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Experimental Analisys and Comparison between Properties of DLC and PCC

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ABSTRACT

The current practices of the construction of Pavement structures of highways and the DPC (Damp Proof course) level in any building require a layer of dry lean concrete (DLC) as a base course over which pavement quality concrete slabs rest. Even the Municipal's concrete roads including white-topping are being constructed using DLC base course. DLC is mostly manufactured with Ordinary Portland Cement (OPC) as per Indian Road Congress specification SP-49: 1998. IRC SP-49: 1998, advocates the use of Portland Pozolona Cement (PPC) and Portland Slag Cement (PSC) also in the manufacture of DLC but says nothing about the concrete mix proportioning i.e. the amount of such cement, aggregate-to-cement ratio and moisture content for the DLC to be manufactured with PPC and PSC. PPC is widely available in market all over the India, however, PPC has properties significantly different from OPC. Hence, in this research study the amount of cement (OPC and PPC), maximum aggregate-to-cement ratio and moisture content for the manufacture of DLC with OPC and PPC meeting the requirement of IRC specification in term of strength development has beenpresented.

Keywords

Dry Lean Concrete(DLC), Plain Cement Concrete(PCC), Compressive Strength, Flexural Strength, Split Tensile Strength

INTRODUCTION

The total road network of the India is about 4.69 million km in length. Out of which about 53.8% (2.53 million km) are paved. Approximately, 2% of the total road length of the country is made of with concrete. Due to overall economy and added advantages of a longer service life with a little maintenance cost, hundreds of kilometers of concrete pavements are constructed/being constructed in the country under the Government of India's National Highway Development Programmed (NHDP). Government of India is encouraging the construction of concrete pavements even at rural levels. The performance of cement concrete pavements is greatly influenced by the uniform support offered by the base or sub-base layer. The current practices of the construction of cement concrete road for highways in India require a base layer of dry lean concrete (DLC) over which pavement quality concrete slabs rest. It is one of the common and popular cement treated sub-base/base for concrete pavements. DLC is a no slump plain concrete with a large ratio of aggregate to cement in comparison with conventional concrete. It contains less amount of cement paste as compared to conventional concrete. A properly constructed DLC layer plays an important role in enhancing the service life of modern concrete roads. The major advantages of using DLC as base layer includes: provision of a uniform and strong support, high resistance to deformation, enhanced load transfer efficiency at joints, proper fixing of form work and proper placement of dowel bar cradles in semi-mechanized construction, movement of construction equipment during construction of roads, all weather construction, and finally a reduction in the depth of pavement slab required from the point of view of axle load consideration. DLC is being also used during rehabilitation and strengthening of existing distressed bituminous roads with white topping. A typical

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conventional white-topping constructed over half width of the distressed bituminous road.DLC is generally manufactured with ordinary Portland cement (OPC). DLC is also manufactured with Portland Pozolona Cement.Today, as OPC is not readily available in open market even in megacity like Delhi, the consumers have no option but to go for PPC. The distinct differences between these two types of cement (PPC and OPC), include the presence of fly ash and much higher value of normal consistency of PPC3, slower early age strength gain, thorough requirement of curing etc. It is to be noted that PPC was introduced as a substitute for OPC-33.Plain Cement Concrete (PCC) is also called as Cement Concrete (CC) or Blinding concrete. It is used for levelling, bedding for footings, grade slabs, concrete roads etc.PCC is used to provide non-porous, rigid, impervious, firm and levelled bed for laying RCC, where earth is soft and yielding.PCC can be use over brick flat soling or without brick flat soling.PCC also used as filler like lump concrete; this is a mix of PCC and boulder. It consists of cement, sand and coarse aggregates mixed with water in the specified proportions.

