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Study and Rate Analysis of Escalation in Construction industry

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Abstract: *The project is said to be successful when it is completed in desired time and cost. The construction delays are common problems in private residential projects in Chennai city. This problem occurs frequently during life time leading to dispute and litigations. Therefore it is essential to study and analyse .causes of construction delay. The construction industry is large, volatile and requires tremendous capital outlays. Delay of the project is a main factor and major cause of construction claims. There is an acute necessity for a detailed investigation to identify the delay factors and choose correct actions to minimize the adverse effect of delay on time, within cost and for high quality output*

I. General

The construction industry has a major role in the development of the Indian economy. This industry consumes 40 to 50% of the national five year plan outlay and contributes 20% of gross domestic product. Medium to large construction projects take over a year for completion and the cost of materials and labour often increase, which leads to major problems in administration of the contract.

Over the past few years the construction industry has been facing several problems due to rapid increase in the price of construction materials, labour, interest charges and equipment cost. Rate escalation is defined as changes in the cost or price of specific goods or services in a given economy over a period. This is a similar to the concepts of inflation and deflation except that escalation is specific to an item or class of items, it is often not primarily driven by changes in the money supply, and it tends to be less sustained.

While escalation includes general inflation related to the money supply, it is also driven by changes in technology, practices, and particularly supply and demand imbalances that are specific to a good or service in a given economy. For example, while general inflation in the US was less than 5% in the 2003-2007 time period, steel prices increased by over 50% because of supply-demand imbalance. Cost escalation may contribute to a project cost overrun. In particular, this increase has been a major problem to the construction industry. In order to find out the percentage increase in cost of construction, a study and analysis has been done in this project

Problems And Issues Due To Rate Escalation

Price escalations have been affecting the construction industry during the last year causing many problems and many developers to rethink projects. Price escalation produces delays in construction projects, reduced scope projects or projects being cancelled. Escalation clauses could also impact public projects adversely due to the fact that prices being submitted are not being guaranteed during long period of time. In the past, general contractors were able to hold subcontractors and suppliers to their quotes for 60 days, 90 days or 120 days. Because of escalation fears, owners are finding fewer bidders for their projects, some projects need to find alternatives funding sources or canceling the project if additional money is not available. Contractor and supplier fears regarding potential, future price escalation, and the absence of price escalation clauses in most construction contracts, often leads to higher contract prices and larger project costs.

1.3 SCOPE

Construction includes building and civil engineering projects including work by contractors, by individual, by public sector direct labor or own account organizations and by construction units in commercial or industrial organizations that are recorded to other industries.

The definition of construction output may include professional services such as designers, planners, managers etc and it may include some but not necessarily all informal construction activity.

1.4 OBJECTIVE

- The objective of the proposed work is to compare the cost of construction such as building materials, labours and equipments for past six years from the year 2008 to 2013.
- To find out various parameters that influences increase in the cost of construction.

- To forecast the percentage increase in cost of construction for the next three years 2014, 2015 and 2016.
- To create a model that guides planners for quoting long term projects.
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II. Scheme Of Work

Below given fig 2.1 represents the scheme of work followed in the project.

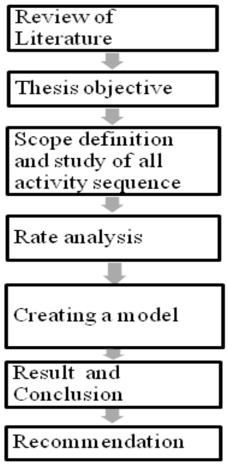


Fig 2.1 Methodology

Construction can be subdivided into new work and work to existing buildings and the latter can be subdivided into refurbishment and improvement and repair and maintenance

2.2 Methods Of Forecasting Factor

Construction cost indices have been used to measure the cost trends in the construction industry. Estimating the increase in price over the long term is almost impossible because of the many uncertainties beyond the control of all parties. The same is true of long term construction projects with multiyear schedules and start dates in the future. Despite this difficulty, the owners of large long-term projects need to come up with the estimated cost of these projects. The more prudent way to approach these problems is to calculate a range of possible costs rather than a single figure. Forecasting methods for escalation factors can be grouped into two major categories:

The last condition implies that some of the past pattern will continue into the future. This is an underlying premise of all the quantitative and many qualitative forecasting methods. Quantitative methods can be divided into two major categories: statistical and causal methods. Statistical methods utilize time-series analysis and curve fitting methods to forecast the variable in the future.

n the other hand, causal methods are developed assuming that the variable to be forecasted presents an explanatory or causal relationship with one or more independent variables.

