WINDOW ANALYSIS FOR PROJECT DELAY ANALYSIS AND CLAIM MANAGEMENT

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Abstract

Claims or counter claims are unavoidable in every civil building/infrastructure contract. The claims may be for extension of time or for monetary compensation and it is due to delay either from employer or employees rights and or obligation. To capture the claims it is required to superimpose the updated project progress over the planned schedule. The five kilometre long stretch out of one hundred kilometre long Agra Etawah six laning project has been considered for study, from this five kilometre long stretch window of all the layers of the highway activities such as earthwork, clearing and grubbing, embankment, sub grade, granular sub base (GSB), wet mix macadam (WMM), dense bituminous macadam (DBM) and lastly the bituminous concrete (BC). But, in this case subgrade work and DBM works considered to demonstrate the claim calculation. Claimable cumulative amount from both window is worked out to be Rs. 53,36,304.30/- (i.e. window 1: sub grade work is Rs. 23,07,616.50/- and window 2:dense bituminous macadam work is Rs.30,28,687.80/-).

Keywords: Project, Schedule, Claim, Delay, Window Analysis

1. INTRODUCTION

Claims or counter claims are inevitable in every contract, due to incomplete drawings, specification, change in the scope of work, site differing condition, revision in the drawings etc,. The claims or counter claim shall be for extension of time or for monetary compensation and maybe it is due to delay either from employer or employees rights and or obligation. The master schedule shall be constructed prior to commencing the project execution and the project progress shall be superimposed over the master schedule to capture the status of project progress, but progress of the project must not be visualized based on bills. It has been observed across the globe that nearly 80 to 95 percent projects are of time over run or of cost over run, which leads to cost burden on the head of project owner. The project progress shall be monitored with respect of time and cost to adhere to the schedule and budgeted amount.

2. SCOPE

The scope of this study is to source the master schedule, project progress and to analyse (i.e. as schedule vs. as progress) the activity and task wise schedule and to assess number days delay in completion of the work.

3. Objectives

The objectives this study is:

3.1 To select the window from master schedule,

3.2 To work out the variances between planned schedule vs. as progress schedule,

3.3 To work out the claim cost to be payable.

4. Literature review

Abdulaziz A et al., [1] in their article titled "Comparison of Delay Analysis Methodologies", it is concluded that "it is not possible predict the outcome of a delay analysis and there is no universally acceptable method, it depends on circumstances".

Khalid S. Al-Gahtani and Satish B Mohan [3] in their article titled "Delay Analysis Techniques Comparison" it is concluded that the technique may vary based on the circumstance hence technique shall be engage day-by-day requirements and at the same some technique/s may not suitable for the same.

Chih-Kuei Kao, Jyh-Bin Yang, [2] in their article titled "Comparison of windows-based delay analysis methods"it is concluded that the window based delay analysis method is preferred than any other method.

5. Construction Project

Mirza, M. A4 has defined project phases as in Table 1 and major stake holder as in Table 2

Table 1 The construction project generally has four well-recognized phases;

a) Ph-1 Pre-tender	Initial concept, design of contract-documentation
	Pre-tender meetings and up to invitation of tenders
b) Ph-2 Contract Formulation	Preparation and submission of tenders, tender
	Assessments, pre-contract negotiations and contract formulation
c) Ph-3 Construction	During construction up to substantial completion
d) Ph-4 Post completion	Settlement of outstanding issues after substantial completion & finalization of accounts

Table 2. Major stake holders of a project

Stake holder	cost	Schedule	Quality/Performance	Contribution to organiztion
Client	Meet or beat	Meet or beat	Meet or beat	High
Project Manger	Target	Target	Meet or Exceed Specifications	High
Contractors/Sub contractors	Not mind more m	wants more time	Meet or beat	NA/want positive visibility
External	Indifferent	Indifferent	High	Org-NA Society -High
Project Team	Want flexibility	Want more time to avoid pressures	Meet or beat	High
Top Management	Beat	Beat	Meet or beat	High
Other Internal Stake holders	Want flexibility	wants more time	Want flexibility	High
adopted from: Jeffrey K.Pinto 1994 Successful/Information System Implementation: The Human Side. Upper Darby				