MIX DSIGN

Table 1. Mix Proportion for M20 Grade of PCC

Proportions comes out as			
Water	Cement	Coarse aggregate	Fine aggregate
186	413.3333	1099.554	676.3649
Ratio			
0.45	1	2.660211	1.636367

Table 2. Mix Proportion for M25 Grade of PCC

Proportions comes out as			
Water	Cement	Coarse aggregate	Fine aggregate
197.16	492.9	1057.968283	623.870349
Ratio			
0.4	1	2.146415669	1.265713834

Table 3. Mix Proportion for M30 Grade of PCC

Proportions comes out as			
Water	Cement	Coarse aggregate	Fine aggregate
191.58	425.733	1127.048223	690.7714914
Ratio			
0.45	1	2.647310264	1.622545

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Table 4. Mix Proportion for M20 Grade of DLC

Proportions comes out as			
Water	Cement	Coarse aggregate	Fine aggregate
186	1860	359.9627	221.4227
Ratio			
0.1	1	0.193528	0.119044

Table 5. Mix Proportion for M25 Grade of DLC

Proportions comes out as			
Water	Cement	Coarse aggregate	Fine aggregate
186	1860	365.8638	215.7452
Ratio			
0.1	1	0.196701	0.115992

Table 6. Mix Proportion for M30 Grade of DLC

Proportions comes out as			
Water	Cement	Coarse aggregate	Fine aggregate
186	1860	374.1789	229.3354
Ratio			
0.1	1	0.201171	0.123299

RESULTS AND DISCUSSION

Slump Test

Slump test is used to determine the workability of fresh concrete. Slump is normally measured in mm.

Table 7. Slump Value of PCC and DLC

Grade of Concrete	Slump Value of PCC	Slump Value of DLC
M20	56 mm	0 mm
M25	62 mm	0 mm
M30	70 mm	0 mm

Compressive Strength

This Clause deals with the procedure for determining the compressive strength of concrete specimen.

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Table 8. Compressive Strength after 7 Days of PCC and DLC

Sr No.	Grade of Concrete	Compressive Strength of PCC(N/mm^2)				Compressive Strength of DLC(N/mm^2)			
1	M20	22.65	21.98	22.34	22.32	24.04	22.86	22.32	23.07
2	M25	32.84	26.33	30.33	29.83	30.56	29.88	29.65	30.03
3	M30	34.57	36.39	34.05	35.00	35.67	38.97	36.12	36.92

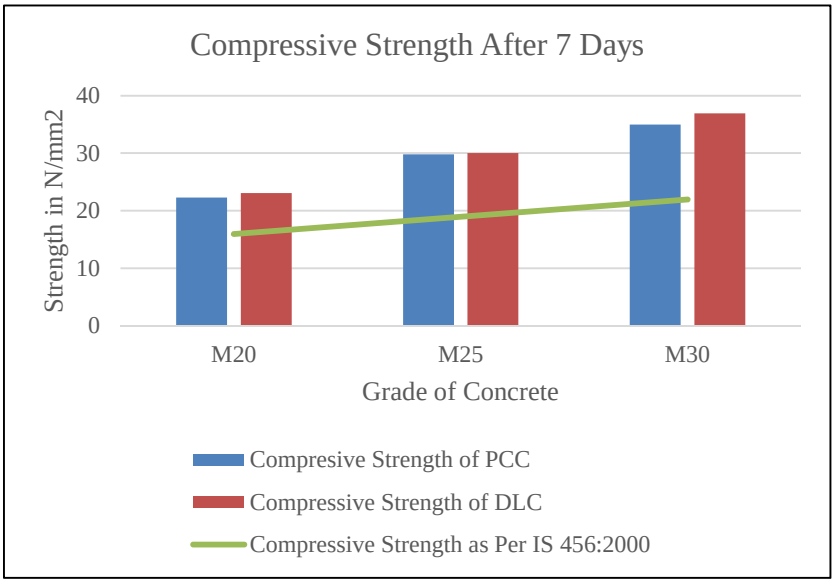

Fig 1. Compressive Strength after 7 days

Table 9. Compressive Strength after 28 Days of PCC and DLC

Sr No.	Grade of Concrete	Compressive Strength of PCC(N/mm^2)				Compressive Strength of DLC(N/mm^2)			
1	M20	30.52	28.21	29.12	29.28	31.54	31.25	32.87	31.89
2	M25	36.52	34.21	35.02	35.25	38.89	37.85	38.12	38.29
3	M30	40.21	42.39	38.56	40.39	41.56	42.67	42.56	42.26

