Life Cycle Cost Analysis of Bituminous Pavements and Concrete Pavements in Urban Areas

Shirole Pratik Ashok[1], Ashwini R. Patil[2], Smita V. Pataskar[3]
[1, 2, 3] Civil Engineering Department
[1, 2, 3] D.Y. Patil College of Engineering, Akurdi, Pune

Abstract- *Road building needs huge investments not only for construction of new infrastructure but also for the repair and maintenance of the old ones. In case of developing countries, like India, there is a shortage of funds required for new infrastructure projects both for construction and more significantly for their maintenance and repairs. Today's focus is on the construction of long-term performing pavement. Most of our roads are bituminous pavements which are showing early sign of distresses like rutting, cracking, ageing, etc due to increasing loads, intensity of traffic, high tyre pressure, etc.*

Concrete pavements can be adopted as an alternative to traditional bituminous pavements. One of the possible alternative rehabilitation solutions to bituminous overlays is the use of whitetopping overlay on an existing bituminous pavement. In this study an attempt is made to evaluate life cycle cost analysis of concrete and bituminous pavements and suggest a beneficial alternative amongst them.

Keywords- LCCA, Whitetopping, Pavement rehabilitation, VOC, Fuel Saving.

I. INTRODUCTION

Road building needs huge investments not only for construction of new infrastructure but also for the repair and maintenance of the old ones. In case of developing countries, like India, there is a shortage of funds required for new infrastructure projects both for construction and more significantly for their maintenance and repairs.

Today's focus is on the construction of long-term performing pavement. Most of our roads are bituminous pavements. Bituminous pavements are showing early sign of distresses due to increasing loads, intensity of traffic, high tyre pressure, etc. The rutting, cracking, ageing, etc. are quite common form of distress in bituminous pavement. These distresses get more pronounced in hot climatic regions like India, since bitumen is highly sensitive to temperature.

Concrete is known to be a relatively stiffer material and is relatively less sensitive to high temperature. Accordingly, concrete pavements can be adopted as an alternative to traditional bituminous pavements. One of the possible alternative rehabilitation solutions to bituminous overlays is the use of whitetopping which is a Portland Cement Concrete (PCC) overlay on an existing bituminous pavement. The principal purpose of this technique is either to restore the functional capacity or to increase the load carrying capacity of the road or both, of the existing pavement. In the process of achieving this objective, whitetopping overlays also restore the ride-ability of the existing asphalt pavements suffering from ruts and deformations, in addition to rectifying other defects such as loss of texture. Whitetopping being stronger than asphalt overlay is more resistant to rutting and surface initiated cracking and thus this technique consists potential, technical and economic benefits.

The appropriate solution for economically beneficial pavement type, bituminous or concrete pavement, is calculated by carrying out Life Cycle Cost Analysis (LCCA) which takes into account the initial investment cost and also the maintenance or rehabilitation cost required for the design life of the pavement. Life cycle cost analysis can be defined as a procedure by which a pavement design alternative will be selected, which will give a satisfactory level of service at lowest cost over design life. The economic analysis methods used most commonly for this study are net present worth and rate of return. The analysis depends on the factors such as inflation rate, discount rate and analysis period. In the present study, an attempt is made to study the long term economic benefits of pavements using the net present value (NPV) method of analysis.

II. OBJECTIVES OF STUDY

1. The main objective of this paper is to calculate the total cost of bituminous and concrete pavements by using life cycle lost analysis (LCCA) methodology, which could assist in the pavement selection process and help to improve the pavement system.
2. Compare the overall cost for 1 kilometer of both flexible and rigid pavements.
3. To suggest a better alternative for the maintenance and rehabilitation required in bituminous pavements.

