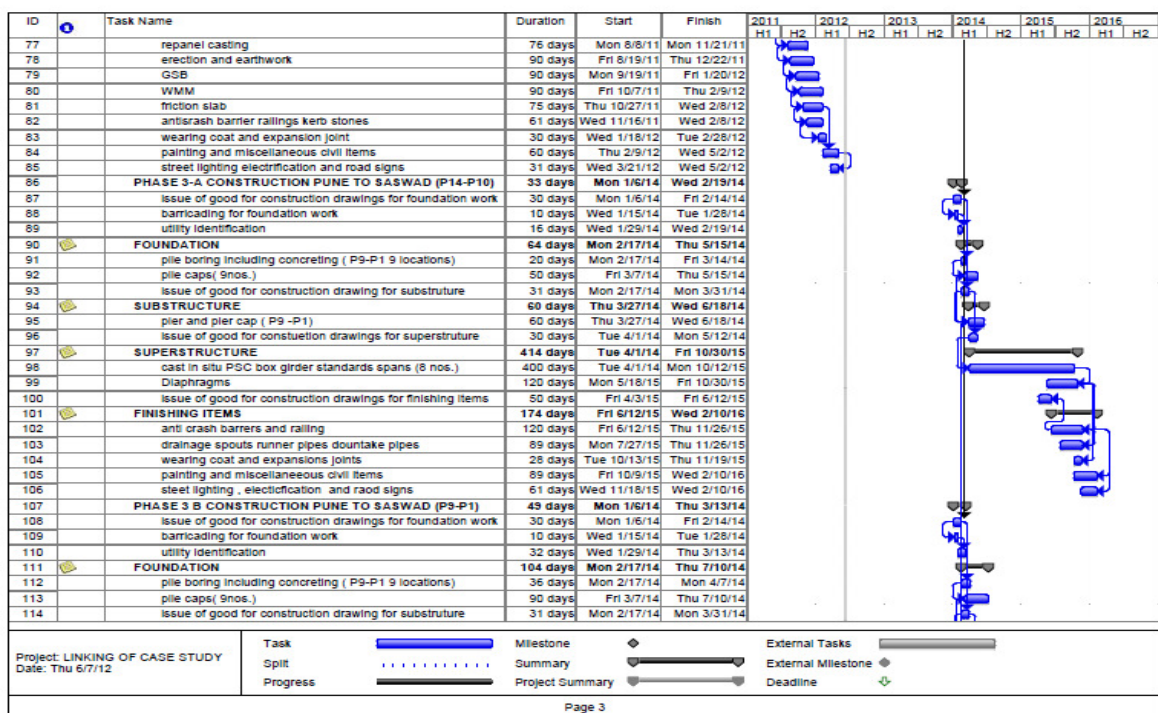
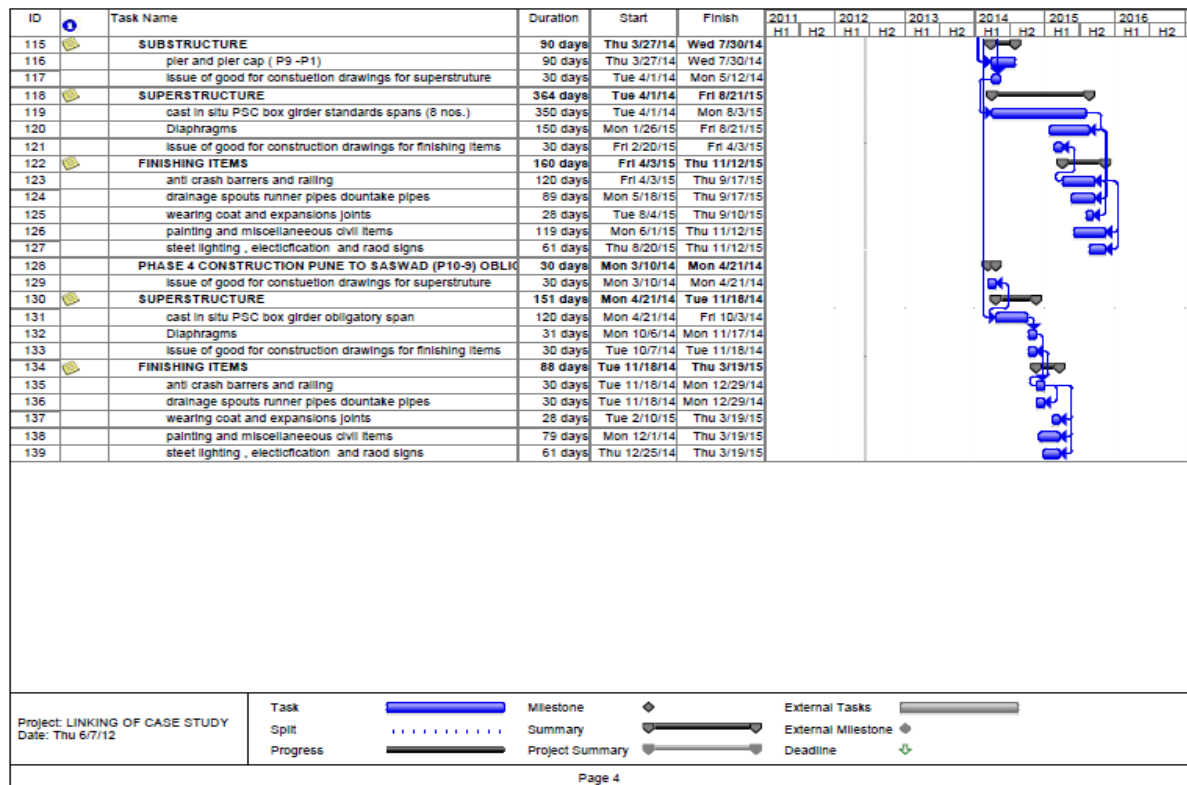


Figure 6: Smoothened schedule of the Bridge Project

CONCLUSION

Three different durations are obtained with varying costs, hence a solution can be obtained in between these three values by experience of the project manager. Suitable action needs to be taken in case of cost over-run and time over-run. An optimal solution must be obtained between the full crash solution and the smoothened solution. The full crash duration is the most expensive but has the least duration while the smoothened duration has the least cost but increased duration. Hence the earned value analysis could be used to analyse what action needs to be taken by the project manager to get an optimal solution.

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