CHAPTER – 6

COST ANALYSIS OF REINFORCED POND ASH USED ROAD CONSTRUCTION

GENERAL

The use of pond ash in road works results in reduction of construction cost by about 10 to 20 %. The cost of borrow soil varies from approx. Rs. 100 to 200 per cubic meter. Fly ash is available free of cost or at cost of Rs 100 to 300 per ton at the power plant, and hence, in case of fly ash only transportation cost, laying and rolling cost are effective. The use of fly ash in pavement construction results in significant savings in cost of road aggregates. If fly ash is utilized as sub-grade material having higher CBR values, the required pavement thickness of road pavement would be reduced substantially resulting in a strong, durable and economized construction.

Besides, the safe-guarding of environment achieved by effective utilization of fly ash results in is far beyond the assessment.

CALCULATION OF PAVEMENT THICKNESS

This is a comparative cost study of a typical cross-section of pavement where the sub-grade material is taken as Delhi silt and then Pond ash without and with fibers.

Table 29 - Various parameters of Delhi silt

Max. Dry Density (gm/cm^3)	1.88	
Optimum water content (%)	12.50	
CBR value (%) for soaked condition	at 2.5 mm penetration	at 5 mm penetration
	3.72	4.62

The design data are reasonably taken as:

Initial traffic in the year of completion of construction = 10 msa

Design life	=	10 years
C. B. R. value of sub-grade	=	5%

As per IRC 37:2001

Pavement thickness	=	660 mm
Top width of embankment	=	3.75 m
Height of embankment	=	2.0 m
Side slope	=	2:1 (H : V)
Length of Pavement	=	1000 m
Sub-grade thickness	=	300 mm
Therefore, total thickness	=	960 mm

The various layers are shown below in figure. 32

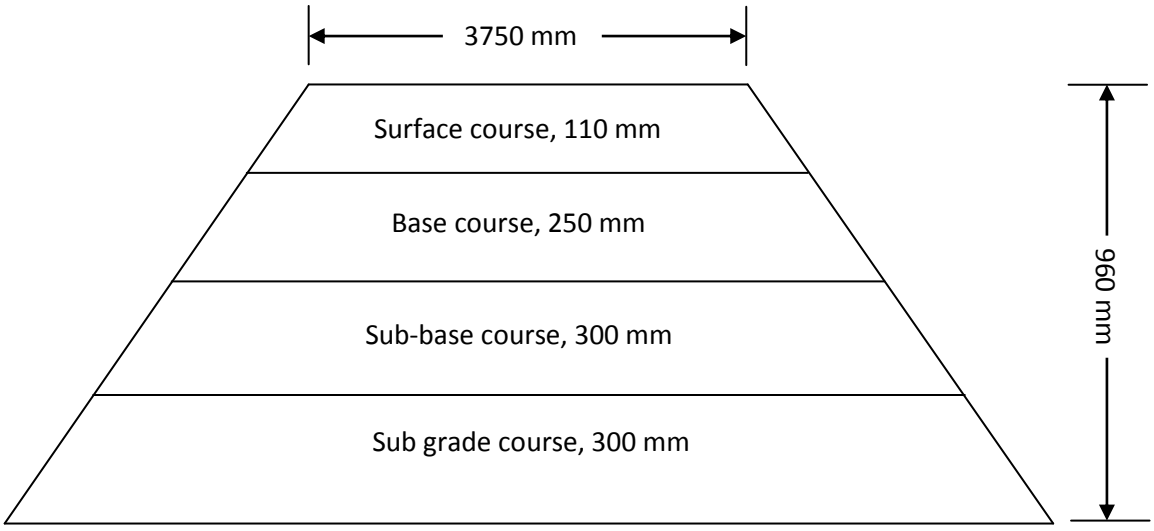

Fig. 33 – Cross-section of a pavement

PAVEMENT DESIGN CATALOGUE

Table 30 – Recommended design for traffic range 10 – 150 msa

CBR 5%				
Cumulative Traffic (msa)	Total Pavement Thickness (mm)	PAVEMENT COMPOSITION		
		Bituminous Surfacing		Granular Base and Sub-base (mm)
		BC (mm)	DBM (mm)	
10	660	40	70	Base = 250 Sub-base = 300
20	690	40	100	
30	710	40	120	
50	730	40	140	
100	750	50	150	
150	770	50	170	