III. METHODOLOGY

Life Cycle Cost Analysis Procedure

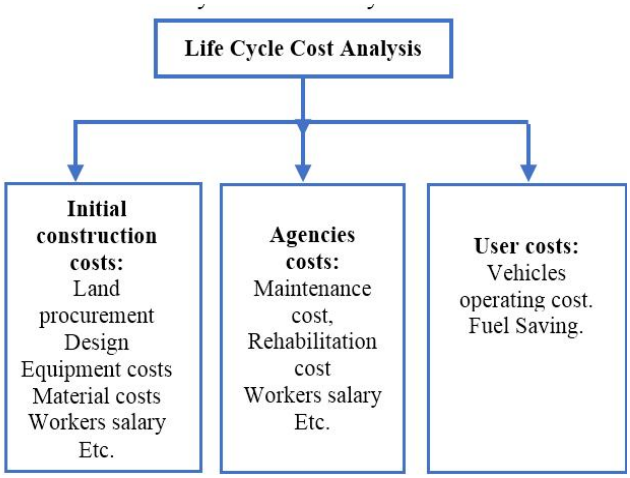

Figure 1.

The steps involved in the LCCA methodology are as follows:

1. Estimate the initial construction cost.
2. Estimate maintenance cost.
3. Estimate road user costs
4. Determine life-cycle cost.

In this study the cost required for initial construction and for maintenance of the pavements is calculated by using net present value method of life cycle cost analysis. IRC SP-30 (2009) gives the formula for net present value.

Agency costs are calculated from the district schedule of rates of Public Works Department (PWD) Pune region.

The procedures of construction and estimates were studied from case studies done on three different roads.

1) Construction of pavements UTWT and TWT, Madhuban area at old Sanghvi ward no 59, PCMC.
2) Construction of PQC pavement road from Chaphekar chowk to bridge on Pavana River towards Thergaon. PCMC
3) Development of 45.00W wide road from Pune Alandi road to Dabhadewasti in PCMC area.

IV. LIFE CYCLE COST ANALYSIS

Analysis period considered is 20 years starting from 2016. Discount rate of 12% is considered as per government policy and inflation rate of 5.5 % has been considered for rise of prices of material in future.

1. Life Cycle Cost of Bituminous Pavements

1) Construction cost of bituminous pavements.

Table 1. Construction Cost of Bituminous Pavements

Pavement Crust	Cost/km	Length (m)	Thickness (mm)	Width (m)	Rate (Rs)
Bituminous Concrete	3,272,800	1000	40	10	8182.00 /Cum
Dense Bituminous Macadam	7,115,000	1000	100	10	7115.0 /Cum
Wet Mix Macadam	2,875,000	1000	250	10	1150.00 /Cum
Granular Sub-Base	3,175,000	1000	250	10	1270.00 /Cum
Prime Coat	210,000	1000	1 Coats	10	21.00 /Sqm.
Tack Coat	350,000	1000	2 Coats	10	17.50 /Sqm.
Initial Cost	16,997,800				

2. Maintenance cost of bituminous pavement

Overlay shall be provided at every 10th year after construction for strengthening of existing pavement having a 75mm DBM layer and 40mm BC layer. Overlay cost is shown in Table II.

According to MoRTH guidelines a layer of 25mm BC is to be provided once in 5 years. Cost of overlays is shown in Table III.

Table 2. Periodic Resurfacing in every Five Years (BC 25mm)

Pavement Layer	Cost/km	Length (m)	Thick(mm)	Width (m)	Rate (Rs)
Bituminous Concrete	2,045,500	1000	25	10	8182.0/ Cum

Year	Cost per Km.	Inflated Cost @5.50% p.a.
5th Year	2,045,500	2,820,422.96
14th Year	2,045,500	4,566,530.66
18th Year	2,045,500	5,657,130.76
Total	6,136,500	13,044,084

Table 3. Cost of Overlay to be provided at every 10th year

Overlay Layer	Cost/km	Length (m)	Thick(mm)	Width (m)	Rate (Rs)
Bituminous Concrete	3,272,800	1000	40	10	8182.0 /Cum
Dense Bituminous Macadam	5,336,250	1000	75	10	7115.0 /Cum
Tack Coat		1000	2	10	17.50

	350,000		Coats		/Sqm.
Initial Cost	8,959,050				

Overlay Year	Initial Cost (Rs)	Inflated Cost @5.50% p.a.
10 th Year	8,959,050	16,145,035.95
Total	8,959,050	16,145,036

2) Life Cycle Cost of Concrete Pavement

Construction cost of concrete pavements.