2.2.1.1 Simple average and exponential smoothing

Examples of statistical methods consist of simple average and exponential smoothing. The method of simple average is basically to take average of all observed data as the forecast. The simple average is suitable for data that fluctuate around a constant or have a slowly changing level and do not have a trend or seasonal effects. The fundamental principle of the exponential smoothing is that the values of the variable in the latest periods have more impact on the forecast and therefore should be given more weight. This method implies that as historical data get older, their weight will decrease exponentially. Usually, it is a poor model for medium or long term forecast. Forecasts can be thrown into great error because of large random fluctuation in recent periods.

2.2.1.2 Box–jenkins approach

Other more complicated statistical forecasting methods are sometimes used also, but rarely in construction. For example, methods based on auto regressive integrated moving average ARIMA models are available; however their use has been limited. The time series analysis, forecasting, and control with the ARIMA model have come to be known as Box–Jenkins methodology. Despite Box–Jenkins promising results and power, forecasters and decision makers seldom use this method because it is complicated. It is best suited to short-term forecast, such as daily, weekly, or monthly and it require a large amount of data.

2.2.1.3 Reregression

Regression methods are any modeling of a forecast variable Y as a function of a set of explanatory variables X1–Xk. The regression method's accuracy depends upon a consistent relationship with the independent variables. In regression methods, an accurate estimate of the independent variables is crucial. Multiple regression methods very often require a large amount of data.

2.2.1.4 Neural networks

Neural networks are part of the causal or explanatory methods. Neural networks are fundamentally based on simple mathematical models of the way the human brain is believed to work. They are distinguished for providing a nonlinear forecasting method when they are applied to time series. The use of neural networks for modeling cost escalation in construction has been limited. Hanna and Chao presented a neural network model as an alternative approach to forecast cost escalation in construction.

2.2.2 Qualitative methods

Qualitative forecasting methods, in contrast with quantitative methods, do not require data in the same way. The inputs required depend on the specific method and are in essence the product of judgment and accumulated knowledge. They can be used separately but are more often used in conjunction with quantitative methods. Qualitative methods are also called subjective methods Blair and judgmental methods.

2.2.2.1 Surveys

Surveys of expectation are one method of forecasting escalation. Surveys have proved to be less expensive, very accessible, and perform as well as many economic models. Several surveys of expected escalation are available today. Two of the most easily accessible and longest-standing surveys are the Livingston survey of professional economists and the Michigan survey of households. These are not aimed at construction costs but the methodology can be tailored for construction industry. One can conduct a survey of expectation of construction professionals to forecast escalation in this industry. Because the survey information is virtually costless, a cost benefit analysis suggests that many firms might agree to use surveys to assess the future cost of escalation.

2.3 Steps Involved In Methodology

The above said methodology is to study, analyze and compare the rate of construction materials cost, labour cost, equipment cost for past six years. The detailed methodology can be explained as follows:

Step1: Study of literature is available in the form of books, journals to get proper understanding of the issue.
Step2: List out various books required for reference and related topic, collect literatures and carry out desk research.
Step3: Making a list of companies and hardware shops to approach.
Step4: Collection of bill of quantity for residential apartment from a construction company.
Step5: Validation of bill of quantity
Step6: Collected labour rates, material rate and equipment rate from a construction company and hardware's for entire structure.
Step7: Rate analysis is done
Step8: Preparation of bill of quantity with rates obtained.
Step9: Comparison of bill of quantity for past six years from 2008 to 2013.
Step10: Forecasting is done for next three years 2014, 2015 and 2016 using Microsoft excel.
Step11: Results, discussion and conclusion.

III. Data Collection

3.1 General

Data Collection is an important aspect of any type of research study. Inaccurate data collection can impact the results of a study and ultimately lead to invalid results. Data are primarily collected to provide information regarding a specific topic. At the one end of this continuum are quantitative methods and at the other end of the continuum are qualitative methods for data collection.