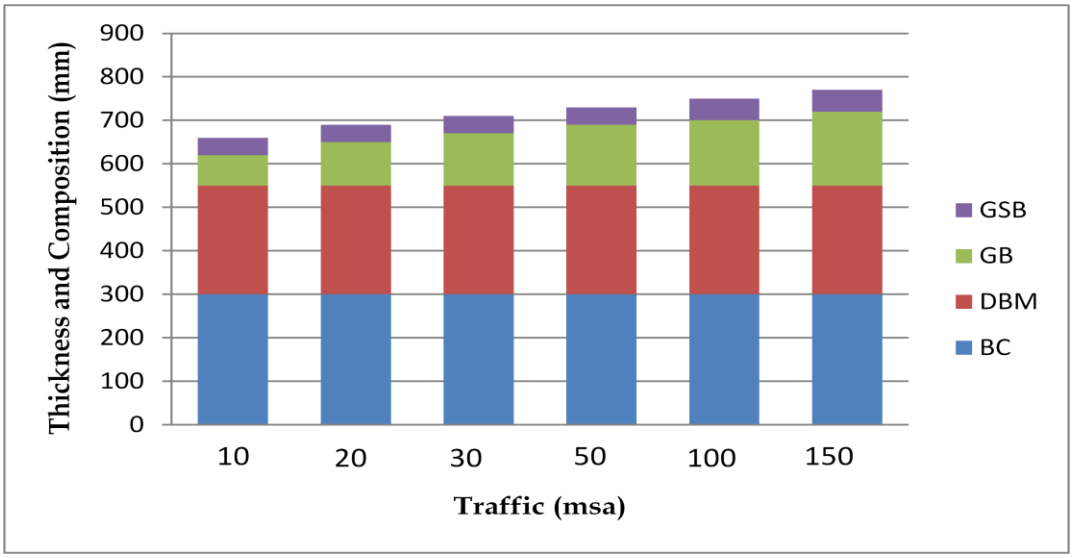

Fig. 34 – Pavement thickness according to IRC specifications

If Delhi silt (CBR value = 5) is replaced by pond ash (CBR value = 7) it will result in reduction of pavement thickness by a significant value which works out to be 580 mm against 660 mm in case of Delhi silt for a cumulative traffic of 10 msa.

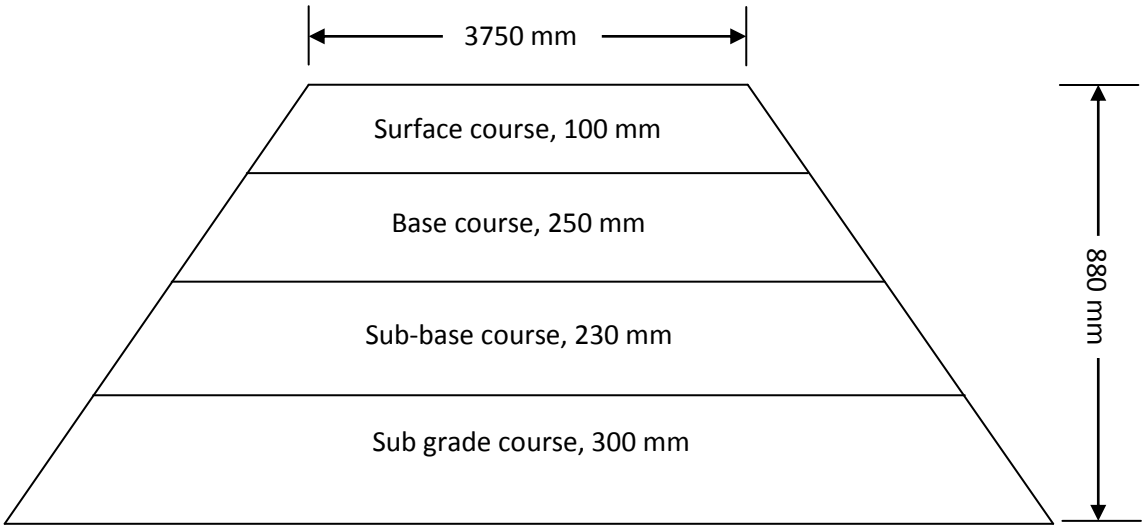

Fig. 35 – Cross-section of a pavement

PAVEMENT DESIGN CATALOGUE

Table 31 – Recommended design for traffic range 10 – 150 msa

CBR 7%				
Cumulative Traffic (msa)	Total Pavement Thickness (mm)	PAVEMENT COMPOSITION		
		Bituminous Surfacing		Granular Base and Sub-base (mm)
		BC (mm)	DBM (mm)	
10	580	40	60	Base = 250 Sub-base = 230
20	610	40	90	
30	630	40	110	
50	650	40	130	
100	675	50	145	
150	695	50	165	