Table 4. Construction Cost of Concrete Pavements

Pavement Layer	Cost/km	Length (m)	Thick(mm)	Width (m)	Rate (Rs)
PQC	1,72,23,000	1000	300	10	5741.0/ Cum
DLC Layer	25,96,000	1000	100	10	2596.0/ Cum
GSB Layer	31,75,000	1000	250	10	1270.0/ Sqm.
Initial Cost	2,29,94,000				

Maintenance cost of Concrete Pavements

Joint Sealing: 50 % of the joint sealants are to be replaced in every 5 year:
Joint Length: Contraction Joint length per km. for 10m wide carriageway 10000m
Longitudinal Joint length for 1 km and two joints in 10m width 10000m
Length to be replaced every 5 years is 30% of total length
Contraction joint = 3333.333 m
Longitudinal joint = 3333.333 m
Cost of joint seals in shown in Table V

Table 5.Cost of Joint Seals (Preformed Seals) per Km

Maintenance Cost of Joints Sealing		
Maintenance Year	Maintenance Cost (Rs.)	Inflated Cost @5.50% p.a.
5 th Year	833,333	1,149,035.67
10 th Year	833,333	1,501,743.67
15 th Year	833,333	1,962,718.92
20 th Year	833,333	2,565,195.13
Total	3,333,333	7,178,693

Concrete spalling:-

0.5% of Joint length for a width of 500mm in every 10 years
10th year spalling concrete = 50 Sqm
Repairs of concrete spalling = 50*6889.2 = Rs 344460

Table 6. Total Cost and Inflated Cost of Concrete Spalling

CONCRETE SPALLING		
Maintenance Year	Maintenance Cost (Rs.)	Inflated Cost @5.50% p.a.
10 th Year	344,460	620,748.75
Total	344,460	620,749

3) Life Cycle Cost of Overlays

Life cycle cost of bituminous overlays

Bituminous Overlays

Table 7. LCC of Bituminous Overlays

Bituminous Overlays		
Overlay	Initial Cost	Inflated cost
Strengthening overlay	8,959,050	16,145,036
Periodic overlays	6,136,500	13,044,084
Total	15,095,550	29,189,120

3. Life cycle cost of Concrete overlays

2) Construction cost of Thin White topping overlay

Table 8. Thin White topping overlay

Pavement Layer	Cost/km	Length (m)	Thick (mm)	Width (m)	Rate (Rs)
Thin White Topping (TWT)	8,6,11,500	1000	150	10	5741.0 /Cum
Milling	26,775	1000	50	10	53.6/Cum
Initial Cost	8,638,300				

Item	Unit	Quantity	Rate (Rs.)	Cost /Km.
Contraction Joint	m	3333.333 m	150	500000
Longitudinal Joint	m	3333.333 m	100	333333.33 3
			Total	833333.33 3

3) **Construction cost of Ultra Thin White topping overlay**

Table 8. Ultra Thin White topping Overlay

Pavement Layer	Cost/km	Length (m)	Thick (mm)	Width (m)	Rate (Rs)
Ultra-Thin White Topping (UTWT)	5,741,000	1000	100	10	5741.0/Cum
Milling	26,775	1000	50	10	53.6/Cum
Initial Cost	5,767,800				

4) Maintenance cost for concrete overlays will be same as that of new concrete roads.

Table 9. Maintenance cost of Concrete Pavements

Stages	Initial cost	Inflated cost
Joint sealing	3,333,333	7,178,693
Concrete spalling	344,460	620,749
Total	3,677,793	7,799,442

Road User Cost.

1. Vehicle Operating Cost (VOC):-

User cost are those that borne by the vehicles that travel on the road. These cost comprise of Vehicle Operating Cost (VOC), time costs of passenger and commodities in transit and accident cost. In the Present analysis, only VOC is considered, assuming the other two costs are equal in both types of pavements. VOC consists of wear and tear of vehicle, fuel, lubricants, depreciation and fixed cost. It has been observed that a well-constructed bituminous concrete surface has a smooth riding quality with a roughness index around 2000 mm/km but the riding quality deteriorate with traffic and may reach value of roughness of 4000 mm/km in a few years and renewal wearing course is given at the stage to improve the riding quality. On the other hand, initial roughness of cement concrete surface is maintained almost throughout its life with very little deterioration, for comparison of life cycle cost, roughness of bituminous surface is taken as 3000 mm/km and for concrete surface 2000 mm/km.

is found from IRC SP: 30 Manual of economic evaluation for transportation projects. Annual growth in traffic 7.5% and inflation rate of 7.5% is considered.