6. Claim management:

It shall be defined as bill raised against work executed at the order issued by the employer or employer's representative/s. The reasons for claims is as follows:

6.1. Work environment between client, contractor and sub-contractor/s

6.2. In adequate planning of a project

6.3. Frequent changing of the orders and plans.

The logical claim management process has been depicted in Table 3

7. **Case** :

The study area has been considered for a stretch of 5km out of 124.48 km

7.1. The details of contract is as follows:

7.1.1. Owner: M/s. PQR

7.1.2. Principal Contractor: M/s.ABC Developers Ltd.

7.1.3. Sub Contractor: M/s.XYZ Pvt. Ltd

7.1.4. Contract Type: EPC Contract

7.1.5. Project Total Highway Length:124.485 Kms

7.1.6.Total Project Cost: 1510 Crores (Approx)

7.1.7. Total Project Duration: 910 Days

7.2 Work Break down Structure (W.B.S) of a Case: The W.B.S is depicted in Fig.1, Fig.2, Fig.3

7.3. Reasons for the delay in work completion as per planned schedule is as follows: The case has been analyzed by considering two windows, Window 1 (i.e. sub grade) and Window 2 (i.e. Dense bitumen macadam)

7.3.1 Window 1: Gantt chart of sub grade

Reason 1: In some stretch, heavy water logging was found which was not well defined in Contract Document thus involving use of water pumps. (4 days)

Reason 2: Mud Pumping in Sub grade soil thus more stabilization of soil was required. (8 days)

7.3.2 Window 2: Gantt chart of Dense Bituminous Macadam

Reason 1: Design changed by the PMC (Project Management Consultancy) (6 days)

Reason 2: The unseasonal rain/s. (2 days)

7.4. As per the conditions of contract, contractor is entitled for time and cost overrun for above mentioned reasons.

7.5. Claim cost calculation: The claim has been calculated for window 1 in Table 4

7.6. Claim cost calculation: The claim has been calculated for window 2 in Table 5

8. Conclusion:

From the above case analysis it is clear that "As per the terms and conditions contractor is entitled for an amount Rs. 53,36,304.30". Window analysis technique is preferred compared to any other technique.

Table 3: Logical Processes for Claim Management at Different Phases of Project

Claim Prevention	**Claim Mitigation**	**Claim Identification**	**Claim Quantification**	**Claim Resolution**
Phase 1 (Pre-tender)	Phase 2 (Contract Formulation) & Phase 3 (Construction)	Phase 3 (Construction) & Phase 4 (Post completion)		Phase 3 (Construction) & Phase 4 (Post completion)
Inputs	Inputs	Inputs	Inputs	Inputs
Scope Assessment	The project plan	Contract scope	Statement of claim	Statement of claim
Required Distribution of Information	Contract terms	Contract terms	Other Work Affected by claimed activity	Claim quantification
Management Scheme of Project	Risk management plan	Extra work description	Return on Resources	Contract
Requirement of risk sharing scheme	Handling of Dispute	Description of extra time requested	Opportunity Lost.	Correspondence
Time frame for project completion	Decision Making Process	Hold-ups and Delays	Loss of Profit	NIL
Dependency.	Information need	NIL	NIL	NIL
Conflicts of Interests	NIL	NIL	NIL	NIL
Strength & Weakness of Employer	NIL	NIL	NIL	NIL
Tools and Techniques	Tools and Techniques	Tools and Techniques	Tools and Techniques	Tools and Techniques
Methodology for Economic Exchange	Clarity of Language	Contract terms	Quantity measurement	Negotiation
Identification & Assessments of Project Scope	Schedule	Expert Judgments	Cost estimation	Alternate Disputes Resolution (ADR)
Information Sharing	Constructability Review	Documentation	Contract law precedents	Litigation
Template	Request for information (RFI) procedure	NIL	Schedule analysis	Cost Estimated for resolution
Expert Judgment	Partnering	NIL	Business History of Party	NIL
Alignment of Documents	Effective Communication	NIL	NIL	NIL
Dispute Resolution	Prequalification Process.	NIL	NIL	NIL
Partnering Approach	Dispute Review Board (DRB).	NIL	NIL	NIL
Monitoring & Control.	Joint Recognition of Changes.	NIL	NIL	NIL
Education & Training	Documentation	NIL	NIL	NIL
Desired outcomes	Desired outcomes	Desired outcomes	Desired outcomes	Desired outcomes
Project Scope	Changes	Statement of claim	Direct and indirect costs	Claim resolved
Contract	Dispute or No claims	Documentation	Time extension	Contract closed
Contract Documents	Enhanced Business Relations	NIL	Documentation.	NIL
Dispute Resolution Methodology	Project Goals	NIL	Opportunity Loss	NIL
Trust Building & Training Plan.	NIL	NIL	NIL	NIL