3.2 Impact Of Inflation On Construction

Due to increase in the cost of fuel, transportation, electricity, lending rate for various small scale industrial sectors, power cuts, and value added taxes and service taxes the overall cost of Construction has escalated, which has been studied in detail hereafter.

3.3 FACTORS INFLUENCING MARKET PRICE

The various important factors which influences increase in the cost of Construction materials in Tamil Nadu are,

- Increase in transportation charges
- Increase in electricity charges
- Increase in labour cost charges
- Increase in equipment charges
- Increase in material charges
- Increase in Lending rate for various SSI sector.
- Power cuts
- Increase in VAT and Service taxes
- Increase in demand for residential building

3.4 Materials And Products

These are basic inputs and include simple materials such as cement, sand, and reinforcement steel as well as manufactured products such as concrete, fired clay products and plywood. This category may also include composite products such as window units comprising frames, glazing and fittings such as hinges and locks and products like these include not only basic material inputs but other manufactured products and the labor involved in assembling them.

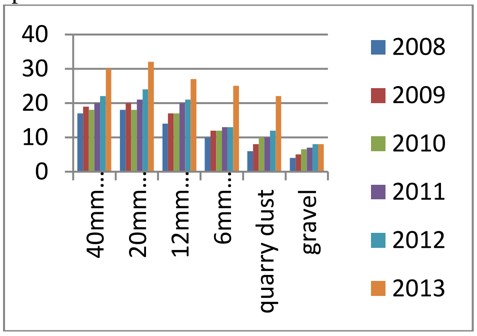
A particular problem area in international comparisons is materials, products and assemblies for mechanical including, lifts and heating, ventilating and air conditioning installations and electrical and other power and utility installations. In developed countries, mechanical and electrical installations can represent one third or more of the total cost of construction, particularly building, projects so they cannot be ignored. The Bar chart and tabular column of comparison of bulk construction materials and comparison of composite construction materials is represented.

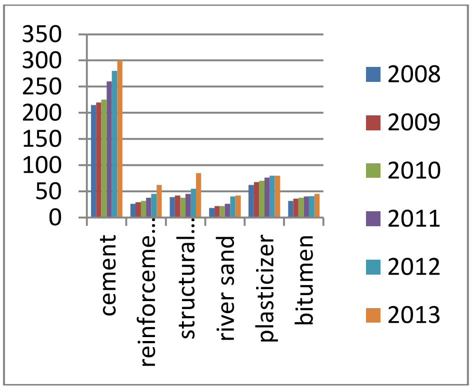
3.5 Bulk Construction Materials

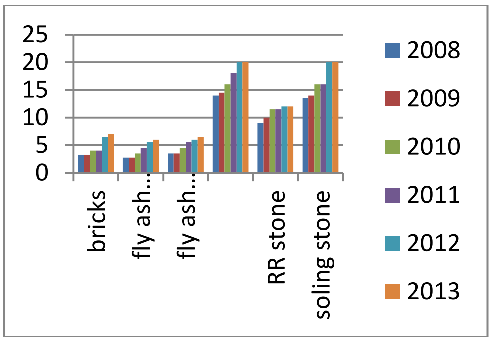
Table 3.1 Comparison tabular column of Bulk construction material

