



**GOVERNMENT OF PAKISTAN
MINISTRY OF COMMUNICATIONS
NATIONAL TRANSPORT RESEARCH CENTRE**



NTRC AXLE LOAD SURVEY IN PAKISTAN (Ports & Dry Ports)



**FINAL REPORT
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NTRC-337

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Finite Engineering (Pvt.) Ltd.

EXECUTIVE SUMMARY

Ports exert great influence on the economy of a country as they are the main routes for import and export. Ports cater to different types of cargo including dry and liquid bulk cargo, roll-on / roll off, break bulk cargo and containers.

All the cargo that enters or leaves the ports uses the road network whereas a very small fraction uses the railway network in Pakistan, contrary to the other countries. Cargo transportation from seaports to the cities all over Pakistan as well as from Dry Ports located in other cities is transported by multi axle trucks.

Similar to the other developing countries; Pakistan also faces the dilemma of overloaded vehicles. These vehicle loads are considerably heavier than the designed strength of road infrastructure and are a major contributor to premature road failure. Highways are designed for a good balance between applied loads, material characteristics and cost during their life. This balance gets greatly affected by overloaded trucks. Thus, the Government cannot reap the benefits of huge foreign investments and loans as envisaged. Besides this, the government earns public's ire due to poor condition of roads. Poor quality roads increase vehicle operating cost and cause time delays and accidents as well.

National Transport Research Centre (NTRC) carried out a nationwide Axle Load Study during 2018-2020 on National Highway and Motorway Network using weigh stations installed by NHA or by using weigh system / pads arranged by the Consultants where weigh stations were not functional.

In continuation of above, NTRC decided to carry out Axle Load Survey on Ports and Dry Ports of the country to gather data of heavy vehicles moving in and out of these facilities. M/s Finite Engineering (Pvt.) Ltd. was appointed as the Consultant for this study. The survey duration was 72 hours on Ports and 48 hours on Dry Ports. This report deals with the quantitative data, analyses, findings and results of the study which are summarized in subsequent paragraphs.

Composition of Truck Traffic

The composition of major truck traffic on Ports and Dry Ports is summarized in Table E-1. The results depict that dominant truck type is 3- Axle Tandem at 39%, followed by 4- Axle Single Tandem at 31% then followed by 6- Axle Tandem Tridem at 20% on both Ports and Dry Ports.

Table E-1: Composition of Truck Traffic w.r.t axle configuration on Ports & Dry Ports

Sr. No.	Axle Configuration	Code	Ports & Dry Ports		Ports		Dry Ports	
			Total Number of Trucks	Percentage	Total Number of Trucks	Percentage	Total Number of Trucks	Percentage
1	2 Axle Single	1.2	43	2.97%	15	1.34%	28	8.62%
2	3 Axle Tandem	1.22	561	38.74%	480	42.74%	81	24.92%
3	4 Axle Single Tandem	1.2-22	456	31.49%	342	30.45%	114	35.08%
4	5 Axle Single Tridem	1.2-222	63	4.35%	23	2.05%	40	12.31%
5	5 Axle Tandem Tandem	1.22-22	19	1.31%	18	1.60%	1	0.31%
6	6 Axle Tandem Tridem	1.22-222	286	19.75%	245	21.82%	41	12.62%
7	Others	-	20	1.38%	-	-	20	6.15%
Total			1448	100.00%	1123	100.00%	325	100.00%

The percentage of each axle configuration on Ports and Dry Ports is compared with National Highways, as stated in NTRC Axle Load Report, 2020 and is illustrated in Table E-2. The results depict that 2- Axle Trucks are dominant on National Highways as compared to Ports and Dry Ports whereas 4- Axle trucks are more on Ports and Dry Ports as compared to National Highways.

Table E-2: Comparison of Truck Traffic on Ports and Dry Ports with National Highways

Sr. No.	Axle Configuration	Code	Ports & Dry Ports		National Highway (NTRC Report, 2020)	
			Total Number of Trucks	Percentage	Total Number of Trucks	Percentage
1	2 Axle Single	1.2	43	2.97%	70168	34.93%
2	3 Axle Tandem	1.22	561	38.74%	52943	26.39%
3	4 Axle Single Tandem	1.2-22	456	31.49%	26748	13.32%

Sr. No.	Axle Configuration	Code	Ports & Dry Ports		National Highway (NTRC Report, 2020)	
			Total Number of Trucks	Percentage	Total Number of Trucks	Percentage
4	5 Axle Single Tridem	1.2-222	63	4.35%	10652	5.30%
5	5 Axle Tandem Tandem	1.22-22	19	1.31%	7756	3.86%
6	6 Axle Tandem Tridem	1.22-222	286	19.75%	32588	16.22%
7	Others	-	20	1.38%	-	-
Total			1448	100.00%	200855	100.00%

Distribution of Vehicles by Make

The percentage of different trucks type, based on manufacturer, observed on Ports and Dry Ports is tabulated in Table E-3. The result illustrates that percentage of Hino trucks is the maximum i.e., 56.72% and 62.25% on Ports and Dry Ports respectively; distantly followed by Nissan with percentage of 29.30% and 24.83% on Ports and Dry Ports respectively.

Table E-3: Composition of Trucks by Make Type on Ports and Dry Ports

Sr. No.	Make	Ports		Dry Ports	
		Count	Percentage	Count	Percentage
1	Bedford	21	1.88%	1	0.33%
2	Nissan	327	29.30%	75	24.83%
3	Faw	10	0.90%	-	-
4	Hino	633	56.72%	188	62.25%
5	Isuzu	35	3.14%	4	1.32%
6	Mercedes	8	0.72%	8	2.65%
7	UD	41	3.67%	20	6.62%
8	Others	41	3.67%	6	1.99%
Total		1116	100.00%	302	100.00%

Distribution of Vehicles by Body Type

The percentage of trucks with respect to Body Type i.e., Flat, Half, Full & Container plying on Ports and Dry Ports is illustrated in Table E-4. The results depict that percentage of container body type is maximum on Ports and Dry Ports i.e., 54.26% and 72.13% respectively. In case of 2- Axle flat body type, 85% were found carrying containers, whereas in case of other axle configurations, this percentage is significantly lower as detailed in articles 5.1.8 and 6.1.8.

Table E-4: Composition of Trucks by Body Type on Ports and Dry Ports

Sr. No.	Body Type	Ports		Dry Ports	
		Count	Percentage	Count	Percentage
1	Flat	329	29.51%	2	0.66%
2	Half	103	9.24%	2	0.66%
3	Full	72	6.46%	69	22.62%
4	Covered	6	0.54%	12	3.93%
5	Container	605	54.26%	220	72.13%
Total		1115	100.00%	305	100.00%

Distribution of Vehicles by Truck Type

The percentage of trucks, semi-trailers and tankers on Ports and Dry Ports are presented in Table E-5. The results are also compared with National Highways data which show that percentage of semi-trailers are more on Ports and Dry Ports. However, percentage of trucks is more on National Highways.

Table E-5: Comparison of Vehicle Type on Ports and Dry Ports with National Highways

Sr. No.	Vehicle Type	Ports		Dry Ports		National Highways (NTRC Report, 2020)	
		Count	Percentage	Count	Percentage	Count	Percentage
1	Truck	525	46.92%	111	36.39%	18090	60.96%
2	Semi-Trailer	594	53.08%	192	62.95%	11252	37.92%
3	Tanker	-	-	2	0.66%	333	1.12%
Total		1119	100.00%	305	100.00%	29675	100.00%

Distribution of Loaded and Empty Trucks

The percentage of loaded and empty trucks on Ports and Dry Ports are tabulated in Table E-6.

Table E-6: Distribution of Loaded and Empty Trucks on Ports and Dry Ports

Sr. No.	Axle Configuration	Ports						Dry Ports					
		Loaded		Empty		Total		Loaded		Empty		Total	
		Count	%age	Count	%age	Count	%age	Count	%age	Count	%age	Count	%age
1	2 Axle Single	14	93.33%	1	6.67%	15	100%	28	100%	0	0%	28	100%
2	3 Axle Tandem	460	95.83%	20	4.17%	480	100%	81	100%	0	0%	81	100%
3	4 Axle Single Tandem	310	90.64%	32	9.36%	342	100%	114	100%	0	0%	114	100%
4	5 Axle Single Tridem	18	78.26%	5	21.74%	23	100%	40	100%	0	0%	40	100%
5	5 Axle Tandem Tandem	17	94.44%	1	5.56%	18	100%	1	100%	0	0%	1	100%
6	6 Axle Tandem Tridem	229	93.47%	16	6.53%	245	100%	41	100%	0	0%	41	100%
7	Others	9	100%	0	0%	9	100%	17	85%	3	15%	20	100%
Total		1057	93.37%	75	6.63%	1132	100%	322	99.08%	3	0.92%	325	100%

Loading Pattern / Trend

Ports and Dry ports were no exception to overloading by trucks and trailers, however, the degree of overloading (i.e., loaded in excess of 15%, 50% & 75%) is far less as compared to degree of overloading on National Highways (see Table 5-3 and Table 6-3). Also overloading at Dry Ports was less than that at Ports. The percentage of overloading on Ports and Dry Ports is listed in Table E-7 and is compared with overloading on National Highways as stated in NTRC Axle Load Report, 2020. The results depict no difference in overloading trend amongst 3- Axle Tandem and 4 & 6- Axle Tandem Tridem Trucks on Ports & Dry Ports and National Highways. The local transporters and distributors are contributing majorly in the deterioration of pavement structures by impenitently following overloading practices.

Table E-7: Percentage of Overloading on Ports and Dry Ports

Sr. No.	Axle Configuration	Percentage overloading on Ports & Dry Ports	Percentage overloading on Ports	Percentage overloading on Dry Ports	Percentage Overloading on National Highways (NTRC Report, 2020)
1	2 Axle Single	46.51%	46.67%	46.43%	74.10%
2	3 Axle Tandem	84.49%	87.08%	69.14%	90.62%
3	4 Axle Single Tandem	55.26%	58.19%	46.49%	57.87%
4	5 Axle Single Tridem	33.33%	26.09%	37.50%	79.45%
5	5 Axle Tandem Tandem	94.74%	94.44%	100%	77.97%
6	6 Axle Tandem Tridem	90.56%	93.47%	73.17%	89.04%

The minimum, maximum and average gross weights for each axle configuration plying on Ports and Dry Ports are presented in Table E-8 & E-9 respectively.

Table E-8: Gross Load Characteristics on Ports

Sr. No.	Axle Configuration	Permissible Load limit	Parameter	KPT	Port Qasim
1	2 Axle Single	17.5	Min. Load (Ton)	10.82	18.10
			Max. Load (Ton)	21.26	20.02
			Avg. Load (Ton)	16.07	19.02
2	3 Axle Tandem	27.5	Min. Load (Ton)	8.14	11.72
			Max. Load (Ton)	61.29	54.66
			Avg. Load (Ton)	31.41	35.50
3	4 Axle Single Tandem	39.5	Min. Load (Ton)	11.40	14.57
			Max. Load (Ton)	61.09	53.48
			Avg. Load (Ton)	36.37	42.39
4	5 Axle Single Tridem	48.5	Min. Load (Ton)	14.67	42.94
			Max. Load (Ton)	59.97	64.57
			Avg. Load (Ton)	34.58	54.25
5	5 Axle Tandem Tandem	49.5	Min. Load (Ton)	18.97	55.28
			Max. Load (Ton)	74.50	55.28
			Avg. Load (Ton)	60.21	55.28
6	6 Axle Tandem Tridem	58.5	Min. Load (Ton)	15.32	21.20
			Max. Load (Ton)	81.17	99.99
			Avg. Load (Ton)	62.89	71.59

Table E-9: Gross Load Characteristics on Dry Ports

Sr. No.	Axle Configuration	Permissible Load limit	Parameter	Quetta Dry Port	NLC Lahore Dry Port	Premnagar Dry Port	Sialkot Dry Port	Islamabad Dry Port	Peshawar Dry Port
1	2 Axle Single	17.5	Min. Load (Ton)	15.00	9.25		12.26		
			Max. Load (Ton)	26.00	21.02		36.68		

Sr. No.	Axle Configuration	Permissible Load limit	Parameter	Quetta Dry Port	NLC Lahore Dry Port	Premnagar Dry Port	Sialkot Dry Port	Islamabad Dry Port	Peshawar Dry Port
2	3 Axle Tandem	27.5	Avg. Load (Ton)	20.68	14.84		21.94		
			Min. Load (Ton)	18.40	17.55		14.33	22.45	
			Max. Load (Ton)	44.35	32.38		38.34	39.26	
			Avg. Load (Ton)	35.60	25.49		28.47	30.46	
3	4 Axle Single Tandem	39.5	Min. Load (Ton)	35.14	18.39	19.78	19.77	23.42	22.27
			Max. Load (Ton)	46.39	54.92	40.03	45.19	50.44	46.09
			Avg. Load (Ton)	41.43	38.46	25.43	32.53	35.87	39.71
			Min. Load (Ton)	32.41	30.73	41.51		36.09	44.49
4	5 Axle Single Tridem	48.5	Max. Load (Ton)	54.12	58.67	41.51		51.31	54.13
			Avg. Load (Ton)	44.37	52.04	41.51		45.12	47.81
			Min. Load (Ton)					53.25	
			Max. Load (Ton)					53.25	
5	5 Axle Tandem	49.5	Avg. Load (Ton)					53.25	
			Min. Load (Ton)	48.52	48.01	45.77		53.99	46.93
			Max. Load (Ton)	99.90	111.00	60.14		79.00	46.93
			Avg. Load (Ton)	74.56	70.87	52.96		67.65	46.93
6	6 Axle Tandem Tridem	58.5	Min. Load (Ton)				6.54		
			Max. Load (Ton)				35.68		
			Avg. Load (Ton)				17.04		
			Min. Load (Ton)						
7	Others		Max. Load (Ton)						
			Avg. Load (Ton)						
			Min. Load (Ton)						
			Max. Load (Ton)						

The results on Ports and Dry Ports are compared with results of National Highway as stated in NTRC Axle Load Survey on National Highway & Motorway Network of Pakistan, 2020, see Table E-10. The results depict that average gross load is maximum on National Highways.

Table E-10: Comparison of Gross Load on Ports & Dry Ports with National Highways

Sr. No.	Axle Configuration	Permissible Load limit	Parameter	Ports	Dry Ports	National Highways (NTRC Report, 2020)
1	2 Axle Single	17.5	Min. Load (Ton)	10.82	9.25	6.33
			Max. Load (Ton)	21.26	36.68	50.12
			Avg. Load (Ton)	16.66	18.79	20.00
2	3 Axle Tandem	27.5	Min. Load (Ton)	8.14	14.33	11.76
			Max. Load (Ton)	61.29	44.35	79.44
			Avg. Load (Ton)	32.08	32.41	40.37
3	4 Axle Single Tandem	39.5	Min. Load (Ton)	11.40	18.39	19.48
			Max. Load (Ton)	61.09	54.92	90.00
			Avg. Load (Ton)	37.72	37.03	41.45
4	5 Axle Single Tridem	48.5	Min. Load (Ton)	14.67	30.73	21.28
			Max. Load (Ton)	64.57	58.67	85.31
			Avg. Load (Ton)	38.86	46.74	57.43
5	5 Axle Tandem	49.5	Min. Load (Ton)	18.97	53.25	21.87
			Max. Load (Ton)	74.50	53.25	84.31
			Avg. Load (Ton)	59.93	53.25	57.74
6	6 Axle Tandem Tridem	58.5	Min. Load (Ton)	15.32	45.77	22.11
			Max. Load (Ton)	99.99	111.00	110.93
			Avg. Load (Ton)	67.68	72.06	75.09

The axle load spectrum of front and rear axles including single, tandem and tridem axles for major axle configuration plying on Ports and Dry Ports is presented in Table E-11 & Table E-12 respectively.

Table E-11: Front and Rear Axle Load Spectrum on Ports

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
Front Axle Load Spectrum					
1	0 - 2.99	72	6.41%	6.41%	93.59%
2	3 - 5.49	105	9.35%	15.76%	84.24%
3	5.5 - 6.99	511	45.50%	61.26%	38.74%
4	7 - 8.99	388	34.55%	95.81%	4.19%
5	9 - 10.99	37	3.29%	99.11%	0.89%
6	11 - 12.99	10	0.89%	100.00%	0.00%
7	13 - 14.99	0	0.00%	100.00%	0.00%
8	15 - 16.99	0	0.00%	100.00%	0.00%
9	17 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Single)					
1	0 - 8.16	364	10.74%	10.74%	89.26%
2	8.17 - 9.99	228	6.73%	17.46%	82.54%
3	10 - 10.99	399	11.77%	29.23%	70.77%
4	11 - 11.99	732	21.59%	50.83%	49.17%
5	12 - 12.99	608	17.94%	68.76%	31.24%

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
6	13 - 13.99	391	11.53%	80.29%	19.71%
7	14 - 14.99	381	11.24%	91.53%	8.47%
8	15 - 19.99	257	7.58%	99.12%	0.88%
9	20 & Above	30	0.88%	100.00%	0.00%
Rear Axle Load Spectrum (Tandem)					
1	0 - 11.99	78	7.07%	7.07%	92.93%
2	12 - 14.99	22	1.99%	9.07%	90.93%
3	15 - 19.99	85	7.71%	16.77%	83.23%
4	20 - 21.99	100	9.07%	25.84%	74.16%
5	22 - 23.99	397	35.99%	61.83%	38.17%
6	24 - 25.99	119	10.79%	72.62%	27.38%
7	26 - 27.99	112	10.15%	82.77%	17.23%
8	28 - 29.99	104	9.43%	92.20%	7.80%
9	30 & Above	86	7.80%	100.00%	0.00%
Rear Axle Load Spectrum (Tridem)					
1	0 - 14.99	22	8.21%	8.21%	91.79%
2	15 - 30.99	11	4.10%	12.31%	87.69%
3	31 - 32.99	0	0.00%	12.31%	87.69%
4	33 - 34.99	9	3.36%	15.67%	84.33%
5	35 - 36.99	105	39.18%	54.85%	45.15%
6	37 - 38.99	62	23.13%	77.99%	22.01%
7	39 - 40.99	6	2.24%	80.22%	19.78%
8	41 - 42.99	18	6.72%	86.94%	13.06%
9	43 & Above	35	13.06%	100.00%	0.00%

Table E-12: Front and Rear Axle Load Spectrum on Dry Ports

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
Front Axle Load Spectrum					
1	0 - 2.99	1	0.33%	0.33%	99.67%
2	3 - 5.49	79	25.90%	26.23%	73.77%
3	5.5 - 6.99	108	35.41%	61.64%	38.36%
4	7 - 8.99	90	29.51%	91.15%	8.85%
5	9 - 10.99	23	7.54%	98.69%	1.31%
6	11 - 12.99	4	1.31%	100.00%	0.00%
7	13 - 14.99	0	0.00%	100.00%	0.00%
8	15 - 16.99	0	0.00%	100.00%	0.00%
9	17 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Single)					
1	0 - 8.16	119	13.21%	13.21%	86.79%
2	8.17 - 9.99	197	21.86%	35.07%	64.93%
3	10 - 10.99	138	15.32%	50.39%	49.61%
4	11 - 11.99	115	12.76%	63.15%	36.85%
5	12 - 12.99	101	11.21%	74.36%	25.64%
6	13 - 13.99	55	6.10%	80.47%	19.53%
7	14 - 14.99	55	6.10%	86.57%	13.43%
8	15 - 19.99	109	12.10%	98.67%	1.33%
9	20 & Above	12	1.33%	100.00%	0.00%
Rear Axle Load Spectrum (Tandem)					
1	0 - 11.99	12	5.04%	5.04%	94.96%
2	12 - 14.99	15	6.30%	11.34%	88.66%
3	15 - 19.99	59	24.79%	36.13%	63.87%
4	20 - 21.99	33	13.87%	50.00%	50.00%
5	22 - 23.99	37	15.55%	65.55%	34.45%
6	24 - 25.99	21	8.82%	74.37%	25.63%
7	26 - 27.99	11	4.62%	78.99%	21.01%
8	28 - 29.99	15	6.30%	85.29%	14.71%
9	30 & Above	35	14.71%	100.00%	0.00%
Rear Axle Load Spectrum (Tridem)					
1	0 - 14.99	0	0.00%	0.00%	100.00%
2	15 - 30.99	35	43.21%	43.21%	56.79%
3	31 - 32.99	11	13.58%	56.79%	43.21%
4	33 - 34.99	5	6.17%	62.96%	37.04%
5	35 - 36.99	5	6.17%	69.14%	30.86%
6	37 - 38.99	10	12.35%	81.48%	18.52%
7	39 - 40.99	0	0.00%	81.48%	18.52%

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
8	41 - 42.99	2	2.47%	83.95%	16.05%
9	43 & Above	13	16.05%	100.00%	0.00%

Damage Factors

The damage factors for major truck types are shown in Table E-13. The damage factors on Ports and Dry Ports are quite less than those determined for National Highways as stated in NTRC Study, 2020, however, in case of Dry Ports one exception exists, i.e., 2- Axle truck.

Table E-13: Comparison of Damage Factors on Ports and Dry Ports with National Highways

Sr. No.	Axle Configuration	Code	Ports		Dry Ports		National Highways (NTRC Study, 2020)	
			Road Note 40	AASHTO 1993	Road Note 40	AASHTO 1993	Road Note 40	AASHTO 1993
1	2 Axle Single	1.2	6.51	4.70	23.63	14.55	19.62	12.28
2	3 Axle Tandem	1.22	20.26	9.89	20.76	10.19	55.24	23.08
3	4 Axle Single Tandem	1.2-22	14.87	9.39	12.59	8.32	26.80	14.88
4	5 Axle Single Tridem	1.2-222	11.31	5.92	12.77	7.42	44.66	19.02
5	5 Axle Tandem Tandem	1.22-22	40.60	19.79	20.09	10.42	39.35	18.42
6	6 Axle Tandem Tridem	1.22-222	42.19	17.36	68.86	25.22	70.05	24.68

Locking Mechanism of Containers

The containers are locked into place on a truck/semi-trailer for securing it from any harmful incident. Depending upon the locking mechanism, they are classified as fully secured, partially secured and un-secured. The collected information during axle load survey shows that almost 100% containers are secured at Ports and Dry Ports (Table E-14).

Table E-14: Percentage of Containers as Fully, Partially and Un-Secured on Ports and Dry Ports

Sr. No.	Description	Ports		Dry Ports	
		Count	Percentage	Count	Percentage
1	Fully Secured	474	95.75%	63	100%
2	Partially Secured	20	4.04%	0	0%
3	Un-Secured	1	0.20%	0	0%
	Total	495	100.00%	63	100.00%

ORGANIZATION OF THE REPORT

Chapter 1 provides technical background, need assessment, scope of work, and objectives of axle load study.

Chapter 2 provides an overview for the technical information on various aspects of axle load such as load distribution, contact pressure, wheel configuration, effect of various factors on pavement stresses, Tire size and pressure, Standard axle load, AASHTO Road test, Equivalence factors and damaging effect of axle load along with Axle Load Limits being followed in different countries.

Chapter 3 deals with the detailed description on resources required for axle load survey such as use of portable weigh pads etc.

Chapter 4 deals with the methodology for the axle load survey including survey planning, site visits, data collection and management and measurement of axle loads.

Chapter 5 deals with the quantitative analysis of axle load survey on Ports.

Chapter 6 deals with the quantitative analysis of axle load survey on Dry Ports.

Chapter 7 deals with the comparison of axle load survey on Ports and Dry Ports with National Highways.

Chapter 8 deals with the quantitative analysis of axle load survey on individual Ports.

Chapter 9 deals with the quantitative analysis of axle load survey on individual Dry Ports.

Chapter 10 deals with conclusions of the study.

LIST OF ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
AADT	Annual Average Daily Traffic
ADB	Asian Development Bank
ADT	Average Daily Traffic
ALS	Axle Load Survey
ARRI	Alberta Road Research Initiative
CPEC	China Pakistan Economic Corridor
CSIR	Council for Scientific & Industrial Research
DFID	Department For International Development
GoP	Government of Pakistan
GVW	Gross Vehicle Weight
JICA	Japan International Cooperation Agency
KICT	Karachi International Container Terminal
KPT	Karachi Port Trust
MC	Marginal Cost
MoC	Ministry of Communications
NHA	National Highway Authority
NHSO	National Highway & Safety Ordinance
NTRC	National Transport Research Centre
NVR	Network Video Recorder
OECD	Organization for Economic Cooperation and Development
PBQ	Port Bin Qasim
PIBT	Pakistan International Bulk Terminal
PICT	Pakistan International Container Terminal
RLW	Registered Laden Weight
SAPT	South Asia Pakistan Terminal
SN	Structural Number
TRL	Transport Research Laboratory
VOC	Vehicle Operating Cost
WIM	Weigh In Motion
W.R.T	With Respect To

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1 INTRODUCTION

1.1 Background

Ports have great influence on the economy of a country because they handle different types of cargo which includes dry and liquid bulk cargo, roll-on / roll off (Ro/Ro), break bulk cargo and containers.

The main Sea Ports of Pakistan are Karachi Port (KP) and Port Qasim (PQ), both are located in Karachi. Pakistan Deep Water Container Terminal, an extension of KPT will be the largest container handling facility of Pakistan once completed. Another port, Gwadar Port located close to the western border of Balochistan, is a new port gradually developing its importance and capacity in the region.

Cargo tonnage of bulk and containerized cargo is a fundamental measure of a port's performance. The 20-foot container is the fundamental unit to count container traffic on ports. The movement of vessels (ships) is an indicator of activity on the port berths. Karachi Port is handling about 42 million tons of cargo per annum which includes 10 million tons of liquid and 32 million tons of dry cargo and 2 million TEUs.

All the cargo that enters or leaves the Ports (Figure 1-1) uses the road network of the country. A very small fraction of the cargo uses the railway facility. Cargo transportation from Seaports to the cities all over Pakistan as well as from Dry Ports located in other cities is carried out by two axle to multi axle trucks.



Figure 1-1: Location Map of Ports & Dry Ports and National Highway & Motorway Network

National Transport Research Centre (NTRC) has undertaken an Axle Load Survey on the National Highway and Motorway Network of Pakistan. The objective was to collect, compile and update existing loading characteristics, spectrum and trends on the road network.

In continuation of the above, NTRC carried out Axle Load Survey on Ports and Dry Ports of the country to gather data of heavy vehicles moving in and out of these facilities. M/s Finite Engineering (Pvt.) Ltd. was engaged to undertake the Axle Load Survey.

1.2 Need Assessment

In Pakistan truck overloading is a serious problem. The overloaded trucks stress the road structure beyond its bearing capacity, thus damaging the pavement structure. Efforts to repair the roads have no positive effect on improvement of roads as overloading continues, thus causing negative impact on the economy of the country. Furthermore, overloaded heavy vehicles are a traffic hazard as overloading puts extra stress on the steering and braking system.

Bulk cargo emanates or terminates at the Ports of the country. It is therefore required to check the pattern of loading carried by the transporting vehicles on the spot from where it is generated. The knowledge of which will be helpful in planning and implementing measures to curb the overloading risk on the road network.

1.3 Scope of the Project

The scope of project required carrying out Axle Load Survey on Ports and Dry Ports using weigh system already installed or by using portable weigh pads in case load measuring device is not available. The project involved:

- Obtaining data for total number of trucks entering and exiting from Karachi Port, Port Qasim (for 72-hour survey) as well as Dry Ports of Karachi, Quetta, Lahore, Multan, Sialkot, Peshawar & Islamabad (for 48-hour survey).
- Determining percentage of empty and loaded trucks (in Traffic Volume).
- Measuring axle load and total weight of vehicle at least 20% of total loaded vehicles covering all types of trucks (axle-wise).
- Obtaining information about commodities carried out by loaded truck.
- Obtaining information of containerized and non-containerized trucks regarding major commodities carried by trucks especially loaded in bulk like coal etc.

1.4 Objectives of the Study

The primary objective of the study is to determine the loading characteristics at Ports and Dry Ports across Pakistan with the results serving as vital input in:

- Updating of transport master plan and road development program.
- Updating data regarding loading pattern & trends.
- To find out the number of different axle configurations of trucks at Ports.
- To assess the degree of overloading at Ports and Dry Ports.
- Determination of Damage / Load Equivalency Factor (LEF).
- Comparison of results of this survey with NTRC Axle Load Study, 2020.

1.5 The Report

This Final Report discusses findings of axle load survey conducted at Ports and Dry Ports for assessing loading pattern followed by freight vehicles emanating and terminating at the Ports.

2 VEHICLE – PAVEMENT INTERACTION

2.1 General

Dynamic loads on the pavement are generated due to interaction of the vehicle suspension system and the pavement surface irregularity (roughness). Tires transfer the load of a vehicle to the pavement structure; thus, tire type, numbers and pressure dictate contact stresses on the pavement surface and geometry of the loaded area. The stresses induced on the pavement and the resulting strain is therefore dependent on the stress, area geometry and material properties of the pavement layer.

2.2 Contact Pressure

The key factors affecting the level of contact pressure from the vehicular traffic are well known and are primarily related to type of tires used, tire pressure and indirectly influenced by the axle loading. Increased tire pressures result in increased contact stresses at the tire / road interface. A research done by the CSIR indicates that the measured vertical contact stresses exceed the tire inflation pressures by approximately 30%. On the other hand, overloaded, under-inflated tires may also result in contact stresses exceeding the tire inflation pressures by 2 to 3 times¹. Generally, this latter condition can be considered the main cause for premature failure of road surfaces and also tire loss, particularly on rough road surfaces carrying heavy vehicles with sub-standard or worn tires. The developed stresses, however, are affected, amongst others, by the type and state of the tire, the load / inflation pressure, the degree of surface roughness of the road and the general operating conditions.

2.3 Load Distribution to Subgrade Soil

Every vehicle, whether standing or moving, causes stress on the road pavement structure, which comprises of superimposed layers of materials above the level of natural soil subgrade, distributing vehicle loads to subgrade level (Figure 2-1). At the surface of the road, the intensity of the pressure is extreme and extents in a pyramidal shape through the thickness of the pavement structure and the underlying soil, usually named subgrade.

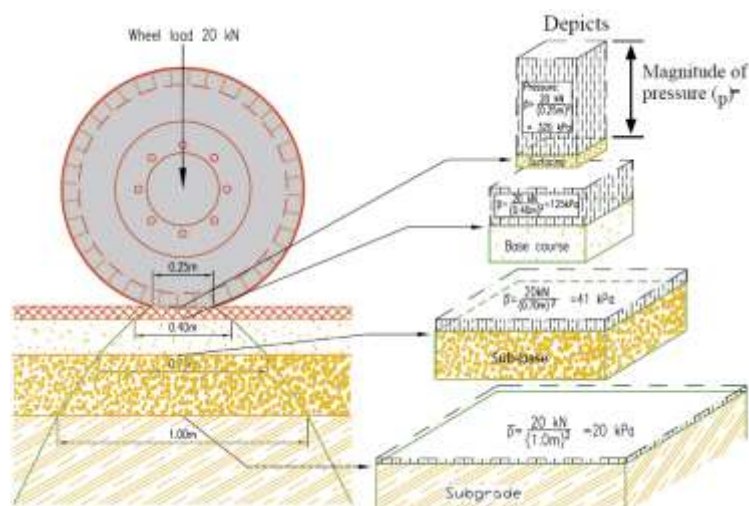


Figure 2-1: Typical Load Spreading in Road Pavement

¹ CSIR, Roads and Transport Technology, *The Damaging Effect of Overloaded Heavy Vehicles on Roads (4th Edition)*, Pretoria, South Africa, 1997

2.4 Factors Affecting Pavement Stresses

Following are the factors that affect the pavement stresses:

2.4.1 Tire Size

On the road surface, tire size of the vehicle determines the area of contact and as a result determines the area of unit load and load distribution. The tires of smaller size vehicle will produce a sharp curve with the road surface and therefore, the area of interaction would be small with additional unit load. Hence, the stress or pressure would differ directly with size of the tire.

Various studies performed indicate that the wider base tires are found to be less aggressive on pavement compared to the narrower base tires. Moreover, the effect of the wide base tires was greater in the thin pavement structure or in other words the damaging effect of wide base tires is greater on thin pavements².

2.4.2 Tire Pressure

The vehicular tires when over-inflated far in excess of their normal pressure shall results in reduction of their contact areas with the road surface. The excessive wheel loads with reduced tire contact areas ultimately exert pressures far in excess of safe bearing capacity of the road pavement structure. When overloaded trucks run on flexible road pavements having unbound bases, signs of distress (rutting) quickly appear after the facility is opened to traffic. The effects of high inflation pressures are most obvious in the upper layers of pavement and have relatively little differential effects at greater depths³ (Figure 2.2).

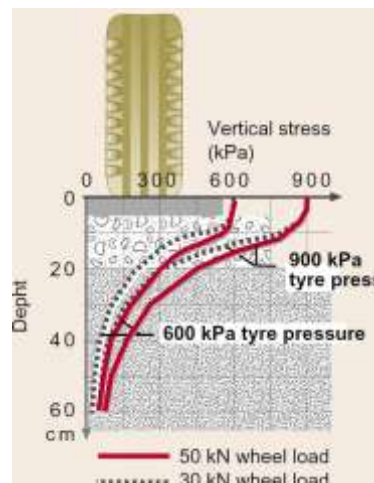


Figure 2-2: Damaging Influence of Tire Pressure (1 kPa = 0.145 psi ; 1 KN = 0.225 kips)

Various studies of tire pressure effects on pavement performance showed that increased tire pressure resulted in increase of pavement distresses due to both cracking and rutting. Tire inflation pressure was also found related to the shape of pavement ruts.

2.4.3 Wheel Configuration

Another important factor is the wheel load which defines the depth of the pavement required to ensure the non-failure of the subgrade soil. The extra wheel load has the

² ARRI Nisku Test Road Project, *Final Report*, 2010

³ C. A. O'Flaherty, Andrew Boyle, *Highways, The Location, Design, Construction and Maintenance of Road Pavements*, 4th Edition, 2002

effect of causing the vertical stress at the pavement subgrade interface, to be increased in direct proportion to the extra load. Therefore, it is clear that as the wheel load is increased, the depth of pavement must also be increased so that the permissible subgrade stress is not surpassed.

Wheel configuration affects the stress distribution and deflection within a pavement. Many commercial vehicles have dual rear wheels which ensure that the contact pressure is within the limits.

2.4.4 Axle Configurations

Axle configurations have a prominent effect on stress distribution and deflections. In the AASHTO Road Test, it is construed that the damaging power of the tandem axle sets was less than that of the two single axles together carrying the same load.

There are several possible basic vehicle wheel and axle arrangements such as single wheel, dual wheel, single axle, tandem axle and tridem axle. Their numbers and configuration greatly influence the dynamic loads transmitted to the road surface. Various studies conducted have indicated that multiple axle groups were found to be less damaging per tonnage than single axles. Increasing the number of axles carrying the same load resulted in less damage.

Research in OECD countries has revealed that road damage can be reduced by 20% through the use of well-designed air spring suspensions in place of leaf-spring suspensions on trucks. Recognizing the beneficial effects of improved suspension systems, the European Community permits 1-ton extra load per axle if the axle is fitted with pneumatic or equivalent suspension⁴.

2.4.5 Static vs Moving Load

When the vehicle is stationary, the loads applied on the pavement surface by the tires are constant. They are only due to the force of gravity. These loads are called static loads. In contrast, when the vehicle is moving along the road, road roughness stimulates the vehicle and it moves up and down causing dynamic variations to the loads, above and below their static values. Higher dynamic loads cause higher rates of pavement deterioration.

Various Test results have indicated that stresses tend to decrease as the vehicle speed increases from crawling speed to about 24 Kph. Above speed of 24 Kph, the values tend to be constant⁵. The magnitude of the variations depends on the vehicle dynamics, the road longitudinal profile and the travel speed. The variation generally increases with both the road roughness and the travel speed.

2.4.6 Load Repetitions

The influence of traffic on pavement not only depends on the magnitude of the wheel load, but also on the frequency of the load applications. Each load application causes some deformation and the total deformation is the summation of all these. Although the pavement deformation due to single axle load is very small, the cumulative effect of numerous load repetitions is significant.

2.5 Standard Axle Load

The axle load of a wheeled vehicle is the total weight sensed by the roadway for all

⁴ The World Bank, *Optimization of Axle Loads of Commercial Vehicles*, Asian Institute of Transport Development

⁵ National Transport Research Centre, Pakistan, *Axle Load Study on National Highways*, July 1995

wheels connected to a given axle. Different classifications of vehicles and different vehicles of the same category have enormous variations in axle loads due to variances in the type and amount of cargo being carried. Accordingly, to bring all axle loads to a uniform scale, different axle loads can be converted to standard equivalent axles on the basis of damaging effect to the road structure. Therefore, modern design is based on total number of standard axle load (usually 80 kN or 8 tons or 18 kips or 18,000 lb. single axle), as per AASHTO Standards.

2.5.1 Damaging Effect of Axle Load

Light vehicles such as cars and delivery vans contribute very little to the damage of the pavement. Heavy trucks and in particular those which are overloaded contribute significantly to the damage of the pavement, thus giving a shorter pavement life than designed for. Heavy vehicle wheel load, tire pressure, frequency and duration together with environmental factors are all important to the performance of the pavements. However, the most significant parameter is the axle load.

2.5.2 AASHTO Road Test

To take account of the magnitude and type of loads that a road will be subjected to during its design life, many attempts have been made to establish equivalency relationships between pavement performance and the magnitude of the axle load. A significant experiment in this regard was the Road Test conducted in the 1950s by the AASHTO.

The principal objective of the AASHTO Road Test research was to establish relationships between performance, structural design (i.e., component thicknesses of the pavement structure) and loading (i.e., the magnitude and rate of application of axle loads). The original axle load equivalency concept developed from the AASHTO Road Test was expressed in the form of a “**power law**”. Because a power of 4 was obtained from an analysis of the AASHTO Road Test data, the law became known as the “**Fourth Power Law**”.

$$LEF = \left(\frac{\text{Actual Axle Load}}{\text{Standard Axle Load}} \right)^4$$

By convention, an 18,000-lb single axle is 1.00 ESAL. The ESAL values for other axles express their effect on pavement wear relative to the 18,000-lb single axle. For example, on a flexible pavement, the load-equivalence factor for a 20,000-lb single axle is about 1.5 because $(20/18)^4$ is approximately equal to 1.5. Thus, 100 passes across a pavement by a 20,000-lb axle would have the same effect on pavement life as 150 passes by an 18,000-lb axle.

The relative damage to a pavement is the number of repetitions of a load that will result in pavement failure and increases very rapidly with increasing axle loads. When doubling the axle load, the damage will not just be doubled but will be increased twenty-fold (because the damage increases exponentially). This correlation indicates, for instance, that an axle carrying, twice the legal load has 22 times the damaging effect of a legal axle load.

2.5.3 AASHTO Pavement Design Guide, 1993

According to AASHTO Pavement Design Guide 1993, following equations will be used for calculating Axle Load Equivalency Factors for Flexible Pavement:

$$\text{Log} \left(\frac{W_{tx}}{W_t} \right) = 4.79 \log (L_1 + L_2) - 4.79 \log (L_{1x} + L_{2x}) + 4.33 \log L_{2x} + \frac{G_t}{B_x} - \frac{G_t}{B}$$

$$G_t = \log [(p_o - p_t) / (p_o - 1.5)]$$

$$B_x = 0.40 + [0.081(L_{1x} + L_{2x})^{3.23} / (SN+1)^{5.19} L_{2x}^{3.23}]$$

$$B = 0.40 + [0.081(L_1 + L_2)^{3.23} / (SN+1)^{5.19} L_2^{3.23}]$$

Where;

W_t = No. of Standard Axle Loads (usually 18k Axle Loads) at the end of time t.

W_{tx} = No. of Subject Axle Loads (Axle Loads to be converted) at the end of time t.

L_1 = Standard Axle Load in Kips

L_2 = No. of Axles in Standard Equivalent Axle Load

L_{1x} = Axle Load in Kips to be converted

L_{2x} = No. of Axles in Load to be converted

SN = Structural Number

P_o = Initial Serviceability Index

P_t = Terminal Serviceability Index

2.5.4 Overseas Road Note 40

According to Road Note 40, following relationship would be used to convert axle loads to equivalency factors per axle:

$$LEF = \left(\frac{\text{Axle Load (in tonnes)}}{8.16} \right)^{4.5}$$

2.5.5 Analysis Methodology Used

During the course of the axle load survey, each freight vehicle was weighed by weighing each axle of the vehicle individually. To obtain the equivalent standard axle value for the vehicle, following two approaches were considered for analyzing the collected survey data:

- Road Note 40
- AASHTO 1993

2.6 Axle Load Limit in Different Countries

Overloading of trucks on highways in Pakistan is very alarming. Road repairing and maintenance executing agencies are unable to deal with the menace over the past few decades. The commercial vehicles in Pakistan are mostly driven by the owners and because of the financial reasons, overloading of vehicular trucks is rampant in the country and increasing day by day. Axle loads have been defined in the governments' legislation but due to poor implementation of laws, overloading practice is wide spread and many trucks are overloaded.

The National Highways Safety Ordinance 2000, Pakistan stipulates maximum axle loads as following:

- Front axle – 5.5 tones
- Single axle - 12 tones
- Tandem axle – 22 tones
- Tridem axle – 31 tones

These regulations were passed in 2000. Till Now, same allowable limits are

implemented on road network of Pakistan (Table 2-1).

Table 2-1: Allowable Load Limits on National Highways & Motorways

Sr. No.	Description	Allowed on National Highways & Motorways
1	2 Axle Single (Bedford)	17.5
2	2 Axle Single (Hino / Nissan)	17.5
3	3 Axle Tandem	27.5
4	4 Axle Single Tandem	39.5
5	5 Axle Single Tridem	48.5
6	5 Axle Tandem Tandem	49.5
7	6 Axle Tandem Tridem	58.5

In developing countries, high axle loads are not uncommon, axle loads as high as 20 tons are observed with tire pressures in excess of normal allowable limits as provided in succeeding sub-sections.

2.6.1 India

The policy at National level for the road system in India with regard to the Registered Laden Weight limit (MOT, Govt. of India 1992) was as follows:

- Maximum Single Axle Load (with 2 Tyres) – 60 KN (6.0 T)
- Maximum Single Axle Load (with 4 Tyres) – 102 KN (10.2 T)
- Maximum Tandem Axle Load (with 8 Tyres) – 180 KN (18.0 T)

A statistical analysis on axle load distribution on Indian National Highway (NH-58) was carried out by Donia Savio, Pranjal Paul & J. Murali Krishnan, Dept. of Civil Engineering, Indian Institute of Technology Madras, Chennai in 2016. Analysis of the data revealed considerable amount of overloading. In 2018, Indian Road Ministry allowed in-use vehicles to raise axle load by 25%. The limits are revised for the first time since 1983.

2.6.2 The United States of America

The United States have a federal set of standards that specify the ‘minimum maximum’ that must be allowed on federally funded highways, which include the interstates and national network of highways. On these roads, there is a standard set of rules that truck drivers follow that are common across the country. These are the well-known weight limits of:

- Single Axle Weight: 20,000 lbs
- Tandem Axle Weight: 34,000 lbs

However, these weight limits differ from state to state. Along with these weight limits, there are bridge laws which restrict the spacing and weight of axle groupings.

2.6.3 South East Asia

An Assessment of Axle Load Control Operations in Greater Mekong Sub region Countries was carried out by ADB in 2019. According to the study, about 50% of the truck ADT on controlled roads is weighed in Cambodia, ranging up to 95% in Vietnam and Thailand. The rate of overloading on uncontrolled roads is estimated at 40% in Thailand, up to 75% in Lao and Yunnan (China); while the rate of overloading on controlled roads is less than 1% in Thailand, ranging up to 10% in Myanmar and Yunnan⁶.

⁶ Asian Development Bank, *Assessment of Axle Load Control Operations in Greater Mekong Sub Region Countries*, 2019

Current Axle Load Limit being followed in different countries is provided in Table 2-2 .

Table 2-2: Legal Load Limit in different Countries⁷

Sr. No.	Country	Legal Load Limit Single Non-Driven Axle (Ton)
1	Afghanistan	17.5
2	Australia	9
3	Bangladesh	10
4	China	11.5
5	Europe	11.5
6	India	10.2
7	Iran	13
8	Kazakhstan	10
9	Myanmar	10
10	Pakistan	12
11	Turkey	11.5
12	United States	9.1
13	Uzbekistan	8

⁷ Recommended Standards on Weights, Dimensions and Emissions of Freight Road Vehicles along the Asian Highway Network, Version 1

3 RESOURCES REQUIRED FOR AXLE LOAD SURVEY

3.1 General

In order to save and preserve road pavements of a region, timely and suitable maintenance and rehabilitation is required. This may only be done if proper data base is available with respect to a particular road. Data related to subgrade condition, pavement structure layer material properties, environment, traffic and load are important characteristics required to plan proper and timely maintenance and rehabilitation of the road asset. In order to properly collect the data regarding traffic loading, axle load survey is required on regular basis. Following Equipment can be used for conducting Axle Load Survey.

- Permanent Weigh Bridges
- Portable Weigh Pads
- Weigh in Motion

3.2 Equipment used for the Study

The Consultant carried out Axle Load Survey on existing weighing equipment installed at Ports and Dry Ports (Figure 3-1). However, at places where weigh bridge facility was not available or not in working condition, the Consultant has used Portable Weigh Pads technology (Table 3-1).



Figure 3-1: Existing Weighing Equipment

Table 3-1: Equipment used for Axle Load Survey at Ports & Dry Ports

Sr. No.	Port	Province	Survey Duration	Equipment Used
1	South Asia Pakistan Terminal (SAPT)	Sindh	October 29, 2020 to November 10, 2020	Existing Weighing Facility
	Karachi International Container Terminal (KICT)			Existing Weighing Facility
	Pakistan International Container Terminal (PICT)			Existing Weighing Facility
	East Wharf			Existing Weighing Facility
	West Wharf			Existing Weighing Facility

Sr. No.	Port	Province	Survey Duration	Equipment Used
2	Port Bin Qasim (PBQ)	Sindh	November 12, 2020 to November 15, 2020	Portable Weigh Pads
3	Pakistan International Bulk Terminal (PIBT)	Sindh		Existing Weighing Facility
4	Quetta Dry Port	Balochistan	November 21, 2020 to November 22, 2020	Portable Weigh Pads
5	Multan Dry Port	Punjab	November 25, 2020	Existing Weighing Facility
6	NLC Lahore Dry Port	Punjab	November 26, 2020 to November 27, 2020	Existing Weighing Facility
7	Premnagar Dry Port	Punjab	November 30, 2020	Existing Weighing Facility
8	Sialkot Dry Port	Punjab	December 3, 2020 to December 4, 2020	Existing Weighing Facility
9	Islamabad Dry Port	Federal	December 8, 2020 to December 9, 2020	Existing Weighing Facility
10	Peshawar Dry Port	KPK	December 11, 2020 to December 12, 2020	Existing Weighing Facility

3.2.1 Portable Weigh Pads

Portable Weigh Pads are small load meters that can be used singly or in pairs to measure the individual wheel or axle load of a vehicle (Figure 3-2). They have the advantage of being able to be set up almost anywhere and easy to operate. The disadvantages are that weighing at the roadside is not as safe as at an off-site location, slight disruption to traffic, and the weighing rate will be slower than a fixed weigh bridge.



Figure 3-2: Portable Weigh Pads

3.3 Specifications of the Portable Weighing Unit

The Consultant has used CAS, RW-15P Portable Weigh Pads (Figure 3-3). The capacity of weigh pad is 15 ton.



Product Characteristics

- Each axle load and load indication of truck are possible
- Outstanding waterproof and anti-dust effects
- Overload status can be checked when the vehicle passes
- Convenient transportation due to compact size
- Backlight function
- Stainless steel and aluminum materials





Figure 3-3: CAS RW-15P Weigh Pads

3.4 Calibration of Portable Weigh Pads

The portable weigh pads, as supplied by the manufacturer, were already calibrated and a certificate was provided by the supplier. The Consultant, however, recalibrated the equipment on periodic basis during axle load survey.

4 METHODOLOGY FOR AXLE LOAD SURVEY

4.1 Introduction

Pavement deterioration caused by traffic results from both the magnitude of the individual wheel loads and the number of times these loads are applied. It is therefore vital to know the traffic composition in terms of:

- Total traffic volume (AADT)
- Magnitude of the loads (axle load)
- Axle configuration
- Contact pressure from the loads (mainly from tire pressure)
- Number of load repetitions

The heavy vehicles cause major structural damage to the pavement as compared to the light vehicles such as cars and delivery vans. Heavy vehicle's wheel load, tire pressure, frequency and duration together with environmental factors such as rainfall, seasonal variations etc. are all important to the performance of the pavements. However, the most significant parameter is the axle load for which the present survey is being carried out to collect the quantitative axle loading data.

4.2 Data Collection

Quality data is one of the most important elements in the analysis procedure and referred as building block for any research work.

The primary and secondary data for the axle load survey was obtained using prescribed questionnaire form attached as Annex – 1. All the relevant data required for analysis has been covered in the questionnaire form. The data collected during survey includes load on each axle, gross weight, and the tire pressure of the trucks along with body type, containerization data, locking mechanism of containers, origin – destination, commodities carried etc.

4.3 Coordination with Relevant Departments

The Consultant visited the Ports and Dry Ports prior to execution of survey, to discuss purpose of survey with concerned officials of the Ports and to complete any formalities required by the relevant authority for according approval to conduct survey. The Client provided valuable input in this regard by issuing letters to concerned Port authorities on immediate basis to facilitate the Consultant's survey team, thereby ensuring that survey activity was not compromised.

4.4 Survey Duration & Timing

Precision of the axle load data largely depends upon the duration of the survey. As per TOR, 72-hour axle load surveys were conducted on Karachi Port and Port Qasim, whereas 48-hour surveys were conducted on Dry Ports. The axle load survey was conducted at in & out gates of Ports and Dry Ports.

West Wharf of KPT was not operational as the side only operates in case of high freight traffic on East Wharf. Due to shallow water depth, only small ships are docked there.





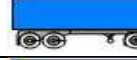

During axle load survey at Multan Dry Port, it was noted that volume of freight traffic is negligible.

4.5 Vehicle Categories & Axle Configuration

The traffic volume is composed of various vehicle types such as passenger cars, light trucks, medium trucks, heavy trucks, buses etc. The classification of heavy vehicles is based upon gross weight and or axle configuration (e.g. 3- axle single unit trucks, 6-axles multi-trailer etc.).

Axle configurations have a prominent effect on stress distribution and deflections. NHA has given truck classification according to number of axles and the truck weight. The same is adopted by the Consultants (Table 4-1).

Table 4-1: Vehicle Category & Axle Configuration

Sr. No.	Axle Configuration	Diagram	Permissible Gross Vehicle Weight (in Tons)	Code
1	2-Axle Single		17.5	1.2
2	3-Axle Single Tandem		27.5	1.22
3	4-Axle Single Tandem		39.5	1.2-22
4	5 Axle Single Tridem		48.5	1.2-222
5	5 Axle Tandem Tandem		49.5	1.22-22
6	6 Axle Tandem Tridem		58.5	1.22-222

4.6 Survey Management

Proper allocation and planning of manpower is essentially required for executing the project successfully. It needs a considerable number of manpower for its execution. The Consultant survey team consisted of 05 people working on a Two-shift (12 hours) basis with 2 people in each shift. Capacity building of the personnel was carried out prior to sending them in the field. A supervisor was heading the team who was responsible for the quality assurance of data.

4.7 Periodic Inspection by Client

The Client inspected axle load survey conducted by the Consultants on regular basis. The Client's officials visited the survey sites and examined the activity (Figure 4-1). The officials were very much impressed and appreciated the Consultant's progress and provided their feedback. The response of the Client was incorporated by the Consultant's site team while conducting survey.





Figure 4-1: Periodic Inspection by Client

4.8 Data Management

Axle load survey was carried out to determine axle load distribution of heavy vehicles using road network. The results of survey were used to calculate the equivalent standard axles for each vehicle type. The data acquired from survey was managed by adopting the following techniques:

4.8.1 Data Sorting

The axle load data obtained during survey was sorted separately for Ports and Dry Ports. Moreover, the axle load data was also arranged as per vehicular type, make type, body type and axle configuration. Apart from axle load data, additional information such as load type, origin- destination & loading mechanism on containers etc. was also organized for secondary analysis.

4.8.2 Data Checking

During digitization of data in MS Excel format, figures were cross checked for errors against raw data. It was particularly important to check all values for axle loads of overloaded vehicles to determine the degree of overloading or the errors / inflated average values (if any) because such values excessively affect average.

4.9 Provision of Data to NTRC

The raw data as obtained from survey and spreadsheets in MS Excel format along with summary of results of each Port and Dry Port was provided to NTRC regularly.

5 SUMMARY RESULTS FOR PORTS

5.1 General

Summary results of Axle Load Survey carried out at different Ports are discussed in this chapter and presented as tables and charts. Data gathered during the axle load survey was analyzed and interpreted before inclusion in the report.

5.1.1 Distribution of Vehicles by Axle Configuration on Ports

The percentage of trucks for major axle configurations surveyed on Ports is summarized in Table 5-1 and is graphically presented in Figure 5-1.

Table 5-1: Percentage of Vehicle w.r.t Axle Configuration on Ports

Sr. No.	Axle Configuration	Code	Total Number of Trucks	Percentage
1	2 Axle Single	1.2	15	1.34%
2	3 Axle Tandem	1.22	480	42.74%
3	4 Axle Single Tandem	1.2-22	342	30.45%
4	5 Axle Single Tridem	1.2-222	23	2.05%
5	5 Axle Tandem Tandem	1.22-22	18	1.60%
6	6 Axle Tandem Tridem	1.22-222	245	21.82%
Total			1123	100.00%

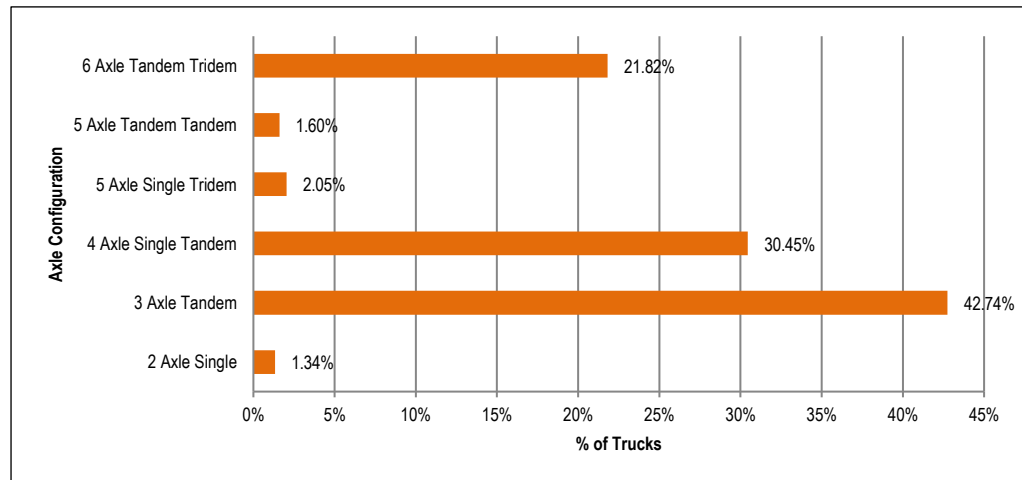


Figure 5-1: Percentage of Vehicles w.r.t Axle Configuration on Ports

5.1.2 Analysis by Axle Configuration on Ports

The analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration on Ports along with standard deviation and variance is presented in Table 5-2. The minimum, maximum and average loads are graphically presented in Figure 5-2 and Figure 5-3 respectively.

In case of **2 Axle Single**, maximum load of 21.26 ton with average load of 16.66 ton was recorded.

In case of **3 Axle Tandem**, maximum load of 61.29 ton with average load of 32.08 ton was recorded.

In case of **4 Axle Single Tandem**, maximum load of 61.09 ton with average load of 37.72 ton was recorded.

In case of **5 Axle Single Tridem**, maximum load of 64.57 ton with average load of 38.86 ton was recorded.

In case of **5 Axle Tandem Tandem**, maximum load of 74.50 ton with average load of 59.93 ton was recorded.

In case of **6 Axle Tandem Tridem**, maximum load of 99.99 ton with average load of 67.68 ton was recorded.

Table 5-2: Stdev, Var, Min, Max & Avg Load Comparison w.r.t Axle Configuration on Ports

Sr. No.	Axle Configuration	Permissible Load Limits	Parameters	Load (Tons)							
				Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total	
1	2 Axle Single	17.5	Min. Load	3.35	7.47						10.82
			Max. Load	6.59	15.30						21.26
			Avg. Load	4.99	11.67						16.66
			Standard Deviation	0.88	2.34						3.10
			Variance	0.78	5.49						9.59
2	3 Axle Tandem	27.5	Min. Load	1.79	3.17	3.17					8.14
			Max. Load	12.03	25.11	27.14					61.29
			Avg. Load	6.99	12.46	12.62					32.08
			Standard Deviation	1.62	2.90	2.94					7.42
			Variance	2.62	8.40	8.65					55.04
3	4 Axle Single Tandem	39.5	Min. Load	1.94	3.53	2.74	3.19				11.40
			Max. Load	10.39	18.94	17.84	19.13				61.09
			Avg. Load	6.26	11.39	9.35	10.83				37.72
			Standard Deviation	1.64	2.98	2.61	2.95				9.64
			Variance	2.68	8.87	6.81	8.70				92.94
4	5 Axle Single Tridem	48.5	Min. Load	1.91	3.37	2.93	3.08	3.37			14.67
			Max. Load	8.39	14.85	12.91	14.41	14.98			64.57
			Avg. Load	4.99	8.65	7.76	8.39	9.06			38.86
			Standard Deviation	1.96	3.36	3.08	3.59	3.73			15.51
			Variance	3.86	11.31	9.51	12.88	13.91			240.63
5	5 Axle Tandem Tandem	49.5	Min. Load	2.47	4.17	3.79	3.98	4.55			18.97
			Max. Load	9.69	16.39	14.90	15.65	17.88			74.50
			Avg. Load	7.79	13.19	11.99	12.59	14.38			59.93
			Standard Deviation	1.48	2.50	2.27	2.39	2.73			11.36
			Variance	2.18	6.25	5.16	5.69	7.43			129.08
6	6 Axle Tandem Tridem	58.5	Min. Load	1.53	2.60	2.76	2.45	2.76	3.22		15.32
			Max. Load	10.00	17.00	18.00	16.42	18.00	21.00		99.99
			Avg. Load	6.76	11.46	12.15	10.87	12.21	14.21		67.68
			Standard Deviation	1.49	2.49	2.64	2.40	2.67	3.08		14.71
			Variance	2.21	6.20	6.95	5.76	7.14	9.50		216.40

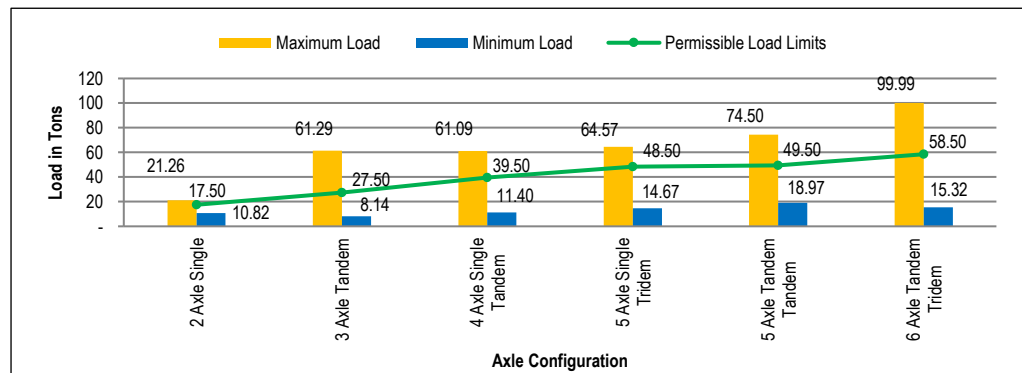


Figure 5-2: Min. & Max. Load Comparison w.r.t Axle Configuration on Ports

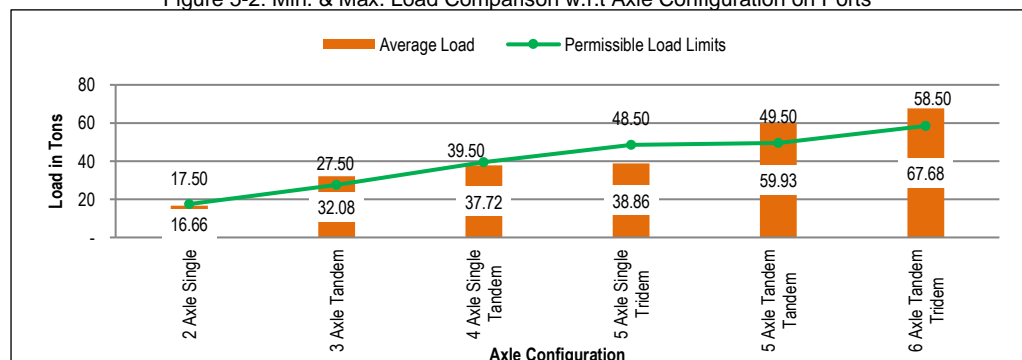


Figure 5-3: Avg. Load Comparison w.r.t Axle Configuration on Ports

5.1.3 Load Spectrum by Axle Configuration on Ports

The major cause of pavement failure is due to excessive overloading. The axle load survey data was organized in a way to identify the number of vehicles carrying load above and below permissible limits. Furthermore, load spectrums were identified and number of vehicles carrying load in specified spectrums were calculated. The results are tabulated in Table 5-3 which illustrates that:

In case of **2 Axle Single**, 53.33% of trucks carried load under permissible limits. Whereas, 13.33% of the trucks carried load more than 15% of permissible load limits.

In case of **3 Axle Tandem**, 12.92% of trucks carried load under permissible limits. Whereas, 46.88% of the trucks carried load more than 15% of permissible load limits.

In case of **4 Axle Single Tandem**, 41.81% of trucks/semi-trailers carried load under permissible limits. Whereas, 13.45% of the trucks/semi-trailers carried load more than 15% of permissible load limits.

In case of **5 Axle Single Tridem**, 73.91% of semi-trailers carried load under permissible limits. Whereas, 21.74% of the trucks carried load more than 15% of permissible load limits.

In case of **5 Axle Tandem Tandem**, 5.56% of semi-trailers carried load under permissible limits. Whereas, 77.78% semi-trailers carried load more than 15% of permissible load limits.

In case of **6 Axle Tandem Tridem**, 6.53% of semi-trailers carried load under permissible limits. Whereas, 43.67% semi-trailers carried load more than 15% of permissible load limits.

The percentage of trucks for major axle configuration carrying load above and below permissible limits on Ports is graphically presented in Figure 5-4.

Table 5-3: Load Spectrum w.r.t Axle Configuration on Ports

Sr. No.	Axle Configuration	Under Permissible Limit	Over Permissible Limit					Total
			15.00%	30.00%	50.00%	75.00%	>75%	
1	2 Axle Single	Max. Load (Tons)	17.5	20.1	22.8	26.3	30.6	
		Average Load (Tons)	14.31	18.60	21.24	-	-	-
		No. of Trucks	8	5	2	0	0	0
		Percentage	53.33%	33.33%	13.33%	0.00%	0.00%	0.00%
		Cumulative Percentage	53.33%	86.67%	100.00%	100.00%	100.00%	100%
		Percentage above Range Value	46.67%	13.33%	0.00%	0.00%	0.00%	0%
2	3 Axle Tandem	Max. Load (Tons)	27.5	31.6	35.8	41.3	48.1	
		Average Load (Tons)	18.92	29.94	34.07	37.99	42.84	53.08
		No. of Trucks	62	193	94	103	15	13
		Percentage	12.92%	40.21%	19.58%	21.46%	3.13%	2.71%
		Cumulative Percentage	12.92%	53.13%	72.71%	94.17%	97.29%	100%
		Percentage above Range Value	87.08%	46.88%	27.29%	5.83%	2.71%	0%
3	4 Axle Single Tandem	Max. Load (Tons)	39.5	45.4	51.4	59.3	69.1	
		Average Load (Tons)	29.14	42.76	47.13	53.06	61.09	-
		No. of Trucks	143	153	43	2	1	0
		Percentage	41.81%	44.74%	12.57%	0.58%	0.29%	0.00%
		Cumulative Percentage	41.81%	86.55%	99.12%	99.71%	100.00%	100%
		Percentage above Range Value	58.19%	13.45%	0.88%	0.29%	0.00%	0%
4	5 Axle Single Tridem	Max. Load (Tons)	48.5	55.8	63.1	72.8	84.9	
		Average Load (Tons)	32.21	50.58	57.76	64.57	-	-
		No. of Trucks	17	1	4	1	0	0
		Percentage	73.91%	4.35%	17.39%	4.35%	0.00%	0.00%
		Cumulative Percentage	73.91%	78.26%	95.65%	100.00%	100.00%	100%
		Percentage above Range Value	26.09%	21.74%	4.35%	0.00%	0.00%	0%
5		Max. Load (Tons)	49.5	56.9	64.4	74.3	86.6	
		Average Load (Tons)	18.97	55.80	61.64	67.18	74.50	-

Sr. No.	Axle Configuration	Under Permissible Limit	Over Permissible Limit					Total	
			15.00%	30.00%	50.00%	75.00%	>75%		
	5 Axle Tandem Tandem	No. of Trucks	1	3	10	3	1	0	18
		Percentage	5.56%	16.67%	55.56%	16.67%	5.56%	0.00%	100%
		Cumulative Percentage	5.56%	22.22%	77.78%	94.44%	100%	100%	
		Percentage above Range Value	94.44%	77.78%	22.22%	5.56%	0%	0%	
6	6 Axle Tandem Tridem	Max. Load (Tons)	58.5	67.3	76.1	87.8	102.4		
		Average Load (Tons)	21.16	66.39	69.36	80.79	96.79	-	
		No. of Trucks	16	122	62	32	13	0	245
		Percentage	6.53%	49.80%	25.31%	13.06%	5.31%	0.00%	100%
		Cumulative Percentage	6.53%	56.33%	81.63%	94.69%	100.00%	100%	
		Percentage above Range Value	93.47%	43.67%	18.37%	5.31%	0.00%	0%	

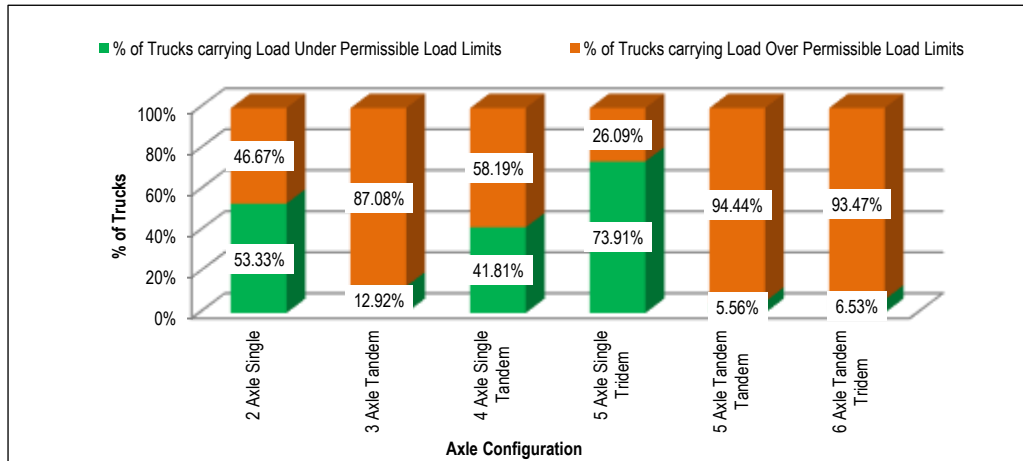


Figure 5-4: Percentage of Vehicles carrying Load above and below Permissible Limits on Ports

5.1.4 Front & Rear Axle Load Spectrum on Ports

The damaging effect of front axle in pavement structure is negligible. The rear axles including single, tandem and tridem have significant effect on the road deterioration. The spectrum of front and rear axle loads for major axle configurations is presented in Table 5-4.

Table 5-4: Front & Rear Axle Load Spectrum on Ports

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
Front Axle Load Spectrum					
1	0 - 2.99	72	6.41%	6.41%	93.59%
2	3 - 5.49	105	9.35%	15.76%	84.24%
3	5.5 - 6.99	511	45.50%	61.26%	38.74%
4	7 - 8.99	388	34.55%	95.81%	4.19%
5	9 - 10.99	37	3.29%	99.11%	0.89%
6	11 - 12.99	10	0.89%	100.00%	0.00%
7	13 - 14.99	0	0.00%	100.00%	0.00%
8	15 - 16.99	0	0.00%	100.00%	0.00%
9	17 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Single)					
1	0 - 8.16	364	10.74%	10.74%	89.26%
2	8.17 - 9.99	228	6.73%	17.46%	82.54%
3	10 - 10.99	399	11.77%	29.23%	70.77%
4	11 - 11.99	732	21.59%	50.83%	49.17%
5	12 - 12.99	608	17.94%	68.76%	31.24%
6	13 - 13.99	391	11.53%	80.29%	19.71%
7	14 - 14.99	381	11.24%	91.53%	8.47%
8	15 - 19.99	257	7.58%	99.12%	0.88%
9	20 & Above	30	0.88%	100.00%	0.00%
Rear Axle Load Spectrum (Tandem)					
1	0 - 11.99	78	7.07%	7.07%	92.93%
2	12 - 14.99	22	1.99%	9.07%	90.93%
3	15 - 19.99	85	7.71%	16.77%	83.23%
4	20 - 21.99	100	9.07%	25.84%	74.16%

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
5	22 - 23.99	397	35.99%	61.83%	38.17%
6	24 - 25.99	119	10.79%	72.62%	27.38%
7	26 - 27.99	112	10.15%	82.77%	17.23%
8	28 - 29.99	104	9.43%	92.20%	7.80%
9	30 & Above	86	7.80%	100.00%	0.00%
Rear Axle Load Spectrum (Tridem)					
1	0 - 14.99	22	8.21%	8.21%	91.79%
2	15 - 30.99	11	4.10%	12.31%	87.69%
3	31 - 32.99	0	0.00%	12.31%	87.69%
4	33 - 34.99	9	3.36%	15.67%	84.33%
5	35 - 36.99	105	39.18%	54.85%	45.15%
6	37 - 38.99	62	23.13%	77.99%	22.01%
7	39 - 40.99	6	2.24%	80.22%	19.78%
8	41 - 42.99	18	6.72%	86.94%	13.06%
9	43 & Above	35	13.06%	100.00%	0.00%

5.1.5 Distribution of Vehicles by Make Type on Ports

The distribution of trucks as per make type is illustrated in Table 5-5 and is graphically presented in Figure 5-5. The results depict that Hino and Nissan have maximum percentage of 56.67% and 29.36% respectively on Ports.

Table 5-5: Percentage of Vehicles w.r.t Make Type on Ports

Sr. No.	Make	Count	Percentage
1	Bedford	21	1.88%
2	Nissan	328	29.36%
3	Faw	10	0.90%
4	Hino	633	56.67%
5	Isuzu	35	3.13%
6	Mercedes	8	0.72%
7	UD	41	3.67%
8	Others	41	3.67%
Total		1116	100.00%

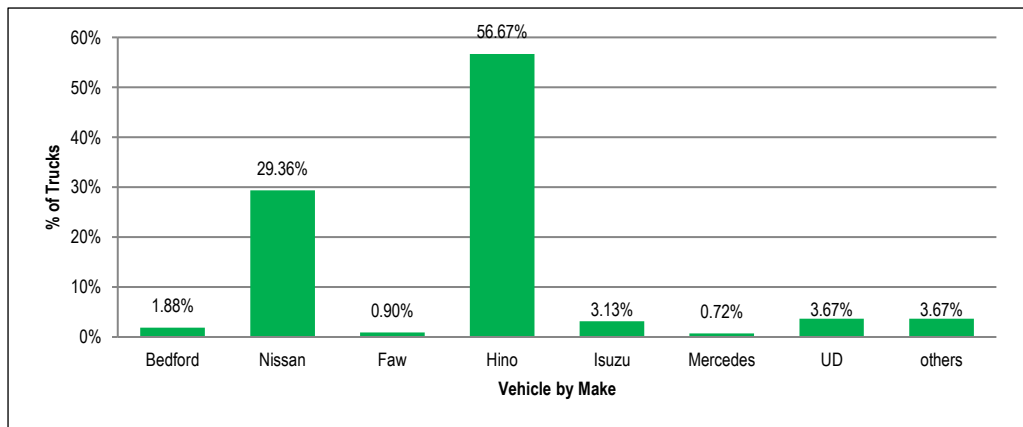


Figure 5-5: Percentage of Vehicles w.r.t Make Type on Ports

5.1.6 Analysis by Make Type on Ports

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to make type is presented in Table 5-6. The results depict that:

In case of **2 Axle Single**, Bedford constitutes maximum percentage of 66.67%, with average gross load of 17.29 ton, followed by Hino with percentage of 20%, carrying average gross load of 15.36 ton.

In case of **3 Axle Tandem**, Hino constitutes maximum percentage of 76.31%, with average gross load of 32.29 ton, followed by Nissan with percentage of 10.06%, carrying average gross load of 31.82 ton.

In case of **4 Axle Single Tandem**, Nissan constitutes maximum percentage of 55.43% with average gross load of 37.61 ton, followed by Hino with percentage of 35.78%, carrying average gross load of 38.08 ton.

In case of **5 Axle Single Tridem**, Hino and Nissan constitute equal percentage of 43.48%, with average gross load of 34.53 ton and 43.66 ton respectively.

In case of **5 Axle Tandem Tandem**, Nissan constitutes maximum percentage of 50%, with average gross load of 60.11 ton, followed by Other categories with percentage of 38.89%, carrying average gross load of 57.10 ton.

In case of **6 Axle Tandem Tridem**, Hino constitutes maximum percentage of 54.32%, with average gross load of 68.69 ton, followed by Nissan with percentage of 28.81%, carrying average gross load of 66.82 ton.

Table 5-6: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Make Type for major Axle Configuration on Ports

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Bedford	10	66.67%	Min. Load	3.93	8.76					12.69
					Max. Load	6.59	15.30				21.26	
					Avg. Load	5.09	12.19				17.29	
					Standard Deviation	0.73	2.11				2.62	
					Variance	0.53	4.43				6.89	
		Nissan	2	13.33%	Min. Load	4.36	9.72				14.08	
					Max. Load	5.24	11.66				16.90	
					Avg. Load	4.80	10.69				15.49	
					Standard Deviation	0.62	1.38				1.99	
					Variance	0.38	1.89				3.98	
		Hino	3	20.00%	Min. Load	3.35	7.47				10.82	
					Max. Load	6.58	14.63				21.21	
					Avg. Load	4.76	10.60				15.36	
					Standard Deviation	1.65	3.67				5.32	
					Variance	2.72	13.47				28.29	
Total	15	100.00%										
2	3 Axle Tandem	Bedford	11	2.31%	Min. Load	2.22	3.94	3.94				10.09
					Max. Load	8.49	15.04	15.04				38.57
					Avg. Load	5.60	9.93	9.93				25.46
					Standard Deviation	1.85	3.28	3.28				8.40
					Variance	3.42	10.73	10.73				70.57
		Hino	364	76.31%	Min. Load	1.79	3.17	3.17				8.14
					Max. Load	12.03	25.11	27.14				61.29
					Avg. Load	7.02	12.55	12.70				32.29
					Standard Deviation	1.56	2.80	2.85				7.18
					Variance	2.44	7.84	8.10				51.49
		Isuzu	20	4.19%	Min. Load	2.55	4.53	4.53				11.61
					Max. Load	8.94	15.85	15.85				40.65
					Avg. Load	6.84	12.14	12.22				31.19
					Standard Deviation	1.67	2.95	2.91				7.52
					Variance	2.80	8.71	8.45				56.50
		Nissan	48	10.06%	Min. Load	2.51	4.45	4.45				11.41
					Max. Load	11.87	21.04	21.04				53.95
					Avg. Load	6.94	12.28	12.59				31.82
					Standard Deviation	1.80	3.16	3.31				8.17
					Variance	3.24	10.01	10.97				66.69
		UD	11	2.31%	Min. Load	5.31	6.78	8.97				21.06
					Max. Load	11.08	19.65	19.65				50.38
					Avg. Load	8.13	14.12	14.51				36.67
					Standard Deviation	1.99	4.02	3.53				9.55
					Variance	3.98	16.14	12.44				91.25
		Others	23	4.82%	Min. Load	6.28	11.14	11.14				28.56
					Max. Load	11.68	20.71	20.71				53.09
Avg. Load	7.04				12.48	12.48				32.00		
Standard Deviation	1.12				1.98	1.98				5.08		
Variance	1.25				3.92	3.92				25.80		
Total	477	100.00%										
3	4 Axle Single Tandem	Hino	122	35.78%	Min. Load	2.14	3.91	3.03	3.53			12.61
					Max. Load	10.39	18.94	14.66	17.29			61.09
					Avg. Load	6.38	11.52	9.30	10.88			38.08
					Standard Deviation	1.81	3.29	2.51	2.99			10.25
					Variance	3.27	10.85	6.28	8.94			105.15
		Faw	1	0.29%	Min. Load	7.49	13.66	10.58	12.34			44.07
					Max. Load	7.49	13.66	10.58	12.34			44.07
					Avg. Load	7.49	13.66	10.58	12.34			44.07
					Standard Deviation	-	-	-	-			-
					Variance	-	-	-	-			-

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)								
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total		
		Isuzu	8	2.35%	Min. Load	2.73	4.98	3.86	4.50			16.07		
					Max. Load	8.13	14.82	13.74	14.51			47.80		
					Avg. Load	5.53	10.36	8.65	9.91			34.48		
					Standard Deviation	1.73	3.15	3.18	3.38			10.89		
		Nissan	189	55.43%	Min. Load	2.00	3.61	2.82	3.30			11.77		
					Max. Load	9.09	16.58	17.84	19.13			53.48		
					Avg. Load	6.21	11.39	9.38	10.80			37.61		
					Standard Deviation	1.49	2.71	2.62	2.86			9.02		
		UD	17	4.99%	Min. Load	2.27	4.14	3.20	3.74			13.34		
					Max. Load	8.73	15.93	13.20	15.98			51.38		
					Avg. Load	6.28	10.93	9.82	11.39			38.42		
					Standard Deviation	1.82	3.25	2.99	3.48			10.97		
		Euro-II	1	0.29%	Min. Load	1.94	3.53	3.03	3.19			11.40		
					Max. Load	1.94	3.53	2.74	3.19			11.40		
					Avg. Load	1.94	3.53	2.74	3.19			11.40		
					Standard Deviation	-	-	-	-			-		
		Others	3	0.88%	Min. Load	0.00	12.82	9.92	11.58			41.35		
					Max. Load	7.69	14.02	10.85	12.66			45.22		
					Avg. Load	7.29	13.30	10.30	12.01			42.91		
					Standard Deviation	0.35	0.63	0.49	0.57			2.04		
Total	341	100.00%	Variance	0.12	0.40	0.24	0.33			4.17				
			Min. Load	2.05	3.62	3.15	3.31	3.62		15.76				
			Max. Load	7.53	13.32	11.58	12.16	13.32		57.91				
			Avg. Load	4.52	7.76	6.95	7.30	8.01		34.53				
4	5 Axle Single Tridem	Hino	10	43.48%	Standard Deviation	2.05	3.40	3.15	3.31	3.65		15.51		
					Variance	4.19	11.56	9.95	10.95	13.32		240.46		
					Min. Load	4.99	8.83	7.68	8.07	8.83		38.41		
					Max. Load	4.99	8.83	7.68	8.07	8.83		38.41		
		Faw	1	4.35%	Avg. Load	4.99	8.83	7.68	8.07	8.83		38.41		
					Standard Deviation	-	-	-	-	-		-		
					Variance	-	-	-	-	-		-		
					Min. Load	1.91	3.37	2.93	3.08	3.37		14.67		
		Nissan	10	43.48%	Max. Load	8.39	14.85	12.91	14.41	14.85		64.57		
					Avg. Load	5.53	9.96	8.66	9.43	10.07		43.66		
					Standard Deviation	1.80	3.27	2.84	3.39	3.37		14.49		
					Variance	3.23	10.66	8.08	11.46	11.34		210.08		
		UD	1	4.35%	Min. Load	7.21	9.12	11.30	14.28	14.98		56.89		
					Max. Load	7.21	9.12	11.30	14.28	14.98		56.89		
					Avg. Load	7.21	9.12	11.30	14.28	14.98		56.89		
					Standard Deviation	-	-	-	-	-		-		
		Mercedes	1	4.35%	Variance	-	-	-	-	-		-		
					Min. Load	2.16	3.81	3.32	3.48	3.81		16.58		
					Max. Load	2.16	3.81	3.32	3.48	3.81		16.58		
					Avg. Load	2.16	3.81	3.32	3.48	3.81		16.58		
Total	23	100.00%	Standard Deviation	-	-	-	-	-		-				
			Variance	-	-	-	-	-		-				
			Min. Load	8.26	13.98	12.71	13.35	15.25		63.56				
			Max. Load	9.69	16.39	14.90	15.65	17.88		74.50				
5	5 Axle Tandem Tandem	Hino	2	11.11%	Avg. Load	8.97	15.19	13.81	14.50	16.57		69.03		
					Standard Deviation	1.01	1.70	1.55	1.62	1.86		7.74		
					Variance	1.01	2.90	2.39	2.64	3.45		59.84		
					Min. Load	7.19	12.16	11.06	11.61	13.27		55.28		
		Nissan	9	50.00%	Max. Load	9.17	15.51	14.10	14.81	16.92		70.50		
					Avg. Load	7.81	13.22	12.02	12.62	14.43		60.11		
					Standard Deviation	0.64	1.08	0.98	1.03	1.18		4.91		
					Variance	0.41	1.17	0.96	1.06	1.39		24.10		
		Others	7	38.89%	Min. Load	2.47	4.17	3.79	3.98	4.55		18.97		
					Max. Load	8.64	14.63	13.30	13.96	15.96		66.48		
					Avg. Load	7.42	12.56	11.42	11.99	13.70		57.10		
					Standard Deviation	2.20	3.72	3.39	3.56	4.06		16.93		
		Total	18	100.00%	Variance	4.84	13.87	11.47	12.64	16.51		286.64		
					Min. Load	1.53	2.60	2.76	2.45	2.76	3.22	15.32		
					Max. Load	10.00	17.00	18.00	16.00	18.00	21.00	99.99		
					Avg. Load	6.87	11.68	12.36	10.99	12.36	14.42	68.69		
		6	6 Axle Tandem Tridem	Hino	132	54.32%	Standard Deviation	1.53	2.60	2.75	2.45	2.75	3.21	15.29
							Variance	2.34	6.75	7.57	5.98	7.57	10.31	233.70
							Min. Load	6.41	10.89	11.53	10.25	11.53	13.45	64.07
							Max. Load	6.76	11.49	12.16	10.81	12.16	14.19	67.57
Faw	8			3.29%	Avg. Load	6.66	11.32	11.99	10.66	11.99	13.99	66.60		
					Standard Deviation	0.11	0.19	0.20	0.18	0.20	0.23	1.10		
					Variance	0.01	0.04	0.04	0.03	0.04	0.05	1.21		

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
		Isuzu	7	2.88%	Min. Load	6.70	11.38	12.05	10.71	12.05	14.06	66.95
					Max. Load	9.84	16.72	17.70	15.74	17.70	20.66	98.36
					Avg. Load	7.85	13.34	14.12	12.55	14.12	16.48	78.46
					Standard Deviation	1.48	2.51	2.66	2.36	2.66	3.10	14.76
		Nissan	70	28.81%	Min. Load	2.01	3.42	3.62	3.22	3.62	4.22	20.11
					Max. Load	9.73	14.88	15.76	16.42	16.99	18.38	87.54
					Avg. Load	6.68	11.24	11.95	10.82	12.11	14.02	66.82
					Standard Deviation	1.14	1.79	1.91	1.94	2.08	2.28	10.94
		UD	12	4.94%	Min. Load	5.11	9.72	11.31	10.48	11.79	13.76	65.50
					Max. Load	8.06	13.71	14.51	12.90	14.51	16.93	80.62
					Avg. Load	6.77	11.59	12.36	11.18	12.52	14.55	68.98
					Standard Deviation	0.74	1.07	1.00	0.93	0.97	1.11	5.33
		Mercedes	7	2.88%	Min. Load	2.13	3.63	3.84	3.41	3.84	4.48	21.33
					Max. Load	7.78	13.23	14.00	12.45	14.00	16.34	77.80
					Avg. Load	3.81	6.48	6.86	6.10	6.86	8.00	38.11
					Standard Deviation	2.63	4.48	4.74	4.22	4.74	5.53	26.35
		Others	7	2.88%	Min. Load	6.70	11.39	12.06	10.72	12.06	14.07	66.98
					Max. Load	9.06	14.93	15.81	14.05	15.81	18.44	87.82
					Avg. Load	7.64	12.77	13.49	12.14	13.63	15.70	75.36
					Standard Deviation	1.10	1.61	1.68	1.65	1.82	1.94	9.71
Total	243	100.00%	Variance	1.20	2.59	2.84	2.72	3.31	3.76	94.38		

5.1.7 Distribution of Vehicles by Body Type on Ports

The percentage of vehicles with respect to Body Type i.e. Flat, Half, Full & Container plying on Ports is tabulated in Table 5-7 and is graphically presented in Figure 5-6.