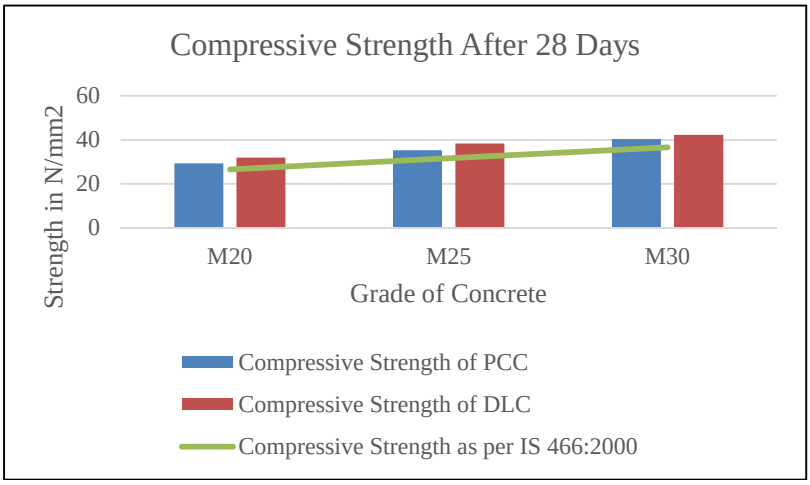

Fig 2. Compressive Strength after 28 days

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Table 10. Flexural Strength after 7 Days of PCC and DLC

Sr No.	Grade of Concrete	Compressive Strength of PCC(N/mm^2)				Compressive Strength of DLC(N/mm^2)			
1	M20	4.29	4.1	4.53	4.31	2.53	2.16	3.02	2.57
2	M25	4.98	5.21	5.29	5.16	2.57	2.46	2.87	2.63
3	M30	5.31	5.45	5.54	5.43	3.17	3.26	2.12	2.85