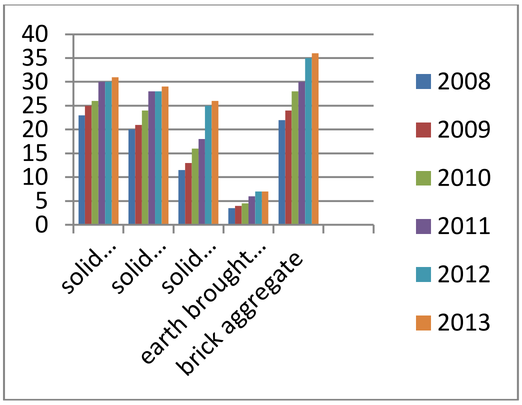
Item no	**Item description**	**Unit**	**Basic rate**					
			2008	**2009**	**2010**	**2011**	**2012**	**2013**
1	Cement	Bag	215.00	220.00	225.00	260.00	280.00	300.00
2	Reinforcement steel	Kg	26.00	29.00	32.00	38.00	45.00	62.00
3	Structural steel	Kg	39.00	42.00	38.00	45.00	55.00	85.00
4	River Sand	Cft	18.00	22.00	22.00	26.00	40.00	42.00
5	40mm aggregate	Cft	17.00	19.00	18.00	20.00	22.00	30.00
6	20mm aggregate	Cft	18.00	20.00	18.00	21.00	24.00	32.00
7	12mm aggregate	Cft	14.00	17.00	17.00	20.00	21.00	27.00
8	6mm aggregate	Cft	10.00	12.00	12.00	13.00	13.00	25.00
9	Quarry Dust	Cft	6.00	8.00	10.00	10.00	12.00	22.00
10	Bricks	No	3.25	3.25	4.00	4.00	6.50	7.00
11	Fly ash bricks 9"x4"x3"	No	2.75	2.75	3.50	4.50	5.50	6.00
12	Fly ash bricks 9"x4"x4"	No	3.50	3.50	4.50	5.00	6.00	6.50
13	Fly ash bricks 9"x9"x4"	No	14.00	14.50	16.00	18.00	20.00	20.00
14	RR Stone	No	9.00	10.00	11.50	11.50	12.00	12.00
15	Soling Stone	Cft	13.50	14.00	16.00	16.00	20.00	20.00
16	Solid Block, 200mm thick	No	23.00	25.00	26.00	30.00	30.00	31.00
17	Solid Block, 150mm thick	No	20.00	21.00	24.00	28.00	28.00	29.00
18	Solid Block, 100mm thick	No	11.50	13.00	16.00	18.00	25.00	26.00
19	Earth brought from Outside	Cft	3.50	4.00	4.50	6.00	7.00	7.00
20	Gravel	Cft	4.00	5.00	6.50	7.00	8.00	8.00
21	Brick aggregate	Cft	22.00	24.00	28.00	30.00	35.00	36.00
22	Plasticizer	Kg	62.00	68.00	70.00	76.00	80.00	80.00
23	Bitumen 80/100	Kg	32.00	36.00	38.00	40.00	41.00	45.00

Graph 3.1 hike in bulk construction materials cost









Graph 3.2 hike in bulk construction materials cost

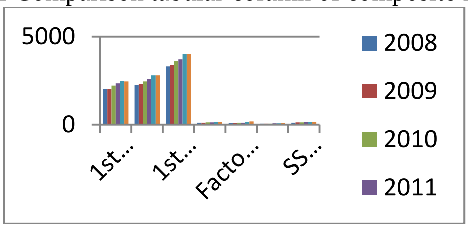
The increase in bulk construction material cost has escalated by 84% during the period 2008-2013 is represented in graph 3.1 and 3.2.