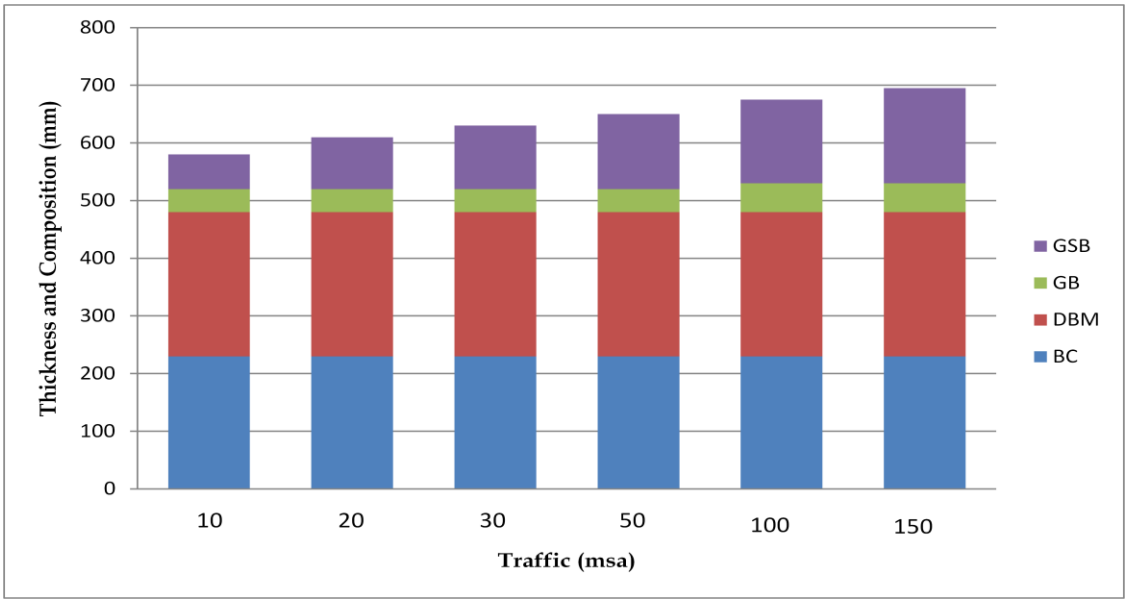

Fig. 36 – Pavement thickness according to IRC specifications

If pond ash being used in sub-grade is mixed with 0.5% polypropylene fibers the CBR value increases to 9% which will further lower the required pavement thickness. The pavement thickness in this case works out to be 540 mm for cumulative traffic of 10 msa. Therefore, according to IRC specifications

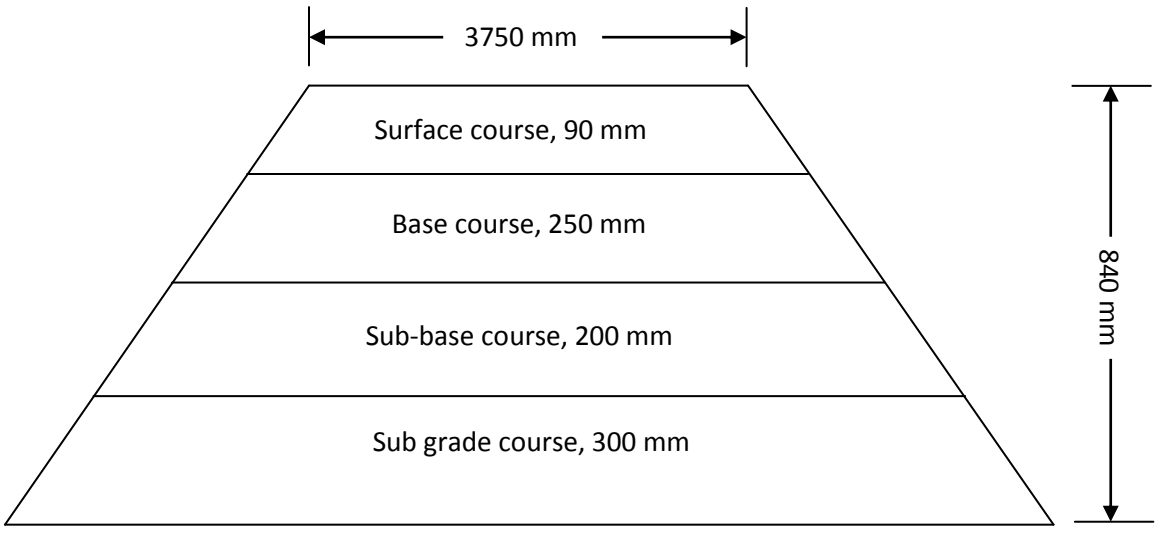

Fig. 37 – Cross-section of a pavement

PAVEMENT DESIGN CATALOGUE

Table 32 – Recommended design for traffic range 10 – 150 msa

CBR 9%				
Cumulative Traffic (msa)	Total Pavement Thickness (mm)	PAVEMENT COMPOSITION		
		Bituminous Surfacing		Granular Base and Sub-base (mm)
		BC (mm)	DBM (mm)	
10	540	40	50	Base = 250 Sub-base = 200
20	570	40	80	
30	585	40	95	
50	605	40	115	
100	635	50	135	
150	655	50	155	