Table 5-7: Percentage of Vehicles w.r.t Body Type on Ports

Sr. No.	Body Type	Count	Percentage
1	Flat	329	29.51%
2	Half	103	9.24%
3	Full	72	6.46%
4	Covered	6	0.54%
5	Container	605	54.26%
	Total	1115	100.00%

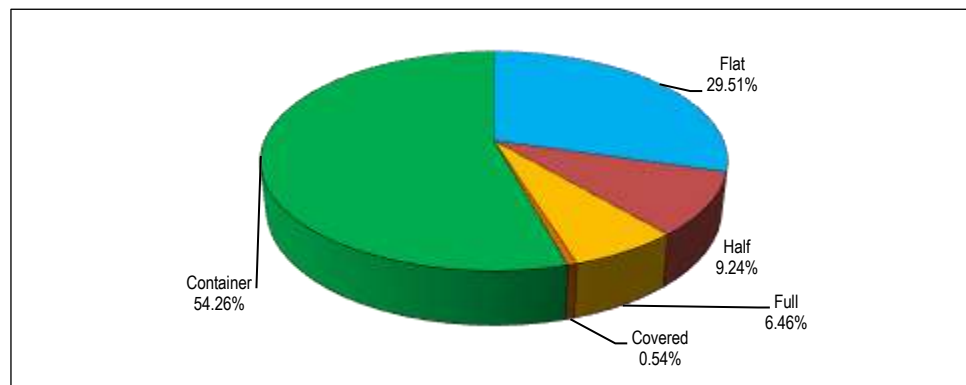


Figure 5-6: Percentage of Vehicles w.r.t Body Type on Ports

5.1.8 Analysis by Body Type on Ports

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to body type is presented in Table 5-8. The results depict that:

In case of **2 Axle Single**, container body type constitutes maximum percentage of 93.33%, with average gross load of 17.08 ton.

In case of **3 Axle Tandem**, container body type constitutes maximum percentage of 48.85%, with average gross load of 33.07 ton. However, maximum average gross load is observed in case of full body type i.e. 40.08 ton, constituting 6.50% of the total.

In case of **4 Axle Single Tandem**, container body type constitutes maximum percentage of 88.82%, with average gross load of 38.78 ton.

In case of **5 Axle Single Tridem**, container body type constitutes maximum percentage of 77.27%, with average gross load of 44.46 ton.

In case of **5 Axle Tandem Tandem**, container body type constitutes maximum percentage of 41.18%, with average gross load of 60.42 ton.

In case of **6 Axle Tandem Tridem**, half body type constitutes maximum percentage of 39.75%, with average gross load of 67.41 ton, followed by flat body type with percentage of 36.48%, carrying average gross load of 67.10 ton. The percentage of container body type on Port is 13.11%, carrying average gross load of 73.30 ton.

Table 5-8: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Body Type for major Axle Configuration on Ports

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Flat	1	6.67%	Min. Load	3.35	7.47					10.82
					Max. Load	3.35	7.47				10.82	
					Avg. Load	3.35	7.47				10.82	
					Standard Deviation	-	-				-	
					Variance	-	-				-	
		Container	14	93.33%	Min. Load	3.93	8.76				12.69	
					Max. Load	6.59	15.30				21.26	
					Avg. Load	5.10	11.97				17.08	
					Standard Deviation	0.79	2.11				2.74	
					Variance	0.62	4.45				7.52	
		Total	15	100.00%								
2	3 Axle Tandem	Flat	209	43.82%	Min. Load	1.79	3.17	3.17				8.14
					Max. Load	11.39	20.19	20.19				51.78
					Avg. Load	6.53	11.61	11.65				29.78
					Standard Deviation	1.27	2.26	2.30				5.80
					Variance	1.60	5.09	5.30				33.62
		Half	3	0.63%	Min. Load	6.09	10.80	10.80				27.70
					Max. Load	7.56	13.40	13.40				34.35
					Avg. Load	6.69	11.85	11.85				30.39
					Standard Deviation	0.77	1.37	1.37				3.50
					Variance	0.59	1.87	1.87				12.28
		Full	31	6.50%	Min. Load	2.26	4.01	4.01				10.27
					Max. Load	12.03	25.11	27.14				61.29
					Avg. Load	8.38	15.43	15.95				40.08
					Standard Deviation	3.03	5.51	5.52				13.69
					Variance	9.19	30.38	30.47				187.49
		Covered	1	0.21%	Min. Load	6.55	11.61	11.61				29.78
					Max. Load	6.55	11.61	11.61				29.78
					Avg. Load	6.55	11.61	11.61				29.78
					Standard Deviation	-	-	-				-
					Variance	-	-	-				-
		Container	233	48.85%	Min. Load	2.55	4.53	4.53				11.61
Max. Load	9.36				16.59	18.94				43.41		
Avg. Load	7.21				12.82	13.04				33.07		
Standard Deviation	1.50				2.61	2.56				6.68		
Variance	2.26				6.83	6.58				44.57		
Total	477	100.00%										
3	4 Axle Single Tandem	Flat	20	5.88%	Min. Load	1.94	3.53	2.74	3.19			11.40
					Max. Load	9.08	15.59	17.84	19.13			52.64
					Avg. Load	2.89	5.22	4.33	4.96			16.94
					Standard Deviation	1.90	3.30	3.62	3.89			11.05
					Variance	3.61	10.90	13.08	15.15			122.01
		full	14	4.12%	Min. Load	7.02	12.80	9.91	11.56			41.29
					Max. Load	7.67	13.98	10.82	12.63			45.10
					Avg. Load	7.42	13.53	10.47	12.22			43.63
					Standard Deviation	0.19	0.34	0.26	0.31			1.09
					Variance	0.03	0.11	0.07	0.09			1.19
		Half	3	0.88%	Min. Load	6.51	13.65	10.57	12.33			35.07
					Max. Load	9.09	16.58	16.54	17.91			53.48
					Avg. Load	7.70	14.78	13.31	15.07			44.19
					Standard Deviation	1.30	1.58	3.02	2.79			9.21
					Variance	1.70	2.48	9.09	7.80			84.75
		Covered	1	0.29%	Min. Load	8.55	15.60	12.08	14.09			50.32
					Max. Load	8.55	15.60	12.08	14.09			50.32
					Avg. Load	8.55	15.60	12.08	14.09			50.32
					Standard Deviation	-	-	-	-			-
					Variance	-	-	-	-			-

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)							
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total	
		Container	302	88.82%	Min. Load	2.01	3.61	2.84	3.31			11.83	
					Max. Load	10.39	18.94	15.11	17.29			61.09	
					Avg. Load	6.41	11.67	9.60	11.12			38.78	
					Standard Deviation	1.36	2.48	2.17	2.45			9.64	
					Variance	1.86	6.14	4.71	5.98			62.34	
	Total		340	100.00%									
4	5 Axle Single Tridem	Flat	4	18.18%	Min. Load	1.91	3.37	2.93	3.08	3.37		14.67	
					Max. Load	2.17	3.83	3.33	3.50	3.83		16.67	
					Avg. Load	2.07	3.66	3.18	3.34	3.66		15.92	
					Standard Deviation	0.12	0.21	0.19	0.19	0.21		0.93	
					Variance	0.01	0.05	0.03	0.04	0.05		0.86	
		full	1	4.55%	Min. Load	5.58	9.88	8.59	9.02	9.88		42.94	
					Max. Load	5.58	9.88	8.59	9.02	9.88		42.94	
					Avg. Load	5.58	9.88	8.59	9.02	9.88		42.94	
					Standard Deviation	-	-	-	-	-		-	
		Container	17	77.27%	Min. Load	2.61	4.62	4.02	4.22	4.62		20.10	
					Max. Load	8.39	14.85	12.91	14.41	14.98		64.57	
					Avg. Load	5.70	9.84	8.87	9.65	10.40		44.46	
					Standard Deviation	1.60	2.76	2.52	3.07	3.11		12.70	
					Variance	2.57	7.59	6.34	9.42	9.67		161.27	
			Total		22	100.00%							
5	5 Axle Tandem Tandem	Flat	6	35.29%	Min. Load	2.47	4.17	3.79	3.98	4.55		18.97	
					Max. Load	8.64	14.63	13.30	13.96	15.96		66.48	
					Avg. Load	7.36	12.45	11.32	11.89	13.58		56.60	
					Standard Deviation	2.40	4.07	3.70	3.88	4.44		18.48	
					Variance	5.77	16.54	13.67	15.07	19.68		341.65	
		Full	3	17.65%	Min. Load	7.19	12.16	11.06	11.61	13.27		55.28	
					Max. Load	8.26	13.99	12.71	13.35	15.26		63.57	
					Avg. Load	7.90	13.38	12.16	12.77	14.59		60.80	
					Standard Deviation	0.62	1.05	0.96	1.00	1.15		4.78	
		Covered	1	5.88%	Min. Load	8.23	13.93	12.67	13.30	15.20		63.33	
					Max. Load	8.23	13.93	12.67	13.30	15.20		63.33	
					Avg. Load	8.23	13.93	12.67	13.30	15.20		63.33	
					Standard Deviation	-	-	-	-	-		-	
		Container	7	41.18%	Min. Load	7.23	12.23	11.12	11.67	13.34		55.58	
					Max. Load	9.69	16.39	14.90	15.65	17.88		74.50	
					Avg. Load	7.85	13.29	12.08	12.69	14.50		60.42	
					Standard Deviation	0.83	1.41	1.28	1.35	1.54		6.41	
					Variance	0.69	1.99	1.64	1.81	2.37		41.10	
			Total		17	100.00%							
		6	6 Axle Tandem Tridem	Flat	89	36.48%	Min. Load	1.53	2.60	2.76	2.45	2.76	3.22
Max. Load	9.86						16.76	17.75	16.42	17.75	20.70	98.59	
Avg. Load	6.71						11.38	12.06	10.77	12.10	14.07	67.10	
Standard Deviation	1.75						2.94	3.12	2.84	3.16	3.65	17.44	
Variance	3.05						8.65	9.75	8.07	10.01	13.29	304.14	
Half	97			39.75%	Min. Load	2.13	3.63	3.84	3.41	3.84	4.48	21.33	
					Max. Load	10.00	17.00	18.00	16.00	18.00	21.00	99.99	
					Avg. Load	6.77	11.44	12.12	10.80	12.14	14.15	67.41	
					Standard Deviation	1.30	2.16	2.28	2.03	2.28	2.66	12.67	
Full	23			9.43%	Min. Load	2.30	3.90	4.13	3.67	4.13	4.82	22.95	
					Max. Load	8.01	13.61	14.41	12.81	14.41	16.81	80.07	
					Avg. Load	6.45	10.97	11.61	10.32	11.61	13.55	64.50	
					Standard Deviation	1.35	2.30	2.43	2.16	2.43	2.84	13.52	
Covered	3			1.23%	Min. Load	1.83	5.28	5.92	4.68	5.92	8.06	182.67	
					Max. Load	6.87	11.69	12.37	11.00	12.37	14.44	68.74	
					Avg. Load	8.47	14.40	15.24	13.55	15.24	17.78	84.69	
					Standard Deviation	7.41	12.59	13.33	11.85	13.33	15.55	74.07	
Container	32			13.11%	Min. Load	0.92	1.56	1.66	1.47	1.66	1.93	9.20	
					Max. Load	0.85	2.44	2.74	2.17	2.74	3.73	84.59	
					Avg. Load	2.56	4.35	4.61	4.09	4.61	5.37	25.59	
					Standard Deviation	8.12	13.80	0.00	14.84	15.11	17.05	81.17	
					Variance	7.23	12.28	13.08	11.94	13.36	15.41	73.30	
	Total				244	100.00%							

5.1.9 Distribution of Vehicles by Type on Ports

The percentage of vehicles with respect to Type i.e. Truck, Semi-Trailer and Tanker plying on Ports is tabulated Table 5-9 and is graphically presented in Figure 5-7.

Table 5-9: Percentage of Vehicles w.r.t Vehicle Type on Ports

Sr. No.	Vehicle Type	Count	Percentage
1	Truck	525	46.92%
2	Semi-Trailer	594	53.08%
Total		1119	100.00%

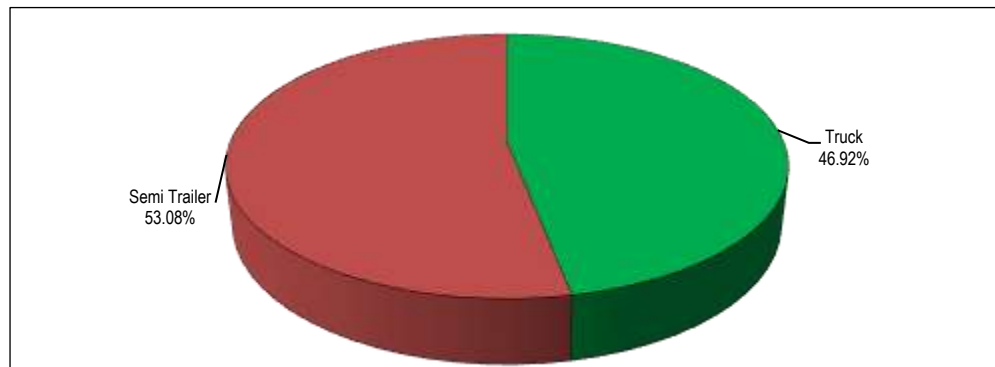


Figure 5-7: Percentage of Vehicles w.r.t Vehicle Type on Ports

5.1.10 Analysis by Vehicle Type on Ports

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to truck type is presented in Table 5-10. The results depict that:

In case of **2 Axle Single**, truck type constitutes maximum percentage of 100%, with average gross load of 16.56 ton.

In case of **3 Axle Tandem**, truck type constitutes maximum percentage of 98.33%, with average gross load of 32.09 ton, followed by semi-trailer type with percentage of 1.67%, carrying average gross load of 31.41 ton.

In case of **4 Axle Single Tandem**, semi-trailer type constitutes maximum percentage of 88.30%, with average gross load of 37.80 ton, followed by truck type with percentage of 11.70%, carrying average gross load of 37.17 ton.

In case of **5 Axle Single Tridem**, semi-trailer type constitutes maximum percentage of 95.45%, with average gross load of 39.02 ton, followed by truck type with percentage of 4.55%, carrying average gross load of 42.94 ton.

In case of **5 Axle Tandem Tandem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 59.93 ton.

In case of **6 Axle Tandem Tridem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 67.68 ton.

Table 5-10: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Vehicle Type for major Axle Configuration on Ports

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Truck	14	100.00%	Min. Load	3.35	7.47					10.82
					Max. Load	6.59	15.30				21.26	
					Avg. Load	4.94	11.61				16.56	
					Standard Deviation	0.90	2.42				3.19	
					Variance	0.81	5.86				10.16	
		Total	14	100.00%								
2	3 Axle Tandem	Truck	470	98.33%	Min. Load	1.79	3.17	3.17				8.14
					Max. Load	12.03	25.11	27.14			61.29	
					Avg. Load	6.99	12.46	12.62			32.09	
					Standard Deviation	1.61	2.88	2.92			7.37	
					Variance	2.58	8.30	8.54			54.37	
		Semi-Trailer	8	1.67%	Min. Load	2.51	4.45	4.45	0.00	0.00		11.41
					Max. Load	9.98	17.70	17.70	0.00	0.00	45.38	
					Avg. Load	6.97	12.08	12.36	-	-	31.41	
					Standard Deviation	2.44	4.29	4.34	0.00	0.00	11.03	
					Variance	5.98	18.40	18.80	0.00	0.00	121.63	
					Total	478	100.00%					

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
3	4 Axle Single Tandem	Semi-Trailer	302	88.30%	Min. Load	1.94	3.53	2.74	3.19	0.00		11.40
					Max. Load	10.39	18.94	17.84	19.13	0.00		61.09
					Avg. Load	6.26	11.39	9.40	10.87	-		37.80
					Standard Deviation	1.64	2.99	2.65	2.97	0.00		9.69
					Variance	2.70	8.96	7.02	8.82	0.00		93.85
		Min. Load	2.11	3.86	2.99	3.48	0.00		12.44			
		Max. Load	8.13	14.82	11.96	17.00	0.00		47.80			
		Avg. Load	6.23	11.41	8.99	10.54	-		37.17			
		Standard Deviation	1.60	2.90	2.29	2.81	0.00		9.38			
		Variance	2.58	8.41	5.25	7.89	0.00		87.93			
Total		342	100.00%									
4	5 Axle Single Tridem	Truck	1	4.55%	Min. Load	5.58	9.88	8.59	9.02	9.88		42.94
					Max. Load	5.58	9.88	8.59	9.02	9.88		42.94
					Avg. Load	5.58	9.88	8.59	9.02	9.88		42.94
					Standard Deviation	-	-	-	-	-		-
					Variance	-	-	-	-	-		-
		Min. Load	1.91	3.37	2.93	3.08	3.37		14.67			
		Max. Load	8.39	14.85	12.91	14.41	14.98		64.57			
		Avg. Load	5.01	8.66	7.79	8.45	9.11		39.02			
		Standard Deviation	2.05	3.50	3.21	3.74	3.88		16.16			
		Variance	4.19	12.26	10.32	13.98	15.09		261.00			
Total		22	100.00%									
5	5 Axle Tandem Tandem	Semi-Trailer	18	100.00%	Min. Load	2.47	4.17	3.79	3.98	4.55		18.97
					Max. Load	9.69	16.39	14.90	15.65	17.88		74.50
					Avg. Load	7.79	13.19	11.99	12.59	14.38		59.93
					Standard Deviation	1.48	2.50	2.27	2.39	2.73		11.36
					Variance	2.18	6.25	5.16	5.69	7.43		129.08
Total		18	100.00%									
6	6 Axle Tandem Tridem	Semi-Trailer	245	100.00%	Min. Load	1.53	2.60	2.76	2.45	2.76	3.22	15.32
					Max. Load	10.00	17.00	18.00	16.42	18.00	21.00	99.99
					Avg. Load	6.76	11.45	12.15	10.87	12.21	14.21	67.68
					Standard Deviation	1.49	2.49	2.64	2.40	2.67	3.08	14.71
					Variance	2.21	6.20	6.95	5.76	7.14	9.50	216.40
Total		245	100.00%									

5.1.11 Commodities carried by vehicles on Ports

The percentage of major commodities carried by heavy vehicles on Ports is tabulated in Table 5-11 and is graphically presented in Figure 5-8. For the sake of analysis, each commodity is assigned a code; details are attached in Annex – 2.

Table 5-11: Percentage of Vehicle w.r.t Commodities on Ports

Sr. No.	Commodity Type	Code	Count	Percentage
1	Agriculture Items	100	224	19.95%
2	Food Items	200	106	9.44%
3	Animals and Animal Products	300	37	3.29%
4	Raw Materials	400	13	1.16%
5	Bulk Manufactures	500	146	13.00%
6	Basic Manufactures	600	170	15.14%
7	Miscellaneous Manufactures	700	30	2.67%
8	Mining and Quarrying	800	47	4.19%
9	Fuel, Lubricants (Minerals)	900	129	11.49%
10	Miscellaneous Goods not Classified	A00	168	14.96%
11	Empty	E00	53	4.72%
Total			1123	100.00%

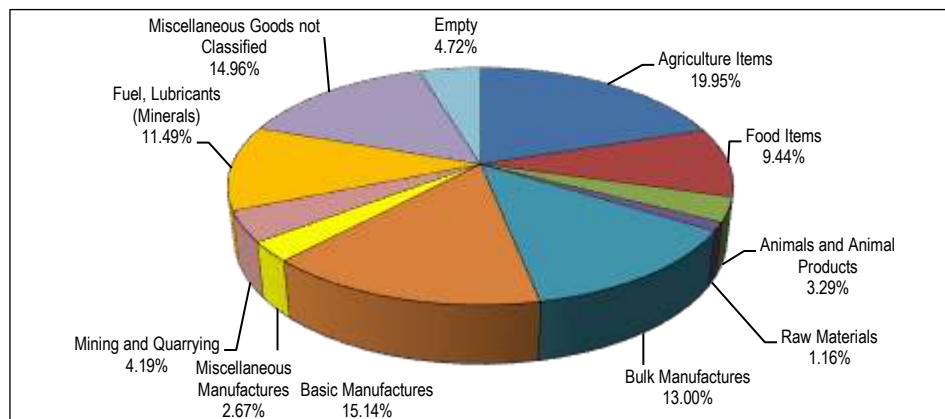


Figure 5-8: Percentage of Vehicles w.r.t Commodities on Ports

5.1.12 Analysis based on Commodities on Ports

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to commodities carried by trucks is presented in Table 5-12. The results depict that:

Major commodities carried by **2 Axle Single** are basic manufactures, covering 46.67% of the total, with average gross load of 15.60 ton, followed by bulk manufactures having percentage of 20% in total, with average gross load of 17.76 ton.

Major commodities carried by **3 Axle Tandem** are agriculture items, covering 31.04% of the total, with average gross load of 32.23 ton, followed by bulk manufactures having percentage of 18.13% in total, with average gross load of 30.29 ton.

Major commodities carried by **4 Axle Single Tandem** are basic manufactures, covering 29.24% of the total, with average gross load of 40.33 ton, followed by miscellaneous goods not classified, having percentage of 23.98% in total, with average gross load of 40.31 ton.

Major commodities carried by **5 Axle Single Tridem** are miscellaneous goods not classified, covering 47.83% of the total, with average gross load of 34.10 ton, followed by basic manufactures, having percentage of 21.74% in total, with average gross load of 46.69 ton.

Major commodities carried by **5 Axle Tandem Tandem** are bulk manufactures and miscellaneous goods not classified, covering 44.44% each of the total, with average gross load of 63.89 ton and 52.84 ton respectively.

Major commodities carried by **6 Axle Tandem Tridem** are fuel, lubricants (minerals), covering 39.59% of the total, with average gross load of 66.71 ton, followed by agriculture items, having percentage of 17.55% in total, with average gross load of 69.12 ton.

Table 5-12: Stdev. Var., Min., Max. & Avg. Load Comparison w.r.t Commodities for major Axle Configuration on Ports

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Agriculture Items	100	1	6.67%	Min. Load	5.36	12.74					18.10
						Max. Load	5.36	12.74					18.10
						Avg. Load	5.36	12.74					18.10
						Standard Deviation	-	-					-
						Variance	-	-					-
		Food Items	200	1	6.67%	Min. Load	4.98	11.08					16.06
						Max. Load	4.98	11.08					16.06
						Avg. Load	4.98	11.08					16.06
						Standard Deviation	-	-					-
						Variance	-	-					-
		Bulk Manufactures	500	3	20.00%	Min. Load	4.44	9.88					14.32
						Max. Load	4.95	15.30					20.02
						Avg. Load	4.70	13.06					17.76
						Standard Deviation	0.26	2.83					3.03
						Variance	0.07	7.99					9.17
		Basic Manufactures	600	7	46.67%	Min. Load	3.93	8.76					12.69
						Max. Load	5.62	12.50					18.12
						Avg. Load	4.84	10.76					15.60
						Standard Deviation	0.65	1.44					2.09
						Variance	0.42	2.07					4.35
		Miscellaneous Goods not Classified	A00	2	13.33%	Min. Load	6.58	14.63					21.21
Max. Load	6.59					14.67					21.26		
Avg. Load	6.58					14.65					21.24		
Standard Deviation	0.01					0.02					0.04		
Variance	0.00					0.00					0.00		
Empty	E00	1	6.67%	Min. Load	3.35	7.47					10.82		
				Max. Load	3.35	7.47					10.82		
				Avg. Load	3.35	7.47					10.82		
				Standard Deviation	-	-					-		
				Variance	-	-					-		
Total			15	100.00%									

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)					Total	
							Front	Rear 1	Rear 2	Rear 3	Rear 4		Rear 5
2	3 Axle Tandem	Agriculture Items	100	149	31.04%	Min. Load	5.10	7.76	10.26				26.52
						Max. Load	11.39	20.19	20.19				51.78
						Avg. Load	6.99	12.49	12.63				32.23
						Standard Deviation	0.83	1.47	1.54				3.71
		Variance	0.69	2.17	2.37				13.77				
		Food Items	200	45	9.38%	Min. Load	3.15	6.78	8.97				21.06
						Max. Load	12.03	21.32	21.32				54.66
						Avg. Load	8.31	14.82	15.11				38.23
						Standard Deviation	2.18	3.68	3.29				9.07
		Variance	4.77	13.52	10.85				82.21				
		Animals and Animal Products	300	11	2.29%	Min. Load	5.41	9.59	9.59				24.60
						Max. Load	9.16	16.24	16.24				41.63
						Avg. Load	6.88	11.97	12.19				31.04
						Standard Deviation	1.30	2.35	2.31				5.90
		Variance	1.70	5.54	5.35				34.77				
		Raw Materials	400	7	1.46%	Min. Load	6.35	11.26	11.26				28.87
						Max. Load	9.36	16.59	16.59				42.54
						Avg. Load	8.14	14.43	14.43				37.01
						Standard Deviation	0.98	1.74	1.74				4.45
		Variance	0.96	3.01	3.01				19.79				
		Bulk Manufactures	500	87	18.13%	Min. Load	5.93	10.51	10.51				26.95
						Max. Load	8.30	14.72	14.72				37.74
						Avg. Load	6.66	11.81	11.81				30.29
						Standard Deviation	0.28	0.50	0.50				1.28
		Variance	0.08	0.25	0.25				1.65				
		Basic Manufactures	600	55	11.46%	Min. Load	3.33	5.90	5.90				15.14
						Max. Load	10.90	25.11	27.14				61.29
						Avg. Load	7.16	12.70	12.94				32.77
Standard Deviation	1.80					3.59	3.75				8.99		
Variance	3.25	12.90	14.07				80.81						
Miscellaneous Manufactures	700	8	1.67%	Min. Load	3.34	5.91	5.91				15.16		
				Max. Load	7.87	13.94	13.94				35.75		
				Avg. Load	6.09	10.84	10.97				27.90		
				Standard Deviation	1.68	2.96	2.89				7.51		
Variance	2.84	8.73	8.33				56.34						
Mining and Quarrying	800	43	8.96%	Min. Load	5.89	11.24	12.72				13.97		
				Max. Load	9.26	16.33	18.95				41.88		
				Avg. Load	7.87	14.30	14.83				36.77		
				Standard Deviation	1.01	1.23	1.18				4.36		
Variance	1.02	1.51	1.38				19.04						
Fuel, Lubricants (Minerals)	900	15	3.13%	Min. Load	5.13	9.09	9.09				23.31		
				Max. Load	9.98	17.70	17.70				45.38		
				Avg. Load	7.31	12.97	12.97				33.25		
				Standard Deviation	1.65	2.92	2.92				7.48		
Variance	2.71	8.51	8.51				55.92						
Miscellaneous Goods not Classified	A00	40	8.33%	Min. Load	2.26	4.01	4.01				10.27		
				Max. Load	9.28	16.45	16.45				42.18		
				Avg. Load	7.16	12.82	12.86				32.83		
				Standard Deviation	1.49	2.50	2.51				6.41		
Variance	2.22	6.23	6.28				41.04						
Empty	E00	20	4.17%	Min. Load	1.79	3.17	3.17				8.14		
				Max. Load	3.25	5.64	5.64				14.45		
				Avg. Load	2.48	4.31	4.34				11.12		
				Standard Deviation	0.40	0.63	0.64				1.63		
Variance	0.16	0.40	0.40				2.67						
Total				480	100.00%								
3	4 Axle Single Tandem	Agriculture Items	100	29	8.48%	Min. Load	3.94	5.96	5.56	6.48			23.15
						Max. Load	8.64	13.92	14.23	17.29			47.09
						Avg. Load	5.76	10.69	9.91	11.40			37.74
						Standard Deviation	1.23	2.10	2.48	2.77			7.16
		Variance	1.51	4.39	6.13	7.65			51.25				
		Food Items	200	16	4.68%	Min. Load	4.79	8.74	6.77	7.90			28.20
						Max. Load	10.39	18.94	14.66	17.11			61.09
						Avg. Load	7.11	12.97	10.04	11.71			41.84
						Standard Deviation	1.56	2.85	2.20	2.57			9.18
		Variance	2.44	8.11	4.86	6.61			84.34				
		Animals and Animal Products	300	23	6.73%	Min. Load	3.94	7.19	5.57	6.49			23.19
						Max. Load	8.08	14.73	11.96	17.00			47.50
						Avg. Load	6.63	12.15	9.63	11.42			39.84
						Standard Deviation	1.18	2.06	1.68	2.29			6.70
		Variance	1.38	4.23	2.82	5.25			44.93				
		Raw Materials	400	6	1.75%	Min. Load	4.95	5.86	5.86	5.86			23.44
						Max. Load	7.06	12.82	13.74	14.51			44.68
						Avg. Load	5.85	10.39	10.84	11.58			38.71
						Standard Deviation	0.98	2.43	2.90	3.09			8.13
		Variance	0.96	5.89	8.39	9.54			66.03				
Bulk Manufactures	500	14	4.09%	Min. Load	4.29	7.82	6.06	7.06			25.23		
				Max. Load	8.55	15.60	12.08	14.09			50.32		
				Avg. Load	6.79	12.37	9.58	11.18			39.91		

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)					Total
							Front	Rear 1	Rear 2	Rear 3	Rear 4	
		Basic Manufactures	600	100	29.24%	Standard Deviation	1.05	1.91	1.48	1.73		6.18
						Variance	1.10	3.66	2.20	2.99		38.13
						Min. Load	2.99	4.20	4.95	5.78		20.64
						Max. Load	9.08	15.59	17.84	19.13		52.64
						Avg. Load	6.63	11.95	10.19	11.71		40.33
		Miscellaneous Manufactures	700	19	5.56%	Standard Deviation	1.01	1.79	1.94	1.96		5.43
						Variance	1.02	3.21	3.76	3.82		29.52
						Min. Load	4.02	7.32	5.67	6.61		23.62
						Max. Load	8.73	15.93	12.33	14.39		51.38
						Avg. Load	6.43	11.72	9.07	10.58		37.80
		Mining and Quarrying	800	4	1.17%	Standard Deviation	1.11	2.03	1.57	1.83		6.55
						Variance	1.24	4.13	2.47	3.37		42.92
						Min. Load	6.51	12.15	9.41	10.97		35.07
						Max. Load	7.38	14.11	16.54	17.91		43.40
						Avg. Load	6.98	13.28	11.69	13.29		40.24
		Fuel, Lubricants (Minerals)	900	17	4.97%	Standard Deviation	0.46	0.82	3.27	3.13		3.96
						Variance	0.21	0.67	10.69	9.79		15.69
						Min. Load	7.02	12.80	9.91			41.29
						Max. Load	9.09	16.58	12.84			53.48
						Avg. Load	7.53	13.73	10.63			44.30
Miscellaneous Goods not Classified	A00	82	23.98%	Standard Deviation	0.44	0.80	0.62			2.58		
				Variance	0.19	0.64	0.38			6.64		
				Min. Load	3.52	6.42	4.97	5.80		20.72		
				Max. Load	8.25	15.04	13.35	14.11		48.51		
				Avg. Load	6.80	12.40	9.74	11.36		40.31		
Empty	E00	32	9.36%	Standard Deviation	1.11	2.03	1.61	1.86		6.42		
				Variance	1.23	4.10	2.58	3.46		41.24		
				Min. Load	1.94	3.53	2.74	3.19		11.40		
				Max. Load	3.24	5.91	4.58	5.34		19.07		
				Avg. Load	2.46	4.43	3.46	4.03		14.38		
Total			342	100%								
4	5 Axle Single Tridem	Agriculture Items	100	2	8.70%	Min. Load	4.24	7.50	6.52	6.84	7.50	32.59
						Max. Load	5.28	9.34	8.12	8.53	9.34	40.61
						Avg. Load	4.76	8.42	7.32	7.69	8.42	36.60
						Standard Deviation	0.74	1.30	1.13	1.19	1.30	5.67
						Variance	0.54	1.70	1.29	1.42	1.70	32.16
		Animals and Animal Products	300	1	4.35%	Min. Load	4.07	7.21	6.27	6.58	7.21	31.34
						Max. Load	4.07	7.21	6.27	6.58	7.21	31.34
						Avg. Load	4.07	7.21	6.27	6.58	7.21	31.34
						Standard Deviation	-	-	-	-	-	-
						Variance	-	-	-	-	-	-
		Bulk Manufactures	500	2	8.70%	Min. Load	5.15	9.12	7.93	8.32	9.12	39.64
						Max. Load	7.21	9.12	11.30	14.28	14.98	56.89
						Avg. Load	6.18	9.12	9.61	11.30	12.05	48.27
						Standard Deviation	1.45	0.00	2.38	4.21	4.15	12.20
						Variance	2.12	0.00	5.69	17.73	17.19	148.78
		Basic Manufactures	600	5	21.74%	Min. Load	5.12	9.07	7.88	8.28	9.07	39.42
						Max. Load	6.84	12.14	10.59	14.41	13.28	56.26
						Avg. Load	5.83	10.22	9.29	10.41	10.94	46.69
						Standard Deviation	0.66	1.20	1.26	2.48	1.81	6.87
						Variance	0.44	1.45	1.58	6.14	3.27	47.26
Miscellaneous Manufactures	700	2	8.70%	Min. Load	4.99	8.83	7.68	8.07	8.83	38.41		
				Max. Load	5.94	10.51	9.14	9.59	10.51	45.68		
				Avg. Load	5.47	9.67	8.41	8.83	9.67	42.05		
				Standard Deviation	0.67	1.18	1.03	1.08	1.18	5.14		
				Variance	0.45	1.40	1.06	1.17	1.40	26.43		
Miscellaneous Goods not Classified	A00	11	47.83%	Min. Load	1.91	3.37	2.93	3.08	3.37	14.67		
				Max. Load	8.39	14.85	12.91	13.56	14.85	64.57		
				Avg. Load	4.43	7.84	6.82	7.16	7.84	34.10		
				Standard Deviation	2.63	4.64	4.04	4.24	4.64	20.19		
				Variance	6.89	21.57	16.31	17.98	21.57	407.74		
Total			23	100.00%								
5	5 Axle Tandem Tandem	Food Items	200	2	11.11%	Min. Load	9.17	15.51	14.10	14.81	16.92	70.50
						Max. Load	9.69	16.39	14.90	15.65	17.88	74.50
						Avg. Load	9.43	15.95	14.50	15.23	17.40	72.50
						Standard Deviation	0.37	0.62	0.57	0.59	0.68	2.83
						Variance	0.14	0.39	0.32	0.35	0.46	8.00
		Bulk Manufactures	500	8	44.44%	Min. Load	8.14	13.77	12.52	13.14	15.02	62.59
						Max. Load	8.64	14.63	13.30	13.96	15.96	66.48
						Avg. Load	8.31	14.06	12.78	13.42	15.33	63.89
						Standard Deviation	0.15	0.26	0.24	0.25	0.28	1.18
						Variance	0.02	0.07	0.06	0.06	0.08	1.38
		Miscellaneous Goods not Classified	A00	8	44.44%	Min. Load	2.47	4.17	3.79	3.98	4.55	18.97
						Max. Load	7.79	13.19	11.99	12.59	14.39	59.96
						Avg. Load	6.87	11.62	10.57	11.10	12.68	52.84
						Standard Deviation	1.79	3.04	2.76	2.90	3.31	13.80
						Variance						

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
						Variance	3.22	9.22	7.62	8.40	10.97	190.40	
		Total		18	100.00%								
6	6 Axle Tandem Tridem	Agriculture Items	100	43	17.55%	Min. Load	6.36	10.82	11.46	10.18	11.46	13.36	63.64
						Max. Load	8.12	13.80	14.61	12.99	14.61	17.05	81.17
						Avg. Load	6.91	11.75	12.44	11.06	12.44	14.52	69.12
						Standard Deviation	0.43	0.72	0.77	0.68	0.77	0.89	4.26
						Variance	0.18	0.52	0.59	0.46	0.59	0.80	18.15
		Food Items	200	42	17.14%	Min. Load	6.88	11.69	12.38	11.00	12.38	14.44	68.78
						Max. Load	10.00	17.00	18.00	16.00	18.00	21.00	99.99
						Avg. Load	8.45	14.37	15.21	13.52	15.21	17.75	84.51
						Standard Deviation	0.95	1.62	1.72	1.52	1.72	2.00	9.53
						Variance	0.91	2.62	2.94	2.32	2.94	4.00	90.80
		Animals and Animal Products	300	2	0.82%	Min. Load	5.11	9.72	11.31	12.42	13.20	14.72	66.48
						Max. Load	7.04	11.98	12.71	14.84	15.11	15.99	77.67
						Avg. Load	6.08	10.85	12.01	13.63	14.16	15.36	72.08
						Standard Deviation	1.36	1.60	0.99	1.71	1.35	0.90	7.91
						Variance	1.86	2.55	0.98	2.93	1.82	0.81	62.61
		Bulk Manufactures	500	32	13.06%	Min. Load	6.13	10.42	11.03	9.80	11.03	12.87	61.28
						Max. Load	8.04	13.18	13.95	13.51	14.97	16.53	77.57
						Avg. Load	6.76	11.43	12.13	10.84	12.19	14.19	67.54
						Standard Deviation	0.43	0.62	0.67	0.76	0.83	0.88	4.08
						Variance	0.19	0.38	0.45	0.58	0.69	0.77	16.62
		Basic Manufactures	600	3	1.22%	Min. Load	5.86	10.94	12.11	13.15	14.94	15.12	72.12
						Max. Load	9.06	13.91	14.71	16.42	16.99	17.66	87.41
						Avg. Load	7.67	12.46	13.79	14.51	15.81	16.48	81.06
						Standard Deviation	1.64	1.49	1.45	1.70	1.06	1.28	7.97
						Variance	2.69	2.21	2.12	2.89	1.12	1.64	63.50
		Miscellaneous Manufactures	700	1	0.41%	Min. Load	7.43	12.63	13.37	11.88	13.37	15.60	74.27
						Max. Load	7.43	12.63	13.37	11.88	13.37	15.60	74.27
						Avg. Load	7.43	12.63	13.37	11.88	13.37	15.60	74.27
Standard Deviation	-					-	-	-	-	-	-		
Variance	-					-	-	-	-	-	-		
Fuel, Lubricants (Minerals)	900	97	39.59%	Min. Load	6.06	10.09	10.91	9.70	10.91	12.73	60.60		
				Max. Load	9.73	11.54	12.21	12.70	13.41	15.06	72.51		
				Avg. Load	6.70	11.32	11.99	10.69	12.01	14.01	66.71		
				Standard Deviation	0.33	0.21	0.18	0.26	0.23	0.23	1.15		
				Variance	0.11	0.04	0.03	0.07	0.05	0.05	1.32		
Miscellaneous Goods not Classified	A00	25	10.20%	Min. Load	1.53	2.60	2.76	2.45	2.76	3.22	15.32		
				Max. Load	7.04	11.97	12.68	11.27	12.68	14.79	70.42		
				Avg. Load	3.87	6.57	6.96	6.18	6.96	8.12	38.65		
				Standard Deviation	2.39	4.07	4.31	3.83	4.31	5.02	23.92		
				Variance	5.72	16.53	18.54	14.64	18.54	25.23	572.07		
		Total		245	100.00%								

5.1.13 Damage Factor for major Axle Configuration on Ports

As discussed in section 2.5.5, damage factors or load equivalency factors have been calculated using following two approaches, i.e. AASHTO 1993 and Road Note 40. The average damage factors calculated for major axle configuration are presented in Table 5-13.

Table 5-13: Damage Factor for major Axle Configuration on Ports

Sr. No.	Axle Configuration	Code	Damage Factor (2020)	
			Road Note 40	AASHTO 1993
1	2 Axle Single	1.2	6.51	4.70
2	3 Axle Tandem	1.22	20.26	9.89
3	4 Axle Single Tandem	1.2-22	14.87	9.39
4	5 Axle Single Tridem	1.2-222	11.31	5.92
5	5 Axle Tandem Tandem	1.22-22	40.60	19.79
6	6 Axle Tandem Tridem	1.22-222	42.19	17.36

5.1.14 Distribution of Loaded & Empty Trucks on Ports

The percentage of loaded and empty trucks on Ports is tabulated in Table 5-14.

Table 5-14: Distribution of Loaded and Empty Trucks on Ports

Sr. No.	Axle Configuration	Loaded		Empty		Total	
		Count	%age	Count	%age	Count	%age
1	2 Axle Single	14	93.33%	1	6.67%	15	100.00%
2	3 Axle Tandem	460	95.83%	20	4.17%	480	100.00%
3	4 Axle Single Tandem	310	90.64%	32	9.36%	342	100.00%
4	5 Axle Single Tridem	18	78.26%	5	21.74%	23	100.00%
5	5 Axle Tandem Tandem	17	94.44%	1	5.56%	18	100.00%
6	6 Axle Tandem Tridem	229	93.47%	16	6.53%	245	100.00%

Sr. No.	Axle Configuration	Loaded		Empty		Total	
		Count	%age	Count	%age	Count	%age
7	Others	9	100.00%	0	0.00%	9	100.00%
Total		1057	93.37%	75	6.63%	1132	100%

5.1.15 Locking Mechanism of Containers on Ports

The containers are locked into place on a truck/semi-trailer for securing it from any harmful incident. Depending upon the locking mechanism, they are classified as fully secured, partially secured and un-secured. The Consultant has collected this information during axle load survey and is presented in Table 5-15.

Table 5-15: Percentage of Containers as Fully Secured, Partially Secured and Un-Secured on Ports

Sr. No.	Description	Count	%age
1	Fully Secured	474	95.75%
2	Partially Secured	20	4.04%
3	Un- Secured	1	0.20%
Total		495	100.00%

6 SUMMARY RESULTS FOR DRY PORTS

6.1 General

Summary results of Axle Load Survey carried out at different Dry Ports are discussed in this chapter and presented as tables and charts. Data gathered during the axle load survey was analyzed and interpreted before inclusion in the report.

6.1.1 Distribution of Vehicles by Axle Configuration on Dry Ports

The percentage of trucks for major axle configurations surveyed on Dry Ports is summarized in Table 6-1 and is graphically presented in Figure 6-1.

Table 6-1: Percentage of Vehicles w.r.t Axle Configuration on Dry Ports

Sr. No.	Axle Configuration	Code	Total Number of Trucks	Percentage
1	2 Axle Single	1.2	28	8.62%
2	3 Axle Tandem	1.22	81	24.92%
3	4 Axle Single Tandem	1.2-22	114	35.08%
4	5 Axle Single Tridem	1.2-222	40	12.31%
5	5 Axle Tandem Tandem	1.22-22	1	0.31%
6	6 Axle Tandem Tridem	1.22-222	41	12.62%
7	Others	-	20	6.15%
Total			325	100.00%

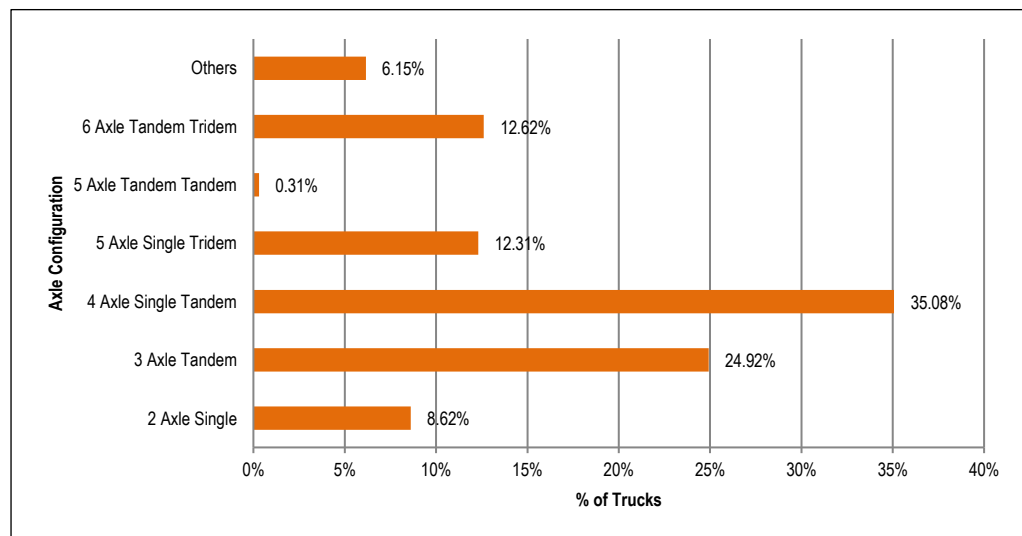


Figure 6-1: Percentage of Vehicles w.r.t Axle Configuration on Dry Ports

6.1.2 Analysis by Axle Configuration on Dry Ports

The analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration on Dry Ports along with standard deviation and variance is presented in Table 6-2. The minimum, maximum and average loads are graphically presented in Figure 6-2 and Figure 6-3 respectively.

In case of **2 Axle Single**, maximum load of 36.68 ton with average load of 18.79 ton was recorded.

In case of **3 Axle Tandem**, maximum load of 44.35 ton with average load of 32.41 ton was recorded.

In case of **4 Axle Single Tandem**, maximum load of 54.92 ton with average load of 37.03 ton was recorded.

In case of **5 Axle Single Tridem**, maximum load of 58.67 ton with average load of 46.74 ton was recorded.

In case of **6 Axle Tandem Tridem**, maximum load of 111.00 ton with average load of 72.06 ton was recorded.

At Sialkot Dry Port, 4-Axle category with tractor at front and 2 axle trailer at back was observed (Figure 6-4). Average load carried by this type of truck was 16.07 ton. The minimum and maximum load of 2.52 ton and 35.68 was observed at Sialkot Dry Port.

Table 6-2: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Axle Configuration on Dry Ports

Sr. No.	Axle Configuration	Permissible Load Limits	Parameters	Load (Tons)						
				Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	17.5	Min. Load	2.87	6.38					9.25
			Max. Load	11.37	25.31					36.68
			Avg. Load	5.82	12.97					18.79
			Standard Deviation	2.30	5.13					7.43
			Variance	5.31	26.31					55.26
2	3 Axle Tandem	27.5	Min. Load	3.15	5.59	5.59				14.33
			Max. Load	9.76	17.30	17.30				44.35
			Avg. Load	7.13	12.64	12.64				32.41
			Standard Deviation	1.72	3.05	3.05				7.82
			Variance	2.96	9.31	9.31				61.21
3	4 Axle Single Tandem	39.5	Min. Load	3.13	5.70	4.41	5.15			18.39
			Max. Load	9.34	17.03	13.18	15.38			54.92
			Avg. Load	6.29	11.48	8.89	10.37			37.03
			Standard Deviation	1.43	2.60	2.01	2.35			8.40
			Variance	2.04	6.77	4.06	5.53			70.48
4	5 Axle Single Tridem	48.5	Min. Load	3.99	7.07	6.15	6.45	7.07		30.73
			Max. Load	7.63	13.49	11.73	12.32	13.49		58.67
			Avg. Load	6.08	10.75	9.35	9.81	10.75		46.74
			Standard Deviation	0.87	1.53	1.33	1.40	1.53		6.67
			Variance	0.75	2.35	1.78	1.96	2.35		44.50
5	5 Axle Tandem Tandem	49.5	Min. Load	6.92	11.72	10.65	11.18	12.78		53.25
			Max. Load	6.92	11.72	10.65	11.18	12.78		53.25
			Avg. Load	6.92	11.72	10.65	11.18	12.78		53.25
			Standard Deviation	-	-	-	-	-		-
			Variance	-	-	-	-	-		-
6	6 Axle Tandem Tridem	58.5	Min. Load	4.58	7.78	8.24	7.32	8.24	9.61	45.77
			Max. Load	11.10	18.87	19.98	17.76	19.98	23.31	111.00
			Avg. Load	7.21	12.25	12.97	11.53	12.97	15.13	72.06
			Standard Deviation	1.91	3.24	3.43	3.05	3.43	4.00	19.06
			Variance	3.63	10.49	11.76	9.30	11.76	16.01	363.11
7	Others	-	Min. Load	1.01	1.51	1.77	2.16			2.52
			Max. Load	1.01	1.51	14.92	18.24			35.68
			Avg. Load	1.01	1.51	6.53	7.99			16.07
			Standard Deviation	0.00	0.00	3.66	4.47			8.68
			Variance	0.00	0.00	13.38	19.99			75.43

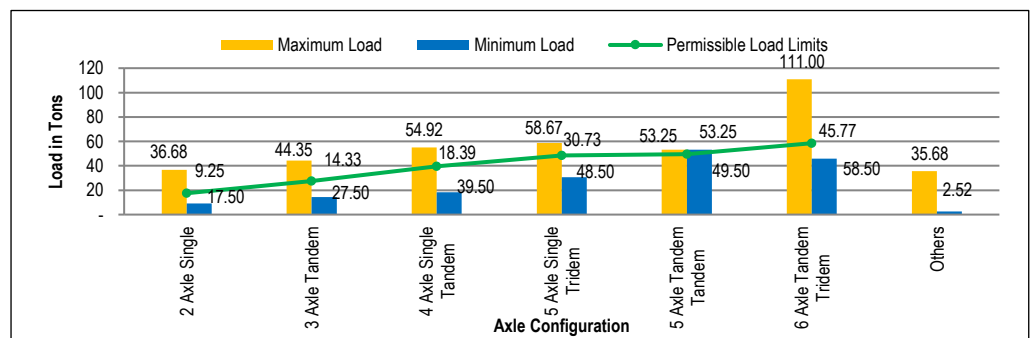


Figure 6-2: Min. & Max. Load Comparison w.r.t Axle Configuration on Dry Ports

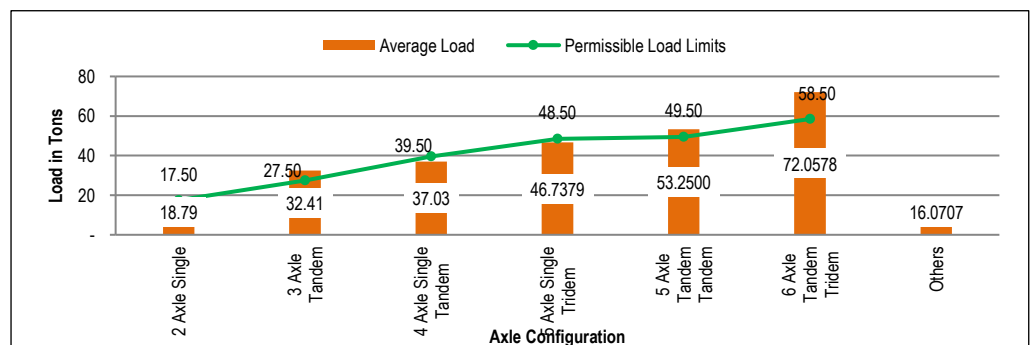


Figure 6-3: Avg. Load Comparison w.r.t Axle Configuration on Dry Ports



Figure 6-4: Other Axle Configuration at Sialkot Dry Port

6.1.3 Load Spectrum by Axle Configuration on Dry Ports

The major cause of pavement failure is due to excessive overloading. The axle load survey data was organized in a way to identify the number of vehicles carrying load above and below permissible limits. Furthermore, load spectrums were identified and number of vehicles carrying load in specified spectrums were calculated. The results are tabulated in Table 6-3 which illustrates that:

In case of **2 Axle Single**, 53.57% of trucks carried load under permissible limits. Whereas, 28.57% of the trucks carried load more than 15% of permissible load limits.

In case of **3 Axle Tandem**, 30.86% of trucks carried load under permissible limits. Whereas, 59.26% of the trucks carried load more than 15% of permissible load limits.

In case of **4 Axle Single Tandem**, 53.51% of trucks/semi-trailers carried load under permissible limits. Whereas, 14.04% of the trucks/semi-trailers carried load more than 15% of permissible load limits.

In case of **5 Axle Single Tridem**, 62.50% of semi-trailers carried load under permissible limits. Whereas, 12.50% semi-trailers carried load more than 15% of permissible load limits.

In case of **6 Axle Tandem Tridem**, 26.83% of semi-trailers carried load under permissible limits. Whereas, 56.10% semi-trailers carried load more than 15% of permissible load limits.

The percentage of trucks for major axle configuration carrying load above and below permissible limits on Dry Ports is graphically presented in Figure 6-5.

Table 6-3: Load Spectrum w.r.t Axle Configuration on Dry Ports

Sr. No.	Axle Configuration	Under Permissible Limit	Over Permissible Limit					Total	
			15.00%	30.00%	50.00%	75.00%	>75%		
1	2 Axle Single	Max. Load (Tons)	17.5	20.1	22.8	26.3	30.6		
		Average Load (Tons)	13.88	18.51	20.96	24.73	-	36.39	
		No. of Trucks	15	5	2	3	0	3	28
		Percentage	53.57%	17.86%	7.14%	10.71%	0.00%	10.71%	100%
		Cumulative Percentage	53.57%	71.43%	78.57%	89.29%	89.29%	100%	
		Percentage above Range Value	46.43%	28.57%	21.43%	10.71%	10.71%	0%	
2	3 Axle Tandem	Max. Load (Tons)	27.5	31.6	35.8	41.3	48.1		
		Average Load (Tons)	22.54	29.01	33.55	38.37	42.37	-	
		No. of Trucks	25	8	10	29	9	0	81
		Percentage	30.86%	9.88%	12.35%	35.80%	11.11%	0.00%	100%
		Cumulative Percentage	30.86%	40.74%	53.09%	88.89%	100.00%	100%	
		Percentage above Range Value	69.14%	59.26%	46.91%	11.11%	0.00%	0%	
3	4 Axle Single Tandem	Max. Load (Tons)	39.5	45.4	51.4	59.3	69.1		
		Average Load (Tons)	30.92	42.38	47.45	54.92	-	-	
		No. of Trucks	61	37	15	1	0	0	114
		Percentage	53.51%	32.46%	13.16%	0.88%	0.00%	0.00%	100%
		Cumulative Percentage	53.51%	85.96%	99.12%	100.00%	100.00%	100%	
		Percentage above Range Value	46.49%	14.04%	0.88%	0.00%	0.00%	0%	
4	5 Axle Single Tridem	Max. Load (Tons)	48.5	55.8	63.1	72.8	84.9		
		Average Load (Tons)	42.92	51.00	57.32	-	-	-	

Sr. No.	Axle Configuration	Under Permissible Limit	Over Permissible Limit					Total
			15.00%	30.00%	50.00%	75.00%	>75%	
	No. of Trucks	25	10	5	0	0	0	40
	Percentage	62.50%	25.00%	12.50%	0.00%	0.00%	0.00%	100%
	Cumulative Percentage	62.50%	87.50%	100.00%	100.00%	100.00%	100%	
	Percentage above Range Value	37.50%	12.50%	0.00%	0.00%	0.00%	0%	
	Max. Load (Tons)	49.5	56.9	64.4	74.3	86.6		
	Average Load (Tons)	-	53.25	-	-	-	-	
5	No. of Trucks	0	1	0	0	0	0	1
	Percentage	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	100%
	Cumulative Percentage	0.00%	100.00%	100.00%	100.00%	100%	100%	
	Percentage above Range Value	100.00%	0.00%	0.00%	0.00%	0%	0%	
	Max. Load (Tons)	58.5	67.3	76.1	87.8	102.4		
	Average Load (Tons)	51.16	60.85	70.63	79.00	97.21	111.00	
6	No. of Trucks	11	7	10	1	11	1	41
	Percentage	26.83%	17.07%	24.39%	2.44%	26.83%	2.44%	100%
	Cumulative Percentage	26.83%	43.90%	68.29%	70.73%	97.56%	100%	
	Percentage above Range Value	73.17%	56.10%	31.71%	29.27%	2.44%	0%	
	Max. Load (Tons)	58.5	67.3	76.1	87.8	102.4		
	Average Load (Tons)	51.16	60.85	70.63	79.00	97.21	111.00	

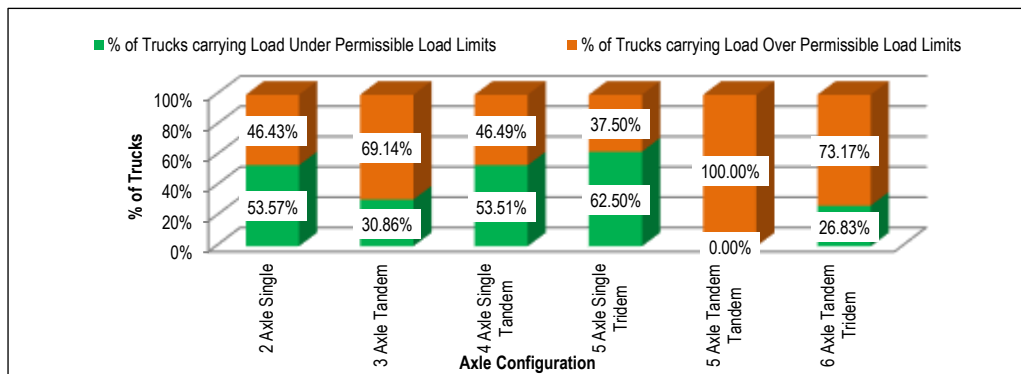


Figure 6-5: Percentage of Vehicles carrying Load above and below Permissible Limits on Dry Ports

6.1.4 Front & Rear Axle Load Spectrum on Dry Ports

The damaging effect of front axle in pavement structure is negligible. The rear axles including single, tandem and tridem have significant effect on the road deterioration. The spectrum of front and rear axle loads for major axle configurations is presented in Table 6-4.

Table 6-4: Front & Rear Axle Load Spectrum on Dry Ports

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
Front Axle Load Spectrum					
1	0 - 2.99	1	0.33%	0.33%	99.67%
2	3 - 5.49	79	25.90%	26.23%	73.77%
3	5.5 - 6.99	108	35.41%	61.64%	38.36%
4	7 - 8.99	90	29.51%	91.15%	8.85%
5	9 - 10.99	23	7.54%	98.69%	1.31%
6	11 - 12.99	4	1.31%	100.00%	0.00%
7	13 - 14.99	0	0.00%	100.00%	0.00%
8	15 - 16.99	0	0.00%	100.00%	0.00%
9	17 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Single)					
1	0 - 8.16	119	13.21%	13.21%	86.79%
2	8.17 - 9.99	197	21.86%	35.07%	64.93%
3	10 - 10.99	138	15.32%	50.39%	49.61%
4	11 - 11.99	115	12.76%	63.15%	36.85%
5	12 - 12.99	101	11.21%	74.36%	25.64%
6	13 - 13.99	55	6.10%	80.47%	19.53%
7	14 - 14.99	55	6.10%	86.57%	13.43%
8	15 - 19.99	109	12.10%	98.67%	1.33%
9	20 & Above	12	1.33%	100.00%	0.00%
Rear Axle Load Spectrum (Tandem)					
1	0 - 11.99	12	5.04%	5.04%	94.96%
2	12 - 14.99	15	6.30%	11.34%	88.66%
3	15 - 19.99	59	24.79%	36.13%	63.87%
4	20 - 21.99	33	13.87%	50.00%	50.00%

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
5	22 - 23.99	37	15.55%	65.55%	34.45%
6	24 - 25.99	21	8.82%	74.37%	25.63%
7	26 - 27.99	11	4.62%	78.99%	21.01%
8	28 - 29.99	15	6.30%	85.29%	14.71%
9	30 & Above	35	14.71%	100.00%	0.00%
Rear Axle Load Spectrum (Tridem)					
1	0 - 14.99	0	0.00%	0.00%	100.00%
2	15 - 30.99	35	43.21%	43.21%	56.79%
3	31 - 32.99	11	13.58%	56.79%	43.21%
4	33 - 34.99	5	6.17%	62.96%	37.04%
5	35 - 36.99	5	6.17%	69.14%	30.86%
6	37 - 38.99	10	12.35%	81.48%	18.52%
7	39 - 40.99	0	0.00%	81.48%	18.52%
8	41 - 42.99	2	2.47%	83.95%	16.05%
9	43 & Above	13	16.05%	100.00%	0.00%

6.1.5 Distribution of Vehicles by Make Type on Dry Ports

The distribution of trucks as per make type is illustrated in Table 6-5 and is graphically presented in Figure 6-6. The results depict that Hino and Nissan have maximum percentage by type of 62.25% and 24.83% on Dry Ports.

Table 6-5: Percentage of Vehicles w.r.t Make Type on Dry Ports

Sr. No.	Make	Count	Percentage
1	Bedford	1	0.33%
2	Nissan	75	24.83%
3	Hino	188	62.25%
4	Isuzu	4	1.32%
5	Mercedes	8	2.65%
6	UD	20	6.62%
7	Others	6	1.99%
Total		302	100.00%

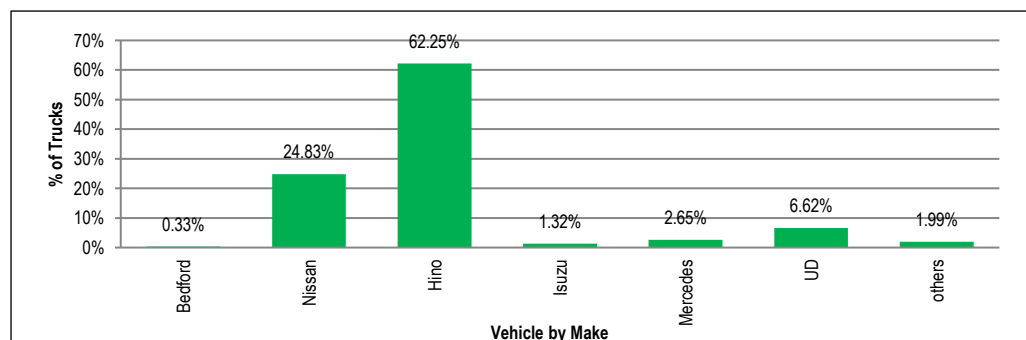


Figure 6-6: Percentage of Vehicles w.r.t Make Type on Dry Ports

6.1.6 Analysis by Make Type on Dry Ports

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to make type is presented in Table 6-6. The results depict that:

In case of **2 Axle Single**, Hino constitutes maximum percentage of 66.67%, with average gross load of 19.40 ton, followed by Nissan with percentage of 22.22%, carrying average gross load of 18.73 ton.

In case of **3 Axle Tandem**, Hino constitutes maximum percentage of 80.25%, with average gross load of 33.43 ton, followed by UD with percentage of 8.64%, carrying average gross load of 29.32 ton.

In case of **4 Axle Single Tandem**, Hino constitutes maximum percentage of 49.12% with average gross load of 36.07 ton, followed by Nissan with percentage of 42.98%, carrying average gross load of 36.65 ton.

In case of **5 Axle Single Tridem**, Hino constitutes maximum percentage of 50%, with average gross load of 47.46 ton, followed by Nissan with percentage of 27.50%, carrying average gross load of 46.27 ton.

In case of **6 Axle Tandem Tridem**, Hino constitutes maximum percentage of 70.73%, with average gross load of 72.32 ton, followed by Mercedes with percentage of 12.20%, carrying average gross load of 67.31 ton.

Table 6-6: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Make Type for major Axle Configuration on Dry Ports

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Nissan	6	22.22%	Min. Load	3.36	7.49					10.85
					Max. Load	11.37	25.31					36.68
					Avg. Load	5.81	12.92					18.73
					Standard Deviation	2.89	6.43					9.31
					Variance	8.34	41.30					86.74
		Hino	18	66.67%	Min. Load	2.87	6.38					9.25
					Max. Load	11.33	25.21					36.54
					Avg. Load	6.01	13.38					19.40
					Standard Deviation	2.35	5.23					7.57
					Variance	5.51	27.32					57.38
		Isuzu	2	7.41%	Min. Load	3.80	8.46					12.26
					Max. Load	4.19	9.34					13.53
					Avg. Load	4.00	8.90					12.90
					Standard Deviation	0.28	0.62					0.90
					Variance	0.08	0.38					0.81
		UD	1	3.70%	Min. Load	6.52	14.50					21.02
					Max. Load	6.52	14.50					21.02
					Avg. Load	6.52	14.50					21.02
					Standard Deviation	-	-					-
					Variance	-	-					-
Total	27	100.00%										
2	3 Axle Tandem	Bedford	1	1.23%	Min. Load	6.53	11.57	11.57				29.66
					Max. Load	6.53	11.57	11.57				29.66
					Avg. Load	6.53	11.57	11.57				29.66
					Standard Deviation	-	-	-				-
					Variance	-	-	-				-
		Hino	65	80.25%	Min. Load	3.62	6.41	6.41				16.44
					Max. Load	9.76	17.30	17.30				44.35
					Avg. Load	7.35	13.04	13.04				33.43
					Standard Deviation	1.68	2.98	2.98				7.63
					Variance	2.82	8.86	8.86				58.27
		Isuzu	1	1.23%	Min. Load	8.26	14.64	14.64				37.54
					Max. Load	8.26	14.64	14.64				37.54
					Avg. Load	8.26	14.64	14.64				37.54
					Standard Deviation	-	-	-				-
					Variance	-	-	-				-
		Nissan	5	6.17%	Min. Load	3.15	5.59	5.59				14.33
					Max. Load	7.12	12.63	12.63				32.38
					Avg. Load	5.61	9.94	9.94				25.49
					Standard Deviation	1.72	3.04	3.04				7.80
					Variance	2.95	9.26	9.26				60.86
UD	7	8.64%	Min. Load	3.96	7.02	7.02				-		
			Max. Load	9.50	16.83	16.83				43.17		
			Avg. Load	6.45	11.44	11.44				29.32		
			Standard Deviation	1.82	3.23	3.23				8.28		
			Variance	3.32	10.42	10.42				68.52		
Others	2	2.47%	Min. Load	4.94	8.76	8.76				22.45		
			Max. Load	6.57	11.64	11.64				29.85		
			Avg. Load	5.75	10.20	10.20				26.15		
			Standard Deviation	1.15	2.04	2.04				5.23		
			Variance	1.33	4.16	4.16				27.38		
Total	81	100.00%										
3	4 Axle Single Tandem	Hino	56	49.12%	Min. Load	3.13	5.70	4.41	5.15			18.39
					Max. Load	8.57	15.64	12.11	14.12			50.44
					Avg. Load	6.13	11.18	8.66	10.10			36.07
					Standard Deviation	1.50	2.73	2.12	2.47			8.81
					Variance	2.25	7.47	4.47	6.09			77.69
		Isuzu	1	0.88%	Min. Load	7.55	13.76	10.66	12.43			44.40
					Max. Load	7.55	13.76	10.66	12.43			44.40
					Avg. Load	7.55	13.76	10.66	12.43			44.40
					Standard Deviation	-	-	-	-			-
					Variance	-	-	-	-			-
		Nissan	49	42.98%	Min. Load	3.51	6.39	4.95	5.77			20.62
					Max. Load	9.34	17.03	13.18	15.38			54.92
					Avg. Load	6.23	11.36	8.80	10.26			36.65
					Standard Deviation	1.33	2.43	1.88	2.19			7.83

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)								
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total		
		Iveco	2	1.75%	Variance	1.77	5.89	3.53	4.80			61.25		
					Min. Load	6.92	12.62	9.77	11.40			40.72		
					Max. Load	7.36	13.42	10.39	12.12			43.30		
					Avg. Load	7.14	13.02	10.08	11.76			42.01		
					Standard Deviation	0.31	0.57	0.44	0.51			1.82		
		UD	6	5.26%	Variance	0.10	0.32	0.19	0.26			3.33		
					Min. Load	6.54	11.93	9.24	10.78			38.49		
					Max. Load	8.54	15.57	12.05	14.06			50.22		
					Avg. Load	7.85	14.31	11.08	12.93			46.17		
					Standard Deviation	0.70	1.27	0.99	1.15			4.11		
		Total	114	100.00%	Variance	0.49	1.62	0.97	1.32			16.85		
		4	5 Axle Single Tridem	Hino	20	50.00%	Min. Load	4.59	8.12	7.06	7.42	8.12		35.32
							Max. Load	7.63	13.49	11.73	12.32	13.49		58.67
							Avg. Load	6.17	10.92	9.49	9.97	10.92		47.46
Standard Deviation	0.82						1.46	1.27	1.33	1.46		6.34		
Variance	0.68						2.13	1.61	1.77	2.13		40.21		
Nissan	11			27.50%	Min. Load	3.99	7.07	6.15	6.45	7.07		30.73		
					Max. Load	7.36	13.03	11.33	11.90	13.03		56.65		
					Avg. Load	6.02	10.64	9.25	9.72	10.64		46.27		
					Standard Deviation	0.92	1.62	1.41	1.48	1.62		7.06		
					Variance	0.84	2.63	1.99	2.20	2.63		49.78		
UD	4			10.00%	Min. Load	4.69	8.30	7.22	7.58	8.30		36.09		
					Max. Load	6.67	11.80	10.26	10.78	11.80		51.31		
					Avg. Load	6.00	10.62	9.24	9.70	10.62		46.19		
					Standard Deviation	0.91	1.60	1.39	1.46	1.60		6.96		
					Variance	0.82	2.56	1.94	2.14	2.56		48.47		
Mercedes	3			7.50%	Min. Load	4.21	7.45	6.48	6.81	7.45		32.41		
					Max. Load	6.31	11.16	9.70	10.19	11.16		48.52		
					Avg. Load	5.27	9.33	8.11	8.52	9.33		40.57		
					Standard Deviation	1.05	1.85	1.61	1.69	1.85		8.06		
					Variance	1.10	3.43	2.60	2.86	3.43		64.92		
Others	2			5.00%	Min. Load	6.59	11.66	10.14	10.65	11.66		50.70		
					Max. Load	7.04	12.45	10.82	11.37	12.45		54.12		
					Avg. Load	6.81	12.05	10.48	11.01	12.05		52.41		
					Standard Deviation	0.31	0.56	0.48	0.51	0.56		2.42		
		Variance	0.10		0.31	0.23	0.26	0.31		5.85				
Total	40	100.00%												
5	5 Axle Tandem Tandem	UD	1	100.00%	Min. Load	6.92	11.72	10.65	11.18	12.78		53.25		
					Max. Load	6.92	11.72	10.65	11.18	12.78		53.25		
					Avg. Load	6.92	11.72	10.65	11.18	12.78		53.25		
					Standard Deviation	-	-	-	-	-		-		
					Variance	-	-	-	-	-		-		
Total	1	100.00%												
6	6 Axle Tandem Tridem	Hino	29	70.73%	Min. Load	4.58	7.78	8.24	7.32	8.24	9.61	45.77		
					Max. Load	11.10	18.87	19.98	17.76	19.98	23.31	111.00		
					Avg. Load	7.23	12.29	13.02	11.57	13.02	15.19	72.32		
					Standard Deviation	1.98	3.36	3.56	3.16	3.56	4.15	19.76		
					Variance	3.91	11.29	12.65	10.00	12.65	17.22	390.56		
		Nissan	4	9.76%	Min. Load	4.80	8.16	8.64	7.68	8.64	10.08	48.01		
					Max. Load	9.92	16.87	17.86	15.88	17.86	20.84	99.24		
					Avg. Load	6.89	11.72	12.41	11.03	12.41	14.48	68.94		
					Standard Deviation	2.21	3.76	3.98	3.54	3.98	4.64	22.10		
					Variance	4.88	14.11	15.82	12.50	15.82	21.53	488.22		
		UD	1	2.44%	Min. Load	9.89	16.81	17.80	15.82	17.80	20.76	98.87		
					Max. Load	9.89	16.81	17.80	15.82	17.80	20.76	98.87		
					Avg. Load	9.89	16.81	17.80	15.82	17.80	20.76	98.87		
					Standard Deviation	-	-	-	-	-	-	-		
					Variance	-	-	-	-	-	-	-		
		Mercedes	5	12.20%	Min. Load	5.00	8.50	9.00	8.00	9.00	10.50	49.99		
					Max. Load	7.55	12.84	13.60	12.09	13.60	15.86	75.54		
					Avg. Load	6.73	11.44	12.12	10.77	12.12	14.14	67.31		
					Standard Deviation	1.05	1.79	1.89	1.68	1.89	2.21	10.51		
					Variance	1.11	3.19	3.58	2.83	3.58	4.87	110.53		
		Others	2	5.00%	Min. Load	5.29	8.99	9.52	8.46	9.52	11.10	52.88		
					Max. Load	9.31	15.82	16.75	14.89	16.75	19.55	93.08		
					Avg. Load	7.30	12.41	13.14	11.68	13.14	15.33	72.98		
					Standard Deviation	2.84	4.83	5.12	4.55	5.12	5.97	28.42		
Variance	8.08				23.35	26.18	20.68	26.18	35.63	807.98				
Total	41	100.12%												

6.1.7 Distribution of Vehicles by Body Type on Dry Ports

The percentage of vehicles with respect to Body Type i.e. Flat, Half, Full & Container plying on Dry Ports is tabulated in Table 6-7 and is graphically presented in Figure 6-7.

Table 6-7: Percentage of Vehicles w.r.t Body Type on Dry Ports

Sr. No.	Body Type	Count	Percentage
1	Flat	2	0.66%
2	Half	2	0.66%
3	Full	69	22.62%
4	Covered	12	3.93%
5	Container	220	72.13%
Total		305	100.00%

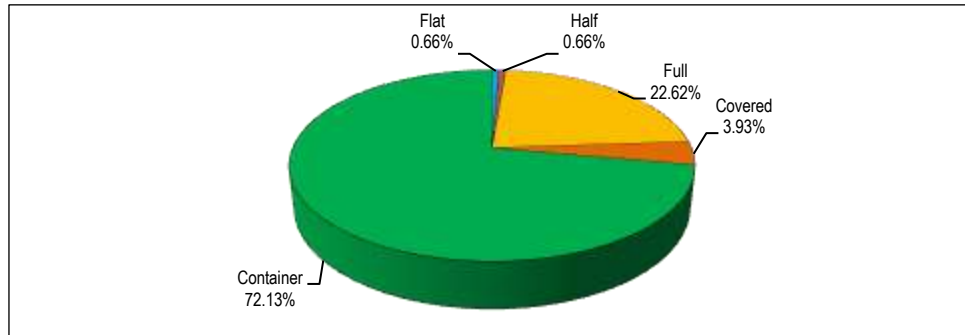


Figure 6-7: Percentage of Vehicles w.r.t Body Type on Dry Ports

6.1.8 Analysis by Body Type on Dry Ports

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to body type is presented in Table 6-8. The results depict that:

In case of **2 Axle Single**, container body type constitutes maximum percentage of 75%, with average gross load of 18.34 ton. However, maximum average gross load is observed in case of full body type i.e. 20.16 ton, constituting 21.43% of the total.

In case of **3 Axle Tandem**, full body type constitutes maximum percentage of 51.85%, with average gross load of 35.80 ton. The percentage of container body type is 39.51% carrying average gross load of 27.82 ton.

In case of **4 Axle Single Tandem**, container body type constitutes maximum percentage of 99.12%, with average gross load of 36.99 ton.

In case of **5 Axle Single Tridem**, container body type constitutes maximum percentage of 90%, with average gross load of 47.45 ton.

In case of **6 Axle Tandem Tridem**, full body type constitutes maximum percentage of 46.34%, with average gross load of 74.20 ton, followed by container body type with percentage of 41.46%, carrying average gross load of 61.46 ton.

Table 6-8: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Body Type for major Axle Configuration on Dry Ports

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Full	6	21.43%	Min. Load	4.78	10.65					15.43
					Max. Load	8.06	17.94					26.00
					Avg. Load	6.25	13.91					20.16
					Standard Deviation	1.26	2.81					4.07
					Variance	1.59	7.88					16.56
		Covered	1	3.57%	Min. Load	6.22	13.84					20.07
					Max. Load	6.22	13.84					20.07
					Avg. Load	6.22	13.84					20.07
					Standard Deviation	-	-					-
					Variance	-	-					-

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
		Container	21	75.00%	Min. Load	2.87	6.38					9.25
					Max. Load	11.37	25.31				36.68	
					Avg. Load	5.68	12.65				18.34	
					Standard Deviation	2.59	5.76				8.34	
					Variance	6.69	33.14				69.60	
	Total		28	100.00%								
2	3 Axle Tandem	Flat	1	1.23%	Min. Load	4.57	8.09	8.09				20.75
					Max. Load	4.57	8.09	8.09			20.75	
					Avg. Load	4.57	8.09	8.09			20.75	
					Standard Deviation	-	-	-			-	
					Variance	-	-	-			-	
		Full	42	51.85%	Min. Load	4.05	7.18	7.18			18.40	
					Max. Load	9.76	17.30	17.30			44.35	
					Avg. Load	7.88	13.96	13.96			35.80	
					Standard Deviation	1.37	2.43	2.43			6.23	
					Variance	1.88	5.91	5.91			38.84	
		Covered	6	7.41%	Min. Load	5.10	9.05	9.05			23.20	
					Max. Load	9.50	16.83	16.83			43.17	
					Avg. Load	7.70	13.66	13.66			35.02	
					Standard Deviation	1.77	3.14	3.14			8.06	
					Variance	3.15	9.89	9.89			65.02	
		Container	32	39.51%	Min. Load	3.15	5.59	5.59			14.33	
					Max. Load	9.12	16.17	16.17			41.47	
					Avg. Load	6.12	10.85	10.85			27.82	
					Standard Deviation	1.60	2.84	2.84			7.29	
					Variance	2.57	8.08	8.08			53.09	
	Total		81	100.00%								
3	4 Axle Single Tandem	Full	1	0.88%	Min. Load	6.97	12.72	9.84	11.49			41.02
					Max. Load	6.97	12.72	9.84	11.49			41.02
					Avg. Load	6.97	12.72	9.84	11.49			41.02
					Standard Deviation	-	-	-	-			-
					Variance	-	-	-	-			-
		Container	113	99.12%	Min. Load	3.13	5.70	4.41	5.15			18.39
					Max. Load	9.34	17.03	13.18	15.38			54.92
					Avg. Load	6.29	11.47	8.88	10.36			36.99
					Standard Deviation	1.43	2.61	2.02	2.36			8.40
					Variance	2.05	6.82	4.09	5.56			70.97
	Total		114	100.00%								
4	5 Axle Single Tridem	Full	1	2.50%	Min. Load	7.04	12.45	10.82	11.37	12.45		54.12
					Max. Load	7.04	12.45	10.82	11.37	12.45		54.12
					Avg. Load	7.04	12.45	10.82	11.37	12.45		54.12
					Standard Deviation	-	-	-	-	-		-
					Variance	-	-	-	-	-		-
		Covered	3	7.50%	Min. Load	4.21	7.45	6.48	6.81	7.45		32.41
					Max. Load	5.12	9.06	7.88	8.27	9.06		39.38
					Avg. Load	4.64	8.21	7.14	7.50	8.21		35.70
					Standard Deviation	0.46	0.81	0.70	0.74	0.81		3.50
					Variance	0.21	0.65	0.49	0.54	0.65		12.25
		Container	36	90.00%	Min. Load	3.99	7.07	6.15	6.45	7.07		30.73
					Max. Load	7.63	13.49	11.73	12.32	13.49		58.67
					Avg. Load	6.17	10.91	9.49	9.97	10.91		47.45
					Standard Deviation	0.78	1.39	1.21	1.27	1.39		6.03
Variance	0.61				1.92	1.45	1.60	1.92		36.36		
	Total		40	100.00%								
5	5 Axle Tandem Tandem	Container	1	100.00%	Min. Load	6.92	11.72	10.65	11.18	12.78		53.25
					Max. Load	6.92	11.72	10.65	11.18	12.78		53.25
					Avg. Load	6.92	11.72	10.65	11.18	12.78		53.25
					Standard Deviation	-	-	-	-	-		-
					Variance	-	-	-	-	-		-
	Total		1	100.00%								
6	6 Axle Tandem Tridem	Flat	1	2.44%	Min. Load	11.10	18.87	19.98	17.76	19.98	23.31	111.00
					Max. Load	11.10	18.87	19.98	17.76	19.98	23.31	111.00
					Avg. Load	11.10	18.87	19.98	17.76	19.98	23.31	111.00
					Standard Deviation	-	-	-	-	-	-	-
					Variance	-	-	-	-	-	-	-

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
		Half	2	4.88%	Min. Load	9.49	16.13	17.08	15.18	17.08	19.93	94.90
					Max. Load	9.57	16.27	17.22	15.31	17.22	20.09	95.69
					Avg. Load	9.53	16.20	17.15	15.25	17.15	20.01	95.30
					Standard Deviation	0.06	0.09	0.10	0.09	0.10	0.12	0.56
					Variance	0.00	0.01	0.01	0.01	0.01	0.01	0.31
		Full	19	46.34%	Min. Load	5.15	8.76	9.28	8.25	9.28	10.82	51.54
					Max. Load	9.99	16.98	17.98	15.98	17.98	20.98	99.90
					Avg. Load	7.42	12.61	13.36	11.87	13.36	15.58	74.20
					Standard Deviation	1.51	2.56	2.71	2.41	2.71	3.16	15.06
					Variance	2.27	6.56	7.35	5.81	7.35	10.00	226.85
		Covered	2	4.88%	Min. Load	9.89	16.81	17.80	15.82	17.80	20.76	98.87
					Max. Load	9.92	16.87	17.86	15.88	17.86	20.84	99.24
					Avg. Load	9.91	16.84	17.83	15.85	17.83	20.80	99.05
					Standard Deviation	0.03	0.04	0.05	0.04	0.05	0.05	0.26
					Variance	0.00	0.00	0.00	0.00	0.00	0.00	0.07
		Container	17	41.46%	Min. Load	4.58	7.78	8.24	7.32	8.24	9.61	45.77
Max. Load	9.92				16.87	-	15.88	17.86	20.84	99.24		
Avg. Load	6.15				10.45	11.06	9.83	11.06	12.91	61.46		
Standard Deviation	1.66				2.82	2.98	2.65	2.98	3.48	16.57		
Variance	2.74				7.93	8.89	7.03	8.89	12.10	274.47		
Total	41	100.00%										

6.1.9 Distribution of Vehicles by Type on Dry Ports

The percentage of vehicles with respect to Type i.e. Truck, Semi-Trailer and Tanker plying on Dry Ports is tabulated Table 6-9 and is graphically presented in Figure 6-8.

