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LIFE CYCLE COST ANALYSIS OF RESIDENTIAL BUILDING BY USING LOCAL STATE GUIDELINES OF MAINTENANCE AND REPAIR COST

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Abstract – *Life cycle costing analysis can be carried out during early phase of an asset's life cycle. It can be used to provide input to decisions regarding to asset design, construction, installation of materials and its operation, maintenance, renewal/refurbishment and disposal. In LCCA process of calculating post constructional values such as maintenance and repair cost, sinking funds, salvage values is very lengthy and time consuming process. It requires accurate and reliable data of materials, equipments use in construction, but some of the local Acts in Maharashtra like MOFA, MAHARERA Act and By-laws gives minimum but much needed guidelines of post constructional costs such as maintenance and repair cost as well as sinking funds. The guidelines and rules mention 0.75% of constructional cost of project as maintenance and repair cost and 0.25% of constructional cost as sinking funds which is use as emergency fund.Net present value was adopted in this study which is generally use for residential structures. Per square feet method of charging annual maintenance charges was use for this study. Combination of this method gives quite satisfactory results related to LCCA over specific period. Duration for this study is considered as 10 years from the year of construction of the site.*

Key Words: LCCA, Maintenance and repair cost, MOFA, MAHARERA

1. INTRODUCTION

Life cycle cost analysis is a proven economic analysis technique based on well-founded economic principles. LCCA is a cost-based process; its goal is to identify the most cost-efficient building design and construction strategies over the life of the asset. LCCA includes initial cost such land cost, constructional cost, design cost. It also includes maintenance and repair cost, salvage cost, scrap value or disposal cost or residual cost.

LCCA= Cash Inflows – Cash Outflows + Scrap Value/Residual Value /Salvage Value

LCCA is cost- based process, its goal is to identify the most efficient building design .Usually, while constructing any structure owner and developer mainly focus on pre-constructional and constructional cost. But maintenance, repair and operational cost plays vital role in overall life of structure. It includes nearly 30-50 % cost in whole life span of structure. But calculating maintenance, repair and operational cost is very lengthy and tedious process because every component or parts and its replacement and maintenance cost is consider while calculating the LCCA and many examples it consumes lot of time, but in Maharashtra there are some local Acts and rules which are mainly use for wellness of constructional industry like MAHARERA Act, MOFA Act. In those acts some portion has been mentioned for rules and regulation about maintenance, repair and operational cost.

1.1 Maharashtra Ownership Flat Act, 1963 (MOFA)

1. Maharashtra Ownership of Flats Act, 1963 has been enacted to regulate the promotion, construction, sale, management and transfer of flats sold on an ownership basis within the State of Maharashtra. The MOFA (Maharashtra Ownership of Flat Act) is revised many times i.e., in 1986, 2008, 2016. Maharashtra is only state which had its act related to flat ownership before RERA.

2. MOFA then replaced by Maharashtra Housing Act and later it is replaced by RERA Act 2016 since 1st May 2016.

1.2 Maharashtra Real Estate and Regulation Authority, 2017 (MAHARERA)

In this act some guidelines which are given in MOFA are taken as it is, According to Section 11 (4) (d) the promoter is responsible for providing and maintaining essential services at reasonable charges, till the taking over of the maintenance of till the taking over of maintenance of the project by the association of allottees.

According to law, Maintenance and repair cost=0.75% of total construction cost per annum, plus Additional sinking fund (use as emergency cost) which is 0.25% of total construction cost per annum for at least 9 to 10 years as per the bond by the owner. The net present value (NPV) allows you to evaluate future cash flows based on present value of money. NPV works on the concept is called as "time value of money ".!

2. METHODOLOGY

Life cycle costing can be analyze and calculate by nearly six methods which simple payback method, discounted payback method, internal rate are of returns method, equivalent annual cost method, net savings method and net present value method. Amongst all, net present value is the most suitable method for building purpose.

The net present value (NPV) allows you to evaluate future cash flows based on present value of money. NPV works on the concept is called as "time value of money". Time value of money is widely accepted concept in world of economics (stock market, shares, banking, value comparison etc.)

2.1 Methods of Maintenance and Repair Cost

As mentioned in abstract, the main focus of research paper is to calculate the maintenance and repair cost by using local state guidelines. Also there are some methods to which are used calculate the maintenance and repair cost which are as follows

1. Per Square Feet Method
2. Equal maintenance method
3. Hybrid Method

Per square feet method is most widely used method and its results are quite satisfying .According to this method equal rate may charge to owners of flat.

Residential building using for this methodology is under construction site in Pune. Location of site is near Bavdhan, West Pune Zone in Pune. Name of project is 'STARGAZE' which is scheme of 6 towers, each tower has 75 flats (30@1BHK+30@2BHK+15@3BHK=75FLATS).Constructional cost of one tower is nearly 30,12,45,000 Rs.