Table 4: Direct and Indirect cost calculation for Window 1

Costing							
A	**Machinery Cost**						
S.No	**Machines**	**No's**	**Cost Per hour (INR)**	**No of working hours per day**	**No of Trips**	**Total Cost per day (INR)**	**Remarks**
1	Excavator	3	1700	10		51000	EX-200
2	Dumpers	6	1050	8		50400	10 tyre
3	Grader	1	3600	8		28800	
4	Vibrator Roller	1	1120	8		8960	8 Tonnes
5	Water tank	2	980		10	19600	8000 litres capacity
6	Dewatering Pump	1	850	10		8500	10 HP
Total Cost per day (A)						**167260**	
B	**Manpower Cost**						
S.No	**Labour**		**No's**	**Wages per day (INR)**		**Total Cost per day (INR)**	**Remarks**
	Unskilled	25	465			11625	
1	**Total Cost per day (B)**					**11625**	
C	**Direct Cost (A+B)**					178885	
D	Indirect Cost (D =7.5% of C)					**13416.4**	
E	**Total Cost per day (E)**					**192301**	

Cost per 12 days will be equal to Rs. 1,92,301/- per day * 12 days = Rs.23,07,616.50

Table 5: Direct and Indirect cost calculation for Window 2

Costing							
A	**Machinery Cost**						
S.No	**Machines**	**No's**	**Cost Per hour**	**No of working hours per day**	**No of Trips**	**Total Cost per day (INR)**	**Remarks**
1	Dumpers	5	1050	8		42000	10 tyre
2	Paver	1	2222	8		17776	
3	Double drum Roller	1	1436	8		11488	8 Tonnes
4	Tandem Roller	1	1843	8		14744	
5	Water tank	2	980		4	7840	8000 liters capacity
6	Bituminous MIX Plant	1	27000	8		216000	100 TPH
7	Loader	1	5000	8		40000	3 Tonnes
Total Cost per day (A)						**349848**	
B	**Manpower Cost**						
S.No	**Labour**	**No's**	**Wages per Day (INR)**			**Total Cost per Day (INR)**	**Remarks**
1	Unskilled	5	465			2325	
2	Skilled	15	520			7800	
Total Cost per day (B)						**2325**	
C	**Direct cost C = A+ B**					**352173**	
D	**Indirect cost**						
	Indirect cost (D) = 7.5% * C					26413	
E	**Total Net Claimable Cost per day (E=C+D)**					378586	

Cost per 8 days will be equal to Rs. 3,78,586/- per day * 8 days = Rs.30,28,687.80

The total amount payable to contractor is equal direct and indirect cost of both window/s Rs.23,07,616.50 + Rs.30,28,687.80 = Rs. 53,36,304.30