Table 6-9: Percentage of Vehicles w.r.t Type on Dry Ports

Sr. No.	Vehicle Type	Count	Percentage
1	Truck	111	36.39%
2	Semi-Trailer	192	62.95%
3	Tanker	2	0.66%
Total		305	100.00%

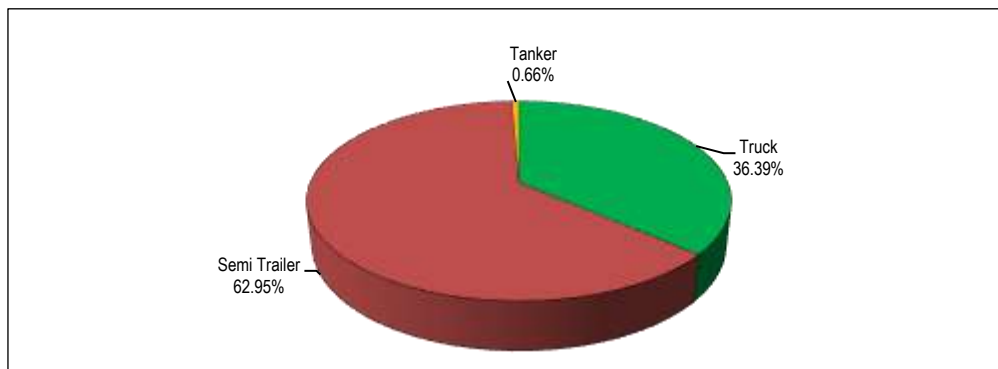


Figure 6-8: Percentage of Vehicles w.r.t Type on Dry Ports

6.1.10 Analysis by Vehicle Type on Dry Ports

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to truck type is presented in Table 6-10. The results depict that:

In case of **2 Axle Single**, truck type constitutes maximum percentage of 100%, with average gross load of 18.79 ton.

In case of **3 Axle Tandem**, truck type constitutes maximum percentage of 97.53%, with average gross load of 32.56 ton.

In case of **4 Axle Single Tandem**, semi-trailer type constitutes maximum percentage of 96.49%, with average gross load of 37.32 ton, followed by truck type with percentage of 3.51%, carrying average gross load of 29.09 ton.

In case of **5 Axle Single Tridem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 46.74 ton.

In case of **6 Axle Tandem Tridem**, semi-trailer type constitutes maximum percentage of 97.56%, with average gross load of 71.08 ton.

Table 6-10: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Type for major Axle Configuration on Dry Ports

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)								
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total		
1	2 Axle Single	Truck	28	100.00%	Min. Load	2.87	6.38					9.25		
					Max. Load	11.37	25.31					36.68		
					Avg. Load	5.82	12.97					18.79		
					Standard Deviation	2.30	5.13					7.43		
					Variance	5.31	26.31					55.26		
	Total		28	100.00%										
2	3 Axle Tandem	Truck	79	97.53%	Min. Load	3.15	5.59	5.59				14.33		
					Max. Load	9.76	17.30	17.30				44.35		
					Avg. Load	7.16	12.70	12.70				32.56		
					Standard Deviation	1.72	3.05	3.05				7.81		
					Variance	2.95	9.28	9.28				61.02		
		Tanker	1	1.23%	Min. Load	4.57	8.09	8.09				20.75		
					Max. Load	4.57	8.09	8.09				20.75		
					Avg. Load	4.57	8.09	8.09				20.75		
					Standard Deviation	-	-	-				-		
		Semi-Trailer	1	1.23%	Min. Load	7.12	12.63	12.63	0.00	0.00		32.38		
					Max. Load	7.12	12.63	12.63	0.00	0.00		32.38		
					Avg. Load	7.12	12.63	12.63	-	-		32.38		
					Standard Deviation	-	-	-	-	-		-		
	Total		81	100.00%										
3	4 Axle Single Tandem	Semi-Trailer	110	96.49%	Min. Load	3.14	5.73	4.44	5.17	0.00		18.48		
					Max. Load	9.34	17.03	13.18	15.38	0.00		54.92		
					Avg. Load	6.34	11.57	8.96	10.45	-		37.32		
					Standard Deviation	1.39	2.54	1.97	2.30	0.00		8.20		
					Variance	1.94	6.47	3.88	5.28	0.00		67.29		
		Truck	4	3.51%	Min. Load	3.13	5.70	4.41	5.15	0.00		18.39		
					Max. Load	6.90	12.59	9.75	11.37	0.00		40.61		
					Avg. Load	4.95	9.02	6.98	8.15	-		29.09		
					Standard Deviation	1.88	3.44	2.66	3.10	0.00		11.08		
			Total		114	100.00%								
		4	5 Axle Single Tridem	Semi-Trailer	40	100.00%	Min. Load	3.99	7.07	6.15	6.45	7.07		30.73
							Max. Load	7.63	13.49	11.73	12.32	13.49		58.67
							Avg. Load	6.08	10.75	9.35	9.81	10.75		46.74
Standard Deviation	0.87						1.53	1.33	1.40	1.53		6.67		
Variance	0.75						2.35	1.78	1.96	2.35		44.50		
	Total		40	100.00%										
5	5 Axle Tandem Tandem	Semi-Trailer	1	100.00%	Min. Load	6.92	11.72	10.65	11.18	12.78		53.25		
					Max. Load	6.92	11.72	10.65	11.18	12.78		53.25		
					Avg. Load	6.92	11.72	10.65	11.18	12.78		53.25		
					Standard Deviation	-	-	-	-	-		-		
					Variance	-	-	-	-	-		-		
	Total		1	100.00%										
6	6 Axle Tandem Tridem	Semi-Trailer	40	97.56%	Min. Load	4.58	7.78	8.24	7.32	8.24	9.61	45.77		
					Max. Load	9.99	16.98	17.98	15.98	17.98	20.98	99.90		
					Avg. Load	7.11	12.08	12.80	11.37	12.80	14.93	71.08		
					Standard Deviation	1.82	3.10	3.28	2.92	3.28	3.83	18.24		
					Variance	3.33	9.61	10.78	8.51	10.78	14.67	332.56		
		Tanker	1	2.44%	Min. Load	11.10	18.87	19.98	17.76	19.98	23.31	111.00		
					Max. Load	11.10	18.87	19.98	17.76	19.98	23.31	111.00		
					Avg. Load	11.10	18.87	19.98	17.76	19.98	23.31	111.00		
					Standard Deviation	-	-	-	-	-	-	-		
			Total		41	100.00%								

6.1.11 Commodities carried by vehicles on Dry Ports

The percentage of major commodities carried by heavy vehicles on Dry Ports is tabulated in Table 6-11 and is graphically presented in Figure 6-9. For the sake of analysis, each commodity is assigned a code; details are attached in Annex – 2.

Table 6-11: Percentage of Vehicle w.r.t Commodities on Dry Ports

Sr. No.	Commodity Type	Code	Count	Percentage
1	Agriculture Items	100	2	0.66%
2	Food Items	200	68	22.30%
3	Animals and Animal Products	300	1	0.33%
4	Raw Materials	400	17	5.57%
5	Bulk Manufactures	500	20	6.56%
6	Basic Manufactures	600	78	25.57%
7	Miscellaneous Manufactures	700	80	26.23%
8	Mining and Quarrying	800	4	1.31%
9	Fuel, Lubricants (Minerals)	900	16	5.25%
10	Miscellaneous Goods not Classified	A00	19	6.23%
Total			305	100.00%

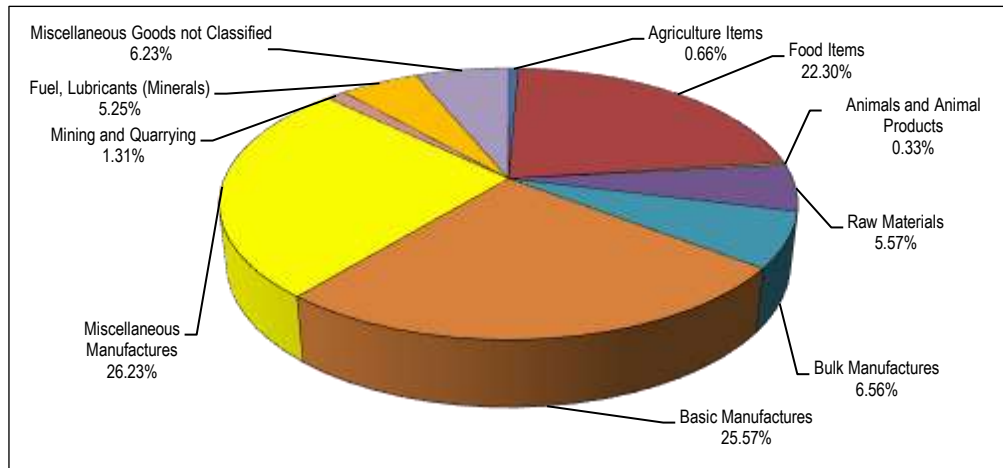


Figure 6-9: Percentage of Vehicles w.r.t Commodities on Dry Ports

6.1.12 Analysis based on Commodities on Dry Ports

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to commodities carried by trucks is presented in Table 6-12. The results depict that:

Major commodities carried by **2 Axle Single** are basic manufactures covering 32.14% of the total, with average gross load of 15.48 ton, followed by food items and miscellaneous manufactures having equal percentage of 25% in total, with average gross load of 20.50 ton and 14.86 ton respectively.

Major commodities carried by **3 Axle Tandem** are food items, covering 44.44% of the total, with average gross load of 36.17 ton, followed by miscellaneous manufactures having percentage of 19.75% in total, with average gross load of 25.98 ton.

Major commodities carried by **4 Axle Single Tandem** are miscellaneous manufactures, covering 37.72% of the total, with average gross load of 35.37 ton, followed by basic manufactures, having percentage of 27.19% in total, with average gross load of 38.69 ton. However, maximum average gross load is recorded in case of raw materials, covering 14.91% of the total, with average gross load of 41.20 ton.

Major commodities carried by **5 Axle Single Tridem** are basic manufactures, covering 47.50% of the total, with average gross load of 45.58 ton, followed by miscellaneous manufactures, having percentage of 22.50% in total, with average gross load of 43.25 ton.

Major commodities carried by **6 Axle Tandem Tridem** are food items, covering 36.59% of the total, with average gross load of 69.67 ton, followed by basic manufactures, having percentage of 24.39% in total, with average gross load of 66.03 ton.

Table 6-12: Stdev. Var., Min., Max. & Avg. Load Comparison w.r.t Commodities for major Axle Configuration on Dry Ports

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						Total
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	
1	2 Axle Single	Food Items	200	7	25.00%	Min. Load	3.36	7.49					10.85
						Max. Load	8.06	17.94				26.00	
						Avg. Load	6.36	14.15				20.50	
						Standard Deviation	1.60	3.55				5.15	
						Variance	2.55	12.63				26.52	
		Bulk Manufactures	500	2	7.14%	Min. Load	3.80	8.46					12.26
						Max. Load	5.52	12.28				17.80	
						Avg. Load	4.66	10.37				15.03	
						Standard Deviation	1.21	2.70				3.92	
						Variance	1.48	7.31				15.35	
		Basic Manufactures	600	9	32.14%	Min. Load	4.01	8.91					12.92
						Max. Load	5.75	12.79				18.54	
						Avg. Load	4.80	10.68				15.48	
						Standard Deviation	0.58	1.29				1.88	
						Variance	0.34	1.67				3.52	
		Miscellaneous Manufactures	700	7	25.00%	Min. Load	2.87	6.38					9.25
						Max. Load	6.52	14.50				21.02	
						Avg. Load	4.61	10.25				14.86	
						Standard Deviation	1.29	2.87				4.17	
						Variance	1.67	8.26				17.36	
		Mining and Quarrying	800	3	10.71%	Min. Load	11.15	24.81					35.96
Max. Load	11.37					25.31				36.68			
Avg. Load	11.28					25.11				36.39			
Standard Deviation	0.12					0.26				0.38			
Variance	0.01					0.07				0.15			
Total				28	100.00%								
2	3 Axle Tandem	Food Items	200	36	44.44%	Min. Load	5.50	9.75	9.75				25.00
						Max. Load	9.50	16.83	16.83				43.17
						Avg. Load	7.96	14.11	14.11				36.17
						Standard Deviation	1.20	2.12	2.12				5.44
						Variance	1.43	4.51	4.51				29.62
		Animals and Animal Products	300	1	1.23%	Min. Load	5.48	9.71	9.71				24.90
						Max. Load	5.48	9.71	9.71				24.90
						Avg. Load	5.48	9.71	9.71				24.90
						Standard Deviation	-	-	-				-
						Variance	-	-	-				-
		Bulk Manufactures	500	6	7.41%	Min. Load	4.05	7.18	7.18				18.40
						Max. Load	9.01	15.96	15.96				40.94
						Avg. Load	6.74	11.95	11.95				30.63
						Standard Deviation	1.99	3.52	3.52				9.03
						Variance	3.95	12.41	12.41				81.62
		Basic Manufactures	600	8	9.88%	Min. Load	5.30	9.40	9.40				24.10
						Max. Load	8.64	15.31	15.31				39.26
						Avg. Load	6.56	11.62	11.62				29.81
						Standard Deviation	1.18	2.10	2.10				5.38
						Variance	1.40	4.40	4.40				28.91
		Miscellaneous Manufactures	700	16	19.75%	Min. Load	3.15	5.59	5.59				14.33
Max. Load	9.12					16.17	16.17				41.47		
Avg. Load	5.72					10.13	10.13				25.98		
Standard Deviation	1.74					3.08	3.08				7.90		
Variance	3.02					9.50	9.50				62.45		
Mining and Quarrying	800	1	1.23%	Min. Load	8.43	14.95	14.95				38.34		
				Max. Load	8.43	14.95	14.95				38.34		
				Avg. Load	8.43	14.95	14.95				38.34		
				Standard Deviation	-	-	-				-		
				Variance	-	-	-				-		
Fuel, Lubricants (Minerals)	900	5	6.17%	Min. Load	4.55	8.06	8.06				20.67		
				Max. Load	9.76	17.30	17.30				44.35		
				Avg. Load	7.05	12.49	12.49				32.03		
				Standard Deviation	2.48	4.40	4.40				11.27		
				Variance	6.15	19.32	19.32				127.0		
Miscellaneous Goods not Classified	A00	8	9.88%	Min. Load	3.86	6.84	6.84				17.55		
				Max. Load	9.14	16.20	16.20				41.54		
				Avg. Load	7.19	12.74	12.74				32.67		
				Standard Deviation	1.80	3.19	3.19				8.18		
				Variance	3.24	10.17	10.17				66.84		
Total				81	100.00%								
3	4 Axle Single Tandem	Food Items	200	4	3.51%	Min. Load	5.97	10.89	8.43	9.84			35.14
						Max. Load	7.36	13.42	10.39	12.12			43.30
						Avg. Load	6.65	12.13	9.39	10.96			39.13
						Standard Deviation	0.68	1.25	0.97	1.13			4.02
						Variance	0.47	1.56	0.93	1.27			16.18
		Raw Materials	400	17	14.91%	Min. Load	5.70	10.39	8.04	9.38			33.51
						Max. Load	8.57	15.64	12.11	14.12			50.44
						Avg. Load	7.00	12.77	9.89	11.54			41.20
						Standard Deviation	0.94	1.72	1.33	1.55			5.53
						Variance	0.89	2.94	1.76	2.40			30.62

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)								
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total		
		Bulk Manufactures	500	6	5.26%	Min. Load	4.24	7.73	5.99	6.99			24.95		
						Max. Load	6.81	12.41	9.61	11.21			40.03		
						Avg. Load	5.26	9.60	7.43	8.67			30.96		
						Standard Deviation	0.98	1.78	1.38	1.61			5.75		
		Basic Manufactures	600	31	27.19%	Min. Load	3.77	6.88	5.32	6.21			22.18		
						Max. Load	8.15	14.86	11.50	13.42			47.92		
						Avg. Load	6.58	12.00	9.29	10.83			38.69		
						Standard Deviation	1.19	2.17	1.68	1.96			7.01		
		Miscellaneous Manufactures	700	43	37.72%	Min. Load	3.14	5.73	4.44	5.17			18.48		
						Max. Load	8.22	14.99	11.61	13.54			48.37		
						Avg. Load	6.01	10.96	8.49	9.90			35.37		
						Standard Deviation	1.56	2.85	2.21	2.58			9.20		
		Fuel, Lubricants (Minerals)	900	5	4.39%	Min. Load	3.13	5.70	4.41	5.15			18.39		
						Max. Load	9.34	17.03	13.18	15.38			54.92		
						Avg. Load	6.13	11.17	8.65	10.09			36.04		
						Standard Deviation	2.71	4.94	3.82	4.46			15.94		
		Miscellaneous Goods not Classified	A00	8	7.02%	Min. Load	4.30	7.85	6.08	7.09			25.32		
						Max. Load	8.25	15.05	11.65	13.59			48.55		
						Avg. Load	5.91	10.77	8.34	9.73			34.75		
						Standard Deviation	1.33	2.43	1.88	2.20			7.85		
		Total			114	100.00%									
4	5 Axle Single Tridem	Food Items	200	6	15.00%	Min. Load	5.24	9.27	8.06	8.47	9.27		40.32		
						Max. Load	7.04	12.45	10.82	11.37	12.45		54.12		
						Avg. Load	6.28	11.11	9.66	10.15	11.11		48.32		
						Standard Deviation	0.59	1.05	0.91	0.96	1.05		4.55		
		Bulk Manufactures	500	1	2.50%	Min. Load	7.53	13.32	11.58	12.16	13.32		57.91		
						Max. Load	7.53	13.32	11.58	12.16	13.32		57.91		
						Avg. Load	7.53	13.32	11.58	12.16	13.32		57.91		
						Standard Deviation	-	-	-	-	-		-		
		Basic Manufactures	600	19	47.50%	Min. Load	4.21	7.45	6.48	6.81	7.45		32.41		
						Max. Load	7.30	12.91	11.22	11.78	12.91		56.12		
						Avg. Load	5.93	10.48	9.12	9.57	10.48		45.58		
						Standard Deviation	0.84	1.48	1.28	1.35	1.48		6.42		
		Miscellaneous Manufactures	700	9	22.50%	Min. Load	3.99	7.07	6.15	6.45	7.07		30.73		
						Max. Load	6.47	11.44	9.95	10.45	11.44		49.74		
						Avg. Load	5.62	9.95	8.65	9.08	9.95		43.25		
						Standard Deviation	0.74	1.32	1.15	1.20	1.32		5.73		
		Fuel, Lubricants (Minerals)	900	3	7.50%	Min. Load	5.55	1.73	1.31	1.45	1.73		32.80		
						Max. Load	5.99	10.60	9.22	9.68	10.60		46.10		
						Avg. Load	7.44	13.16	11.45	12.02	13.16		57.23		
						Standard Deviation	6.54	11.58	10.07	10.57	11.58		50.33		
		Miscellaneous Goods not Classified	A00	2	5.00%	Min. Load	0.78	1.39	1.21	1.27	1.39		6.03		
Max. Load	0.61					1.92	1.45	1.60	1.92		36.33				
Avg. Load	7.36					13.03	11.33	11.90	13.03		56.65				
Standard Deviation	7.63					13.49	11.73	12.32	13.49		58.67				
Total			40	100.00%											
5	5 Axle Tandem Tandem	Basic Manufactures	600	1	100.00%	Min. Load	6.92	11.72	10.65	11.18	12.78		53.25		
						Max. Load	6.92	11.72	10.65	11.18	12.78		53.25		
						Avg. Load	6.92	11.72	10.65	11.18	12.78		53.25		
						Standard Deviation	-	-	-	-	-		-		
		Total			1	100.00%									
6	6 Axle Tandem Tridem	Agriculture Items	100	2	4.88%	Min. Load	7.05	11.99	12.70	11.29	12.70	14.81	70.54		
						Max. Load	9.49	16.13	17.08	15.18	17.08	19.93	94.90		
						Avg. Load	8.27	14.06	14.89	13.24	14.89	17.37	82.72		
						Standard Deviation	1.72	2.93	3.10	2.76	3.10	3.62	17.23		
		Food Items	200	15	36.59%	Min. Load	2.97	8.57	9.61	7.60	9.61	13.08	296.7		
						Max. Load	4.85	8.25	8.73	7.76	8.73	10.19	48.52		
						Avg. Load	9.92	16.87	17.86	15.88	17.86	20.84	99.24		
						Standard Deviation	6.97	11.84	12.54	11.15	12.54	14.63	69.67		
		Bulk Manufactures	500	5	12.20%	Min. Load	1.75	2.98	3.15	2.80	3.15	3.68	17.51		
						Max. Load	3.07	8.86	9.93	7.85	9.93	13.52	306.57		
						Avg. Load	5.64	9.58	10.15	9.02	10.15	11.84	56.38		
						Standard Deviation	9.99	16.98	17.98	15.98	17.98	20.98	99.90		
		Total													

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
	Basic Manufactures	600	10	24.39%	Min. Load	4.69	7.98	8.45	7.51	8.45	9.86	46.93	
					Max. Load	9.31	15.82	16.75	14.89	16.75	19.55	93.08	
					Avg. Load	6.60	11.23	11.89	10.56	11.89	13.87	66.03	
					Standard Deviation	1.37	2.32	2.46	2.18	2.46	2.87	13.65	
	Variance	1.86	5.39	6.04	4.77	6.04	8.22	186.37					
	Miscellaneous Manufactures	700	5	12.20%	Min. Load	4.58	7.78	8.24	7.32	8.24	9.61	45.77	
					Max. Load	6.60	11.21	11.87	10.56	11.87	13.85	65.97	
					Avg. Load	5.57	9.47	10.03	8.92	10.03	11.70	55.72	
					Standard Deviation	0.85	1.45	1.54	1.37	1.54	1.79	8.55	
	Variance	0.73	2.11	2.37	1.87	2.37	3.22	73.03					
	Fuel, Lubricants (Minerals)	900	3	7.32%	Min. Load	9.85	16.74	17.73	15.76	17.73	20.68	98.48	
					Max. Load	11.10	18.87	19.98	17.76	19.98	23.31	111.00	
					Avg. Load	10.28	17.47	18.50	16.45	18.50	21.58	102.78	
					Standard Deviation	0.71	1.21	1.28	1.14	1.28	1.49	7.12	
	Variance	0.51	1.46	1.64	1.30	1.64	2.23	50.67					
	Miscellaneous Goods not Classified	A00	1	2.44%	Min. Load	5.36	9.11	9.65	8.57	9.65	11.25	53.59	
Max. Load					5.36	9.11	9.65	8.57	9.65	11.25	53.59		
Avg. Load					5.36	9.11	9.65	8.57	9.65	11.25	53.59		
Standard Deviation					-	-	-	-	-	-	-		
Variance	-	-	-	-	-	-	-						
Total			41	100.00%									

6.1.13 Damage Factor for major Axle Configuration on Dry Ports

As discussed in section 2.5.5, damage factors or load equivalency factors have been calculated using following two approaches, i.e. AASHTO 1993 and Road Note 40. The average damage factors calculated for major axle configuration are presented in Table 6-13.

Table 6-13: Damage Factor for major Axle Configuration on Dry Ports

Sr. No.	Axle Configuration	Code	Damage Factor (2020)	
			Road Note 40	AASHTO 1993
1	2 Axle Single	1.2	23.63	14.55
2	3 Axle Tandem	1.22	20.76	10.19
3	4 Axle Single Tandem	1.2-22	12.59	8.32
4	5 Axle Single Tridem	1.2-222	12.77	7.42
5	5 Axle Tandem Tandem	1.22-22	20.09	10.42
6	6 Axle Tandem Tridem	1.22-222	68.86	25.22

6.1.14 Distribution of Loaded & Empty Trucks on Dry Ports

The percentage of loaded and empty trucks on Dry Ports is tabulated in Table 6-14.

Table 6-14: Percentage distribution based on Empty and Loaded vehicles on Dry Ports

Sr. No.	Axle Configuration	Loaded		Empty		Total	
		Count	%age	Count	%age	Count	%age
1	2 Axle Single	28	100.00%	0	0.00%	28	100.00%
2	3 Axle Tandem	81	100.00%	0	0.00%	81	100.00%
3	4 Axle Single Tandem	114	100.00%	0	0.00%	114	100.00%
4	5 Axle Single Tridem	40	100.00%	0	0.00%	40	100.00%
5	5 Axle Tandem Tandem	1	100.00%	0	0.00%	1	100.00%
6	6 Axle Tandem Tridem	41	100.00%	0	0.00%	41	100.00%
7	Others	17	85.00%	3	15.00%	20	100.00%
Total		322	99.08%	3	0.92%	325	100%

6.1.15 Locking Mechanism of Containers on Dry Ports

The containers are locked into place on a truck / semi-trailer for securing it from any harmful incident. Depending upon the locking mechanism, they are classified as fully secured, partially secured and un-secured. The Consultant has collected this information during axle load survey and is presented in Table 6-15.

Table 6-15: Percentage of Containers as Fully Secured, Partially Secured and Un-Secured on Dry Ports

Sr. No.	Description	Count	%age
1	Fully Secured	63	100%
2	Partially Secured	0	0%
3	Un- Secured	0	0%
Total		63	100.00%

7 COMPARISON OF RESULTS ON PORTS & DRY PORTS WITH NATIONAL HIGHWAYS

This section compares results of axle load survey on Ports and Dry Ports with National Highways as stated in NTRC Axle Load Report, 2020. The results including Axle Configuration, Gross Load, Body Type, Make Type, Truck Type and Damage Factors are analyzed and discussed in succeeding sub- sections.

7.1.1 Comparison of Axle Configuration on Ports, Dry Ports and National Highways

Firstly, the composition of major truck traffic on Ports and Dry Ports is summarized in Table 7-1. The results depict that on both Ports and Dry Ports, the dominant truck type is 3- Axle Tandem at 39%, followed by 4- Axle Single Tandem at 31% then followed by 6- Axle Tandem Tridem at 20%.

Table 7-1: Composition of Truck Traffic w.r.t Axle Configuration on Ports & Dry Ports

Sr. No.	Axle Configuration	Code	Ports & Dry Ports		Ports		Dry Ports	
			Total Number of Trucks	Percentage	Total Number of Trucks	Percentage	Total Number of Trucks	Percentage
1	2 Axle Single	1.2	43	2.97%	15	1.34%	28	8.62%
2	3 Axle Tandem	1.22	561	38.74%	480	42.74%	81	24.92%
3	4 Axle Single Tandem	1.2-22	456	31.49%	342	30.45%	114	35.08%
4	5 Axle Single Tridem	1.2-222	63	4.35%	23	2.05%	40	12.31%
5	5 Axle Tandem Tandem	1.22-22	19	1.31%	18	1.60%	1	0.31%
6	6 Axle Tandem Tridem	1.22-222	286	19.75%	245	21.82%	41	12.62%
7	Others	-	20	1.38%	-	-	20	6.15%
Total			1448	100.00%	1448	100.00%	325	100.00%

Secondly, the percentage of each axle configuration on Ports and Dry Ports is compared with National Highways as stated in NTRC Axle Load Report, 2020 and is illustrated in Table 7-2. The results depict that 2- Axle Trucks are more dominant on National Highways as compared to Ports and Dry Ports whereas 4- Axle trucks are more on Ports and Dry Ports as compared to National Highways.

Table 7-2: Comparison of Truck Traffic on Ports and Dry Ports with National Highways

Sr. No.	Axle Configuration	Code	Ports & Dry Ports		National Highway (NTRC Report, 2020)	
			Total Number of Trucks	Percentage	Total Number of Trucks	Percentage
1	2 Axle Single	1.2	43	2.97%	70168	34.93%
2	3 Axle Tandem	1.22	561	38.74%	52943	26.39%
3	4 Axle Single Tandem	1.2-22	456	31.49%	26748	13.32%
4	5 Axle Single Tridem	1.2-222	63	4.35%	10652	5.30%
5	5 Axle Tandem Tandem	1.22-22	19	1.31%	7756	3.86%
6	6 Axle Tandem Tridem	1.22-222	286	19.75%	32588	16.22%
7	Others	-	20	1.38%	-	-
Total			1448	100.00%	200855	100.00%

7.1.2 Comparison of Loading Pattern on Ports, Dry Ports and National Highways

Ports and Dry ports were no exception to overloading by trucks and trailers, however, the degree of overloading (i.e., loaded in excess of 15%, 50% & 75%) is far less as compared to degree of overloading on National Highways (see Table 5-3 and Table 6-3) of this report. Also overloading at Dry Ports was less than that at Ports. The percentage of overloading on Ports and Dry Ports is listed in Table 7-3 and is compared with overloading on National Highways as stated in NTRC Axle Load Report, 2020. The results show that there is no significant difference in terms of percentage of overloaded trucks (see column 3 and 6) except for 2- Axle trucks, which constituted a

very small fraction at Ports and Dry Ports as compared to other types. The local transporters and distributors are contributing impenitently in the deterioration of pavement structures by constantly following overloading practices.

Table 7-3: Percentage of Overloading on Ports and Dry Ports

Sr. No.	Axle Configuration	Percentage overloading on Ports & Dry Ports	Percentage overloading on Ports	Percentage overloading on Dry Ports	Percentage Overloading on National Highways (NTRC Report, 2020)
1	2 Axle Single	46.51%	46.67%	46.43%	74.10%
2	3 Axle Tandem	84.49%	87.08%	69.14%	90.62%
3	4 Axle Single Tandem	55.26%	58.19%	46.49%	57.87%
4	5 Axle Single Tridem	33.33%	26.09%	37.50%	79.45%
5	5 Axle Tandem Tandem	94.74%	94.44%	100%	77.97%
6	6 Axle Tandem Tridem	90.56%	93.47%	73.17%	89.04%

The minimum, maximum and average gross weights for each axle configuration plying on Ports and Dry Ports are presented in Table 7-4 & Table 7-5 respectively.

Table 7-4: Gross Load Characteristics on Ports

Sr. No.	Axle Configuration	Permissible Load limit	Parameter	KPT	Port Qasim
1	2 Axle Single	17.5	Min. Load (Ton)	10.82	18.10
			Max. Load (Ton)	21.26	20.02
			Avg. Load (Ton)	16.07	19.02
2	3 Axle Tandem	27.5	Min. Load (Ton)	8.14	11.72
			Max. Load (Ton)	61.29	54.66
			Avg. Load (Ton)	31.41	35.50
3	4 Axle Single Tandem	39.5	Min. Load (Ton)	11.40	14.57
			Max. Load (Ton)	61.09	53.48
			Avg. Load (Ton)	36.37	42.39
4	5 Axle Single Tridem	48.5	Min. Load (Ton)	14.67	42.94
			Max. Load (Ton)	59.97	64.57
			Avg. Load (Ton)	34.58	54.25
5	5 Axle Tandem Tandem	49.5	Min. Load (Ton)	18.97	55.28
			Max. Load (Ton)	74.50	55.28
			Avg. Load (Ton)	60.21	55.28
6	6 Axle Tandem Tridem	58.5	Min. Load (Ton)	15.32	21.20
			Max. Load (Ton)	81.17	99.99
			Avg. Load (Ton)	62.89	71.59

Table 7-5: Gross Load Characteristics on Dry Ports

Sr. No.	Axle Configuration	Permissible Load limit	Parameter	Quetta Dry Port	NLC Lahore Dry Port	Premnagar Dry Port	Sialkot Dry Port	Islamabad Dry Port	Peshawar Dry Port
1	2 Axle Single	17.5	Min. Load (Ton)	15.00	9.25		12.26		
			Max. Load (Ton)	26.00	21.02		36.68		
			Avg. Load (Ton)	20.68	14.84		21.94		
2	3 Axle Tandem	27.5	Min. Load (Ton)	18.40	17.55		14.33	22.45	
			Max. Load (Ton)	44.35	32.38		38.34	39.26	
			Avg. Load (Ton)	35.60	25.49		28.47	30.46	
3	4 Axle Single Tandem	39.5	Min. Load (Ton)	35.14	18.39	19.78	19.77	23.42	22.27
			Max. Load (Ton)	46.39	54.92	40.03	45.19	50.44	46.09
			Avg. Load (Ton)	41.43	38.46	25.43	32.53	35.87	39.71
4	5 Axle Single Tridem	48.5	Min. Load (Ton)	32.41	30.73	41.51		36.09	44.49
			Max. Load (Ton)	54.12	58.67	41.51		51.31	54.13
			Avg. Load (Ton)	44.37	52.04	41.51		45.12	47.81
5	5 Axle Tandem Tandem	49.5	Min. Load (Ton)					53.25	
			Max. Load (Ton)					53.25	
			Avg. Load (Ton)					53.25	
6	6 Axle Tandem Tridem	58.5	Min. Load (Ton)	48.52	48.01	45.77		53.99	46.93
			Max. Load (Ton)	99.90	111.00	60.14		79.00	46.93
			Avg. Load (Ton)	74.56	70.87	52.96		67.65	46.93
7	Others		Min. Load (Ton)				6.54		
			Max. Load (Ton)				35.68		
			Avg. Load (Ton)				17.04		

The results on Ports and Dry Ports are compared with results of National Highway as stated in NTRC Axle Load Survey on National Highway & Motorway Network of Pakistan, 2020 (Table 7-6). The results depict that average gross load is maximum on National Highways.

Table 7-6: Comparison of Gross Load on Ports & Dry Ports with National Highways

Sr. No.	Axle Configuration	Permissible Load limit	Parameter	Ports	Dry Ports	National Highways (NTRC Report, 2020)
1	2 Axle Single	17.5	Min. Load (Ton)	10.82	9.25	6.33
			Max. Load (Ton)	21.26	36.68	50.12
			Avg. Load (Ton)	16.66	18.79	20.00
2	3 Axle Tandem	27.5	Min. Load (Ton)	8.14	14.33	11.76

Sr. No.	Axle Configuration	Permissible Load limit	Parameter	Ports	Dry Ports	National Highways (NTRC Report, 2020)
3	4 Axle Single Tandem	39.5	Max. Load (Ton)	61.29	44.35	79.44
			Avg. Load (Ton)	32.08	32.41	40.37
			Min. Load (Ton)	11.40	18.39	19.48
			Max. Load (Ton)	61.09	54.92	90.00
			Avg. Load (Ton)	37.72	37.03	41.45
4	5 Axle Single Tridem	48.5	Min. Load (Ton)	14.67	30.73	21.28
			Max. Load (Ton)	64.57	58.67	85.31
			Avg. Load (Ton)	38.86	46.74	57.43
5	5 Axle Tandem Tandem	49.5	Min. Load (Ton)	18.97	53.25	21.87
			Max. Load (Ton)	74.50	53.25	84.31
			Avg. Load (Ton)	59.93	53.25	57.74
6	6 Axle Tandem Tridem	58.5	Min. Load (Ton)	15.32	45.77	22.11
			Max. Load (Ton)	99.99	111.00	110.93
			Avg. Load (Ton)	67.68	72.06	75.09

7.1.3 Comparison of Body Type on Ports, Dry Ports and National Highways

The percentage of trucks with respect to Body Type i.e., Flat, Half, Full & Container plying on Ports and Dry Ports are illustrated in Table 7-7. The results depict that percentage of container body type is maximum on Ports and Dry Ports i.e., 54.26% and 72.13% respectively. Around 85% of 2- Axle flat body type carry containers on Ports and Dry Ports.

Table 7-7: Composition of Trucks by Body Type on Ports and Dry Ports

Sr. No.	Body Type	Ports		Dry Ports	
		Count	Percentage	Count	Percentage
1	Flat	329	29.51%	2	0.66%
2	Half	103	9.24%	2	0.66%
3	Full	72	6.46%	69	22.62%
4	Covered	6	0.54%	12	3.93%
5	Container	605	54.26%	220	72.13%
Total		1115	100.00%	305	100.00%

The results of body type on Ports and Dry Ports are compared with results of National Highway as stated in NTRC Axle Load Survey on National Highway & Motorway Network of Pakistan, 2020 (Table 7-8). The results depict that container body type dominates at Ports and Dry Ports whereas full body type is plying more on National Highways.

Table 7-8: Comparison of Body Type on Ports & Dry Ports with National Highways

Sr. No.	Body Type	Ports & Dry Ports		National Highways (NTRC Report, 2020)	
		Count	Percentage	Count	Percentage
1	Flat	331	23.31%	6306	21.95%
2	Half	105	7.39%	2420	8.42%
3	Full	141	9.93%	12557	43.70%
4	Covered	18	1.27%	2205	7.67%
5	Container	825	58.10%	5244	18.25%
Total		1420	100.00%	28732	100.00%

7.1.4 Comparison of Make Type on Ports, Dry Ports and National Highways

The percentage of different trucks type (based on manufacturer) observed on Ports and Dry Ports is tabulated in Table 7-9. The result illustrates that percentage of Hino trucks is maximum on Ports and Dry Ports i.e., 56.72% and 62.25% respectively followed by Nissan with percentage of 29.30% and 24.83% respectively.

Table 7-9: Composition of Trucks by Make Type on Ports and Dry Ports

Sr. No.	Make	Ports		Dry Ports	
		Count	Percentage	Count	Percentage
1	Bedford	21	1.88%	1	0.33%
2	Nissan	327	29.30%	75	24.83%
3	Faw	10	0.90%	-	-
4	Hino	633	56.72%	188	62.25%
5	Isuzu	35	3.14%	4	1.32%
6	Mercedes	8	0.72%	8	2.65%

Sr. No.	Make	Ports		Dry Ports	
		Count	Percentage	Count	Percentage
7	UD	41	3.67%	20	6.62%
8	Others	41	3.67%	6	1.99%
Total		1116	100.00%	302	100.00%

The results of make type on Ports and Dry Ports are compared with results of National Highway as stated in NTRC Axle Load Survey on National Highway & Motorway Network of Pakistan, 2020 (Table 7-10). The results depict that Hino make is the overall leader amongst various manufactures, 58% at Ports and Dry Ports and 68% on National Highways whereas the once ubiquitous Bedford is being eliminated, gradually. Nissan which showed handsome presence on Ports and Dry Ports constitutes just 11% of overall truck fleet on National Highways.

Table 7-10: Comparison of Make Type on Ports & Dry Ports with National Highways

Sr. No.	Make	Ports & Dry Ports		National Highways (NTRC Report, 2020)	
		Count	Percentage	Count	Percentage
1	Bedford	22	1.55%	3859	13.01%
2	Nissan	402	28.35%	3155	10.64%
3	Faw	10	0.71%	713	2.40%
4	Hino	821	57.90%	20033	67.54%
5	Isuzu	39	2.75%	530	1.79%
6	Mercedes	16	1.13%	483	1.63%
7	UD	61	4.30%	401	1.35%
8	Others	47	3.31%	488	1.64%
Total		1418	100.00%	29662	100.00%

7.1.5 Comparison of Truck Type on Ports, Dry Ports and National Highways

The percentage of trucks, semi-trailers and tankers on Ports and Dry Ports are presented in Table 7-11. The results are also compared with National Highways data which show that percentage of semi-trailers are more on Ports and Dry Ports, 52%, whereas trucks constitutes 61% on National Highways.

Table 7-11: Comparison of Vehicle Type on Ports and Dry Ports with National Highways

Sr. No.	Vehicle Type	Ports		Dry Ports		National Highways (NTRC Report, 2020)	
		Count	Percentage	Count	Percentage	Count	Percentage
1	Truck	538	48.08%	111	36.39%	18090	60.96%
2	Semi-Trailer	581	51.92%	192	62.95%	11252	37.92%
3	Tanker	-	-	2	0.66%	333	1.12%
Total		1119	100.00%	305	100.00%	29675	100.00%

7.1.6 Comparison of Damage Factors on Ports, Dry Ports and National Highways

The damage factors for major truck types are shown in Table 7-12. The damage factors on Ports and Dry Ports are quite less than those determined for National Highways as stated in NTRC Study, 2020, however, in case of Dry Ports one exception exists, i.e., 2- Axle truck. This truck type constituted a very small fraction at Ports and Dry Ports (3.74%).

Table 7-12: Comparison of Damage Factors on Ports and Dry Ports with National Highways

Sr. No.	Axle Configuration	Code	Ports		Dry Ports		National Highways (NTRC Study, 2020)	
			Road Note 40	AASHTO 1993	Road Note 40	AASHTO 1993	Road Note 40	AASHTO 1993
1	2 Axle Single	1.2	6.51	4.70	23.63	14.55	19.62	12.28
2	3 Axle Tandem	1.22	20.26	9.89	20.76	10.19	55.24	23.08
3	4 Axle Single Tandem	1.2-22	14.87	9.39	12.59	8.32	26.80	14.88
4	5 Axle Single Tridem	1.2-222	11.31	5.92	12.77	7.42	44.66	19.02
5	5 Axle Tandem Tandem	1.22-22	40.60	19.79	20.09	10.42	39.35	18.42
6	6 Axle Tandem Tridem	1.22-222	42.19	17.36	68.86	25.22	70.05	24.68

8 DATA ANALYSIS ON PORTS

8.1 General

Summary results of the Axle Load Survey carried out at different Ports are discussed in following sub- sections.

8.2 Karachi Port Trust (KPT)

The results of axle load survey performed on SAPT, KICT, PICT and East Wharf of KPT are discussed in subsequent sections.

8.3 South Asia Pakistan Terminal (SAPT)

The results of axle load survey performed on SAPT of KPT are discussed in subsequent sub-sections.

8.3.1 Distribution of Vehicles by Axle Configuration on SAPT

The percentage of trucks for major axle configurations surveyed on SAPT is summarized in Table 8-1 and is graphically presented in Figure 8-1.

Table 8-1: Percentage of Vehicle w.r.t Axle Configuration on SAPT

Sr. No.	Axle Configuration	Code	Total Number of Trucks	Percentage
1	2 Axle Single	1.2	1	0.52%
2	3 Axle Tandem	1.22	67	34.90%
3	4 Axle Single Tandem	1.2-22	111	57.81%
4	5 Axle Single Tridem	1.2-222	4	2.08%
5	5 Axle Tandem Tandem	1.22-22	1	0.52%
6	6 Axle Tandem Tridem	1.22-222	3	1.56%
7	Others		5	2.60%
Total			192	100.00%

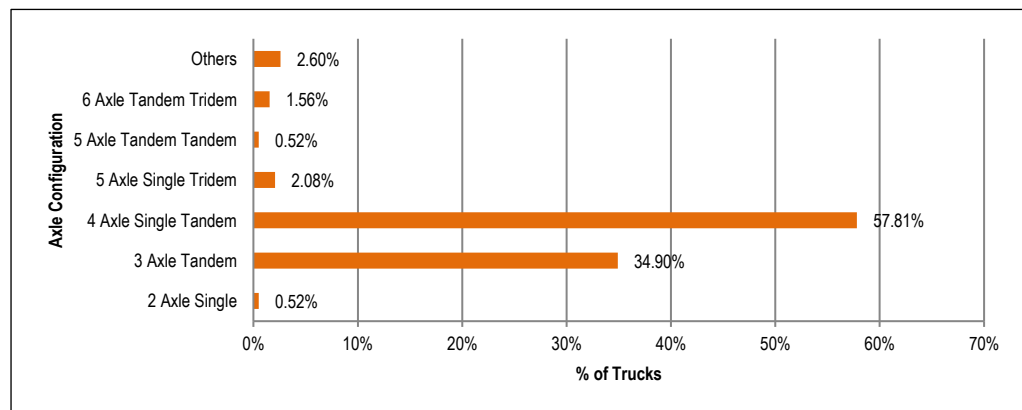


Figure 8-1: Percentage of Vehicles w.r.t Axle Configuration on SAPT

8.3.2 Analysis by Axle Configuration on SAPT

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks on SAPT along with standard deviation and variance is presented in Table 8-2. The minimum, maximum and average loads are graphically presented in Figure 8-2 and Figure 8-3 respectively.

In case of **3 Axle Tandem**, maximum load of 42.54 ton with average load of 35.14 ton was recorded.

In case of **4 Axle Single Tandem**, maximum load of 47.55 ton with average load of 37.56 ton was recorded.

In case of **5 Axle Single Tridem**, maximum load of 45.89 ton with average load of 39.28 ton was recorded.

In case of **6 Axle Tandem Tridem**, maximum load of 74.27 ton with average load of 39.17 ton was recorded.

Table 8-2: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Axle Configuration on SAPT

Sr. No.	Axle Configuration	Permissible Load Limits	Parameters	Load (Tons)						
				Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	17.5	Min. Load	6.59	14.67					21.26
			Max. Load	6.59	14.67					21.26
			Avg. Load	6.59	14.67					21.26
			Standard Deviation	-	-					-
			Variance	-	-					-
2	3 Axle Tandem	27.5	Min. Load	2.55	4.53	4.53				11.61
			Max. Load	9.36	16.59	16.59				42.54
			Avg. Load	7.73	13.70	13.70				35.14
			Standard Deviation	1.36	2.41	2.41				6.17
			Variance	1.84	5.79	5.79				38.06
3	4 Axle Single Tandem	39.5	Min. Load	2.27	4.14	3.20	3.74			13.34
			Max. Load	8.08	14.74	11.41	13.31			47.55
			Avg. Load	6.39	11.64	9.01	10.52			37.56
			Standard Deviation	1.20	2.18	1.69	1.97			7.04
			Variance	1.43	4.76	2.85	3.88			49.54
4	5 Axle Single Tridem	48.5	Min. Load	2.61	4.62	4.02	4.22	4.62		20.10
			Max. Load	5.97	10.55	9.18	9.64	10.55		45.89
			Avg. Load	5.11	9.03	7.86	8.25	9.03		39.28
			Standard Deviation	1.66	2.94	2.56	2.69	2.94		12.79
			Variance	2.76	8.65	6.54	7.21	8.65		163.53
5	5 Axle Tandem Tandem	49.5	Min. Load	7.23	12.23	11.12	11.67	13.34		55.58
			Max. Load	7.23	12.23	11.12	11.67	13.34		55.58
			Avg. Load	7.23	12.23	11.12	11.67	13.34		55.58
			Standard Deviation	-	-	-	-	-		-
			Variance	-	-	-	-	-		-
6	6 Axle Tandem Tridem	58.5	Min. Load	1.77	3.00	3.18	2.83	3.18	3.71	17.66
			Max. Load	7.43	12.63	13.37	11.88	13.37	15.60	74.27
			Avg. Load	3.92	6.66	7.05	6.27	7.05	8.23	39.17
			Standard Deviation	3.07	5.21	5.52	4.90	5.52	6.44	30.65
			Variance	9.40	27.15	30.44	24.05	30.44	41.43	939.55

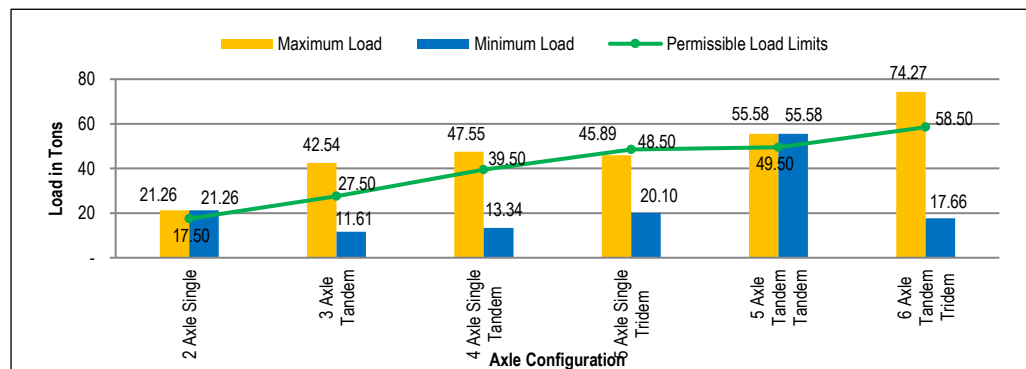


Figure 8-2: Min. & Max. Load Comparison w.r.t Axle Configuration on SAPT

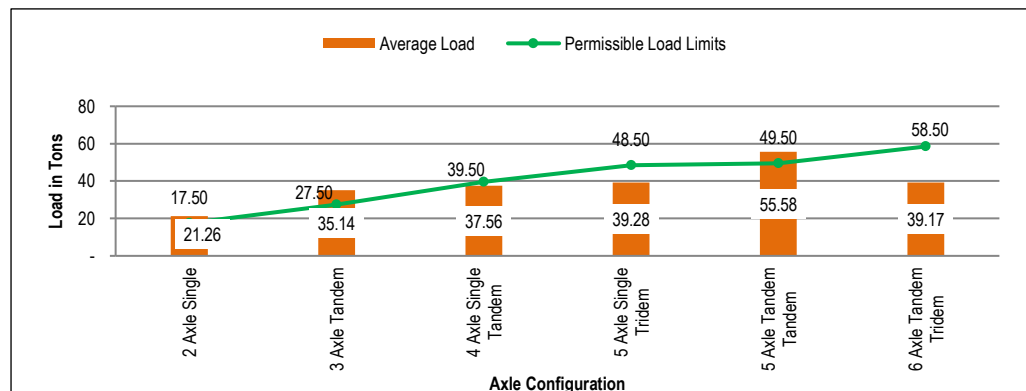


Figure 8-3: Avg. Load Comparison w.r.t Axle Configuration on SAPT

8.3.3 Load Spectrum by Axle Configuration on SAPT

The major cause of pavement failure is due to excessive overloading. The axle load survey data was organized in a way to identify the number of vehicles carrying load above and below permissible limits. Furthermore, load spectrums were identified and number of vehicles carrying load in specified spectrums were calculated. The results are tabulated in Table 8-3 which illustrates that:

In case of **3 Axle Tandem**, 14.93% of trucks carried load under permissible limits. Whereas, 80.60% of the trucks carried load more than 15% of permissible load limits.

In case of **4 Axle Single Tandem**, 48.65% of trucks/semi-trailers carried load under permissible limits. Whereas, 4.50% of the trucks/semi-trailers carried load more than 15% of permissible load limits.

In case of **5 Axle Single Tridem**, 100% of semi-trailers carried load under permissible limits.

In case of **6 Axle Tandem Tridem**, 66.67% of semi-trailers carried load under permissible limits. Whereas, 33.33% semi-trailers carried load more than 15% of permissible load limits

The percentage of trucks for major axle configuration carrying load above and below permissible limits on SAPT is graphically presented in Figure 8-4.

Table 8-3: Load Spectrum w.r.t Axle Configuration on SAPT

Sr. No.	AXLE CONFIGURATION	Under Permissible Limit	Over Permissible Limit					Total	
			15.00%	30.00%	50.00%	75.00%	>75%		
1	2 Axle Single	Max. Load (Tons)	17.5	20.1	22.8	26.3	30.6		
		Average Load (Tons)	-	-	21.26	-	-	-	
		No. of Trucks	0	0	1	0	0	0	1
		Percentage	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	0.00%	0.00%	100.00%	100.00%	100.00%	100%	
		Percentage above Range Value	100.00%	100.00%	0.00%	0.00%	0.00%	0%	
2	3 Axle Tandem	Max. Load (Tons)	27.5	31.6	35.8	41.3	48.1		
		Average Load (Tons)	22.60	29.75	34.38	38.37	42.05	-	
		No. of Trucks	10	3	11	40	3	0	67
		Percentage	14.93%	4.48%	16.42%	59.70%	4.48%	0.00%	100%
		Cumulative Percentage	14.93%	19.40%	35.82%	95.52%	100.00%	100%	
		Percentage above Range Value	85.07%	80.60%	64.18%	4.48%	0.00%	0%	
3	4 Axle Single Tandem	Max. Load (Tons)	39.5	45.4	51.4	59.3	69.1		
		Average Load (Tons)	32.26	42.22	46.32	-	-	-	
		No. of Trucks	54	52	5	0	0	0	111
		Percentage	48.65%	46.85%	4.50%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	48.65%	95.50%	100.00%	100.00%	100.00%	100%	
		Percentage above Range Value	51.35%	4.50%	0.00%	0.00%	0.00%	0%	
4	5 Axle Single Tridem	Max. Load (Tons)	48.5	55.8	63.1	72.8	84.9		
		Average Load (Tons)	39.28	-	-	-	-	-	
		No. of Trucks	4	0	0	0	0	0	4
		Percentage	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	100.00%	100.00%	100.00%	100.00%	100.00%	100%	
		Percentage above Range Value	0.00%	0.00%	0.00%	0.00%	0.00%	0%	
5	5 Axle Tandem	Max. Load (Tons)	49.5	56.9	64.4	74.3	86.6		
		Average Load (Tons)	-	55.58	-	-	-	-	
		No. of Trucks	0	1	0	0	0	0	1
		Percentage	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	0.00%	100.00%	100.00%	100.00%	100%	100%	
		Percentage above Range Value	100.00%	0.00%	0.00%	0.00%	0%	0%	
6	6 Axle Tandem Tridem	Max. Load (Tons)	58.5	67.3	76.1	87.8	102.4		
		Average Load (Tons)	21.63	-	74.27	-	-	-	
		No. of Trucks	2	0	1	0	0	0	3
		Percentage	66.67%	0.00%	33.33%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	66.67%	66.67%	100.00%	100.00%	100.00%	100%	
		Percentage above Range Value	33.33%	33.33%	0.00%	0.00%	0.00%	0%	

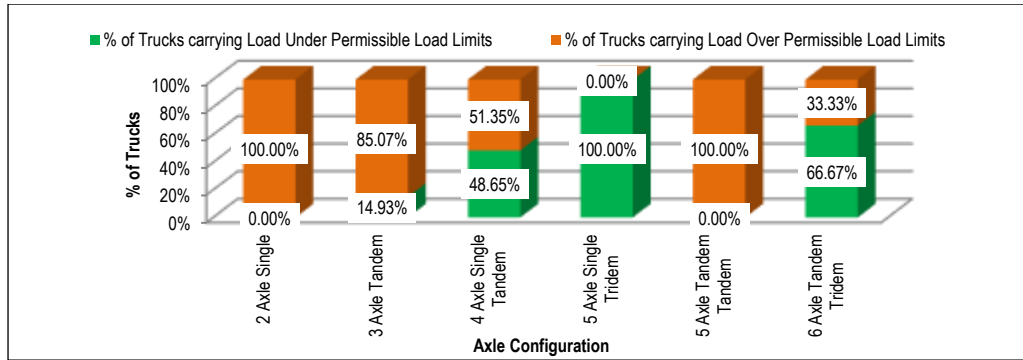


Figure 8-4: Percentage of Vehicles carrying Load above and below Permissible Limits on SAPT

8.3.4 Front & Rear Axle Load Spectrum on SAPT

The spectrum of front and rear axle loads for major axle configurations is presented in Table 8-4.

Table 8-4: Front & Rear Axle Load Spectrum on SAPT

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
Front Axle Load Spectrum					
1	0 - 2.99	6	3.21%	3.21%	96.79%
2	3 - 5.49	23	12.30%	15.51%	84.49%
3	5.5 - 6.99	64	34.22%	49.73%	50.27%
4	7 - 8.99	91	48.66%	98.40%	1.60%
5	9 - 10.99	3	1.60%	100.00%	0.00%
6	11 - 12.99	0	0.00%	100.00%	0.00%
7	13 - 14.99	0	0.00%	100.00%	0.00%
8	15 - 16.99	0	0.00%	100.00%	0.00%
9	17 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Single)					
1	0 - 8.16	66	13.12%	13.12%	86.88%
2	8.17 - 9.99	99	19.68%	32.80%	67.20%
3	10 - 10.99	73	14.51%	47.32%	52.68%
4	11 - 11.99	59	11.73%	59.05%	40.95%
5	12 - 12.99	63	12.52%	71.57%	28.43%
6	13 - 13.99	48	9.54%	81.11%	18.89%
7	14 - 14.99	52	10.34%	91.45%	8.55%
8	15 - 19.99	43	8.55%	100.00%	0.00%
9	20 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Tandem)					
1	0 - 11.99	9	4.92%	4.92%	95.08%
2	12 - 14.99	8	4.37%	9.29%	90.71%
3	15 - 19.99	40	21.86%	31.15%	68.85%
4	20 - 21.99	39	21.31%	52.46%	47.54%
5	22 - 23.99	28	15.30%	67.76%	32.24%
6	24 - 25.99	7	3.83%	71.58%	28.42%
7	26 - 27.99	9	4.92%	76.50%	23.50%
8	28 - 29.99	22	12.02%	88.52%	11.48%
9	30 & Above	21	11.48%	100.00%	0.00%
Rear Axle Load Spectrum (Tridem)					
1	0 - 14.99	3	42.86%	42.86%	57.14%
2	15 - 30.99	3	42.86%	85.71%	14.29%
3	31 - 32.99	0	0.00%	85.71%	14.29%
4	33 - 34.99	0	0.00%	85.71%	14.29%
5	35 - 36.99	0	0.00%	85.71%	14.29%
6	37 - 38.99	0	0.00%	85.71%	14.29%
7	39 - 40.99	1	14.29%	100.00%	0.00%
8	41 - 42.99	0	0.00%	100.00%	0.00%
9	43 & Above	0	0.00%	100.00%	0.00%

8.3.5 Distribution of Vehicles by Make Type on SAPT

The distribution of trucks as per make type is illustrated in Table 8-5 and is graphically presented in Figure 8-5. The results depict that Hino and Nissan have maximum percentage of 43.85% and 49.73% plying on SAPT.

Table 8-5: Percentage of Vehicles w.r.t Make Type on SAPT

Sr. No.	Make	Count	Percentage
1	Bedford	2	1.07%
2	Nissan	93	49.73%
3	Hino	82	43.85%
4	Isuzu	4	2.14%
5	UD	6	3.21%
Total		187	100.00%

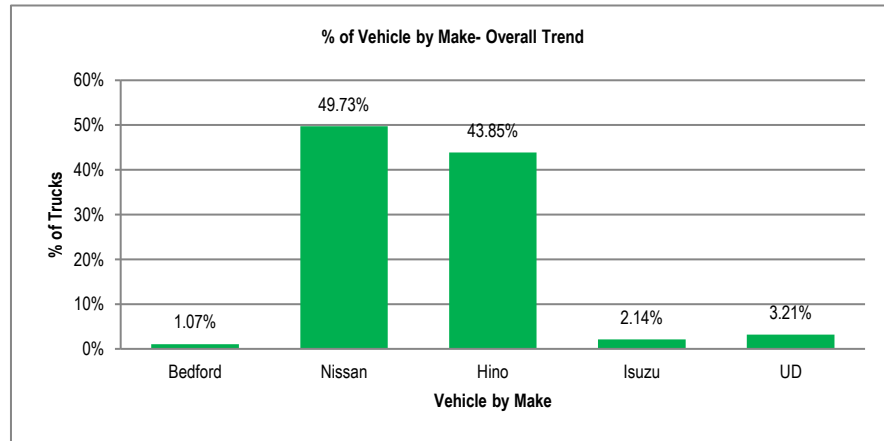


Figure 8-5: Percentage of Vehicles w.r.t Make Type on SAPT

8.3.6 Analysis by Make Type on SAPT

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to make type is presented in Table 8-6. The results depict that:

In case of **3 Axle Tandem**, Hino constitutes maximum percentage of 94.03%, with average gross load of 35.42 ton.

In case of **4 Axle Single Tandem**, Nissan constitutes maximum percentage of 80.18% with average gross load of 37.92 ton, followed by Hino with percentage of 12.61%, carrying average gross load of 37.54 ton.

In case of **5 Axle Single Tridem**, Hino constitutes maximum percentage of 75%, with average gross load of 37.22 ton.

In case of **6 Axle Tandem Tridem**, Hino constitutes maximum percentage of 66.67%, with average gross load of 45.97 ton.

Table 8-6: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Make Type for major Axle Configuration on SAPT

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Bedford	1	100.00%	Min. Load	6.59	14.67					21.26
					Max. Load	6.59	14.67				21.26	
					Avg. Load	6.59	14.67				21.26	
					Standard Deviation	-	-				-	
					Variance	-	-				-	
		Total	1	100.00%								
2	3 Axle Tandem	Bedford	1	1.49%	Min. Load	8.49	15.04	15.04				38.57
					Max. Load	8.49	15.04	15.04			38.57	
					Avg. Load	8.49	15.04	15.04			38.57	
					Standard Deviation	-	-	-			-	
					Variance	-	-	-			-	
		Hino	63	94.03%	Min. Load	3.93	6.96	6.96			17.85	
					Max. Load	9.36	16.59	16.59			42.54	
					Avg. Load	7.79	13.81	13.81			35.42	
					Standard Deviation	1.22	2.17	2.17			5.56	
					Variance	1.49	4.70	4.70			30.87	
		Isuzu	2	2.99%	Min. Load	2.55	4.53	4.53			11.61	
					Max. Load	8.79	15.58	15.58			39.94	
					Avg. Load	5.67	10.05	10.05			25.78	
					Standard Deviation	4.41	7.81	7.81			20.03	
					Variance	19.42	61.04	61.04			401.29	

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)											
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total					
3	4 Axle Single Tandem	Nissan	1	1.49%	Min. Load	7.26	12.87	12.87					33.00				
					Max. Load	7.26	12.87	12.87				33.00					
					Avg. Load	7.26	12.87	12.87				33.00					
					Standard Deviation	-	-	-				-					
					Variance	-	-	-				-					
		Total	67	100.00%													
		Hino	14	12.61%	Min. Load	3.52	6.42	4.97	5.80					20.72			
					Max. Load	7.72	14.08	10.90	12.72				45.42				
					Avg. Load	6.38	11.64	9.01	10.51				37.54				
					Standard Deviation	1.22	2.23	1.72	2.01				7.18				
					Variance	1.49	4.96	2.97	4.05				51.60				
					Isuzu	2	1.80%	Min. Load	4.02	7.32	5.67	6.61					23.62
								Max. Load	6.72	12.25	9.48	11.07				39.52	
								Avg. Load	5.37	9.79	7.58	8.84				31.57	
								Standard Deviation	1.91	3.49	2.70	3.15				11.24	
								Variance	3.65	12.15	7.28	9.91				126.41	
					Nissan	89	80.18%	Min. Load	2.36	4.31	3.34	3.89					13.91
								Max. Load	8.08	14.74	11.41	13.31				47.55	
								Avg. Load	6.45	11.76	9.10	10.62				37.92	
								Standard Deviation	1.08	1.98	1.53	1.79				6.38	
Variance	1.18							3.91	2.34	3.19				40.69			
UD	6	5.41%	Min. Load	2.27	4.14	3.20	3.74					13.34					
			Max. Load	7.37	13.43	10.40	12.13				43.33						
			Avg. Load	5.83	10.63	8.23	9.60				34.28						
			Standard Deviation	2.31	4.21	3.26	3.81				13.60						
			Variance	5.34	17.77	10.65	14.49				184.87						
Total	111	100.00%															
4	5 Axle Single Tridem	Hino	3	75.00%	Min. Load	2.61	4.62	4.02	4.22	4.62			20.10				
					Max. Load	5.97	10.55	9.18	9.64	10.55			45.89				
					Avg. Load	4.84	8.56	7.44	7.82	8.56			37.22				
					Standard Deviation	1.93	3.41	2.97	3.11	3.41			14.83				
					Variance	3.72	11.63	8.80	9.70	11.63			219.92				
		Nissan	1	25.00%	Min. Load	5.91	10.45	9.09	9.54	10.45				45.45			
					Max. Load	5.91	10.45	9.09	9.54	10.45			45.45				
					Avg. Load	5.91	10.45	9.09	9.54	10.45			45.45				
					Standard Deviation	-	-	-	-	-			-				
					Variance	-	-	-	-	-			-				
		Total	4	100.00%													
		5	5 Axle Tandem Tandem	Nissan	1	100.00%	Min. Load	7.23	12.23	11.12	11.67	13.34			55.58		
							Max. Load	7.23	12.23	11.12	11.67	13.34			55.58		
							Avg. Load	7.23	12.23	11.12	11.67	13.34			55.58		
Standard Deviation	-						-	-	-	-			-				
Variance	-						-	-	-	-			-				
Total	1	100.00%															
6	6 Axle Tandem Tridem	Hino	2	66.67%	Min. Load	1.77	3.00	3.18	2.83	3.18	3.71		17.66				
					Max. Load	7.43	12.63	13.37	11.88	13.37	15.60		74.27				
					Avg. Load	4.60	7.81	8.27	7.35	8.27	9.65		45.97				
					Standard Deviation	4.00	6.80	7.21	6.40	7.21	8.41		40.03				
					Variance	16.02	46.31	51.92	41.02	51.92	70.66		1602.35				
		Nissan	1	33.33%	Min. Load	2.56	4.35	4.61	4.09	4.61	5.37		25.59				
					Max. Load	2.56	4.35	4.61	4.09	4.61	5.37		25.59				
					Avg. Load	2.56	4.35	4.61	4.09	4.61	5.37		25.59				
					Standard Deviation	-	-	-	-	-	-		-				
					Variance	-	-	-	-	-	-		-				
		Total	3	100.00%													

8.3.7 Distribution of Vehicles by Body Type on SAPT

The percentage of vehicles with respect to Body Type i.e. Flat, Half, Full & Container plying on SAPT is tabulated in Table 8-7 and is graphically presented in Figure 8-6.

Table 8-7: Percentage of Vehicles w.r.t Body Type on SAPT

Sr. No.	Body Type	Count	Percentage
1	Flat	3	1.60%
2	Container	184	98.40%
	Total	187	100.00%

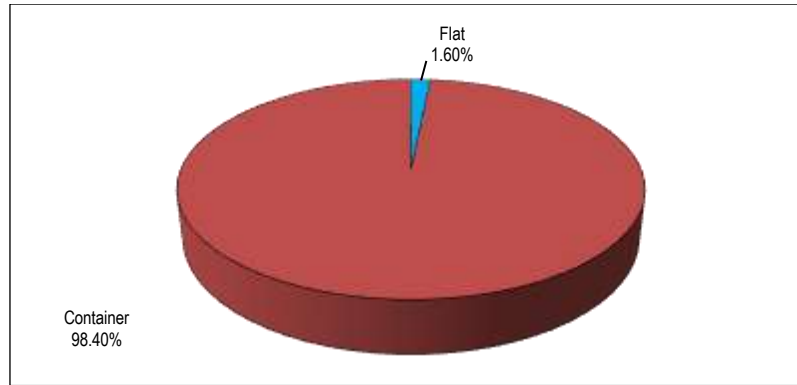


Figure 8-6 : Percentage of Vehicles w.r.t Body Type on SAPT

8.3.8 Analysis by Body Type on SAPT

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to body type is presented in Table 8-8. The results depict that:

In case of **3 Axle Tandem**, container body type constitutes overall percentage of 100%, with average gross load of 35.14 ton.

In case of **4 Axle Single Tandem**, container body type constitutes maximum percentage of 98.20%, with average gross load of 38 ton.

In case of **5 Axle Single Tridem**, container body type constitutes maximum percentage of 100%, with average gross load of 39.28 ton.

In case of **6 Axle Tandem Tridem**, container body type constitutes maximum percentage of 66.67%, with average gross load of 49.93 ton.

Table 8-8: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Body Type for major Axle Configuration on SAPT

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Container	1	100.00%	Min. Load	6.59	14.67					21.26
					Max. Load	6.59	14.67				21.26	
					Avg. Load	6.59	14.67				21.26	
					Standard Deviation	-	-				-	
					Variance	-	-				-	
	Total		1	100.00%								
2	3 Axle Tandem	Container	67	100.00%	Min. Load	2.55	4.53	4.53				11.61
					Max. Load	9.36	16.59	16.59			42.54	
					Avg. Load	7.73	13.70	13.70			35.14	
					Standard Deviation	1.36	2.41	2.41			6.17	
					Variance	1.84	5.79	5.79			38.06	
	Total		67	100.00%								
3	4 Axle Single Tandem	Flat	2	1.80%	Min. Load	2.27	4.14	3.20	3.74			13.34
					Max. Load	2.36	4.31	3.34	3.89		13.91	
					Avg. Load	2.32	4.22	3.27	3.82		13.63	
					Standard Deviation	0.07	0.12	0.10	0.11		0.40	
					Variance	0.00	0.02	0.01	0.01		0.16	
		Container	109	98.20%	Min. Load	3.51	6.40	4.95	5.78		20.64	
					Max. Load	8.08	14.74	11.41	13.31		47.55	
					Avg. Load	6.46	11.78	9.12	10.64		38.00	
					Standard Deviation	1.07	1.95	1.51	1.76		7.04	
					Variance	1.15	3.81	2.28	3.11		39.66	
	Total		111	100.00%								
4	5 Axle Single Tridem	Container	4	100.00%	Min. Load	2.61	4.62	4.02	4.22	4.62		20.10
					Max. Load	5.97	10.55	9.18	9.64	10.55		45.89
					Avg. Load	5.11	9.03	7.86	8.25	9.03		39.28
					Standard Deviation	1.66	2.94	2.56	2.69	2.94		12.79
					Variance	2.76	8.65	6.54	7.21	8.65		163.53
	Total		4	100.00%								
5	5 Axle Tandem Tandem	Container	1	100.00%	Min. Load	7.23	12.23	11.12	11.67	13.34		55.58
					Max. Load	7.23	12.23	11.12	11.67	13.34		55.58
					Avg. Load	7.23	12.23	11.12	11.67	13.34		55.58
					Standard Deviation	-	-	-	-	-		-
					Variance	-	-	-	-	-		-
	Total		1	100.00%								

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
6	6 Axle Tandem Tridem	Flat	1	33.33%	Min. Load	1.77	3.00	3.18	2.83	3.18	3.71	17.66
					Max. Load	1.77	3.00	3.18	2.83	3.18	3.71	17.66
					Avg. Load	1.77	3.00	3.18	2.83	3.18	3.71	17.66
					Standard Deviation	-	-	-	-	-	-	-
					Variance	-	-	-	-	-	-	-
		Container	2	66.67%	Min. Load	2.56	4.35	4.61	4.09	4.61	5.37	25.59
					Max. Load	7.43	12.63	-	11.88	13.37	15.60	74.27
					Avg. Load	4.99	8.49	8.99	7.99	8.99	10.49	49.93
					Standard Deviation	3.44	5.85	6.20	5.51	6.20	7.23	34.42
					Variance	11.85	34.24	38.39	30.33	38.39	52.25	1184.87
Total	3	100.00%										

8.3.9 Distribution of Vehicles by Type on SAPT

The percentage of vehicles with respect to Type i.e. Truck, Semi-Trailer and Tanker plying on SAPT is tabulated in Table 8-9 and is graphically presented in Figure 8-7.

Table 8-9: Percentage of Vehicles w.r.t Type on SAPT

Sr. No.	Vehicle Type	Count	Percentage
1	Truck	89	46.35%
2	Semi-Trailer	103	53.65%
	Total	192	100.00%

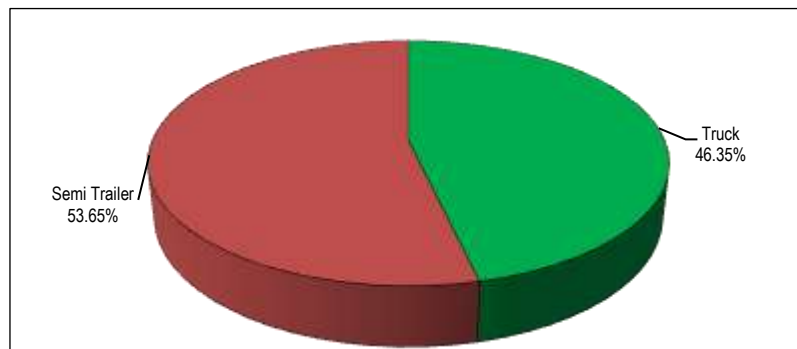


Figure 8-7: Percentage of Vehicles w.r.t Type on SAPT

8.3.10 Analysis by Vehicle Type on SAPT

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to truck type is presented in Table 8-10. The results depict that:

In case of **3 Axle Tandem**, truck type constitutes maximum percentage of 100%, with average gross load of 35.14 ton.

In case of **4 Axle Single Tandem**, semi-trailer type constitutes maximum percentage of 85.59%, with average gross load of 37.59 ton, followed by truck type with percentage of 14.41%, carrying average gross load of 37.39 ton.

In case of **5 Axle Single Tridem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 39.28 ton.

In case of **6 Axle Tandem Tridem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 39.17 ton.

Table 8-10: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Type for major Axle Configuration on SAPT

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Truck	1	100.00%	Min. Load	6.59	14.67					21.26
					Max. Load	6.59	14.67				21.26	
					Avg. Load	6.59	14.67				21.26	
					Standard Deviation	-	-				-	
					Variance	-	-				-	
		Total	1	100.00%								

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
2	3 Axle Tandem	Truck	67	100.00%	Min. Load	2.55	4.53	4.53				11.61
					Max. Load	9.36	16.59	16.59				42.54
					Avg. Load	7.73	13.70	13.70				35.14
					Standard Deviation	1.36	2.41	2.41				6.17
					Variance	1.84	5.79	5.79				38.06
	Total		67	100.00%								
3	4 Axle Single Tandem	Semi-Trailer	95	85.59%	Min. Load	2.27	4.14	3.20	3.74	0.00		13.34
					Max. Load	8.08	14.74	11.41	13.31	0.00		47.55
					Avg. Load	6.39	11.65	9.02	10.53	-		37.59
					Standard Deviation	1.26	2.29	1.78	2.07	0.00		7.40
					Variance	1.58	5.27	3.16	4.30	0.00		54.80
		Truck	16	14.41%	Min. Load	4.97	9.07	7.02	8.19	0.00		29.26
					Max. Load	7.22	13.17	10.19	11.89	0.00		42.47
					Avg. Load	6.36	11.59	8.97	10.47	-		37.39
					Standard Deviation	0.76	1.38	1.07	1.25	0.00		4.46
					Variance	0.57	1.91	1.14	1.56	0.00		19.87
	Total		111	100.00%								
4	5 Axle Single Tridem	Semi-Trailer	4	100.00%	Min. Load	2.61	4.62	4.02	4.22	4.62		20.10
					Max. Load	5.97	10.55	9.18	9.64	10.55		45.89
					Avg. Load	5.11	9.03	7.86	8.25	9.03		39.28
					Standard Deviation	1.66	2.94	2.56	2.69	2.94		12.79
					Variance	2.76	8.65	6.54	7.21	8.65		163.53
	Total		4	100.00%								
5	5 Axle Tandem Tandem	Semi-Trailer	1	100.00%	Min. Load	7.23	12.23	11.12	11.67	13.34		55.58
					Max. Load	7.23	12.23	11.12	11.67	13.34		55.58
					Avg. Load	7.23	12.23	11.12	11.67	13.34		55.58
					Standard Deviation	-	-	-	-	-		-
					Variance	-	-	-	-	-		-
	Total		1	100.00%								
6	6 Axle Tandem Tridem	Semi-Trailer	3	100.00%	Min. Load	1.77	3.00	3.18	2.83	3.18	3.71	17.66
					Max. Load	7.43	12.63	13.37	11.88	13.37	15.60	74.27
					Avg. Load	3.92	6.66	7.05	6.27	7.05	8.23	39.17
					Standard Deviation	3.07	5.21	5.52	4.90	5.52	6.44	30.65
					Variance	9.40	27.15	30.44	24.05	30.44	41.43	939.55
	Total		3	100.00%								

8.3.11 Commodities carried by vehicles on SAPT

The percentage of major commodities carried by heavy vehicles on SAPT is tabulated in Table 8-11 and is graphically presented in Figure 8-8. For the sake of analysis, each commodity is assigned a code; details are attached in Annex – 2.

Table 8-11: Percentage of Vehicle w.r.t Commodities on SAPT

Sr. No.	Commodity Type	Code	Count	Percentage
1	Agriculture Items	100	9	4.69%
2	Food Items	200	3	1.56%
3	Animals and Animal Products	300	4	2.08%
4	Raw Materials	400	4	2.08%
5	Bulk Manufactures	500	5	2.60%
6	Basic Manufactures	600	74	38.54%
7	Miscellaneous Manufactures	700	18	9.38%
8	Mining and Quarrying	800	31	16.15%
9	Fuel, Lubricants (Minerals)	900	1	0.52%
10	Miscellaneous Goods not Classified	A00	40	20.83%
11	Empty	E00	3	1.56%
	Total		192	100.00%

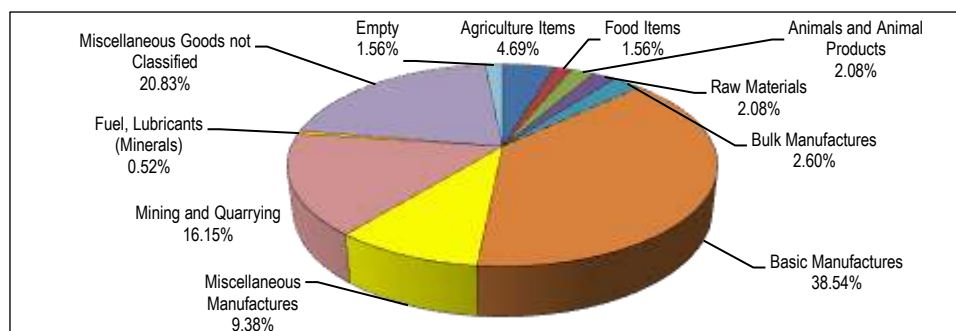


Figure 8-8: Percentage of Vehicles w.r.t Commodities on SAPT

8.3.12 Analysis based on Commodities on SAPT

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to commodities carried by trucks is presented in Table 8-12. The results depict that:

Major commodities carried by **3 Axle Tandem** are mining and quarrying, covering 40.3% of the total, with average gross load of 37.6 ton, followed by basic manufactures having percentage of 22.39% in total, with average gross load of 35.10 ton.

Major commodities carried by **4 Axle Single Tandem** are basic manufactures, covering 50.45% of the total, with average gross load of 39.43 ton, followed by miscellaneous goods not classified, having 22.52% in total, with average gross load of 34.03 ton.

Major commodity carried by **5 Axle Single Tridem** is miscellaneous goods not classified, covering 50% of the total, with average gross load of 32.78 ton.

Major commodity carried by **6 Axle Tandem Tridem** is miscellaneous goods not classified, covering 66.67% of the total, with average gross load of 21.63 ton.

Table 8-12: Stdev. Var., Min., Max. & Avg. Load Comparison w.r.t Commodities for major Axle Configuration on SAPT

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Miscellaneous Goods not Classified	A00	1	100.00%	Min. Load	6.59	14.67					21.26
						Max. Load	6.59	14.67					21.26
						Avg. Load	6.59	14.67					21.26
						Standard Deviation	-	-					-
						Variance	-	-					-
Total				1	100%								
2	3 Axle Tandem	Agriculture Items	100	8	11.94%	Min. Load	7.71	13.67	13.67				35.06
						Max. Load	8.75	15.51	15.51				39.78
						Avg. Load	8.23	14.59	14.59				37.40
						Standard Deviation	0.38	0.68	0.68				1.75
						Variance	0.15	0.46	0.46				3.05
		Raw Materials	400	4	5.97%	Min. Load	8.26	14.64	14.64				37.54
						Max. Load	9.36	16.59	16.59				42.54
						Avg. Load	8.74	15.50	15.50				39.74
						Standard Deviation	0.47	0.84	0.84				2.14
						Variance	0.22	0.70	0.70				4.59
		Basic Manufactures	600	15	22.39%	Min. Load	4.86	8.61	8.61				22.09
						Max. Load	9.11	16.16	16.16				41.43
						Avg. Load	7.72	13.69	13.69				35.10
						Standard Deviation	1.25	2.21	2.21				5.66
						Variance	1.55	4.88	4.88				32.08
		Miscellaneous Manufactures	700	3	4.48%	Min. Load	6.10	10.81	10.81				27.73
						Max. Load	7.87	13.94	13.94				35.75
						Avg. Load	7.08	12.54	12.54				32.16
						Standard Deviation	0.90	1.59	1.59				4.08
						Variance	0.80	2.53	2.53				16.61
		Mining and Quarrying	800	27	40.30%	Min. Load	7.18	12.72	12.72				32.62
						Max. Load	8.92	15.81	15.81				40.55
						Avg. Load	8.27	14.67	14.67				37.60
						Standard Deviation	0.48	0.85	0.85				2.18
						Variance	0.23	0.72	0.72				4.74
		Fuel, Lubricants (Minerals)	900	1	1.49%	Min. Load	5.13	9.09	9.09				23.31
						Max. Load	5.13	9.09	9.09				23.31
						Avg. Load	5.13	9.09	9.09				23.31
						Standard Deviation	-	-	-				-
						Variance	-	-	-				-
		Miscellaneous Goods not Classified	A00	8	11.94%	Min. Load	3.93	6.96	6.96				17.85
						Max. Load	9.28	16.45	16.45				42.18
						Avg. Load	6.13	10.87	10.87				27.87
						Standard Deviation	1.74	3.09	3.09				7.92
						Variance	3.03	9.53	9.53				62.66
		Empty	E00	1	1.49%	Min. Load	2.55	4.53	4.53				11.61
						Max. Load	2.55	4.53	4.53				11.61
						Avg. Load	2.55	4.53	4.53				11.61
						Standard Deviation	-	-	-				-
						Variance	-	-	-				-
Total				67	100.00%								
3	4 Axle Single Tandem	Agriculture Items	100	1	0.90%	Min. Load	7.49	13.65	10.57	12.33			44.04
						Max. Load	7.49	13.65	10.57	12.33			44.04
						Avg. Load	7.49	13.65	10.57	12.33			44.04

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
		Food Items	200	3	2.70%	Standard Deviation	-	-	-	-	-	-	-
						Variance	-	-	-	-	-	-	-
						Min. Load	6.32	11.53	8.92	10.41			37.18
						Max. Load	8.08	14.74	11.41	13.31			47.55
						Avg. Load	6.94	12.66	9.80	11.43			40.84
						Standard Deviation	0.99	1.80	1.40	1.63			5.82
						Variance	0.98	3.26	1.95	2.66			33.89
						Min. Load	7.57	13.81	10.69	12.47			44.54
						Max. Load	7.80	14.23	11.02	12.85			45.91
						Avg. Load	7.70	14.05	10.87	12.69			45.31
		Animals and Animal Products	300	4	3.60%	Standard Deviation	0.10	0.19	0.15	0.17			0.61
						Variance	0.01	0.04	0.02	0.03			0.37
						Min. Load	4.29	7.82	6.06	7.06			25.23
						Max. Load	7.72	14.08	10.90	12.72			45.42
						Avg. Load	6.52	11.88	9.20	10.73			38.34
		Bulk Manufactures	500	5	4.50%	Standard Deviation	1.45	2.64	2.04	2.38			8.52
						Variance	2.10	6.97	4.18	5.68			72.51
						Min. Load	3.51	6.40	4.95	5.78			20.64
						Max. Load	8.00	14.58	11.29	13.17			47.03
						Avg. Load	6.70	12.22	9.46	11.04			39.43
		Basic Manufactures	600	56	50.45%	Standard Deviation	0.88	1.61	1.24	1.45			5.19
						Variance	0.78	2.58	1.55	2.11			26.89
						Min. Load	4.02	7.32	5.67	6.61			23.62
						Max. Load	7.14	13.02	10.08	11.76			42.01
						Avg. Load	5.98	10.90	8.44	9.85			35.16
		Miscellaneous Manufactures	700	13	11.71%	Standard Deviation	0.92	1.67	1.30	1.51			5.40
Variance	0.84					2.80	1.68	2.28			29.13		
Min. Load	7.36					13.42	10.39	12.12			43.28		
Max. Load	7.38					13.45	10.42	12.15			43.40		
Avg. Load	7.37					13.44	10.40	12.14			43.34		
Mining and Quarrying	800	2	1.80%	Standard Deviation	0.01	0.03	0.02	0.02			0.08		
				Variance	0.00	0.00	0.00	0.00			0.01		
				Min. Load	3.52	6.42	4.97	5.80			20.72		
				Max. Load	7.37	13.44	10.40	12.14			43.35		
				Avg. Load	5.79	10.55	8.17	9.53			34.03		
Miscellaneous Goods not Classified	A00	25	22.52%	Standard Deviation	1.18	2.15	1.66	1.94			6.93		
				Variance	1.39	4.61	2.76	3.76			47.97		
				Min. Load	2.27	4.14	3.20	3.74			13.34		
				Max. Load	2.36	4.31	3.34	3.89			13.91		
				Avg. Load	2.32	4.22	3.27	3.82			13.63		
Empty	E00	2	1.80%	Standard Deviation	0.07	0.12	0.10	0.11			0.40		
				Variance	0.00	0.02	0.01	0.01			0.16		
				Min. Load	5.97	10.55	9.18	9.64	10.55		45.89		
				Max. Load	5.97	10.55	9.18	9.64	10.55		45.89		
				Avg. Load	5.97	10.55	9.18	9.64	10.55		45.89		
Total			111	100.00%									
4	5 Axle Single Tridem	Basic Manufactures	600	1	25.00%	Min. Load	5.97	10.55	9.18	9.64	10.55		45.89
						Max. Load	5.97	10.55	9.18	9.64	10.55		45.89
						Avg. Load	5.97	10.55	9.18	9.64	10.55		45.89
						Standard Deviation	-	-	-	-	-		-
						Variance	-	-	-	-	-		-
		Miscellaneous Manufactures	700	1	25.00%	Min. Load	5.94	10.51	9.14	9.59	10.51		45.68
						Max. Load	5.94	10.51	9.14	9.59	10.51		45.68
						Avg. Load	5.94	10.51	9.14	9.59	10.51		45.68
						Standard Deviation	-	-	-	-	-		-
						Variance	-	-	-	-	-		-
		Miscellaneous Goods not Classified	A00	2	50.00%	Min. Load	2.61	4.62	4.02	4.22	4.62		20.10
						Max. Load	5.91	10.45	9.09	9.54	10.45		45.45
						Avg. Load	4.26	7.54	6.56	6.88	7.54		32.78
						Standard Deviation	2.33	4.12	3.59	3.76	4.12		17.93
Variance	5.43					17.00	12.85	14.17	17.00		321.31		
Total			4	100.00%									
5	5 Axle Tandem Tandem	Miscellaneous Goods not Classified	A00	1	100.00%	Min. Load	7.23	12.23	11.12	11.67	13.34		55.58
						Max. Load	7.23	12.23	11.12	11.67	13.34		55.58
						Avg. Load	7.23	12.23	11.12	11.67	13.34		55.58
						Standard Deviation	-	-	-	-	-		-
						Variance	-	-	-	-	-		-
Total			1	100.00%									
6	6 Axle Tandem Tridem	Miscellaneous Manufactures	700	1	33.33%	Min. Load	7.43	12.63	13.37	11.88	13.37	15.60	74.27
						Max. Load	7.43	12.63	13.37	11.88	13.37	15.60	74.27
						Avg. Load	7.43	12.63	13.37	11.88	13.37	15.60	74.27
						Standard Deviation	-	-	-	-	-	-	-
						Variance	-	-	-	-	-	-	-
		Miscellaneous Goods not Classified	A00	2	66.67%	Min. Load	1.77	3.00	3.18	2.83	3.18	3.71	17.66
						Max. Load	2.56	4.35	4.61	4.09	4.61	5.37	25.59
						Avg. Load	2.16	3.68	3.89	3.46	3.89	4.54	21.63
						Standard Deviation	0.56	0.95	1.01	0.90	1.01	1.18	5.61
						Variance	0.31	0.91	1.02	0.80	1.02	1.39	31.44
Total			3	100.00%									

8.3.13 Damage Factor for major Axle Configuration on SAPT

The average damage factors calculated for major axle configuration are presented in Table 8-13.