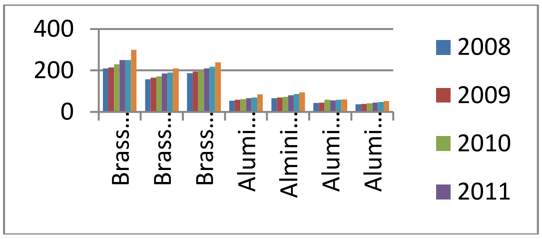
3.6 Composite Materials

Table 3.2 Comparison tabular column of composite materials

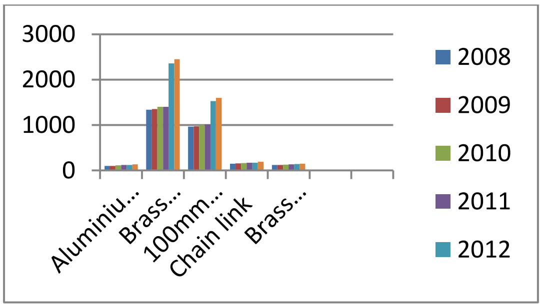
JOINERY WORK								
Item no	**Item description**	**Unit**	**Basic rate**					
			2008	**2009**	**2010**	**2011**	**2012**	**2013**
1	1st class Padauk wood	Cft	2020	2040	2210	2340	2464	2450
2	2nd class teak wood	Cft	2250	2300	2450	2600	2800	2800
3	1st class Burma Teak wood	Cft	3300	3400	3600	3700	4000	4000
4	Skin moulded door shutter - 35mm tk. made with high density Fiberboards(HDF) and Skin (Boiling Water Proof) facing, solid timber core and heavy duty - 6mm tk. Teak wood lipping.	Sqft	110	115	120	130	160	170
5	Factory made flush shutter - solid core type - both side commercial ply veneered IS: 2202 Part I (1999) and ISI with black board core and 12mm tk. external teak wood lipping (For Internal and Toi. Doors)	Sqft	88	92	100	105	155	180
6	Labour charges for wood work	Sqft	55	57	60	65	70	80
7	SS Butt hinges IS:12817 with SS screws(125x64x1.9mm)	Each	114	120	133	140	140	160
8	Brass handle - 125mm size - IS 3843-1995)	Each	210	215	230	250	250	300
9	Brass hanging type floor door stopper (0.357 Kg)	Each	158	165	172	185	190	210
10	Brass tower bolt 250x10mm (IS: 204-1992) - Barrel type.	Each	187	195	200	210	218	240
11	Aluminum handle -100mm with screws	Each	54	58	62	66	70	85
12	Aluminum tower bolt 250x10mm- ISI - (Anodic coating not less than grade AC	Each	66	70	72	80	86	95
13	Aluminum bolt - 150x10mm	Each	43	45	48	55	58	60
14	Aluminum tower bolt - 100x10mm	Each	37	39	42	45	48	52
15	Aluminum sliding door bolt 300x16mm ISI - (IS:7534-1985) (Anodic coating not less than grade AC 10)	Each	100	104	115	120	125	140
16	Aluminum hanging type floor door stopper.	Each	18	18	20	20	25	25
17	Brass Mortise latch and lock - Vertical type - size 100mm - clear depth of body not more than 150mm - Latch bolt of size 12mmx16mm.	Each	1337	1350	1400	1400	2360	2450
18	100mm MS Mortise latch of vertical lock - two levers - Latch bolt of size 8x25mm (IS 5930-1970)	Each	965	970	1000	1015	1530	1600
19	Chain link - solid brass (Antique metallic finish round type 6" to 8" length and dia 8mm	Each	153	158	163	170	175	190
20	Brass Antique door viewer made of solid brass & lenses (Covering angle of 180*) - 25mm dia.	Each	120	124	130	136	142	150
21	Rubber buffer - 50mm dia – 65mm long.	Each	22	22	24	24	26	30

Table 3.2 Comparison tabular column of composite materials





Graph 3.3 Hike in composite materials cost



Graph 3.4 Hike in composite materials cost

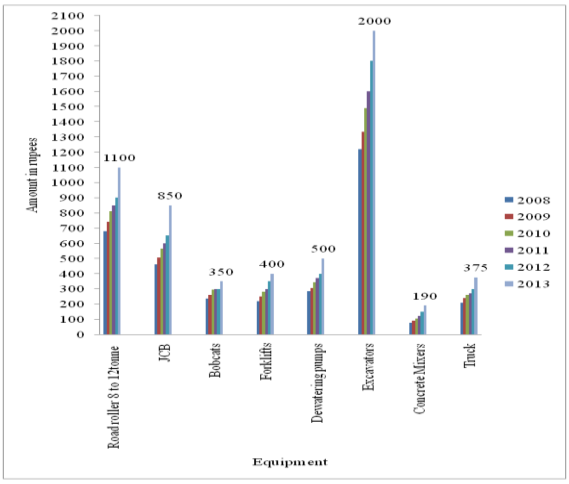
The increase in composite material cost has escalated by 52% during the period 2008-2013 is represented in graph 3.3 and 3.4.

3.7 Construction Equipment Hire

- Construction equipment includes a range of items from tower cranes and bulldozers to smaller hand operated items.
- Equipment can be owned by the main contractor, hired as required or included in sub contractor prices.
- If it is owned by the main contractor then the costs of use are generally calculated as a periodic rate such as daily, weekly etc based on the purchase cost, ownership costs and running costs over the life of the item.
- Rates may include the cost of specialist operators, transport, establishment on site and return to depot costs.
- The rent for hiring each construction equipment from the year 2008 to 2013 is shown in table 3.3 and Graph 3.5