VOC is calculated as VOC per year = (No. of vehicle per day) * (365) * (VOC Rs /km)

Calculation of VOC is shown in Table XI

Traffic volume survey was conducted manually for three days, twelve hours daily and number of commercial vehicles per day were considered.

Table 10. Traffic Volume Count

Site Name	Chaphekar Chowk			Dabhadewasti, Charholi		
	CVPD			CVPD		
Day	D1	D2	D3	D1	D2	D3
Time(9am to 9pm)						
9.00 - 10.00	58	61	58	58	59	63
10.00 - 11.00	61	58	58	59	64	61
11.00 - 12.00	48	51	55	69	67	64
12.00 - 01.00	53	55	52	57	61	59
01.00 - 02.00	49	47	52	52	48	47
02.00 - 03.00	55	51	47	45	53	43
03.00 - 04.00	48	50	49	58	56	55
04.00 - 05.00	50	48	53	54	51	59
05.00 - 06.00	55	53	55	61	59	66
06.00 - 07.00	57	61	60	53	66	61
07.00 - 08.00	62	58	56	58	61	60
08.00 - 09.00	63	60	65	68	67	66
Total	659	653	660	692	712	704
Average	657.33			702.67		
	657			703		

2. Fuel Saving

In USA, a study was made and it was observed that there is fuel saving of 20% on concrete road as compared to bituminous roads having same roughness index.

In India, central road research institute (CRRI), New Delhi also made similar study on Delhi-Agra (NH-2) and found that there is a fuel saving of 14% on concrete roads as compared to bituminous roads for commercial vehicles. Due to increase in traffic on roads and rising in the fuel prices in the international market, the impact of fuel saving has been found quite important as compared to extra initial cost of concrete road over bituminous road.

A case study on Durable and cost effective concrete overlay on city bituminous roads: White topping by Binod Kumar, Scientist, CRRI also states that there is 10% – 15% fuel saving for heavy vehicles on concrete roads.

Annual fuel saving (Rs) = No. of CVPD * 365 * 14/100 *1/4 *58

14/100 = 14 % fuel saving, 1/4 = (4km per litre), Inflation rate - 5% in diesel cost

Calculation of Fuel saving is shown in table XII

V. RESULTS AND DISCUSSION

Life cycle cost comparison of new bituminous and concrete pavements is shown in Table XIII

Life Cycle Cost Comparison of New Bituminous Pavements XIV

VI. CONCLUSION

1) Life cycle cost analysis shows that even if the initial cost of concrete pavements is high the net present value of concrete pavements is Rs 193 lakhs/km (5%) less than bituminous pavements.
2) Life cycle cost analysis of overlays shows that the net present value of ultra thin white topping is Rs 283 lakhs/km (7%) less and of thin white topping is Rs 254 lakhs/km (6%) less than the cost of bituminous overlays.
3) When the net present value of bituminous overlays and concrete white toppings without considering vehicle operating cost and fuel saving the total cost of bituminous overlays is Rs 172 lakhs and that of concrete white toppings is Rs 107 lakhs for thin white topping and Rs 78 lakhs for ultra thin white topping, which is 38% and 55% lesser than bituminous overlays.
4) LCCA concludes that concrete pavements are more beneficial than bituminous pavements and concrete overlays can be considered as beneficial option for rehabilitation of existing bituminous pavements.