Table 8-13: Damage Factor for major Axle Configuration on SAPT

Sr. No.	Axle Configuration	Code	Damage Factor (2020)	
			Road Note 40	AASHTO 1993
1	2 Axle Single	1.2	14.07	9.52
2	3 Axle Tandem	1.22	24.97	12.00
3	4 Axle Single Tandem	1.2-22	12.02	8.18
4	5 Axle Single Tridem	1.2-222	7.54	4.90
5	5 Axle Tandem Tandem	1.22-22	24.36	13.65
6	6 Axle Tandem Tridem	1.22-222	16.49	6.98

8.4 Karachi International Container Terminal (KICT)

The results of axle load survey performed on KICT of KPT are discussed in subsequent sub-sections.

8.4.1 Distribution of Vehicles by Axle Configuration on KICT

The percentage of trucks for major axle configurations surveyed on KICT is summarized in Table 8-14 and is graphically presented in Figure 8-9.

Table 8-14: Percentage of Vehicle w.r.t Axle Configuration on KICT

Sr. No.	Axle Configuration	Code	Total Number of Trucks	%age
1	2 Axle Single	1.2	5	2.98%
2	3 Axle Tandem	1.22	88	52.38%
3	4 Axle Single Tandem	1.2-22	60	35.71%
4	5 Axle Single Tridem	1.2-222	10	5.95%
5	6 Axle Tandem Tridem	1.22-222	5	2.98%
Total			168	100.00%

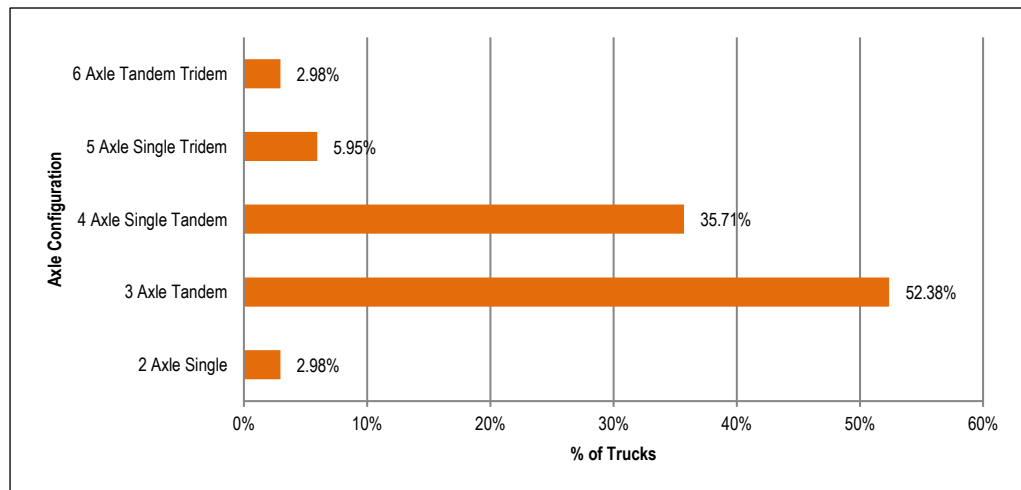


Figure 8-9: Percentage of Vehicles w.r.t Axle Configuration on KICT

8.4.2 Analysis by Axle Configuration on KICT

The analysis comprising minimum, maximum and average loads per axle carried by trucks on KICT along with standard deviation and variance is presented in Table 8-15. The minimum, maximum and average loads are graphically presented in Figure 8-10 and Figure 8-11 respectively.

In case of **2 Axle Single**, maximum load of 16.06 ton with average load of 14.49 ton was recorded.

In case of **3 Axle Tandem**, maximum load of 42.52 ton with average load of 31.85 ton was recorded.

In case of **4 Axle Single Tandem**, maximum load of 47.80 ton with average load of 35.32 ton was recorded.

In case of **5 Axle Single Tridem**, maximum load of 59.97 ton with average load of 38.70 ton was recorded.

In case of **6 Axle Tandem Tridem**, maximum load of 81.17 ton with average load of 55.21 ton was recorded.

Table 8-15: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Axle Configuration on KICT

Sr. No.	Axle Configuration	Permissible Load Limits	Parameters	Load (Tons)							
				Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total	
1	2 Axle Single	17.5	Min. Load	3.93	8.76						12.69
			Max. Load	4.98	11.08						16.06
			Avg. Load	4.49	10.00						14.49
			Standard Deviation	0.42	0.93						1.35
			Variance	0.17	0.86						1.81
2	3 Axle Tandem	27.5	Min. Load	1.79	3.17	3.17					8.14
			Max. Load	9.35	16.58	16.58					42.52
			Avg. Load	7.01	12.42	12.42					31.85
			Standard Deviation	1.81	3.21	3.21					8.23
			Variance	3.28	10.31	10.31					67.78
3	4 Axle Single Tandem	39.5	Min. Load	2.01	3.67	2.84	3.31				11.83
			Max. Load	8.13	14.82	11.47	13.38				47.80
			Avg. Load	6.00	10.95	8.48	9.89				35.32
			Standard Deviation	1.73	3.15	2.44	2.85				10.17
			Variance	2.99	9.94	5.96	8.11				103.44
4	5 Axle Single Tridem	48.5	Min. Load	2.17	3.83	3.33	3.50	3.83			16.67
			Max. Load	7.80	13.79	11.99	12.59	13.79			59.97
			Avg. Load	5.03	8.90	7.74	8.13	8.90			38.70
			Standard Deviation	1.78	3.15	2.74	2.88	3.15			13.69
			Variance	3.17	9.92	7.50	8.27	9.92			187.52
5	6 Axle Tandem Tridem	58.5	Min. Load	1.53	2.60	2.76	2.45	2.76	3.22		15.32
			Max. Load	8.12	13.80	14.61	12.99	14.61	17.05		81.17
			Avg. Load	5.52	9.39	9.94	8.83	9.94	11.59		55.21
			Standard Deviation	3.49	5.94	6.29	5.59	6.29	7.33		34.93
			Variance	12.20	35.26	39.53	31.23	39.53	53.80		1219.98

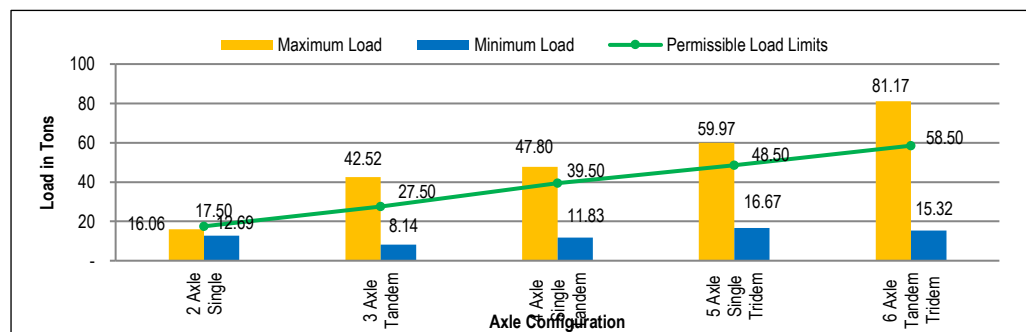


Figure 8-10: Min. & Max. Load Comparison w.r.t Axle Configuration on KICT

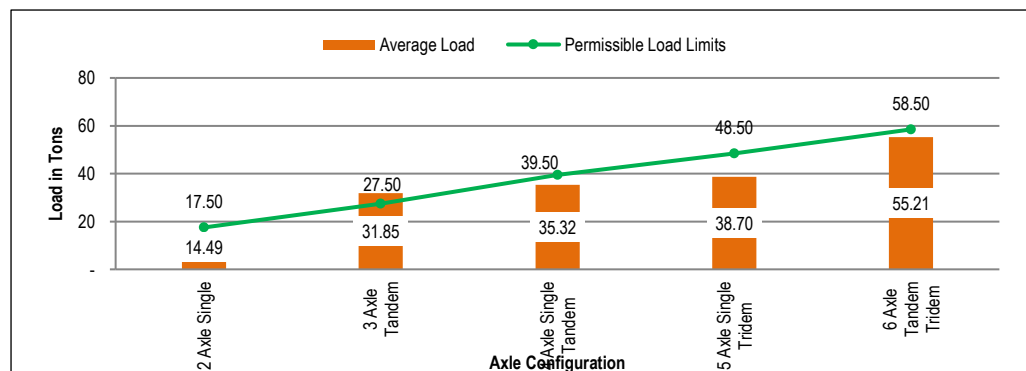


Figure 8-11: Avg. Load Comparison w.r.t Axle Configuration on KICT

8.4.3 Load Spectrum by Axle Configuration on KICT

The major cause of pavement failure is due to excessive overloading. The axle load survey data was organized in a way to identify the number of vehicles carrying load above and below permissible limits. Furthermore, load spectrums were identified and number of vehicles carrying load in specified spectrums were calculated. The results are tabulated in Table 8-16 which illustrates that:

In case of **2 Axle Single**, 100% of trucks carried load under permissible limits.

In case of **3 Axle Tandem**, 15.91% of trucks carried load under permissible limits. Whereas, 65.91% of the trucks carried load more than 15% of permissible load limits.

In case of **4 Axle Single Tandem**, 61.67% of trucks/semi-trailers carried load under permissible limits. Whereas, 10% of the trucks/semi-trailers carried load more than 15% of permissible load limits.

In case of **5 Axle Single Tridem**, 80% of semi-trailers carried load under permissible limits. Whereas, 20% semi-trailers carried load more than 15% of permissible load limits

In case of **6 Axle Tandem Tridem**, 40% of semi-trailers carried load under permissible limits. Whereas, 60% semi-trailers carried load more than 15% of permissible load limits

The percentage of trucks and trailers for major axle configuration carrying load above and below permissible limits on KICT is graphically presented in Figure 8-12.

Table 8-16: Load Spectrum w.r.t Axle Configuration on KICT

Sr. No.	Axle Configuration	Under Permissible Limit	Over Permissible Limit					Total	
			15.00%	30.00%	50.00%	75.00%	>75%		
1	2 Axle Single	Max. Load (Tons)	17.5	20.1	22.8	26.3	30.6		
		Average Load (Tons)	14.49	-	-	-	-	-	
		No. of Trucks	5	0	0	0	0	0	5
		Percentage	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
2	3 Axle Tandem	Max. Load (Tons)	27.5	31.6	35.8	41.3	48.1		
		Average Load (Tons)	15.28	29.56	34.88	37.44	41.88	-	
		No. of Trucks	14	16	27	28	3	0	88
		Percentage	15.91%	18.18%	30.68%	31.82%	3.41%	0.00%	100%
		Cumulative Percentage	15.91%	34.09%	64.77%	96.59%	100.00%	100.00%	
		Percentage above Range Value	84.09%	65.91%	35.23%	3.41%	0.00%	0.00%	
3	4 Axle Single Tandem	Max. Load (Tons)	39.5	45.4	51.4	59.3	69.1		
		Average Load (Tons)	30.44	41.82	47.00	-	-	-	
		No. of Trucks	37	17	6	0	0	0	60
		Percentage	61.67%	28.33%	10.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	61.67%	90.00%	100.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	38.33%	10.00%	0.00%	0.00%	0.00%	0.00%	
4	5 Axle Single Tridem	Max. Load (Tons)	48.5	55.8	63.1	72.8	84.9		
		Average Load (Tons)	33.64	-	-	-	-	-	
		No. of Trucks	8	0	2	0	0	0	10
		Percentage	80.00%	0.00%	20.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	80.00%	80.00%	100.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	20.00%	20.00%	0.00%	0.00%	0.00%	0.00%	
5	6 Axle Tandem Tridem	Max. Load (Tons)	58.5	67.3	76.1	87.8	102.4		
		Average Load (Tons)	16.98	-	-	-	-	-	
		No. of Trucks	2	0	0	3	0	0	5
		Percentage	40.00%	0.00%	0.00%	60.00%	0.00%	0.00%	100%
		Cumulative Percentage	40.00%	40.00%	40.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	60.00%	60.00%	60.00%	0.00%	0.00%	0.00%	

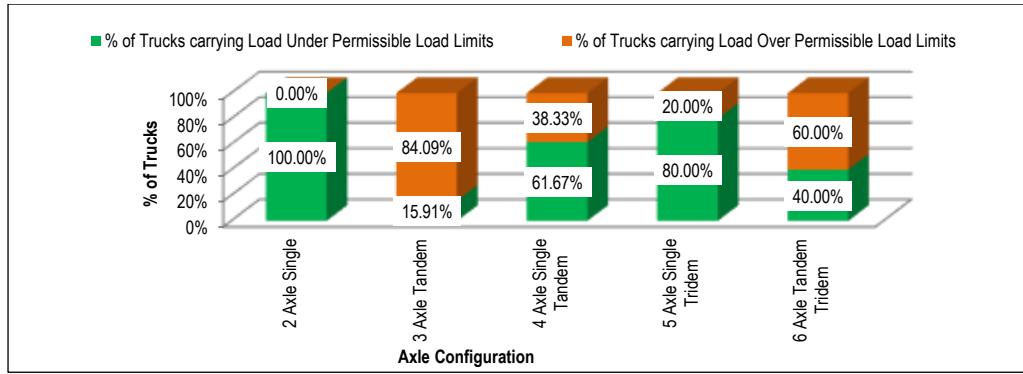


Figure 8-12: Percentage of Vehicles carrying Load above and below Permissible Limits on KICT

8.4.4 Front & Rear Axle Load Spectrum on KICT

The spectrum of front and rear axle loads for major axle configurations is presented in Table 8-17.

Table 8-17: Front & Rear Axle Load Spectrum on KICT

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
Front Axle Load Spectrum					
1	0 - 2.99	18	10.71%	10.71%	89.29%
2	3 - 5.49	22	13.10%	23.81%	76.19%
3	5.5 - 6.99	49	29.17%	52.98%	47.02%
4	7 - 8.99	76	45.24%	98.21%	1.79%
5	9 - 10.99	3	1.79%	100.00%	0.00%
6	11 - 12.99	0	0.00%	100.00%	0.00%
7	13 - 14.99	0	0.00%	100.00%	0.00%
8	15 - 16.99	0	0.00%	100.00%	0.00%
9	17 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Single)					
1	0 - 8.16	86	20.19%	20.19%	79.81%
2	8.17 - 9.99	60	14.08%	34.27%	65.73%
3	10 - 10.99	36	8.45%	42.72%	57.28%
4	11 - 11.99	62	14.55%	57.28%	42.72%
5	12 - 12.99	38	8.92%	66.20%	33.80%
6	13 - 13.99	68	15.96%	82.16%	17.84%
7	14 - 14.99	59	13.85%	96.01%	3.99%
8	15 - 19.99	17	3.99%	100.00%	0.00%
9	20 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Tandem)					
1	0 - 11.99	22	14.38%	14.38%	85.62%
2	12 - 14.99	2	1.31%	15.69%	84.31%
3	15 - 19.99	21	13.73%	29.41%	70.59%
4	20 - 21.99	22	14.38%	43.79%	56.21%
5	22 - 23.99	19	12.42%	56.21%	43.79%
6	24 - 25.99	9	5.88%	62.09%	37.91%
7	26 - 27.99	25	16.34%	78.43%	21.57%
8	28 - 29.99	26	16.99%	95.42%	4.58%
9	30 & Above	7	4.58%	100.00%	0.00%
Rear Axle Load Spectrum (Tridem)					
1	0 - 14.99	4	26.67%	26.67%	73.33%
2	15 - 30.99	6	40.00%	66.67%	33.33%
3	31 - 32.99	0	0.00%	66.67%	33.33%
4	33 - 34.99	0	0.00%	66.67%	33.33%
5	35 - 36.99	0	0.00%	66.67%	33.33%
6	37 - 38.99	2	13.33%	80.00%	20.00%
7	39 - 40.99	0	0.00%	80.00%	20.00%
8	41 - 42.99	0	0.00%	80.00%	20.00%
9	43 & Above	3	20.00%	100.00%	0.00%

8.4.5 Distribution of Vehicles by Make Type on KICT

The distribution of trucks as per make type is illustrated in Table 8-18 and is graphically presented in Figure 8-13. The results depict that Hino and Nissan have maximum percentage of 59.88% and 23.95% on KICT.

Table 8-18: Percentage of Vehicles w.r.t Make Type on KICT

Sr. No.	Make	Count	Percentage
1	Bedford	5	2.99%
2	Nissan	40	23.95%
3	Faw	2	1.20%
4	Hino	100	59.88%
5	Isuzu	17	10.18%
6	UD	3	1.80%
Total		167	100.00%

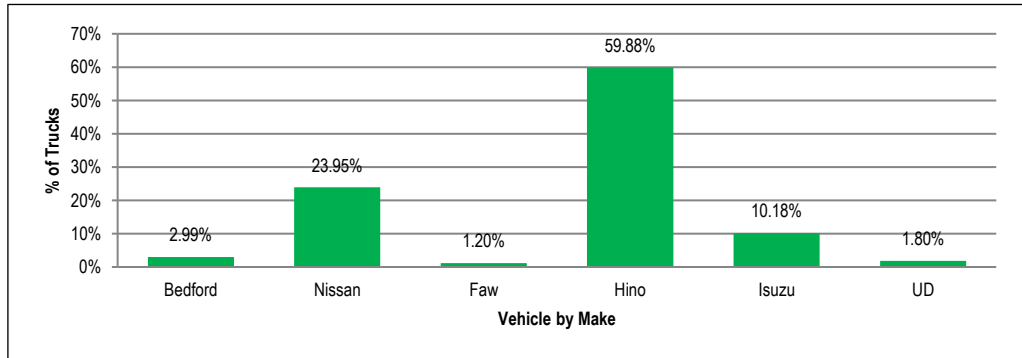


Figure 8-13: Percentage of Vehicles w.r.t Make Type on KICT

8.4.6 Analysis by Make Type on KICT

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to make type is presented in Table 8-19. The results depict that:

In case of **2 Axle Single**, Bedford constitutes maximum percentage of 60%, with average gross load of 14.77 ton.

In case of **3 Axle Tandem**, Hino constitutes maximum percentage of 79.55%, with average gross load of 31.84 ton, followed by Isuzu with percentage of 14.77%, carrying average gross load of 33.47 ton.

In case of **4 Axle Single Tandem**, Nissan constitutes maximum percentage of 55.93% with average gross load of 35.72 ton, followed by Hino with percentage of 33.90%, carrying average gross load of 35.17 ton.

In case of **5 Axle Single Tridem**, Hino constitutes maximum percentage of 50%, with average gross load of 33.46 ton, followed by Nissan with percentage of 40%, carrying average gross load of 45.33 ton.

In case of **6 Axle Tandem Tridem**, Hino constitutes maximum percentage of 80%, with average gross load of 48.86 ton.

Table 8-19: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Make Type for major Axle Configuration on KICT

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Bedford	3	60.00%	Min. Load	3.93	8.76					12.69
					Max. Load	4.98	11.08					16.06
					Avg. Load	4.58	10.19					14.77
					Standard Deviation	0.56	1.26					1.82
					Variance	0.32	1.58					3.32
		Nissan	1	20.00%	Min. Load	4.36	9.72					14.08
					Max. Load	4.36	9.72					14.08
					Avg. Load	4.36	9.72					14.08
					Standard Deviation	-	-					-
					Variance	-	-					-
		Hino	1	20.00%	Min. Load	4.35	9.69					14.04
					Max. Load	4.35	9.69					14.04
					Avg. Load	4.35	9.69					14.04
					Standard Deviation	-	-					-
					Variance	-	-					-
Total		5	100%									

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
2	3 Axle Tandem	Bedford	2	2.27%	Min. Load	3.33	5.90	5.90				15.14
					Max. Load	3.34	5.91	5.91				15.16
					Avg. Load	3.33	5.91	5.91				15.15
					Standard Deviation	0.00	0.01	0.01				0.01
		Variance	0.00	0.00	0.00				0.00			
		Hino	70	79.55%	Min. Load	1.79	3.17	3.17				8.14
					Max. Load	9.35	16.58	16.58				42.52
					Avg. Load	7.00	12.42	12.42				31.84
					Standard Deviation	1.89	3.34	3.34				8.57
		Variance	3.55	11.17	11.17				73.43			
		Isuzu	13	14.77%	Min. Load	6.13	10.86	10.86				27.85
					Max. Load	8.94	15.85	15.85				40.65
					Avg. Load	7.36	13.06	13.06				33.47
					Standard Deviation	0.84	1.49	1.49				3.82
		Variance	0.71	2.22	2.22				14.58			
		Nissan	2	2.27%	Min. Load	7.66	13.57	13.57				34.80
					Max. Load	7.86	13.94	13.94				35.74
					Avg. Load	7.76	13.76	13.76				35.27
					Standard Deviation	0.15	0.26	0.26				0.66
		Variance	0.02	0.07	0.07				0.44			
UD	1	1.14%	Min. Load	8.38	14.85	14.85				38.08		
			Max. Load	8.38	14.85	14.85				38.08		
			Avg. Load	8.38	14.85	14.85				38.08		
			Standard Deviation	-	-	-				-		
Variance	-	-	-				-					
Total	88	100.00%										
3	4 Axle Single Tandem	Hino	20	33.90%	Min. Load	2.94	5.36	4.15	4.84			17.28
					Max. Load	8.09	14.76	11.42	13.33			47.60
					Avg. Load	5.98	10.90	8.44	9.85			35.17
					Standard Deviation	1.73	3.15	2.44	2.85			10.16
		Variance	2.99	9.93	5.95	8.10			103.30			
		Faw	1	1.69%	Min. Load	7.49	13.66	10.58	12.34			44.07
					Max. Load	7.49	13.66	10.58	12.34			44.07
					Avg. Load	7.49	13.66	10.58	12.34			44.07
					Standard Deviation	-	-	-	-			-
		Variance	-	-	-	-			-			
		Isuzu	4	6.78%	Min. Load	2.73	4.98	3.86	4.50			16.07
					Max. Load	8.13	14.82	11.47	13.38			47.80
					Avg. Load	5.94	10.83	8.39	9.78			34.94
					Standard Deviation	2.29	4.18	3.24	3.78			13.49
		Variance	5.26	17.48	10.48	14.26			181.86			
		Nissan	33	55.93%	Min. Load	2.01	3.67	2.84	3.31			11.83
					Max. Load	8.12	14.81	11.46	13.38			47.77
					Avg. Load	6.07	11.07	8.57	10.00			35.72
					Standard Deviation	1.70	3.10	2.40	2.80			9.99
		Variance	2.88	9.59	5.75	7.82			99.75			
UD	1	1.69%	Min. Load	2.97	5.41	4.19	4.89			17.45		
			Max. Load	2.97	5.41	4.19	4.89			17.45		
			Avg. Load	2.97	5.41	4.19	4.89			17.45		
			Standard Deviation	-	-	-	-			-		
Variance	-	-	-	-			-					
Total	59	100.00%										
4	5 Axle Single Tridem	Hino	5	50.00%	Min. Load	2.17	3.83	3.33	3.50	3.83		16.67
					Max. Load	7.53	13.32	11.58	12.16	13.32		57.91
					Avg. Load	4.35	7.70	6.69	7.03	7.70		33.46
					Standard Deviation	2.14	3.79	3.30	3.46	3.79		16.48
		Variance	4.59	14.37	10.87	11.98	14.37		271.72			
		Faw	1	10.00%	Min. Load	4.99	8.83	7.68	8.07	8.83		38.41
					Max. Load	4.99	8.83	7.68	8.07	8.83		38.41
					Avg. Load	4.99	8.83	7.68	8.07	8.83		38.41
					Standard Deviation	-	-	-	-	-		-
		Variance	-	-	-	-	-		-			
		Nissan	4	40.00%	Min. Load	5.12	9.07	7.88	8.28	9.07		39.42
					Max. Load	7.80	13.79	11.99	12.59	13.79		59.97
					Avg. Load	5.89	10.43	9.07	9.52	10.43		45.33
					Standard Deviation	1.27	2.25	1.96	2.06	2.25		9.79
		Variance	1.62	5.07	3.83	4.23	5.07		95.87			
		Total	10	100.00%								
5	6 Axle Tandem Tridem	Hino	4	80.00%	Min. Load	1.53	2.60	2.76	2.45	2.76	3.22	15.32
					Max. Load	8.12	13.80	14.61	12.99	14.61	17.05	81.17
					Avg. Load	4.89	8.31	8.80	7.82	8.80	10.26	48.86
					Standard Deviation	3.68	6.26	6.63	5.90	6.63	7.74	36.85
		Variance	13.58	39.24	43.99	34.76	43.99	59.87	1357.69			
		UD	1	20.00%	Min. Load	8.06	13.71	14.51	12.90	14.51	16.93	80.62
					Max. Load	8.06	13.71	14.51	12.90	14.51	16.93	80.62
					Avg. Load	8.06	13.71	14.51	12.90	14.51	16.93	80.62
					Standard Deviation	-	-	-	-	-	-	-
		Variance	-	-	-	-	-	-	-			
Total	5	100.00%										

8.4.7 Distribution of Vehicles by Body Type on KICT

The percentage of vehicles with respect to Body Type i.e. Flat, Half, Full & Container plying on KICT is tabulated in Table 8-20 and is graphically presented in Figure 8-14.

Table 8-20: Percentage of Vehicles w.r.t Body Type on KICT

Sr. No.	Body Type	Count	Percentage
1	Flat	11	6.55%
2	Container	157	93.45%
	Total	168	100.00%

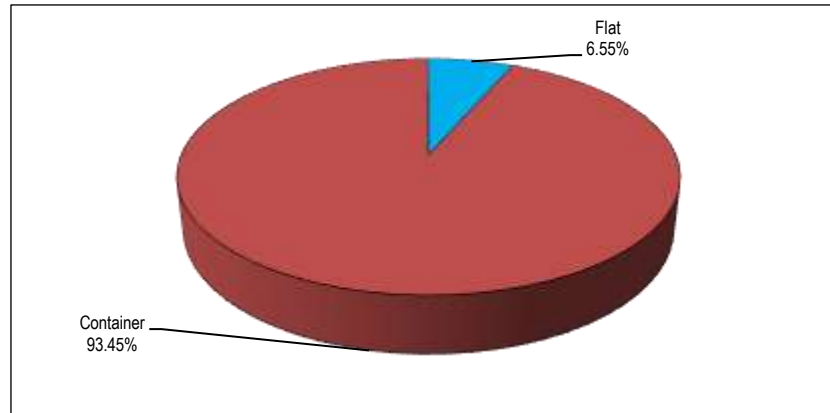


Figure 8-14 : Percentage of Vehicles w.r.t Body Type on KICT

8.4.8 Analysis by Body Type on KICT

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to body type is presented in Table 8-21. The results depict that:

In case of **2 Axle Single**, container body type constitutes maximum percentage of 100%, with average gross load of 14.49 ton.

In case of **3 Axle Tandem**, container body type constitutes maximum percentage of 95.45%, with average gross load of 32.93 ton, followed by flat body type with percentage of 4.55%, carrying average gross load of 9.14 ton

In case of **4 Axle Single Tandem**, container body type constitutes maximum percentage of 93.33%, with average gross load of 36.86 ton, followed by flat body type with percentage of 6.67%, carrying average gross load of 13.84 ton.

In case of **5 Axle Single Tridem**, container body type constitutes maximum percentage of 90%, with average gross load of 41.15 ton.

In case of **6 Axle Tandem Tridem**, container body type constitutes maximum percentage of 60%, with average gross load of 80.71 ton, followed by flat body type with percentage of 40%, carrying average gross load of 16.98 ton.

Table 8-21: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Body Type for major Axle Configuration on KICT

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Container	5	100.00%	Min. Load	3.93	8.76					12.69
					Max. Load	4.98	11.08				16.06	
					Avg. Load	4.49	10.00				14.49	
					Standard Deviation	0.42	0.93				1.35	
					Variance	0.17	0.86				1.81	
		Total	5	100.00%								
2	3 Axle Tandem	Flat	4	4.55%	Min. Load	1.79	3.17	3.17				8.14
					Max. Load	2.26	4.00	4.00			10.26	
					Avg. Load	2.01	3.56	3.56			9.14	
					Standard Deviation	0.24	0.42	0.42			1.09	
					Variance	0.06	0.18	0.18			1.18	
		Total	4	4.55%								

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)								
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total		
3	4 Axle Single Tandem	Container	84	95.45%	Min. Load	2.62	4.65	4.65				11.92		
					Max. Load	9.35	16.58	16.58				42.52		
					Avg. Load	7.24	12.84	12.84				32.93		
					Standard Deviation	1.47	2.61	2.61				6.70		
					Variance	2.18	6.84	6.84				44.95		
		Total	88	100.00%										
		Flat	4	6.67%	Min. Load	2.11	3.86	2.99	3.48			12.44		
					Max. Load	2.45	4.46	3.46	4.03			14.40		
					Avg. Load	2.35	4.29	3.32	3.88			13.84		
					Standard Deviation	0.16	0.29	0.22	0.26			0.94		
					Variance	0.03	0.08	0.05	0.07			0.88		
		Container	56	93.33%	Min. Load	2.01	3.67	2.84	3.31			11.83		
					Max. Load	8.13	14.82	11.47	13.38			47.80		
					Avg. Load	6.27	11.43	8.85	10.32			36.86		
					Standard Deviation	1.47	2.68	2.08	2.42			-		
					Variance	2.17	7.20	4.32	5.88			74.96		
		Total	60	100.00%										
4	5 Axle Single Tridem	Flat	1	10.00%	Min. Load	2.17	3.83	3.33	3.50	3.83		16.67		
					Max. Load	2.17	3.83	3.33	3.50	3.83		16.67		
					Avg. Load	2.17	3.83	3.33	3.50	3.83		16.67		
					Standard Deviation	-	-	-	-	-		-		
					Variance	-	-	-	-	-		-		
		Container	9	90.00%	Min. Load	2.66	4.71	4.10	4.30	4.71		20.49		
					Max. Load	7.80	13.79	11.99	12.59	13.79		59.97		
					Avg. Load	5.35	9.46	8.23	8.64	9.46		41.15		
					Standard Deviation	1.56	2.76	2.40	2.52	2.76		11.98		
					Variance	2.43	7.59	5.74	6.33	7.59		143.54		
		Total	10	100.00%										
		5	6 Axle Tandem Tridem	Flat	2	40.00%	Min. Load	1.53	2.60	2.76	2.45	2.76	3.22	15.32
							Max. Load	1.86	3.17	3.35	2.98	3.35	3.91	18.63
Avg. Load	1.70						2.89	3.06	2.72	3.06	3.56	16.98		
Standard Deviation	0.23						0.40	0.42	0.37	0.42	0.49	2.34		
Variance	0.05						0.16	0.18	0.14	0.18	0.24	5.48		
Container	3			60.00%	Min. Load	8.03	13.66	14.46	12.85	14.46	16.87	80.33		
					Max. Load	8.12	13.80	-	12.99	14.61	17.05	81.17		
					Avg. Load	8.07	13.72	14.53	12.91	14.53	16.95	80.71		
					Standard Deviation	0.04	0.07	0.08	0.07	0.08	0.09	0.43		
					Variance	0.00	0.01	0.01	0.00	0.01	0.01	0.18		
Total	5			100.00%										

8.4.9 Distribution of Vehicles by Type on KICT

The percentage of vehicles with respect to Type i.e. Truck, Semi-Trailer and Tanker plying on KICT is tabulated in Table 8-22 and is graphically presented in Figure 8-15.

Table 8-22: Percentage of Vehicles w.r.t Type on KICT

Sr. No.	Vehicle Type	Count	Percentage
1	Truck	98	58.33%
2	Semi-Trailer	70	41.67%
	Total	168	100.00%

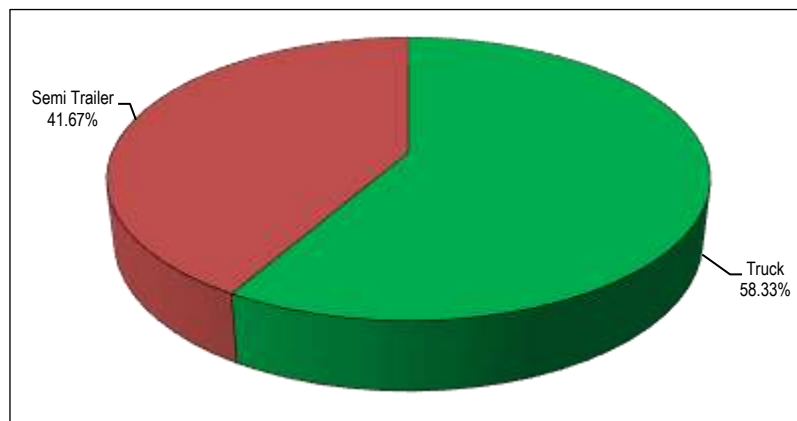


Figure 8-15: Percentage of Vehicles w.r.t Type on KICT

8.4.10 Analysis by Vehicle Type on KICT

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to truck type is presented in Table 8-23. The results depict that:

In case of **2 Axle Single**, truck type constitutes maximum percentage of 100%, with average gross load of 14.49 ton.

In case of **3 Axle Tandem**, truck type constitutes maximum percentage of 97.73%, with average gross load of 31.75 ton, followed by semi-trailer type with percentage of 2.27%, carrying average gross load of 36.27 ton.

In case of **4 Axle Single Tandem**, semi-trailer type constitutes maximum percentage of 88.33%, with average gross load of 35.98 ton, followed by truck type with percentage of 11.67%, carrying average gross load of 30.35 ton.

In case of **5 Axle Single Tridem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 38.70 ton.

In case of **6 Axle Tandem Tridem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 55.21 ton.

Table 8-23: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Type for major Axle Configuration on KICT

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Truck	5	100.00%	Min. Load	3.93	8.76					12.69
					Max. Load	4.98	11.08				16.06	
					Avg. Load	4.49	10.00				14.49	
					Standard Deviation	0.42	0.93				1.35	
					Variance	0.17	0.86				1.81	
		Total	5	100.00%								
2	3 Axle Tandem	Truck	86	97.73%	Min. Load	1.79	3.17	3.17				8.14
					Max. Load	9.35	16.58	16.58			42.52	
					Avg. Load	6.98	12.38	12.38			31.75	
					Standard Deviation	1.83	3.24	3.24			8.30	
					Variance	3.33	10.47	10.47			68.82	
		Semi-Trailer	2	2.27%	Min. Load	7.58	13.44	13.44	0.00	0.00		34.45
					Max. Load	8.38	14.85	14.85	0.00	0.00	38.08	
					Avg. Load	7.98	14.14	14.14	-	-	36.27	
					Standard Deviation	0.56	1.00	1.00	0.00	0.00	2.57	
					Variance	0.32	1.00	1.00	0.00	0.00	6.59	
		Total	88	100.00%								
3	4 Axle Single Tandem	Semi-Trailer	53	88.33%	Min. Load	2.01	3.67	2.84	3.31	0.00		11.83
					Max. Load	8.12	14.81	11.46	13.38	0.00	47.77	
					Avg. Load	6.12	11.15	8.63	10.07	-	35.98	
					Standard Deviation	1.56	2.84	2.20	2.56	0.00	9.15	
					Variance	2.42	8.05	4.82	6.57	0.00	83.75	
		Truck	7	11.67%	Min. Load	2.11	3.86	2.99	3.48	0.00	12.44	
					Max. Load	8.13	14.82	11.47	13.38	0.00	47.80	
					Avg. Load	5.16	9.41	7.28	8.50	-	30.35	
					Standard Deviation	2.73	4.99	3.86	4.50	0.00	16.08	
					Variance	7.48	24.86	14.90	20.28	0.00	258.72	
		Total	60	100.00%								
4	5 Axle Single Tridem	Semi-Trailer	10	100.00%	Min. Load	2.17	3.83	3.33	3.50	3.83	16.67	
					Max. Load	7.80	13.79	11.99	12.59	13.79	59.97	
					Avg. Load	5.03	8.90	7.74	8.13	8.90	38.70	
					Standard Deviation	1.78	3.15	2.74	2.88	3.15	13.69	
					Variance	3.17	9.92	7.50	8.27	9.92	187.52	
		Total	10	100.00%								
5	6 Axle Tandem Tridem	Semi-Trailer	5	100.00%	Min. Load	1.53	2.60	2.76	2.45	2.76	3.22	15.32
					Max. Load	8.12	13.80	14.61	12.99	14.61	17.05	81.17
					Avg. Load	5.52	9.39	9.94	8.83	9.94	11.59	55.21
					Standard Deviation	3.49	5.94	6.29	5.59	6.29	7.33	34.93
					Variance	12.20	35.26	39.53	31.23	39.53	53.80	1219.98
		Total	5	100.00%								

8.4.11 Commodities carried by vehicles on KICT

The percentage of major commodities carried by heavy vehicles on KICT is tabulated in Table 8-24 and is graphically presented in Figure 8-16. For the sake of analysis,

each commodity is assigned a code; details are attached in Annex – 2.

Table 8-24: Percentage of Vehicle w.r.t Commodities on KICT

Sr. No.	Commodity Type	Code	Count	Percentage
1	Agriculture Items	100	32	19.05%
2	Food Items	200	22	13.10%
3	Animals and Animal Products	300	17	10.12%
4	Bulk Manufactures	500	18	10.71%
5	Basic Manufactures	600	31	18.45%
6	Miscellaneous Manufactures	700	3	1.79%
7	Mining and Quarrying	800	4	2.38%
8	Miscellaneous Goods not Classified	A00	23	13.69%
9	Empty	E00	18	10.71%
Total			168	100.00%

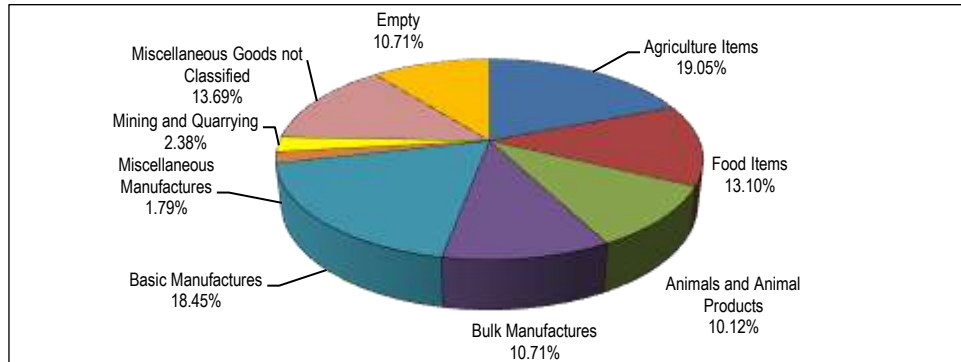


Figure 8-16: Percentage of Vehicles w.r.t Commodities on KICT

8.4.12 Analysis based on Commodities on KICT

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to commodities carried by trucks is presented in Table 8-25. The results depict that:

Major commodity carried by **2 Axle Single** is basic manufactures, covering 80% of the total, with average gross load of 14.10 ton.

Major commodities carried by **3 Axle Tandem** are agriculture items, covering 28.41% of the total, with average gross load of 36.04 ton, followed by food items having percentage of 20.45% in total, with average gross load of 35.97 ton.

Major commodities carried by **4 Axle Single Tandem** are basic manufactures, covering 25% of the total, with average gross load of 39.90 ton, followed by animals and animal products, having percentage of 23.33% in total, with average gross load of 39.82 ton.

Major commodities carried by **5 Axle Single Tridem** are miscellaneous goods not classified, covering 40% of the total, with average gross load of 38.76 ton, followed by basic manufactures and agriculture items, having percentage of 20% each, with average gross load of 40.37 ton and 36.60 ton respectively.

Major commodities carried by **6 Axle Tandem Tridem** are agricultural items, covering 60% of the total, with average gross load of 80.71 ton, followed by miscellaneous goods not classified, having percentage of 40% in total, with average gross load of 16.98 ton.

Table 8-25: Stdev. Var., Min., Max. & Avg. Load Comparison w.r.t Commodities for major Axle Configuration on KICT

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Food Items	200	1	20.00%	Min. Load	4.98	11.08					16.06
						Max. Load	4.98	11.08					16.06
						Avg. Load	4.98	11.08					16.06
						Standard Deviation	-	-					-
						Variance	-	-					-

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)								
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total		
		Basic Manufactures	600	4	80.00%	Min. Load	3.93	8.76					12.69		
						Max. Load	4.83	10.74					15.57		
						Avg. Load	4.37	9.73					14.10		
						Standard Deviation	0.36	0.81					1.18		
						Variance	0.13	0.66					1.38		
Total				5	100%										
2	3 Axle Tandem	Agriculture Items	100	25	28.41%	Min. Load	7.70	13.65	13.65				35.00		
						Max. Load	8.38	14.85	14.85				38.08		
						Avg. Load	7.93	14.06	14.06				36.04		
						Standard Deviation	0.20	0.36	0.36				0.93		
						Variance	0.04	0.13	0.13				0.86		
		Food Items	200	18	20.45%	Min. Load	7.54	13.37	13.37				34.28		
						Max. Load	8.55	15.16	15.16				38.86		
						Avg. Load	7.91	14.03	14.03				35.97		
						Standard Deviation	0.32	0.57	0.57				1.47		
						Variance	0.10	0.33	0.33				2.15		
		Animals and Animal Products	300	3	3.41%	Min. Load	6.74	11.95	11.95				30.63		
						Max. Load	9.16	16.24	16.24				41.63		
						Avg. Load	8.34	14.79	14.79				37.92		
						Standard Deviation	1.39	2.46	2.46				6.31		
						Variance	1.93	6.06	6.06				39.86		
		Bulk Manufactures	500	12	13.64%	Min. Load	5.93	10.51	10.51				26.95		
						Max. Load	8.30	14.72	14.72				37.74		
						Avg. Load	6.58	11.66	11.66				29.90		
						Standard Deviation	0.63	1.11	1.11				2.85		
						Variance	0.39	1.24	1.24				8.13		
		Basic Manufactures	600	10	11.36%	Min. Load	3.33	5.90	5.90				15.14		
						Max. Load	9.35	16.58	16.58				42.52		
						Avg. Load	6.23	11.05	11.05				28.32		
						Standard Deviation	2.28	4.05	4.05				10.38		
						Variance	5.22	16.40	16.40				107.84		
		Miscellaneous Manufactures	700	1	1.14%	Min. Load	3.34	5.91	5.91				15.16		
						Max. Load	3.34	5.91	5.91				15.16		
						Avg. Load	3.34	5.91	5.91				15.16		
						Standard Deviation	-	-	-				-		
						Variance	-	-	-				-		
		Mining and Quarrying	800	4	4.55%	Min. Load	7.25	12.85	12.85				32.95		
						Max. Load	8.43	14.95	14.95				38.33		
						Avg. Load	8.12	14.39	14.39				36.91		
						Standard Deviation	0.58	1.03	1.03				2.64		
						Variance	0.34	1.06	1.06				6.98		
		Miscellaneous Goods not Classified	A00	8	9.09%	Min. Load	5.62	9.96	9.96				25.55		
						Max. Load	8.55	15.16	15.16				38.86		
						Avg. Load	7.16	12.69	12.69				32.53		
						Standard Deviation	0.94	1.66	1.66				4.26		
						Variance	0.88	2.76	2.76				18.15		
		Empty	E00	7	7.95%	Min. Load	1.79	3.17	3.17				8.14		
						Max. Load	3.18	5.64	5.64				14.45		
						Avg. Load	2.37	4.20	4.20				10.77		
						Standard Deviation	0.51	0.90	0.90				2.31		
						Variance	0.26	0.81	0.81				5.35		
		Total				88	100.00%								
		3	4 Axle Single Tandem	Agriculture Items	100	2	3.33%	Min. Load	5.80	10.58	8.19	9.56			34.14
								Max. Load	6.22	11.34	8.78	10.24			36.58
Avg. Load	6.01							10.96	8.49	9.90			35.36		
Standard Deviation	0.29							0.53	0.41	0.48			1.73		
Variance	0.09							0.29	0.17	0.23			2.98		
Food Items	200			3	5.00%	Min. Load	6.86	12.51	9.68	11.30			40.35		
						Max. Load	8.13	14.82	11.47	13.38			47.80		
						Avg. Load	7.49	13.66	10.58	12.34			44.07		
						Standard Deviation	0.63	1.15	0.89	1.04			3.73		
						Variance	0.40	1.33	0.80	1.09			13.88		

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
		Animals and Animal Products	300	14	23.33%	Min. Load	5.02	9.15	7.08	8.26			29.51
						Max. Load	8.08	14.73	11.40	13.30			47.50
						Avg. Load	6.77	12.34	9.56	11.15			39.82
						Standard Deviation	0.99	1.80	1.40	1.63			5.82
						Variance	0.98	3.26	1.95	2.66			33.87
		Bulk Manufactures	500	5	8.33%	Min. Load	6.06	11.05	8.56	9.98			35.65
						Max. Load	6.70	12.23	9.47	11.04			39.44
						Avg. Load	6.36	11.60	8.98	10.48			37.43
						Standard Deviation	0.32	0.59	0.46	0.53			1.90
						Variance	0.10	0.35	0.21	0.28			3.61
		Basic Manufactures	600	15	25.00%	Min. Load	6.11	11.15	8.63	10.07			35.96
						Max. Load	8.12	14.81	11.46	13.38			47.77
						Avg. Load	6.78	12.37	9.58	11.17			39.90
						Standard Deviation	0.51	0.94	0.72	0.85			3.02
						Variance	0.26	0.88	0.53	0.71			9.12
		Miscellaneous Manufactures	700	1	1.67%	Min. Load	8.09	14.76	11.42	13.33			47.60
						Max. Load	8.09	14.76	11.42	13.33			47.60
						Avg. Load	8.09	14.76	11.42	13.33			47.60
						Standard Deviation	-	-	-	-			-
						Variance	-	-	-	-			-
		Miscellaneous Goods not Classified	A00	9	15.00%	Min. Load	6.21	11.32	8.76	10.22			36.51
						Max. Load	7.40	13.49	10.44	12.18			43.51
						Avg. Load	6.67	12.17	9.42	10.99			39.26
						Standard Deviation	0.39	0.72	0.55	0.65			2.31
Variance	0.15					0.51	0.31	0.42			5.32		
Empty	E00	11	18.33%	Min. Load	2.01	3.67	2.84	3.31			11.83		
				Max. Load	3.24	5.91	4.58	5.34			19.07		
				Avg. Load	2.66	4.86	3.76	4.39			15.66		
				Standard Deviation	0.40	0.73	0.57	0.66			2.36		
				Variance	0.16	0.54	0.32	0.44			5.57		
Total				60	100.00%								
4	5 Axle Single Tridem	Agriculture Items	100	2	20.00%	Min. Load	4.24	7.50	6.52	6.84	7.50		32.59
						Max. Load	5.28	9.34	8.12	8.53	9.34		40.61
						Avg. Load	4.76	8.42	7.32	7.69	8.42		36.60
						Standard Deviation	0.74	1.30	1.13	1.19	1.30		5.67
						Variance	0.54	1.70	1.29	1.42	1.70		32.16
		Bulk Manufactures	500	1	10.00%	Min. Load	5.15	9.12	7.93	8.32	9.12		39.64
						Max. Load	5.15	9.12	7.93	8.32	9.12		39.64
						Avg. Load	5.15	9.12	7.93	8.32	9.12		39.64
						Standard Deviation	-	-	-	-	-		-
						Variance	-	-	-	-	-		-
		Basic Manufactures	600	2	20.00%	Min. Load	5.12	9.07	7.88	8.28	9.07		39.42
						Max. Load	5.37	9.50	8.26	8.68	9.50		41.32
						Avg. Load	5.25	9.29	8.07	8.48	9.29		40.37
						Standard Deviation	0.17	0.31	0.27	0.28	0.31		1.34
						Variance	0.03	0.10	0.07	0.08	0.10		1.81
		Miscellaneous Manufactures	700	1	10.00%	Min. Load	4.99	8.83	7.68	8.07	8.83		38.41
						Max. Load	4.99	8.83	7.68	8.07	8.83		38.41
						Avg. Load	4.99	8.83	7.68	8.07	8.83		38.41
						Standard Deviation	-	-	-	-	-		-
						Variance	-	-	-	-	-		-
		Miscellaneous Goods not Classified	A00	4	40.00%	Min. Load	2.17	3.83	3.33	3.50	3.83		16.67
						Max. Load	7.80	13.79	11.99	12.59	13.79		59.97
						Avg. Load	5.04	8.91	7.75	8.14	8.91		38.76
						Standard Deviation	3.04	5.37	4.67	4.91	5.37		23.37
Variance	9.23					28.89	21.84	24.08	28.89		546.12		
Total				10	100.00%								
5	6 Axle Tandem Tridem	Agriculture Items	100	3	60.00%	Min. Load	8.03	13.66	14.46	12.85	14.46	16.87	80.33
						Max. Load	8.12	13.80	14.61	12.99	14.61	17.05	81.17
						Avg. Load	8.07	13.72	14.53	12.91	14.53	16.95	80.71
						Standard Deviation	0.04	0.07	0.08	0.07	0.08	0.09	0.43
						Variance	0.00	0.01	0.01	0.00	0.01	0.01	0.18

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
		Miscellaneous Goods not Classified	A00	2	40.00%	Min. Load	1.53	2.60	2.76	2.45	2.76	3.22	15.32
	Max. Load					1.86	3.17	3.35	2.98	3.35	3.91	18.63	
	Avg. Load					1.70	2.89	3.06	2.72	3.06	3.56	16.98	
	Standard Deviation					0.23	0.40	0.42	0.37	0.42	0.49	2.34	
	Variance					0.05	0.16	0.18	0.14	0.18	0.24	5.48	
	Total			5	100.00%								

8.4.13 Damage Factor for major Axle Configuration on KICT

The average damage factors calculated for major axle configuration are presented in Table 8-26.

Table 8-26: Damage Factor for major Axle Configuration on KICT

Sr. No.	Axle Configuration	Code	Damage Factor (2020)	
			Road Note 40	AASHTO 1993
1	2 Axle Single	1.2	2.64	2.21
2	3 Axle Tandem	1.22	18.73	9.19
3	4 Axle Single Tandem	1.2-22	11.21	7.48
4	5 Axle Single Tridem	1.2-222	9.28	5.23
5	6 Axle Tandem Tridem	1.22-222	42.78	16.53

8.5 Pakistan International Container Terminal (PICT)

The results of axle load survey performed on PICT of KPT are discussed in subsequent sub-sections.

8.5.1 Distribution of Vehicles by Axle Configuration on PICT

The percentage of trucks for major axle configurations surveyed on PICT is summarized in Table 8-27 and is graphically presented in Figure 8-17.

Table 8-27: Percentage of Vehicle w.r.t Axle Configuration on PICT

Sr. No.	Axle Configuration	Code	Total Number of Trucks	%age
1	2 Axle Single	1.2	5	2.62%
2	3 Axle Tandem	1.22	60	31.41%
3	4 Axle Single Tandem	1.2-22	87	45.55%
4	5 Axle Single Tridem	1.2-222	4	2.09%
5	5 Axle Tandem Tandem	1.22-22	7	3.66%
6	6 Axle Tandem Tridem	1.22-222	28	14.66%
Total			191	100.00%

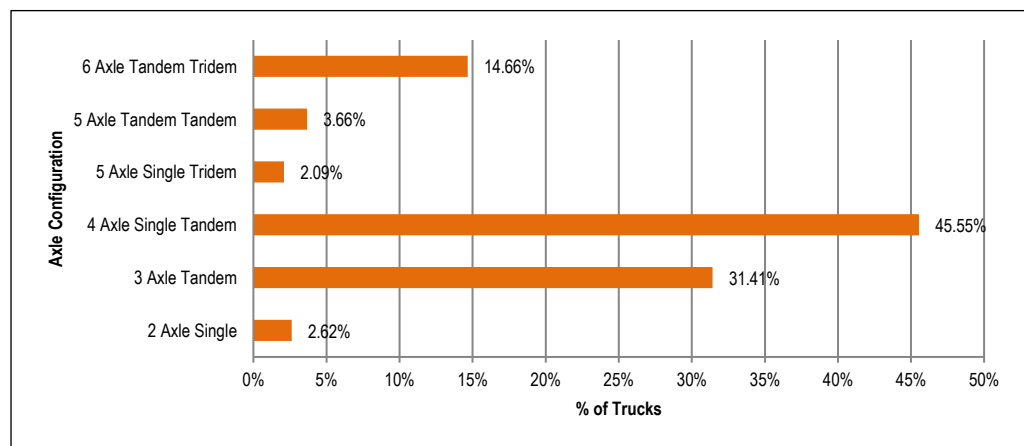


Figure 8-17: Percentage of Vehicles w.r.t Axle Configuration on PICT

8.5.2 Analysis by Axle Configuration on PICT

The analysis comprising minimum, maximum and average loads per axle carried by trucks on PICT along with standard deviation and variance is presented in Table 8-28. The minimum, maximum and average loads are graphically presented in Figure 8-18 and Figure 8-19 respectively.

In case of **2 Axle Single** trucks, maximum load of 21.21 ton with average load of 17.67 ton was recorded.

In case of **3 Axle Tandem**, maximum load of 41.88 ton with average load of 31.79 ton was recorded.

In case of **4 Axle Single Tandem**, maximum load of 48.51 ton with average load of 36.00 ton was recorded.

In case of **5 Axle Single Tridem**, maximum load of 31.34 ton with average load of 19.59 ton was recorded.

In case of **5 Axle Tandem Tandem**, maximum load of 74.50 ton with average load of 62.55 ton was recorded.

In case of **6 Axle Tandem Tridem**, maximum load of 78.91 ton with average load of 61.4 ton was recorded.

Table 8-28: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Axle Configuration on PICT

Sr. No.	Axle Configuration	Permissible Load Limits	Parameters	Load (Tons)						
				Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	17.5	Min. Load	4.44	9.88					14.32
			Max. Load	6.58	14.63					21.21
			Avg. Load	5.48	12.19					17.67
			Standard Deviation	0.77	1.71					2.48
			Variance	0.59	2.92					6.14
2	3 Axle Tandem	27.5	Min. Load	2.01	3.56	3.56				9.13
			Max. Load	9.21	16.33	16.33				41.88
			Avg. Load	6.99	12.40	12.40				31.79
			Standard Deviation	1.68	2.97	2.97				7.62
			Variance	2.81	8.82	8.82				57.99
3	4 Axle Single Tandem	39.5	Min. Load	1.94	3.53	2.74	3.19			11.40
			Max. Load	8.25	15.04	11.64	13.58			48.51
			Avg. Load	6.12	11.16	8.64	10.08			36.00
			Standard Deviation	2.04	3.72	2.88	3.36			12.01
			Variance	4.17	13.87	8.31	11.31			144.31
4	5 Axle Single Tridem	48.5	Min. Load	1.91	3.37	2.93	3.08	3.37		14.67
			Max. Load	4.07	7.21	6.27	6.58	7.21		31.34
			Avg. Load	2.55	4.51	3.92	4.11	4.51		19.59
			Standard Deviation	1.02	1.81	1.57	1.65	1.81		7.87
			Variance	1.05	3.28	2.48	2.73	3.28		62.00
5	5 Axle Tandem Tandem	49.5	Min. Load	7.35	12.44	11.31	11.87	13.57		56.54
			Max. Load	9.69	16.39	14.90	15.65	17.88		74.50
			Avg. Load	8.13	13.76	12.51	13.14	15.01		62.55
			Standard Deviation	0.91	1.54	1.40	1.47	1.68		6.99
			Variance	0.83	2.36	1.95	2.15	2.81		48.83
6	6 Axle Tandem Tridem	58.5	Min. Load	1.88	3.20	3.39	3.01	3.39	3.95	18.82
			Max. Load	7.89	13.41	14.20	12.63	14.20	16.57	78.91
			Avg. Load	6.14	10.44	11.05	9.82	11.05	12.89	61.40
			Standard Deviation	2.32	3.94	4.17	3.71	4.17	4.86	23.16
			Variance	5.36	15.50	17.38	13.73	17.38	23.65	536.34

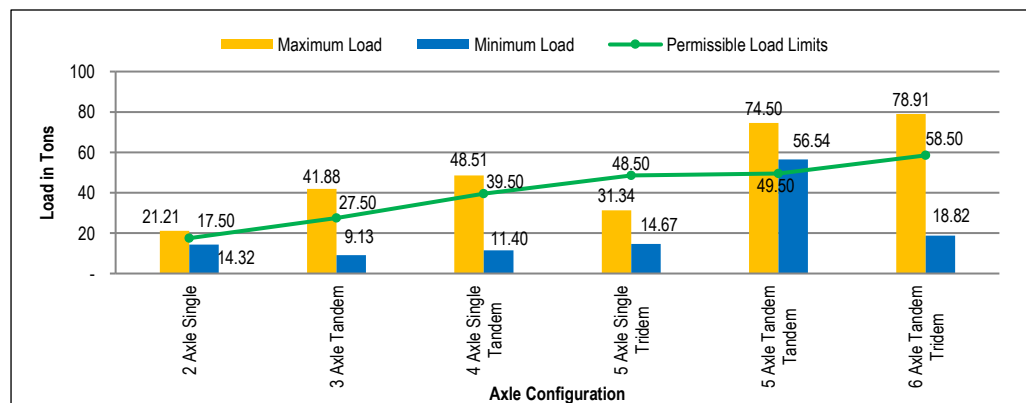


Figure 8-18: Min. & Max. Load Comparison w.r.t Axle Configuration on PICT

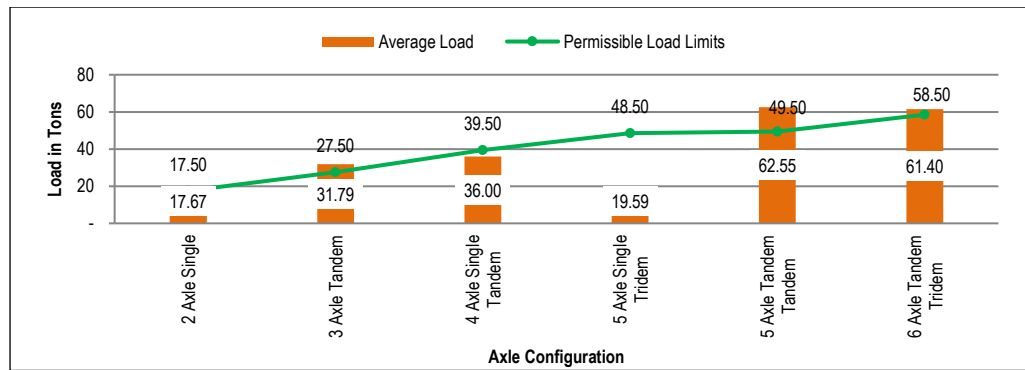


Figure 8-19: Avg. Load Comparison w.r.t Axle Configuration on PICT

8.5.3 Load Spectrum by Axle Configuration on PICT

The major cause of pavement failure is due to excessive overloading. The axle load survey data was organized in a way to identify the number of vehicles carrying load above and below permissible limits. Furthermore, load spectrums were identified and number of vehicles carrying load in specified spectrums were calculated. The results are tabulated in Table 8-29 which illustrates that:

In case of **2 Axle Single**, 40% of trucks carried load under permissible limits. Whereas, 20% of the trucks carried load more than 15% of permissible load limits.

In case of **3 Axle Tandem**, 18.33% of trucks carried load under permissible limits. Whereas, 68.33% of the trucks carried load more than 15% of permissible load limits.

In case of **4 Axle Single Tandem**, 41.38% of trucks/semi-trailers carried load under permissible limits. Whereas, 20.69% of the trucks/semi-trailers carried load more than 15% of permissible load limits.

In case of **5 Axle Single Tridem**, 100% of semi-trailers carried load under permissible limits.

In case of **5 Axle Tandem Tandem**, 100% of the semi-trailers carried load above permissible load limits.

In case of **6 Axle Tandem Tridem**, 25% of semi-trailers carried load under permissible limits. Whereas, 75% semi-trailers carried load more than 15% of permissible load limits.

The percentage of trucks for major axle configuration carrying load above and below permissible limits on PICT is graphically presented in Figure 8-20.

Table 8-29: Load Spectrum w.r.t Axle Configuration on PICT

Sr. No.	Axle Configuration		Under Permissible Limit	Over Permissible Limit					Total	
				15.00%	30.00%	50.00%	75.00%	>75%		
1	2 Axle Single	Max. Load (Tons)	17.5	20.1	22.8	26.3	30.6	-	-	-
		Average Load (Tons)	15.61	17.96	21.21	-	-	-	-	-
		No. of Trucks	2	2	1	0	0	0	0	5
		Percentage	40.00%	40.00%	20.00%	0.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	40.00%	80.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100%
2	3 Axle Tandem	Percentage above Range Value	60.00%	20.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
		Max. Load (Tons)	27.5	31.6	35.8	41.3	48.1	-	-	-
		Average Load (Tons)	17.77	28.91	34.56	37.38	41.88	-	-	-
		No. of Trucks	11	8	20	20	1	0	0	60
		Percentage	18.33%	13.33%	33.33%	33.33%	1.67%	0.00%	0.00%	100%
3	4 Axle Single Tandem	Cumulative Percentage	18.33%	31.67%	65.00%	98.33%	100.00%	100.00%	100.00%	100%
		Percentage above Range Value	81.67%	68.33%	35.00%	1.67%	0.00%	0.00%	0.00%	0.00%
		Max. Load (Tons)	39.5	45.4	51.4	59.3	69.1	-	-	-
		Average Load (Tons)	23.73	43.56	46.70	-	-	-	-	-
		No. of Trucks	36	33	18	0	0	0	0	87
Percentage	41.38%	37.93%	20.69%	0.00%	0.00%	0.00%	0.00%	100%		

Sr. No.	Axle Configuration	Under Permissible Limit	Over Permissible Limit					Total
			15.00%	30.00%	50.00%	75.00%	>75%	
		Cumulative Percentage	41.38%	79.31%	100.00%	100.00%	100.00%	
		Percentage above Range Value	58.62%	20.69%	0.00%	0.00%	0.00%	
4	5 Axle Single Tridem	Max. Load (Tons)	48.5	55.8	63.1	72.8	84.9	
		Average Load (Tons)	19.59	-	-	-	-	
		No. of Trucks	4	0	0	0	0	4
		Percentage	100.00%	0.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	100.00%	100.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	0.00%	0.00%	0.00%	0.00%	0.00%	
5	5 Axle Tandem Tandem	Max. Load (Tons)	49.5	56.9	64.4	74.3	86.6	
		Average Load (Tons)	-	56.54	59.08	70.50	74.50	
		No. of Trucks	0	1	4	1	1	7
		Percentage	0.00%	14.29%	57.14%	14.29%	14.29%	100%
		Cumulative Percentage	0.00%	14.29%	71.43%	85.71%	100.00%	
		Percentage above Range Value	100.00%	85.71%	28.57%	14.29%	0.00%	
6	6 Axle Tandem Tridem	Max. Load (Tons)	58.5	67.3	76.1	87.8	102.4	
		Average Load (Tons)	22.34	-	72.14	77.47	-	
		No. of Trucks	7	0	12	9	0	28
		Percentage	25.00%	0.00%	42.86%	32.14%	0.00%	100%
		Cumulative Percentage	25.00%	25.00%	67.86%	100.00%	100.00%	
		Percentage above Range Value	75.00%	75.00%	32.14%	0.00%	0.00%	

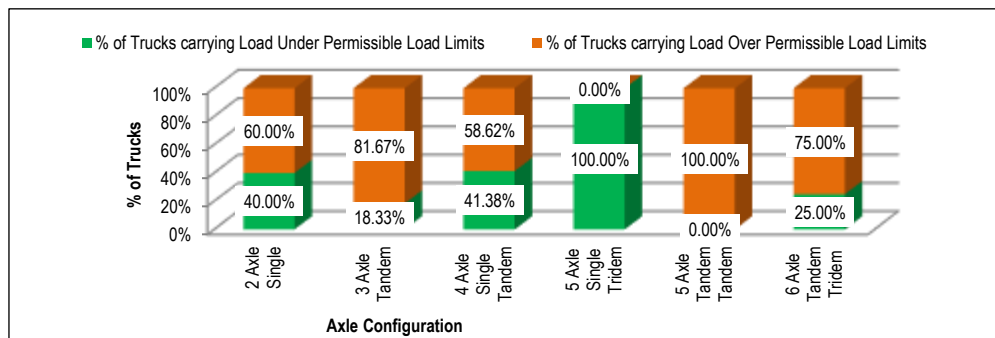


Figure 8-20: Percentage of Vehicles carrying Load above and below Permissible Limits on PICT

8.5.4 Front & Rear Axle Load Spectrum on PICT

The spectrum of front and rear axle loads for major axle configurations is presented in Table 8-30.

Table 8-30: Front & Rear Axle Load Spectrum on PICT

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
Front Axle Load Spectrum					
1	0 - 2.99	27	14.14%	14.14%	85.86%
2	3 - 5.49	26	13.61%	27.75%	72.25%
3	5.5 - 6.99	21	10.99%	38.74%	61.26%
4	7 - 8.99	114	59.69%	98.43%	1.57%
5	9 - 10.99	3	1.57%	100.00%	0.00%
6	11 - 12.99	0	0.00%	100.00%	0.00%
7	13 - 14.99	0	0.00%	100.00%	0.00%
8	15 - 16.99	0	0.00%	100.00%	0.00%
9	17 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Single)					
1	0 - 8.16	138	24.21%	24.21%	75.79%
2	8.17 - 9.99	37	6.49%	30.70%	69.30%
3	10 - 10.99	44	7.72%	38.42%	61.58%
4	11 - 11.99	58	10.18%	48.60%	51.40%
5	12 - 12.99	80	14.04%	62.63%	37.37%
6	13 - 13.99	116	20.35%	82.98%	17.02%
7	14 - 14.99	64	11.23%	94.21%	5.79%
8	15 - 19.99	33	5.79%	100.00%	0.00%
9	20 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Tandem)					
1	0 - 11.99	24	12.70%	12.70%	87.30%
2	12 - 14.99	12	6.35%	19.05%	80.95%
3	15 - 19.99	17	8.99%	28.04%	71.96%

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
4	20 - 21.99	12	6.35%	34.39%	65.61%
5	22 - 23.99	36	19.05%	53.44%	46.56%
6	24 - 25.99	27	14.29%	67.72%	32.28%
7	26 - 27.99	37	19.58%	87.30%	12.70%
8	28 - 29.99	15	7.94%	95.24%	4.76%
9	30 & Above	9	4.76%	100.00%	0.00%
Rear Axle Load Spectrum (Tridem)					
1	0 - 14.99	10	31.25%	31.25%	68.75%
2	15 - 30.99	1	3.13%	34.38%	65.63%
3	31 - 32.99	0	0.00%	34.38%	65.63%
4	33 - 34.99	0	0.00%	34.38%	65.63%
5	35 - 36.99	0	0.00%	34.38%	65.63%
6	37 - 38.99	7	21.88%	56.25%	43.75%
7	39 - 40.99	1	3.13%	59.38%	40.63%
8	41 - 42.99	12	37.50%	96.88%	3.13%
9	43 & Above	1	3.13%	100.00%	0.00%

8.5.5 Distribution of Vehicles by Make Type on PICT

The distribution of trucks as per make type is illustrated in Table 8-31 and is graphically presented in Figure 8-21. The results depict that Hino and Nissan have maximum percentage of 65.96% and 21.81% on PICT.

Table 8-31: Percentage of Vehicles w.r.t Make Type on PICT

Sr. No.	Make	Count	Percentage
1	Bedford	3	1.60%
2	Nissan	41	21.81%
3	Hino	124	65.96%
4	Isuzu	3	1.60%
5	Mercedes	8	4.26%
6	UD	3	1.60%
7	Others	6	3.19%
Total		188	100.00%

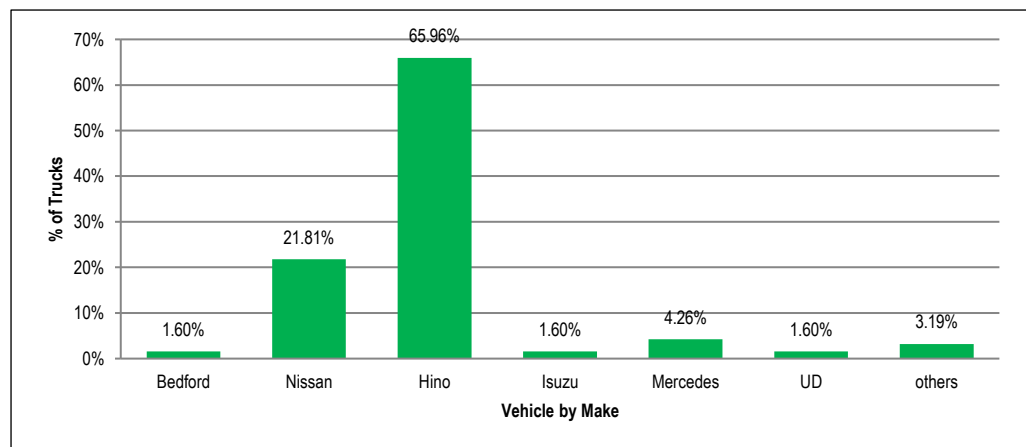


Figure 8-21: Percentage of Vehicles w.r.t Make Type on PICT

8.5.6 Analysis by Make Type on PICT

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to make type is presented in Table 8-32. The results depict that:

In case of **2 Axle Single**, Bedford constitutes maximum percentage of 60%, with average gross load of 16.75 ton.

In case of **3 Axle Tandem**, Hino constitutes maximum percentage of 77.59%, with average gross load of 32.83 ton, followed by Nissan with percentage of 13.79%, carrying average gross load of 27.21 ton.

In case of **4 Axle Single Tandem**, Hino constitutes maximum percentage of 64.37% with average gross load of 38.49 ton, followed by Nissan with percentage of 28.74%, carrying average gross load of 31.07 ton.

In case of **5 Axle Single Tridem**, Nissan constitutes maximum percentage of 50%, with average gross load of 23.01 ton.

In case of **5 Axle Tandem Tandem**, Nissan constitutes maximum percentage of 66.67%, with average gross load of 58.23 ton.

In case of **6 Axle Tandem Tridem**, Hino constitutes maximum percentage of 71.43%, with average gross load of 69.11 ton, followed by Mercedes with percentage of 25%, carrying average gross load of 38.11 ton.

Table 8-32: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Make Type for major Axle Configuration on PICT

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Bedford	3	60.00%	Min. Load	4.44	9.88					14.32
					Max. Load	5.62	12.50				18.12	
					Avg. Load	5.19	11.56				16.75	
					Standard Deviation	0.65	1.45				2.11	
					Variance	0.43	2.11				4.44	
		Nissan	1	20.00%	Min. Load	5.24	11.66				16.90	
					Max. Load	5.24	11.66				16.90	
					Avg. Load	5.24	11.66				16.90	
					Standard Deviation	-	-				-	
					Variance	-	-				-	
		Hino	1	20.00%	Min. Load	6.58	14.63				21.21	
					Max. Load	6.58	14.63				21.21	
					Avg. Load	6.58	14.63				21.21	
					Standard Deviation	-	-				-	
					Variance	-	-				-	
Total	5	100.00%										
2	3 Axle Tandem	Hino	45	77.59%	Min. Load	2.66	4.71	4.71				12.08
					Max. Load	9.21	16.33	16.33				41.88
					Avg. Load	7.22	12.80	12.80				32.83
					Standard Deviation	1.43	2.54	2.54				6.51
					Variance	2.05	6.45	6.45				42.43
		Isuzu	2	3.45%	Min. Load	7.48	13.27	13.27				34.02
					Max. Load	7.54	13.37	13.37				34.29
					Avg. Load	7.51	13.32	13.32				34.16
					Standard Deviation	0.04	0.07	0.07				0.19
					Variance	0.00	0.01	0.01				0.04
		Nissan	8	13.79%	Min. Load	2.51	4.45	4.45				11.41
					Max. Load	8.32	14.76	14.76				37.84
					Avg. Load	5.99	10.61	10.61				27.21
					Standard Deviation	2.24	3.97	3.97				10.19
					Variance	5.02	15.79	15.79				103.80
		UD	1	1.72%	Min. Load	6.08	10.78	10.78				27.65
					Max. Load	6.08	10.78	10.78				27.65
					Avg. Load	6.08	10.78	10.78				27.65
					Standard Deviation	-	-	-				-
					Variance	-	-	-				-
		Others	2	3.45%	Min. Load	7.50	13.30	13.30				34.11
					Max. Load	8.70	15.42	15.42				39.54
					Avg. Load	8.10	14.36	14.36				36.83
					Standard Deviation	0.84	1.50	1.50				3.84
Variance	0.71				2.24	2.24				14.74		
Total	58	100.00%										
3	4 Axle Single Tandem	Hino	56	64.37%	Min. Load	2.14	3.91	3.03	3.53			12.61
					Max. Load	8.25	15.04	11.64	13.58			48.51
					Avg. Load	6.54	11.93	9.24	10.78			38.49
					Standard Deviation	1.91	3.49	2.70	3.15			11.25
					Variance	3.65	12.15	7.28	9.92			126.47
		Isuzu	1	1.15%	Min. Load	4.82	8.79	6.80	7.94			28.34
					Max. Load	4.82	8.79	6.80	7.94			28.34
					Avg. Load	4.82	8.79	6.80	7.94			28.34
					Standard Deviation	-	-	-	-			-
					Variance	-	-	-	-			-
		Nissan	25	28.74%	Min. Load	2.00	3.65	2.82	3.30			11.77
					Max. Load	8.08	14.73	11.40	13.30			47.51
					Avg. Load	5.28	9.63	7.46	8.70			31.07
					Standard Deviation	2.10	3.84	2.97	3.47			12.38
					Variance	4.43	14.72	8.82	12.01			153.18
		UD	2	2.30%	Min. Load	5.48	9.99	7.73	9.02			32.21
					Max. Load	7.63	13.92	10.78	12.57			44.91

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
					Avg. Load	6.56	11.95	9.25	10.80			38.56
					Standard Deviation	1.53	2.78	2.16	2.51			8.98
					Variance	2.33	7.75	4.65	6.32			80.64
		Others	3	3.45%	Min. Load	1.94	3.53	2.74	3.19			11.40
					Max. Load	7.17	13.07	10.12	11.80			42.15
					Avg. Load	5.38	9.81	7.59	8.86			31.63
		Total	87	100.00%	Standard Deviation	2.98	5.43	4.21	4.91			17.53
					Variance	8.88	29.52	17.69	24.08			307.20
		4	5 Axle Single Tridem	Hino	1	25.00%	Min. Load	2.05	3.62	3.15	3.31	3.62
Max. Load	2.05						3.62	3.15	3.31	3.62		15.76
Avg. Load	2.05						3.62	3.15	3.31	3.62		15.76
Standard Deviation	-						-	-	-	-		-
Nissan	2			50.00%	Variance	-	-	-	-	-		-
					Min. Load	1.91	3.37	2.93	3.08	3.37		14.67
					Max. Load	4.07	7.21	6.27	6.58	7.21		31.34
					Avg. Load	2.99	5.29	4.60	4.83	5.29		23.01
Mercedes	1			25.00%	Standard Deviation	1.53	2.71	2.36	2.48	2.71		11.79
					Variance	2.35	7.35	5.56	6.13	7.35		138.94
					Min. Load	2.16	3.81	3.32	3.48	3.81		16.58
					Max. Load	2.16	3.81	3.32	3.48	3.81		16.58
Total	4			100.00%	Avg. Load	2.16	3.81	3.32	3.48	3.81		16.58
					Standard Deviation	-	-	-	-	-		-
					Variance	-	-	-	-	-		-
5	5 Axle Tandem Tandem	Hino	1	16.67%	Min. Load	9.69	16.39	14.90	15.65	17.88		74.50
					Max. Load	9.69	16.39	14.90	15.65	17.88		74.50
					Avg. Load	9.69	16.39	14.90	15.65	17.88		74.50
					Standard Deviation	-	-	-	-	-		-
		Nissan	4	66.67%	Variance	-	-	-	-	-		-
					Min. Load	7.35	12.44	11.31	11.87	13.57		56.54
					Max. Load	7.75	13.11	11.92	12.52	14.31		59.61
					Avg. Load	7.57	12.81	11.65	12.23	13.97		58.23
		Others	1	16.67%	Standard Deviation	0.18	0.30	0.27	0.28	0.32		1.35
					Variance	0.03	0.09	0.07	0.08	0.10		1.81
					Min. Load	7.79	13.19	11.99	12.59	14.39		59.96
					Max. Load	7.79	13.19	11.99	12.59	14.39		59.96
		Total	6	100.00%	Avg. Load	7.79	13.19	11.99	12.59	14.39		59.96
					Standard Deviation	-	-	-	-	-		-
					Variance	-	-	-	-	-		-
6	6 Axle Tandem Tridem	Hino	20	71.43%	Min. Load	1.88	3.20	3.39	3.01	3.39	3.95	18.82
					Max. Load	7.89	13.41	14.20	12.63	14.20	16.57	78.91
					Avg. Load	6.91	11.75	12.44	11.06	12.44	14.51	69.11
					Standard Deviation	1.66	2.83	2.99	2.66	2.99	3.49	16.62
					Variance	2.76	7.98	8.95	7.07	8.95	12.18	276.26
		Nissan	1	3.57%	Min. Load	7.03	11.95	12.65	11.24	12.65	14.76	70.28
					Max. Load	7.03	11.95	12.65	11.24	12.65	14.76	70.28
					Avg. Load	7.03	11.95	12.65	11.24	12.65	14.76	70.28
					Standard Deviation	-	-	-	-	-		-
		Mercedes	7	25.00%	Variance	-	-	-	-	-		-
					Min. Load	2.13	3.63	3.84	3.41	3.84	4.48	21.33
					Max. Load	7.78	13.23	14.00	12.45	14.00	16.34	77.80
					Avg. Load	3.81	6.48	6.86	6.10	6.86	8.00	38.11
					Standard Deviation	2.63	4.48	4.74	4.22	4.74	5.53	26.35
		Total	28	100.00%	Variance	6.94	20.06	22.49	17.77	22.49	30.62	694.25

8.5.7 Distribution of Vehicles by Body Type on PICT

The percentage of vehicles with respect to Body Type i.e. Flat, Half, Full & Container plying on PICT is tabulated in Table 8-33 and is graphically presented in Figure 8-22.

Table 8-33: Percentage of Vehicles w.r.t Body Type on PICT

Sr. No.	Body Type	Count	Percentage
1	Flat	20	10.75%
2	Half	4	2.15%
3	Full	1	0.54%
4	Container	161	86.56%
	Total	186	100.00%

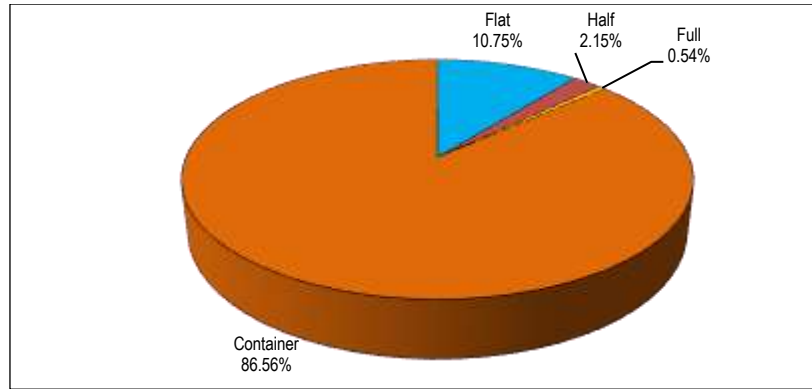


Figure 8-22 : Percentage of Vehicles w.r.t Body Type on PICT

8.5.8 Analysis by Body Type on PICT

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to body type is presented in Table 8-34. The results depict that:

In case of **2 Axle Single**, container body type constitutes maximum percentage of 100%, with average gross load of 17.67 ton.

In case of **3 Axle Tandem**, container body type constitutes maximum percentage of 94.83%, with average gross load of 32.29 ton.

In case of **4 Axle Single Tandem**, container body type constitutes maximum percentage of 86.05%, with average gross load of 40.02 ton.

In case of **5 Axle Single Tridem**, flat body type constitutes maximum percentage of 100%, with average gross load of 15.67 ton.

In case of **5 Axle Tandem Tandem**, container body type constitutes maximum percentage of 100%, with average gross load of 61.23 ton.

In case of **6 Axle Tandem Tridem**, container body type constitutes maximum percentage of 75%, with average gross load of 74.42 ton, followed by half body type with percentage of 14.29%, carrying average gross load of 22.63 ton.

