



How to design a pavement with an overload environment

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Introduction

- **Inter-cities transport development is growing remarkable by the last dedicate years. Land transport start main transport mode of the user.**
- **The traffic of non-standard truck, overloading on standard factory vehicle and local design vehicles is often seen in all national roads.**
- **Degree of road degradation is high then expectation.**



Design Background

- **Traffic volume is an important design parameter. The factors to calculate traffic volumes in term of passenger car units PCU for calculating the design capacity a proposal road are different from country to country and vary with standard which road engineer use for projecting and forecasting.**



Design Note

- **Design Vehicles and Characterizes**

Ministry of Public Works and Transport has accept the design vehicle as in PW 03-101-99 to be used for geometric design. Some dimension is presenting in [table 1](#) herewith.





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Table 1: Design Vehicle Dimensions

Design Vehicle		Dimensions (m)						Turning Radius (m)
Type	Symbol	Wheel Base	Overhang		Overall Length	Overall Width	Height	
			Front	Rear				
Passenger Car	P	3.4	0.9	1.5	5.8	2.1	1.3	7.3
Single Unit Truck	SU	6.1	1.2	1.8	9.1	2.6	4.1	12.8
Truck Combination	WB-15	7.9	0.9	0.6	16.7	2.6	4.1	13.7



Traffic Design

- Following the CAM PW 103-101-99, road has classified roads by Rural and Urban Group.
- A proposal study of Design class from **Hierarchy** to **Access** have associated bands of traffic flow in [Table 2](#)
- The design is covering for single carriageways.
- The converted coefficient to light vehicle has been specified in [Table 3](#)



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Table 2: Road Design Class

ROAD FUNCTION	Design Class	TRAFFIC FLOW	
		ADT	Light Vehicle ¹
HIERARCHY (Highway)	1	more 3,000	more 6,000
ARTERIAL (National)	2A	1,500 - 3,000	3,000 - 6,000
	2B	300 – 1,500	600 - 3,000
COLLECTOR (Provincial)	3A	150 – 300	300 – 600
	3B	50 – 150	100 – 300
ACCESS (District)	4	< 50	< 100





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Table 3: Converted Coefficient PCU

MODE OF TRANSPORT		Converted Coefficient	
		Study*	CAM PW 03-103
Light Vehicle		1.00	1.00
Motorcycle		0.50	0.75
Motorcycle with trail		0.75	0.75/1.00
Transport Truck with weight, kN	20	1.50	2.00
	60	2.00	2.00
	80	2.50	2.00
	140	3.00	3.00
	more 140	3.50	3.30
Transport Truck with Trail, kN	120	3.50	3.00
	200	4.00	3.00
	300	5.00	3.00
	More 300	6.00	3.00





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Table 4: Coefficient PCU of non standard mode of transport

MODE of Transport	Converted Coefficient
Oxcart	0.50
Horse cart	0.75
Non-standard (Kau Yunn)	1.00
Non standard(local agriculture vehicle)	2.00



Traffic Loading

- Axle number, load distribution, loading rate and tyre pressures can be significant in determining pavement performance.
- In general, it is appropriate to consider axle groups loading of the standard vehicle as follows:
 - single axle with single wheels;
 - single wheels single axle with dual wheels
 - tandem axles both with dual wheels;
 - tri-axles all with dual wheels.
- The number of equivalent standard axle for the same damage could calculate as follows:

No. of standard axle for same damage = [(load on axle group)/(appropriate load from table 5)]^{exp}



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Table 5: Equal damage axle loading (CAM PW 03-102-99)

Axles	Single	Single	Tandem	Tri axle
Configuration	Single	Dual	Dual	Dual
Loads (kN)	53	80	135	181



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Table 6: Design standard load for Road Pavement

	Standard axle load (tonne)	Reference source
USA	8.2	Design of Pavement Structure(AASHTO) 18 kpi-single axle
Australia	8.2	AusRoad, Pavement design 1992. Revised edition 2002, it uses tyre pressure equal to 750 kPa.
Japan	10	Asphalt pavement design, 1989.