Table 3.3 comparison tabular column for hiring equipments

EQUIPMENT RENT								
Ite no	**Item description**	**Unit**	**Basic rate**					
			2008	**2009**	**2010**	**2011**	**2012**	**2013**
1	Road roller 8 to 12tonne capacity	Per hour	680	740	810	850	900	1100
2	JCB	Per hour	460	505	565	600	650	850
3	Bobcats	Per hour	235	260	294	300	300	350
4	Forklifts	Per hour	220	250	280	300	350	400
5	Dewatering pumps	Per hour	285	305	345	370	400	500
6	Excavators	Per hour	1220	1335	1490	1600	1800	2000
7	Concrete Mixers	Per hour	75	90	105	120	150	190
8	Truck	Per hour	210	240	260	270	300	375



Graph 3.5 Hike in construction equipment hire charges

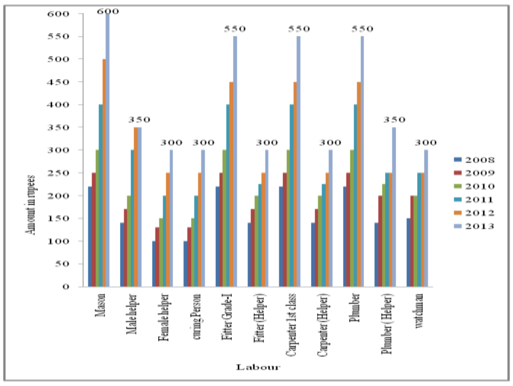
The increase in hiring cost of construction equipment charges has escalated by **73%** during period 2008-2013 is represented in graph 3.5.

3.8 Construction Labour

- This includes various types and categories of labor and how labor is described may vary from location to location and even from project to project.
- It includes direct labours who are employed directly by the main contractor, and such labor may include skilled trade people and general semi skilled or unskilled people.
- It also includes supervisory staffs who are generally employed by the main contractor.
- Costs associated with supervisory staff such as site foremen and site managers may be clearly specific while more senior staff costs may be embedded in company overheads so some care is required in measuring the costs of supervision in overall construction costs.
- The construction labour cost from the year 2008 to 2013 is shown in table 3.4 and graph 3.6.

Table 3.4 Comparison tabular column for construction labour

Item no	Item description	Unit	Basic rate					
			2008	2009	2010	2011	2012	2013
1	Mason	Per day	220	250	300	400	500	600
2	Male helper	Per day	140	170	200	300	350	350
3	Female helper	Per day	100	130	150	200	250	300
4	curing Person	Per day	100	130	150	200	250	300
5	Fitter Grade-I	Per day	220	250	300	400	450	550
6	Fitter Grade – II	Per day	180	200	225	250	300	400
7	Fitter (Helper)	Per day	140	170	200	225	250	300
8	Carpenter 1st class	Per day	220	250	300	400	450	550
9	Carpenter 2nd class	Per day	180	200	225	300	350	450
10	Carpenter (Helper)	Per day	140	170	200	225	250	300
11	Painter / White washer	Per day	220	250	300	350	400	500
12	Painter (Helper)	Per day	140	200	225	250	300	350
13	Tile layer	Per day	220	250	300	350	400	550
14	Tiles layer (Helper)	Per day	140	200	225	225	300	400
15	Glazier	Per day	230	250	300	400	450	500
16	Glazier (Helper)	Per day	150	200	225	250	250	300
17	Plumber	Per day	220	250	300	400	450	550
18	Electrician (Helper)	Per day	220	200	225	250	250	350
19	Mixer machine operator	Per day	140	170	200	250	350	400
20	Watchman	Per day	150	170	200	250	250	300



Graph 3.6 Hike in construction Labour cost

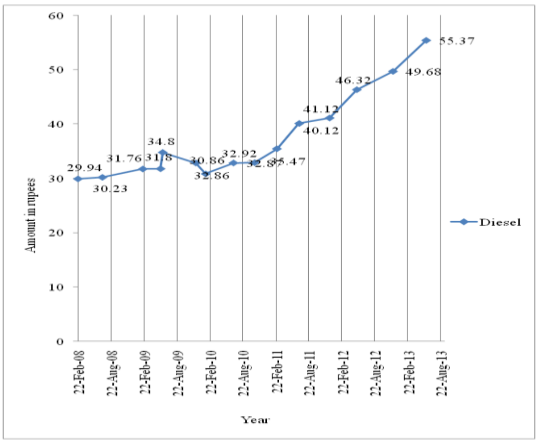
The increase in construction labour charges has escalated by 120**%** during the period 2008-2013 is represented in graph 3.6.