Table 8-34: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Body Type for major Axle Configuration on PICT

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Container	5	100.00%	Min. Load	4.44	9.88					14.32
					Max. Load	6.58	14.63					21.21
					Avg. Load	5.48	12.19					17.67
					Standard Deviation	0.77	1.71					2.48
					Variance	0.59	2.92					6.14
		Total	5	100.00%								
2	3 Axle Tandem	Flat	3	5.17%	Min. Load	2.01	3.56	3.56				9.13
					Max. Load	8.18	14.51	14.51				37.20
					Avg. Load	4.23	7.51	7.51				19.25
					Standard Deviation	3.43	6.08	6.08				15.59
					Variance	11.76	36.97	36.97				243.04
		Container	55	94.83%	Min. Load	2.66	4.71	4.71				12.08
					Max. Load	9.21	16.33	16.33				41.88
					Avg. Load	7.10	12.59	12.59				32.29
					Standard Deviation	1.46	2.60	2.60				6.66
					Variance	2.14	6.74	6.74				44.31
Total	58	100.00%										
3	4 Axle Single Tandem	Flat	12	13.95%	Min. Load	1.94	3.53	2.74	3.19			11.40
					Max. Load	2.52	4.59	3.55	4.14			14.80
					Avg. Load	2.24	4.09	3.17	3.70			13.20
					Standard Deviation	0.18	0.34	0.26	0.30			1.09
					Variance	0.03	0.11	0.07	0.09			1.18

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
		Container	74	86.05%	Min. Load	2.15	3.92	3.04	3.54			12.66
					Max. Load	8.25	15.04	11.64	13.58			48.51
					Avg. Load	6.80	12.41	9.60	11.21			40.02
					Standard Deviation	1.32	2.41	1.87	2.18			-
					Variance	1.75	5.82	3.49	4.74			60.52
	Total		86	100.00%								
4	5 Axle Single Tridem	Flat	3	100.00%	Min. Load	1.91	3.37	2.93	3.08	3.37		14.67
					Max. Load	2.16	3.81	3.32	3.48	3.81		16.58
					Avg. Load	2.04	3.60	3.13	3.29	3.60		15.67
					Standard Deviation	0.12	0.22	0.19	0.20	0.22		0.96
					Variance	0.02	0.05	0.04	0.04	0.05		0.92
	Total		3	100.00%								
5	5 Axle Tandem Tandem	Container	6	100.00%	Min. Load	7.35	12.44	11.31	11.87	13.57		56.54
					Max. Load	9.69	16.39	14.90	15.65	17.88		74.50
					Avg. Load	7.96	13.47	12.25	12.86	14.69		61.23
					Standard Deviation	0.86	1.46	1.32	1.39	1.59		6.62
					Variance	0.74	2.12	1.75	1.93	2.53		43.85
	Total		6	100.00%								
6	6 Axle Tandem Tridem	Flat	2	7.14%	Min. Load	1.88	3.20	3.39	3.01	3.39	3.95	18.82
					Max. Load	2.41	4.10	4.34	3.86	4.34	5.07	24.12
					Avg. Load	2.15	3.65	3.86	3.44	3.86	4.51	21.47
					Standard Deviation	0.37	0.64	0.67	0.60	0.67	0.79	3.75
					Variance	0.14	0.41	0.45	0.36	0.45	0.62	14.03
		Half	4	14.29%	Min. Load	2.13	3.63	3.84	3.41	3.84	4.48	21.33
					Max. Load	2.37	4.02	4.26	3.79	4.26	4.97	23.67
					Avg. Load	2.26	3.85	4.07	3.62	4.07	4.75	22.63
					Standard Deviation	0.10	0.18	0.19	0.17	0.19	0.22	1.04
					Variance	0.01	0.03	0.04	0.03	0.04	0.05	1.08
		Full	1	3.57%	Min. Load	2.30	3.90	4.13	3.67	4.13	4.82	22.95
					Max. Load	2.30	3.90	4.13	3.67	4.13	4.82	22.95
					Avg. Load	2.30	3.90	4.13	3.67	4.13	4.82	22.95
					Standard Deviation	-	-	-	-	-	-	-
					Variance	-	-	-	-	-	-	-
		Container	21	75.00%	Min. Load	6.96	11.83	12.52	11.13	12.52	14.61	69.57
					Max. Load	7.89	13.41	#VALUE !	12.63	14.20	16.57	78.91
Avg. Load	7.44				12.65	13.40	11.91	13.40	15.63	74.42		
Standard Deviation	0.33				0.56	0.60	0.53	0.60	0.70	3.32		
Variance	0.11				0.32	0.36	0.28	0.36	0.49	11.03		
	Total		28	100.00%								

8.5.9 Distribution of Vehicles by Type on PICT

The percentage of vehicles with respect to Type i.e. Truck, Semi-Trailer and Tanker plying on PICT is tabulated in Table 8-35 and is graphically presented in Figure 8-23.

Table 8-35: Percentage of Vehicles w.r.t Type on PICT

Sr. No.	Vehicle Type	Count	Percentage
1	Truck	63	33.51%
2	Semi-Trailer	125	66.49%
	Total	188	100.00%

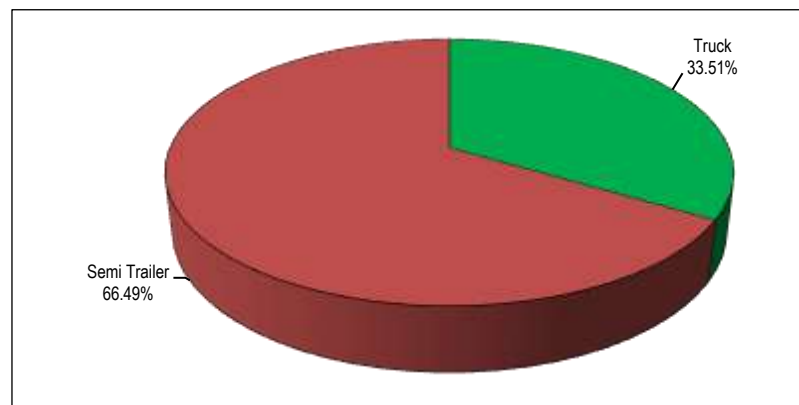


Figure 8-23: Percentage of Vehicles w.r.t Type on PICT

8.5.10 Analysis by Vehicle Type on PICT

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to truck type is presented in Table 8-36. The results depict that:

In case of **2 Axle Single**, truck type constitutes maximum percentage of 100%, with average gross load of 17.56 ton.

In case of **3 Axle Tandem**, truck type constitutes maximum percentage of 94.92%, with average gross load of 32.17 ton, followed by semi-trailer with percentage of 5.08%, carrying average gross load of 23.59 ton.

In case of **4 Axle Single Tandem**, semi-trailer type constitutes maximum percentage of 96.55%, with average gross load of 36.42 ton, followed by truck with percentage of 3.45%, carrying average gross load of 24.37 ton.

In case of **5 Axle Single Tridem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 15.67 ton.

In case of **5 Axle Tandem Tandem**, semi-trailer type constitutes overall percentage of 100%, with average gross load of 62.55 ton.

In case of **6 Axle Tandem Tridem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 61.40 ton.

Table 8-36: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Type for major Axle Configuration on PICT

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Truck	4	100.00%	Min. Load	4.44	9.88					14.32
					Max. Load	6.58	14.63				21.21	
					Avg. Load	5.44	12.11				17.56	
					Standard Deviation	0.88	1.96				2.85	
					Variance	0.78	3.86				8.10	
		Total	4	100.00%								
2	3 Axle Tandem	Truck	56	94.92%	Min. Load	2.01	3.56	3.56				9.13
					Max. Load	9.21	16.33	16.33			41.88	
					Avg. Load	7.08	12.55	12.55			32.17	
					Standard Deviation	1.57	2.78	2.78			7.12	
					Variance	2.46	7.72	7.72			50.76	
		Semi-Trailer	3	5.08%	Min. Load	2.51	4.45	4.45	0.00	0.00		11.41
					Max. Load	8.65	15.34	15.34	0.00	0.00	39.34	
					Avg. Load	5.19	9.20	9.20	-	-	23.59	
					Standard Deviation	3.15	5.58	5.58	0.00	0.00	14.30	
					Variance	9.90	31.11	31.11	0.00	0.00	204.54	
Total	59	100.00%										
3	4 Axle Single Tandem	Semi-Trailer	84	96.55%	Min. Load	1.94	3.53	2.74	3.19	0.00		11.40
					Max. Load	8.25	15.04	11.64	13.58	0.00	48.51	
					Avg. Load	6.19	11.29	8.74	10.20	--	36.42	
					Standard Deviation	2.03	3.69	2.86	3.34	0.00	11.92	
					Variance	4.10	13.65	8.18	11.14	0.00	142.04	
		Truck	3	3.45%	Min. Load	2.19	4.00	3.09	3.61	0.00	12.89	
					Max. Load	5.36	9.77	7.56	8.83	0.00	31.52	
					Avg. Load	4.14	7.56	5.85	6.82	-	24.37	
					Standard Deviation	1.71	3.11	2.41	2.81	0.00	10.04	
					Variance	2.92	9.69	5.81	7.91	0.00	100.87	
Total	87	100.00%										
4	5 Axle Single Tridem	Semi-Trailer	3	100.00%	Min. Load	1.91	3.37	2.93	3.08	3.37		14.67
					Max. Load	2.16	3.81	3.32	3.48	3.81	16.58	
					Avg. Load	2.04	3.60	3.13	3.29	3.60	15.67	
					Standard Deviation	0.12	0.22	0.19	0.20	0.22	0.96	
					Variance	0.02	0.05	0.04	0.04	0.05	0.92	
		Total	3	100.00%								
5	5 Axle Tandem Tandem	Semi-Trailer	7	100.00%	Min. Load	7.35	12.44	11.31	11.87	13.57		56.54
					Max. Load	9.69	16.39	14.90	15.65	17.88	74.50	
					Avg. Load	8.13	13.76	12.51	13.14	15.01	62.55	
					Standard Deviation	0.91	1.54	1.40	1.47	1.68	6.99	
					Variance	0.83	2.36	1.95	2.15	2.81	48.83	
		Total	7	100.00%								

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
6	6 Axle Tandem Tridem	Semi-Trailer	28	100.00%	Min. Load	1.88	3.20	3.39	3.01	3.39	3.95	18.82
					Max. Load	7.89	13.41	14.20	12.63	14.20	16.57	78.91
					Avg. Load	6.14	10.44	11.05	9.82	11.05	12.89	61.40
					Standard Deviation	2.32	3.94	4.17	3.71	4.17	4.86	23.16
		Variance	5.36	15.50	17.38	13.73	17.38	23.65	536.34			
		Total	28	100.00%								

8.5.11 Commodities carried by vehicles on PICT

The percentage of major commodities carried by heavy vehicles on PICT is tabulated in Table 8-37 and is graphically presented in Figure 8-24. For the sake of analysis, each commodity is assigned a code; details are attached in Annex – 2.

Table 8-37: Percentage of Vehicle w.r.t Commodities on PICT

Sr. No.	Commodity Type	Code	Count	Percentage
1	Agriculture Items	100	26	13.61%
2	Food Items	200	26	13.61%
3	Animals and Animal Products	300	6	3.14%
4	Raw Materials	400	4	2.09%
5	Bulk Manufactures	500	3	1.57%
6	Basic Manufactures	600	16	8.38%
7	Miscellaneous Manufactures	700	4	2.09%
8	Mining and Quarrying	800	3	1.57%
9	Miscellaneous Goods not Classified	A00	86	45.03%
10	Empty	E00	17	8.90%
	Total		191	100.00%

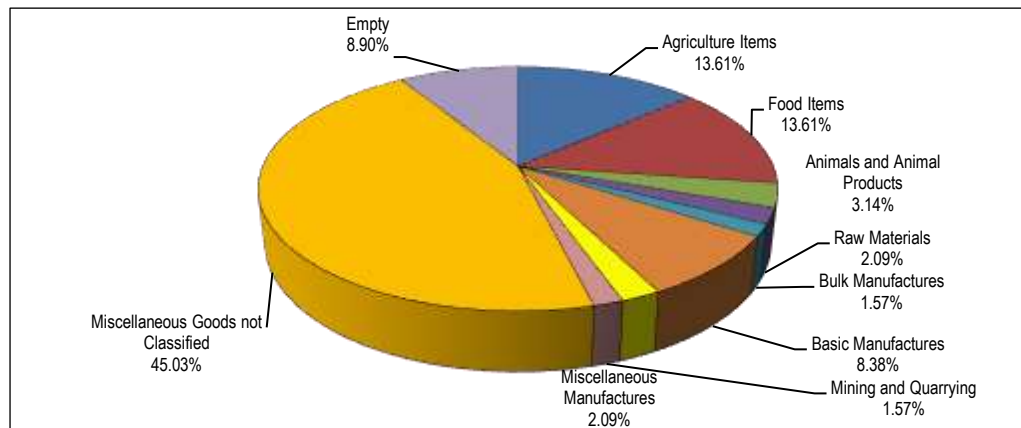


Figure 8-24: Percentage of Vehicles w.r.t Commodities on PICT

8.5.12 Analysis based on Commodities on PICT

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to commodities carried by trucks is presented in Table 8-38. The results depict that:

Major commodity carried by **2 Axle Single** is manufactures, covering 60% of the total, with average gross load of 17.61 ton.

Major commodities carried by **3 Axle Tandem** are miscellaneous goods not classified, covering 36.67% of the total, with average gross load of 35.86 ton, followed by agriculture items having percentage of 20% in total, with average gross load of 34.84 ton.

Major commodities carried by **4 Axle Single Tandem** are miscellaneous goods not classified, covering 47.13% of the total, with average gross load of 44.11 ton, followed by agriculture items, having percentage of 14.94% in total, with average gross load of 33.01 ton.

Major commodity carried by **5 Axle Single Tridem** is miscellaneous goods not classified, covering 75% of the total, with average gross load of 15.67 ton.

Major commodity carried by **5 Axle Tandem Tandem** is miscellaneous goods not classified, covering 71.43% of the total, with average gross load of 58.57 ton.

Major commodities carried by **6 Axle Tandem Tridem** are miscellaneous goods not classified, covering 50% of the total, with average gross load of 46.24 ton, followed by food items, having percentage of 39.29% in total, with average gross load of 76.55 ton.

Table 8-38: Stdev. Var., Min., Max. & Avg. Load Comparison w.r.t Commodities for major Axle Configuration on PICT

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						Total	
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5		
1	2 Axle Single	Bulk Manufactures	500	1	20.00%	Min. Load	4.44	9.88						14.32
						Max. Load	4.44	9.88					14.32	
						Avg. Load	4.44	9.88					14.32	
						Standard Deviation	-	-					-	
						Variance	-	-					-	
		Basic Manufactures	600	3	60.00%	Min. Load	5.24	11.66						16.90
						Max. Load	5.62	12.50					18.12	
						Avg. Load	5.46	12.15					17.61	
						Standard Deviation	0.20	0.44					0.63	
						Variance	0.04	0.19					0.40	
		Miscellaneous Goods not Classified	A00	1	20.00%	Min. Load	6.58	14.63						21.21
						Max. Load	6.58	14.63					21.21	
						Avg. Load	6.58	14.63					21.21	
						Standard Deviation	-	-					-	
						Variance	-	-					-	
Total				5	100%									
2	3 Axle Tandem	Agriculture Items	100	12	20.00%	Min. Load	6.32	11.21	11.21					28.74
						Max. Load	8.30	14.72	14.72					37.74
						Avg. Load	7.67	13.59	13.59					34.84
						Standard Deviation	0.52	0.91	0.91					2.35
						Variance	0.27	0.84	0.84					5.50
		Food Items	200	5	8.33%	Min. Load	6.16	10.92	10.92					27.99
						Max. Load	8.42	14.93	14.93					38.27
						Avg. Load	7.32	12.98	12.98					33.29
						Standard Deviation	1.06	1.88	1.88					4.82
						Variance	1.12	3.53	3.53					23.19
		Animals and Animal Products	300	2	3.33%	Min. Load	6.08	10.78	10.78					27.65
						Max. Load	7.54	13.37	13.37					34.29
						Avg. Load	6.81	12.08	12.08					30.97
						Standard Deviation	1.03	1.83	1.83					4.70
						Variance	1.07	3.35	3.35					22.04
		Raw Materials	400	3	5.00%	Min. Load	6.35	11.26	11.26					28.87
						Max. Load	8.18	14.51	14.51					37.20
						Avg. Load	7.34	13.01	13.01					33.36
						Standard Deviation	0.92	1.64	1.64					4.20
						Variance	0.86	2.69	2.69					17.67
		Basic Manufactures	600	8	13.33%	Min. Load	3.96	7.02	7.02					18.00
						Max. Load	6.13	10.86	10.86					27.85
						Avg. Load	4.69	8.32	8.32					21.34
						Standard Deviation	0.81	1.44	1.44					3.69
						Variance	0.66	2.07	2.07					13.61
		Miscellaneous Manufactures	700	3	5.00%	Min. Load	4.41	7.81	7.81					20.03
						Max. Load	7.44	13.18	13.18					33.80
						Avg. Load	6.42	11.37	11.37					29.16
						Standard Deviation	1.74	3.08	3.08					7.91
						Variance	3.03	9.51	9.51					62.52
		Mining and Quarrying	800	2	3.33%	Min. Load	8.65	15.34	15.34					39.34
						Max. Load	9.21	16.33	16.33					41.88
						Avg. Load	8.93	15.84	15.84					40.61
						Standard Deviation	0.40	0.70	0.70					1.80
						Variance	0.16	0.49	0.49					3.23
		Miscellaneous Goods not Classified	A00	22	36.67%	Min. Load	6.71	11.90	11.90					30.51
						Max. Load	8.70	15.42	15.42					39.54
						Avg. Load	7.89	13.98	13.98					35.86
						Standard Deviation	0.53	0.95	0.95					2.43
						Variance	0.28	0.90	0.90					5.89
		Empty	E00	3	5.00%	Min. Load	2.01	3.56	3.56					9.13
						Max. Load	2.66	4.71	4.71					12.08
						Avg. Load	2.39	4.24	4.24					10.87
						Standard Deviation	0.34	0.60	0.60					1.55
						Variance	0.12	0.36	0.36					2.39
Total				60	100.00%									

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)							
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total	
3	4 Axle Single Tandem	Agriculture Items	100	13	14.94%	Min. Load	3.94	7.18	5.56	6.48			23.15	
						Max. Load	7.63	13.92	10.78	12.57			44.91	
						Avg. Load	5.61	10.23	7.92	9.24			33.01	
						Standard Deviation	1.22	2.23	1.73	2.02			7.20	
		Variance	1.50	4.98	2.99	4.07			51.86					
		Food Items	200	8	9.20%	Min. Load	4.79	8.74	6.77	7.90			28.20	
						Max. Load	8.25	15.04	11.64	13.58			48.51	
						Avg. Load	6.50	11.85	9.17	10.70			38.22	
						Standard Deviation	1.63	2.97	2.30	2.68			9.56	
		Variance	2.64	8.79	5.27	7.17			91.49					
		Animals and Animal Products	300	3	3.45%	Min. Load	3.94	7.19	5.57	6.49			23.19	
						Max. Load	5.61	10.22	7.92	9.23			32.98	
						Avg. Load	5.01	9.13	7.07	8.25			29.46	
						Standard Deviation	0.93	1.69	1.31	1.52			5.44	
		Variance	0.86	2.85	1.71	2.32			29.63					
		Raw Materials	400	1	1.15%	Min. Load	7.03	12.82	9.92	11.58			41.35	
						Max. Load	7.03	12.82	9.92	11.58			41.35	
						Avg. Load	7.03	12.82	9.92	11.58			41.35	
						Standard Deviation	-	-	-	-			-	
		Variance	-	-	-	-			-					
		Basic Manufactures	600	5	5.75%	Min. Load	4.97	9.06	7.01	8.18			29.21	
						Max. Load	7.39	13.48	10.43	12.17			43.47	
						Avg. Load	6.61	12.06	9.33	10.89			38.89	
						Standard Deviation	0.99	1.81	1.40	1.64			5.84	
		Variance	0.99	3.28	1.97	2.68			34.15					
		Miscellaneous Manufactures	700	1	1.15%	Min. Load	7.14	13.01	10.08	11.75			41.98	
						Max. Load	7.14	13.01	10.08	11.75			41.98	
						Avg. Load	7.14	13.01	10.08	11.75			41.98	
						Standard Deviation	-	-	-	-			-	
		Variance	-	-	-	-			-					
		Mining and Quarrying	800	1	1.15%	Min. Load	6.66	12.15	9.41	10.97			39.19	
						Max. Load	6.66	12.15	9.41	10.97			39.19	
Avg. Load	6.66					12.15	9.41	10.97			39.19			
Standard Deviation	-					-	-	-			-			
Variance	-	-	-	-			-							
Miscellaneous Goods not Classified	A00	41	47.13%	Min. Load	4.82	8.79	6.80	7.94			28.34			
				Max. Load	8.25	15.04	11.64	13.58			48.51			
				Avg. Load	7.50	13.67	10.59	12.35			44.11			
				Standard Deviation	0.61	1.11	0.86	1.00			3.58			
Variance	0.37	1.23	0.74	1.01			12.83							
Empty	E00	14	16.09%	Min. Load	1.94	3.53	2.74	3.19			11.40			
				Max. Load	2.52	4.59	3.55	4.14			14.80			
				Avg. Load	2.23	4.07	3.15	3.67			13.12			
				Standard Deviation	0.17	0.32	0.24	0.29			1.02			
Variance	0.03	0.10	0.06	0.08			1.04							
Total				87	100.00%									
4	5 Axle Single Tridem	Animals and Animal Products	300	1	25.00%	Min. Load	4.07	7.21	6.27	6.58	7.21		31.34	
						Max. Load	4.07	7.21	6.27	6.58	7.21		31.34	
						Avg. Load	4.07	7.21	6.27	6.58	7.21		31.34	
						Standard Deviation	-	-	-	-	-		-	
		Variance	-	-	-	-	-		-					
		Miscellaneous Goods not Classified	A00	3	75.00%	Min. Load	1.91	3.37	2.93	3.08	3.37		14.67	
						Max. Load	2.16	3.81	3.32	3.48	3.81		16.58	
						Avg. Load	2.04	3.60	3.13	3.29	3.60		15.67	
						Standard Deviation	0.12	0.22	0.19	0.20	0.22		0.96	
		Variance	0.02	0.05	0.04	0.04	0.05		0.92					
Total				4	100.00%									
5	5 Axle Tandem	Food Items	200	2	28.57%	Min. Load	9.17	15.51	14.10	14.81	16.92		70.50	
						Max. Load	9.69	16.39	14.90	15.65	17.88		74.50	
						Avg. Load	9.43	15.95	14.50	15.23	17.40		72.50	
						Standard Deviation	0.37	0.62	0.57	0.59	0.68		2.83	
		Variance	0.14	0.39	0.32	0.35	0.46		8.00					
		Miscellaneous Goods not Classified	A00	5	71.43%	Min. Load	7.35	12.44	11.31	11.87	13.57		56.54	
						Max. Load	7.79	13.19	11.99	12.59	14.39		59.96	
						Avg. Load	7.61	12.89	11.71	12.30	14.06		58.57	
						Standard Deviation	0.18	0.31	0.28	0.29	0.34		1.40	
		Variance	0.03	0.09	0.08	0.09	0.11		1.96					
Total				7	100.00%									
6	6 Axle Tandem Tridem	Agriculture Items	100	1	3.57%	Min. Load	7.56	12.86	13.62	12.10	13.62	15.88	75.64	
						Max. Load	7.56	12.86	13.62	12.10	13.62	15.88	75.64	
						Avg. Load	7.56	12.86	13.62	12.10	13.62	15.88	75.64	
						Standard Deviation	-	-	-	-	-	-	-	
		Variance	-	-	-	-	-	-	-					
		Food Items	200	11	39.29%	Min. Load	7.35	12.50	13.23	11.76	13.23	15.44	73.51	
						Max. Load	7.89	13.41	14.20	12.63	14.20	16.57	78.91	
						Avg. Load	7.66	13.01	13.78	12.25	13.78	16.08	76.55	
						Standard Deviation	0.16	0.27	0.29	0.26	0.29	0.34	1.61	
		Variance	0.03	0.07	0.08	0.07	0.08	0.11	2.58					

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
	Bulk Manufactures	500	2	7.14%	Min. Load	7.67	13.04	13.81	12.27	13.81	16.11	76.71	
					Max. Load	7.75	13.18	13.95	12.40	13.95	16.28	77.50	
					Avg. Load	7.71	13.11	13.88	12.34	13.88	16.19	77.11	
					Standard Deviation	0.06	0.09	0.10	0.09	0.10	0.12	0.56	
	Variance	0.00	0.01	0.01	0.01	0.01	0.01	0.31					
	Miscellaneous Goods not Classified	A00	14	50.00%	Min. Load	1.88	3.20	3.39	3.01	3.39	3.95	18.82	
					Max. Load	7.04	11.97	12.68	11.27	12.68	14.79	70.42	
					Avg. Load	4.62	7.86	8.32	7.40	8.32	9.71	46.24	
Standard Deviation					2.48	4.22	4.47	3.97	4.47	5.21	24.83		
Variance	6.17	17.82	19.98	15.79	19.98	27.20	616.68						
Total			28	100.00%									

8.5.13 Damage Factor for major Axle Configuration on PICT

The average damage factors calculated for major axle configuration are presented in Table 8-39.

Table 8-39: Damage Factor for major Axle Configuration on PICT

Sr. No.	Axle Configuration	Code	Damage Factor (2020)	
			Road Note 40	AASHTO 1993
1	2 Axle Single	1.2	6.90	5.09
2	3 Axle Tandem	1.22	18.04	9.08
3	4 Axle Single Tandem	1.2-22	13.79	8.97
4	5 Axle Single Tridem	1.2-222	0.52	0.41
5	5 Axle Tandem Tandem	1.22-22	45.27	20.77
6	6 Axle Tandem Tridem	1.22-222	37.71	15.60

8.6 East Wharf

The results of axle load survey performed on East Wharf of KPT are discussed in subsequent sub-sections.

8.6.1 Distribution of Vehicles by Axle Configuration on East Wharf

The percentage of trucks for major axle configurations surveyed on East Wharf is summarized in Table 8-40 and is graphically presented in Figure 8-25.

Table 8-40: Percentage of Vehicle w.r.t Axle Configuration on East Wharf

Sr. No.	Axle Configuration	Code	Total Number of Trucks	%age
1	2 Axle Single	1.2	1	0.36%
2	3 Axle Tandem	1.22	186	66.91%
3	4 Axle Single Tandem	1.2-22	7	2.52%
4	5 Axle Tandem Tandem	1.22-22	9	3.24%
5	6 Axle Tandem Tridem	1.22-222	74	26.62%
6	Others	-	1	0.36%
Total			278	100%

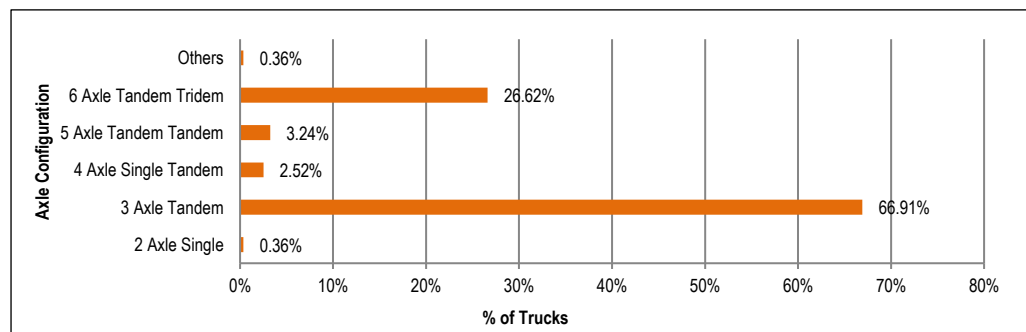


Figure 8-25: Percentage of Vehicles w.r.t Axle Configuration on East Wharf

8.6.2 Analysis by Axle Configuration on East Wharf

The analysis comprising minimum, maximum and average loads per axle carried by trucks on East Wharf along with standard deviation and variance is presented in Table 8-41. The minimum, maximum and average loads are graphically presented in Figure 8-26 and Figure 8-27 respectively.

In case of **3 Axle Tandem**, maximum load of 61.29 ton with average load of 29.73 ton was recorded.

In case of **4 Axle Single Tandem**, maximum load of 61.09 ton with average load of 30.93 ton was recorded.

In case of **5 Axle Tandem Tandem**, maximum load of 66.48 ton with average load of 58.90 ton was recorded.

In case of **6 Axle Tandem Tridem**, maximum load of 80.07 ton with average load of 64.93 ton was recorded.

Table 8-41: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Axle Configuration on East Wharf

Sr. No.	Axle Configuration	Permissible Load Limits	Parameters	Load (Tons)								
				Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total		
1	2 Axle Single	17.5	Min. Load	3.35	7.47						10.82	
			Max. Load	3.35	7.47							10.82
			Avg. Load	3.35	7.47							10.82
			Standard Deviation	-	-							-
			Variance	-	-							-
2	3 Axle Tandem	27.5	Min. Load	2.22	3.94	3.94					10.09	
			Max. Load	9.04	25.11	27.14					61.29	
			Avg. Load	6.52	11.60	11.61					29.73	
			Standard Deviation	0.90	1.86	1.94					4.64	
			Variance	0.81	3.44	3.76					21.52	
3	4 Axle Single Tandem	39.5	Min. Load	2.60	4.75	3.68	4.29				15.32	
			Max. Load	10.39	18.94	14.66	17.11				61.09	
			Avg. Load	5.26	9.59	7.42	8.66				30.93	
			Standard Deviation	3.36	6.12	4.74	5.53				19.75	
			Variance	11.27	37.48	22.46	30.57				389.98	
4	5 Axle Tandem Tandem	49.5	Min. Load	2.47	4.17	3.79	3.98	4.55			18.97	
			Max. Load	8.64	14.63	13.30	13.96	15.96			66.48	
			Avg. Load	7.66	12.96	11.78	12.37	14.14			58.90	
			Standard Deviation	1.95	3.30	3.00	3.15	3.60			15.01	
			Variance	3.81	10.91	9.02	9.94	12.98			225.39	
5	6 Axle Tandem Tridem	58.5	Min. Load	1.93	3.28	3.47	3.09	3.47	4.05		19.29	
			Max. Load	8.01	13.61	14.41	12.81	14.41	16.81		80.07	
			Avg. Load	6.49	11.04	11.69	10.39	11.69	13.63		64.93	
			Standard Deviation	1.09	1.86	1.97	1.75	1.97	2.29		10.93	
			Variance	1.19	3.45	3.87	3.06	3.87	5.27		119.42	

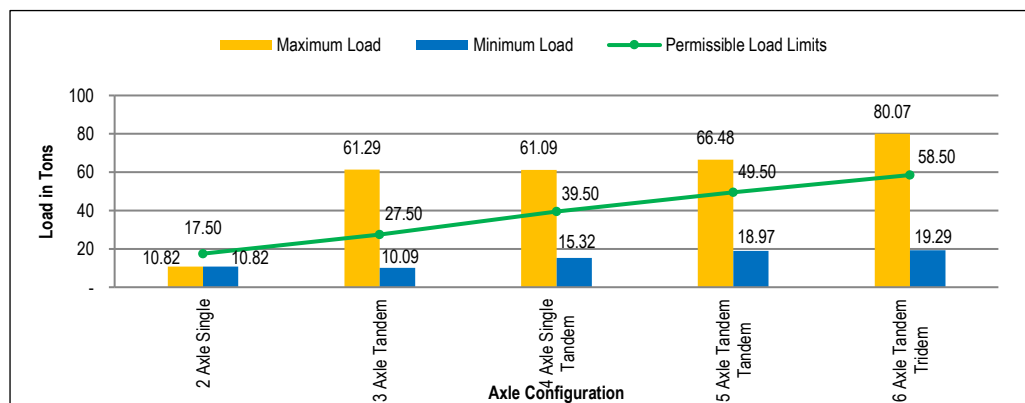


Figure 8-26: Min. & Max. Load Comparison w.r.t Axle Configuration on East Wharf

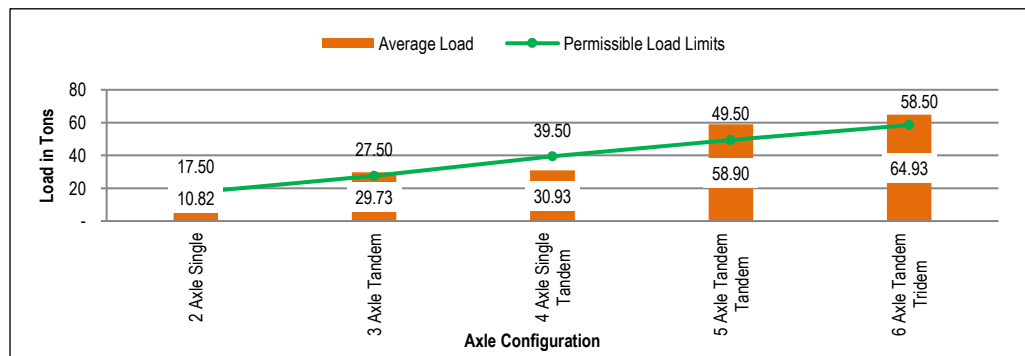


Figure 8-27: Avg. Load Comparison w.r.t Axle Configuration on East Wharf

8.6.3 Load Spectrum by Axle Configuration on East Wharf

The major cause of pavement failure is due to excessive overloading. The axle load survey data was organized in a way to identify the number of vehicles carrying load above and below permissible limits. Furthermore, load spectrums were identified and number of vehicles carrying load in specified spectrums were calculated. The results are tabulated in Table 8-42 which illustrates that:

In case of **3 Axle Tandem**, 5.38% of trucks carried load under permissible limits. Whereas, 10.22% of the trucks carried load more than 15% of permissible load limits.

In case of **4 Axle Single Tandem**, 57.14% of trucks/semi-trailers carried load under permissible limits. Whereas, 28.57% of the trucks/semi-trailers carried load more than 15% of permissible load limits.

In case of **5 Axle Tandem Tandem**, 11.11% of semi-trailers carried load under permissible limits. Whereas, 88.89% semi-trailers carried load more than 15% of permissible load limits.

In case of **6 Axle Tandem Tridem**, 5.41% of semi-trailers carried load under permissible limits. Whereas, 48.65% semi-trailers carried load more than 15% of permissible load limits

The percentage of trucks for major axle configuration carrying load above and below permissible limits on East Wharf is graphically presented in Figure 8-28.

Table 8-42: Load Spectrum w.r.t Axle Configuration on East Wharf

Sr. No.	Axle Configuration	Under Permissible Limit	Over Permissible Limit					Total	
			15.00%	30.00%	50.00%	75.00%	>75%		
1	2 Axle Single	Max. Load (Tons)	17.5	20.1	22.8	26.3	30.6		
		Average Load (Tons)	10.82	-	-	-	-	-	
		No. of Trucks	1	0	0	0	0	0	1
		Percentage	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
2	3 Axle Tandem	Max. Load (Tons)	27.5	31.6	35.8	41.3	48.1		
		Average Load (Tons)	15.67	30.03	31.94	39.24	-	61.29	
		No. of Trucks	10	157	15	3	0	1	186
		Percentage	5.38%	84.41%	8.06%	1.61%	0.00%	0.54%	100%
		Cumulative Percentage	5.38%	89.78%	97.85%	99.46%	99.46%	100.00%	
		Percentage above Range Value	94.62%	10.22%	2.15%	0.54%	0.54%	0.00%	
3	4 Axle Single Tandem	Max. Load (Tons)	39.5	45.4	51.4	59.3	69.1		
		Average Load (Tons)	15.59	45.22	47.81	-	61.09	-	
		No. of Trucks	4	1	1	0	1	0	7
		Percentage	57.14%	14.29%	14.29%	0.00%	14.29%	0.00%	100%
		Cumulative Percentage	57.14%	71.43%	85.71%	85.71%	100.00%	100.00%	
		Percentage above Range Value	42.86%	28.57%	14.29%	14.29%	0.00%	0.00%	
4	5 Axle Tandem Tandem	Max. Load (Tons)	49.5	56.9	64.4	74.3	86.6		
		Average Load (Tons)	18.97	-	63.34	65.52	-	-	
		No. of Trucks	1	0	6	2	0	0	9
		Percentage	11.11%	0.00%	66.67%	22.22%	0.00%	0.00%	100%
		Cumulative Percentage	11.11%	11.11%	77.78%	100.00%	100.00%	100.00%	
		Percentage above Range Value	88.89%	88.89%	22.22%	0.00%	0.00%	0.00%	
5	6 Axle Tandem Tridem	Max. Load (Tons)	58.5	67.3	76.1	87.8	102.4		
		Average Load (Tons)	20.94	65.94	68.29	78.33	-	-	
		No. of Trucks	4	34	34	2	0	0	74
		Percentage	5.41%	45.95%	45.95%	2.70%	0.00%	0.00%	100%
		Cumulative Percentage	5.41%	51.35%	97.30%	100.00%	100.00%	100.00%	
		Percentage above Range Value	94.59%	48.65%	2.70%	0.00%	0.00%	0.00%	

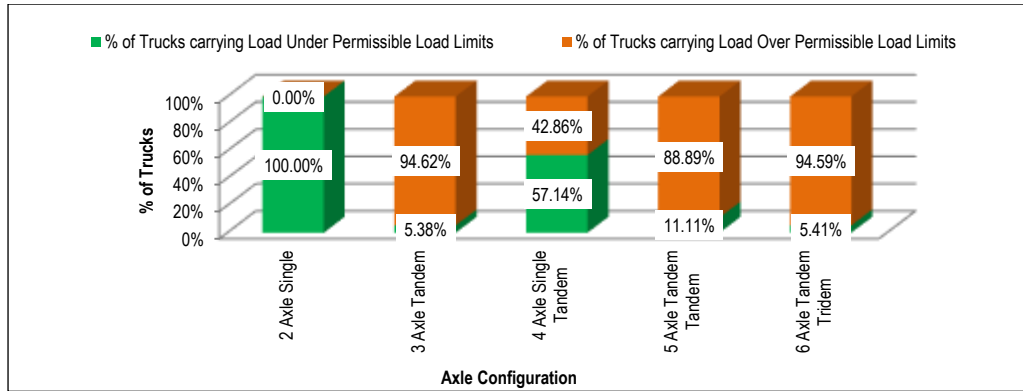


Figure 8-28: Percentage of Vehicles carrying Load above and below Permissible Limits on East Wharf

8.6.4 Front & Rear Axle Load Spectrum on East Wharf

The spectrum of front and rear axle loads for major axle configurations is presented in Table 8-43.

Table 8-43: Front & Rear Axle Load Spectrum on East Wharf

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
Front Axle Load Spectrum					
1	0 - 2.99	16	5.78%	5.78%	94.22%
2	3 - 5.49	1	0.36%	6.14%	93.86%
3	5.5 - 6.99	234	84.48%	90.61%	9.39%
4	7 - 8.99	24	8.66%	99.28%	0.72%
5	9 - 10.99	2	0.72%	100.00%	0.00%
6	11 - 12.99	0	0.00%	100.00%	0.00%
7	13 - 14.99	0	0.00%	100.00%	0.00%
8	15 - 16.99	0	0.00%	100.00%	0.00%
9	17 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Single)					
1	0 - 8.16	51	6.38%	6.38%	93.63%
2	8.17 - 9.99	1	0.13%	6.50%	93.50%
3	10 - 10.99	78	9.75%	16.25%	83.75%
4	11 - 11.99	350	43.75%	60.00%	40.00%
5	12 - 12.99	204	25.50%	85.50%	14.50%
6	13 - 13.99	36	4.50%	90.00%	10.00%
7	14 - 14.99	61	7.63%	97.63%	2.38%
8	15 - 19.99	17	2.13%	99.75%	0.25%
9	20 & Above	2	0.25%	100.00%	0.00%
Rear Axle Load Spectrum (Tandem)					
1	0 - 11.99	17	5.96%	5.96%	94.04%
2	12 - 14.99	0	0.00%	5.96%	94.04%
3	15 - 19.99	0	0.00%	5.96%	94.04%
4	20 - 21.99	9	3.16%	9.12%	90.88%
5	22 - 23.99	183	64.21%	73.33%	26.67%
6	24 - 25.99	52	18.25%	91.58%	8.42%
7	26 - 27.99	10	3.51%	95.09%	4.91%
8	28 - 29.99	10	3.51%	98.60%	1.40%
9	30 & Above	4	1.40%	100.00%	0.00%
Rear Axle Load Spectrum (Tridem)					
1	0 - 14.99	4	5.41%	5.41%	94.59%
2	15 - 30.99	0	0.00%	5.41%	94.59%
3	31 - 32.99	0	0.00%	5.41%	94.59%
4	33 - 34.99	5	6.76%	12.16%	87.84%
5	35 - 36.99	26	35.14%	47.30%	52.70%
6	37 - 38.99	36	48.65%	95.95%	4.05%
7	39 - 40.99	0	0.00%	95.95%	4.05%
8	41 - 42.99	2	2.70%	98.65%	1.35%
9	43 & Above	1	1.35%	100.00%	0.00%

8.6.5 Distribution of Vehicles by Make Type on East Wharf

The distribution of trucks as per make type is illustrated in Table 8-44 and is graphically presented in Figure 8-29. The results depict that Hino and Nissan have maximum

percentage of 64.49% and 18.12% on KPT East Wharf.

Table 8-44: Percentage of Vehicles w.r.t Make Type on East Wharf

Sr. No.	Make	Count	Percentage
1	Bedford	8	2.90%
2	Nissan	50	18.12%
3	Faw	1	0.36%
4	Hino	178	64.49%
5	Isuzu	2	0.72%
6	UD	7	2.54%
7	Others	32	11.51%
Total		278	100.00%

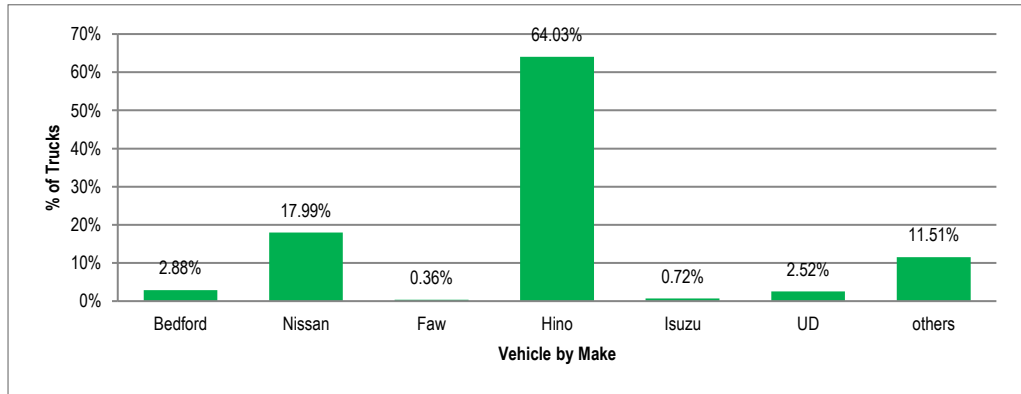


Figure 8-29: Percentage of Vehicles w.r.t Make Type on East Wharf

8.6.6 Analysis by Make Type on East Wharf

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to make type is presented in Table 8-45. The results depict that:

In case of **3 Axle Tandem**, Hino constitutes maximum percentage of 70.43%, with average gross load of 29.82 ton, followed by Nissan with percentage of 12.37%, carrying average gross load of 29.28 ton.

In case of **4 Axle Single Tandem**, Hino constitutes maximum percentage of 57.14% with average gross load of 26.96 ton, followed by Nissan with percentage of 28.57%, carrying average gross load of 31.72 ton.

In case of **5 Axle Tandem Tandem**, other manufacture category constitutes maximum percentage of 66.67%, with average gross load of 56.63 ton followed by Nissan with percentage of 22.22%, carrying average gross load of 63.38 ton.

In case of **6 Axle Tandem Tridem**, Hino constitutes maximum percentage of 54.67%, with average gross load of 64.18 ton, followed by Nissan with percentage of 30.67%, carrying average gross load of 65.18 ton.

Table 8-45: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Make Type for major Axle Configuration on East Wharf

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Hino	1	100.00%	Min. Load	3.35	7.47					10.82
					Max. Load	3.35	7.47				10.82	
					Avg. Load	3.35	7.47				10.82	
					Standard Deviation	-	-				-	
					Variance	-	-				-	
		Total	1	100.00%								
2	3 Axle Tandem	Bedford	8	4.30%	Min. Load	2.22	3.94	3.94				10.09
					Max. Load	6.71	11.89	11.89			30.48	
					Avg. Load	5.81	10.29	10.29			26.39	
					Standard Deviation	1.47	2.61	2.61			6.70	
					Variance	2.17	6.83	6.83			44.89	
		Hino	131	70.43%	Min. Load	2.22	3.94	3.94			10.09	
					Max. Load	9.04	25.11	27.14			61.29	
					Avg. Load	6.53	11.64	11.66			29.82	

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
		Isuzu	1	0.54%	Standard Deviation	0.92	1.97	2.09				4.90
					Variance	0.84	3.90	4.35				24.06
					Min. Load	6.45	11.43	11.43				29.30
					Max. Load	6.45	11.43	11.43				29.30
					Avg. Load	6.45	11.43	11.43				29.30
		Nissan	23	12.37%	Standard Deviation	-	-	-				-
					Variance	-	-	-				-
					Min. Load	2.73	4.84	4.84				12.42
					Max. Load	6.97	12.36	12.36				31.68
					Avg. Load	6.44	11.42	11.42				29.28
		UD	3	1.61%	Standard Deviation	-	1.47	1.47				3.77
					Variance	0.69	2.16	2.16				14.18
					Min. Load	6.55	11.61	11.61				29.77
					Max. Load	8.82	15.64	15.64				40.10
					Avg. Load	7.31	12.96	12.96				33.24
		Others	20	10.75%	Standard Deviation	1.31	2.32	2.32				5.94
					Variance	1.71	5.37	5.37				35.33
					Min. Load	6.28	11.14	11.14				28.56
					Max. Load	7.02	12.44	12.44				31.91
					Avg. Load	6.70	11.88	11.88				30.46
Total	186	100.00%	Standard Deviation	0.19	0.34	0.34				0.87		
			Variance	0.04	0.11	0.11				0.75		
3	4 Axle Single Tandem	Hino	4	57.14%	Min. Load	2.60	4.75	3.68	4.29			15.32
					Max. Load	10.39	18.94	14.66	17.11			61.09
					Avg. Load	4.58	8.36	6.47	7.55			26.96
					Standard Deviation	3.87	7.05	5.46	6.37			22.75
					Variance	14.96	49.76	29.82	40.59			517.77
		Nissan	2	28.57%	Min. Load	2.66	4.84	3.75	4.37			15.62
					Max. Load	8.13	14.82	11.47	13.39			47.81
					Avg. Load	5.39	9.83	7.61	8.88			31.72
					Standard Deviation	3.87	7.06	5.46	6.37			22.76
					Variance	14.97	49.79	29.84	40.62			518.10
		Others	1	14.29%	Min. Load	7.69	14.02	10.85	12.66			45.22
					Max. Load	7.69	14.02	10.85	12.66			45.22
					Avg. Load	7.69	14.02	10.85	12.66			45.22
					Standard Deviation	-	-	-	-			-
					Variance	-	-	-	-			-
Total	7	100.00%	Min. Load	8.26	13.98	12.71	13.35	15.25		63.56		
			Max. Load	8.26	13.98	12.71	13.35	15.25		63.56		
			Avg. Load	8.26	13.98	12.71	13.35	15.25		63.56		
			Standard Deviation	-	-	-	-	-		-		
			Variance	-	-	-	-	-		-		
4	5 Axle Tandem Tandem	Hino	1	11.11%	Min. Load	8.26	13.98	12.71	13.35	15.25		63.56
					Max. Load	8.26	13.98	12.71	13.35	15.25		63.56
					Avg. Load	8.26	13.98	12.71	13.35	15.25		63.56
					Standard Deviation	-	-	-	-	-		-
					Variance	-	-	-	-	-		-
		Nissan	2	22.22%	Min. Load	8.23	13.93	12.67	13.30	15.20		63.33
					Max. Load	8.24	13.95	12.68	13.32	15.22		63.42
					Avg. Load	8.24	13.94	12.68	13.31	15.21		63.38
					Standard Deviation	0.01	0.01	0.01	0.01	0.02		0.06
					Variance	0.00	0.00	0.00	0.00	0.00		0.00
		Others	6	66.67%	Min. Load	2.47	4.17	3.79	3.98	4.55		18.97
					Max. Load	8.64	14.63	13.30	13.96	15.96		66.48
					Avg. Load	7.36	12.46	11.33	11.89	13.59		56.63
					Standard Deviation	2.40	4.07	3.70	3.88	4.44		18.49
					Variance	5.78	16.56	13.68	15.08	19.70		342.06
Total	9	100.00%	Min. Load	1.93	3.28	3.47	3.09	3.47	4.05	19.29		
			Max. Load	8.01	13.61	14.41	12.81	14.41	16.81	80.07		
			Avg. Load	6.42	10.91	11.55	10.27	11.55	13.48	64.18		
			Standard Deviation	1.27	2.16	2.29	2.03	2.29	2.67	12.71		
			Variance	1.62	4.67	5.24	4.14	5.24	7.13	161.64		
5	6 Axle Tandem Tridem	Hino	41	54.67%	Min. Load	6.76	11.49	12.16	10.81	12.16	14.19	67.57
					Max. Load	6.76	11.49	12.16	10.81	12.16	14.19	67.57
					Avg. Load	6.76	11.49	12.16	10.81	12.16	14.19	67.57
					Standard Deviation	-	-	-	-	-	-	-
					Variance	-	-	-	-	-	-	-
		Faw	1	1.33%	Min. Load	6.74	11.46	12.13	10.79	12.13	14.16	67.41
					Max. Load	6.74	11.46	12.13	10.79	12.13	14.16	67.41
					Avg. Load	6.74	11.46	12.13	10.79	12.13	14.16	67.41
					Standard Deviation	-	-	-	-	-	-	-
					Variance	-	-	-	-	-	-	-
		Isuzu	1	1.33%	Min. Load	2.01	3.42	3.62	3.22	3.62	4.22	20.11
					Max. Load	6.96	11.83	12.53	11.13	12.53	14.61	69.59
					Avg. Load	6.52	11.08	11.73	10.43	11.73	13.69	65.18
					Standard Deviation	0.99	1.69	1.79	1.59	1.79	2.08	9.92
					Variance	0.98	2.84	3.19	2.52	3.19	4.34	98.37
Nissan	23	30.67%	Min. Load	6.67	11.33	12.00	10.67	12.00	14.00	66.67		
			Max. Load	6.75	11.48	12.15	10.80	12.15	14.18	67.50		
			Avg. Load	6.72	11.42	12.09	10.75	12.09	14.11	67.19		
			Standard Deviation	-	-	-	-	-	-	-		
			Variance	-	-	-	-	-	-	-		
UD	4	5.33%	Min. Load	6.72	11.42	12.09	10.75	12.09	14.11	67.19		
			Max. Load	6.75	11.48	12.15	10.80	12.15	14.18	67.50		
			Avg. Load	6.72	11.42	12.09	10.75	12.09	14.11	67.19		
			Standard Deviation	-	-	-	-	-	-	-		
			Variance	-	-	-	-	-	-	-		

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
					Standard Deviation	0.04	0.06	0.06	0.06	0.06	0.08	0.36
					Variance	0.00	0.00	0.00	0.00	0.00	0.01	0.13
		Others	3	2.67%	Min. Load	6.70	11.39	12.06	10.72	12.06	14.07	66.98
					Max. Load	6.88	6.88	12.39	11.01	12.39	14.45	68.82
					Avg. Load	6.78	11.52	12.20	10.84	12.20	14.23	67.78
					Standard Deviation	0.09	0.16	0.17	0.15	0.17	0.20	0.94
					Variance	0.01	0.03	0.03	0.02	0.03	0.04	0.89
		Total	75	100.00%								

8.6.7 Distribution of Vehicles by Body Type on East Wharf

The percentage of vehicles with respect to Body Type i.e. Flat, Half, Full & Container plying on KPT East Wharf is tabulated in Table 8-46 and is graphically presented in Figure 8-30.

Table 8-46: Percentage of Vehicles w.r.t Body Type on East Wharf

Sr. No.	Body Type	Count	Percentage
1	Flat	247	89.49%
2	Half	7	2.54%
3	Full	13	4.71%
4	Covered	3	1.09%
5	Container	6	2.17%
	Total	276	100.00%

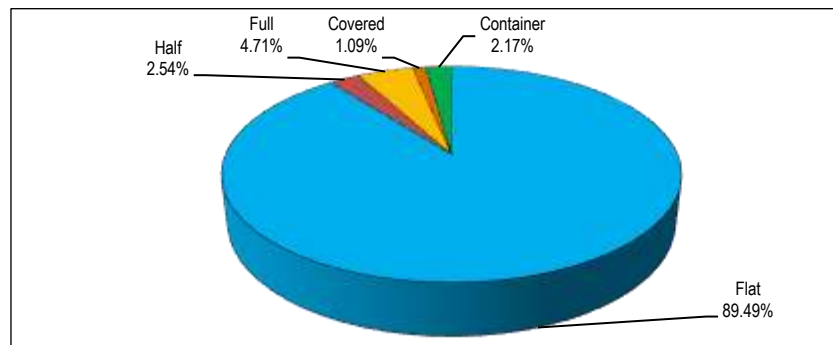


Figure 8-30 : Percentage of Vehicles w.r.t Body Type on East Wharf

8.6.8 Analysis by Body Type on East Wharf

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to body type is presented in Table 8-47. The results depict that:

In case of **3 Axle Tandem**, flat body type constitutes maximum percentage of 95.70%, with average gross load of 29.73 ton.

In case of **4 Axle Single Tandem**, container body type constitutes maximum percentage of 85.71%, with average gross load of 28.55 ton.

In case of **5 Axle Tandem Tandem**, flat body type constitutes maximum percentage of 66.67%, with average gross load of 56.60 ton followed by full body type constituting 22.22% in total, with average gross load of 63.57 ton.

In case of **6 Axle Tandem Tridem**, flat body type constitutes maximum percentage of 83.56%, with average gross load of 65.56 ton, followed by full body type with percentage of 8.22%, carrying average gross load of 63.47 ton.

Table 8-47: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Body Type for major Axle Configuration on East Wharf

Sr.No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Flat	1	100.00%	Min. Load	3.35	7.47					10.82
					Max. Load	3.35	7.47				10.82	
					Avg. Load	3.35	7.47				10.82	
					Standard Deviation	-	-				-	

Sr.No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)									
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total			
					Variance	-	-					-			
		Total	1	100.00%											
2	3 Axle Tandem	Flat	178	95.70%	Min. Load	2.22	3.94	3.94					10.09		
					Max. Load	8.67	15.37	15.37					39.40		
					Avg. Load	6.54	11.59	11.59					29.73		
					Standard Deviation	0.77	1.37	1.37					3.52		
					Variance	0.60	1.88	1.88					12.38		
		Half	2	1.08%	Min. Load	6.09	10.80	10.80						27.70	
					Max. Load	6.40	11.35	11.35					29.11		
					Avg. Load	6.25	11.08	11.08					28.41		
					Standard Deviation	0.22	0.39	0.39					1.00		
					Variance	0.05	0.15	0.15					0.99		
		Full	5	2.69%	Min. Load	2.26	4.01	4.01						10.27	
					Max. Load	9.04	25.11	27.14					61.29		
					Avg. Load	5.81	12.11	12.52					30.43		
					Standard Deviation	3.23	8.68	9.45					21.11		
					Variance	10.43	75.32	89.34					445.53		
		Covered	1	0.54%	Min. Load	6.55	11.61	11.61						29.78	
					Max. Load	6.55	11.61	11.61					29.78		
					Avg. Load	6.55	11.61	11.61					29.78		
					Standard Deviation	-	-	-					-		
					Variance	-	-	-					-		
		Total	186	100.00%											
3	4 Axle Single Tandem	Flat	1	14.29%	Min. Load	7.69	14.02	10.85	12.66				45.22		
					Max. Load	7.69	14.02	10.85	12.66				45.22		
					Avg. Load	7.69	14.02	10.85	12.66				45.22		
					Standard Deviation	-	-	-	-				-		
		Container	6	85.71%	Min. Load	2.60	4.75	3.68	4.29					15.32	
					Max. Load	10.39	18.94	14.66	17.11				61.09		
					Avg. Load	4.85	8.85	6.85	7.99				28.55		
					Standard Deviation	3.49	6.36	4.92	5.74				19.75		
					Variance	12.15	40.39	24.21	32.95				420.31		
				Total	7	100.00%									
		5	5 Axle Tandem Tandem	Flat	6	66.67%	Min. Load	2.47	4.17	3.79	3.98	4.55			18.97
							Max. Load	8.64	14.63	13.30	13.96	15.96			66.48
Avg. Load	7.36						12.45	11.32	11.89	13.58			56.60		
Standard Deviation	2.40						4.07	3.70	3.88	4.44			18.48		
Variance	5.77						16.54	13.67	15.07	19.68			341.65		
Full	2			22.22%	Min. Load	8.26	13.98	12.71	13.35	15.25				63.56	
					Max. Load	8.26	13.98	12.71	13.35	15.26			63.57		
					Avg. Load	8.26	13.98	12.71	13.35	15.26			63.57		
					Standard Deviation	0.00	0.00	0.00	0.00	0.00			0.01		
					Variance	0.00	0.00	0.00	0.00	0.00			0.00		
Covered	1			11.11%	Min. Load	8.23	13.93	12.67	13.30	15.20				63.33	
					Max. Load	8.23	13.93	12.67	13.30	15.20			63.33		
					Avg. Load	8.23	13.93	12.67	13.30	15.20			63.33		
					Standard Deviation	-	-	-	-	-			-		
		Total	9	100.00%											
6	6 Axle Tandem Tridem	Flat	61	83.56%	Min. Load	1.93	3.28	3.47	3.09	3.47	4.05		19.29		
					Max. Load	7.66	13.02	13.79	12.25	13.79	16.08		76.59		
					Avg. Load	6.56	11.15	11.80	10.49	11.80	13.77		65.56		
					Standard Deviation	0.88	1.50	1.58	1.41	1.58	1.85		8.80		
					Variance	0.77	2.24	2.51	1.98	2.51	3.41		77.36		
							Half	5	6.85%	Min. Load	6.30	10.72	11.35	10.09	11.35
		Max. Load	6.96	11.83	12.53	11.13				12.53	14.61		69.59		
		Avg. Load	6.72	11.42	12.09	10.74				12.09	14.10		67.15		
		Standard Deviation	0.24	0.41	0.44	0.39				0.44	0.51		2.44		
		Variance	0.06	0.17	0.19	0.15				0.19	0.26		5.96		
		Full	6	8.22%	Min. Load	2.47	4.20	4.44	3.95	4.44	5.18			24.69	
					Max. Load	8.01	13.61	14.41	12.81	14.41	16.81		80.07		
					Avg. Load	6.35	10.79	11.42	10.15	11.42	13.33		63.47		
					Standard Deviation	1.98	3.37	3.57	3.17	3.57	4.17		19.83		
					Variance	3.93	11.37	12.75	10.07	12.75	17.35		393.40		
							Covered	1	1.37%	Min. Load	6.87	11.69	12.37	11.00	12.37
		Max. Load	6.87	11.69	12.37	11.00				12.37	14.44		68.74		
		Avg. Load	6.87	11.69	12.37	11.00				12.37	14.44		68.74		
		Standard Deviation	-	-	-	-				-	-		-		
		Variance	-	-	-	-				-	-		-		
				Total	73	100.00%									

8.6.9 Distribution of Vehicles by Type on East Wharf

The percentage of vehicles with respect to Type i.e. Truck, Semi-Trailer and Tanker plying on KPT East-Wharf is tabulated in Table 8-48 and is graphically presented in

Figure 8-31.

Table 8-48: Percentage of Vehicles w.r.t Type on East Wharf

Sr. No.	Vehicle Type	Count	Percentage
1	Truck	187	67.51%
2	Semi-Trailer	90	32.49%
Total		277	100.00%

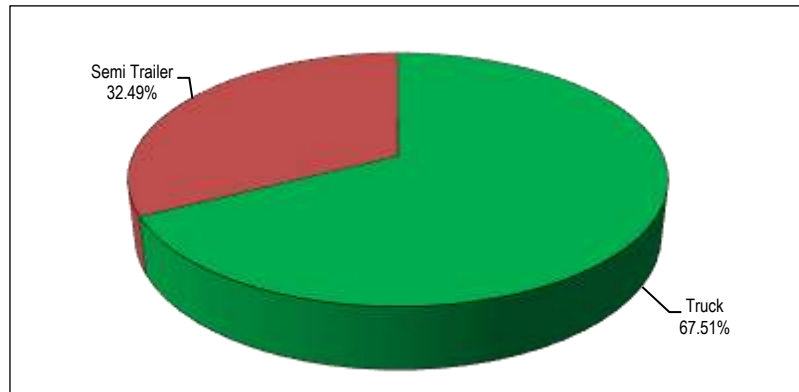


Figure 8-31: Percentage of Vehicles w.r.t Type on East Wharf

8.6.10 Analysis by Vehicle Type on East Wharf

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to truck type is presented in Table 8-49. The results depict that:

In case of **3 Axle Tandem**, truck type constitutes maximum percentage of 99.46%, with average gross load of 29.73 ton.

In case of **4 Axle Single Tandem**, semi-trailer type constitutes maximum percentage of 85.71%, with average gross load of 28.55 ton.

In case of **5 Axle Tandem Tandem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 58.90 ton.

In case of **6 Axle Tandem Tridem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 64.93 ton.

Table 8-49: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Type for major Axle Configuration on East Wharf

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Truck	1	100.00%	Min. Load	3.35	7.47					10.82
					Max. Load	3.35	7.47				10.82	
					Avg. Load	3.35	7.47				10.82	
					Standard Deviation	-	-				-	
					Variance	-	-				-	
Total		1	100.00%									
2	3 Axle Tandem	Truck	185	99.46%	Min. Load	2.22	3.94	3.94				10.09
					Max. Load	9.04	25.11	27.14			61.29	
					Avg. Load	6.52	11.60	11.61			29.73	
					Standard Deviation	0.90	1.86	1.94			4.65	
					Variance	0.82	3.46	3.78			21.63	
		Semi-Trailer	1	0.54%	Min. Load	6.39	11.33	11.33	0.00	0.00	29.05	
					Max. Load	6.39	11.33	11.33	0.00	0.00	29.05	
					Avg. Load	6.39	11.33	11.33	-	-	29.05	
					Standard Deviation	-	-	-	-	-	-	
					Variance	-	-	-	-	-	-	
Total		186	100.00%									
3	4 Axle Single Tandem	Semi-Trailer	6	85.71%	Min. Load	2.60	4.75	3.68	4.29	0.00	15.32	
					Max. Load	10.39	18.94	14.66	17.11	0.00	61.09	
					Avg. Load	4.85	8.85	6.85	7.99	-	28.55	
					Standard Deviation	3.49	-	4.92	5.74	0.00	20.50	
					Variance	12.15	40.39	24.21	32.95	0.00	420.31	
		Truck	1	14.29%	Min. Load	7.69	14.02	10.85	12.66	0.00	45.22	
					Max. Load	7.69	14.02	10.85	12.66	0.00	45.22	
					Avg. Load	7.69	14.02	10.85	12.66	-	45.22	
					Standard Deviation	-	-	-	-	-	-	
					Variance	-	-	-	-	-	-	

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
					Variance	-	-	-	-	-	-	-
		Total	7	100.00%								
4	5 Axle Tandem Tandem	Semi-Trailer	9	100.00%	Min. Load	2.47	4.17	3.79	3.98	4.55		18.97
					Max. Load	8.64	14.63	13.30	13.96	15.96		66.48
					Avg. Load	7.66	12.96	11.78	12.37	14.14		58.90
					Standard Deviation	1.95	3.30	3.00	3.15	3.60		15.01
					Variance	3.81	10.91	9.02	9.94	12.98		225.39
	Total	9	100.00%									
5	6 Axle Tandem Tridem	Semi-Trailer	74	100.00%	Min. Load	1.93	3.28	3.47	3.09	3.47	4.05	19.29
					Max. Load	8.01	13.61	14.41	12.81	14.41	16.81	80.07
					Avg. Load	6.49	11.04	11.69	10.39	11.69	13.63	64.93
					Standard Deviation	1.09	1.86	1.97	1.75	1.97	2.29	10.93
					Variance	1.19	3.45	3.87	3.06	3.87	5.27	119.42
	Total	74	100.00%									

8.6.11 Commodities carried by vehicles on East Wharf

The percentage of major commodities carried by heavy vehicles on KPT East Wharf is tabulated in Table 8-50 and is graphically presented in Figure 8-32. For the sake of analysis, each commodity is assigned a code; details are attached in Annex – 2.

Table 8-50: Percentage of Vehicle w.r.t Commodities on East Wharf

Sr. No.	Commodity Type	Code	Count	Percentage
1	Agriculture Items	100	132	47.65%
2	Food Items	200	3	1.08%
3	Bulk Manufactures	500	112	40.43%
4	Basic Manufactures	600	4	1.44%
5	Fuel, Lubricants (Minerals)	900	7	2.53%
6	Miscellaneous Goods not Classified	A00	8	2.89%
7	Empty	E00	11	3.97%
Total			277	100.00%

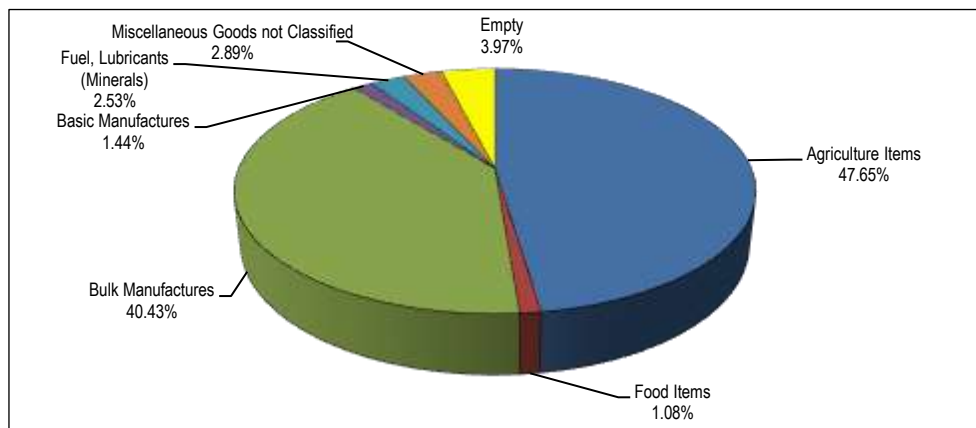


Figure 8-32: Percentage of Vehicles w.r.t Commodities on KPT East Wharf

8.6.12 Analysis based on Commodities on East Wharf

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to commodities carried by trucks is presented in Table 8-51. The results depict that:

Major commodities carried by **3 Axle Tandem** are agriculture items, covering 50% of the total, with average gross load of 29.99 ton, followed by bulk manufactures having percentage of 39.78% in total, with average gross load of 30.32 ton.

Major commodity carried by **5 Axle Tandem Tandem** is bulk manufactures, covering 88.89% of the total, with average gross load of 63.89 ton.

Major commodities carried by **6 Axle Tandem Tridem** are agriculture items, covering 52.70% of the total, with average gross load of 68.06 ton, followed by bulk manufactures, having percentage of 39.19% in total, with average gross load of 66.54

ton.

Table 8-51: Stdev. Var., Min., Max. & Avg. Load Comparison w.r.t Commodities for major Axle Configuration on East Wharf

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameter	Load (Tons)								
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total		
1	2 Axle Single	Empty	E00	1	100.00%	Min. Load	3.35	7.47					10.82		
						Max. Load	3.35	7.47					10.82		
						Avg. Load	3.35	7.47					10.82		
						Standard Deviation	-	-					-		
						Variance	-	-					-		
Total				1	100%										
2	3 Axle Tandem	Agriculture Items	100	93	50.00%	Min. Load	5.83	10.34	10.34				26.52		
						Max. Load	8.67	15.37	15.37				39.40		
						Avg. Load	6.60	11.70	11.70				29.99		
						Standard Deviation	0.33	0.58	0.58				1.49		
						Variance	0.11	0.34	0.34				2.21		
		Food Items	200	1	0.54%	Min. Load	8.82	15.64	15.64				40.10		
						Max. Load	8.82	15.64	15.64				40.10		
						Avg. Load	8.82	15.64	15.64				40.10		
						Standard Deviation	-	-	-				-		
		Bulk Manufactures	500	74	39.78%	Min. Load	6.09	10.80	10.80				27.70		
						Max. Load	7.02	12.44	12.44				31.91		
						Avg. Load	6.67	11.82	11.82				30.32		
						Standard Deviation	0.17	0.31	0.31				0.79		
		Basic Manufactures	600	4	2.15%	Min. Load	6.88	12.20	12.20				31.29		
						Max. Load	9.04	25.11	27.14				61.29		
						Avg. Load	7.85	16.19	16.70				40.74		
						Standard Deviation	1.04	6.07	7.06				14.04		
		Fuel, Lubricants (Minerals)	900	7	3.76%	Min. Load	6.18	10.96	10.96				28.09		
						Max. Load	6.98	12.37	12.37				31.73		
						Avg. Load	6.84	12.13	12.13				31.11		
						Standard Deviation	0.29	0.52	0.52				1.34		
		Miscellaneous Goods not Classified	A00	1	0.54%	Min. Load	2.26	4.01	4.01				10.27		
						Max. Load	2.26	4.01	4.01				10.27		
						Avg. Load	2.26	4.01	4.01				10.27		
						Standard Deviation	-	-	-				-		
		Empty	E00	6	3.23%	Min. Load	2.22	3.94	3.94				10.09		
						Max. Load	2.78	4.93	4.93				12.65		
						Avg. Load	2.42	4.29	4.29				10.99		
						Standard Deviation	0.26	0.47	0.47				1.20		
		Total				186	100.00%								
		3	4 Axle Single Tandem	Food Items	200	2	28.57%	Min. Load	8.13	14.82	11.47	13.39			47.81
								Max. Load	10.39	18.94	14.66	17.11			61.09
Avg. Load	9.26							16.88	13.07	15.25			54.45		
Standard Deviation	1.60							2.91	2.25	2.63			9.39		
Variance	2.55							8.47	5.08	6.91			88.18		
Bulk Manufactures	500			1	14.29%	Min. Load	7.69	14.02	10.85	12.66			45.22		
						Max. Load	7.69	14.02	10.85	12.66			45.22		
						Avg. Load	7.69	14.02	10.85	12.66			45.22		
						Standard Deviation	-	-	-	-			-		
Empty	E00			4	57.14%	Min. Load	2.60	4.75	3.68	4.29			15.32		
						Max. Load	2.70	4.93	3.82	4.45			15.91		
						Avg. Load	2.65	4.83	3.74	4.37			15.59		
						Standard Deviation	0.04	0.08	0.06	0.07			0.25		
Total				7	100.00%										
4	5 Axle Tandem Tandem	Bulk Manufactures	500	8	88.89%	Min. Load	8.14	13.77	12.52	13.14	15.02		62.59		
						Max. Load	8.64	14.63	13.30	13.96	15.96		66.48		
						Avg. Load	8.31	14.06	12.78	13.42	15.33		63.89		
						Standard Deviation	0.15	0.26	0.24	0.25	0.28		1.18		
						Variance	0.02	0.07	0.06	0.06	0.08		1.38		
		Miscellaneous Goods not Classified	A00	1	11.11%	Min. Load	2.47	4.17	3.79	3.98	4.55		18.97		
						Max. Load	2.47	4.17	3.79	3.98	4.55		18.97		
						Avg. Load	2.47	4.17	3.79	3.98	4.55		18.97		
						Standard Deviation	-	-	-	-	-		-		
Total				9	100.00%										
5	6 Axle Tandem Tridem	Agriculture Items	100	39	52.70%	Min. Load	6.36	10.82	11.46	10.18	11.46	13.36	63.64		
						Max. Load	8.01	13.61	14.41	12.81	14.41	16.81	80.07		
						Avg. Load	6.81	11.57	12.25	10.89	12.25	14.29	68.06		
						Standard Deviation	0.27	0.46	0.48	0.43	0.48	0.56	2.68		

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameter	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
						Variance	0.07	0.21	0.23	0.18	0.23	0.32	7.18
		Bulk Manufactures	500	29	39.19%	Min. Load	6.13	10.42	11.03	9.80	11.03	12.87	61.28
						Max. Load	7.54	12.82	13.57	12.06	13.57	15.83	75.40
						Avg. Load	6.65	11.31	11.98	10.65	11.98	13.97	66.54
						Standard Deviation	0.27	0.46	0.48	0.43	0.48	0.56	2.69
						Variance	0.07	0.21	0.23	0.18	0.23	0.32	7.21
		Miscellaneous Goods not Classified	A00	6	8.11%	Min. Load	1.93	3.28	3.47	3.09	3.47	4.05	19.29
						Max. Load	6.95	11.82	12.51	11.12	12.51	14.60	69.51
						Avg. Load	3.68	6.25	6.62	5.88	6.62	7.72	36.76
						Standard Deviation	2.46	4.18	4.43	3.93	4.43	5.16	24.59
						Variance	6.05	17.48	19.59	15.48	19.59	26.67	604.77
		Total		74	100.00%								

8.6.13 Damage Factor for major Axle Configuration on East Wharf

The average damage factors calculated for major axle configuration are presented in Table 8-52.

Table 8-52: Damage Factor for major Axle Configuration on East Wharf

Sr. No.	Axle Configuration	Code	Damage Factor (2020)	
			Road Note 40	AASHTO 1993
1	2 Axle Single	1.2	0.67	0.66
2	3 Axle Tandem	1.22	12.54	6.85
3	4 Axle Single Tandem	1.2-22	19.90	10.92
4	5 Axle Tandem Tandem	1.22-22	40.65	20.40
5	6 Axle Tandem Tridem	1.22-222	30.46	13.43

8.7 Port Bin Qasim (PBQ)

The results of axle load survey performed on PQ and PIBT of PBQ are discussed in subsequent sections.

8.8 Port Qasim (PQ)

The results of axle load survey performed on PQ of PBQ are discussed in subsequent sub-sections.

8.8.1 Distribution of Vehicles by Axle Configuration on PQ

The percentage of trucks for major axle configurations surveyed on PQ is summarized in Table 8-53 and is graphically presented in Figure 8-33.

Table 8-53: Percentage of Vehicle w.r.t Axle Configuration on PQ

Sr. No.	Axle Configuration	Code	Total Number of Trucks	Percentage
1	2 Axle Single	1.2	3	1.68%
2	3 Axle Tandem	1.22	72	40.22%
3	4 Axle Single Tandem	1.2-22	60	33.52%
4	5 Axle Single Tridem	1.2-222	4	2.23%
5	6 Axle Tandem Tridem	1.22-222	39	21.79%
6	Others	-	1	0.56%
Total			179	100%

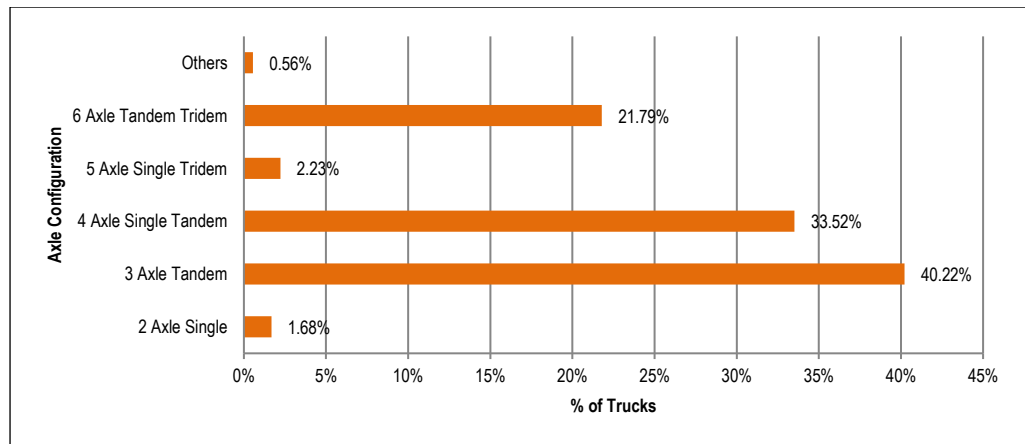


Figure 8-33: Percentage of Vehicles w.r.t Axle Configuration on PQ

8.8.2 Analysis by Axle Configuration on PQ

The analysis comprising minimum, maximum and average loads per axle carried by trucks on PQ along with standard deviation and variance is presented in Table 8-54. The minimum, maximum and average loads are graphically presented in Figure 8-34 and Figure 8-35 respectively.

In case of **2 Axle Single** trucks, maximum load of 20.02 ton with average load of 19.02 ton was recorded.

In case of **3 Axle Tandem**, maximum load of 54.66 ton with average load of 35.37 ton was recorded.

In case of **4 Axle Single Tandem**, maximum load of 52.64 ton with average load of 41.85 ton was recorded.

In case of **5 Axle Single Tridem**, maximum load of 64.57 ton with average load of 57.08 ton was recorded.

In case of **6 Axle Tandem Tridem**, maximum load of 99.99 ton with average load of 83.74 ton was recorded.

Table 8-54: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Axle Configuration on PQ

Sr. No.	Axle Configuration	Permissible Load Limits	Parameters	Load (Tons)							
				Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total	
1	2 Axle Single	17.5	Min. Load	4.72	12.74						18.10
			Max. Load	5.36	15.30						20.02
			Avg. Load	5.01	14.01						19.02
			Standard Deviation	0.32	1.28						0.96
			Variance	0.11	1.64						0.93
2	3 Axle Tandem	27.5	Min. Load	2.58	4.11	4.57					11.72
			Max. Load	12.03	21.32	21.32					54.66
			Avg. Load	7.37	13.44	14.47					35.37
			Standard Deviation	2.40	4.06	3.80					10.21
			Variance	5.75	16.47	14.41					104.22
3	4 Axle Single Tandem	39.5	Min. Load	2.97	3.61	3.89	4.10				14.57
			Max. Load	9.08	15.93	17.84	19.13				52.64
			Avg. Load	6.23	11.24	11.72	13.24				41.85
			Standard Deviation	1.36	2.43	2.29	2.47				6.63
			Variance	1.86	5.89	5.24	6.09				43.97
4	5 Axle Single Tridem	48.5	Min. Load	5.84	9.12	10.55	11.06	12.31			50.58
			Max. Load	8.39	14.85	12.91	14.41	14.98			64.57
			Avg. Load	7.07	11.48	11.34	13.33	13.86			57.08
			Standard Deviation	1.05	2.59	1.11	1.56	1.29			5.75
			Variance	1.11	6.71	1.22	2.42	1.66			33.02
5	6 Axle Tandem Tridem	58.5	Min. Load	2.12	3.60	3.82	3.39	3.82	4.45		21.20
			Max. Load	10.00	17.00	18.00	16.42	18.00	21.00		99.99
			Avg. Load	8.35	13.96	14.90	13.68	15.26	17.56		83.74
			Standard Deviation	1.56	2.64	2.68	2.24	2.50	2.98		14.25
			Variance	2.42	6.97	7.20	5.02	6.25	8.86		202.95

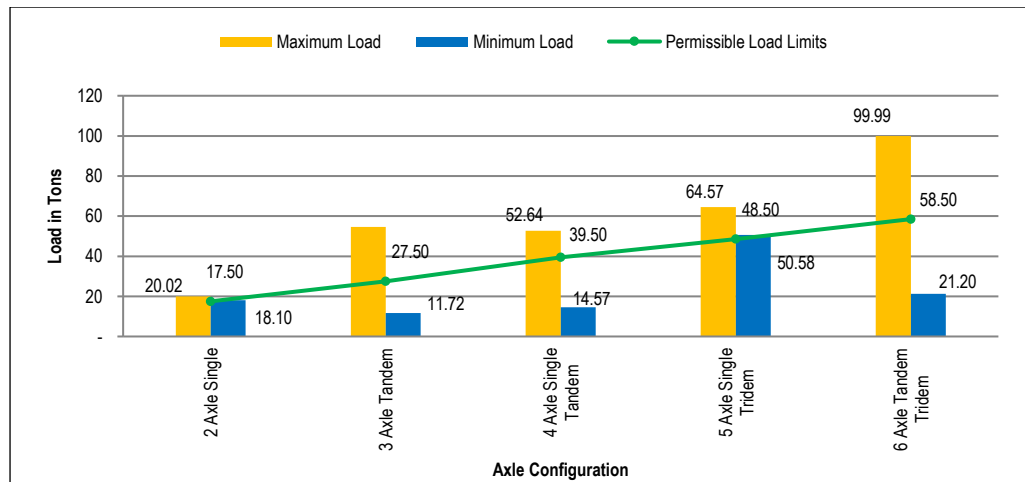


Figure 8-34: Min. & Max. Load Comparison w.r.t Axle Configuration on PQ

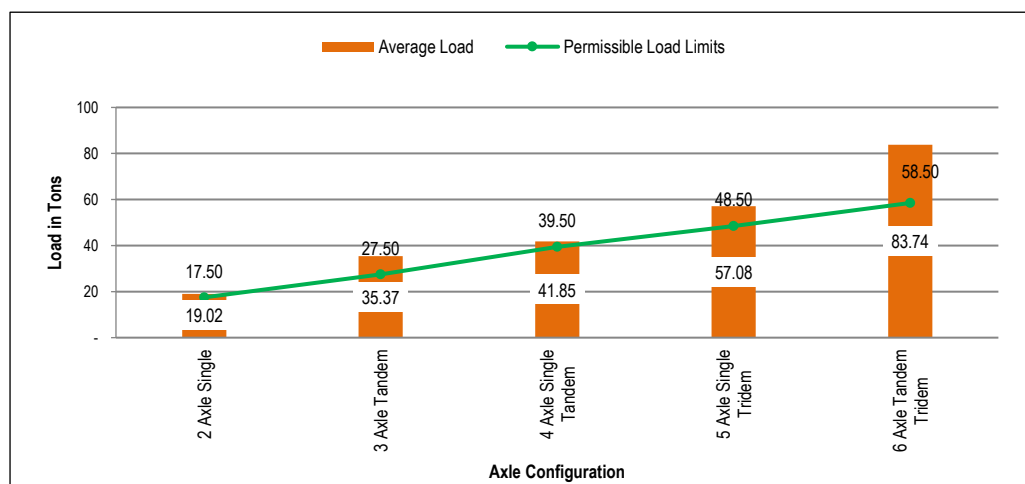


Figure 8-35: Avg. Load Comparison w.r.t Axle Configuration on PQ

8.8.3 Load Spectrum by Axle Configuration on PQ

The major cause of pavement failure is due to excessive overloading. The axle load survey data was organized in a way to identify the number of vehicles carrying load above and below permissible limits. Furthermore, load spectrums were identified and number of vehicles carrying load in specified spectrums were calculated. The results are tabulated in Table 8-55 which illustrates that:

In case of **2 Axle Single**, 100% of the trucks carried load above permissible load limits.

In case of **3 Axle Tandem**, 19.44% of trucks were carrying loads under permissible limits. Whereas, 68.06% of the trucks carried more than 15% of permissible load limits.

In case of **4 Axle Single Tandem**, 20% of trucks/semi-trailers were carrying loads under permissible limits. Whereas, 23.33% of the trucks/semi-trailers carried load more than 15% of permissible load limits.

In case of **5 Axle Single Tridem**, 100% of the semi-trailers carried load above permissible load limits.

In case of **6 Axle Tandem Tridem**, 2.56% of semi-trailers were carrying loads under permissible limits. Whereas, 94.87% semi-trailers carried load more than 15% of permissible load limits

The percentage of trucks for major axle configuration carrying load above and below permissible limits on PQ is graphically presented in Figure 8-36.