Method design

- The general design procedure for road pavement is the CBR Method, which is the formulation of CBR value of sub-grade and cumulative traffic volume during design period. By the mean time, the Ministry of Public Works and Transport had approved the above selected method to design pavement.



Design of New Flexible Pavement

- New flexible pavements shall be designed in accordance with the following charts.
- [Chart 1](#)-Granular Roadbase / Surface Dressing
- [Chart 2](#)-Composite roadbase (Unbound & Cement) / Surface Dressing
- [Chart 3](#)-Granular Roadbase / Semi-Structural Surface
- [Chart 4](#)-Composite Road base / Semi-Structural Surface
- [Chart 5](#)-Granular Roadbase / Structural Surface
- [Chart 6](#)-Composite Roadbase / Structural Surface
- [Chart 7](#)-Bituminous Roadbase / Semi-Structural Surface
- [Chart 8](#)-Cement Roadbase / Surface Dressing





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- Traffic Classes(10 million ESA)
 - T1 = < 0.3
 - T2=0.3 – 0.7
 - T3=0.7 – 1.5
 - T4=1.5 – 3.0
 - T5=3.0 – 6.0
 - T6=6.0 – 10
 - T7=10 – 17
 - T8=17 - 30
- Sub-grade strength classes(CBR%)
 - S1=2
 - S2=3, 4
 - S3=5 – 7
 - S4=8 – 14
 - S5=15 – 29
 - S6=30+









































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CHART 1 GRANULAR ROADBASE / SURFACE DRESSING

	T1	T2	T3	T4	T5	T6	T7	T8
S1								
S2								
S3								
S4								
S5								
S6								

Note:

- 1 * Up to 100mm of sub-base may be substituted with selected fill provided the sub-base is not reduced to less than the roadbase thickness or 200mm whichever is the greater.
The substitution ratio of sub-base to selected fill is 25mm : 32mm
- 2 * A cement or lime-stabilised sub-base may also be used.