	WBS	ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Successors
1	**1**	**1**		**Construction of Agra Etawah 6 Lane Highway**	**259 days**	**Tue 16-08-16**	**Wed 14-06-17**		
2	**1.1**	**2**		**Clearing and Grubbing**	**50 days**	**Tue 16-08-16**	**Wed 12-10-16**		
3	1.1.1	3		Loading and unloading of Flexible payment	25 days	Tue 16-08-16	Tue 13-09-16		4
4	1.1.2	4		Land clearing	25 days	Wed 14-09-16	Wed 12-10-16	3	5SS+4 days,7SS+1 day
5	1.1.3	5		Levelling	15 days	Mon 19-09-16	Wed 05-10-16	4SS+4 days	
6	**1,2**	**6**		**Earthwork Excavation**	**33 days**	**Thu 15-09-16**	**Sat 22-10-16**		
7	1.2.1	7		Disposed of dressed material	30 days	Thu 15-09-16	Wed 19-10-16	4SS+1 day	8
8	1.2.2	8		Soil testing	3 days	Thu 20-10-16	Sat 22-10-16	7	10
9	**1.3**	**9**		**Embankment**	**38 days**	**Mon 24-10-16**	**Tue 06-12-16**		
10	1.3.1	10		Laying 1 st layer of dredged mate	23 days	Mon 24-10-16	Fri 18-11-16	8	11,13FS-5 days
11	1.3.2	11		Compaction by Vibro roller	3 days	Sat 19-11-16	Tue 22-11-16	10	12SS
12	1.3.3	12		Water Sprinkling	3 days	Sat 19-11-16	Tue 22-11-16	11SS	
13	1.3.4	13		Laying Top layer 150 mm	20 days	Mon 14-11-16	Tue 06-12-16	10FS-5 days	14SS
14	1.3.5	14		Water Sprinkling	4 days	Mon 14-11-16	Thu 17-11-16	13SS	15
15	1.3.6	15		Compaction and clearing	3 days	Fri 18-11-16	Mon 21-11-16	14	16FF
16	1.3.7	16		Dressing the camber	7 days	Mon 14-11-16	Mon 21-11-16	15FF	18

Fig.1. Work Break down Structure of a considered case

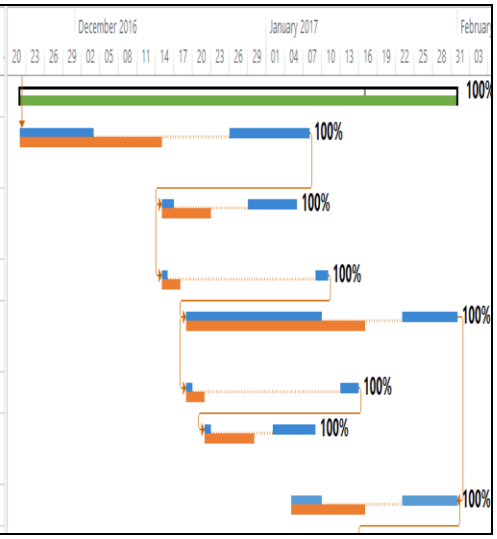
	WBS	ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Successors
17	**1.4**	**17**		**Sub grade**	**48 days**	**Tue 22-11-16**	**Mon 16-01-17**		
18	1.4.1	18		Laying 1 st layer of 250 mm	20 days	Tue 22-11-16	Wed 14-12-16	16	19
19	1.4.2	19		Compaction by Vibro roller	7 days	Thu 15-12-16	Thu 22-12-16	18	20SS
20	1.4.3	20		Water Sprinkling	3 days	Thu 15-12-16	Sat 17-12-16	19SS	21
21	1.4.4	21		Laying Top layer 250 mm	25 days	Mon 19-12-16	Mon 16-01-17	20	22SS,24FF
22	1.4.5	22		Water Sprinkling	3 days	Mon 19-12-16	Wed 21-12-16	21SS	23
23	1.4.6	23		Compaction and clearing	7 days	Thu 22-12-16	Thu 29-12-16	22	
24	1.4.7	24		Dressing the camber	10 days	Thu 05-01-17	Mon 16-01-17	21FF	26
25	**1.5**	**25**		**Granular sub base**	**40 days**	**Tue 17-01-17**	**Sat 04-03-17**		
26	1.5.1	26		Laying 100 mm of first layer	25 days	Tue 17-01-17	Wed 15-02-17	24	27SS+5 days,29SS+10 day
27	1.5.2	27		Manual dressing and Water sprinl	10 days	Mon 23-01-17	Fri 03-02-17	26SS+5 days	28SS-2 days
28	1.5.3	28		Compaction of 1 st layer	10 days	Fri 20-01-17	Wed 01-02-17	27SS-2 days	
29	1.5.4	29		Laying 100 mm of 2nd layer	30 days	Mon 30-01-17	Sat 04-03-17	26SS+10 days	30SS-2 days
30	1.5.5	30		Manual dressing and Water sprinl	7 days	Fri 27-01-17	Fri 03-02-17	29SS-2 days	31
31	1.5.6	31		Compaction of 2 nd layer	9 days	Sat 04-02-17	Tue 14-02-17	30	32,33SS+5 days
32	1.5.7	32		Laying soling coat	7 days	Wed 15-02-17	Wed 22-02-17	31	
33	1.5.8	33		Compaction after water spinkling	10 days	Fri 10-02-17	Tue 21-02-17	31SS+5 days	35