Table 8-55: Load Spectrum w.r.t Axle Configuration on PQ

Sr. No.	Axle Configuration	Under Permissible Limit	Over Permissible Limit					Total	
			15.00%	30.00%	50.00%	75.00%	>75%		
1	2 Axle Single	Max. Load (Tons)	17.5	20.1	22.8	26.3	30.6		
		Average Load (Tons)	-	19.02	-	-	-	-	
		No. of Trucks	0	3	0	0	0	0	3
		Percentage	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	0.00%	100.00%	100.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
2	3 Axle Tandem	Max. Load (Tons)	27.5	31.6	35.8	41.3	48.1		
		Average Load (Tons)	21.52	29.89	33.93	38.67	42.79	52.40	
		No. of Trucks	14	9	21	12	4	12	72
		Percentage	19.44%	12.50%	29.17%	16.67%	5.56%	16.67%	100%
		Cumulative Percentage	19.44%	31.94%	61.11%	77.78%	83.33%	100.00%	
		Percentage above Range Value	80.56%	68.06%	38.89%	22.22%	16.67%	0.00%	
3	4 Axle Single Tandem	Max. Load (Tons)	39.5	45.4	51.4	59.3	69.1		
		Average Load (Tons)	31.76	42.72	48.07	52.64	-	-	
		No. of Trucks	12	34	13	1	0	0	60
		Percentage	20.00%	56.67%	21.67%	1.67%	0.00%	0.00%	100%
		Cumulative Percentage	20.00%	76.67%	98.33%	100.00%	100.00%	100.00%	
		Percentage above Range Value	80.00%	23.33%	1.67%	0.00%	0.00%	0.00%	
4	5 Axle Single Tridem	Max. Load (Tons)	48.5	55.8	63.1	72.8	84.9		
		Average Load (Tons)	-	50.58	56.58	64.57	-	-	
		No. of Trucks	0	1	2	1	0	0	4
		Percentage	0.00%	25.00%	50.00%	25.00%	0.00%	0.00%	100%
		Cumulative Percentage	0.00%	25.00%	75.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	100.00%	75.00%	25.00%	0.00%	0.00%	0.00%	
5	6 Axle Tandem Tridem	Max. Load (Tons)	58.5	67.3	76.1	87.8	102.4		
		Average Load (Tons)	21.20	66.48	71.77	82.74	96.79	-	
		No. of Trucks	1	1	6	18	13	0	39
		Percentage	2.56%	2.56%	15.38%	46.15%	33.33%	0.00%	100%
		Cumulative Percentage	2.56%	5.13%	20.51%	66.67%	100.00%	100.00%	
		Percentage above Range Value	97.44%	94.87%	79.49%	33.33%	0.00%	0.00%	

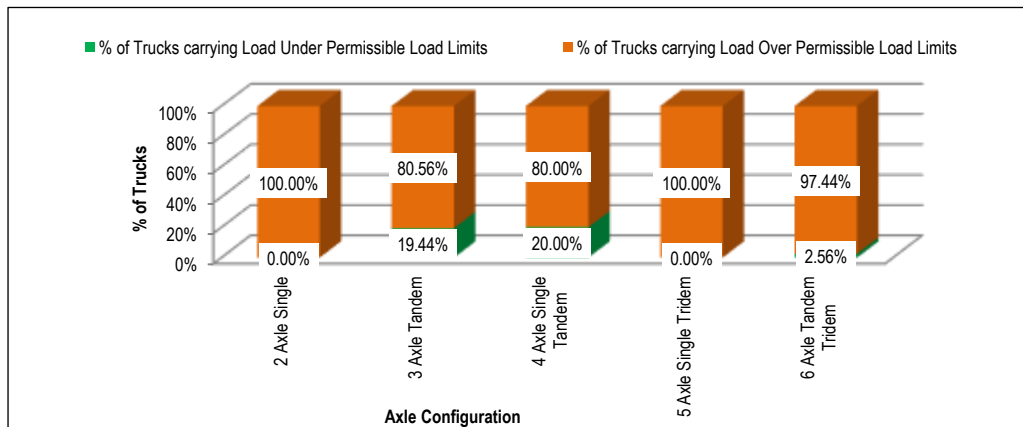


Figure 8-36: Percentage of Vehicles carrying Load above and below Permissible Limits on PQ

8.8.4 Front & Rear Axle Load Spectrum on PQ

The spectrum of front and rear axle loads for major axle configurations is presented in Table 8-56.

Table 8-56: Front & Rear Axle Load Spectrum on PQ

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
Front Axle Load Spectrum					
1	0 - 2.99	5	2.81%	2.81%	97.19%
2	3 - 5.49	33	18.54%	21.35%	78.65%
3	5.5 - 6.99	43	24.16%	45.51%	54.49%
4	7 - 8.99	66	37.08%	82.58%	17.42%

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
5	9 - 10.99	21	11.80%	94.38%	5.62%
6	11 - 12.99	10	5.62%	100.00%	0.00%
7	13 - 14.99	0	0.00%	100.00%	0.00%
8	15 - 16.99	0	0.00%	100.00%	0.00%
9	17 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Single)					
1	0 - 8.16	23	4.28%	4.28%	95.72%
2	8.17 - 9.99	25	4.65%	8.92%	91.08%
3	10 - 10.99	46	8.55%	17.47%	82.53%
4	11 - 11.99	52	9.67%	27.14%	72.86%
5	12 - 12.99	70	13.01%	40.15%	59.85%
6	13 - 13.99	79	14.68%	54.83%	45.17%
7	14 - 14.99	77	14.31%	69.14%	30.86%
8	15 - 19.99	138	25.65%	94.80%	5.20%
9	20 & Above	28	5.20%	100.00%	0.00%
Rear Axle Load Spectrum (Tandem)					
1	0 - 11.99	6	3.51%	3.51%	96.49%
2	12 - 14.99	0	0.00%	3.51%	96.49%
3	15 - 19.99	7	4.09%	7.60%	92.40%
4	20 - 21.99	13	7.60%	15.20%	84.80%
5	22 - 23.99	20	11.70%	26.90%	73.10%
6	24 - 25.99	23	13.45%	40.35%	59.65%
7	26 - 27.99	30	17.54%	57.89%	42.11%
8	28 - 29.99	31	18.13%	76.02%	23.98%
9	30 & Above	41	23.98%	100.00%	0.00%
Rear Axle Load Spectrum (Tridem)					
1	0 - 14.99	0	0.00%	0.00%	100.00%
2	15 - 30.99	9	75.00%	75.00%	25.00%
3	31 - 32.99	2	16.67%	91.67%	8.33%
4	33 - 34.99	1	8.33%	100.00%	0.00%
5	35 - 36.99	0	0.00%	100.00%	0.00%
6	37 - 38.99	0	0.00%	100.00%	0.00%
7	39 - 40.99	0	0.00%	100.00%	0.00%
8	41 - 42.99	0	0.00%	100.00%	0.00%
9	43 & Above	0	0.00%	100.00%	0.00%

8.8.5 Distribution of Vehicles by Make Type on PQ

The distribution of trucks as per make type is illustrated in Table 8-57 and is graphically presented in Figure 8-37. The results depict that Hino and Nissan have maximum percentage of 50.85% and 33.90% on PQ.

Table 8-57: Percentage of Vehicles w.r.t Make Type on PQ

Sr. No.	Make	Count	%age
1	Bedford	3	1.69%
2	Nissan	60	33.90%
3	Hino	90	50.85%
4	Isuzu	6	3.39%
5	UD	14	7.91%
6	others	4	2.26%
Total		177	100.00%

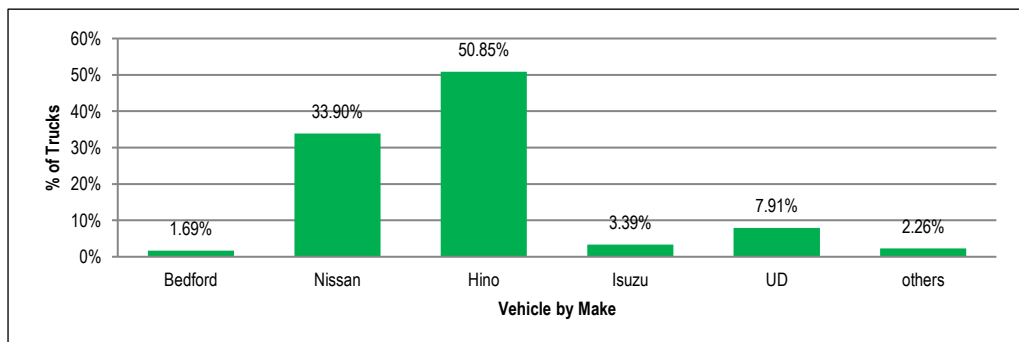


Figure 8-37: Percentage of Vehicles w.r.t Make Type on PQ

8.8.6 Analysis by Make Type on PQ

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to make type is presented in Table 8-58. The results depict that:

In case of **2 Axle Single**, Bedford constitutes maximum percentage of 100%, with average gross load of 19.02 ton.

In case of **3 Axle Tandem**, Hino constitutes maximum percentage of 71.83%, with average gross load of 34.62 ton, followed by Nissan with percentage of 18.31%, carrying average gross load of 38.91 ton.

In case of **4 Axle Single Tandem**, Nissan constitutes maximum percentage of 56.67% with average gross load of 42.50 ton, followed by Hino with percentage of 30%, carrying average gross load of 39.67 ton.

In case of **5 Axle Single Tridem**, Nissan constitutes maximum percentage of 50%, with average gross load of 60.42 ton.

In case of **6 Axle Tandem Tridem**, Hino constitutes maximum percentage of 51.28%, with average gross load of 88.06 ton, followed by Nissan with percentage of 28.21%, carrying average gross load of 74.62 ton.

Table 8-58: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Make Type for major Axle Configuration on PQ

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Bedford	3	100.00%	Min. Load	4.72	12.74					18.10
					Max. Load	5.36	15.30				20.02	
					Avg. Load	5.01	14.01				19.02	
					Standard Deviation	0.32	1.28				0.96	
					Variance	0.11	1.64				0.93	
		Total	3	100.00%								
2	3 Axle Tandem	Hino	51	71.83%	Min. Load	2.58	4.11	4.57				11.72
					Max. Load	12.03	21.32	21.32			54.66	
					Avg. Load	7.12	13.17	14.18			34.62	
					Standard Deviation	2.27	3.75	3.55			9.60	
					Variance	5.14	14.03	12.60			92.07	
		Isuzu	2	2.82%	Min. Load	2.89	5.12	5.12			13.12	
					Max. Load	5.31	9.78	11.31			26.40	
					Avg. Load	4.10	7.45	8.21			19.76	
					Standard Deviation	1.71	3.30	4.38			9.39	
					Variance	2.94	10.87	19.18			88.18	
		Nissan	13	18.31%	Min. Load	4.36	9.65	10.60			24.61	
					Max. Load	11.87	21.04	21.04			53.95	
					Avg. Load	8.34	14.72	15.85			38.91	
					Standard Deviation	2.25	3.95	3.52			9.45	
					Variance	5.08	15.63	12.37			89.34	
		UD	4	5.63%	Min. Load	5.31	6.78	8.97			21.06	
					Max. Load	11.08	19.65	19.65			50.38	
					Avg. Load	8.46	14.16	15.26			37.63	
					Standard Deviation	2.89	6.24	5.05			14.31	
					Variance	8.33	38.97	25.49			204.89	
		Others	1	1.41%	Min. Load	11.68	20.71	20.71			53.09	
					Max. Load	11.68	20.71	20.71			53.09	
					Avg. Load	11.68	20.71	20.71			53.09	
					Standard Deviation	-	-	-			-	
Variance	-				-	-			-			
Total	71	100.00%										
3	4 Axle Single Tandem	Hino	18	30.00%	Min. Load	2.99	4.20	8.82	10.28			26.99
					Max. Load	8.66	13.80	13.29	17.29		49.68	
					Avg. Load	6.10	10.36	10.61	12.60		39.67	
					Standard Deviation	1.58	2.61	1.17	1.98		5.46	
					Variance	2.50	6.81	1.37	3.90		29.77	
		Isuzu	1	1.67%	Min. Load	4.95	11.19	13.74	14.51		44.59	
					Max. Load	4.95	11.19	13.74	14.51		44.59	
					Avg. Load	4.95	11.19	13.74	14.51		44.59	
					Standard Deviation	-	-	-	-		-	
					Variance	-	-	-	-		-	
		Nissan	34	56.67%	Min. Load	2.97	3.61	3.89	4.10		14.57	
					Max. Load	9.08	15.60	17.84	19.13		52.64	
					Avg. Load	6.21	11.69	12.19	13.42		42.50	

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
		UD	7	11.67%	Standard Deviation	1.29	2.34	2.74	2.87			7.45
					Variance	1.66	5.49	7.53	8.23			55.54
					Min. Load	5.21	9.12	11.20	12.10			37.63
					Max. Load	8.73	15.93	13.20	15.98			51.38
					Avg. Load	6.86	11.25	12.00	13.84			43.97
					Standard Deviation	1.11	2.22	0.68	1.20			4.41
					Variance	1.24	4.93	0.46	1.44			19.41
Total	60	100.00%										
4	5 Axle Single Tridem	Hino	1	25.00%	Min. Load	6.84	9.82	10.55	11.06	12.31		50.58
					Max. Load	6.84	9.82	10.55	11.06	12.31		50.58
					Avg. Load	6.84	9.82	10.55	11.06	12.31		50.58
					Standard Deviation	-	-	-	-	-		-
					Variance	-	-	-	-	-		-
		Nissan	2	50.00%	Min. Load	5.84	12.14	10.59	13.56	13.28		56.26
					Max. Load	8.39	14.85	12.91	14.41	14.85		64.57
					Avg. Load	7.12	13.50	11.75	13.98	14.07		60.42
					Standard Deviation	1.81	1.92	1.64	0.60	1.11		5.88
					Variance	3.26	3.68	2.70	0.36	1.23		34.53
		UD	1	25.00%	Min. Load	7.21	9.12	11.30	14.28	14.98		56.89
					Max. Load	7.21	9.12	11.30	14.28	14.98		56.89
					Avg. Load	7.21	9.12	11.30	14.28	14.98		56.89
					Standard Deviation	-	-	-	-	-		-
Variance	-	-	-	-	-		-					
Total	4	100.00%										
5	6 Axle Tandem Tridem	Hino	20	51.28%	Min. Load	7.03	11.96	12.66	11.25	12.66	14.77	70.33
					Max. Load	10.00	17.00	18.00	16.00	18.00	21.00	99.99
					Avg. Load	8.81	14.97	15.85	14.09	15.85	18.49	88.06
					Standard Deviation	1.05	1.78	1.89	1.68	1.89	2.20	10.48
					Variance	1.10	3.17	3.56	2.81	3.56	4.84	109.81
		Isuzu	3	7.69%	Min. Load	8.42	14.31	15.15	13.47	15.15	17.68	84.19
					Max. Load	9.84	16.72	17.70	15.74	17.70	20.66	98.36
					Avg. Load	9.34	15.89	16.82	14.95	16.82	19.62	93.44
					Standard Deviation	0.80	1.36	1.44	1.28	1.44	1.68	8.02
					Variance	0.64	1.86	2.08	1.65	2.08	2.84	64.30
		Nissan	11	28.21%	Min. Load	2.12	3.60	3.82	3.39	3.82	4.45	21.20
					Max. Load	9.73	14.88	15.76	16.42	16.99	18.38	87.54
					Avg. Load	7.47	11.89	12.91	12.73	13.95	15.58	74.62
					Standard Deviation	2.06	3.21	3.39	3.37	3.57	3.94	18.96
					Variance	4.26	10.30	11.51	11.33	12.74	15.54	359.45
		UD	2	5.13%	Min. Load	5.11	9.72	11.31	12.42	13.20	14.72	66.48
					Max. Load	8.00	13.60	14.40	12.80	14.40	16.80	79.98
					Avg. Load	6.55	11.66	12.85	12.61	13.80	15.76	73.23
					Standard Deviation	2.04	2.74	2.18	0.27	0.85	1.47	9.55
		Variance	4.17	7.51	4.76	0.07	0.72	2.15	91.13			
		Others	3	7.69%	Min. Load	8.55	13.91	14.54	13.68	15.38	16.67	83.66
					Max. Load	9.06	14.93	15.81	14.05	15.81	18.44	87.82
					Avg. Load	8.80	14.46	15.24	13.90	15.57	17.69	85.65
					Standard Deviation	0.26	0.51	0.65	0.20	0.22	0.91	2.09
					Variance	0.07	0.26	0.42	0.04	0.05	0.84	4.35
		Total	39	100.00%								

8.8.7 Distribution of Vehicles by Body Type on PQ

The percentage of vehicles with respect to Body Type i.e. Flat, Half, Full & Container plying on PQ is tabulated in Table 8-59 and is graphically presented in Figure 8-38.

Table 8-59: Percentage of Vehicles w.r.t Body Type on PQ

Sr. No.	Body Type	Count	%age
1	Flat	46	26.29%
2	Half	11	6.29%
3	Full	20	11.43%
4	Covered	1	0.57%
5	Container	97	55.43%
Total		175	100.00%

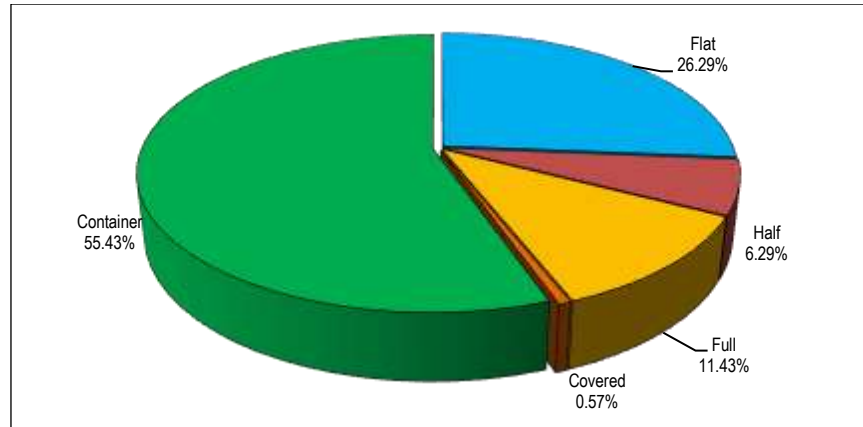


Figure 8-38 : Percentage of Vehicles w.r.t Body Type on PQ

8.8.8 Analysis by Body Type on PQ

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to body type is presented in Table 8-60. The results depict that:

In case of **2 Axle Single**, container body type constitutes maximum percentage of 100%, carrying average gross load of 19.02 ton.

In case of **3 Axle Tandem**, container body type constitutes maximum percentage of 38.03%, with average gross load of 29.96 ton, followed by flat body type with percentage of 33.80%, carrying average gross load of 34.94 ton.

In case of **4 Axle Single Tandem**, container body type constitutes maximum percentage of 95%, with average gross load of 41.64 ton.

In case of **5 Axle Single Tridem**, container body type constitutes maximum percentage of 100%, carrying average gross load of 57.08 ton.

In case of **6 Axle Tandem Tridem**, flat body type constitutes maximum percentage of 56.76%, with average gross load of 83.01 ton, followed by half body type with percentage of 24.32%, carrying average gross load of 94.28 ton.

Table 8-60: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Body Type for major Axle Configuration on PQ

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)					Total	
						Front	Rear 1	Rear 2	Rear 3	Rear 4		Rear 5
1	2 Axle Single	Container	3	100.00%	Min. Load	4.72	12.74					18.10
					Max. Load	5.36	15.30				20.02	
					Avg. Load	5.01	14.01				19.02	
					Standard Deviation	0.32	1.28				0.96	
					Variance	0.11	1.64				0.93	
		Total	3	100.00%								
2	3 Axle Tandem	Flat	24	33.80%	Min. Load	2.58	4.57	4.57				11.72
					Max. Load	11.39	20.19	20.19			51.78	
					Avg. Load	7.50	13.58	13.90			34.94	
					Standard Deviation	1.91	3.29	3.37			8.43	
					Variance	3.64	10.81	11.33			71.09	
		Half	1	1.41%	Min. Load	7.56	13.40	13.40			34.35	
					Max. Load	7.56	13.40	13.40			34.35	
					Avg. Load	7.56	13.40	13.40			34.35	
					Standard Deviation	-	-	-			-	
		Full	19	26.76%	Min. Load	3.15	4.11	4.66			12.02	
					Max. Load	12.03	21.32	21.32			54.66	
					Avg. Load	9.17	16.70	17.44			43.82	
					Standard Deviation	3.00	4.90	4.43			11.74	
					Variance	8.98	24.00	19.64			137.94	
		Container	27	38.03%	Min. Load	2.89	5.12	5.12			13.12	
					Max. Load	9.26	15.61	18.94			43.41	
					Avg. Load	6.05	11.05	12.94			29.96	
					Standard Deviation	1.41	2.25	2.55			6.57	
					Variance	1.98	5.07	6.49			43.17	

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
		Total	71	100.00%								
3	4 Axle Single Tandem	Flat	1	1.67%	Min. Load	9.08	15.59	17.84	19.13			52.64
					Max. Load	9.08	15.59	17.84	19.13			52.64
					Avg. Load	9.08	15.59	17.84	19.13			52.64
					Standard Deviation	-	-	-	-			-
					Variance	-	-	-	-			-
		Half	1	1.67%	Min. Load	6.51	14.11	16.54	17.91			35.07
					Max. Load	6.51	14.11	16.54	17.91			35.07
					Avg. Load	6.51	14.11	16.54	17.91			35.07
					Standard Deviation	-	-	-	-			-
					Variance	-	-	-	-			-
		Covered	1	1.67%	Min. Load	8.55	15.60	12.08	14.09			50.32
					Max. Load	8.55	15.60	12.08	14.09			50.32
					Avg. Load	8.55	15.60	12.08	14.09			50.32
					Standard Deviation	-	-	-	-			-
					Variance	-	-	-	-			-
		Container	57	95.00%	Min. Load	2.97	3.61	3.89	4.10			14.57
Max. Load	8.73				15.93	15.11	17.29			51.38		
Avg. Load	6.14				11.03	11.52	13.04			41.64		
Standard Deviation	1.31				2.31	2.10	2.31			-		
Variance	1.70				5.33	4.39	5.36			42.10		
		Total	60	100.00%								
4	5 Axle Single Tridem	Container	4	100.00%	Min. Load	5.84	9.12	10.55	11.06	12.31		50.58
					Max. Load	8.39	14.85	12.91	14.41	14.98		64.57
					Avg. Load	7.07	11.48	11.34	13.33	13.86		57.08
					Standard Deviation	1.05	2.59	1.11	1.56	1.29		5.75
					Variance	1.11	6.71	1.22	2.42	1.66		33.02
		Total	4	100.00%								
5	6 Axle Tandem Tridem	Flat	21	56.76%	Min. Load	2.12	3.60	3.82	3.39	3.82	4.45	21.20
					Max. Load	9.86	16.76	17.75	16.42	17.75	20.70	98.59
					Avg. Load	8.30	13.99	14.87	13.43	15.02	17.36	83.01
					Standard Deviation	1.59	2.71	2.84	2.62	2.88	3.32	15.83
					Variance	2.53	7.32	8.09	6.88	8.30	11.03	250.44
		Half	9	24.32%	Min. Load	8.42	10.09	11.52	12.70	13.41	15.06	72.51
					Max. Load	10.00	17.00	18.00	16.00	18.00	21.00	99.99
					Avg. Load	9.70	15.78	16.80	15.21	17.01	19.78	94.28
					Standard Deviation	0.50	2.30	2.17	1.23	1.62	2.06	9.57
					Variance	0.25	5.27	4.73	1.52	2.63	4.23	91.49
		Full	1	2.70%	Min. Load	8.00	13.60	14.40	12.80	14.40	16.80	79.98
					Max. Load	8.00	13.60	14.40	12.80	14.40	16.80	79.98
					Avg. Load	8.00	13.60	14.40	12.80	14.40	16.80	79.98
					Standard Deviation	-	-	-	-	-	-	-
					Variance	-	-	-	-	-	-	-
		Container	6	16.22%	Min. Load	5.11	9.72	11.31	11.59	13.04	14.72	66.48
					Max. Load	8.04	12.65	-	14.84	15.11	16.53	77.67
					Avg. Load	6.79	11.53	12.59	12.90	14.11	15.53	73.45
					Standard Deviation	1.09	1.07	0.76	1.19	0.99	0.65	4.17
					Variance	1.19	1.14	0.58	1.43	0.98	0.43	17.40
		Total	37	100.00%								

8.8.9 Distribution of Vehicles by Type on PQ

The percentage of vehicles with respect to Type i.e. Truck, Semi-Trailer and Tanker plying on PQ is tabulated in Table 8-61 and is graphically presented in Figure 8-39.

Table 8-61: Percentage of Vehicles w.r.t Type on PQ

Sr. No.	Vehicle Type	Count	Percentage
1	Truck	75	42.37%
2	Semi-Trailer	102	57.63%
	Total	177	100.00%

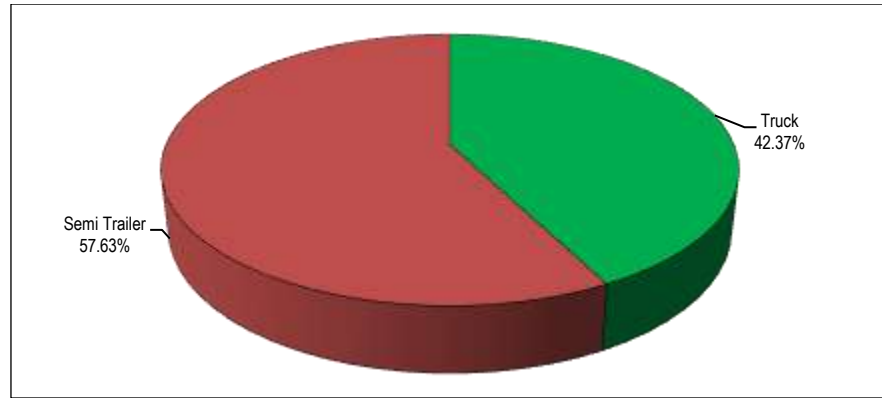


Figure 8-39: Percentage of Vehicles w.r.t Type on PQ

8.8.10 Analysis by Vehicle Type on PQ

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to truck type is presented in Table 8-62. The results depict that:

In case of **2 Axle Single**, truck constitutes maximum percentage of 100%, with average gross load of 19.02 ton.

In case of **3 Axle Tandem**, truck constitutes maximum percentage of 98.59%, with average gross load of 35.44 ton.

In case of **4 Axle Single Tandem**, semi-trailer constitutes maximum percentage of 96.67%, with average gross load of 41.91 ton, followed by truck having percentage of 3.33% with average gross load of 40.19 ton.

In case of **5 Axle Single Tridem**, semi-trailer constitutes maximum percentage of 100%, with average gross load of 57.08 ton.

In case of **6 Axle Tandem Tridem**, semi-trailer constitutes maximum percentage of 100%, with average gross load of 83.74 ton.

Table 8-62: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Type for major Axle Configuration on PQ

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Truck	3	100.00%	Min. Load	4.72	12.74					18.10
					Max. Load	5.36	15.30				20.02	
					Avg. Load	5.01	14.01				19.02	
					Standard Deviation	0.32	1.28				0.96	
					Variance	0.11	1.64				0.93	
		Total	3	100.00%								
2	3 Axle Tandem	Truck	70	98.59%	Min. Load	2.58	4.11	4.57				11.72
					Max. Load	12.03	21.32	21.32			54.66	
					Avg. Load	7.39	13.48	14.48			35.44	
					Standard Deviation	2.43	4.11	3.85			10.35	
					Variance	5.88	16.90	14.82			107.08	
		Semi-Trailer	1	1.41%	Min. Load	7.84	11.76	13.95	0.00	0.00	33.55	
					Max. Load	7.84	11.76	13.95	0.00	0.00	33.55	
					Avg. Load	7.84	11.76	13.95	-	-	33.55	
					Standard Deviation	-	-	-	-	-	-	
					Variance	-	-	-	-	-	-	
Total	71	100.00%										
3	4 Axle Single Tandem	Semi-Trailer	58	96.67%	Min. Load	2.97	3.61	3.89	4.10	0.00	14.57	
					Max. Load	9.08	15.93	17.84	19.13	0.00	52.64	
					Avg. Load	6.27	11.27	11.74	13.22	-	41.91	
					Standard Deviation	1.37	2.46	2.32	2.44	0.00	6.69	
					Variance	1.87	6.05	5.37	5.96	0.00	44.79	
		Truck	2	3.33%	Min. Load	4.91	9.74	10.06	10.95	0.00	35.96	
					Max. Load	5.21	10.54	-	17.00	0.00	44.41	
					Avg. Load	5.06	10.14	11.01	13.98	-	40.19	
					Standard Deviation	0.21	0.57	1.34	4.28	0.00	5.98	
					Variance	0.04	0.32	1.81	18.30	0.00	35.70	

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)							
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total	
		Total	60	100.00%									
4	5 Axle Single Tridem	Semi-Trailer	4	100.00%	Min. Load	5.84	9.12	10.55	11.06	12.31			50.58
					Max. Load	8.39	14.85	12.91	14.41	14.98			64.57
					Avg. Load	7.07	11.48	11.34	13.33	13.86			57.08
					Standard Deviation	1.05	2.59	1.11	1.56	1.29			5.75
					Variance	1.11	6.71	1.22	2.42	1.66			33.02
		Total	4	100.00%									
5	6 Axle Tandem Tridem	Semi-Trailer	39	100.00%	Min. Load	2.12	3.60	3.82	3.39	3.82	4.45		21.20
					Max. Load	10.00	17.00	18.00	16.42	18.00	21.00		99.99
					Avg. Load	8.35	13.96	14.90	13.68	15.26	17.56		83.74
					Standard Deviation	1.56	2.64	2.68	2.24	2.50	2.98		14.25
					Variance	2.42	6.97	7.20	5.02	6.25	8.86		202.95
		Total	39	100.00%									

8.8.11 Commodities carried by vehicles on PQ

The percentage of major commodities carried by heavy vehicles on PQ is tabulated in Table 8-63 and is graphically presented in Figure 8-40. For the sake of analysis, each commodity is assigned a code; details are attached in Annex – 2.

Table 8-63: Percentage of Vehicle w.r.t Commodities on PQ

Sr. No.	Commodities	Code	Count	%age
1	Agriculture Items	100	25	14.04%
2	Food Items	200	52	29.21%
3	Animals and Animal Products	300	10	5.62%
4	Raw Materials	400	5	2.81%
5	Bulk Manufactures	500	8	4.49%
6	Basic Manufactures	600	47	26.40%
7	Miscellaneous Manufactures	700	5	2.81%
8	Mining and Quarrying	800	11	6.18%
9	Fuel, Lubricants (Minerals)	900	1	0.56%
10	Miscellaneous Goods not Classified	A00	10	5.62%
11	Empty	E00	4	2.25%
	Total		178	100.00%

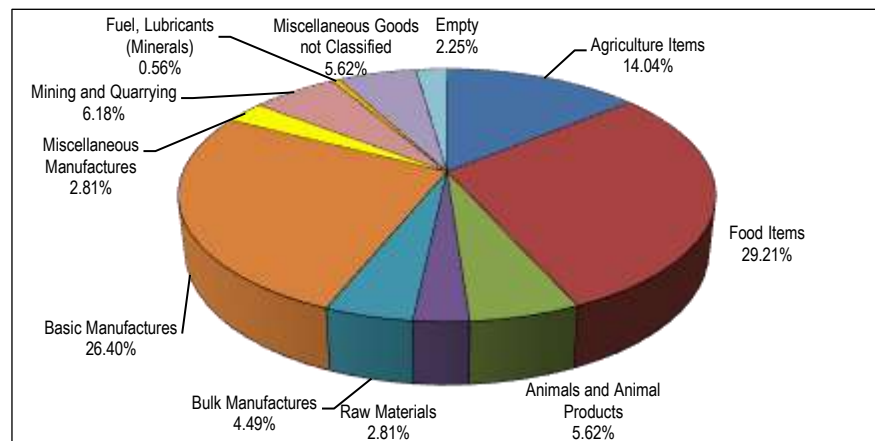


Figure 8-40: Percentage of Vehicles w.r.t Commodities on PQ

8.8.12 Analysis based on Commodities on PQ

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to commodities carried by trucks is presented in Table 8-64. The results depict that:

Major commodity carried by **2 Axle Single** is bulk manufactures, covering 66.67%, with average gross load of 19.48 ton.

Major commodities carried by **3 Axle Tandem** are food items, covering 29.17% of the total, with average gross load of 41.27 ton, followed by basic manufactures having percentage of 25%, with average gross load of 36.62 ton.

Major commodities carried by **4 Axle Single Tandem** are basic manufactures, covering 40% of the total, with average gross load of 43.01 ton, followed by agriculture items, having percentage of 21.67% in total, with average gross load of 42.34 ton.

Major commodity carried by **5 Axle Single Tridem** is basic manufactures, covering 50%, with average gross load of 53.42 ton.

Major commodities carried by **6 Axle Tandem Tridem** are food items, covering 79.49% of the total, with average gross load of 87.33 ton, followed by basic manufactures, having percentage of 7.69% in total, with average gross load of 81.06 ton.

Table 8-64: Stdev. Var., Min., Max. & Avg. Load Comparison w.r.t Commodities for major Axle Configuration on PQ

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Agriculture Items	100	1	33.33%	Min. Load	5.36	12.74					18.10
						Max. Load	5.36	12.74					18.10
						Avg. Load	5.36	12.74					18.10
						Standard Deviation	-	-					-
						Variance	-	-					-
		Bulk Manufactures	500	2	66.67%	Min. Load	4.72	13.99					18.94
						Max. Load	4.95	15.30					20.02
						Avg. Load	4.84	14.65					19.48
						Standard Deviation	0.16	0.93					0.76
						Variance	0.03	0.86					0.58
Total			3	100%									
2	3 Axle Tandem	Agriculture Items	100	11	15.28%	Min. Load	5.10	7.76	10.26				27.46
						Max. Load	11.39	20.19	20.19				51.78
						Avg. Load	6.52	12.88	14.80				35.81
						Standard Deviation	1.75	3.20	2.80				6.83
						Variance	3.06	10.27	7.83				46.61
		Food Items	200	21	29.17%	Min. Load	3.15	6.78	8.97				21.06
						Max. Load	12.03	21.32	21.32				54.66
						Avg. Load	8.86	15.89	16.51				41.27
						Standard Deviation	3.08	5.11	4.31				12.40
						Variance	9.47	26.12	18.61				153.84
		Animals and Animal Products	300	6	8.33%	Min. Load	5.41	9.59	9.59				24.60
						Max. Load	7.25	11.88	12.93				30.64
						Avg. Load	6.16	10.52	10.94				27.62
						Standard Deviation	0.71	0.84	1.29				2.60
						Variance	0.51	0.70	1.65				6.78
		Bulk Manufactures	500	1	1.39%	Min. Load	7.16	12.69	12.69				32.54
						Max. Load	7.16	12.69	12.69				32.54
						Avg. Load	7.16	12.69	12.69				32.54
						Standard Deviation	-	-	-				-
						Variance	-	-	-				-
		Basic Manufactures	600	18	25.00%	Min. Load	6.37	10.20	11.30				28.97
						Max. Load	10.90	19.32	19.32				49.54
						Avg. Load	8.14	13.96	14.58				36.62
						Standard Deviation	1.02	2.21	1.87				4.91
						Variance	1.04	4.88	3.51				24.16
		Miscellaneous Manufactures	700	1	1.39%	Min. Load	4.92	9.04	10.12				24.08
						Max. Load	4.92	9.04	10.12				24.08
						Avg. Load	4.92	9.04	10.12				24.08
						Standard Deviation	-	-	-				-
						Variance	-	-	-				-
		Mining and Quarrying	800	10	13.89%	Min. Load	5.89	11.24	12.91				13.97
						Max. Load	9.26	15.24	18.95				40.85
						Avg. Load	6.47	12.98	15.26				33.71
						Standard Deviation	1.01	1.31	1.84				7.53
						Variance	1.02	1.71	3.38				56.67
		Miscellaneous Goods not Classified	A00	1	1.39%	Min. Load	4.12	12.61	14.28				31.01
						Max. Load	4.12	12.61	14.28				31.01
						Avg. Load	4.12	12.61	14.28				31.01
						Standard Deviation	-	-	-				-
						Variance	-	-	-				-
Empty	E00	3	4.17%	Min. Load	2.58	4.11	4.57				11.72		
				Max. Load	3.25	5.12	5.12				13.12		
				Avg. Load	2.90	4.60	4.78				12.29		
				Standard Deviation	0.34	0.50	0.29				0.74		
				Variance	0.11	0.25	0.09				0.54		
Total			72	100.00%									
3	4 Axle Single Tandem	Agriculture Items	100	13	21.67%	Min. Load	4.18	5.96	10.20	12.10			33.73
						Max. Load	8.64	13.80	14.23	17.29			47.09
						Avg. Load	5.73	10.87	12.06	13.72			42.34
						Standard Deviation	1.31	2.06	1.27	1.56			4.01
						Variance	1.72	4.24	1.61	2.43			16.08

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)								
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total		
		Animals and Animal Products	300	2	3.33%	Variance	1.72	4.24	1.61	2.44			16.08		
						Min. Load	4.91	10.54	10.96	14.14			44.41		
						Max. Load	7.08	12.54	11.96	17.00			44.73		
						Avg. Load	6.00	11.54	11.46	15.57			44.57		
		Raw Materials	400	5	8.33%	Standard Deviation	1.53	1.41	0.71	2.02			0.23		
						Variance	2.35	2.00	0.50	4.09			0.05		
						Min. Load	4.95	5.86	5.86	5.86			23.44		
						Max. Load	7.06	11.54	13.74	14.51			44.68		
		Bulk Manufactures	500	3	5.00%	Avg. Load	5.61	9.90	11.03	11.58			38.18		
						Standard Deviation	0.89	2.36	3.20	3.45			8.97		
						Variance	0.79	5.59	10.24	11.92			80.44		
						Min. Load	7.05	12.85	9.95	11.61			41.45		
		Basic Manufactures	600	24	40.00%	Max. Load	8.55	15.60	12.08	14.09			50.32		
						Avg. Load	7.63	13.92	10.78	12.57			44.90		
						Standard Deviation	0.81	1.47	1.14	1.33			4.75		
						Variance	0.65	2.17	1.30	1.77			22.56		
		Miscellaneous Manufactures	700	4	6.67%	Min. Load	2.99	4.20	7.09	8.27			26.99		
						Max. Load	9.08	15.59	17.84	19.13			52.64		
						Avg. Load	6.35	11.02	12.45	13.79			43.01		
						Standard Deviation	1.44	2.31	2.19	2.14			6.42		
		Mining and Quarrying	800	1	1.67%	Variance	2.08	5.34	4.78	4.57			41.19		
						Min. Load	6.24	11.39	8.82	10.28			36.73		
						Max. Load	8.73	15.93	12.33	14.39			51.38		
						Avg. Load	7.29	13.30	10.29	12.01			42.89		
Miscellaneous Goods not Classified	A00	7	11.67%	Standard Deviation	1.05	1.92	1.49	1.74			6.20				
				Variance	1.11	3.70	2.22	3.02			38.50				
				Min. Load	6.51	14.11	16.54	17.91			35.07				
				Max. Load	6.51	14.11	16.54	17.91			35.07				
Empty	E00	1	1.67%	Avg. Load	6.51	14.11	16.54	17.91			35.07				
				Standard Deviation	-	-	-	-			-				
				Variance	-	-	-	-			-				
				Min. Load	5.46	9.74	9.28	10.82			38.66				
Total				60	100.00%	Max. Load	7.40	13.50	13.35	14.11			45.54		
						Avg. Load	6.47	11.89	10.79	12.62			41.80		
						Standard Deviation	0.79	1.53	1.33	1.31			2.27		
						Variance	0.62	2.34	1.78	1.72			5.17		
4	5 Axle Single Tridem	Bulk Manufactures	500	1	25.00%	Min. Load	2.97	3.61	3.89	4.10			14.57		
						Max. Load	2.97	3.61	3.89	4.10			14.57		
						Avg. Load	2.97	3.61	3.89	4.10			14.57		
						Standard Deviation	-	-	-	-			-		
		Basic Manufactures	600	2	50.00%	Variance	-	-	-	-			-		
						Min. Load	5.84	9.82	10.55	11.06	12.31		50.58		
						Max. Load	6.84	12.14	10.59	14.41	13.28		56.26		
						Avg. Load	6.34	10.98	10.57	12.74	12.80		53.42		
		Miscellaneous Goods not Classified	A00	1	25.00%	Standard Deviation	0.71	1.64	0.03	2.37	0.69		4.02		
						Variance	0.50	2.69	0.00	5.61	0.47		16.13		
						Min. Load	8.39	14.85	12.91	13.56	14.85		64.57		
						Max. Load	8.39	14.85	12.91	13.56	14.85		64.57		
		Total				4	100.00%	Avg. Load	8.39	14.85	12.91	13.56	14.85		64.57
								Standard Deviation	-	-	-	-	-		-
								Variance	-	-	-	-	-		-
								Min. Load	6.88	11.69	12.38	11.00	12.38	14.44	68.78
5	6 Axle Tandem Tridem	Food Items	200	31	79.49%	Max. Load	10.00	17.00	18.00	16.00	18.00	21.00	99.99		
						Avg. Load	8.73	14.85	15.72	13.97	15.72	18.34	87.33		
						Standard Deviation	0.96	1.63	1.72	1.53	1.72	2.01	9.58		
						Variance	0.92	2.65	2.97	2.35	2.97	4.05	91.80		
		Animals and Animal Products	300	2	5.13%	Min. Load	5.11	9.72	11.31	12.42	13.20	14.72	66.48		
						Max. Load	7.04	11.98	12.71	14.84	15.11	15.99	77.67		
						Avg. Load	6.08	10.85	12.01	13.63	14.16	15.36	72.08		
						Standard Deviation	1.36	1.60	0.99	1.71	1.35	0.90	7.91		
		Bulk Manufactures	500	1	2.56%	Variance	1.86	2.55	0.98	2.93	1.82	0.81	62.61		
						Min. Load	8.04	11.55	12.97	13.51	14.97	16.53	77.57		
						Max. Load	8.04	11.55	12.97	13.51	14.97	16.53	77.57		
						Avg. Load	8.04	11.55	12.97	13.51	14.97	16.53	77.57		
Total				1	2.56%	Standard Deviation	-	-	-	-	-	-	-		

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
						Variance	-	-	-	-	-	-	-
		Basic Manufactures	600	3	7.69%	Min. Load	5.86	10.94	12.11	13.15	14.94	15.12	72.12
	Max. Load					9.06	13.91	14.71	16.42	16.99	17.66	87.41	
	Avg. Load					7.67	12.46	13.79	14.51	15.81	16.48	81.06	
	Standard Deviation					1.64	1.49	1.45	1.70	1.06	1.28	7.97	
						Variance	2.69	2.21	2.12	2.89	1.12	1.64	63.50
		Fuel, Lubricants (Minerals)	900	1	2.56%	Min. Load	9.73	10.09	11.52	12.70	13.41	15.06	72.51
	Max. Load					9.73	10.09	11.52	12.70	13.41	15.06	72.51	
	Avg. Load					9.73	10.09	11.52	12.70	13.41	15.06	72.51	
	Standard Deviation					-	-	-	-	-	-	-	
						Variance	-	-	-	-	-	-	-
		Miscellaneous Goods not Classified	A00	1	2.56%	Min. Load	2.12	3.60	3.82	3.39	3.82	4.45	21.20
	Max. Load					2.12	3.60	3.82	3.39	3.82	4.45	21.20	
	Avg. Load					2.12	3.60	3.82	3.39	3.82	4.45	21.20	
	Standard Deviation					-	-	-	-	-	-	-	
						Variance	-	-	-	-	-	-	-
		Total		39	100.00%								

8.8.13 Damage Factor for major Axle Configuration on PQ

The average damage factors calculated for major axle configuration are presented in Table 8-65.

Table 8-65: Damage Factor for major Axle Configuration on PQ

Sr. No.	Axle Configuration	Code	Damage Factor (2020)	
			Road Note 40	AASHTO 1993
1	2 Axle Single	1.2	11.74	7.92
2	3 Axle Tandem	1.22	37.88	16.57
3	4 Axle Single Tandem	1.2-22	23.02	12.84
4	5 Axle Single Tridem	1.2-222	31.87	14.61
5	6 Axle Tandem Tridem	1.22-22	99.15	36.28

8.9 Pakistan International Bulk Terminal (PIBT)

The results of axle load survey performed on PIBT of PBQ are discussed in subsequent sub-sections.

8.9.1 Distribution of Vehicles by Axle Configuration on PIBT

The percentage of trucks for major axle configurations surveyed on PIBT is summarized in Table 8-66 and is graphically presented in Figure 8-41.

Table 8-66: Percentage of Vehicle w.r.t Axle Configuration on PIBT

Sr. No.	Axle Configuration	Code	Total Number of Trucks	%age
1	3 Axle Tandem	1.22	7	5.69%
2	4 Axle Single Tandem	1.2-22	17	13.82%
3	5 Axle Single Tridem	1.2-222	1	0.81%
4	5 Axle Tandem Tandem	1.22-22	1	0.81%
5	6 Axle Tandem Tridem	1.22-222	96	78.05%
6	Others	-	1	0.81%
	Total		123	100%

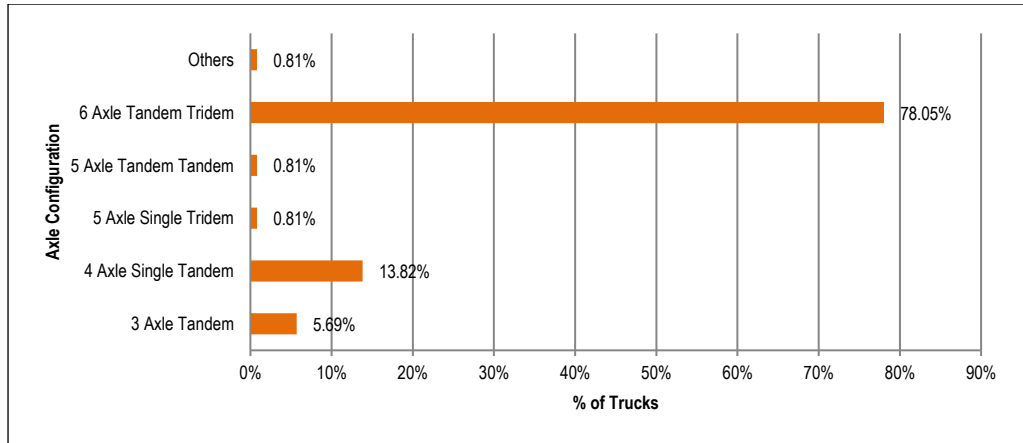


Figure 8-41: Percentage of Vehicles w.r.t Axle Configuration on PIBT

8.9.2 Analysis by Axle Configuration on PIBT

The analysis comprising minimum, maximum and average loads per axle carried by trucks on PIBT along with standard deviation and variance is presented in Table 8-67. The minimum, maximum and average loads are graphically presented in Figure 8-42 and Figure 8-43 respectively.

In case of **3 Axle Tandem**, maximum load of 45.38 ton with average load of 36.80 ton was recorded.

In case of **4 Axle Single Tandem**, maximum load of 53.48 ton with average load of 44.30 ton was recorded.

In case of **6 Axle Tandem Tridem**, maximum load of 67.86 ton with average load of 66.65 ton was recorded.

Table 8-67: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Axle Configuration on PIBT

Sr. No.	Axle Configuration	Permissible Load Limits	Parameters	Load (Tons)								
				Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total		
1	3 Axle Tandem	27.5	Min. Load	5.81	10.30	10.30					26.41	
			Max. Load	9.98	17.70	17.70						45.38
			Avg. Load	8.10	14.35	14.35						36.80
			Standard Deviation	2.11	3.75	3.75						9.60
			Variance	4.46	14.03	14.03						92.23
2	4 Axle Single Tandem	39.5	Min. Load	7.02	12.80	9.91	11.56				41.29	
			Max. Load	9.09	16.58	12.84	14.97				53.48	
			Avg. Load	7.53	13.73	10.63	12.40				44.30	
			Standard Deviation	0.44	0.80	0.62	0.72				2.58	
			Variance	0.19	0.64	0.38	0.52				6.64	
3	5 Axle Single Tridem	48.5	Min. Load	5.58	9.88	8.59	9.02	9.88			42.94	
			Max. Load	5.58	9.88	8.59	9.02	9.88			42.94	
			Avg. Load	5.58	9.88	8.59	9.02	9.88			42.94	
			Standard Deviation	-	-	-	-	-			-	
			Variance	-	-	-	-	-			-	
4	5 Axle Tandem Tandem	49.5	Min. Load	7.19	12.16	11.06	11.61	13.27			55.28	
			Max. Load	7.19	12.16	11.06	11.61	13.27			55.28	
			Avg. Load	7.19	12.16	11.06	11.61	13.27			55.28	
			Standard Deviation	-	-	-	-	-			-	
			Variance	-	-	-	-	-			-	
5	6 Axle Tandem Tridem	58.5	Min. Load	6.06	10.30	10.91	9.70	10.91	12.73		60.60	
			Max. Load	6.79	11.54	12.21	10.86	12.21	14.25		67.86	
			Avg. Load	6.67	11.33	12.00	10.66	12.00	14.00		66.65	
			Standard Deviation	0.10	0.17	0.18	0.16	0.18	0.21		0.99	
			Variance	0.01	0.03	0.03	0.02	0.03	0.04		0.97	

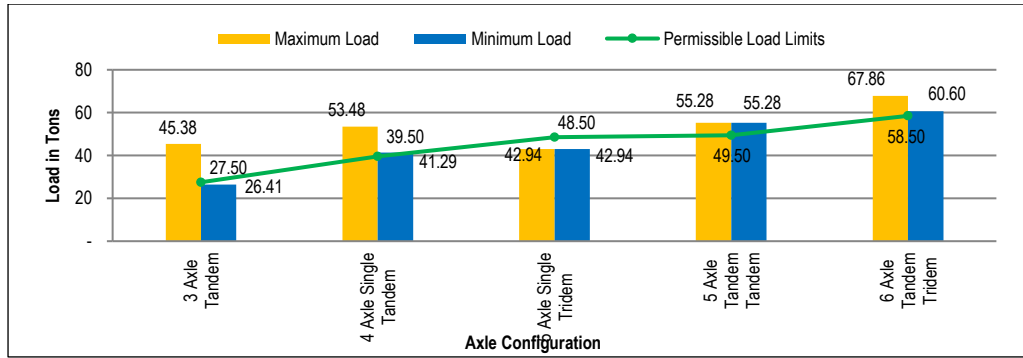


Figure 8-42: Min. & Max. Load Comparison w.r.t Axle Configuration on PIBT

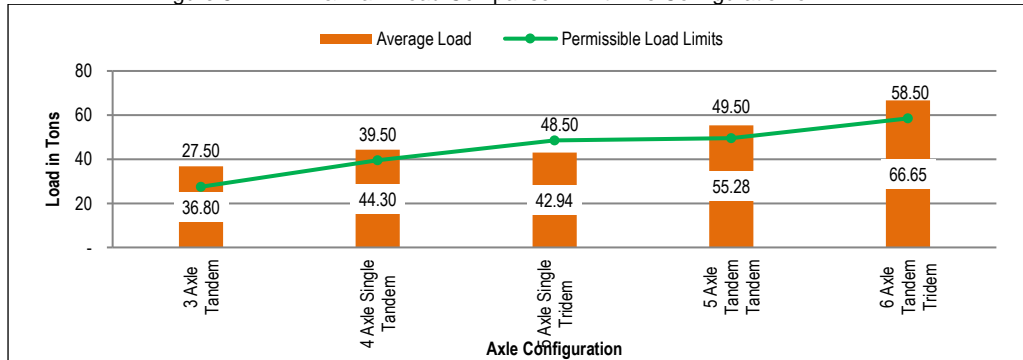


Figure 8-43: Avg. Load Comparison w.r.t Axle Configuration on PIBT

8.9.3 Load Spectrum by Axle Configuration on PIBT

The major cause of pavement failure is due to excessive overloading. The axle load survey data was organized in a way to identify the number of vehicles carrying load above and below permissible limits. Furthermore, load spectrums were identified and number of vehicles carrying load in specified spectrums were calculated. The results are tabulated in Table 8-68 which illustrates that:

In case of **3 Axle Tandem**, 42.86% of trucks carried load under permissible limits. Whereas, 57.14% of the trucks carried load more than 15% of permissible load limits.

In case of **4 Axle Single Tandem**, 100% of the trucks/semi-trailers carried load above permissible load limits.

In case of **6 Axle Tandem Tridem**, 100% of the semi-trailers carried load above permissible load limits.

The percentage of trucks for major axle configuration carrying load above and below permissible limits on PIBT is graphically presented in Figure 9-44.

Table 8-68: Load Spectrum w.r.t Axle Configuration on PIBT

Sr. No.	Axle Configuration	Under Permissible Limit	Over Permissible Limit					Total	
			15.00%	30.00%	50.00%	75.00%	>75%		
1	3 Axle Tandem	Max. Load (Tons)	27.5	31.6	35.8	41.3	48.1		
		Average Load (Tons)	26.60	-	-	-	44.44	-	
		No. of Trucks	3	0	0	0	4	0	7
		Percentage	42.86%	0.00%	0.00%	0.00%	57.14%	0.00%	100%
		Cumulative Percentage	42.86%	42.86%	42.86%	42.86%	100.00%	100.00%	
		Percentage above Range Value	57.14%	57.14%	57.14%	57.14%	0.00%	0.00%	
2	4 Axle Single Tandem	Max. Load (Tons)	39.5	45.4	51.4	59.3	69.1		
		Average Load (Tons)	-	43.73	-	53.48	-	-	
		No. of Trucks	0	16	0	1	0	0	17
		Percentage	0.00%	94.12%	0.00%	5.88%	0.00%	0.00%	100%
		Cumulative Percentage	0.00%	94.12%	94.12%	100.00%	100.00%	100.00%	
		Percentage above Range Value	100.00%	5.88%	5.88%	0.00%	0.00%	0.00%	

Sr. No.	Axle Configuration	Under Permissible Limit	Over Permissible Limit					Total	
			15.00%	30.00%	50.00%	75.00%	>75%		
3	5 Axle Single Tridem	Max. Load (Tons)	48.5	55.8	63.1	72.8	84.9		
		Average Load (Tons)	42.94	-	-	-	-	-	
		No. of Trucks	1	0	0	0	0	0	1
		Percentage	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	
	Percentage above Range Value	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		
4	5 Axle Tandem Tandem	Max. Load (Tons)	49.5	56.9	64.4	74.3	86.6		
		Average Load (Tons)	-	55.28	-	-	-	-	
		No. of Trucks	0	1	0	0	0	0	1
		Percentage	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	0.00%	100.00%	100.00%	100.00%	100.00%	100.00%	
	Percentage above Range Value	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%		
5	6 Axle Tandem Tridem	Max. Load (Tons)	58.5	67.3	76.1	87.8	102.4		
		Average Load (Tons)	-	66.56	67.50	-	-	-	
		No. of Trucks	0	87	9	0	0	0	96
		Percentage	0.00%	90.63%	9.38%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	0.00%	90.63%	100.00%	100.00%	100.00%	100.00%	
	Percentage above Range Value	100.00%	9.38%	0.00%	0.00%	0.00%	0.00%		

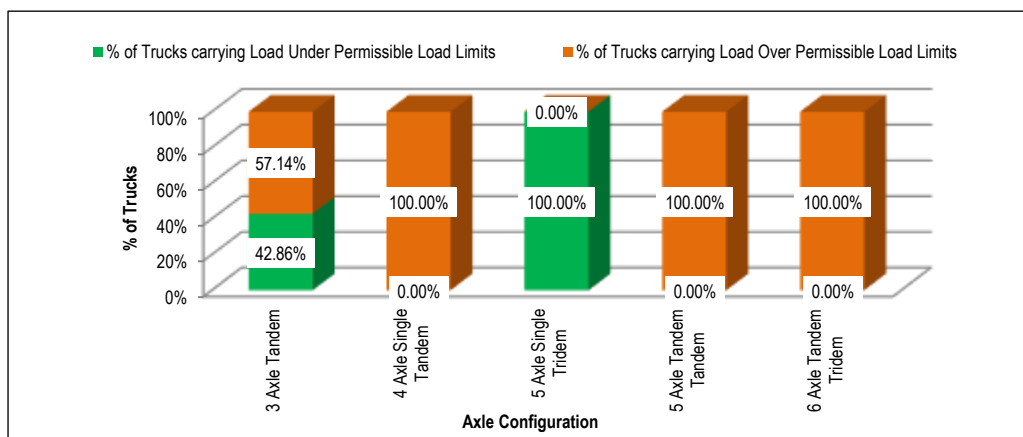


Figure 8-44: Percentage of Vehicles carrying Load above and below Permissible Limits on PIBT

8.9.4 Front & Rear Axle Load Spectrum on PIBT

The spectrum of front and rear axle loads for major axle configurations is presented in Table 8-69.

Table 8-69: Front & Rear Axle Load Spectrum on PIBT

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
Front Axle Load Spectrum					
1	0 - 2.99	0	0.00%	0.00%	100.00%
2	3 - 5.49	0	0.00%	0.00%	100.00%
3	5.5 - 6.99	100	81.97%	81.97%	18.03%
4	7 - 8.99	17	13.93%	95.90%	4.10%
5	9 - 10.99	5	4.10%	100.00%	0.00%
6	11 - 12.99	0	0.00%	100.00%	0.00%
7	13 - 14.99	0	0.00%	100.00%	0.00%
8	15 - 16.99	0	0.00%	100.00%	0.00%
9	17 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Single)					
1	0 - 8.16	0	0.00%	0.00%	100.00%
2	8.17 - 9.99	6	1.08%	1.08%	98.92%
3	10 - 10.99	122	22.06%	23.15%	76.85%
4	11 - 11.99	151	27.31%	50.45%	49.55%
5	12 - 12.99	153	27.67%	78.12%	21.88%
6	13 - 13.99	44	7.96%	86.08%	13.92%
7	14 - 14.99	68	12.30%	98.37%	1.63%
8	15 - 19.99	9	1.63%	100.00%	0.00%
9	20 & Above	0	0.00%	100.00%	0.00%

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
Rear Axle Load Spectrum (Tandem)					
1	0 - 11.99	0	0.00%	0.00%	100.00%
2	12 - 14.99	0	0.00%	0.00%	100.00%
3	15 - 19.99	0	0.00%	0.00%	100.00%
4	20 - 21.99	5	4.10%	4.10%	95.90%
5	22 - 23.99	111	90.98%	95.08%	4.92%
6	24 - 25.99	1	0.82%	95.90%	4.10%
7	26 - 27.99	1	0.82%	96.72%	3.28%
8	28 - 29.99	0	0.00%	96.72%	3.28%
9	30 & Above	4	3.28%	100.00%	0.00%
Rear Axle Load Spectrum (Tridem)					
1	0 - 14.99	0	0.00%	0.00%	100.00%
2	15 - 30.99	1	1.03%	1.03%	98.97%
3	31 - 32.99	0	0.00%	1.03%	98.97%
4	33 - 34.99	3	3.09%	4.12%	95.88%
5	35 - 36.99	79	81.44%	85.57%	14.43%
6	37 - 38.99	14	14.43%	100.00%	0.00%
7	39 - 40.99	0	0.00%	100.00%	0.00%
8	41 - 42.99	0	0.00%	100.00%	0.00%
9	43 & Above	0	0.00%	100.00%	0.00%

8.9.5 Distribution of Vehicles by Make Type on PIBT

The distribution of trucks as per make type is illustrated in Table 8-70 and is graphically presented in Figure 8-45. The results depict that Hino and Nissan have maximum percentage of 48.76% and 35.54% on PIBT.

Table 8-70: Percentage of Vehicles w.r.t Make Type on PIBT

Sr. No.	Make	Count	Percentage
1	Nissan	43	35.54%
2	Faw	7	5.79%
3	Hino	59	48.76%
4	Isuzu	3	2.48%
5	UD	8	6.61%
6	others	1	0.83%
Total		121	100.00%

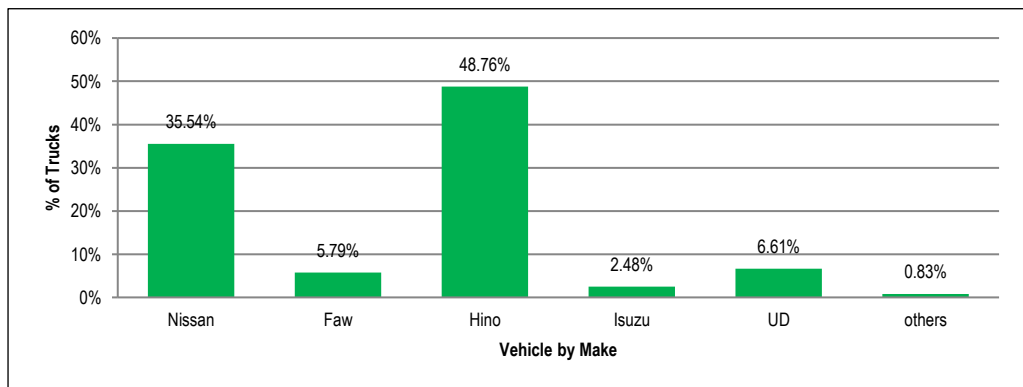


Figure 8-45: Percentage of Vehicles w.r.t Make Type on PIBT

8.9.6 Analysis by Make Type on PIBT

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to make type is presented in Table 8-71. The results depict that:

In case of **3 Axle Tandem**, Hino constitute maximum percentage of 57.14%, with average gross load of 35.88 ton, followed by UD with percentage of 28.57%, carrying average gross load of 43.72 ton.

In case of **4 Axle Single Tandem**, Hino constitutes maximum percentage of 58.82%, with average gross load of 43.92 ton, followed by Nissan with percentage of 35.29%,

carrying average gross load of 44.81 ton.

In case of **6 Axle Tandem Tridem**, Hino constitutes maximum percentage of 47.37%, with average gross load of 66.76 ton, followed by Nissan with percentage of 35.79%, carrying average gross load of 66.52 ton.

Table 8-71: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Make Type for major Axle Configuration on PIBT

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	3 Axle Tandem	Hino	4	57.14%	Min. Load	5.81	10.30	10.30				26.41
					Max. Load	9.98	17.69	17.69				45.37
					Avg. Load	7.89	13.99	13.99				35.88
					Standard Deviation	2.36	4.19	4.19				10.73
					Variance	5.57	17.52	17.52				115.18
		Nissan	1	14.29%	Min. Load	5.86	10.39	10.39				26.64
					Max. Load	5.86	10.39	10.39				26.64
					Avg. Load	5.86	10.39	10.39				26.64
					Standard Deviation	-	-	-				-
					Variance	-	-	-				-
		UD	2	28.57%	Min. Load	9.25	16.40	16.40				42.05
					Max. Load	9.98	17.70	17.70				45.38
					Avg. Load	9.62	17.05	17.05				43.72
					Standard Deviation	0.52	0.92	0.92				2.35
Variance	0.27				0.84	0.84				5.54		
Total	7	100.00%										
2	4 Axle Single Tandem	Hino	10	58.82%	Min. Load	7.02	12.80	9.91	11.56			41.29
					Max. Load	7.66	13.96	10.81	12.61			45.03
					Avg. Load	7.47	13.61	10.54	12.30			43.92
					Standard Deviation	0.19	0.34	0.27	0.31			1.11
					Variance	0.04	0.12	0.07	0.10			1.22
		Nissan	6	35.29%	Min. Load	7.20	13.12	10.16	11.85			42.33
					Max. Load	9.09	16.58	12.84	14.97			53.48
					Avg. Load	7.62	13.89	10.75	12.55			44.81
					Standard Deviation	0.73	1.33	1.03	1.20			4.28
					Variance	0.53	1.76	1.06	1.44			18.32
		UD	1	5.88%	Min. Load	7.67	13.98	10.82	12.63			45.10
					Max. Load	7.67	13.98	10.82	12.63			45.10
					Avg. Load	7.67	13.98	10.82	12.63			45.10
					Standard Deviation	-	-	-	-			-
Variance	-				-	-	-			-		
Total	17	100.00%										
3	5 Axle Single Tridem	Nissan	1	100.00%	Min. Load	5.58	9.88	8.59	9.02	9.88		42.94
					Max. Load	5.58	9.88	8.59	9.02	9.88		42.94
					Avg. Load	5.58	9.88	8.59	9.02	9.88		42.94
					Standard Deviation	-	-	-	-	-		-
					Variance	-	-	-	-	-		-
		Total	1	100.00%								
4	5 Axle Tandem Tandem	Nissan	1	100.00%	Min. Load	7.19	12.16	11.06	11.61	13.27		55.28
					Max. Load	7.19	12.16	11.06	11.61	13.27		55.28
					Avg. Load	7.19	12.16	11.06	11.61	13.27		55.28
					Standard Deviation	-	-	-	-	-		-
					Variance	-	-	-	-	-		-
		Total	1	100.00%								
5	6 Axle Tandem Tridem	Hino	45	47.37%	Min. Load	6.34	10.78	11.41	10.14	11.41	13.31	63.39
					Max. Load	6.79	11.54	12.21	10.86	12.21	14.25	67.86
					Avg. Load	6.68	11.35	12.02	10.68	12.02	14.02	66.76
					Standard Deviation	0.07	0.12	0.12	0.11	0.12	0.15	0.69
					Variance	0.00	0.01	0.02	0.01	0.02	0.02	0.48
		Faw	7	7.37%	Min. Load	6.41	10.89	11.53	10.25	11.53	13.45	64.07
					Max. Load	6.73	11.45	12.12	10.77	12.12	14.14	67.33
					Avg. Load	6.65	11.30	11.96	10.63	11.96	13.96	66.46
					Standard Deviation	0.11	0.19	0.20	0.18	0.20	0.23	1.11
					Variance	0.01	0.04	0.04	0.03	0.04	0.05	1.24
		Isuzu	3	3.16%	Min. Load	6.70	11.38	12.05	10.71	12.05	14.06	66.95
					Max. Load	6.73	11.43	12.11	10.76	12.11	14.12	67.26
					Avg. Load	6.72	11.42	12.09	10.74	12.09	14.10	67.15
					Standard Deviation	0.02	0.03	0.03	0.03	0.03	0.04	0.17
					Variance	0.00	0.00	0.00	0.00	0.00	0.00	0.03

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
		Nissan	34	35.79%	Min. Load	6.06	10.30	10.91	9.70	10.91	12.73	60.60
					Max. Load	6.78	11.52	12.20	10.84	12.20	14.23	67.77
					Avg. Load	6.65	11.31	11.97	10.64	11.97	13.97	66.52
					Standard Deviation	0.13	0.23	0.24	0.21	0.24	0.28	1.33
					Variance	0.02	0.05	0.06	0.05	0.06	0.08	1.78
		UD	5	5.26%	Min. Load	6.55	11.14	11.79	10.48	11.79	13.76	65.50
					Max. Load	6.71	11.40	12.07	10.73	12.07	14.08	67.06
					Avg. Load	6.64	11.28	11.95	10.62	11.95	13.94	66.38
					Standard Deviation	0.08	0.13	0.14	0.12	0.14	0.16	0.75
		Others	1	1.05%	Min. Load	6.73	11.43	12.11	10.76	12.11	14.12	67.25
					Max. Load	6.73	11.43	12.11	10.76	12.11	14.12	67.25
					Avg. Load	6.73	11.43	12.11	10.76	12.11	14.12	67.25
					Standard Deviation	-	-	-	-	-	-	-
Variance	-				-	-	-	-	-	-		
Total	95	100.00%										

8.9.7 Distribution of Vehicles by Body Type on PIBT

The percentage of vehicles with respect to Body Type i.e. Flat, Half, Full & Container plying on PIBT is tabulated in Table 8-72 and is graphically presented in Figure 8-46.

Table 8-72: Percentage of Vehicles w.r.t Body Type on PIBT

Sr. No.	Body Type	Count	%age
1	Flat	2	1.65%
2	Half	81	66.94%
3	Full	38	31.40%
Total		121	100.00%

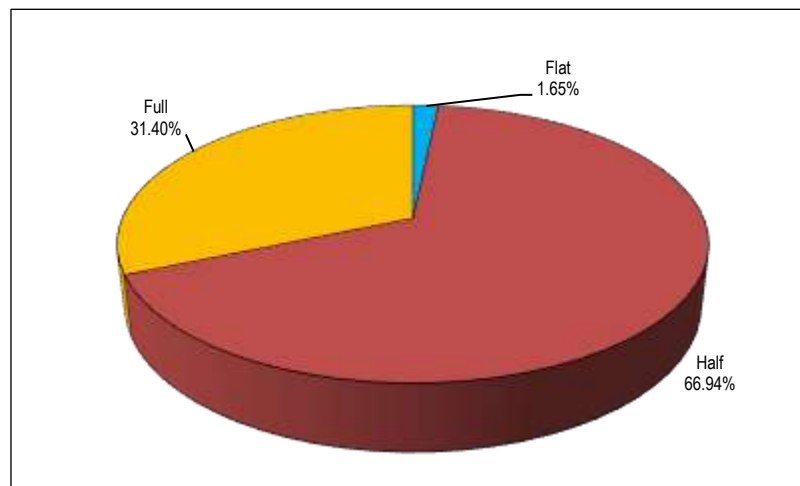


Figure 8-46 : Percentage of Vehicles w.r.t Body Type on PIBT

8.9.8 Analysis by Body Type on PIBT

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to body type is presented in Table 8-73. The results depict that:

In case of **3 Axle Tandem**, full body type constitutes maximum percentage of 100%, with average gross load of 36.80 ton.

In case of **4 Axle Single Tandem**, full body type constitutes maximum percentage of 87.50%, with average gross load of 43.63 ton, followed by half body type having percentage of 12.5% with average gross load of 48.76 ton.

In case of **6 Axle Tandem Tridem**, half body type constitutes maximum percentage of 82.29%, with average gross load of 66.63 ton, followed by full body type having percentage of 15.63% with average gross load of 66.65 ton.

Table 8-73: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Body Type for major Axle Configuration on PIBT

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	3 Axle Tandem	Full	7	100.00%	Min. Load	5.81	10.30	10.30				26.41
					Max. Load	9.98	17.70	17.70				45.38
					Avg. Load	8.10	14.35	14.35				36.80
					Standard Deviation	2.11	3.75	3.75				9.60
					Variance	4.46	14.03	14.03				92.23
	Total		7	100.00%								
2	4 Axle Single Tandem	Half	2	12.50%	Min. Load	7.49	13.65	10.57	12.33			44.03
					Max. Load	9.09	16.58	12.84	14.97			53.48
					Avg. Load	8.29	15.11	11.70	13.65			48.76
					Standard Deviation	1.14	2.07	1.60	1.87			6.68
					Variance	1.29	4.29	2.57	3.50			44.65
		Full	14	87.50%	Min. Load	7.02	12.80	9.91	11.56			41.29
					Max. Load	-	13.98	10.82	12.63			45.10
					Avg. Load	7.42	13.53	10.47	12.22			43.63
					Standard Deviation	0.19	0.34	0.26	0.31			1.09
					Variance	0.03	0.11	0.07	0.09			1.19
	Total		16	100.00%								
3	5 Axle Single Tridem	Full	1	100.00%	Min. Load	5.58	9.88	8.59	9.02	9.88		42.94
					Max. Load	5.58	9.88	8.59	9.02	9.88		42.94
					Avg. Load	5.58	9.88	8.59	9.02	9.88		42.94
					Standard Deviation	-	-	-	-	-		-
					Variance	-	-	-	-	-		-
	Total		1	100.00%								
4	5 Axle Tandem Tandem	Full	1	100.00%	Min. Load	7.19	12.16	11.06	11.61	13.27		55.28
					Max. Load	7.19	12.16	11.06	11.61	13.27		55.28
					Avg. Load	7.19	12.16	11.06	11.61	13.27		55.28
					Standard Deviation	-	-	-	-	-		-
					Variance	-	-	-	-	-		-
	Total		1	100.00%								
5	6 Axle Tandem Tridem	Flat	2	2.08%	Min. Load	6.74	11.46	12.13	10.78	12.13	14.15	67.39
					Max. Load	6.75	11.48	12.15	10.80	12.15	14.18	67.51
					Avg. Load	6.75	11.47	12.14	10.79	12.14	14.16	67.45
					Standard Deviation	0.01	0.01	0.02	0.01	0.02	0.02	0.08
					Variance	0.00	0.00	0.00	0.00	0.00	0.00	0.01
		Half	79	82.29%	Min. Load	6.06	10.30	10.91	9.70	10.91	12.73	60.60
					Max. Load	6.79	11.54	12.21	10.86	12.21	14.25	67.86
					Avg. Load	6.66	11.33	11.99	10.66	11.99	13.99	66.63
					Standard Deviation	0.10	0.17	0.18	0.16	0.18	0.21	1.02
					Variance	0.01	0.03	0.03	0.03	0.03	0.05	1.04
		Full	15	15.63%	Min. Load	6.41	10.89	11.53	10.25	11.53	13.45	64.07
					Max. Load	6.75	11.48	12.15	10.80	12.15	14.18	67.50
					Avg. Load	6.67	11.33	12.00	10.66	12.00	14.00	66.65
					Standard Deviation	0.08	0.14	0.15	0.13	0.15	0.18	0.83
					Variance	0.01	0.02	0.02	0.02	0.02	0.03	0.70
	Total		96	100.00%								

8.9.9 Distribution of Vehicles by Type on PIBT

The percentage of vehicles with respect to Type i.e., Truck and Semi-Trailer plying on PIBT is tabulated in Table 8-74 and is graphically presented in Figure 8-47.

Table 8-74: Percentage of Vehicles w.r.t Type on PIBT

Sr. No.	Vehicle Type	Count	Percentage
1	Truck	18	14.75%
2	Semi-Trailer	104	85.25%
	Total	122	100.00%

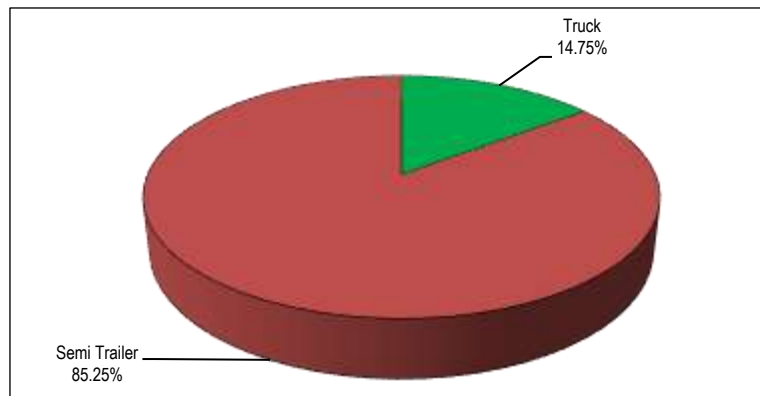


Figure 8-47: Percentage of Vehicles w.r.t Type on PIBT

8.9.10 Analysis by Vehicle Type on PIBT

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to truck type is presented in Table 8-75. The results depict that:

In case of **3 Axle Tandem**, truck type constitutes maximum percentage of 85.71%, with average gross load of 35.37 ton.

In case of **4 Axle Single Tandem**, truck type constitutes maximum percentage of 64.71%, with average gross load of 43.41 ton, followed by semi-trailer having percentage of 35.29% with average gross load of 45.93 ton.

In case of **6 Axle Tandem Tridem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 66.65 ton.

Table 8-75: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Type for major Axle Configuration on PIBT

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	3 Axle Tandem	Truck	6	85.71%	Min. Load	5.81	10.30	10.30				26.41
					Max. Load	9.98	17.69	17.69				45.37
					Avg. Load	7.78	13.79	13.79				35.37
					Standard Deviation	2.13	3.77	3.77				9.67
					Variance	4.52	14.22	14.22				93.48
		Semi-Trailer	1	14.29%	Min. Load	9.98	17.70	17.70	0.00	0.00		45.38
					Max. Load	9.98	17.70	17.70	0.00	0.00		45.38
					Avg. Load	9.98	17.70	17.70	-	-		45.38
					Standard Deviation	-	-	-	-	-		-
					Variance	-	-	-	-	-		-
Total	7	100.00%										
2	4 Axle Single Tandem	Semi-Trailer	6	35.29%	Min. Load	7.44	13.56	10.50	12.25	0.00		43.75
					Max. Load	9.09	16.58	12.84	14.97	0.00		53.48
					Avg. Load	7.81	14.24	11.02	12.86	-		45.93
					Standard Deviation	0.63	1.16	0.90	1.05	0.00		3.73
					Variance	0.40	1.34	0.80	1.09	0.00		13.93
		Truck	11	64.71%	Min. Load	7.02	12.80	9.91	11.56	0.00		41.29
					Max. Load	7.66	13.96	-	12.61	0.00		45.03
					Avg. Load	7.38	13.46	10.42	12.16	-		43.41
					Standard Deviation	0.19	0.34	0.26	0.31	0.00		1.10
					Variance	0.04	0.12	0.07	0.10	0.00		1.21
Total	17	100.00%										
3	5 Axle Single Tridem	Truck	1	100.00%	Min. Load	5.58	9.88	8.59	9.02	9.88		42.94
					Max. Load	5.58	9.88	8.59	9.02	9.88		42.94
					Avg. Load	5.58	9.88	8.59	9.02	9.88		42.94
					Standard Deviation	-	-	-	-	-		-
					Variance	-	-	-	-	-		-
Total	1	100.00%										
4	5 Axle Tandem Tandem	Semi-Trailer	1	100.00%	Min. Load	7.19	12.16	11.06	11.61	13.27		55.28
					Max. Load	7.19	12.16	11.06	11.61	13.27		55.28
					Avg. Load	7.19	12.16	11.06	11.61	13.27		55.28
					Standard Deviation	-	-	-	-	-		-
					Variance	-	-	-	-	-		-
Total	1	100.00%										
5	6 Axle Tandem Tridem	Semi-Trailer	96	100.00%	Min. Load	6.06	10.30	10.91	9.70	10.91	12.73	60.60
					Max. Load	6.79	11.54	12.21	10.86	12.21	14.25	67.86
					Avg. Load	6.67	11.33	12.00	10.66	12.00	14.00	66.65
					Standard Deviation	0.10	0.17	0.18	0.16	0.18	0.21	0.99
					Variance	0.01	0.03	0.03	0.02	0.03	0.04	0.97
Total	96	100.00%										

8.9.11 Commodities carried by vehicles on PIBT

The percentage of major commodities carried by heavy vehicles on PIBT is tabulated in Table 8-76 and is graphically presented in Figure 8-48. For the sake of analysis, each commodity is assigned a code; details are attached in Annex – 2.

Table 8-76: Percentage of Vehicle w.r.t Commodities on PIBT

Sr. No.	Commodity Type	Code	Count	Percentage
1	Fuel, Lubricants (Minerals)	900	120	98.36%
2	Miscellaneous Goods not Classified	A00	2	1.64%
Total			122	100.00%

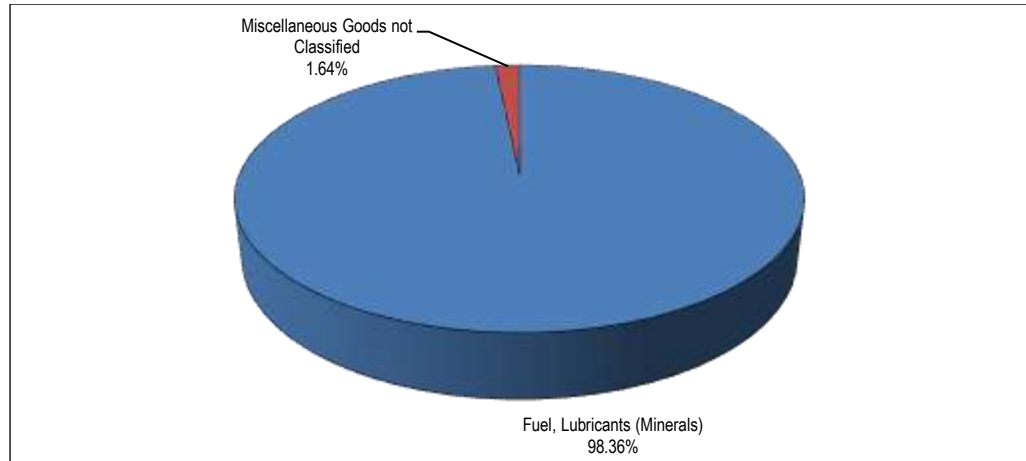


Figure 8-48: Percentage of Vehicles w.r.t Commodities on PIBT

8.9.12 Analysis based on Commodities on PIBT

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to commodities carried by trucks is presented in Table 8-77. The results depict that:

Major commodity carried by **3 Axle Tandem** is fuel, lubricants (minerals), covering 100% of the total, with average gross load of 36.80 ton.

Major commodity carried by **4 Axle Single Tandem** is fuel, lubricants (minerals), covering 100% of the total, with average gross load of 44.30 ton.

Major commodity carried by **6 Axle Tandem Tridem** is fuel, lubricants (minerals), covering 100% of the total, with average gross load of 66.65 ton.

Table 8-77: Stdev. Var., Min., Max. & Avg. Load Comparison w.r.t Commodities for major Axle Configuration on PIBT

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	3 Axle Tandem	Fuel, Lubricants (Minerals)	900	7	100.00%	Min. Load	5.81	10.30	10.30				26.41
						Max. Load	9.98	17.70	17.70				45.38
						Avg. Load	8.10	14.35	14.35				36.80
						Standard Deviation	2.11	3.75	3.75				9.60
						Variance	4.46	14.03	14.03				92.23
						Total			7	100.00%			
2	4 Axle Single Tandem	Fuel, Lubricants (Minerals)	900	17	100.00%	Min. Load	7.02	12.80	9.91	11.56			41.29
						Max. Load	9.09	16.58	12.84	14.97			53.48
						Avg. Load	7.53	13.73	10.63	12.40			44.30
						Standard Deviation	0.44	0.80	0.62	0.72			2.58
						Variance	0.19	0.64	0.38	0.52			6.64
						Total			17	100.00%			
3	5 Axle Single Tridem	Miscellaneous Goods not Classified	A00	1	100.00%	Min. Load	5.58	9.88	8.59	9.02	9.88		42.94
						Max. Load	5.58	9.88	8.59	9.02	9.88		42.94
						Avg. Load	5.58	9.88	8.59	9.02	9.88		42.94
						Standard Deviation	-	-	-	-	-		-
						Variance	-	-	-	-	-		-
						Total			1	100.00%			
4	5 Axle Tandem Tandem	Miscellaneous Goods not Classified	A00	1	100.00%	Min. Load	7.19	12.16	11.06	11.61	13.27		55.28
						Max. Load	7.19	12.16	11.06	11.61	13.27		55.28
						Avg. Load	7.19	12.16	11.06	11.61	13.27		55.28
						Standard Deviation	-	-	-	-	-		-
						Variance	-	-	-	-	-		-
						Total			1	100.00%			
5	6 Axle Tandem Tridem	Fuel, Lubricants (Minerals)	900	96	100.00%	Min. Load	6.06	10.30	10.91	9.70	10.91	12.73	60.60
						Max. Load	6.79	11.54	12.21	10.86	12.21	14.25	67.86
						Avg. Load	6.67	11.33	12.00	10.66	12.00	14.00	66.65
						Standard Deviation	0.10	0.17	0.18	0.16	0.18	0.21	0.99
						Variance	0.01	0.03	0.03	0.02	0.03	0.04	0.97
						Total			96	100.00%			

8.9.13 Damage Factor for major Axle Configuration on PIBT

The average damage factors calculated for major axle configuration are presented in Table 8-78.