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Table 11. Vehicle Operating Cost

VOC													
Vehicle Operating Cost for Concrete Pavements							Vehicle Operating Cost for Bituminous Pavements						
Sr No	Year	CVPD Traffic Growth @ 7.5%	VOC (IRC SP 30 for Roughness) **2000**	Days	VOC	**VOC (in Lakhs)**	Sr No	Year	CVPD Traffic Growth @ 7.5%	VOC (IRC SP 30 for Roughness) **3000**	Days	VOC	**VOC (in Lakhs)**
1	2016	0	57.95	365	0	**0**	1	2016	0	59.26	365	0	**0**
2	2017	700	62.30	365	15917384.39	**159.174**	2	2017	700	63.71	365	16277506.21	**162.775**
3	2018	753	66.97	365	18394527.34	**183.945**	3	2018	753	68.49	365	18810693.12	**188.107**
4	2019	809	71.99	365	21257175.66	**212.572**	4	2019	809	73.62	365	21738107.23	**217.381**
5	2020	870	77.39	365	24565323.62	**245.653**	5	2020	870	79.14	365	25121100.17	**251.211**
6	2021	935	83.20	365	28388302.1	**283.883**	6	2021	935	85.08	365	29030571.38	**290.306**
7	2022	1005	89.44	365	32806231.62	**328.062**	7	2022	1005	91.46	365	33548454.05	**335.485**
8	2023	1080	96.15	365	37911701.42	**379.117**	8	2023	1080	98.32	365	38769432.22	**387.694**
9	2024	1161	103.36	365	43811709.95	**438.117**	9	2024	1161	105.70	365	44802925.11	**448.029**
10	2025	1248	111.11	365	50629907.31	**506.299**	10	2025	1248	113.62	365	51775380.33	**517.754**
11	2026	1342	119.44	365	58509186.63	**585.092**	11	2026	1342	122.14	365	59832923.89	**598.329**
12	2027	1443	128.40	365	67614678.8	**676.147**	12	2027	1443	131.31	365	69144422.67	**691.444**
13	2028	1551	138.03	365	78137213.19	**781.372**	13	2028	1551	141.15	365	79905023.45	**799.050**
14	2029	1667	148.38	365	90297317	**902.973**	14	2029	1667	151.74	365	92340242.72	**923.402**
15	2030	1792	159.51	365	104349837	**1043.498**	15	2030	1792	163.12	365	106710693	**1067.107**
16	2031	1927	171.47	365	120589280.3	**1205.893**	16	2031	1927	175.35	365	123317544.6	**1233.175**
17	2032	2071	184.33	365	139355987.1	**1393.560**	17	2032	2071	188.51	365	142508837.5	**1425.088**
18	2033	2227	198.16	365	161043262.6	**1610.433**	18	2033	2227	202.64	365	164686775.3	**1646.868**
19	2034	2394	213.02	365	186105620.3	**1861.056**	19	2034	2394	217.84	365	190316154.7	**1903.162**
20	2035	2573	229.00	365	215068307.5	**2150.683**	20	2035	2573	234.18	365	219934106.3	**2199.341**
21	2036	2766	246.17	365	248538312.8	**2485.383**	21	2036	2766	251.74	365	254161351.6	**2541.614**

Table 12. Fuel Saving

FUEL SAVING							
Year	CVPD	Days	Fuel Saving @ 14%	Mileage (1/4)	Diesel Cost Inflation @ 5%	Extra Fuel Cost	Extra Fuel Cost in Lakhs
2016	0	0	0	0	0	0	0
2017	703	365	0.14	0.25	58	520887.85	5.21
2018	756	365	0.14	0.25	61	587952.1607	5.88
2019	812	365	0.14	0.25	64	663651.0014	6.64
2020	873	365	0.14	0.25	67	749096.0678	7.49
2021	939	365	0.14	0.25	70	845542.1865	8.46
2022	1009	365	0.14	0.25	74	954405.743	9.54
2023	1085	365	0.14	0.25	78	1077285.482	10.77
2024	1166	365	0.14	0.25	82	1215985.988	12.16
2025	1254	365	0.14	0.25	86	1372544.184	13.73
2026	1348	365	0.14	0.25	90	1549259.248	15.49
2027	1449	365	0.14	0.25	94	1748726.376	17.49
2028	1558	365	0.14	0.25	99	1973874.897	19.74
2029	1674	365	0.14	0.25	104	2228011.29	22.28
2030	1800	365	0.14	0.25	109	2514867.744	25.15
2031	1935	365	0.14	0.25	115	2838656.966	28.39
2032	2080	365	0.14	0.25	121	3204134.05	32.04
2033	2236	365	0.14	0.25	127	3616666.309	36.17
2034	2404	365	0.14	0.25	133	4082312.096	40.82
2035	2584	365	0.14	0.25	140	4607909.779	46.08
2036	2778	365	0.14	0.25	147	5201178.163	52.01