3.9 Increases In Fuel Cost

Table 3.5 Comparisons of petrol and diesel prices

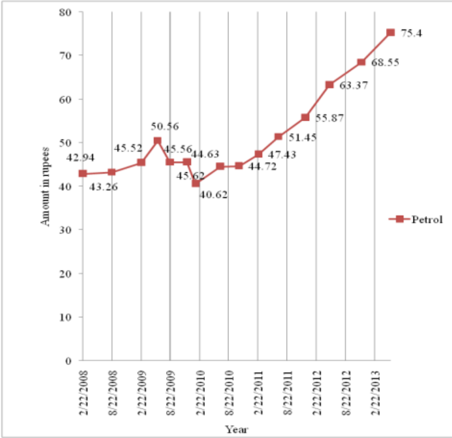
DATES	PETROL	DIESEL
02-22-08	42.94	29.94
07-06-08	43..26	30.23
02-15-09	45.52	31.76
05-24-09	45.56	31.80
06-05-09	50.56	34.80
12-06-09	45.62	32.86
01-29-10	40.62	30.86
07-02-10	44.63	32.87
10-27-10	44.72	32.92
02-27-11	47.43	35.47
07-01-11	51.45	40.12
12-16-11	55.87	40.12
05-15-12	63.37	41.12
12-01-12	68.55	46.32
06-03-13	75.40	49.68
09-14-13	73.52	55.37

The cost of petrol and diesel prices from 2008 to 2013 is mentioned in table 3.5.



Graph 3.7 Hike in Diesel prices

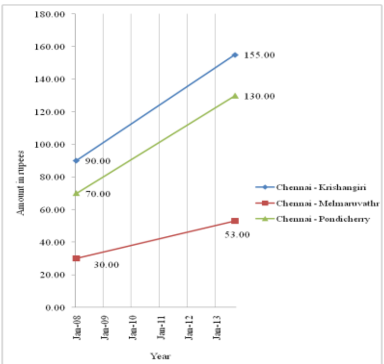
The diesel price has escalated by **84 %** during the period 2008-2013 is represented in graph 3.7.



Graph 3.8 Hike in Petrol prices

The Petrol prices have escalated by **76 %** during the period 2008-2013 is represented in graph 3.8.

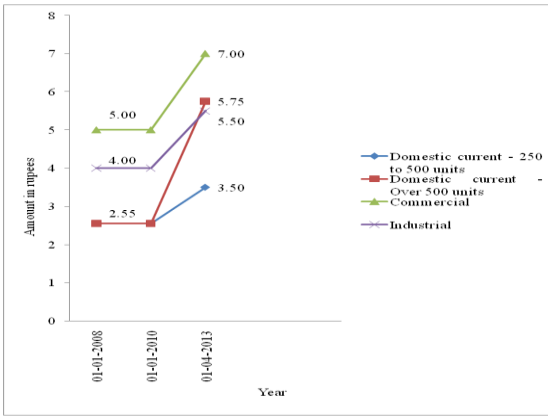
3.10 Increases In Transportation Cost



Graph 3.9 Hike in Transportation cost

The transportation cost has escalated by **72% to 86%** during the period 2008-2013 due to increase in fuel cost is mentioned in graph 3.7&3.8.

3.11 Increases In Electricity Cost



Graph 3.10 Hike in Electricity charges

The increase in electricity charges has escalated by **40%, 37.5%, 125.49% , 37.25%** during the period2008-2013 is represented in graph 3.10.