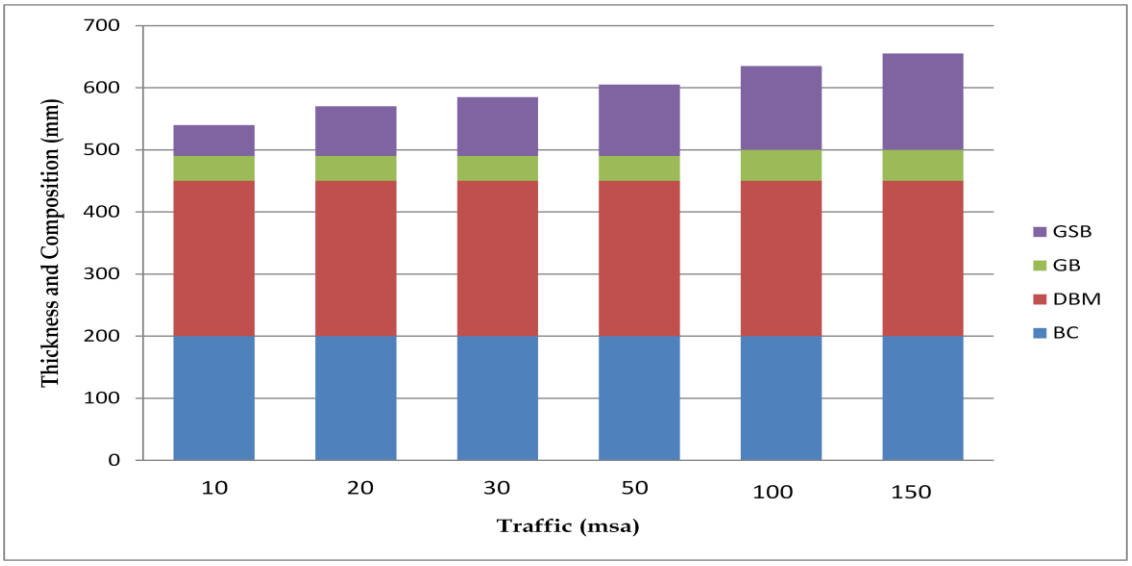

Fig. 38 – Pavement thickness according to IRC specifications

COST ANALYSIS

The savings made in construction cost of pavement by using pond ash against Delhi silt as sub-grade is shown in table 33.

Table 33 – Cost comparison between Delhi silt and pond ash when used as sub-grade material

Material	Layers	a (m)	b (m)	h (m)	Volume (m^3)	Rate per m^3 (Rs)	Total Rate (Rs)
For soil of CBR value 5%	Surface Course	3.75	4.19	0.11	436.7	515	224901
	Base Course	4.19	5.19	0.25	1172.5	245	287262
	Sub-base Course	5.19	6.39	0.30	1737	210	364770
	Sub-grade	6.39	7.59	0.30	2097	200	419400
						Total (Rs)	1296333
For pond ash of CBR 7% (10 msa)	Surface Course	3.75	4.15	0.10	395	515	203425
	Base Course	4.15	5.15	0.25	1162.5	245	284813
	Sub-base Course	5.15	6.07	0.23	1290.3	210	270963
	Sub-grade	6.07	7.27	0.30	2001	100	200100
						Total (Rs)	959301
						Net Savings (Rs)	337032

Due to increase in CBR value, there is significant amount of saving in the total cost incurred in the construction of pavement as there is a significant reduction in pavement thickness.

Cost Effectiveness of Pond Ash in Road Construction

The savings observed with the use of pond ash with 0.5% polypropylene fibers against Delhi silt is given in table 34.

Table 34 – Cost comparison between Delhi silt and pond ash (with 0.5% PP fibers) when used as sub-grade material

Material	Layers	a (m)	b (m)	h (m)	Volume (m^3)	Rate per m^3 (Rs)	Total Rate (Rs)
For soil of CBR value 5%	Surface Course	3.75	4.19	0.11	436.7	515	224901
	Base Course	4.19	5.19	0.25	1172.5	245	287262
	Sub-base Course	5.19	6.39	0.30	1737	210	364770
	Sub-grade	6.39	7.59	0.30	2097	200	419400
						Total (Rs)	1296333
For pond ash of CBR 9% (10 msa)	Surface Course	3.75	4.11	0.009	353.7	515	182156
	Base Course	4.11	5.11	0.25	1152.5	245	282363
	Sub-base Course	5.11	5.91	0.20	1102	210	231420
	Sub-grade	5.91	7.11	0.30	1953	130	263655
						Total (Rs)	949829
						Net Savings (Rs)	346504