Table 13. Life Cycle Cost Comparison of Bituminous and Concrete Pavements

LIFE CYCLE COST ANALYSIS									LIFE CYCLE COST ANALYSIS							
Bituminous Pavements									Concrete Pavements							
								Cost/Rs/Lakhs								Cost/Rs/Lakhs
Sr No	Year	Construction & Maintenance cost	VOC	Extra Fuel Cost	Total Cost	(1/1.12)^n	NPV Construction & Maintenance	NPV Total	Sr No	Year	Construction & Maintenance cost	VOC	Total Cost	(1/1.12)^n	NPV Construction & Maintenance	NPV Total
1	2016	169.97	0.00	0	169.98	1.00	169.98	169.98	1	2016	229.94	0.00	229.94	1.00	229.94	229.94
2	2017		162.78	5.21	167.98	0.89	0.00	149.99	2	2017	0.00	159.17	159.17	0.89	0.00	142.12
3	2018		188.11	5.88	193.99	0.80	0.00	154.64	3	2018	0.00	183.95	183.95	0.80	0.00	146.64
4	2019		217.38	6.64	224.02	0.71	0.00	159.45	4	2019	0.00	212.57	212.57	0.71	0.00	151.30
5	2020		251.21	7.49	258.70	0.64	0.00	164.41	5	2020	0.00	245.65	245.65	0.64	0.00	156.12
6	2021	28.20	290.31	8.46	326.97	0.57	16.00	185.53	6	2021	11.49	283.88	295.37	0.57	6.52	167.60
7	2022		335.48	9.54	345.03	0.51	0.00	174.80	7	2022	0.00	328.06	328.06	0.51	0.00	166.21
8	2023		387.69	10.77	398.47	0.45	0.00	180.25	8	2023	0.00	379.12	379.12	0.45	0.00	171.49
9	2024		448.03	12.16	460.19	0.40	0.00	185.86	9	2024	0.00	438.12	438.12	0.40	0.00	176.95
10	2025		517.75	13.73	531.48	0.36	0.00	191.66	10	2025	0.00	506.30	506.30	0.36	0.00	182.58
11	2026	161.45	598.33	15.49	775.27	0.32	51.98	249.62	11	2026	21.22	585.09	606.32	0.32	6.83	195.22
12	2027		691.44	17.49	708.93	0.29	0.00	203.80	12	2027	0.00	676.15	676.15	0.29	0.00	194.38
13	2028		799.05	19.74	818.79	0.26	0.00	210.16	13	2028	0.00	781.37	781.37	0.26	0.00	200.56
14	2029		923.40	22.28	945.68	0.23	0.00	216.73	14	2029	0.00	902.97	902.97	0.23	0.00	206.94
15	2030	45.67	1067.11	25.15	1137.92	0.20	9.34	232.84	15	2030	0.00	1043.50	1043.50	0.20	0.00	213.52
16	2031		1233.18	28.39	1261.56	0.18	0.00	230.48	16	2031	19.63	1205.89	1225.52	0.18	3.59	223.90
17	2032		1425.09	32.04	1457.13	0.16	0.00	237.69	17	2032	0.00	1393.56	1393.56	0.16	0.00	227.32
18	2033		1646.87	36.17	1683.03	0.15	0.00	245.12	18	2033	0.00	1610.43	1610.43	0.15	0.00	234.55
19	2034	56.57	1903.16	40.82	2000.56	0.13	7.36	260.15	19	2034	0.00	1861.06	1861.06	0.13	0.00	242.01
20	2035		2199.34	46.08	2245.42	0.12	0.00	260.71	20	2035	0.00	2150.68	2150.68	0.12	0.00	249.71
21	2036		2541.61	52.01	2593.63	0.10	0.00	268.87	21	2036	25.65	2485.38	2511.04	0.10	2.66	260.31
Total NPV							254.67	4332.74	Total NPV						249.54	4139.36