Maintenance and repair cost is 0.75% of constructional cost and additional sinking fund is nearly 0.25% of constructional cost

Maintenance cost = 0.75% of 30,12,45,000

= 22,59,337.5 Rs

Sinking fund = 0.25% of 30,12,45,000

= 7,53,112.5 Rs

Using per square feet method charges per sq.ft

= (M & R Cost + Sinking Fund) / Total Area

= 30,12,450 / 77,758

= 38.74 Rs/sq.ft

M & R cost is nearly 29.05 Rs/sq.ft and sinking fund is nearly 9.68 Rs/sq.ft

Value of per square feet may utilize to calculate maintenance and repair as well as sinking fund per flat.
This site is under constructional phase

Table -1: Area of Flats

Utility	1BHK	2BHK	3BHK
Total Flats	30	30	15
Price Per Unit	Rs.59.98 lakhs	Rs.84.25 lakhs	Rs.1.47 Cr
Area Per Flat	714.01sq.ft	1003.94sq.ft	1748sq.ft
Total Area	21,420sq.ft	30,118sq.ft	26,220sq.ft

Table -2: Total M& R and Sinking Fund

Utility	1BHK	2BHK	3BHK
Total Maintenance Cost (In Rs)	6,22,260	8,74,920	7,61,685
Total Sinking Fund (In Rs)	2,07,330	2,91,540	2,53,800

Salvage value also consider in LCCA. It is the expected or estimated value of the asset at the end of its useful life. In this calculation only 10 years of life cycle will be taken into consideration. During this period depreciation of building may take place hence salvage value by using depreciation rate for 10 year will be assume in a account.

SALVAGE VALUE = P(1-i)^y

Where P= total investment, i= depreciation rate i.e. 10%

y= No of years

Table -3: Salvage Value

Year	Depreciation Rate	Salvage value
1St	10%	27,11,20,500
2nd	10%	24,40,08,450
3rd	10%	21,96,07,605
4th	10%	19,76,46,844
5th	10%	17,78,82,160
6th	10%	16,00,93,944
7th	10%	14,40,84,549
8th	10%	12,96,76,094
9th	10%	11,67,08,485
10th	10%	10,50,37,636

3. RESULTS

3.1 Details of Cash Inflows and Outflows

After calculating all charges under the regulation of MOFA, MAHARERA and By-laws following results are obtained

Table -1: Cash Flows in 10 Years

YEAR	Cash Inflow In Rs (+VE Value)	Cash Outflow In Rs (-VE Value)	Total Cash flow In Rs
0	0	30,12,45,000	-30,15,45,000
1st	24,14,00,000	8,35,056	24,05,64,944
2nd	41,17,00,000	30,11,981	40,86,88,019
3rd	-	30,11,981	-30,11,981
4th	-	30,11,981	-30,11,981
5th	-	30,11,981	-30,11,981
6th	-	30,11,981	-30,11,981
7th	-	30,11,981	-30,11,981
8th	-	30,11,981	-30,11,981
9th	-	30,11,981	-30,11,981
10th	-	30,11,981	-30,11,981

3.2 Details of Net Present Value (NPV)

Condition for acceptance of project is
If NPV is positive –accept the project (i.e. NPV>0)
If NPV is negative-reject the project (i.e. NPV<0)

NPV = C.T/ (1+r)^t

Where C.T= total cash flow in ' t' years, r= discounted rate i.e. 7% , t= time period in years

Discounted rate for real estate is falls between 6% to 12%.higher the discount rate implies greater uncertainty. It also reduces present value of upcoming future cash flows.

Table -1: NPV in Every Year

YEAR	Discounted Rate	NPV In Rs
0	7%	-30,15,45,000
1st	7%	22,48,27,050
2nd	7%	35,69,63,943
3rd	7%	-24,58,673
4th	7%	-22,97,825
5th	7%	-21,47,500
6th	7%	-20,07,010
7th	7%	-18,75,710
8th	7%	-17,53,000
9th	7%	-16,38,318
10th	7%	-15,31,138

NPV at the end of 10th year is 26,45,36,819 Rs.

Salvage value get redue from NPV at the end to calculate total NPV

Where TOTAL NPV = 26,45,36,819 – 10,50,37,636

= 15,94,99,183 Rs

NPV is positive, Developer may accept this project. Feasibility of project is good in terms of its long term investment.

Value of NPV is greater than zero means this project can give satisfactory benefits to the owner. According to NPV considerations the balance between money coming in and going out gives the better value

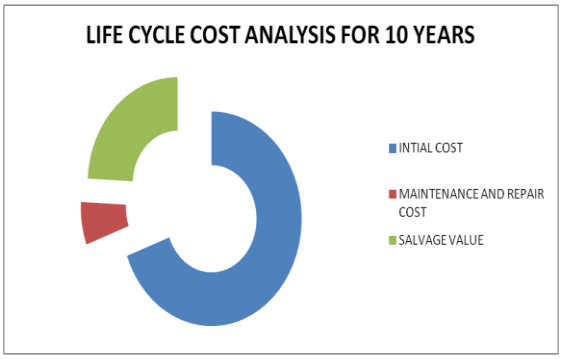

Fig -1: Life Cycle Cost analysis for 10 years

4. CONCLUSIONS

The following are the final outcomes obtained by using MOFA, MAHARERA rules in NPV method are as follows

1. For long term effect, Life cycle cost instead of total initial constructional cost gives better value perspective than considering, only initial investment.

2. Life cycle cost of project ensures effective management of assets over its entire life

3. Value of assets at the end of 10 years in terms of net present value is nearly 51% of initial investment.

4. Post-constructional cost of assets i.e. maintenance and repair cost, sinking fund and salvage value is nearly 31% of whole life cycle cost at the end of 10 years.

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