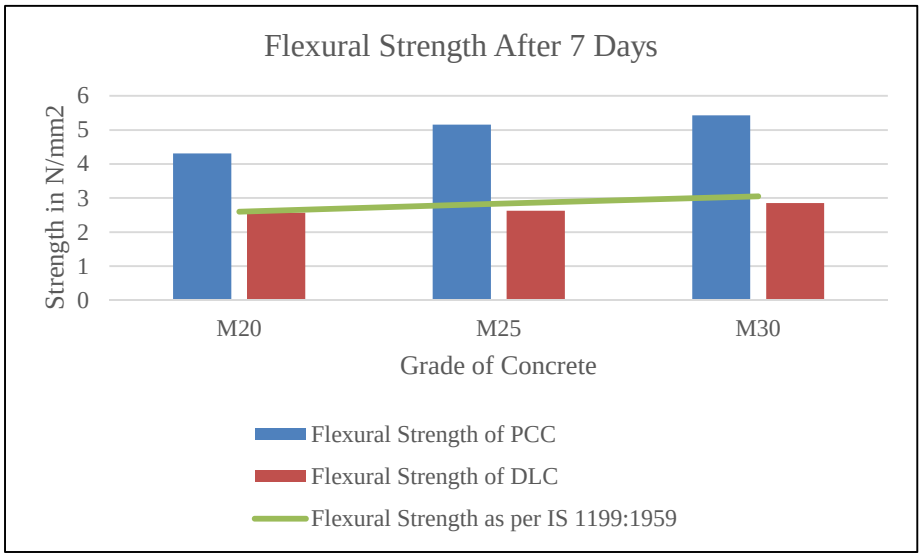

Fig3. Flexural Strength after 7 days

Table 11. Flexural Strength after 28 Days of PCC and DLC

Sr No.	Grade of Concrete	Compressive Strength of PCC(N/mm^2)				Compressive Strength of DLC(N/mm^2)			
1	M20	4.92	5.1	4.86	4.96	2.67	2.45	2.87	2.66
2	M25	5.72	5.46	5.86	5.68	2.68	2.62	3.12	2.81
3	M30	6.13	5.84	5.98	5.98	3.21	3.45	3.26	3.31

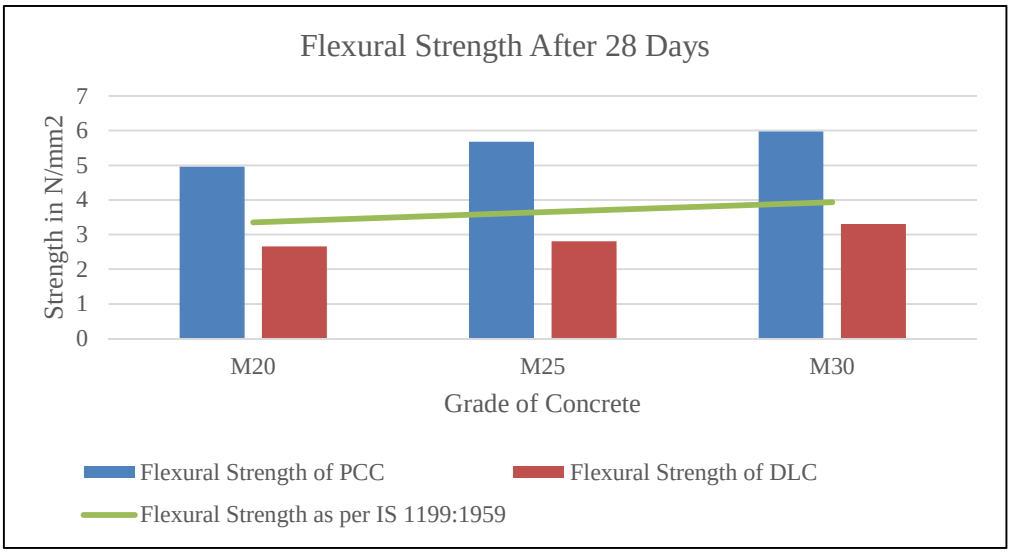

Fig 4. Flexural Strength after 28 days

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Table 12. Split Tensile Strength after 7 Days of PCC and DLC

Sr No.	Grade of Concrete	Compressive Strength of PCC(N/mm^2)				Compressive Strength of DLC(N/mm^2)			
1	M20	2.97	3.15	3.02	3.05	2.16	2.56	2.84	2.52
2	M25	3.32	3.35	3.74	3.47	2.89	2.96	2.98	2.94
3	M30	3.26	4.02	3.89	3.72	3.14	3.22	3.26	3.21