Table 8-78: Damage Factor for major Axle Configuration on PIBT

Sr. No.	Axle Configuration	Code	Damage Factor (2020)	
			Road Note 40	AASHTO 1993
1	3 Axle Tandem	1.22	37.25	17.25
2	4 Axle Single Tandem	1.2-22	21.11	13.48
3	5 Axle Single Tridem	1.2-222	7.56	4.21
4	5 Axle Tandem Tandem	1.22-22	23.78	13.65
5	6 Axle Tandem Tridem	1.22-222	30.17	13.59

9 DATA ANALYSIS ON DRY PORTS

9.1 General

Summary results of the Axle Load Survey carried out at different Dry Ports are discussed in following sub- sections.

9.2 Quetta Dry Port (QDP)

The results of axle load survey performed on QDP are discussed in subsequent sub-sections.

9.2.1 Distribution of Vehicles by Axle Configuration on QDP

The percentage of trucks for major axle configurations surveyed on QDP is summarized in Table 9-1 and is graphically presented in Figure 9-1.

Table 9-1: Percentage of Vehicle w.r.t Axle Configuration on QDP

Sr. No.	Axle Configuration	Code	Total Number of Trucks	Percentage
1	2 Axle Single	1.2	8	6.96%
2	3 Axle Tandem	1.22	51	44.35%
3	4 Axle Single Tandem	1.2-22	9	7.83%
4	5 Axle Single Tridem	1.2-222	13	11.30%
5	6 Axle Tandem Tridem	1.22-222	32	27.83%
6	Others	-	2	1.74%
Total			115	100%

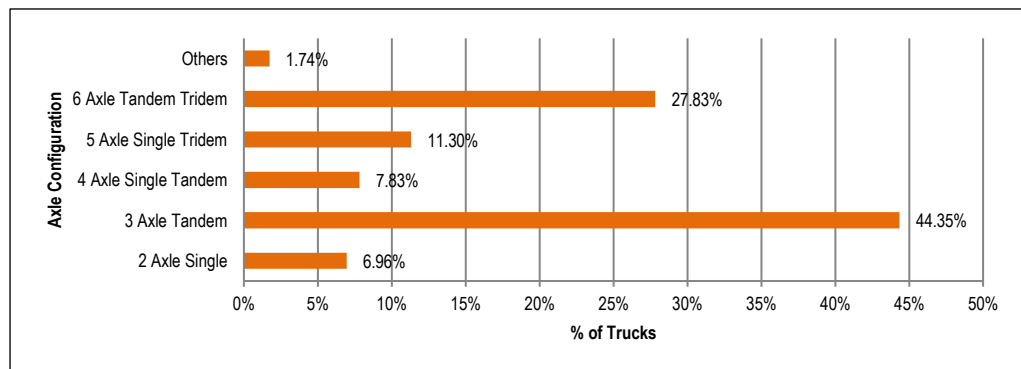


Figure 9-1: Percentage of Vehicles w.r.t Axle Configuration on QDP

9.2.2 Analysis by Axle Configuration on QDP

The analysis comprising minimum, maximum and average loads per axle carried by trucks on QDP along with standard deviation and variance is presented in Table 9-2. The minimum, maximum and average loads are graphically presented in Figure 9-2 and Figure 9-3 respectively.

In case of **2 Axle Single** trucks, maximum load of 26.00 ton with average load of 20.68 ton was recorded.

In case of **3 Axle Tandem**, maximum load of 44.35 ton with average load of 35.60 ton was recorded.

In case of **4 Axle Single Tandem**, maximum load of 46.39 ton with average load of 41.43 ton was recorded.

In case of **5 Axle Single Tridem**, maximum load of 54.12 ton with average load of 44.37 ton was recorded.

In case of **6 Axle Tandem Tridem**, maximum load of 99.90 ton with average load of 74.56 ton was recorded.

Table 9-2: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Axle Configuration on QDP

Sr. No.	Axle Configuration	Permissible Load Limits	Parameters	Load (Tons)					Total	
				Front	Rear 1	Rear 2	Rear 3	Rear 4		Rear 5
1	2 Axle Single	17.5	Min. Load	4.65	10.35					15.00
			Max. Load	8.06	17.94					26.00
			Avg. Load	6.41	14.27					20.68
			Standard Deviation	1.19	2.65					3.84
			Variance	1.42	7.02					14.76
2	3 Axle Tandem	27.5	Min. Load	4.05	7.18	7.18				18.40
			Max. Load	9.76	17.30	17.30				44.35
			Avg. Load	7.83	13.88	13.88				35.60
			Standard Deviation	1.41	2.50	2.50				6.41
			Variance	1.99	6.26	6.26				41.13
3	4 Axle Single Tandem	39.5	Min. Load	5.97	10.89	8.43	9.84			35.14
			Max. Load	7.89	14.38	11.13	12.99			46.39
			Avg. Load	7.04	12.84	9.94	11.60			41.43
			Standard Deviation	0.64	1.17	0.90	1.05			3.76
			Variance	0.41	1.36	0.82	1.11			14.16
4	5 Axle Single Tridem	48.5	Min. Load	4.21	7.45	6.48	6.81	7.45		32.41
			Max. Load	7.04	12.45	10.82	11.37	12.45		54.12
			Avg. Load	5.77	10.21	8.87	9.32	10.21		44.37
			Standard Deviation	0.89	1.57	1.36	1.43	1.57		6.82
			Variance	0.79	2.46	1.86	2.05	2.46		46.56
5	6 Axle Tandem Tridem	58.5	Min. Load	4.85	8.25	8.73	7.76	8.73	10.19	48.52
			Max. Load	9.99	16.98	17.98	15.98	17.98	20.98	99.90
			Avg. Load	7.46	12.68	13.42	11.93	13.42	15.66	74.56
			Standard Deviation	1.80	3.06	3.24	2.88	3.24	3.78	18.00
			Variance	3.24	9.36	10.50	8.29	10.50	14.29	324.01

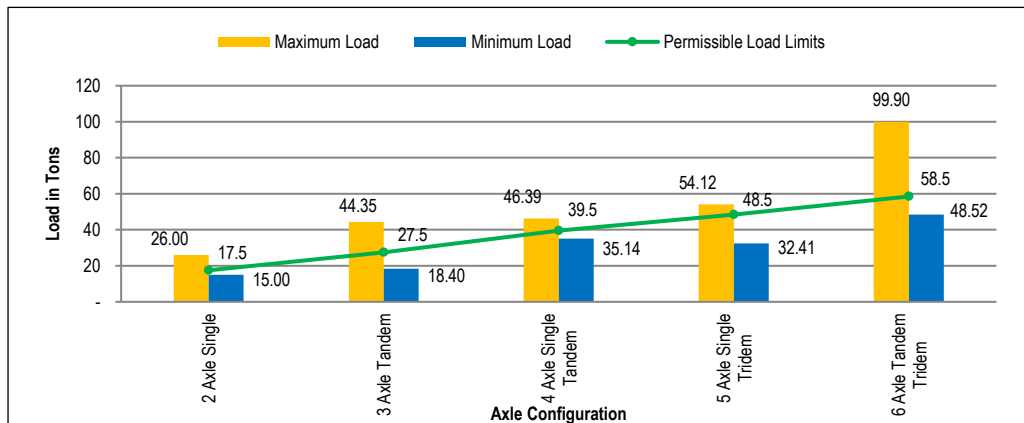


Figure 9-2: Min. & Max. Load Comparison w.r.t Axle Configuration on QDP

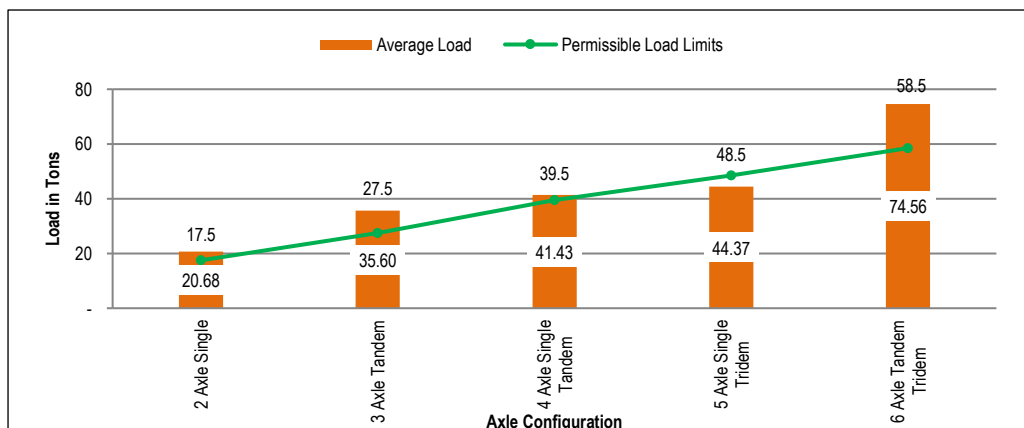


Figure 9-3: Avg. Load Comparison w.r.t Axle Configuration on QDP

9.2.3 Load Spectrum by Axle Configuration on QDP

The major cause of pavement failure is due to excessive overloading. The axle load survey data was organized in a way to identify the number of vehicles carrying load above and below permissible limits. Furthermore, load spectrums were identified and number of vehicles carrying load in specified spectrums were calculated. The results are tabulated in Table 9-3 which illustrates that:

In case of **2 Axle Single**, 25% of trucks were carrying loads under permissible limits. Whereas, 50% of the trucks carried load more than 15% of permissible load limits.

In case of **3 Axle Tandem**, 19.61% of trucks were carrying loads under permissible limits. Whereas, 76.47% of the trucks carried load more than 15% of permissible load limits.

In case of **4 Axle Single Tandem**, 22.22% of semi-trailers were carrying loads under permissible limits. Whereas, 22.22% of the semi-trailers carried load more than 15% of permissible load limits.

In case of **5 Axle Single Tridem**, 61.54% of semi-trailers were carrying loads under permissible limits.

In case of **6 Axle Tandem Tridem**, 18.75% of semi-trailers were carrying loads under permissible limits. Whereas, 62.50% semi-trailers carried load more than 15% of permissible load limits.

The percentage of trucks for major axle configuration carrying load above and below permissible limits on QDP is graphically presented in Figure 9-4.

Table 9-3: Load Spectrum w.r.t Axle Configuration on QDP

Sr. No.	Axle Configuration	Under Permissible Limit	Over Permissible Limit					Total	
			15.00%	30.00%	50.00%	75.00%	>75%		
1	2 Axle Single	Max. Load (Tons)	17.5	20.1	22.8	26.3	30.6		
		Average Load (Tons)	16.25	18.93	20.90	24.73	-	-	
		No. of Trucks	2	2	1	3	0	0	8
		Percentage	25.00%	25.00%	12.50%	37.50%	0.00%	0.00%	100%
		Cumulative Percentage	25.00%	50.00%	62.50%	100.00%	100.00%	100.00%	
		Percentage above Range Value	75.00%	50.00%	37.50%	0.00%	0.00%	0.00%	
2	3 Axle Tandem	Max. Load (Tons)	27.5	31.6	35.8	41.3	48.1		
		Average Load (Tons)	24.66	29.40	34.12	38.70	42.37	-	
		No. of Trucks	10	2	7	23	9	0	51
		Percentage	19.61%	3.92%	13.73%	45.10%	17.65%	0.00%	100%
		Cumulative Percentage	19.61%	23.53%	37.25%	82.35%	100.00%	100.00%	
		Percentage above Range Value	80.39%	76.47%	62.75%	17.65%	0.00%	0.00%	
3	4 Axle Single Tandem	Max. Load (Tons)	39.5	45.4	51.4	59.3	69.1		
		Average Load (Tons)	35.71	41.89	45.97	-	-	-	
		No. of Trucks	2	5	2	0	0	0	9
		Percentage	22.22%	55.56%	22.22%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	22.22%	77.78%	100.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	77.78%	22.22%	0.00%	0.00%	0.00%	0.00%	
4	5 Axle Single Tridem	Max. Load (Tons)	48.5	55.8	63.1	72.8	84.9		
		Average Load (Tons)	40.17	51.09	-	-	-	-	
		No. of Trucks	8	5	0	0	0	0	13
		Percentage	61.54%	38.46%	0.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	61.54%	100.00%	100.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	38.46%	0.00%	0.00%	0.00%	0.00%	0.00%	
5	6 Axle Tandem Tridem	Max. Load (Tons)	58.5	67.3	76.1	87.8	102.4		
		Average Load (Tons)	52.42	60.97	70.70	-	97.21	-	
		No. of Trucks	6	6	9	0	11	0	32
		Percentage	18.75%	18.75%	28.13%	0.00%	34.38%	0.00%	100%
		Cumulative Percentage	18.75%	37.50%	65.63%	65.63%	100.00%	100.00%	
		Percentage above Range Value	81.25%	62.50%	34.38%	34.38%	0.00%	0.00%	

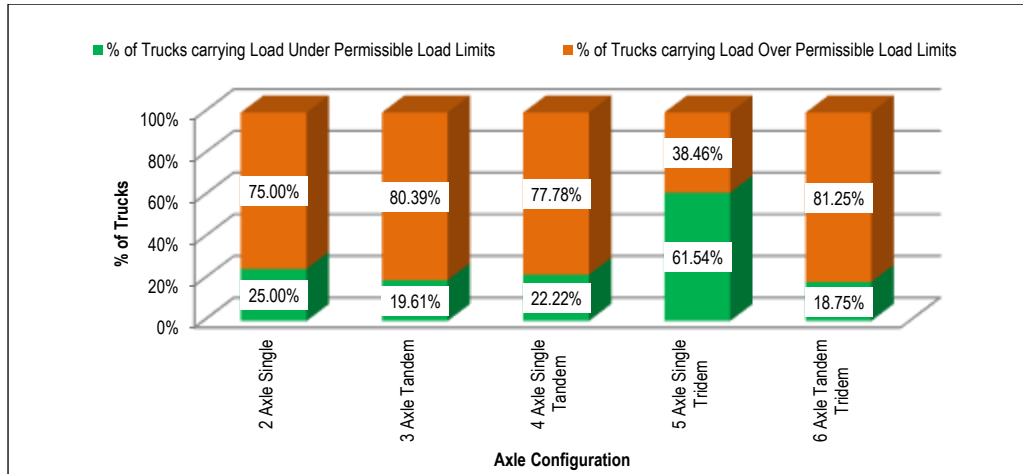


Figure 9-4: Percentage of Vehicles carrying Load above and below Permissible Limits on QDP

9.2.4 Front & Rear Axle Load Spectrum on QDP

The spectrum of front and rear axle loads for major axle configurations is presented in Table 9-4.

Table 9-4: Front & Rear Axle Load Spectrum on QDP

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
Front Axle Load Spectrum					
1	0 - 2.99	0	0.00%	0.00%	100.00%
2	3 - 5.49	16	14.16%	14.16%	85.84%
3	5.5 - 6.99	34	30.09%	44.25%	55.75%
4	7 - 8.99	41	36.28%	80.53%	19.47%
5	9 - 10.99	22	19.47%	100.00%	0.00%
6	11 - 12.99	0	0.00%	100.00%	0.00%
7	13 - 14.99	0	0.00%	100.00%	0.00%
8	15 - 16.99	0	0.00%	100.00%	0.00%
9	17 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Single)					
1	0 - 8.16	16	4.58%	4.58%	95.42%
2	8.17 - 9.99	61	17.48%	22.06%	77.94%
3	10 - 10.99	43	12.32%	34.38%	65.62%
4	11 - 11.99	36	10.32%	44.70%	55.30%
5	12 - 12.99	40	11.46%	56.16%	43.84%
6	13 - 13.99	19	5.44%	61.60%	38.40%
7	14 - 14.99	31	8.88%	70.49%	29.51%
8	15 - 19.99	95	27.22%	97.71%	2.29%
9	20 & Above	8	2.29%	100.00%	0.00%
Rear Axle Load Spectrum (Tandem)					
1	0 - 11.99	0	0.00%	0.00%	100.00%
2	12 - 14.99	1	1.09%	1.09%	98.91%
3	15 - 19.99	14	15.22%	16.30%	83.70%
4	20 - 21.99	10	10.87%	27.17%	72.83%
5	22 - 23.99	8	8.70%	35.87%	64.13%
6	24 - 25.99	9	9.78%	45.65%	54.35%
7	26 - 27.99	7	7.61%	53.26%	46.74%
8	28 - 29.99	10	10.87%	64.13%	35.87%
9	30 & Above	33	35.87%	100.00%	0.00%
Rear Axle Load Spectrum (Tridem)					
1	0 - 14.99	0	0.00%	0.00%	100.00%
2	15 - 30.99	13	28.89%	28.89%	71.11%
3	31 - 32.99	7	15.56%	44.44%	55.56%
4	33 - 34.99	3	6.67%	51.11%	48.89%
5	35 - 36.99	2	4.44%	55.56%	44.44%
6	37 - 38.99	7	15.56%	71.11%	28.89%
7	39 - 40.99	0	0.00%	71.11%	28.89%
8	41 - 42.99	2	4.44%	75.56%	24.44%
9	43 & Above	11	24.44%	100.00%	0.00%

9.2.5 Distribution of Vehicles by Make Type on QDP

The distribution of trucks as per make type is illustrated in Table 9-5 and is graphically presented in Figure 9-5. The results depict that Hino and Mercedes have maximum percentage of 81.82% and 7.27% on QDP.

Table 9-5: Percentage of Vehicles w.r.t Make Type on QDP

Sr. No.	Make	Count	%age
1	Nissan	3	2.73%
2	Hino	90	81.82%
3	Isuzu	1	0.91%
4	Mercedes	8	7.27%
5	UD	3	2.73%
6	others	5	4.55%
Total		110	100.00%

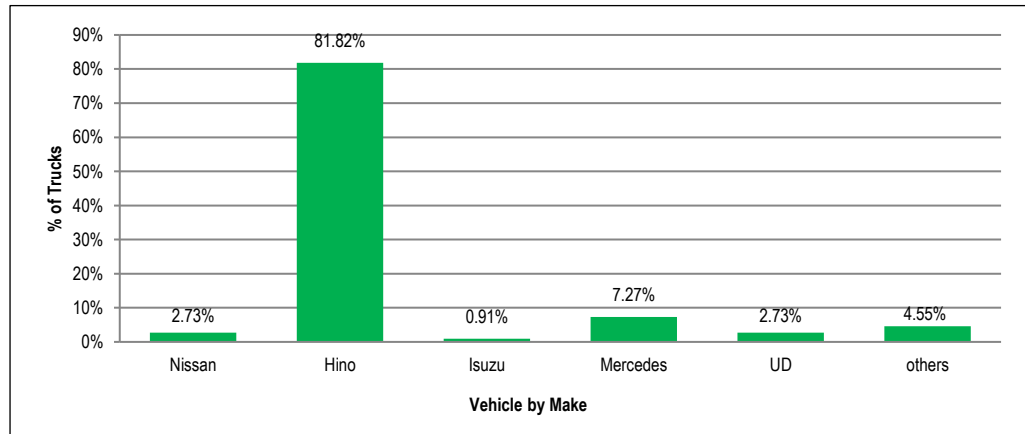


Figure 9-5: Percentage of Vehicles w.r.t Make Type on QDP

9.2.6 Analysis by Make Type on QDP

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to make type is presented in Table 9-6. The results depict that:

In case of **2 Axle Single**, Hino constitutes maximum percentage of 100%, with average gross load of 21.10 ton.

In case of **3 Axle Tandem**, Hino constitutes maximum percentage of 92.16%, with average gross load of 35.51 ton, followed by UD with percentage of 3.92%, carrying average gross load of 39.64 ton.

In case of **4 Axle Single Tandem**, Hino constitutes maximum percentage of 85.71% with average gross load of 40.54 ton.

In case of **5 Axle Single Tridem**, Hino constitutes maximum percentage of 61.54%, with average gross load of 43.79 ton, followed by Mercedes with percentage of 23.08%, carrying average gross load of 40.57 ton.

In case of **6 Axle Tandem Tridem**, Hino constitutes maximum percentage of 68.75%, with average gross load of 74.85 ton, followed by Mercedes with percentage of 15.63%, carrying average gross load of 67.31 ton.

Table 9-6: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Make Type for major Axle Configuration on QDP

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						Total	
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5		
1	2 Axle Single	Hino	7	100.00%	Min. Load	4.65	10.35						15.00
					Max. Load	8.06	17.94					26.00	
					Avg. Load	6.54	14.56					21.10	
					Standard Deviation	1.23	2.73					3.95	
					Variance	1.50	7.44					15.63	
Total			7	100.00%									

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
2	3 Axle Tandem	Hino	47	92.16%	Min. Load	4.05	7.18	7.18				18.40
					Max. Load	9.76	17.30	17.30				44.35
					Avg. Load	7.81	13.85	13.85				35.51
					Standard Deviation	1.44	2.55	2.55				6.53
					Variance	2.06	6.49	6.49				42.65
		Isuzu	1	1.96%	Min. Load	8.26	14.64	14.64				37.54
					Max. Load	8.26	14.64	14.64				37.54
					Avg. Load	8.26	14.64	14.64				37.54
					Standard Deviation	-	-	-				-
		UD	2	3.92%	Min. Load	7.95	14.09	14.09				36.12
					Max. Load	9.50	16.83	16.83				43.17
					Avg. Load	8.72	15.46	15.46				39.64
					Standard Deviation	1.10	1.94	1.94				4.98
					Variance	1.20	3.77	3.77				24.82
		Others	1	1.96%	Min. Load	6.57	11.64	11.64				29.85
					Max. Load	6.57	11.64	11.64				29.85
					Avg. Load	6.57	11.64	11.64				29.85
Standard Deviation	-				-	-				-		
Total	51	100.00%	Min. Load									
			Max. Load									
			Avg. Load									
			Standard Deviation									
			Variance									
3	4 Axle Single Tandem	Hino	6	85.71%	Min. Load	5.97	10.89	8.43	9.84			35.14
					Max. Load	7.89	14.38	11.13	12.99			46.39
					Avg. Load	6.89	12.57	9.73	11.35			40.54
					Standard Deviation	0.71	1.30	1.00	1.17			4.19
					Variance	0.51	1.68	1.01	1.37			17.52
		Nissan	1	14.29%	Min. Load	7.74	14.12	10.93	12.75			45.55
					Max. Load	7.74	14.12	10.93	12.75			45.55
					Avg. Load	7.74	14.12	10.93	12.75			45.55
					Standard Deviation	-	-	-	-			-
					Variance	-	-	-	-			-
Total	7	100.00%	Min. Load									
			Max. Load									
			Avg. Load									
			Standard Deviation									
			Variance									
			Total									
4	5 Axle Single Tridem	Hino	8	61.54%	Min. Load	4.59	8.12	7.06	7.42	8.12		35.32
					Max. Load	6.97	12.33	10.72	11.25	12.33		53.59
					Avg. Load	5.69	10.07	8.76	9.20	10.07		43.79
					Standard Deviation	0.77	1.37	1.19	1.25	1.37		5.95
					Variance	0.60	1.87	1.42	1.56	1.87		35.38
		Mercedes	3	23.08%	Min. Load	4.21	7.45	6.48	6.81	7.45		32.41
					Max. Load	6.31	11.16	9.70	10.19	11.16		48.52
					Avg. Load	5.27	9.33	8.11	8.52	9.33		40.57
					Standard Deviation	1.05	1.85	1.61	1.69	1.85		8.06
					Variance	1.10	3.43	2.60	2.86	3.43		64.92
		Others	2	15.38%	Min. Load	6.59	11.66	10.14	10.65	11.66		50.70
					Max. Load	7.04	12.45	10.82	11.37	12.45		54.12
					Avg. Load	6.81	12.05	10.48	11.01	12.05		52.41
					Standard Deviation	0.31	0.56	0.48	0.51	0.56		2.42
		Total	13	100.00%	Min. Load							
					Max. Load							
					Avg. Load							
Standard Deviation												
Variance												
Total												
5	6 Axle Tandem Tridem	Hino	22	68.75%	Min. Load	4.85	8.25	8.73	7.76	8.73	10.19	48.52
					Max. Load	9.99	16.98	17.98	15.98	17.98	20.98	99.90
					Avg. Load	7.49	12.73	13.47	11.98	13.47	15.72	74.85
					Standard Deviation	1.83	3.12	3.30	2.94	3.30	3.85	18.35
					Variance	3.37	9.73	10.91	8.62	10.91	14.84	336.62
		Nissan	2	6.25%	Min. Load	5.86	9.96	10.54	9.37	10.54	12.30	58.56
					Max. Load	9.92	16.87	17.86	15.88	17.86	20.84	99.24
					Avg. Load	7.89	13.41	14.20	12.62	14.20	16.57	78.90
					Standard Deviation	2.88	4.89	5.18	4.60	5.18	6.04	28.76
		UD	1	3.13%	Min. Load	8.27	23.91	26.80	21.18	26.80	36.48	827.23
					Max. Load	9.89	16.81	17.80	15.82	17.80	20.76	98.87
					Max. Load	9.89	16.81	17.80	15.82	17.80	20.76	98.87
					Avg. Load	9.89	16.81	17.80	15.82	17.80	20.76	98.87
					Standard Deviation	-	-	-	-	-	-	-
		Mercedes	5	15.63%	Min. Load	5.00	8.50	9.00	8.00	9.00	10.50	49.99
					Max. Load	7.55	12.84	13.60	12.09	13.60	15.86	75.54
					Avg. Load	6.73	11.44	12.12	10.77	12.12	14.14	67.31
					Standard Deviation	1.05	1.79	1.89	1.68	1.89	2.21	10.51
					Variance	1.11	3.19	3.58	2.83	3.58	4.87	110.53
		Others	2	6.25%	Min. Load	5.29	8.99	9.52	8.46	9.52		52.88
					Max. Load	9.31	15.82	16.75	14.89	16.75		93.08
					Avg. Load	7.30	12.41	13.14	11.68	13.14		72.98
					Standard Deviation	2.84	4.83	5.12	4.55	5.12		28.42
		Total	32	100.00%	Min. Load							
					Max. Load							
					Avg. Load							
					Standard Deviation							
Variance												
Total												

9.2.7 Distribution of Vehicles by Body Type on QDP

The percentage of vehicles with respect to Body Type i.e. Flat, Half, Full & Container plying on QDP is tabulated in Table 9-7 and is graphically presented in Figure 9-6.

Table 9-7: Percentage of Vehicles w.r.t Body Type on QDP

Sr.No.	Body Type	Count	%age
1	Half	2	1.77%
2	Full	67	59.29%
3	Covered	12	10.62%
4	Container	32	28.32%
Total		113	100.00%

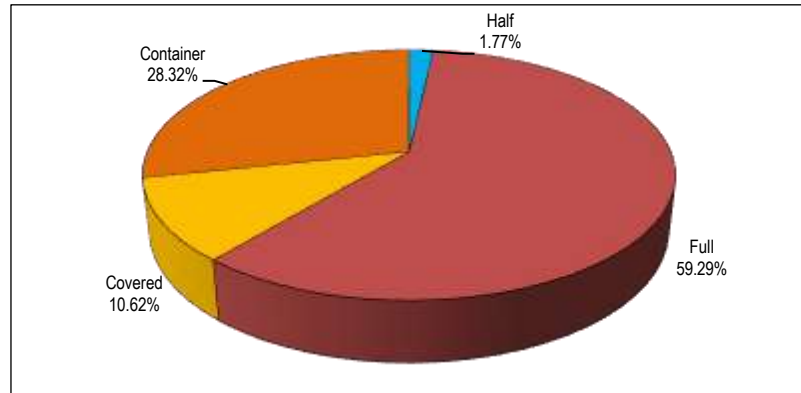


Figure 9-6 : Percentage of Vehicles w.r.t Body Type on QDP

9.2.8 Analysis by Body Type on QDP

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to body type is presented in Table 9-8. The results depict that:

In case of **2 Axle Single**, full body type constitutes maximum percentage of 50%, with average gross load of 22 ton, followed by container body type with percentage of 37.5%, carrying average gross load of 19.13 ton.

In case of **3 Axle Tandem**, full body type constitutes maximum percentage of 82.35%, with average gross load of 35.80 ton, followed by covered type with percentage of 11.76%, carrying average gross load of 35.02 ton.

In case of **4 Axle Single Tandem**, container body type constitutes maximum percentage of 88.89%, with average Load gross load of 41.48 ton.

In case of **5 Axle Single Tridem**, container body type constitutes maximum percentage of 69.23%, with average gross load of 46.18 ton, followed by covered type with percentage of 23.08%, carrying average gross load of 35.70 ton.

In case of **6 Axle Tandem Tridem**, full body type constitutes maximum percentage of 59.38%, with average gross load of 74.20 ton, followed by container body type with percentage of 28.13%, carrying average gross load of 65.28 ton.

Table 9-8: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Body Type for major Axle Configuration on QDP

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Full	4	50.00%	Min. Load	5.43	12.08					17.50
					Max. Load	8.06	17.94					26.00
					Avg. Load	6.82	15.18					22.00
					Standard Deviation	1.13	2.52					3.65
					Variance	1.28	6.35					13.34
		Covered	1	12.50%	Min. Load	6.22	13.84					20.07
					Max. Load	6.22	13.84					20.07
					Avg. Load	6.22	13.84					20.07
					Standard Deviation	-	-					-
					Variance	-	-					-

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)								
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total		
		Container	3	37.50%	Min. Load	4.65	10.35					15.00		
					Max. Load	7.63	16.97				24.60			
					Avg. Load	5.93	13.20				19.13			
					Standard Deviation	1.53	3.41				4.94			
					Variance	2.34	11.60				24.37			
	Total		8	100.00%										
2	3 Axle Tandem	Full	42	82.35%	Min. Load	4.05	7.18	7.18				18.40		
					Max. Load	9.76	17.30	17.30			44.35			
					Avg. Load	7.88	13.96	13.96			35.80			
					Standard Deviation	1.37	2.43	2.43			6.23			
					Variance	1.88	5.91	5.91			38.84			
		Covered	6	11.76%	Min. Load	5.10	9.05	9.05			23.20			
					Max. Load	9.50	16.83	16.83			43.17			
					Avg. Load	7.70	13.66	13.66			35.02			
					Standard Deviation	1.77	3.14	3.14			8.06			
		Container	3	5.88%	Min. Load	5.63	9.98	9.98			25.60			
					Max. Load	9.12	16.17	16.17			41.47			
					Avg. Load	7.46	13.23	13.23			33.92			
					Standard Deviation	1.75	3.11	3.11			7.96			
			Total		51	100.00%								
		3	4 Axle Single Tandem	Full	1	11.11%	Min. Load	6.97	12.72	9.84	11.49			41.02
							Max. Load	-	12.72	9.84	11.49			41.02
							Avg. Load	6.97	12.72	9.84	11.49			41.02
Standard Deviation	-						-	-	-			-		
Variance	-						-	-	-			-		
Container	8			88.89%	Min. Load	5.97	10.89	8.43	9.84			35.14		
					Max. Load	7.89	14.38	11.13	12.99			46.39		
					Avg. Load	7.05	12.86	9.95	11.61			41.48		
					Standard Deviation	0.68	1.25	0.96	1.13			-		
	Total				9	100.00%								
4	5 Axle Single Tridem			Full	1	7.69%	Min. Load	7.04	12.45	10.82	11.37	12.45		54.12
							Max. Load	7.04	12.45	10.82	11.37	12.45		54.12
							Avg. Load	7.04	12.45	10.82	11.37	12.45		54.12
		Standard Deviation	-				-	-	-	-		-		
		Variance	-				-	-	-	-		-		
		Covered	3	23.08%	Min. Load	4.21	7.45	6.48	6.81	7.45		32.41		
					Max. Load	5.12	9.06	7.88	8.27	9.06		39.38		
					Avg. Load	4.64	8.21	7.14	7.50	8.21		35.70		
					Standard Deviation	0.46	0.81	0.70	0.74	0.81		3.50		
		Container	9	69.23%	Min. Load	5.24	9.27	8.06	8.47	9.27		40.32		
					Max. Load	6.97	12.33	10.72	11.25	12.33		53.59		
					Avg. Load	6.00	10.62	9.24	9.70	10.62		46.18		
					Standard Deviation	0.62	1.10	0.96	1.01	1.10		4.80		
			Total		13	100.00%								
		5	6 Axle Tandem Tridem	Half	2	6.25%	Min. Load	9.49	16.13	17.08	15.18	17.08	19.93	94.90
							Max. Load	9.57	16.27	17.22	15.31	17.22	20.09	95.69
							Avg. Load	9.53	16.20	17.15	15.25	17.15	20.01	95.30
Standard Deviation	0.06						0.09	0.10	0.09	0.10	0.12	0.56		
Variance	0.00						0.01	0.01	0.01	0.01	0.01	0.31		
Full	19			59.38%	Min. Load	5.15	8.76	9.28	8.25	9.28	10.82	51.54		
					Max. Load	9.99	16.98	17.98	15.98	17.98	20.98	99.90		
					Avg. Load	7.42	12.61	13.36	11.87	13.36	15.58	74.20		
					Standard Deviation	1.51	2.56	2.71	2.41	2.71	3.16	15.06		
Covered	2			6.25%	Min. Load	2.27	6.56	7.35	5.81	7.35	10.00	226.85		
					Max. Load	9.89	16.81	17.80	15.82	17.80	20.76	98.87		
					Avg. Load	9.92	16.87	17.86	15.88	17.86	20.84	99.24		
					Standard Deviation	0.03	0.04	0.05	0.04	0.05	0.05	0.26		
Container	9			28.13%	Min. Load	0.00	0.00	0.00	0.00	0.00	0.00	0.07		
					Max. Load	4.85	8.25	8.73	7.76	8.73	10.19	48.52		
					Avg. Load	9.92	16.87	-	15.88	17.86	20.84	99.24		
					Standard Deviation	6.53	11.10	11.75	10.44	11.75	13.71	65.28		
	Total				32	100.00%								
							3.90	11.28	12.65	9.99	12.65	17.21	390.34	

9.2.9 Distribution of Vehicles by Type on QDP

The percentage of vehicles with respect to Type i.e., Truck and Semi-Trailer plying on QDP is tabulated in Table 9-9 and is graphically presented in Figure 9-7.

Table 9-9: Percentage of Vehicles w.r.t Type on QDP

Sr. No.	Vehicle Type	Count	Percentage
1	Truck	59	52.21%
2	Semi-Trailer	54	47.79%
Total		113	100.00%

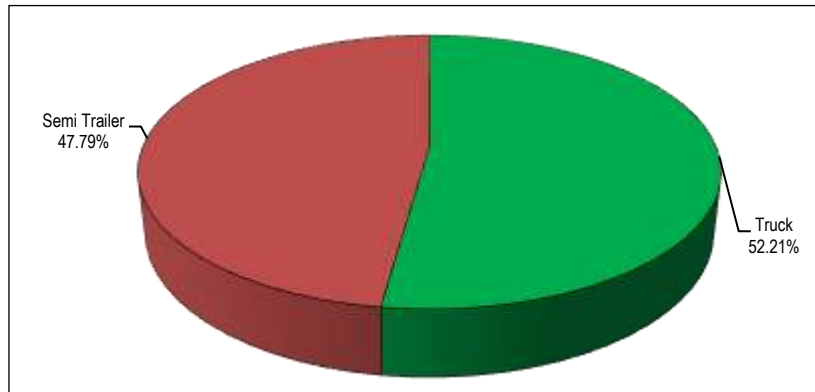


Figure 9-7: Percentage of Vehicles w.r.t Type on QDP

9.2.10 Analysis by Vehicle Type on QDP

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to truck type is presented in Table 9-10. The results depict that:

In case of **2 Axle Single**, truck type constitutes maximum percentage of 100%, with average gross load of 20.68 ton.

In case of **3 Axle Tandem**, truck type constitutes maximum percentage of 100%, with average gross load of 35.60 ton.

In case of **4 Axle Single Tandem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 41.43 ton.

In case of **5 Axle Single Tridem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 44.37 ton.

In case of **6 Axle Tandem Tridem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 74.56 ton.

Table 9-10: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Type for major Axle Configuration on QDP

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)							
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total	
1	2 Axle Single	Truck	8	100.00%	Min. Load	4.65	10.35						15.00
					Max. Load	8.06	17.94					26.00	
					Avg. Load	6.41	14.27					20.68	
					Standard Deviation	1.19	2.65					3.84	
					Variance	1.42	7.02					14.76	
Total		8	100.00%										
2	3 Axle Tandem	Truck	51	100.00%	Min. Load	4.05	7.18	7.18					18.40
					Max. Load	9.76	17.30	17.30				44.35	
					Avg. Load	7.83	13.88	13.88				35.60	
					Standard Deviation	1.41	2.50	2.50				6.41	
					Variance	1.99	6.26	6.26				41.13	
Total		51	100.00%										
3	4 Axle Single Tandem	Semi-Trailer	9	100.00%	Min. Load	5.97	10.89	8.43	9.84	0.00		35.14	
					Max. Load	7.89	14.38	11.13	12.99	0.00		46.39	
					Avg. Load	7.04	12.84	9.94	11.60	-		41.43	
					Standard Deviation	0.64	1.17	0.90	1.05	0.00		3.76	
					Variance	0.41	1.36	0.82	1.11	0.00		14.16	
Total		9	100.00%										
4	5 Axle Single Tridem	Semi-Trailer	13	100.00%	Min. Load	4.21	7.45	6.48	6.81	7.45		32.41	
					Max. Load	7.04	12.45	10.82	11.37	12.45		54.12	
					Avg. Load	5.77	10.21	8.87	9.32	10.21		44.37	
					Standard Deviation	0.89	1.57	1.36	1.43	1.57		6.82	
					Variance	0.79	2.46	1.86	2.05	2.46		46.56	
Total		13	100.00%										

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
5	6 Axle Tandem Tridem	Semi-Trailer	32	100.00%	Min. Load	4.85	8.25	8.73	7.76	8.73	10.19	48.52
					Max. Load	9.99	16.98	17.98	15.98	17.98	20.98	99.90
					Avg. Load	7.46	12.68	13.42	11.93	13.42	15.66	74.56
					Standard Deviation	1.80	3.06	3.24	2.88	3.24	3.78	18.00
					Variance	3.24	9.36	10.50	8.29	10.50	14.29	324.01
		Total	32	100.00%								

9.2.11 Commodities carried by vehicles on QDP

The percentage of major commodities carried by heavy vehicles on QDP is tabulated in Table 9-11 and is graphically presented in Figure 9-8. For the sake of analysis, each commodity is assigned a code; details are attached in Annex – 2.

Table 9-11: Percentage of Vehicle w.r.t Commodities on QDP

Sr. No.	Commodities	Code	Count	%age
1	Agriculture Items	100	2	1.77%
2	Food Items	200	69	59.29%
3	Animals and Animal Products	300	1	0.88%
4	Bulk Manufactures	500	12	10.62%
5	Basic Manufactures	600	15	13.27%
6	Miscellaneous Manufactures	700	9	7.96%
7	Fuel, Lubricants (Minerals)	900	5	4.42%
8	Miscellaneous Goods not Classified	A00	2	1.77%
	Total		113	100.00%

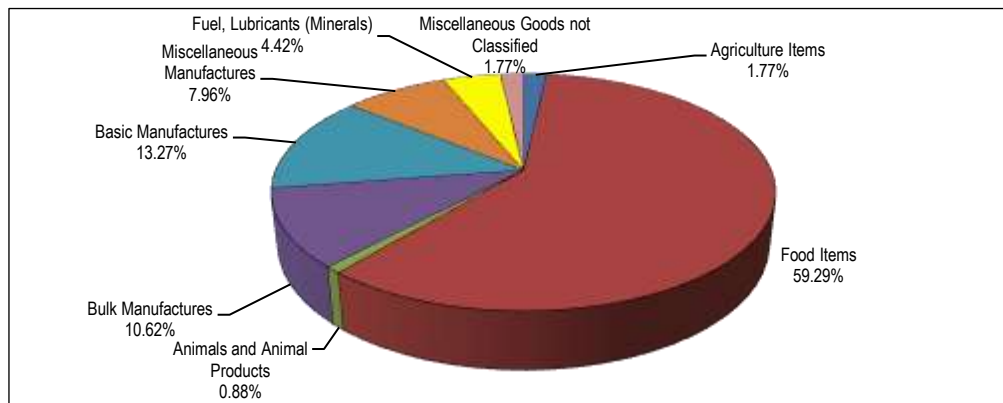


Figure 9-8: Percentage of Vehicles w.r.t Commodities on QDP

9.2.12 Analysis based on Commodities on QDP

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to commodities carried by trucks is presented in Table 9-12. The results depict that:

Major commodity carried by **2 Axle Single** is food items, covering 75%, with average gross load of 22.11 ton.

Major commodities carried by **3 Axle Tandem** are food items, covering 70.59% of the total, with average gross load of 36.17 ton, followed by bulk manufactures having percentage of 11.76%, with average gross load of 30.63 ton.

Major commodities carried by **4 Axle Single Tandem** are food items, covering 44.44% of the total, with average gross load of 39.13 ton, followed by miscellaneous manufactures, having percentage of 33.33% in total, with average gross load of 43.24 ton.

Major commodities carried by **5 Axle Single Tridem** are food items, covering 46.15%, with average gross load of 48.32 ton, followed by basic manufactures, having percentage of 38.46%, with average gross load of 41.08 ton.

Major commodities carried by **6 Axle Tandem Tridem** are food items, covering 46.88%

of the total, with average gross load of 69.67 ton, followed by basic Manufactures, having percentage of 18.75% in total, with average gross load of 68.40 ton.

Table 9-12: Stdev. Var., Min., Max. & Avg. Load Comparison w.r.t Commodities for major Axle Configuration on QDP

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						Total		
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5			
1	2 Axle Single	Food Items	200	6	75.00%	Min. Load	5.43	12.08					17.50		
						Max. Load	8.06	17.94					26.00		
						Avg. Load	6.85	15.26					22.11		
						Standard Deviation	0.98	2.19					3.18		
		Bulk Manufactures	500	1	12.50%	Min. Load	5.52	12.28						17.80	
						Max. Load	5.52	12.28					17.80		
						Avg. Load	5.52	12.28					17.80		
						Standard Deviation	-	-					-		
		Basic Manufactures	600	1	12.50%	Min. Load	4.65	10.35						15.00	
						Max. Load	4.65	10.35					15.00		
						Avg. Load	4.65	10.35					15.00		
Standard Deviation	-					-					-				
Total				8	100%										
2	3 Axle Tandem	Food Items	200	36	70.59%	Min. Load	5.50	9.75	9.75				25.00		
						Max. Load	9.50	16.83	16.83				43.17		
						Avg. Load	7.96	14.11	14.11				36.17		
						Standard Deviation	1.20	2.12	2.12				5.44		
						Variance	1.43	4.51	4.51				29.62		
		Animals and Animal Products	300	1	1.96%	Min. Load	5.48	9.71	9.71					24.90	
						Max. Load	5.48	9.71	9.71				24.90		
						Avg. Load	5.48	9.71	9.71				24.90		
						Standard Deviation	-	-	-				-		
		Bulk Manufactures	500	6	11.76%	Min. Load	4.05	7.18	7.18					18.40	
						Max. Load	9.01	15.96	15.96				40.94		
						Avg. Load	6.74	11.95	11.95				30.63		
						Standard Deviation	1.99	3.52	3.52				9.03		
						Variance	3.95	12.41	12.41				81.62		
		Basic Manufactures	600	2	3.92%	Min. Load	5.30	9.40	9.40					24.10	
						Max. Load	8.09	14.35	14.35				36.79		
						Avg. Load	6.70	11.87	11.87				30.44		
						Standard Deviation	1.97	3.50	3.50				8.97		
		Miscellaneous Manufactures	700	2	3.92%	Min. Load	8.70	15.42	15.42					39.54	
						Max. Load	9.12	16.17	16.17				41.47		
						Avg. Load	8.91	15.80	15.80				40.51		
						Standard Deviation	0.30	0.53	0.53				1.36		
		Fuel, Lubricants (Minerals)	900	2	3.92%	Min. Load	9.24	16.39	16.39					42.02	
						Max. Load	9.76	17.30	17.30				44.35		
Avg. Load	9.50					16.84	16.84				43.19				
Standard Deviation	0.36					0.64	0.64				1.65				
Miscellaneous Goods not Classified	A00	2	3.92%	Min. Load	7.68	13.61	13.61					34.90			
				Max. Load	9.14	16.20	16.20				41.54				
				Avg. Load	8.41	14.91	14.91				38.22				
				Standard Deviation	1.03	1.83	1.83				4.70				
Total				51	100.00%										
3	4 Axle Single Tandem	Food Items	200	4	44.44%	Min. Load	5.97	10.89	8.43	9.84			35.14		
						Max. Load	7.36	13.42	10.39	12.12			43.30		
						Avg. Load	6.65	12.13	9.39	10.96			39.13		
						Standard Deviation	0.68	1.25	0.97	1.13			4.02		
						Variance	0.47	1.56	0.93	1.27			16.18		
		Basic Manufactures	600	1	11.11%	Min. Load	7.74	14.12	10.93	12.75			45.55		
						Max. Load	7.74	14.12	10.93	12.75			45.55		
						Avg. Load	7.74	14.12	10.93	12.75			45.55		
						Standard Deviation	-	-	-	-			-		
		Miscellaneous Manufactures	700	3	33.33%	Min. Load	6.92	12.62	9.77	11.40			40.72		
						Max. Load	7.89	14.38	11.13	12.99			46.39		
						Avg. Load	7.35	13.40	10.38	12.11			43.24		
						Standard Deviation	0.49	0.89	0.69	0.81			2.88		
		Fuel, Lubricants (Minerals)	900	1	11.11%	Min. Load	6.97	12.72	9.84	11.49			41.02		
						Max. Load	6.97	12.72	9.84	11.49			41.02		
Avg. Load	6.97					12.72	9.84	11.49			41.02				
Standard Deviation	-					-	-	-			-				
Total				9	100.00%										

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)								
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total		
4	5 Axle Single Tridem	Food Items	200	6	46.15%	Min. Load	5.24	9.27	8.06	8.47	9.27		40.32		
						Max. Load	7.04	12.45	10.82	11.37	12.45		54.12		
						Avg. Load	6.28	11.11	9.66	10.15	11.11		48.32		
						Standard Deviation	0.59	1.05	0.91	0.96	1.05		4.55		
						Variance	0.35	1.10	0.83	0.91	1.10		20.75		
		Basic Manufactures	600	5	38.46%	Min. Load	4.21	7.45	6.48	6.81	7.45		32.41		
						Max. Load	6.97	12.33	10.72	11.25	12.33		53.59		
						Avg. Load	5.34	9.45	8.22	8.63	9.45		41.08		
						Standard Deviation	1.09	1.93	1.68	1.76	1.93		8.38		
		Miscellaneous Manufactures	700	2	15.38%	Min. Load	5.29	9.37	8.14	8.55	9.37		40.72		
						Max. Load	5.30	9.38	8.16	8.56	9.38		40.79		
						Avg. Load	5.30	9.37	8.15	8.56	9.37		40.75		
						Standard Deviation	0.01	0.01	0.01	0.01	0.01		0.05		
Total				13	100.00%										
5	6 Axle Tandem Tridem	Agriculture Items	100	2	6.25%	Min. Load	7.05	11.99	12.70	11.29	12.70	14.81	70.54		
						Max. Load	9.49	16.13	17.08	15.18	17.08	19.93	94.90		
						Avg. Load	8.27	14.06	14.89	13.24	14.89	17.37	82.72		
						Standard Deviation	1.72	2.93	3.10	2.76	3.10	3.62	17.23		
						Variance	2.97	8.57	9.61	7.60	9.61	13.08	296.70		
		Food Items	200	15	46.88%	Min. Load	4.85	8.25	8.73	7.76	8.73	10.19	48.52		
						Max. Load	9.92	16.87	17.86	15.88	17.86	20.84	99.24		
						Avg. Load	6.97	11.84	12.54	11.15	12.54	14.63	69.67		
						Standard Deviation	1.75	2.98	3.15	2.80	3.15	3.68	17.51		
		Bulk Manufactures	500	5	15.63%	Min. Load	5.64	9.58	10.15	9.02	10.15	11.84	56.38		
						Max. Load	9.99	16.98	17.98	15.98	17.98	20.98	99.90		
						Avg. Load	8.86	15.06	15.95	14.18	15.95	18.61	88.60		
						Standard Deviation	1.81	3.08	3.26	2.90	3.26	3.80	18.11		
		Basic Manufactures	600	6	18.75%	Min. Load	5.29	8.99	9.52	8.46	9.52	11.10	52.88		
						Max. Load	9.31	15.82	16.75	14.89	16.75	19.55	93.08		
						Avg. Load	6.84	11.63	12.31	10.94	12.31	14.36	68.40		
						Standard Deviation	1.38	2.34	2.48	2.21	2.48	2.89	13.78		
		Miscellaneous Manufactures	700	2	6.25%	Min. Load	1.90	5.49	6.16	4.86	6.16	8.38	190.01		
						Max. Load	5.87	9.98	10.57	9.40	10.57	12.33	58.73		
						Avg. Load	6.60	11.21	11.87	10.56	11.87	13.85	65.97		
						Standard Deviation	0.51	0.87	0.92	0.82	0.92	1.08	5.12		
		Fuel, Lubricants (Minerals)	900	2	6.25%	Min. Load	0.26	0.76	0.85	0.67	0.85	1.16	26.21		
						Max. Load	9.85	16.74	17.73	15.76	17.73	20.68	98.48		
						Avg. Load	9.89	16.81	17.80	15.82	17.80	20.76	98.87		
						Standard Deviation	9.87	16.77	17.76	15.79	17.76	20.72	98.68		
		Total				32	100.00%								

9.2.13 Damage Factor for major Axle Configuration on QDP

The average damage factors calculated for major axle configuration are presented in Table 9-13.

Table 9-13: Damage Factor for major Axle Configuration on QDP

Sr. No.	Axle Configuration	Code	Damage Factor (2020)	
			Road Note 40	AASHTO 1993
1	2 Axle Single	1.2	15.43	10.47
2	3 Axle Tandem	1.22	27.18	13.02
3	4 Axle Single Tandem	1.2-22	16.02	10.20
4	5 Axle Single Tridem	1.2-222	10.26	6.07
5	6 Axle Tandem Tridem	1.22-222	73.79	27.06

9.3 Lahore Dry Ports (LDP)

The results of axle load survey performed on NLC Lahore Dry Port and Premnagar Dry Port are discussed in subsequent sections.

9.4 NLC Lahore Dry Port

The results of axle load survey performed on NLC Dry Port of LDP are discussed in subsequent sub-sections.

9.4.1 Distribution of Vehicles by Axle Configuration on NLC Dry Port

The percentage of trucks for major axle configurations surveyed on NLC Dry Port is summarized in Table 9-14 and is graphically presented in Figure 9-9.

Table 9-14: Percentage of Vehicle w.r.t Axle Configuration on NLC Dry Port

Sr. No.	Axle Configuration	Code	Total Number of Trucks	%age
1	2 Axle Single	1.2	11	16.18%
2	3 Axle Tandem	1.22	17	25.00%
3	4 Axle Single Tandem	1.2-22	30	44.12%
4	5 Axle Single Tridem	1.2-222	7	10.29%
5	6 Axle Tandem Tridem	1.22-222	3	4.41%
Total			68	100%

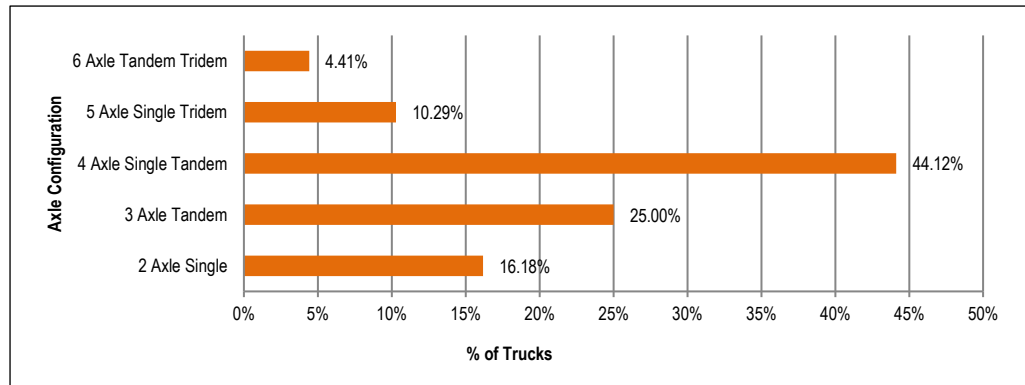


Figure 9-9: Percentage of Vehicles w.r.t Axle Configuration on NLC Dry Port

9.4.2 Analysis by Axle Configuration on NLC Dry Port

The analysis comprising minimum, maximum and average loads per axle carried by trucks on NLC Dry Port along with standard deviation and variance is presented in Table 9-15. The minimum, maximum and average loads are graphically presented in Figure 9-10 and Figure 9-11 respectively.

In case of **2 Axle Single**, maximum load of 21.02 ton with average load of 14.84 ton was recorded.

In case of **3 Axle Tandem**, maximum load of 32.38 ton with average load of 25.49 ton was recorded.

In case of **4 Axle Single Tandem**, maximum load of 54.92 ton with average load of 38.46 ton was recorded.

In case of **5 Axle Single Tridem**, maximum load of 58.67 ton with average load of 52.04 ton was recorded.

In case of **6 Axle Tandem Tridem**, maximum load of 111.00 ton with average load of 70.87 ton was recorded.

Table 9-15: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Axle Configuration on NLC Dry Port

Sr. No.	Axle Configuration	Permissible Load Limits	Parameters	Load (Tons)								
				Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total		
1	2 Axle Single	17.5	Min. Load	2.87	6.38						9.25	
			Max. Load	6.52	14.50							21.02
			Avg. Load	4.60	10.24							14.84
			Standard Deviation	1.12	2.50							3.62
			Variance	1.26	6.25							13.12
2	3 Axle Tandem	27.5	Min. Load	3.86	6.84	6.84					17.55	
			Max. Load	7.12	12.63	12.63					32.38	
			Avg. Load	5.61	9.94	9.94					25.49	
			Standard Deviation	1.13	2.01	2.01					5.15	
			Variance	1.28	4.04	4.04					26.55	
3	4 Axle Single Tandem	39.5	Min. Load	3.13	5.70	4.41	5.15				18.39	
			Max. Load	9.34	17.03	13.18	15.38				54.92	
			Avg. Load	6.54	11.92	9.23	10.77				38.46	
			Standard Deviation	1.66	3.03	2.35	2.74				9.78	
			Variance	2.76	9.18	5.50	7.49				95.56	

Sr. No.	Axle Configuration	Permissible Load Limits	Parameters	Load (Tons)						
				Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
4	5 Axle Single Tridem	48.5	Min. Load	3.99	7.07	6.15	6.45	7.07	30.73	
			Max. Load	7.63	13.49	11.73	12.32	13.49	58.67	
			Avg. Load	6.77	11.97	10.41	10.93	11.97	52.04	
			Standard Deviation	1.32	2.34	2.04	2.14	2.34	10.19	
			Variance	1.75	5.49	4.15	4.58	5.49	103.79	
5	6 Axle Tandem Tridem	58.5	Min. Load	4.80	8.16	8.64	7.68	8.64	10.08	48.01
			Max. Load	11.10	18.87	19.98	17.76	19.98	23.31	111.00
			Avg. Load	7.09	12.05	12.76	11.34	12.76	14.88	70.87
			Standard Deviation	3.49	5.93	6.28	5.58	6.28	7.32	34.87
			Variance	12.16	35.14	39.39	31.12	39.39	53.62	1215.8

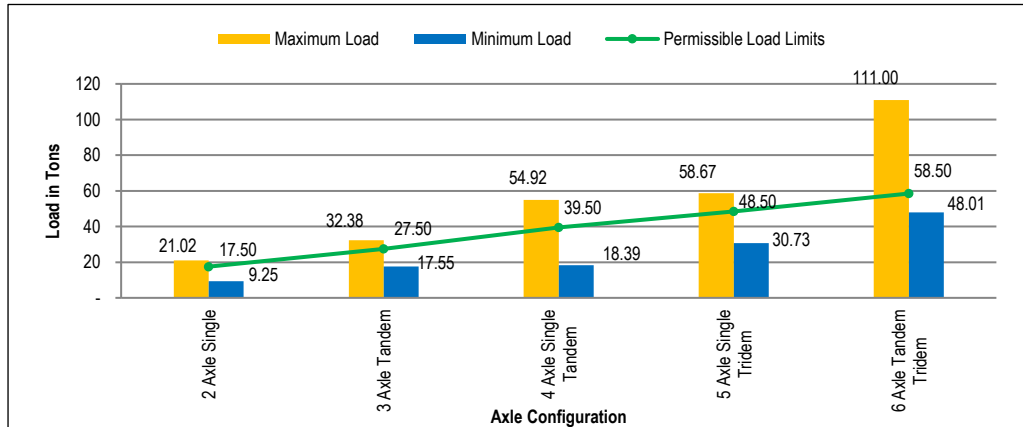


Figure 9-10: Min. & Max. Load Comparison w.r.t Axle Configuration on NLC Dry Port

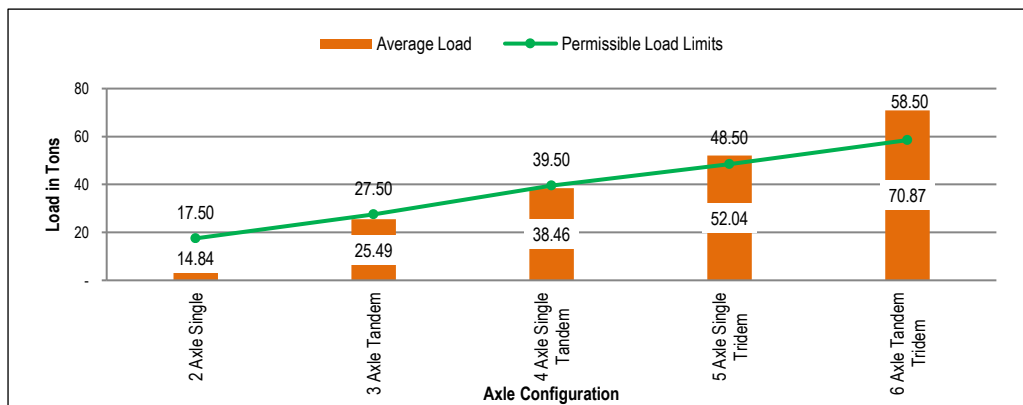


Figure 9-11: Avg. Load Comparison w.r.t Axle Configuration on NLC Dry Port

9.4.3 Load Spectrum by Axle Configuration on NLC Dry Port

The major cause of pavement failure is due to excessive overloading. The axle load survey data was organized in a way to identify the number of vehicles carrying load above and below permissible limits. Furthermore, load spectrums were identified and number of vehicles carrying load in specified spectrums were calculated. The results are tabulated in Table 9-16 which illustrates that:

In case of **2 Axle Single**, 72.73% of trucks carried load under permissible limits. Whereas, 9.09% of the trucks carried load more than 15% of permissible load limits.

In case of **3 Axle Tandem**, 52.94% of trucks carried load under permissible limits. Whereas, 17.65% of the trucks carried load more than 15% of permissible load limits.

In case of **4 Axle Single Tandem**, 43.33% of trucks/semi-trailers carried load under permissible limits. Whereas, 26.67% of the trucks/semi-trailers carried load more than 15% of permissible load limits.

In case of **5 Axle Single Tridem**, 28.57% of semi-trailers carried load under permissible limits. Whereas, 71.43% semi-trailers carried load more than 15% of permissible load limits.

In case of **6 Axle Tandem Tridem**, 66.67% of semi-trailers carried load under permissible limits. Whereas, 33.33% semi-trailers carried load more than 15% of permissible load limits.

The percentage of trucks for major axle configuration carrying load above and below permissible limits on NLC Dry Port is graphically presented in Figure 9-12.

Table 9-16: Load Spectrum w.r.t Axle Configuration on NLC Dry Port

Sr. No.	Axle Configuration	Under Permissible Limit	Over Permissible Limit					Total
			15.00%	30.00%	50.00%	75.00%	>75%	
1	2 Axle Single	Max. Load (Tons)	17.5	20.1	22.8	26.3	30.6	
		Average Load (Tons)	13.13	18.58	21.02	-	-	-
		No. of Trucks	8	2	1	0	0	0
		Percentage	72.73%	18.18%	9.09%	0.00%	0.00%	0.00%
		Cumulative Percentage	72.73%	90.91%	100.00%	100.00%	100.00%	100.00%
		Percentage above Range Value	27.27%	9.09%	0.00%	0.00%	0.00%	0.00%
2	3 Axle Tandem	Max. Load (Tons)	27.5	31.6	35.8	41.3	48.1	
		Average Load (Tons)	21.46	28.72	32.21	-	-	-
		No. of Trucks	9	5	3	0	0	0
		Percentage	52.94%	29.41%	17.65%	0.00%	0.00%	0.00%
		Cumulative Percentage	52.94%	82.35%	100.00%	100.00%	100.00%	100.00%
		Percentage above Range Value	47.06%	17.65%	0.00%	0.00%	0.00%	0.00%
3	4 Axle Single Tandem	Max. Load (Tons)	39.5	45.4	51.4	59.3	69.1	
		Average Load (Tons)	29.49	42.86	47.09	54.92	-	-
		No. of Trucks	13	9	7	1	0	0
		Percentage	43.33%	30.00%	23.33%	3.33%	0.00%	0.00%
		Cumulative Percentage	43.33%	73.33%	96.67%	100.00%	100.00%	100.00%
		Percentage above Range Value	56.67%	26.67%	3.33%	0.00%	0.00%	0.00%
4	5 Axle Single Tridem	Max. Load (Tons)	48.5	55.8	63.1	72.8	84.9	
		Average Load (Tons)	38.87	-	57.32	-	-	-
		No. of Trucks	2	0	5	0	0	0
		Percentage	28.57%	0.00%	71.43%	0.00%	0.00%	0.00%
		Cumulative Percentage	28.57%	28.57%	100.00%	100.00%	100.00%	100.00%
		Percentage above Range Value	71.43%	71.43%	0.00%	0.00%	0.00%	0.00%
5	6 Axle Tandem Tridem	Max. Load (Tons)	58.5	67.3	76.1	87.8	102.4	
		Average Load (Tons)	50.80	-	-	-	-	111.00
		No. of Trucks	2	0	0	0	0	1
		Percentage	66.67%	0.00%	0.00%	0.00%	0.00%	33.33%
		Cumulative Percentage	66.67%	66.67%	66.67%	66.67%	66.67%	100.00%
		Percentage above Range Value	33.33%	33.33%	33.33%	33.33%	33.33%	0.00%

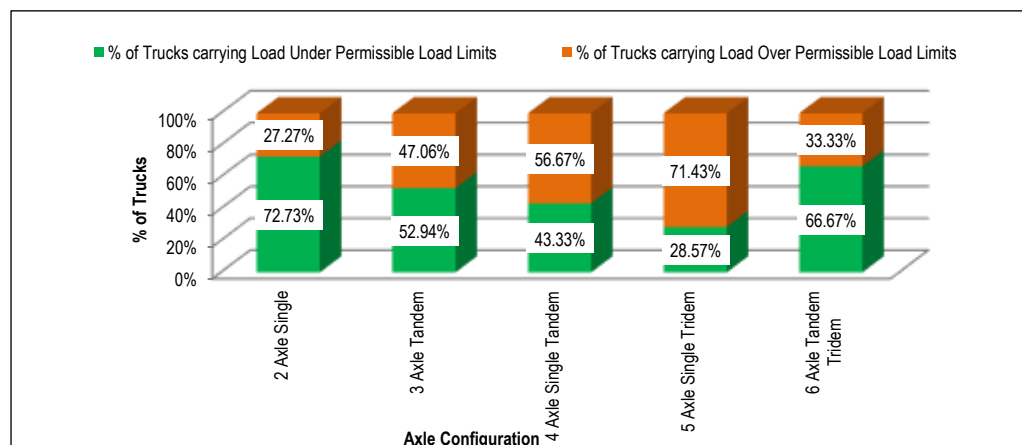


Figure 9-12: Percentage of Vehicles carrying Load above and below Permissible Limits on NLC Dry Port

9.4.4 Front & Rear Axle Load Spectrum on NLC Dry Port

The spectrum of front and rear axle loads for major axle configurations is presented in Table 9-17.

Table 9-17: Front & Rear Axle Load Spectrum on NLC Dry Port

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
Front Axle Load Spectrum					
1	0 - 2.99	1	1.47%	1.47%	98.53%
2	3 - 5.49	23	33.82%	35.29%	64.71%
3	5.5 - 6.99	21	30.88%	66.18%	33.82%
4	7 - 8.99	21	30.88%	97.06%	2.94%
5	9 - 10.99	1	1.47%	98.53%	1.47%
6	11 - 12.99	1	1.47%	100.00%	0.00%
7	13 - 14.99	0	0.00%	100.00%	0.00%
8	15 - 16.99	0	0.00%	100.00%	0.00%
9	17 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Single)					
1	0 - 8.16	39	21.91%	21.91%	78.09%
2	8.17 - 9.99	27	15.17%	37.08%	62.92%
3	10 - 10.99	23	12.92%	50.00%	50.00%
4	11 - 11.99	30	16.85%	66.85%	33.15%
5	12 - 12.99	24	13.48%	80.34%	19.66%
6	13 - 13.99	19	10.67%	91.01%	8.99%
7	14 - 14.99	8	4.49%	95.51%	4.49%
8	15 - 19.99	7	3.93%	99.44%	0.56%
9	20 & Above	1	0.56%	100.00%	0.00%
Rear Axle Load Spectrum (Tandem)					
1	0 - 11.99	4	8.00%	8.00%	92.00%
2	12 - 14.99	4	8.00%	16.00%	84.00%
3	15 - 19.99	12	24.00%	40.00%	60.00%
4	20 - 21.99	8	16.00%	56.00%	44.00%
5	22 - 23.99	11	22.00%	78.00%	22.00%
6	24 - 25.99	9	18.00%	96.00%	4.00%
7	26 - 27.99	0	0.00%	96.00%	4.00%
8	28 - 29.99	1	2.00%	98.00%	2.00%
9	30 & Above	1	2.00%	100.00%	0.00%
Rear Axle Load Spectrum (Tridem)					
1	0 - 14.99	0	0.00%	0.00%	100.00%
2	15 - 30.99	4	40.00%	40.00%	60.00%
3	31 - 32.99	0	0.00%	40.00%	60.00%
4	33 - 34.99	0	0.00%	40.00%	60.00%
5	35 - 36.99	3	30.00%	70.00%	30.00%
6	37 - 38.99	2	20.00%	90.00%	10.00%
7	39 - 40.99	0	0.00%	90.00%	10.00%
8	41 - 42.99	0	0.00%	90.00%	10.00%
9	43 & Above	1	10.00%	100.00%	0.00%

9.4.5 Distribution of Vehicles by Make Type on NLC Dry Port

The distribution of trucks as per make type is illustrated in Table 9-18 and is graphically presented in Figure 9-13. The results depict that Hino and Nissan have maximum percentage of 48.53% and 38.24% on NLC Dry Port.

Table 9-18: Percentage of Vehicles w.r.t Make Type on NLC Dry Port

Sr. No.	Make	Count	Percentage
1	Nissan	26	38.24%
2	Hino	33	48.53%
3	UD	9	13.24%
Total		68	100.00%

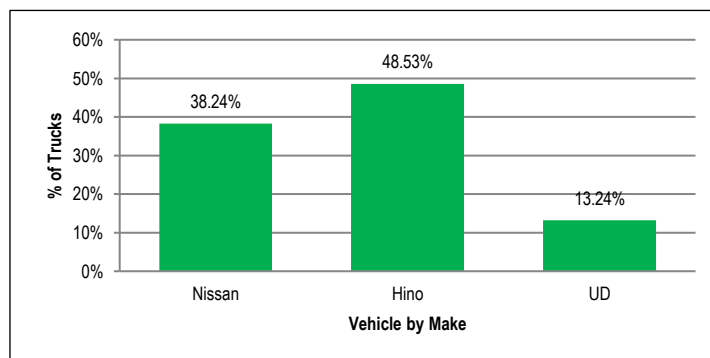


Figure 9-13: Percentage of Vehicles w.r.t Make Type on NLC Dry Port

9.4.6 Analysis by Make Type on NLC Dry Port

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to make type is presented in Table 9-19. The results depict that:

In case of **2 Axle Single**, Nissan and Hino constitute maximum percentage of 45.45% each, with average gross load of 15.14 ton and 13.29 ton respectively.

In case of **3 Axle Tandem**, Hino constitutes maximum percentage of 47.06%, with average gross load of 24.28 ton, followed by UD with percentage of 29.41%, carrying average gross load of 25.19 ton.

In case of **4 Axle Single Tandem**, Hino constitutes maximum percentage of 46.67% with average gross load of 36.34 ton, followed by Nissan with percentage of 43.33%, carrying average gross load of 39.46 ton.

In case of **5 Axle Single Tridem**, Hino constitutes maximum percentage of 57.14%, with average gross load of 55.20 ton, followed by Nissan with percentage of 42.86%, carrying average gross load of 47.83 ton.

In case of **6 Axle Tandem Tridem**, Hino constitutes maximum percentage of 66.67%, with average gross load of 82.30 ton, followed by Nissan with percentage of 33.33%, carrying average gross load of 48.01 ton.

Table 9-19: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Make Type for major Axle Configuration on NLC Dry Port

Sr.No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Nissan	5	45.45%	Min. Load	3.36	7.49					10.85
					Max. Load	5.77	12.85					18.62
					Avg. Load	4.69	10.45					15.14
					Standard Deviation	1.06	2.37					3.43
					Variance	1.13	5.61					11.78
		Hino	5	45.45%	Min. Load	2.87	6.38					9.25
					Max. Load	5.30	11.81					17.11
					Avg. Load	4.12	9.17					13.29
					Standard Deviation	0.90	1.99					2.89
					Variance	0.80	3.98					8.35
		UD	1	9.09%	Min. Load	6.52	14.50					21.02
					Max. Load	6.52	14.50					21.02
					Avg. Load	6.52	14.50					21.02
					Standard Deviation	-	-					-
Variance	-				-					-		
Total	11	100.00%										
2	3 Axle Tandem	Hino	8	47.06%	Min. Load	3.86	6.84	6.84				17.55
					Max. Load	7.12	12.62	12.62				32.36
					Avg. Load	5.34	9.47	9.47				24.28
					Standard Deviation	1.19	2.11	2.11				5.42
					Variance	1.42	4.47	4.47				29.40
		Nissan	4	23.53%	Min. Load	4.55	8.06	8.06				20.67
					Max. Load	7.12	12.63	12.63				32.38
					Avg. Load	6.22	11.03	11.03				28.28
					Standard Deviation	1.19	2.11	2.11				5.41
					Variance	1.42	4.45	4.45				29.25
		UD	5	29.41%	Min. Load	3.96	7.02	7.02				17.99
					Max. Load	6.37	11.29	11.29				28.94
					Avg. Load	5.54	9.82	9.82				25.19
					Standard Deviation	1.03	1.83	1.83				4.69
Variance	1.06				3.35	3.35				21.99		
Total	17	100.00%										
3	4 Axle Single Tandem	Hino	14	46.67%	Min. Load	3.13	5.70	4.41	5.15			18.39
					Max. Load	8.22	14.99	11.61	13.54			48.37
					Avg. Load	6.18	11.27	8.72	10.18			36.34
					Standard Deviation	1.73	3.16	2.45	2.86			10.20
					Variance	3.01	10.01	6.00	8.16			104.12
		Nissan	13	43.33%	Min. Load	3.51	6.39	4.95	5.77			20.62
					Max. Load	9.34	17.03	13.18	15.38			54.92
					Avg. Load	6.71	12.23	9.47	11.05			39.46
					Standard Deviation	1.70	3.11	2.41	2.81			10.03
					Variance	2.91	9.66	5.79	7.88			100.53
		UD	3	10.00%	Min. Load	6.54	11.93	9.24	10.78			38.49
					Max. Load	7.99	14.56	11.28	13.15			46.98

Sr.No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
4	5 Axle Single Tridem	Total	30	100.00%	Avg. Load	7.47	13.62	10.55	12.31			43.95
					Standard Deviation	0.81	1.47	1.14	1.33			4.74
					Variance	0.65	2.16	1.29	1.76			22.45
		Hino	4	57.14%	Min. Load	6.11	10.81	9.40	9.87	10.81		47.00
					Max. Load	7.63	13.49	11.73	12.32	13.49		58.67
					Avg. Load	7.18	12.70	11.04	11.59	12.70		55.20
					Standard Deviation	0.71	1.26	1.10	1.15	1.26		5.50
					Variance	0.51	1.60	1.21	1.33	1.60		30.25
					Min. Load	3.99	7.07	6.15	6.45	7.07		30.73
		Nissan	3	42.86%	Max. Load	7.36	13.03	11.33	11.90	13.03		56.65
Avg. Load	6.22				11.00	9.57	10.04	11.00		47.83		
Standard Deviation	1.93				3.41	2.96	3.11	3.41		14.81		
Variance	3.71				11.61	8.78	9.68	11.61		219.45		
Total	7	100.00%										
5	6 Axle Tandem Tridem	Hino	2	66.67%	Min. Load	5.36	9.11	9.65	8.57	9.65	11.25	53.59
					Max. Load	11.10	18.87	19.98	17.76	19.98	23.31	111.00
					Avg. Load	8.23	13.99	14.81	13.17	14.81	17.28	82.30
					Standard Deviation	4.06	6.90	7.31	6.50	7.31	8.52	40.60
					Variance	16.48	47.63	53.39	42.19	53.39	72.67	1647.95
		Nissan	1	33.33%	Min. Load	4.80	8.16	8.64	7.68	8.64	10.08	48.01
					Max. Load	4.80	8.16	8.64	7.68	8.64	10.08	48.01
					Avg. Load	4.80	8.16	8.64	7.68	8.64	10.08	48.01
					Standard Deviation	-	-	-	-	-	-	-
					Variance	-	-	-	-	-	-	-
Total	3	100.00%										

9.4.7 Distribution of Vehicles by Body Type on NLC Dry Port

The percentage of vehicles with respect to Body Type i.e. Flat, Half, Full & Container plying on NLC Dry Port is tabulated in Table 9-20 and is graphically presented in Figure 9-14.

Table 9-20: Percentage of Vehicles w.r.t Body Type on NLC Dry Port

Sr. No.	Body Type	Count	Percentage
1	Flat	2	2.94%
2	Container	66	97.06%
	Total	68	100.00%

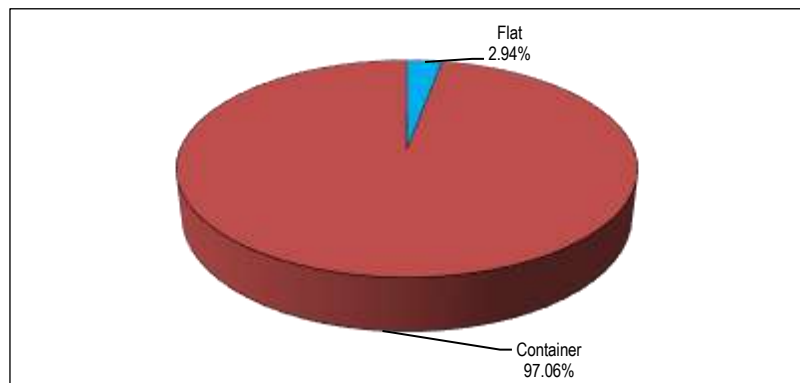


Figure 9-14 : Percentage of Vehicles w.r.t Body Type on NLC Dry Port

9.4.8 Analysis by Body Type on NLC Dry Port

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to body type is presented in Table 9-21. The results depict that:

In case of **2 Axle Single**, container body type constitutes maximum percentage of 100%, with average gross load of 14.84 ton.

In case of **3 Axle Tandem**, container body type constitutes maximum percentage of 94.12%, with average gross load of 25.79 ton.

In case of **4 Axle Single Tandem**, container body type constitutes maximum percentage of 100%, with average gross load of 38.46 ton.

In case of **5 Axle Single Tridem**, container body type constitutes maximum percentage of 100%, with average gross load of 52.04 ton.

In case of **6 Axle Tandem Tridem**, container body type constitutes maximum percentage of 66.67%, with average gross load of 50.80 ton.

Table 9-21: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Body Type for major Axle Configuration on NLC Dry Port

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Container	11	100.00%	Min. Load	2.87	6.38					9.25
					Max. Load	6.52	14.50				21.02	
					Avg. Load	4.60	10.24				14.84	
					Standard Deviation	1.12	2.50				3.62	
					Variance	1.26	6.25				13.12	
	Total		11	100.00%								
2	3 Axle Tandem	Flat	1	5.88%	Min. Load	4.57	8.09	8.09				20.75
					Max. Load	4.57	8.09	8.09			20.75	
					Avg. Load	4.57	8.09	8.09			20.75	
					Standard Deviation	-	-	-			-	
					Variance	-	-	-			-	
		Container	16	94.12%	Min. Load	3.86	6.84	6.84			17.55	
					Max. Load	7.12	12.63	12.63			32.38	
					Avg. Load	5.67	10.06	10.06			25.79	
					Standard Deviation	1.14	2.02	2.02			5.17	
					Variance	1.29	4.07	4.07			26.73	
	Total		17	100.00%								
3	4 Axle Single Tandem	Container	30	100.00%	Min. Load	3.13	5.70	4.41	5.15			18.39
					Max. Load	9.34	17.03	13.18	15.38			54.92
					Avg. Load	6.54	11.92	9.23	10.77			38.46
					Standard Deviation	1.66	3.03	2.35	2.74			-
					Variance	2.76	9.18	5.50	7.49			95.56
	Total		30	100.00%								
4	5 Axle Single Tridem	Container	7	100.00%	Min. Load	3.99	7.07	6.15	6.45	7.07		30.73
					Max. Load	7.63	13.49	11.73	12.32	13.49		58.67
					Avg. Load	6.77	11.97	10.41	10.93	11.97		52.04
					Standard Deviation	1.32	2.34	2.04	2.14	2.34		10.19
					Variance	1.75	5.49	4.15	4.58	5.49		103.79
	Total		7	100.00%								
5	6 Axle Tandem Tridem	Flat	1	33.33%	Min. Load	11.10	18.87	19.98	17.76	19.98	23.31	111.00
					Max. Load	11.10	18.87	19.98	17.76	19.98	23.31	111.00
					Avg. Load	11.10	18.87	19.98	17.76	19.98	23.31	111.00
					Standard Deviation	-	-	-	-	-	-	-
					Variance	-	-	-	-	-	-	-
		Container	2	66.67%	Min. Load	4.80	8.16	8.64	7.68	8.64	10.08	48.01
					Max. Load	5.36	9.11	-	8.57	9.65	11.25	53.59
					Avg. Load	5.08	8.64	9.14	8.13	9.14	10.67	50.80
					Standard Deviation	0.39	0.67	0.71	0.63	0.71	0.83	3.95
					Variance	0.16	0.45	0.50	0.40	0.50	0.69	15.57
	Total		3	100.00%								

9.4.9 Distribution of Vehicles by Type on NLC Dry Port

The percentage of vehicles with respect to Type i.e. Truck, Semi-Trailer and Tanker plying on NLC Dry Port is tabulated in Table 9-22 and is graphically presented in Figure 9-15.

Table 9-22: Percentage of Vehicles w.r.t Type on NLC Dry Port

Sr. No.	Vehicle Type	Count	Percentage
1	Truck	27	39.71%
2	Semi-Trailer	39	57.35%
3	Tanker	2	2.94%
	Total	68	100.00%

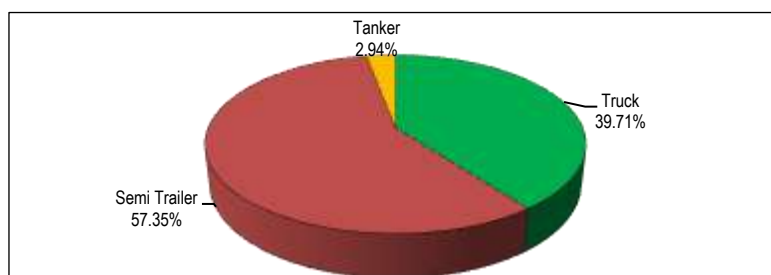


Figure 9-15: Percentage of Vehicles w.r.t Type on NLC Dry Port

9.4.10 Analysis by Vehicle Type on NLC Dry Port

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to truck type is presented in Table 9-23. The results depict that:

In case of **2 Axle Single**, truck type constitutes maximum percentage of 100%, with average gross load of 14.84 ton.

In case of **3 Axle Tandem**, truck type constitutes maximum percentage of 88.24%, with average gross load of 25.35 ton.

In case of **4 Axle Single Tandem**, semi-trailer type constitutes maximum percentage of 96.67%, with average gross load of 39.15 ton.

In case of **5 Axle Single Tridem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 52.04 ton.

In case of **6 Axle Tandem Tridem**, semi-trailer type constitutes maximum percentage of 66.67%, with average gross load of 50.80 ton.

Table 9-23: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Type for major Axle Configuration on NLC Dry Port

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)								
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total		
1	2 Axle Single	Truck	11	100.00%	Min. Load	2.87	6.38					9.25		
					Max. Load	6.52	14.50				21.02			
					Avg. Load	4.60	10.24				14.84			
					Standard Deviation	1.12	2.50				3.62			
		Variance	1.26	6.25				13.12						
		Total	11	100.00%										
2	3 Axle Tandem	Truck	15	88.24%	Min. Load	3.86	6.84	6.84				17.55		
					Max. Load	7.12	12.62	12.62			32.36			
					Avg. Load	5.58	9.89	9.89			25.35			
					Standard Deviation	1.11	1.96	1.96			5.03			
					Variance	1.23	3.85	3.85			25.32			
		Tanker	1	5.88%	Min. Load	4.57	8.09	8.09	0.00	0.00	20.75			
					Max. Load	4.57	8.09	8.09	0.00	0.00	20.75			
					Avg. Load	4.57	8.09	8.09	-	-	20.75			
		Semi-Trailer	1	5.88%	Min. Load	7.12	12.63	12.63	0.00	0.00	32.38			
					Max. Load	7.12	12.63	12.63	0.00	0.00	32.38			
					Avg. Load	7.12	12.63	12.63	-	-	32.38			
				Total	17	100.00%								
		3	4 Axle Single Tandem	Semi-Trailer	29	96.67%	Min. Load	3.14	5.73	4.44	5.17	0.00		18.48
Max. Load	9.34						17.03	13.18	15.38	0.00	54.92			
Avg. Load	6.66						12.14	9.40	10.96	-	39.15			
Standard Deviation	1.56						2.84	2.20	2.57	0.00	9.17			
Variance	2.43						8.08	4.84	6.59	0.00	84.10			
Truck	1			3.33%	Min. Load	3.13	5.70	4.41	5.15	0.00	18.39			
					Max. Load	3.13	5.70	4.41	5.15	0.00	18.39			
					Avg. Load	3.13	5.70	4.41	5.15	-	18.39			
				Total	30	100.00%								
4	5 Axle Single Tridem			Semi-Trailer	7	100.00%	Min. Load	3.99	7.07	6.15	6.45	7.07	30.73	
		Max. Load	7.63				13.49	11.73	12.32	13.49	58.67			
		Avg. Load	6.77				11.97	10.41	10.93	11.97	52.04			
		Standard Deviation	1.32				2.34	2.04	2.14	2.34	10.19			
		Variance	1.75	5.49	4.15	4.58	5.49	103.79						
		Total	7	100.00%										
5	6 Axle Tandem Tridem	Semi-Trailer	2	66.67%	Min. Load	4.80	8.16	8.64	7.68	8.64	10.08	48.01		
					Max. Load	5.36	9.11	9.65	8.57	9.65	11.25	53.59		
					Avg. Load	5.08	8.64	9.14	8.13	9.14	10.67	50.80		
					Standard Deviation	0.39	0.67	0.71	0.63	0.71	0.83	3.95		
					Variance	0.16	0.45	0.50	0.40	0.50	0.69	15.57		
		Tanker	1	33.33%	Min. Load	11.10	18.87	19.98	17.76	19.98	23.31	111.00		
					Max. Load	11.10	18.87	19.98	17.76	19.98	23.31	111.00		
					Avg. Load	11.10	18.87	19.98	17.76	19.98	23.31	111.00		
				Total	3	100.00%								

9.4.11 Commodities carried by vehicles on NLC Dry Port

The percentage of major commodities carried by heavy vehicles on NLC Dry Port is tabulated in Table 9-24 and is graphically presented in Figure 9-16. For the sake of analysis, each commodity is assigned a code; details are attached in Annex – 2.