Table 14. Life Cycle Cost Comparison of Bituminous and Concrete Overlays

Net Present Value of OVERLAYS																		
NPV Bituminous Overlays							NPV Concrete Overlays (Ultra Thin White Topping Thickness - 100mm)						NPV Concrete Overlays (Thin White Topping Thickness - 150mm)					
Sr No	Year	Construction & Maintenance cost	VOC	Extra Fuel Cost	(1/1.12)^n	NPV	Sr No	Year	Construction & Maintenance cost	VOC	(1/1.12)^n	NPV	Sr No	Year	Construction & Maintenance cost	VOC	(1/1.12)^n	NPV
1	2016	89.5905	0.000	0	1.00	89.5905	1	2016	57.678	0.000	1.00	57.678	1	2016	86.383	0.000	1.00	86.383
2	2017		162.775	5.21	0.89	149.985661	2	2017		159.174	0.89	142.12	2	2017		159.174	0.89	142.119504
3	2018		188.107	5.88	0.80	154.644812	3	2018		183.945	0.80	146.64	3	2018		183.945	0.80	146.640046
4	2019		217.381	6.64	0.71	159.45129	4	2019		212.572	0.71	151.3	4	2019		212.572	0.71	151.304378
5	2020		251.211	7.49	0.64	164.409774	5	2020		245.653	0.64	156.12	5	2020		245.653	0.64	156.117073
6	2021	28.20	290.306	8.46	0.57	185.528929	6	2021	11.49	283.883	0.57	167.6	6	2021	11.49	283.883	0.57	167.602787
7	2022		335.485	9.54	0.51	174.802225	7	2022		328.062	0.51	166.21	7	2022		328.062	0.51	166.206579
8	2023		387.694	10.77	0.45	180.246315	8	2023		379.117	0.45	171.49	8	2023		379.117	0.45	171.493284
9	2024		448.029	12.16	0.40	185.862664	9	2024		438.117	0.40	176.95	9	2024		438.117	0.40	176.948148
10	2025		517.754	13.73	0.36	191.656744	10	2025		506.299	0.36	182.58	10	2025		506.299	0.36	182.576521
11	2026	161.45	598.329	15.49	0.32	249.616897	11	2026	21.22	585.092	0.32	195.22	11	2026	21.22	585.092	0.32	195.217779
12	2027		691.444	17.49	0.29	203.800863	12	2027		676.147	0.29	194.38	12	2027		676.147	0.29	194.376044
13	2028		799.050	19.74	0.26	210.162738	13	2028		781.372	0.26	200.56	13	2028		781.372	0.26	200.558765
14	2029		923.402	22.28	0.23	216.72603	14	2029		902.973	0.23	206.94	14	2029		902.973	0.23	206.938145
15	2030		1067.107	25.15	0.20	223.497138	15	2030		1043.498	0.20	213.52	15	2030		1043.498	0.20	213.520441
16	2031	45.67	1233.175	28.39	0.18	238.825544	16	2031	19.63	1205.893	0.18	223.9	16	2031	19.63	1205.893	0.18	223.897921
17	2032		1425.088	32.04	0.16	237.689421	17	2032		1393.560	0.16	227.32	17	2032		1393.560	0.16	227.319802
18	2033		1646.868	36.17	0.15	245.124438	18	2033		1610.433	0.15	234.55	18	2033		1610.433	0.15	234.550398
19	2034		1903.162	40.82	0.13	252.794969	19	2034		1861.056	0.13	242.01	19	2034		1861.056	0.13	242.010986
20	2035		2199.341	46.08	0.12	260.708498	20	2035		2150.683	0.12	249.71	20	2035		2150.683	0.12	249.70888
21	2036	56.57	2541.614	52.01	0.10	274.737309	21	2036	25.65	2485.383	0.10	260.31	21	2036	25.65	2485.383	0.10	260.310884
					Total	**4249.86**					**Total**	**3967.1**					**Total**	**3995.8014**