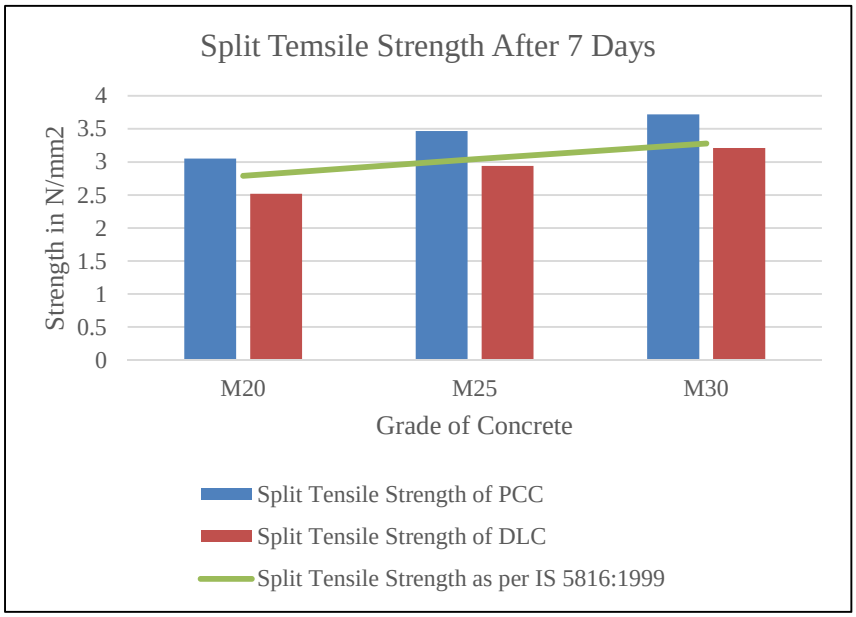

Fig 5. Split Tensile Strength after 7 days

Table 13. Split Tensile Strength after 28 Days of PCC and DLC

Sr No.	Grade of Concrete	Compressive Strength of PCC(N/mm^2)				Compressive Strength of DLC(N/mm^2)			
1	M20	4.12	4.36	4.56	4.35	2.94	3.16	3.22	3.11
2	M25	4.65	4.89	4.92	4.82	3.2	3.33	3.65	3.39
3	M30	5.26	5.83	5.74	5.61	3.76	3.42	3.83	3.67

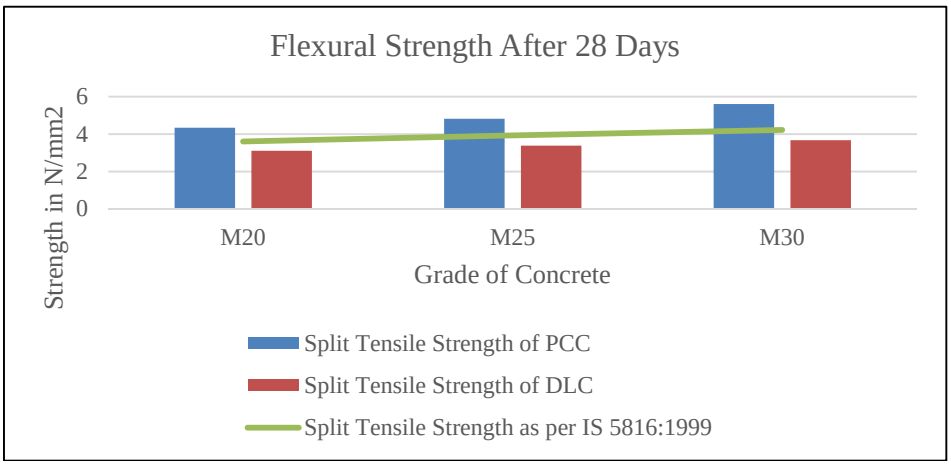

Fig 6. Split Tensile Strength after 28 days

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CONCLUSION

As per current scenario use of PCC is gradually increased but now a days requirement of water is higher than availability of potable water. So, DLC is best option in place of PCC. Compared to PCC, DLC has low water cement ratio, in PCC water cement ratio is between 0.35 to 0.5 but in DLC it is about 0.06 to 0.1.

Always workability was measured for only fresh concrete. There were so many test available for measuring workability, among those we adopted slump test. Basically DLC have negligible water content compared to PCC. So, slump value of DLC was zero.

Coming to the concrete compressive strength is first component which strikes in our mind. For compressive strength the cubes are tested in CTM(Compressive Testing Machine). DLC has low water cement ratio but compressive strength of DLC was quit high than the PCC at both time duration.

Now a days civil engineers start to focus on tensile strength and flexural strength also. For testing work of tensile strength cylindrical specimens were required and for flexural strength, beams. But DLC was weak in tension and flexural.

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