Fig.2. Work Break down Structure of a considered case

	WBS	ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Successors
34	**1.6**	**34**		**Wet Mix Macadam**	**48 days**	**Wed 22-02-17**	**Tue 18-04-17**		
35	1.6.1	35		Laying coarse aggregate (layer 250 mm)	20 days	Wed 22-02-17	Thu 16-03-17	33	36,37FS+5 days
36	1.6.2	36		Manual dressing and Water sprinl	7 days	Fri 17-03-17	Fri 24-03-17	35	
37	1.6.3	37		Compaction by vibro power roller	3 days	Thu 23-03-17	Sat 25-03-17	35FS+5 days	38
38	1.6.4	38		Laying fine aggregate	10 days	Mon 27-03-17	Thu 06-04-17	37	39,40FS+2 days
39	1.6.5	39		Water Sprinkling	3 days	Fri 07-04-17	Mon 10-04-17	38	
40	1.6.6	40		Compaction	5 days	Mon 10-04-17	Fri 14-04-17	38FS+2 days	41
41	1.6.7	41		Applying of Prime Coat	3 days	Sat 15-04-17	Tue 18-04-17	40	43
42	**1.7**	**42**		**Dense Bituminous Macadam**	**25 days**	**Wed 19-04-17**	**Wed 17-05-17**		
43	1.7.1	43		Compaction	5 days	Wed 19-04-17	Mon 24-04-17	41	44FS+5 days
44	1.7.2	44		applying of tack coat	3 days	Mon 01-05-17	Wed 03-05-17	43FS+5 days	45
45	1.7.3	45		Laying top layer of 90 mm	10 days	Thu 04-05-17	Mon 15-05-17	44	46
46	1.7.4	46		Compaction	2 days	Tue 16-05-17	Wed 17-05-17	45	48FS+1 day
47	**1.8**	**47**		**Bituminous Concrete**	**7 days**	**Fri 19-05-17**	**Fri 26-05-17**		
48	1.8.1	48		Apply seal coat	2 days	Fri 19-05-17	Sat 20-05-17	46FS+1 day	49
49	1.8.2	49		Compaction by power roller	3 days	Mon 22-05-17	Wed 24-05-17	48	50SS+1 day
50	1.8.3	50		Laying Mix	4 days	Tue 23-05-17	Fri 26-05-17	49SS+1 day	52
51	**1.9**	**51**		**Miscellanous works**	**16 days**	**Sat 27-05-17**	**Wed 14-06-17**		
52	1.9.1	52		Road marking and shoulder marki	10 days	Sat 27-05-17	Wed 07-06-17	50	53SS+1 day,54SS
53	1.9.2	53		Sign board and caution signs fixin	15 days	Mon 29-05-17	Wed 14-06-17	52SS+1 day	
54	1.9.3	54		Street light fixing	15 days	Sat 27-05-17	Tue 13-06-17	52SS	