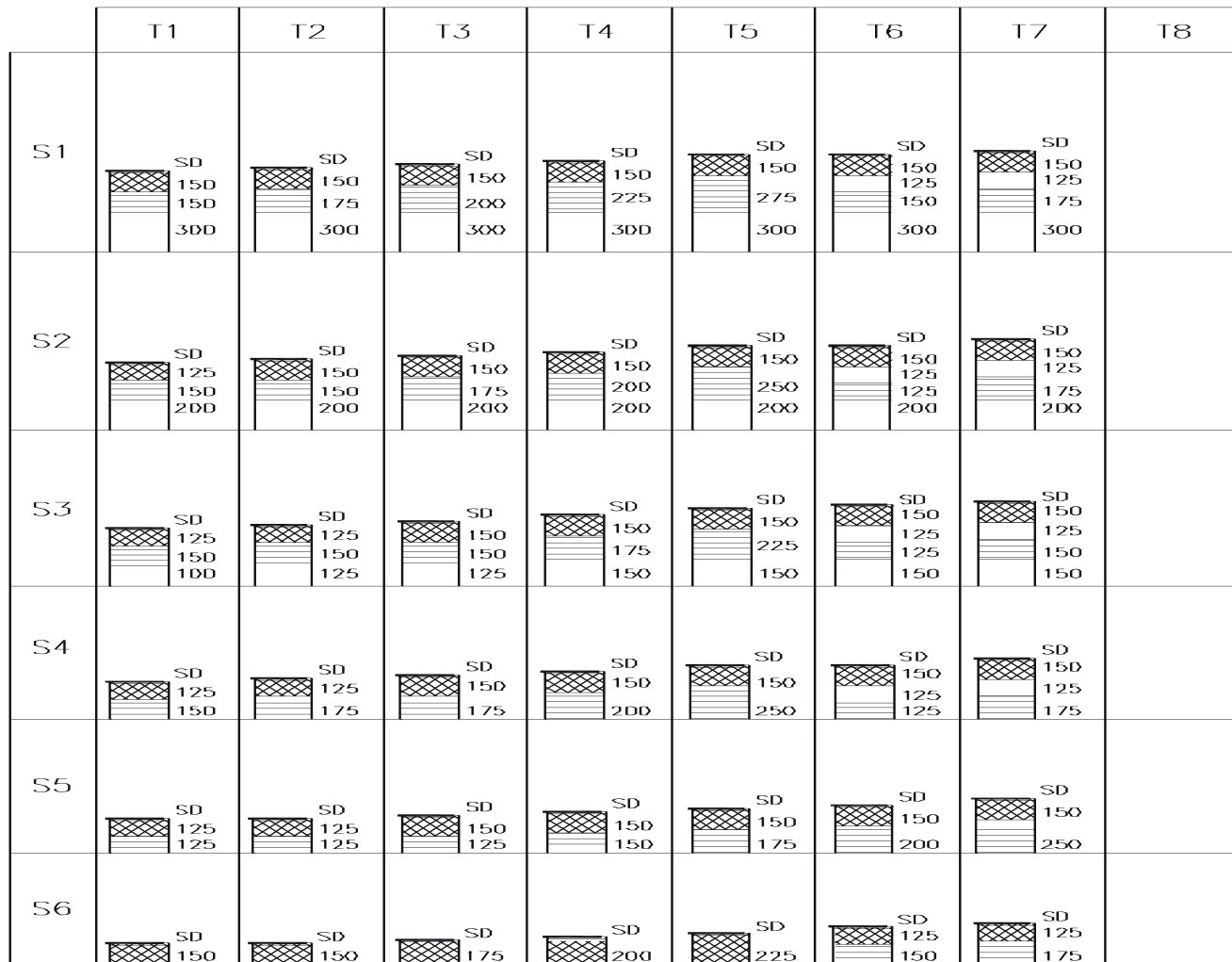




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CHART 2 COMPOSITE ROADBASE (UNBOUND & CEMENT) / SURFACE DRESSING



Note:

Sub - base to fill substitution not permitted





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CHART 3 GRANULAR ROADBASE / SEMI - STRUCTURAL SURFACE

	T1	T2	T3	T4	T5	T6	T7	T8
S1			 50 175 200 300	 50 175 250* 300	 50 175 300* 300	 50 175 325* 300		
S2			 50 175 175 200	 50 175 225* 200	 50 175 275* 200	 50 175 300* 200		
S3			 50 175 225	 50 175 275*	 50 175 325*	 50 200 350*		
S4			 50 175 150	 50 175 200	 50 175 250	 50 175 275*		
S5			 50 150 100	 50 175 125	 50 175 150	 50 200 175		
S6			 50 150	 50 175	 50 200	 50 225		

Note:

- 1 * Up to 100mm of sub-base may be substituted with selected fill provided the sub-base is not reduced to less than the roadbase thickness or 200mm whichever is the greater. The substitution ratio of sub-base to selected fill is 25mm : 32mm
- 2 * A cement or lime-stabilised sub-base may also be used.









































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CHART 4 COMPOSITE ROAD BASE / SEMI - STRUCTURAL SURFACE

	T1	T2	T3	T4	T5	T6	T7	T8
S1			 50 150 175 300	 50 150 200 300	 50 150 250 300	 50 150 125 125 300	 50 150 125 150 300	 50 150 150 150 300
S2			 50 150 175 200	 50 150 200 200	 50 150 225 200	 50 150 125 125 200	 50 150 125 150 200	 50 150 150 150 200
S3			 50 150 150 125	 50 150 150 150	 50 150 200 150	 50 150 250 150	 50 150 125 125 150	 50 150 150 125 150
S4			 50 150 150	 50 150 175	 50 150 225	 50 150 250	 50 150 125 150	 50 150 150 150
S5			 50 125 125	 50 150 125	 50 150 150	 50 150 175	 50 150 225	 50 150 125 125
S6			 50 150	 50 175	 50 200	 50 100 150	 50 150 150	 50 150 150

Note:

Sub - base to fill substitution not permitted





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CHART 5 GRANULAR ROADBASE / STRUCTURAL SURFACE

	T1	T2	T3	T4	T5	T6	T7	T8
S1						 100 200 225* 350	 125 225 225 350	 150 250 250 350
S2						 100 200 225* 200	 125 225 225 200	 150 250 250 200
S3						 100 200 250	 125 225 250	 150 250 275
S4						 100 200 175	 125 225 175	 150 250 175
S5						 100 200 100	 125 225 100	 150 250 100
S6						 100 200	 125 225	 150 250

Note:

- 1 * Up to 100mm of sub-base may be substituted with selected fill provided the sub-base is not reduced to less than the roadbase thickness or 200mm whichever is the greater. The substitution ratio of sub-base to selected fill is 25mm : 32mm
- 2 * A cement or lime-stabilised sub-base may also be used.





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CHART 6 COMPOSITE ROADBASE / STRUCTURAL SURFACE

	T1	T2	T3	T4	T5	T6	T7	T8
S1								
S2								
S3								
S4								
S5								
S6								

Note: Sub-base to fill substitution not permitted





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CHART 7 BITUMINOUS ROADBASE / SEMI-STRUCTURAL SURFACE

	T1	T2	T3	T4	T5	T6	T7	T8
S1				 SD 150 200 350	 50 125 225* 350	 50 150 225* 350	 50 175 225* 350	 50 200 250* 350
S2				 SD 150 200 200	 50 125 225* 200	 50 150 225* 200	 50 175 225* 200	 50 200 250* 200
S3				 SD 150 250	 50 125 250	 50 150 275*	 50 175 275*	 50 200 275*
S4				 SD 150 175 200	 50 125 200	 50 150 200	 50 175 200	 50 200 200
S5				 SD 150 125	 50 125 125	 50 150 125	 50 175 125	 50 200 125
S6				 SD 150	 50 125	 50 150	 50 175	 50 200

Note:

- 1 * Up to 100mm of sub-base may be substituted with selected fill provided the sub-base is not reduced to less than the roadbase thickness or 200mm whichever is the greater. The substitution ratio of sub-base to selected fill is 25mm : 32mm
- 2 * A cement or lime-stabilised sub-base may also be used.

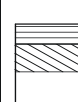
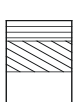




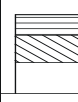
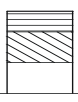

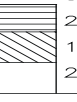

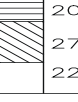

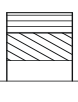







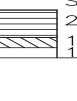
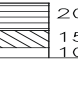

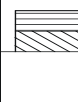
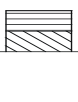

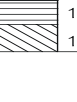
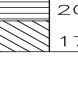











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CHART 8 CEMENT ROADBASE / SURFACE DRESSING

	T1	T2	T3	T4	T5	T6	T7	T8
S1	 SD 150 150 350	 SD 150 175 350	 SD 175 175 350	 SD 200 200 350	 SD 200 225 350	 SD 200 250 350		
S2	 SD 150 150 225	 SD 150 175 225	 SD 175 175 225	 SD 200 175 225	 SD 200 225 225	 SD 200 275 225		
S3	 SD 150 150 125	 SD 150 150 125	 SD 175 150 125	 SD 200 175 125	 SD 200 200 125	 SD 200 225 125		
S4	 SD 150 150	 SD 150 150	 SD 175 150	 SD 200 200 100	 SD 200 150 100	 SD 200 200 100		
S5	 SD 150 100	 SD 150 100	 SD 175 100	 SD 175 150	 SD 200 175	 SD 200 200		
S6	 SD 150	 SD 150	 SD 175	 SD 200	 SD 225	 SD 250		

Note: A granular sub - base may also be used.





Conclusions

- As in this study the overload vehicles from standard and non-standard vehicle intend to decrease the design life of road pavement of specific projected road class.
- Prevention of overload vehicles along the roads is mean to extend life of road and serviceability in transport sector. Nowadays MPWT is setting some control system to monitoring and implementing the corrective actions against them. Various mitigation measures have been implemented in the main national roads with different regulations, sub-decree and furthermore with road law.
- New standard axle load equal damage jncreases to 10 tonnes ?



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THANK YOU!