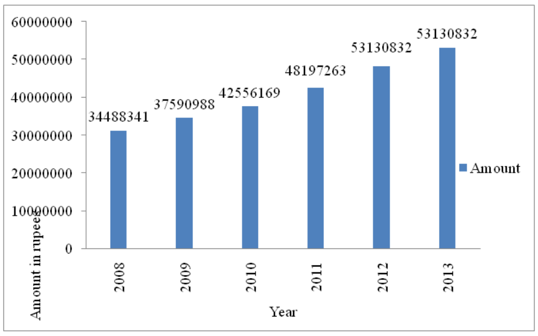
IV. Results And Discussion

4.1 Comparison Of Bill Of Quantity

The detailed comparison bill of quantity for past six years from 2008 to 2013 is explained in annexure 1; the percentage increase in cost of construction is tabulated:

Table 4.1 Summary report of percentage increase in cost of construction

Year	Total cost of project	Increase in %
2008	3,11,81,134.00	---
2009	3,44,88,341.00	**10.61%**
2010	3,75,90,988.00	**9.00%**
2011	4,25,56,169.00	**13.21%**
2012	4,81,97,263.00	**13.26%**
2013	5,31,30832.00	**10.24%**



Graph 4.1 Percentage increase in cost of construction

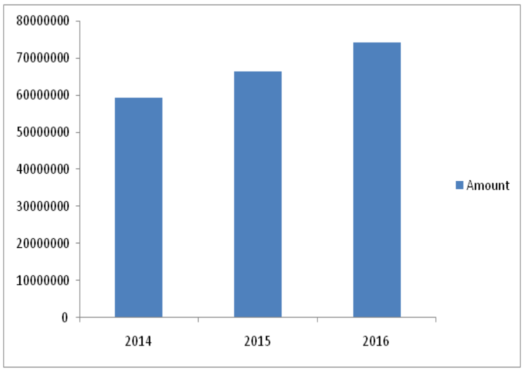
The percentage increase in cost of construction is represented in graph 4.1. The construction cost form the year 2008-2009, 2009-2010, 2010-2011, 2011-2012,2012 -2013 has increased by 10.61%, 9.00%, 13.21%, 13.26%, 10.24% respectively during this period is explained in annexure 1.

4.2 Forecasted Bill Of Quantity

Using Microsoft excel software the construction prices are forecasted for next three years 2014, 2015 and 2016. The past data's collected for the analysis is given as input data's. The input variables are year and cost. The target variable is cost. Through forecasting technique using Microsoft excel is explained clearly in annexure 2, the percentage increase in cost of construction for next three years from is tabulated:

Table 4.2 Summary report of forecasted cost

Year	Total cost of project	Increase in %
2014	5,94,28,448.00	**11.85%**
2015	6,64,69,342.00	**11.85%**
2016	7,44,08,271.00	**11.94%**



Graph 4.2 Forecasted cost

The forecasted cost of construction from the year 2014 to 2016 is mentioned in graph 4.2. Through forecasting technique, it is found that cost escalation from 2013-2014, 2014-2015, and 2015-2016 will be increased by 11.85%, 11.85% and 11.94% is explained in annexure 2.

V. Conclusions

1. The major parameters that influence the cost escalation in construction industry are steel, cement, aggregate, bricks, composite materials, equipments and labour costs are found.
2. From this case study, it is found that the price of steel, cement, aggregate, bricks, composite materials, equipments and labour cost were escalated by 138%, 36%, 60%, 115%, 55%, 63%, & 140% for the past six years from 2008 to 2013.
3. Labour cost plays a major role in cost escalation which has been escalated by 140% during this period.
4. The construction cost form the year 2008-2009, 2009-2010, 2010-2011, 2011-2012, 2012-2013 has increased by 10.61%, 9.00%, 13.21%, 13.26%, 10.24% respectively during this period is shown in annexure 1.
5. Forecasting has been done for next three years 2014, 2015 and 2016 using Microsoft excel.
6. Through forecasting technique, it is found that cost escalation from 2013-2014, 2014-2015, and 2015-2016 would be increased by 11.85%, 11.85% and 11.94% is shown in annexure 2.
7. Forecasting has been done for 2014, 2015 and 2016 which will be useful for planning engineers for quoting new long term projects.
8. Labour cost plays a major role in cost escalation which has been escalated by 120%, whereas equipment cost has escalated by 73% during last six years. So the use of equipments in construction industry can be maximized to reduce increase in construction cost.

VI. Recommendation

Labour cost plays a major role in cost escalation which has been escalated by 120%, whereas equipment cost has escalated by 73% during last six years. So the use of equipments in construction industry can be maximized to reduce increase in construction cost and avoid delaying of projects due to shortage of labours.

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