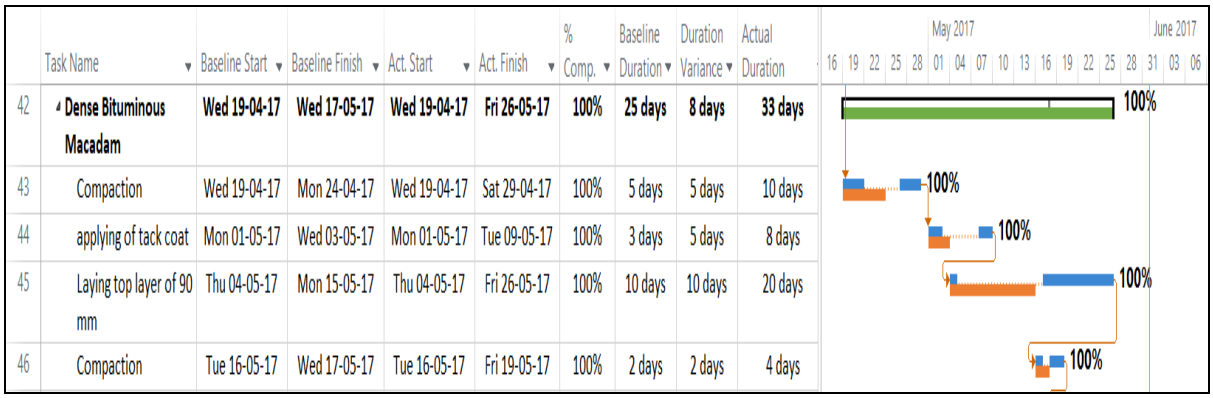
Fig.3. Work Break down Structure of a considered case

	Task Name	Baseline Start	Baseline Finish	Act. Start	Act. Finish	% Comp.	Baseline Duration	Duration Variance	Actual Duration
17	**Sub grade**	**Tue 22-11-16**	**Mon 16-01-17**	**Tue 22-11-16**	**Tue 31-01-17**	**100%**	**48 days**	**12 days**	**60 days**
18	Laying 1 st layer of 250 mm	Tue 22-11-16	Wed 14-12-16	Tue 22-11-16	Sat 07-01-17	100%	20 days	21 days	41 days
19	Compaction by Vibro roller	Thu 15-12-16	Thu 22-12-16	Thu 15-12-16	Thu 05-01-17	100%	7 days	12 days	19 days
20	Water Sprinkling	Thu 15-12-16	Sat 17-12-16	Thu 15-12-16	Tue 10-01-17	100%	3 days	20 days	23 days
21	Laying Top layer 250 mm	Mon 19-12-16	Mon 16-01-17	Mon 19-12-16	Tue 31-01-17	100%	25 days	12 days	37 days
22	Water Sprinkling	Mon 19-12-16	Wed 21-12-16	Mon 19-12-16	Sun 15-01-17	100%	3 days	21 days	24 days
23	Compaction and clearing	Thu 22-12-16	Thu 29-12-16	Thu 22-12-16	Sun 08-01-17	100%	7 days	8 days	15 days
24	Dressing the camber	Thu 05-01-17	Mon 16-01-17	Thu 05-01-17	Tue 31-01-17	100%	10 days	12 days	22 days



Window 1: Gantt chart of sub grade

Legend: As planned; As progress



	Task Name	Baseline Start	Baseline Finish	Act. Start	Act. Finish	% Comp.	Baseline Duration	Duration Variance	Actual Duration
42	**Dense Bituminous Macadam**	**Wed 19-04-17**	**Wed 17-05-17**	**Wed 19-04-17**	**Fri 26-05-17**	**100%**	**25 days**	**8 days**	**33 days**
43	Compaction	Wed 19-04-17	Mon 24-04-17	Wed 19-04-17	Sat 29-04-17	100%	5 days	5 days	10 days
44	applying of tack coat	Mon 01-05-17	Wed 03-05-17	Mon 01-05-17	Tue 09-05-17	100%	3 days	5 days	8 days
45	Laying top layer of 90 mm	Thu 04-05-17	Mon 15-05-17	Thu 04-05-17	Fri 26-05-17	100%	10 days	10 days	20 days
46	Compaction	Tue 16-05-17	Wed 17-05-17	Tue 16-05-17	Fri 19-05-17	100%	2 days	2 days	4 days

Window 2: Gantt chart of Dense Bituminous Macadam

Legend: As planned; As progress

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