Table 9-24: Percentage of Vehicle w.r.t Commodities on NLC Dry Port

Sr. No.	Commodity Type	Code	Count	Percentage
1	Food Items	200	1	1.47%
2	Raw Materials	400	2	2.94%
3	Bulk Manufactures	500	1	1.47%
4	Basic Manufactures	600	19	27.94%
5	Miscellaneous Manufactures	700	32	47.06%
6	Fuel, Lubricants (Minerals)	900	9	13.24%
7	Miscellaneous Goods not Classified	A00	4	5.88%
Total			68	100.00%

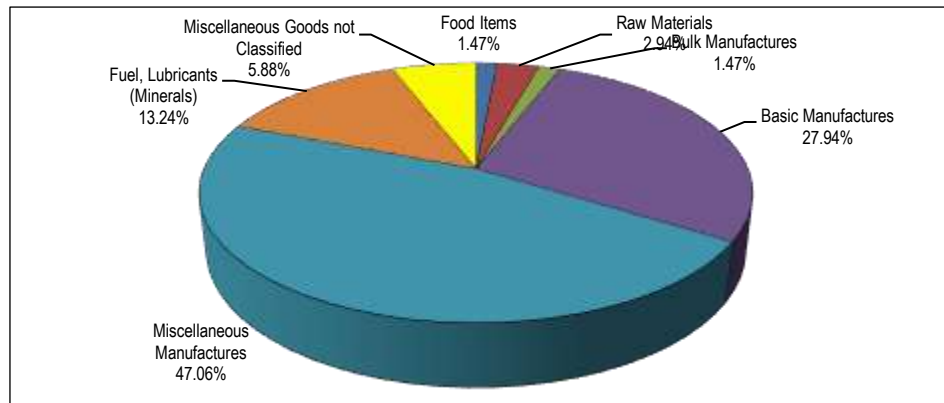


Figure 9-16: Percentage of Vehicles w.r.t Commodities on NLC Dry Port

9.4.12 Analysis based on Commodities on NLC Dry Port

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to commodities carried by trucks is presented in Table 9-25. The results depict that:

Major commodities carried by **2 Axle Single** are basic manufactures and miscellaneous manufactures, covering 45.45% each, with average gross load of 14.85 ton and 15.62 ton respectively.

Major commodities carried by **3 Axle Tandem** are miscellaneous manufactures, covering 58.82% of the total, with average gross load of 26.01 ton, followed by basic manufactures and fuel, lubricants (minerals) having percentage of 17.65% each, with average gross load of 27.30 ton and 24.60 ton respectively.

Major commodities carried by **4 Axle Single Tandem** are miscellaneous manufactures, covering 50% of the total, with average gross load of 39.70 ton, followed by basic Manufactures, having percentage of 30% in total, with average gross load of 37.82 ton.

Major commodities carried by **5 Axle Single Tridem** are basic manufactures and miscellaneous goods not classified, covering 28.57% each, with average gross load of 51.56 ton and 57.66 ton respectively.

Table 9-25: Stdev. Var., Min., Max. & Avg. Load Comparison w.r.t Commodities for major Axle Configuration on NLC Dry Port

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)							
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total	
1	2 Axle Single	Food Items	200	1	9.09%	Min. Load	3.36	7.49						10.85
						Max. Load	3.36	7.49					10.85	
						Avg. Load	3.36	7.49					10.85	
						Standard Deviation	-	-					-	
						Variance	-	-					-	

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)							
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total	
		Basic Manufactures	600	5	45.45%	Min. Load	4.01	8.91					12.92	
						Max. Load	5.75	12.79					18.54	
						Avg. Load	4.60	10.25					14.85	
						Standard Deviation	0.67	1.50					2.17	
						Variance	0.45	2.25					4.72	
		Miscellaneous Manufactures	700	5	45.45%	Min. Load	2.87	6.38						9.25
						Max. Load	6.52	14.50					21.02	
						Avg. Load	4.84	10.78					15.62	
						Standard Deviation	1.50	3.33					4.83	
						Variance	2.24	11.11					23.34	
		Total			11	100%								
2	3 Axle Tandem	Basic Manufactures	600	3	17.65%	Min. Load	5.71	10.13	10.13				25.97	
						Max. Load	6.30	11.16	11.16				28.62	
						Avg. Load	6.01	10.65	10.65				27.30	
						Standard Deviation	0.29	0.52	0.52				1.33	
						Variance	0.08	0.27	0.27				1.76	
		Miscellaneous Manufactures	700	10	58.82%	Min. Load	3.96	7.02	7.02				17.99	
						Max. Load	7.12	12.62	12.62				32.36	
						Avg. Load	5.72	10.14	10.14				26.01	
						Standard Deviation	1.17	2.07	2.07				5.30	
						Variance	1.36	4.27	4.27				28.06	
		Fuel, Lubricants (Minerals)	900	3	17.65%	Min. Load	4.55	8.06	8.06				20.67	
						Max. Load	7.12	12.63	12.63				32.38	
						Avg. Load	5.41	9.59	9.59				24.60	
						Standard Deviation	1.48	2.63	2.63				6.74	
						Variance	2.20	6.91	6.91				45.40	
		Miscellaneous Goods not Classified	A00	1	5.88%	Min. Load	3.86	6.84	6.84				17.55	
						Max. Load	3.86	6.84	6.84				17.55	
Avg. Load	3.86					6.84	6.84				17.55			
Standard Deviation	-					-	-				-			
Variance	-					-	-				-			
Total			17	100.00%										
4	4 Axle Single Tandem	Raw Materials	400	2	6.67%	Min. Load	5.91	10.78	8.34	9.74			34.77	
						Max. Load	7.45	13.58	10.51	12.26			43.80	
						Avg. Load	6.68	12.18	9.43	11.00			39.29	
						Standard Deviation	1.09	1.98	1.53	1.79			6.39	
						Variance	1.18	3.92	2.35	3.20			40.77	
		Basic Manufactures	600	9	30.00%	Min. Load	3.77	6.88	5.32	6.21			22.18	
						Max. Load	8.15	14.86	11.50	13.42			47.92	
						Avg. Load	6.43	11.73	9.08	10.59			37.82	
						Standard Deviation	1.60	2.92	2.26	2.63			9.41	
						Variance	2.56	8.51	5.10	6.94			88.52	
		Miscellaneous Manufactures	700	15	50.00%	Min. Load	3.14	5.73	4.44	5.17			18.48	
						Max. Load	8.22	14.99	11.61	13.54			48.37	
						Avg. Load	6.75	12.31	9.53	11.12			39.70	
						Standard Deviation	1.40	2.56	1.98	2.31			8.26	
						Variance	1.97	6.56	3.93	5.35			68.27	
		Fuel, Lubricants (Minerals)	900	4	13.33%	Min. Load	3.13	5.70	4.41	5.15			18.39	
						Max. Load	9.34	17.03	13.18	15.38			54.92	
Avg. Load	5.92					10.79	8.35	9.74			34.80			
Standard Deviation	3.08					5.62	4.35	5.07			18.12			
Variance	9.49					31.55	18.91	25.74			328.27			
Total			30	100.00%										
5	5 Axle Single Tridem	Bulk Manufactures	500	1	14.29%	Min. Load	7.53	13.32	11.58	12.16	13.32		57.91	
						Max. Load	7.53	13.32	11.58	12.16	13.32		57.91	
						Avg. Load	7.53	13.32	11.58	12.16	13.32		57.91	
						Standard Deviation	-	-	-	-	-		-	
						Variance	-	-	-	-	-		-	
		Basic Manufactures	600	2	28.57%	Min. Load	6.11	10.81	9.40	9.87	10.81		47.00	
						Max. Load	7.30	12.91	11.22	11.78	12.91		56.12	
						Avg. Load	6.70	11.86	10.31	10.83	11.86		51.56	
						Standard Deviation	0.84	1.48	1.29	1.35	1.48		6.45	
						Variance	0.70	2.20	1.66	1.83	2.20		41.58	
		Miscellaneous Manufactures	700	1	14.29%	Min. Load	3.99	7.07	6.15	6.45	7.07		30.73	
						Max. Load	3.99	7.07	6.15	6.45	7.07		30.73	
						Avg. Load	3.99	7.07	6.15	6.45	7.07		30.73	
						Standard Deviation	-	-	-	-	-		-	
						Variance	-	-	-	-	-		-	
		Fuel, Lubricants (Minerals)	900	1	14.29%	Min. Load	7.44	13.16	11.45	12.02	13.16		57.23	
						Max. Load	7.44	13.16	11.45	12.02	13.16		57.23	
Avg. Load	7.44					13.16	11.45	12.02	13.16		57.23			
Standard Deviation	-					-	-	-	-		-			
Variance	-					-	-	-	-		-			
Miscellaneous Goods not Classified	A00	2	28.57%	Min. Load	7.36	13.03	11.33	11.90	13.03		56.65			
				Max. Load	7.63	13.49	11.73	12.32	13.49		58.67			
				Avg. Load	7.50	13.26	11.53	12.11	13.26		57.66			
				Standard Deviation	0.19	0.33	0.29	0.30	0.33		1.43			
				Variance	0.03	0.11	0.08	0.09	0.11		2.04			
Total			7	100.00%										

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
7	6 Axle Tandem Tridem	Miscellaneous Manufactures	700	1	33.33%	Min. Load	4.80	8.16	8.64	7.68	8.64	10.08	48.01
						Max. Load	4.80	8.16	8.64	7.68	8.64	10.08	48.01
						Avg. Load	4.80	8.16	8.64	7.68	8.64	10.08	48.01
						Standard Deviation	-	-	-	-	-	-	-
						Variance	-	-	-	-	-	-	-
		Min. Load	11.10	18.87	19.98	17.76	19.98	23.31	111.0				
		Max. Load	11.10	18.87	19.98	17.76	19.98	23.31	111.0				
		Avg. Load	11.10	18.87	19.98	17.76	19.98	23.31	111.0				
		Standard Deviation	-	-	-	-	-	-	-				
		Variance	-	-	-	-	-	-	-				
		Min. Load	5.36	9.11	9.65	8.57	9.65	11.25	53.59				
		Max. Load	5.36	9.11	9.65	8.57	9.65	11.25	53.59				
		Avg. Load	5.36	9.11	9.65	8.57	9.65	11.25	53.59				
		Standard Deviation	-	-	-	-	-	-	-				
		Variance	-	-	-	-	-	-	-				
Total				3	100.00%								

9.4.13 Damage Factor for major Axle Configuration on NLC Dry Port

The average damage factors calculated for major axle configuration are presented in Table 9-26.

Table 9-26: Damage Factor for major Axle Configuration on NLC Dry Port

Sr. No.	Axle Configuration	Code	Damage Factor (2020)	
			Road Note 40	AASHTO 1993
1	2 Axle Single	1.2	4.06	3.36
2	3 Axle Tandem	1.22	6.41	3.87
3	4 Axle Single Tandem	1.2-22	15.63	9.91
4	5 Axle Single Tridem	1.2-222	21.71	11.06
5	6 Axle Tandem Tridem	1.22-222	105.71	35.33

9.5 Premnagar Dry Port

The results of axle load survey performed on Premnagar Dry Port of LDP are discussed in subsequent sub-sections.

9.5.1 Distribution of Vehicles by Axle Configuration on Premnagar Dry Port

The percentage of trucks for major axle configurations surveyed on Premnagar Dry Port is summarized in Table 9-27 and is graphically presented in Figure 9-17.

Table 9-27: Percentage of Vehicle w.r.t Axle Configuration on Premnagar Dry Port

Sr. No.	Axle Configuration	Code	Total Number of Trucks	Percentage
1	4 Axle Single Tandem	1.2-22	4	57.14%
2	5 Axle Single Tridem	1.2-222	1	14.29%
3	6 Axle Tandem Tridem	1.22-222	2	28.57%
Total			7	100%

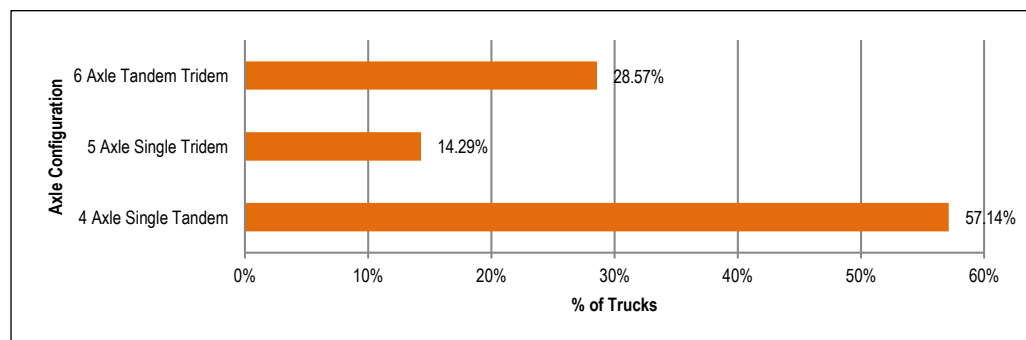


Figure 9-17: Percentage of Vehicles w.r.t Axle Configuration on Premnagar Dry Port

9.5.2 Analysis by Axle Configuration on Premnagar Dry Port

The analysis comprising minimum, maximum and average loads per axle carried by trucks on Premnagar Dry Port along with standard deviation and variance is presented

in Table 9-28. The minimum, maximum and average loads are graphically presented in Figure 9-18 and Figure 9-19 respectively.

In case of **4 Axle Single Tandem**, maximum load of 40.03 ton with average load of 25.43 ton was recorded.

In case of **6 Axle Tandem Tridem**, maximum load of 60.14 ton with average load of 52.96 ton was recorded.

Table 9-28: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Axle Configuration on Premnagar Dry Port

Sr. No.	Axle Configuration	Permissible Load Limits	Parameters	Load (Tons)							
				Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total	
1	4 Axle Single Tandem	39.5	Min. Load	3.36	6.13	4.75	5.54				19.78
			Max. Load	6.81	12.41	9.61	11.21				40.03
			Avg. Load	4.32	7.88	6.10	7.12				25.43
			Standard Deviation	1.66	3.02	2.34	2.73				9.75
			Variance	2.75	9.13	5.48	7.45				95.05
2	5 Axle Single Tridem	48.5	Min. Load	5.40	9.55	8.30	8.72	9.55			41.51
			Max. Load	5.40	9.55	8.30	8.72	9.55			41.51
			Avg. Load	5.40	9.55	8.30	8.72	9.55			41.51
			Standard Deviation	-	-	-	-	-			-
			Variance	-	-	-	-	-			-
3	6 Axle Tandem Tridem	58.5	Min. Load	4.58	7.78	8.24	7.32	8.24	9.61		45.77
			Max. Load	6.01	10.22	10.83	9.62	10.83	12.63		60.14
			Avg. Load	5.30	9.00	9.53	8.47	9.53	11.12		52.96
			Standard Deviation	1.02	1.73	1.83	1.63	1.83	2.13		10.16
			Variance	1.03	2.98	3.35	2.64	3.35	4.55		103.25

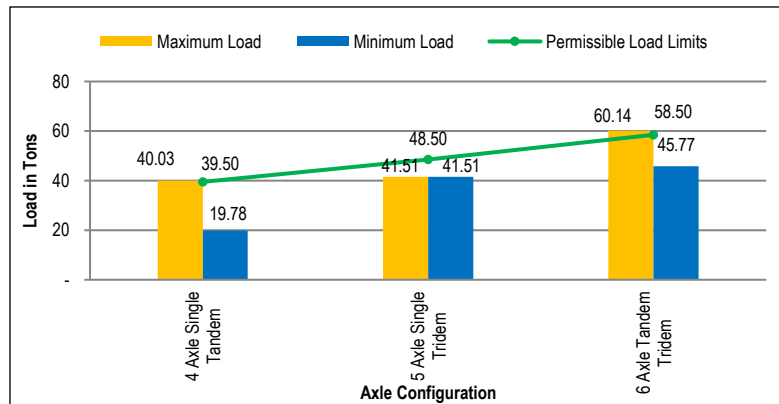


Figure 9-18: Min. & Max. Load Comparison w.r.t Axle Configuration on Premnagar Dry Port

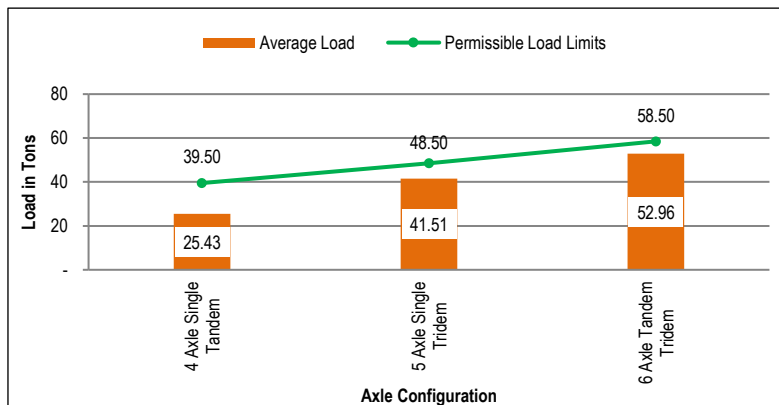


Figure 9-19: Avg. Load Comparison w.r.t Axle Configuration on Premnagar Dry Port

9.5.3 Load Spectrum by Axle Configuration on Premnagar Dry Port

The major cause of pavement failure is due to excessive overloading. The axle load survey data was organized in a way to identify the number of vehicles carrying load above and below permissible limits. Furthermore, load spectrums were identified and number of vehicles carrying load in specified spectrums were calculated. The results are tabulated in Table 9-29 which illustrates that:

In case of **4 Axle Single Tandem**, 75% of semi-trailers carried load under permissible limits.

In case of **6 Axle Tandem Tridem**, 50% of semi-trailers carried load under permissible limits.

The percentage of trucks for major axle configuration carrying load above and below permissible limits on Premnagar Dry Port is graphically presented in Figure 9-20.

Table 9-29: Load Spectrum w.r.t Axle Configuration on Premnagar Dry Port

Sr. No.	Axle Configuration	Under Permissible Limit	Over Permissible Limit					Total	
			15.00%	30.00%	50.00%	75.00%	>75%		
1	4 Axle Single Tandem	Max. Load (Tons)	39.5	45.4	51.4	59.3	69.1		
		Average Load (Tons)	20.56	40.03	-	-	-	-	
		No. of Trucks	3	1	0	0	0	0	4
		Percentage	75.00%	25.00%	0.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	75.00%	100.00%	100.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	25.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
2	5 Axle Single Tridem	Max. Load (Tons)	48.5	55.8	63.1	72.8	84.9		
		Average Load (Tons)	41.51	-	-	-	-	-	
		No. of Trucks	1	0	0	0	0	0	1
		Percentage	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
3	6 Axle Tandem Tridem	Max. Load (Tons)	58.5	67.3	76.1	87.8	102.4		
		Average Load (Tons)	45.77	60.14	-	-	-	-	
		No. of Trucks	1	1	0	0	0	0	2
		Percentage	50.00%	50.00%	0.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	50.00%	100.00%	100.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	

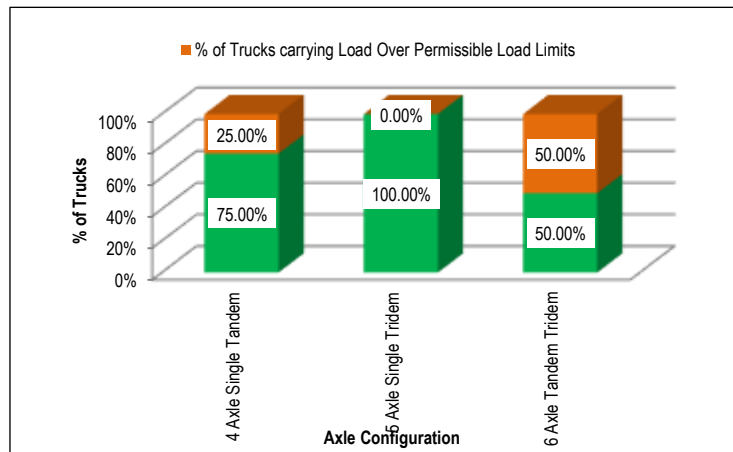


Figure 9-20: Percentage of Vehicles carrying Load above and below Permissible Limits on Premnagar Dry Port

9.5.4 Front & Rear Axle Load Spectrum on Premnagar Dry Port

The spectrum of front and rear axle loads for major axle configurations is presented in Table 9-30.

Table 9-30: Front & Rear Axle Load Spectrum on Premnagar Dry Port

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
Front Axle Load Spectrum					
1	0 - 2.99	0	0.00%	0.00%	100.00%
2	3 - 5.49	5	71.43%	71.43%	28.57%
3	5.5 - 6.99	2	28.57%	100.00%	0.00%
4	7 - 8.99	0	0.00%	100.00%	0.00%
5	9 - 10.99	0	0.00%	100.00%	0.00%

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
6	11 - 12.99	0	0.00%	100.00%	0.00%
7	13 - 14.99	0	0.00%	100.00%	0.00%
8	15 - 16.99	0	0.00%	100.00%	0.00%
9	17 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Single)					
1	0 - 8.16	11	42.31%	42.31%	57.69%
2	8.17 - 9.99	9	34.62%	76.92%	23.08%
3	10 - 10.99	3	11.54%	88.46%	11.54%
4	11 - 11.99	1	3.85%	92.31%	7.69%
5	12 - 12.99	2	7.69%	100.00%	0.00%
6	13 - 13.99	0	0.00%	100.00%	0.00%
7	14 - 14.99	0	0.00%	100.00%	0.00%
8	15 - 19.99	0	0.00%	100.00%	0.00%
9	20 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Tandem)					
1	0 - 11.99	3	50.00%	50.00%	50.00%
2	12 - 14.99	0	0.00%	50.00%	50.00%
3	15 - 19.99	1	16.67%	66.67%	33.33%
4	20 - 21.99	2	33.33%	100.00%	0.00%
5	22 - 23.99	0	0.00%	100.00%	0.00%
6	24 - 25.99	0	0.00%	100.00%	0.00%
7	26 - 27.99	0	0.00%	100.00%	0.00%
8	28 - 29.99	0	0.00%	100.00%	0.00%
9	30 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Tridem)					
1	0 - 14.99	0	0.00%	0.00%	100.00%
2	15 - 30.99	2	66.67%	66.67%	33.33%
3	31 - 32.99	0	0.00%	66.67%	33.33%
4	33 - 34.99	1	33.33%	100.00%	0.00%
5	35 - 36.99	0	0.00%	100.00%	0.00%
6	37 - 38.99	0	0.00%	100.00%	0.00%
7	39 - 40.99	0	0.00%	100.00%	0.00%
8	41 - 42.99	0	0.00%	100.00%	0.00%
9	43 & Above	0	0.00%	100.00%	0.00%

9.5.5 Distribution of Vehicles by Make Type on Premnagar Dry Port

The distribution of trucks as per make type is illustrated in Table 9-31 and is graphically presented in Figure 9-21.

Table 9-31: Percentage of Vehicles w.r.t Make Type on Premnagar Dry Port

Sr. No.	Make	Count	Percentage
1	Nissan	2	28.57%
2	Hino	5	71.43%
Total		7	100.00%

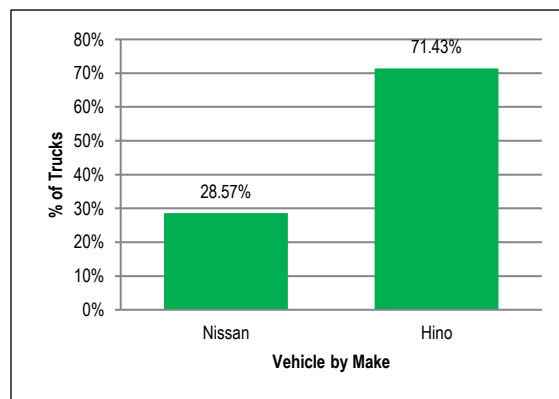


Figure 9-21: Percentage of Vehicles w.r.t Make Type on Premnagar Dry Port

9.5.6 Analysis by Make Type on Premnagar Dry Port

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to make type is presented in Table 9-32. The results depict that:

In case of **4 Axle Single Tandem**, Hino constitutes maximum percentage of 75% with average gross load of 26.88 ton.

In case of **6 Axle Tandem Tridem**, Hino constitutes maximum percentage of 100%, with average gross load of 52.96 ton.

Table 9-32: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Make Type for major Axle Configuration on Premnagar Dry Port

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	4 Axle Single Tandem	Hino	3	75.00%	Min. Load	3.36	6.13	4.75	5.54			19.78
					Max. Load	6.81	12.41	9.61	11.21			40.03
					Avg. Load	4.57	8.33	6.45	7.53			26.88
					Standard Deviation	1.94	3.53	2.74	3.19			11.40
					Variance	3.75	12.48	7.48	10.18			129.91
		Nissan	1	25.00%	Min. Load	3.58	6.53	5.06	5.90			21.07
					Max. Load	3.58	6.53	5.06	5.90			21.07
					Avg. Load	3.58	6.53	5.06	5.90			21.07
					Standard Deviation	-	-	-	-			-
					Variance	-	-	-	-			-
Total	4	100.00%										
2	5 Axle Single Tridem	Nissan	1	100.00%	Min. Load	5.40	9.55	8.30	8.72	9.55		41.51
					Max. Load	5.40	9.55	8.30	8.72	9.55		41.51
					Avg. Load	5.40	9.55	8.30	8.72	9.55		41.51
					Standard Deviation	-	-	-	-	-		-
					Variance	-	-	-	-	-		-
Total	1	100.00%										
3	6 Axle Tandem Tridem	Hino	2	100.00%	Min. Load	4.58	7.78	8.24	7.32	8.24	9.61	45.77
					Max. Load	6.01	10.22	10.83	9.62	10.83	12.63	60.14
					Avg. Load	5.30	9.00	9.53	8.47	9.53	11.12	52.96
					Standard Deviation	1.02	1.73	1.83	1.63	1.83	2.13	10.16
					Variance	1.03	2.98	3.35	2.64	3.35	4.55	103.25
		Total	2	100.00%								

9.5.7 Distribution of Vehicles by Body Type on Premnagar Dry Port

The percentage of vehicles with respect to Body Type i.e. Flat, Half, Full & Container plying on Premnagar Dry Port is tabulated in Table 9-33 and is graphically presented in Figure 9-22.

Table 9-33: Percentage of Vehicles w.r.t Body Type on Premnagar Dry Port

Sr. No.	Body Type	Count	Percentage
1	Container	7	100.00%
	Total	7	100.00%

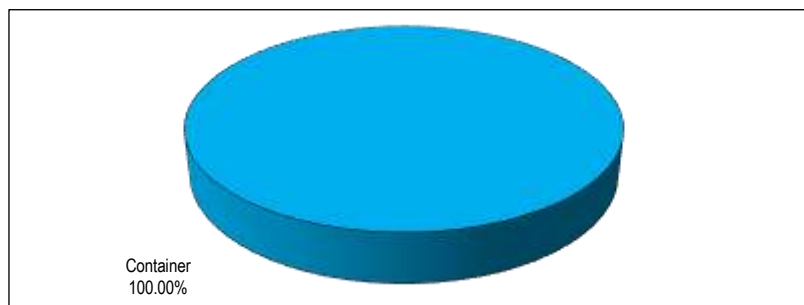


Figure 9-22 : Percentage of Vehicles w.r.t Body Type on Premnagar Dry Port

9.5.8 Analysis by Body Type on Premnagar Dry Port

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to body type is presented in Table 9-34. The results depict that:

In case of **4 Axle Single Tandem**, container body type constitutes maximum percentage of 100%, with average gross load of 25.43 ton.

In case of **6 Axle Tandem Tridem**, container body type constitutes overall percentage of 100%, with average gross load of 52.96 ton.

Table 9-34: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Body Type for major Axle Configuration on Premnagar Dry Port

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	4 Axle Single Tandem	Container	4	100.00%	Min. Load	3.36	6.13	4.75	5.54			19.78
					Max. Load	6.81	12.41	9.61	11.21			40.03
					Avg. Load	4.32	7.88	6.10	7.12			25.43
					Standard Deviation	1.66	3.02	2.34	2.73			-
					Variance	2.75	9.13	5.48	7.45			95.05
	Total		4	100.00%								
2	5 Axle Single Tridem	Container	1	100.00%	Min. Load	5.40	9.55	8.30	8.72	9.55		41.51
					Max. Load	5.40	9.55	8.30	8.72	9.55		41.51
					Avg. Load	5.40	9.55	8.30	8.72	9.55		41.51
					Standard Deviation	-	-	-	-	-		-
					Variance	-	-	-	-	-		-
	Total		1	100.00%								
3	6 Axle Tandem Tridem	Container	2	100.00%	Min. Load	4.58	7.78	8.24	7.32	8.24	9.61	45.77
					Max. Load	6.01	10.22	-	9.62	10.83	12.63	60.14
					Avg. Load	5.30	9.00	9.53	8.47	9.53	11.12	52.96
					Standard Deviation	1.02	1.73	1.83	1.63	1.83	2.13	10.16
					Variance	1.03	2.98	3.35	2.64	3.35	4.55	103.25
	Total		2	100.00%								

9.5.9 Distribution of Vehicles by Type on Premnagar Dry Port

The percentage of vehicles with respect to Type i.e. Truck, Semi-Trailer and Tanker plying on Premnagar Dry Port is tabulated in Table 9-35 and is graphically presented in Figure 9-23.

Table 9-35: Percentage of Vehicles w.r.t Type on Premnagar Dry Port

Sr. No.	Vehicle Type	Count	Percentage
1	Semi-Trailer	7	100.00%
	Total	7	100.00%

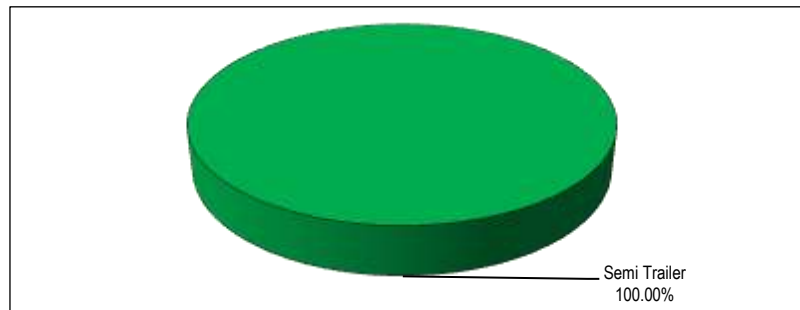


Figure 9-23: Percentage of Vehicles w.r.t Type on Premnagar Dry Port

9.5.10 Analysis by Vehicle Type on Premnagar Dry Port

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to truck type is presented in Table 9-36. The results depict that:

In case of **4 Axle Single Tandem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 25.43 ton.

In case of **6 Axle Tandem Tridem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 52.96 ton.

Table 9-36: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Type for major Axle Configuration on Premnagar Dry Port

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	4 Axle Single Tandem	Semi-Trailer	4	100.00%	Min. Load	3.36	6.13	4.75	5.54	0.00		19.78
					Max. Load	6.81	12.41	9.61	11.21	0.00		40.03
					Avg. Load	4.32	7.88	6.10	7.12	-		25.43
					Standard Deviation	1.66	3.02	2.34	2.73	0.00		9.75
					Variance	2.75	9.13	5.48	7.45	0.00		95.05
	Total		4	100.00%								
2	5 Axle Single Tridem	Semi-Trailer	1	100.00%	Min. Load	5.40	9.55	8.30	8.72	9.55		41.51
					Max. Load	5.40	9.55	8.30	8.72	9.55		41.51
					Avg. Load	5.40	9.55	8.30	8.72	9.55		41.51

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
					Standard Deviation	-	-	-	-	-	-	-
					Variance	-	-	-	-	-	-	-
		Total	1	100.00%								
3	6 Axle Tandem Tridem	Semi-Trailer	2	100.00%	Min. Load	4.58	7.78	8.24	7.32	8.24	9.61	45.77
					Max. Load	6.01	10.22	10.83	9.62	10.83	12.63	60.14
					Avg. Load	5.30	9.00	9.53	8.47	9.53	11.12	52.96
					Standard Deviation	1.02	1.73	1.83	1.63	1.83	2.13	10.16
					Variance	1.03	2.98	3.35	2.64	3.35	4.55	103.25
		Total	2	100.00%								

9.5.11 Commodities carried by vehicles on Premnagar Dry Port

The percentage of major commodities carried by heavy vehicles on Premnagar Dry Port is tabulated in Table 9-37 and is graphically presented in Figure 9-24. For the sake of analysis, each commodity is assigned a code; details are attached in Annex – 2.

Table 9-37: Percentage of Vehicle w.r.t Commodities on Premnagar Dry Port

Sr. No.	Commodity Type	Code	Count	Percentage
1	Bulk Manufactures	500	1	14.29%
2	Miscellaneous Manufactures	700	6	85.71%
Total			7	100.00%

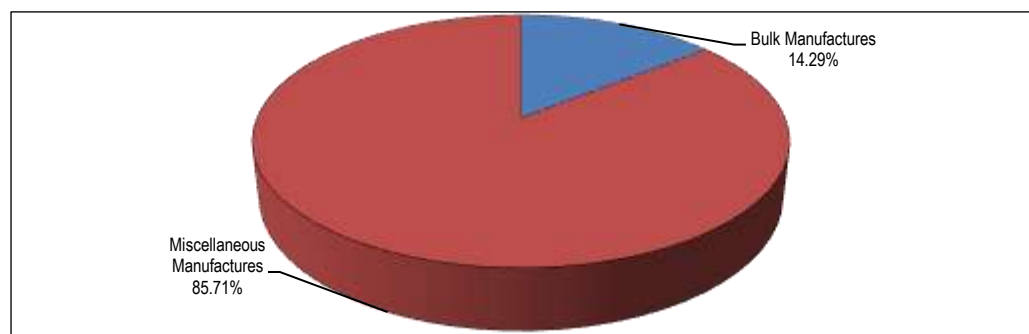


Figure 9-24: Percentage of Vehicles w.r.t Commodities on Premnagar Dry Port

9.5.12 Analysis based on Commodities on Premnagar Dry Port

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to commodities carried by trucks is presented in Table 9-38. The results depict that:

Major commodity carried by **4 Axle Single Tandem** is miscellaneous manufactures, covering 75% of the total, with average gross load of 20.56 ton.

Major commodity carried by **6 Axle Tandem Tridem** is miscellaneous manufactures, covering 100% of the total, with average gross load of 52.96 ton.

Table 9-38: Stdev. Var., Min., Max. & Avg. Load Comparison w.r.t Commodities for major Axle Configuration on Premnagar Dry Port

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	4 Axle Single Tandem	Bulk Manufactures	500	1	25.00%	Min. Load	6.81	12.41	9.61	11.21			40.03
						Max. Load	6.81	12.41	9.61	11.21			40.03
						Avg. Load	6.81	12.41	9.61	11.21			40.03
						Standard Deviation	-	-	-	-			-
		Variance	-	-	-	-			-				
		Miscellaneous Manufactures	700	3	75.00%	Min. Load	3.36	6.13	4.75	5.54			19.78
						Max. Load	3.58	6.53	5.06	5.90			21.07
						Avg. Load	3.50	6.37	4.94	5.76			20.56
Standard Deviation	0.12					0.21	0.17	0.19			0.69		
Variance	0.01	0.05	0.03	0.04			0.47						
Total			4	100.00%									
2	5 Axle Single Tridem	Miscellaneous Manufactures	700	1	100.00%	Min. Load	5.40	9.55	8.30	8.72	9.55		41.51
						Max. Load	5.40	9.55	8.30	8.72	9.55		41.51
						Avg. Load	5.40	9.55	8.30	8.72	9.55		41.51
						Standard Deviation	-	-	-	-	-		-
						Variance	-	-	-	-	-		-
Total			1	100.00%									

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
3	6 Axle Tandem Tridem	Miscellaneous Manufactures	700	2	100.00%	Min. Load	4.58	7.78	8.24	7.32	8.24	9.61	45.77
						Max. Load	6.01	10.22	10.83	9.62	10.83	12.63	60.14
						Avg. Load	5.30	9.00	9.53	8.47	9.53	11.12	52.96
						Standard Deviation	1.02	1.73	1.83	1.63	1.83	2.13	10.16
						Variance	1.03	2.98	3.35	2.64	3.35	4.55	103.25
Total				2	100.00%								

9.5.13 Damage Factor for major Axle Configuration on Premnagar Dry Port

The average damage factors calculated for major axle configuration are presented in Table 9-39.

Table 9-39: Damage Factor for major Axle Configuration on Premnagar Dry Port

Sr. No.	Axle Configuration	Code	Damage Factor (2020)	
			Road Note 40	AASHTO 1993
1	4 Axle Single Tandem	1.2-22	3.74	2.83
2	5 Axle Single Tridem	1.2-222	6.49	4.21
3	6 Axle Tandem Tridem	1.22-222	12.25	6.43

9.6 Sialkot Dry Port (SDP)

The results of axle load survey performed on SDP are discussed in subsequent sub-sections.

9.6.1 Distribution of Vehicles by Axle Configuration on SDP

The percentage of trucks for major axle configurations surveyed on SDP is summarized in Table 9-40 and is graphically presented in Figure 9-25.

Table 9-40: Percentage of Vehicle w.r.t Axle Configuration on SDP

Sr. No.	Axle Configuration	Code	Total Number of Trucks	Percentage
1	2 Axle Single	1.2	9	17.65%
2	3 Axle Tandem	1.22	10	19.61%
3	4 Axle Single Tandem	1.2-22	16	31.37%
4	Others	-	16	31.37%
Total			51	100%

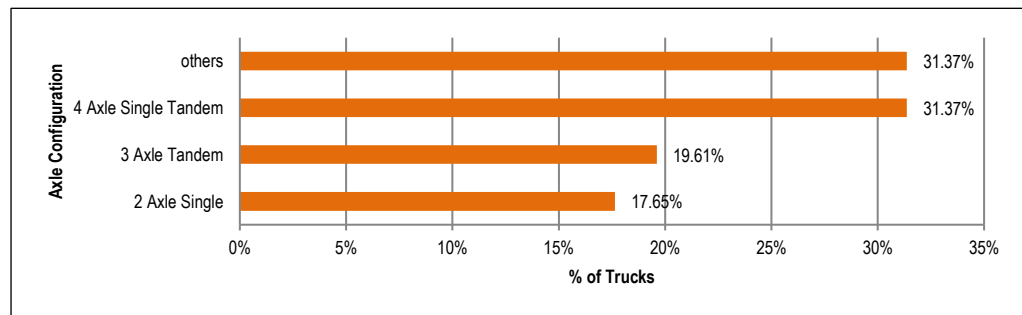


Figure 9-25: Percentage of Vehicles w.r.t Axle Configuration on SDP

9.6.2 Analysis by Axle Configuration on SDP

The analysis comprising minimum, maximum and average loads per axle carried by trucks on SDP along with standard deviation and variance is presented in Table 9-41. The minimum, maximum and average loads are graphically presented in Figure 9-26 and Figure 9-27 respectively.

In case of **2 Axle Single**, maximum load of 36.68 ton with average load of 21.94 ton was recorded.

In case of **3 Axle Tandem**, maximum load of 38.34 ton with average load of 28.47 ton was recorded.

In case of **4 Axle Single Tandem**, maximum load of 45.19 ton with average load of 32.53 ton was recorded.

Table 9-41: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Axle Configuration on SDP

Sr. No.	Axle Configuration	Permissible Load Limits	Parameters	Load (Tons)					Total	
				Front	Rear 1	Rear 2	Rear 3	Rear 4		Rear 5
1	2 Axle Single	17.5	Min. Load	3.80	8.46					12.26
			Max. Load	11.37	25.31					36.68
			Avg. Load	6.80	15.14					21.94
			Standard Deviation	3.41	7.59					11.00
			Variance	11.62	57.58					120.94
2	3 Axle Tandem	27.5	Min. Load	3.15	5.59	5.59				14.33
			Max. Load	8.43	14.95	14.95				38.34
			Avg. Load	6.26	11.10	11.10				28.47
			Standard Deviation	2.04	3.61	3.61				9.27
			Variance	4.16	13.07	13.07				85.90
3	4 Axle Single Tandem	39.5	Min. Load	3.36	6.13	4.74	5.54			19.77
			Max. Load	7.68	14.01	10.85	12.65			45.19
			Avg. Load	5.53	10.08	7.81	9.11			32.53
			Standard Deviation	1.25	2.27	1.76	2.05			7.33
			Variance	1.55	5.17	3.10	4.22			53.78
4	Others	-	Min. Load	1.01	1.51	1.77	2.16			2.52
			Max. Load	1.01	1.51	14.92	18.24			35.68
			Avg. Load	1.01	1.51	6.53	7.99			16.07
			Standard Deviation	0.00	0.00	3.66	4.47			8.68
			Variance	0.00	0.00	13.38	19.99			75.43

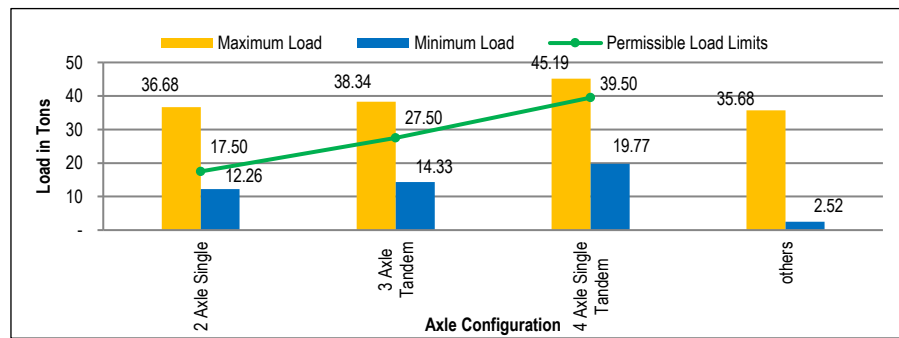


Figure 9-26: Min. & Max. Load Comparison w.r.t Axle Configuration on SDP

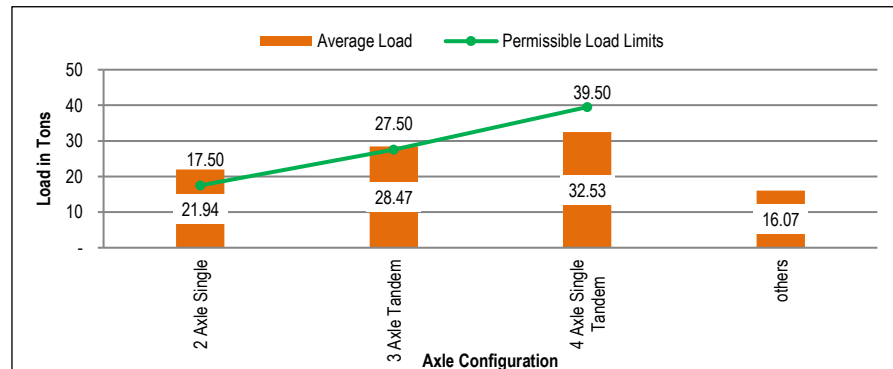


Figure 9-27: Avg. Load Comparison w.r.t Axle Configuration on SDP

9.6.3 Load Spectrum by Axle Configuration on SDP

The major cause of pavement failure is due to excessive overloading. The axle load survey data was organized in a way to identify the number of vehicles carrying load above and below permissible limits. Furthermore, load spectrums were identified and number of vehicles carrying load in specified spectrums were calculated. The results are tabulated in Table 9-42 which illustrates that:

In case of **2 Axle Single**, 55.56% of trucks carried load under permissible limits. Whereas, 33.33% of the trucks carried load more than 15% of permissible load limits.

In case of **3 Axle Tandem**, 50% of trucks carried load under permissible limits. Whereas, 50% of the trucks carried load more than 15% of permissible load limits.

In case of **4 Axle Single Tandem**, 81.25% of trucks/semi-trailers carried load under permissible limits.

The percentage of trucks for major axle configuration carrying load above and below permissible limits on SDP is graphically presented in Figure 9-28.

Table 9-42: Load Spectrum w.r.t Axle Configuration on SDP

Sr. No.	Axle Configuration	Under Permissible Limit	Over Permissible Limit					Total	
			15.00%	30.00%	50.00%	75.00%	>75%		
1	2 Axle Single	Max. Load (Tons)	17.5	20.1	22.8	26.3	30.6		
		Average Load (Tons)	14.15	17.54	-	-	-	36.39	
		No. of Trucks	5	1	0	0	0	3	9
		Percentage	55.56%	11.11%	0.00%	0.00%	0.00%	33.33%	100%
		Cumulative Percentage	55.56%	66.67%	66.67%	66.67%	66.67%	100.00%	
		Percentage above Range Value	44.44%	33.33%	33.33%	33.33%	33.33%	0.00%	
2	3 Axle Tandem	Max. Load (Tons)	27.5	31.6	35.8	41.3	48.1		
		Average Load (Tons)	20.27	-	-	36.66	-	-	
		No. of Trucks	5	0	0	5	0	0	10
		Percentage	50.00%	0.00%	0.00%	50.00%	0.00%	0.00%	100%
		Cumulative Percentage	50.00%	50.00%	50.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	50.00%	50.00%	50.00%	0.00%	0.00%	0.00%	
3	4 Axle Single Tandem	Max. Load (Tons)	39.5	45.4	51.4	59.3	69.1		
		Average Load (Tons)	30.43	41.60	-	-	-	-	
		No. of Trucks	13	3	0	0	0	0	16
		Percentage	81.25%	18.75%	0.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	81.25%	100.00%	100.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	18.75%	0.00%	0.00%	0.00%	0.00%	0.00%	

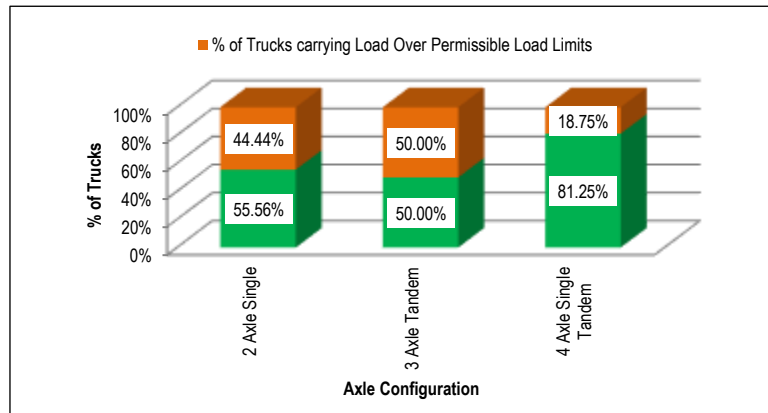


Figure 9-28: Percentage of Vehicles carrying Load above and below Permissible Limits on SDP

9.6.4 Front & Rear Axle Load Spectrum on SDP

The spectrum of front and rear axle loads for major axle configurations is presented in Table 9-43.

Table 9-43: Front & Rear Axle Load Spectrum on SDP

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
Front Axle Load Spectrum					
1	0 - 2.99	0	0.00%	0.00%	100.00%
2	3 - 5.49	17	48.57%	48.57%	51.43%
3	5.5 - 6.99	9	25.71%	74.29%	25.71%
4	7 - 8.99	6	17.14%	91.43%	8.57%
5	9 - 10.99	0	0.00%	91.43%	8.57%
6	11 - 12.99	3	8.57%	100.00%	0.00%
7	13 - 14.99	0	0.00%	100.00%	0.00%
8	15 - 16.99	0	0.00%	100.00%	0.00%
9	17 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Single)					
1	0 - 8.16	19	24.68%	24.68%	75.32%
2	8.17 - 9.99	23	29.87%	54.55%	45.45%
3	10 - 10.99	10	12.99%	67.53%	32.47%
4	11 - 11.99	7	9.09%	76.62%	23.38%
5	12 - 12.99	4	5.19%	81.82%	18.18%

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
6	13 - 13.99	2	2.60%	84.42%	15.58%
7	14 - 14.99	9	11.69%	96.10%	3.90%
8	15 - 19.99	0	0.00%	96.10%	3.90%
9	20 & Above	3	3.90%	100.00%	0.00%
Rear Axle Load Spectrum (Tandem)					
1	0 - 11.99	4	15.38%	15.38%	84.62%
2	12 - 14.99	1	3.85%	19.23%	80.77%
3	15 - 19.99	12	46.15%	65.38%	34.62%
4	20 - 21.99	3	11.54%	76.92%	23.08%
5	22 - 23.99	1	3.85%	80.77%	19.23%
6	24 - 25.99	0	0.00%	80.77%	19.23%
7	26 - 27.99	1	3.85%	84.62%	15.38%
8	28 - 29.99	4	15.38%	100.00%	0.00%
9	30 & Above	0	0.00%	100.00%	0.00%

9.6.5 Distribution of Vehicles by Make Type on SDP

The distribution of trucks as per make type is illustrated in Table 9-44 and is graphically presented in Figure 9-29. The results depict that Hino and Nissan have maximum percentage of 71.43% and 22.86% on SDP.

Table 9-44: Percentage of Vehicles w.r.t Make Type on SDP

Sr. No.	Make	Count	Percentage
1	Nissan	8	22.86%
2	Hino	25	71.43%
3	Isuzu	2	5.71%
Total		35	100.00%

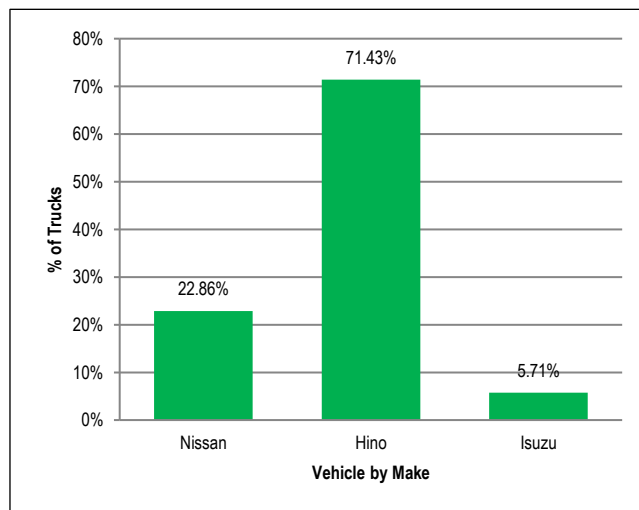


Figure 9-29: Percentage of Vehicles w.r.t Make Type on SDP

9.6.6 Analysis by Make Type on SDP

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to make type is presented in Table 9-45. The results depict that:

In case of **2 Axle Single**, Hino constitutes maximum percentage of 66.67%, with average gross load of 22.50 ton, followed by Isuzu with percentage of 22.22%, carrying average gross load of 12.90 ton.

In case of **3 Axle Tandem**, Hino constitutes maximum percentage of 90%, with average gross load of 30.04 ton.

In case of **4 Axle Single Tandem**, Hino constitutes maximum percentage of 62.50% with average gross load of 29.70 ton, followed by Nissan with percentage of 37.50%, carrying average gross load of 37.24 ton.

Table 9-45: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Make Type for major Axle Configuration on SDP

Sr. No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Nissan	1	11.11%	Min. Load	11.37	25.31					36.68
					Max. Load	11.37	25.31				36.68	
					Avg. Load	11.37	25.31				36.68	
					Standard Deviation	-	-				-	
					Variance	-	-				-	
		Hino	6	66.67%	Min. Load	3.84	8.54				12.38	
					Max. Load	11.33	25.21				36.54	
					Avg. Load	6.98	15.53				22.50	
					Standard Deviation	3.35	7.46				10.81	
					Variance	11.22	55.60				116.78	
		Isuzu	2	22.22%	Min. Load	3.80	8.46				12.26	
					Max. Load	4.19	9.34				13.53	
					Avg. Load	4.00	8.90				12.90	
					Standard Deviation	0.28	0.62				0.90	
Variance	0.08				0.38				0.81			
Total	9	100.00%										
2	3 Axle Tandem	Hino	9	90.00%	Min. Load	3.62	6.41	6.41				16.44
					Max. Load	8.43	14.95	14.95				38.34
					Avg. Load	6.61	11.71	11.71				30.04
					Standard Deviation	1.83	3.24	3.24				8.30
					Variance	3.33	10.48	10.48				68.88
		Nissan	1	10.00%	Min. Load	3.15	5.59	5.59				14.33
					Max. Load	3.15	5.59	5.59				14.33
					Avg. Load	3.15	5.59	5.59				14.33
					Standard Deviation	-	-	-				-
					Variance	-	-	-				-
Total	10	100.00%										
3	4 Axle Single Tandem	Hino	10	62.50%	Min. Load	3.36	6.13	4.74	5.54			19.77
					Max. Load	6.75	12.31	9.53	11.12			39.71
					Avg. Load	5.05	9.21	7.13	8.32			29.70
					Standard Deviation	1.24	2.26	1.75	2.05			7.31
					Variance	1.54	5.13	3.07	4.18			53.37
		Nissan	6	37.50%	Min. Load	5.47	9.97	7.72	9.00			32.15
					Max. Load	7.68	14.01	10.85	12.65			45.19
					Avg. Load	6.33	11.55	8.94	10.43			37.24
					Standard Deviation	0.81	1.47	1.14	1.33			4.75
					Variance	0.65	2.17	1.30	1.77			22.58
		Total	16	100.00%								

9.6.7 Distribution of Vehicles by Body Type on SDP

The percentage of vehicles with respect to Body Type i.e. Flat, Half, Full & Container plying on SDP is tabulated in Table 9-46 and is graphically presented in Figure 9-30.

Table 9-46: Percentage of Vehicles w.r.t Body Type on SDP

Sr. No.	Body Type	Count	Percentage
1	Full	2	5.71%
2	Container	33	94.29%
	Total	35	100.00%

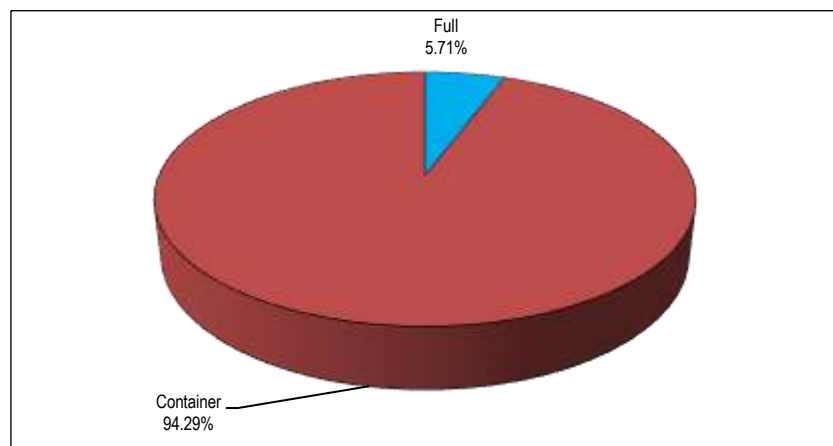


Figure 9-30 : Percentage of Vehicles w.r.t Body Type on SDP

9.6.8 Analysis by Body Type on SDP

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to body type is presented in Table 9-47. The results depict that:

In case of **2 Axle Single**, container body type constitutes maximum percentage of 77.78%, with average gross load of 23.50 ton followed by full body type constituting 22.22% in total, with average gross load of 16.49 ton.

In case of **3 Axle Tandem**, container body type constitutes maximum percentage of 100%, with average gross load of 28.47 ton.

In case of **4 Axle Single Tandem**, container body type constitutes maximum percentage of 100%, with average gross load of 32.53 ton.

Table 9-47: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Body Type for major Axle Configuration on SDP

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Full	2	22.22%	Min. Load	4.78	10.65					15.43
					Max. Load	5.44	12.10				17.54	
					Avg. Load	5.11	11.37				16.49	
					Standard Deviation	0.46	1.03				1.49	
					Variance	0.21	1.06				2.23	
		Container	7	77.78%	Min. Load	3.80	8.46				12.26	
					Max. Load	11.37	25.31				36.68	
					Avg. Load	7.29	16.22				23.50	
					Standard Deviation	3.77	8.40				12.17	
					Variance	14.23	70.52				148.12	
Total	9	100.00%										
2	3 Axle Tandem	Container	10	100.00%	Min. Load	3.15	5.59	5.59				14.33
					Max. Load	8.43	14.95	14.95				38.34
					Avg. Load	6.26	11.10	11.10				28.47
					Standard Deviation	2.04	3.61	3.61				9.27
					Variance	4.16	13.07	13.07				85.90
Total	10	100.00%										
3	4 Axle Single Tandem	Container	16	100.00%	Min. Load	3.36	6.13	4.74	5.54			19.77
					Max. Load	7.68	14.01	10.85	12.65			45.19
					Avg. Load	5.53	10.08	7.81	9.11			32.53
					Standard Deviation	1.25	2.27	1.76	2.05			-
					Variance	1.55	5.17	3.10	4.22			53.78
Total	16	100.00%										

9.6.9 Distribution of Vehicles by Type on SDP

The percentage of vehicles with respect to Type i.e., Truck and Semi-Trailer plying on SDP is tabulated in Table 9-48 and is graphically presented in Figure 9-31.

Table 9-48: Percentage of Vehicles w.r.t Type on SDP

Sr. No.	Vehicle Type	Count	Percentage
1	Truck	21	60.00%
2	Semi-Trailer	14	40.00%
	Total	35	100.00%

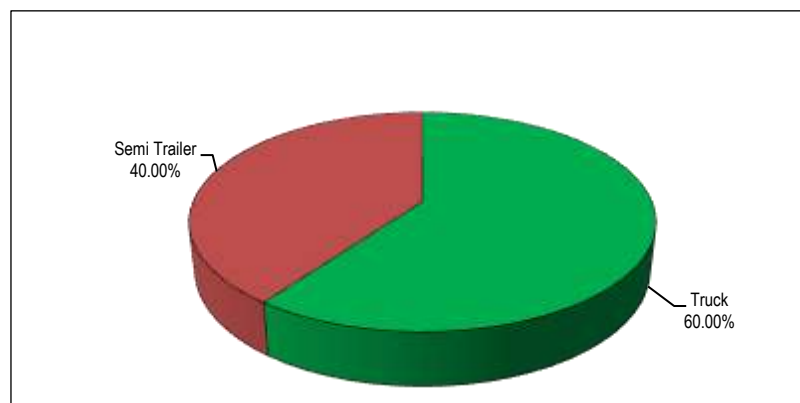


Figure 9-31: Percentage of Vehicles w.r.t Type on SDP

9.6.10 Analysis by Vehicle Type on SDP

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to truck type is presented in Table 9-49. The results depict that:

In case of **2 Axle Single**, truck type constitutes maximum percentage of 100%, with average gross load of 21.94 ton.

In case of **3 Axle Tandem**, truck type constitutes maximum percentage of 100%, with average gross load of 28.47 ton.

In case of **4 Axle Single Tandem**, semi-trailer type constitutes maximum percentage of 87.50%, with average gross load of 33.08 ton, followed by truck type with percentage of 12.50%, carrying average gross load of 28.68 ton.

Table 9-49: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Type for major Axle Configuration on SDP

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Truck	9	100.00%	Min. Load	3.80	8.46					12.26
					Max. Load	11.37	25.31					36.68
					Avg. Load	6.80	15.14					21.94
					Standard Deviation	3.41	7.59					11.00
					Variance	11.62	57.58					120.94
					Total	9	100.00%					
2	3 Axle Tandem	Truck	10	100.00%	Min. Load	3.15	5.59	5.59				14.33
					Max. Load	8.43	14.95	14.95				38.34
					Avg. Load	6.26	11.10	11.10				28.47
					Standard Deviation	2.04	3.61	3.61				9.27
					Variance	4.16	13.07	13.07				85.90
					Total	10	100.00%					
3	4 Axle Single Tandem	Semi-Trailer	14	87.50%	Min. Load	3.36	6.13	4.74	5.54	0.00		19.77
					Max. Load	7.68	14.01	10.85	12.65	0.00		45.19
					Avg. Load	5.62	10.25	7.94	9.26	-		33.08
					Standard Deviation	1.20	2.27	1.70	1.98	0.00		7.08
					Variance	1.45	4.82	2.89	3.93	0.00		50.14
					Total	14	87.50%					
		Truck	2	12.50%	Min. Load	3.55	6.48	5.02	5.85	0.00		20.90
					Max. Load	6.20	11.30	8.75	10.21	0.00		36.46
					Avg. Load	4.88	8.89	6.88	8.03	-		28.68
					Standard Deviation	1.87	3.41	2.64	3.08	0.00		11.00
					Variance	3.50	11.63	6.97	9.49	0.00		121.06
					Total	2	12.50%					
Total	16	100.00%										

9.6.11 Commodities carried by vehicles on SDP

The percentage of major commodities carried by heavy vehicles on SDP is tabulated in Table 9-50 and is graphically presented in Figure 9-32. For the sake of analysis, each commodity is assigned a code; details are attached in Annex – 2.

Table 9-50: Percentage of Vehicle w.r.t Commodities on SDP

Sr. No.	Commodity Type	Code	Count	Percentage
1	Raw Materials	400	4	11.43%
2	Bulk Manufactures	500	1	2.86%
3	Basic Manufactures	600	5	14.29%
4	Miscellaneous Manufactures	700	17	48.57%
5	Mining and Quarrying	800	4	11.43%
6	Miscellaneous Goods not Classified	A00	4	11.43%
Total			35	100.00%

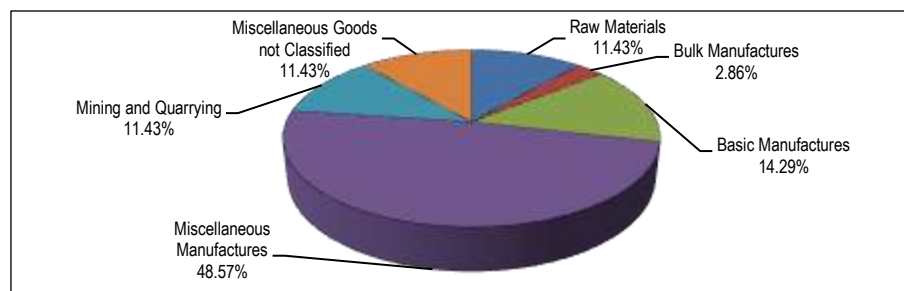


Figure 9-32: Percentage of Vehicles w.r.t Commodities on SDP

9.6.12 Analysis based on Commodities on SDP

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to commodities carried by trucks is presented in Table 9-51. The results depict that:

Major commodities carried by **2 Axle Single** are basic manufactures & mining and quarrying, covering 33.33% each of the total, with average gross load of 16.71 ton and 36.39 ton respectively, followed by miscellaneous manufactures having percentage of 22.22% in total, with average gross load of 12.96 ton.

Major commodities carried by **3 Axle Tandem** are miscellaneous manufactures and miscellaneous goods not classified, covering 40% each of the total, with average gross load of 18.66 ton and 36.24 ton respectively.

Major commodities carried by **4 Axle Single Tandem** are miscellaneous manufactures, covering 68.75% of the total, with average gross load of 30.22 ton, followed by raw materials, having percentage of 25% in total, with average gross load of 38.04 ton.

Table 9-51: Stdev. Var., Min., Max. & Avg. Load Comparison w.r.t Commodities for major Axle Configuration on SDP

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	2 Axle Single	Bulk Manufactures	500	1	11.11%	Min. Load	3.80	8.46					12.26
						Max. Load	3.80	8.46				12.26	
						Avg. Load	3.80	8.46				12.26	
						Standard Deviation	-	-				-	
		Variance	-	-				-					
		Basic Manufactures	600	3	33.33%	Min. Load	4.78	10.65					15.43
						Max. Load	5.44	12.10				17.54	
						Avg. Load	5.18	11.53				16.71	
						Standard Deviation	0.35	0.77				1.12	
		Variance	0.12	0.60				1.26					
		Miscellaneous Manufactures	700	2	22.22%	Min. Load	3.84	8.54					12.38
						Max. Load	4.19	9.34				13.53	
						Avg. Load	4.02	8.94				12.96	
						Standard Deviation	0.25	0.56				0.81	
		Variance	0.06	0.31				0.66					
		Mining and Quarrying	800	3	33.33%	Min. Load	11.15	24.81					35.96
Max. Load	11.37					25.31				36.68			
Avg. Load	11.28					25.11				36.39			
Standard Deviation	0.12					0.26				0.38			
Variance	0.01	0.07				0.15							
Total				9	100%								
2	3 Axle Tandem	Basic Manufactures	600	1	10.00%	Min. Load	5.88	10.43	10.43				26.74
						Max. Load	5.88	10.43	10.43				26.74
						Avg. Load	5.88	10.43	10.43				26.74
						Standard Deviation	-	-	-				-
		Variance	-	-	-				-				
		Miscellaneous Manufactures	700	4	40.00%	Min. Load	3.15	5.59	5.59				14.33
						Max. Load	4.97	8.81	8.81				22.59
						Avg. Load	4.10	7.28	7.28				18.66
						Standard Deviation	0.86	1.53	1.53				3.91
		Variance	0.74	2.33	2.33				15.31				
		Mining and Quarrying	800	1	10.00%	Min. Load	8.43	14.95	14.95				38.34
						Max. Load	8.43	14.95	14.95				38.34
						Avg. Load	8.43	14.95	14.95				38.34
						Standard Deviation	-	-	-				-
		Variance	-	-	-				-				
		Miscellaneous Goods not Classified	A00	4	40.00%	Min. Load	7.88	13.97	13.97				35.83
Max. Load	8.02					14.22	14.22				36.47		
Avg. Load	7.97					14.13	14.13				36.24		
Standard Deviation	0.07					0.12	0.12				0.30		
Variance	0.00	0.01	0.01				0.09						
Total				10	100.00%								
3	4 Axle Single Tandem	Raw Materials	400	4	25.00%	Min. Load	5.70	10.39	8.04	9.38			33.51
						Max. Load	7.68	14.01	10.85	12.65			45.19
						Avg. Load	6.47	11.79	9.13	10.65			38.04
						Standard Deviation	0.85	1.55	1.20	1.40			5.01
		Variance	0.72	2.41	1.44	1.97			25.08				
		Basic Manufactures	600	1	6.25%	Min. Load	6.09	11.11	8.60	10.04			35.84
						Max. Load	6.09	11.11	8.60	10.04			35.84
						Avg. Load	6.09	11.11	8.60	10.04			35.84
Variance	0.00					0.00	0.00	0.00			0.00		

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
						Standard Deviation	-	-	-	-	-	-	-
						Variance	-	-	-	-	-	-	-
		Miscellaneous Manufactures	700	11	68.75%	Min. Load	3.36	6.13	4.74	5.54			19.77
						Max. Load	6.78	12.37	9.57	11.17			39.89
						Avg. Load	5.14	9.37	7.25	8.46			30.22
						Standard Deviation	1.25	2.28	1.76	2.06			7.35
						Variance	1.56	5.20	3.11	4.24			54.06
		Total		16	100.00%								

9.6.13 Damage Factor for major Axle Configuration on SDP

The average damage factors calculated for major axle configuration are presented in Table 9-52.

Table 9-52: Damage Factor for each Axle Configuration on SDP

Sr. No.	Axle Configuration	Code	Damage Factor (2020)	
			Road Note 40	AASHTO 1993
1	2 Axle Single	1.2	54.8290	31.85
2	3 Axle Tandem	1.22	13.9462	7.03
3	4 Axle Single Tandem	1.2-22	6.948	5.03

9.7 Islamabad Dry Port (IDP)

The results of axle load survey performed on IDP are discussed in subsequent sub-sections.

9.7.1 Distribution of Vehicles by Axle Configuration on IDP

The percentage of trucks for major axle configurations surveyed on IDP is summarized in Table 9-53 and is graphically presented in Figure 9-33.

Table 9-53: Percentage of Vehicle w.r.t Axle Configuration on IDP

Sr. No.	Axle Configuration	Code	Total Number of Trucks	Percentage
1	3 Axle Tandem	1.22	3	6.52%
2	4 Axle Single Tandem	1.2-22	29	63.04%
3	5 Axle Single Tridem	1.2-222	8	17.39%
4	5 Axle Tandem Tandem	1.22-22	1	2.17%
5	6 Axle Tandem Tridem	1.22-222	3	6.52%
6	Others	-	2	4.35%
	Total		46	100%

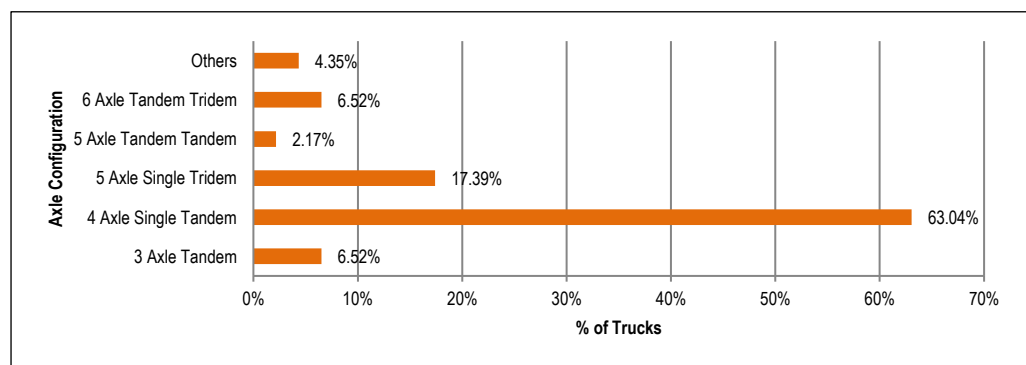


Figure 9-33: Percentage of Vehicles w.r.t Axle Configuration on IDP

9.7.2 Analysis by Axle Configuration on IDP

The analysis comprising minimum, maximum and average loads per axle carried by trucks on IDP along with standard deviation and variance is presented in Table 9-54. The minimum, maximum and average loads are graphically presented in Figure 9-34 and Figure 9-35 respectively.

In case of **3 Axle Tandem**, maximum load of 39.26 ton with average load of 30.46 ton was recorded.

In case of **4 Axle Single Tandem**, maximum load of 50.44 ton with average load of 35.87 ton was recorded.

In case of **5 Axle Single Tridem**, maximum load of 51.31 ton with average load of 45.12 ton was recorded.

In case of **6 Axle Tandem Tridem**, maximum load of 79.00 ton with average load of 67.65 ton was recorded.

Table 9-54: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Axle Configuration on IDP

Sr. No.	Axle Configuration	Permissible Load Limits	Parameters	Load (Tons)						
				Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	3 Axle Tandem	27.5	Min. Load	4.94	8.76	8.76				22.45
			Max. Load	8.64	15.31	15.31				39.26
			Avg. Load	6.70	11.88	11.88				30.46
			Standard Deviation	1.86	3.29	3.29				8.43
			Variance	3.44	10.82	10.82				71.12
2	4 Axle Single Tandem	39.5	Min. Load	3.98	7.26	5.62	6.56			23.42
			Max. Load	8.57	15.64	12.11	14.12			50.44
			Avg. Load	6.10	11.12	8.61	10.04			35.87
			Standard Deviation	1.39	2.53	1.96	2.29			8.18
			Variance	1.93	6.43	3.85	5.24			66.86
3	5 Axle Single Tridem	48.5	Min. Load	4.69	8.30	7.22	7.58	8.30		36.09
			Max. Load	6.67	11.80	10.26	10.78	11.80		51.31
			Avg. Load	5.87	10.38	9.02	9.47	10.38		45.12
			Standard Deviation	0.62	1.09	0.95	0.99	1.09		4.74
			Variance	0.38	1.19	0.90	0.99	1.19		22.43
4	5 Axle Tandem Tandem	49.5	Min. Load	6.92	11.72	10.65	11.18	12.78		53.25
			Max. Load	6.92	11.72	10.65	11.18	12.78		53.25
			Avg. Load	6.92	11.72	10.65	11.18	12.78		53.25
			Standard Deviation	-	-	-	-	-		-
			Variance	-	-	-	-	-		-
5	6 Axle Tandem Tridem	58.5	Min. Load	5.40	9.18	9.72	8.64	9.72	11.34	53.99
			Max. Load	7.90	13.43	14.22	12.64	14.22	16.59	79.00
			Avg. Load	6.77	11.50	12.18	10.82	12.18	14.21	67.65
			Standard Deviation	1.27	2.15	2.28	2.03	2.28	2.66	12.66
			Variance	1.60	4.64	5.20	4.11	5.20	7.07	160.40

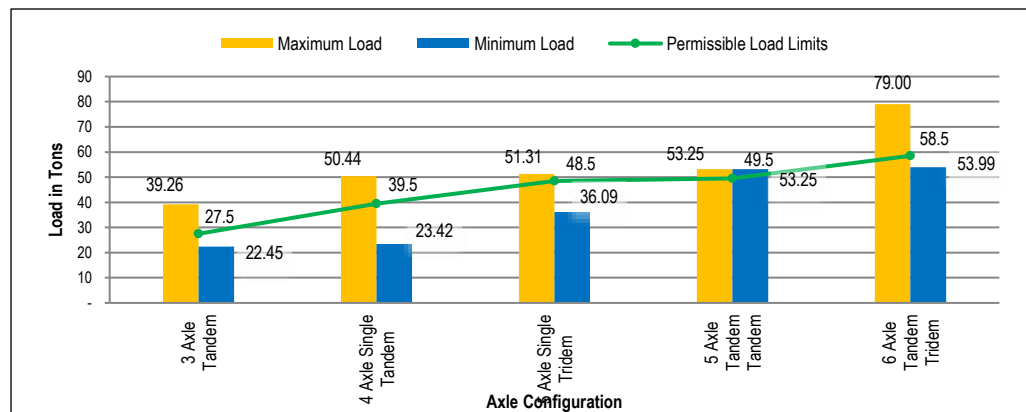


Figure 9-34: Min. & Max. Load Comparison w.r.t Axle Configuration on IDP

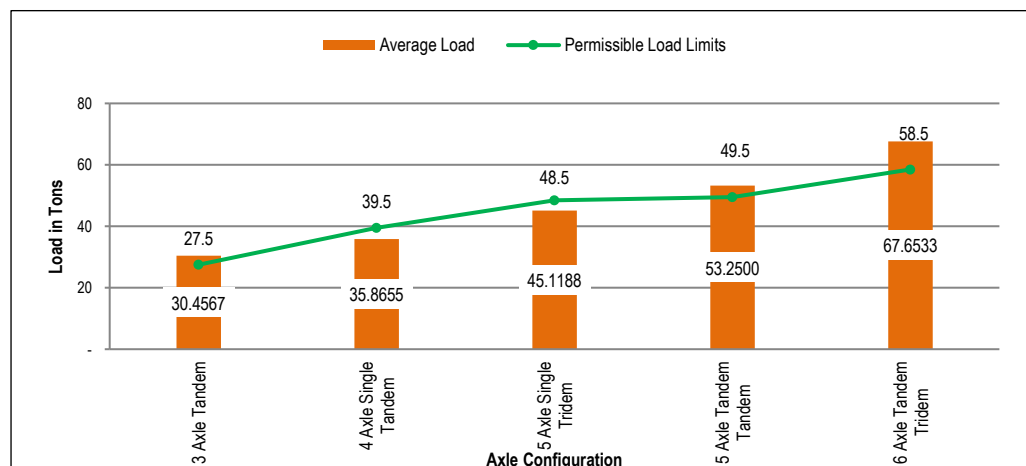


Figure 9-35: Avg. Load Comparison w.r.t Axle Configuration on IDP

9.7.3 Load Spectrum by Axle Configuration on IDP

The major cause of pavement failure is due to excessive overloading. The axle load survey data was organized in a way to identify the number of vehicles carrying load above and below permissible limits. Furthermore, load spectrums were identified and number of vehicles carrying load in specified spectrums were calculated. The results are tabulated in Table 9-55 which illustrates that:

In case of **3 Axle Tandem**, 33.33% of trucks carried load under permissible limits. Whereas, 33.33% of the trucks carried load more than 15% of permissible load limits.

In case of **4 Axle Single Tandem**, 68.97% of semi-trailers carried load under permissible limits. Whereas, 17.24% of the semi-trailers carried load more than 15% of permissible load limits.

In case of **5 Axle Single Tridem**, 75% of semi-trailers carried load under permissible limits.

In case of **6 Axle Tandem Tridem**, 33.33% of semi-trailers carried load under permissible limits. Whereas, 66.67% semi-trailers carried load more than 15% of permissible load limits.

The percentage of trucks for major axle configuration carrying load above and below permissible limits on IDP is graphically presented in Figure 9-36.

Table 9-55: Load Spectrum w.r.t Axle Configuration on IDP

Sr. No.	Axle Configuration	Under Permissible Limit	Over Permissible Limit					Total	
			15.00%	30.00%	50.00%	75.00%	>75%		
1	3 Axle Tandem	Max. Load (Tons)	27.5	31.6	35.8	41.3	48.1		
		Average Load (Tons)	22.45	29.66	-	39.26	-	-	
		No. of Trucks	1	1	0	1	0	0	3
		Percentage	33.33%	33.33%	0.00%	33.33%	0.00%	0.00%	100%
		Cumulative Percentage	33.33%	66.67%	66.67%	100.00%	100.00%	100.00%	
		Percentage above Range Value	66.67%	33.33%	33.33%	0.00%	0.00%	0.00%	
2	4 Axle Single Tandem	Max. Load (Tons)	39.5	45.4	51.4	59.3	69.1		
		Average Load (Tons)	31.58	41.08	48.83	-	-	-	
		No. of Trucks	20	4	5	0	0	0	29
		Percentage	68.97%	13.79%	17.24%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	68.97%	82.76%	100.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	31.03%	17.24%	0.00%	0.00%	0.00%	0.00%	
3	5 Axle Single Tridem	Max. Load (Tons)	48.5	55.8	63.1	72.8	84.9		
		Average Load (Tons)	43.24	50.77	-	-	-	-	
		No. of Trucks	6	2	0	0	0	0	8
		Percentage	75.00%	25.00%	0.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	75.00%	100.00%	100.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	25.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
4	5 Axle Tandem Tandem	Max. Load (Tons)	49.5	56.9	64.4	74.3	86.6		
		Average Load (Tons)	-	53.25	-	-	-	-	
		No. of Trucks	0	1	0	0	0	0	1
		Percentage	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	0.00%	100.00%	100.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
5	6 Axle Tandem Tridem	Max. Load (Tons)	58.5	67.3	76.1	87.8	102.4		
		Average Load (Tons)	53.99	-	69.97	79.00	-	-	
		No. of Trucks	1	0	1	1	0	0	3
		Percentage	33.33%	0.00%	33.33%	33.33%	0.00%	0.00%	100%
		Cumulative Percentage	33.33%	33.33%	66.67%	100.00%	100.00%	100.00%	
		Percentage above Range Value	66.67%	66.67%	33.33%	0.00%	0.00%	0.00%	

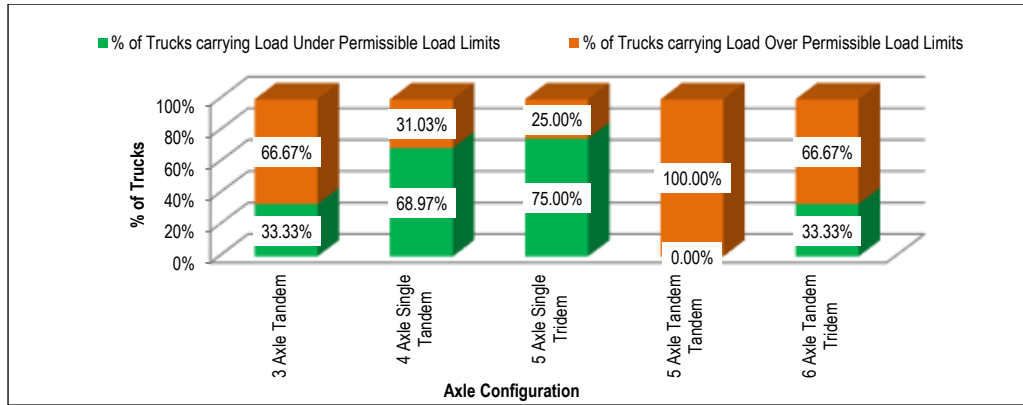


Figure 9-36: Percentage of Vehicles carrying Load above and below Permissible Limits on IDP

9.7.4 Front & Rear Axle Load Spectrum on IDP

The spectrum of front and rear axle loads for major axle configurations is presented in Table 9-56.

Table 9-56: Front & Rear Axle Load Spectrum on IDP

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
Front Axle Load Spectrum					
1	0 - 2.99	0	0.00%	0.00%	100.00%
2	3 - 5.49	14	31.82%	31.82%	68.18%
3	5.5 - 6.99	21	47.73%	79.55%	20.45%
4	7 - 8.99	9	20.45%	100.00%	0.00%
5	9 - 10.99	0	0.00%	100.00%	0.00%
6	11 - 12.99	0	0.00%	100.00%	0.00%
7	13 - 14.99	0	0.00%	100.00%	0.00%
8	15 - 16.99	0	0.00%	100.00%	0.00%
9	17 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Single)					
1	0 - 8.16	26	18.06%	18.06%	81.94%
2	8.17 - 9.99	42	29.17%	47.22%	52.78%
3	10 - 10.99	23	15.97%	63.19%	36.81%
4	11 - 11.99	24	16.67%	79.86%	20.14%
5	12 - 12.99	12	8.33%	88.19%	11.81%
6	13 - 13.99	4	2.78%	90.97%	9.03%
7	14 - 14.99	6	4.17%	95.14%	4.86%
8	15 - 19.99	7	4.86%	100.00%	0.00%
9	20 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Tandem)					
1	0 - 11.99	0	0.00%	0.00%	100.00%
2	12 - 14.99	8	21.62%	21.62%	78.38%
3	15 - 19.99	13	35.14%	56.76%	43.24%
4	20 - 21.99	4	10.81%	67.57%	32.43%
5	22 - 23.99	5	13.51%	81.08%	18.92%
6	24 - 25.99	3	8.11%	89.19%	10.81%
7	26 - 27.99	3	8.11%	97.30%	2.70%
8	28 - 29.99	0	0.00%	97.30%	2.70%
9	30 & Above	1	2.70%	100.00%	0.00%
Rear Axle Load Spectrum (Tridem)					
1	0 - 14.99	0	0.00%	0.00%	100.00%
2	15 - 30.99	7	63.64%	63.64%	36.36%
3	31 - 32.99	2	18.18%	81.82%	18.18%
4	33 - 34.99	0	0.00%	81.82%	18.18%
5	35 - 36.99	0	0.00%	81.82%	18.18%
6	37 - 38.99	1	9.09%	90.91%	9.09%
7	39 - 40.99	0	0.00%	90.91%	9.09%
8	41 - 42.99	0	0.00%	90.91%	9.09%
9	43 & Above	1	9.09%	100.00%	0.00%

9.7.5 Distribution of Vehicles by Make Type on IDP

The distribution of trucks as per make type is illustrated in Table 9-57 and is graphically presented in Figure 9-37. The results depict that Hino and Nissan have maximum

percentage of 25.58% and 51.16% on IDP.

Table 9-57: Percentage of Vehicles w.r.t Make Type on IDP

Sr. No.	Make	Count	Percentage
1	Bedford	1	2.33%
2	Nissan	22	51.16%
3	Hino	11	25.58%
4	Isuzu	1	2.33%
5	UD	8	18.60%
Total		43	100.00%

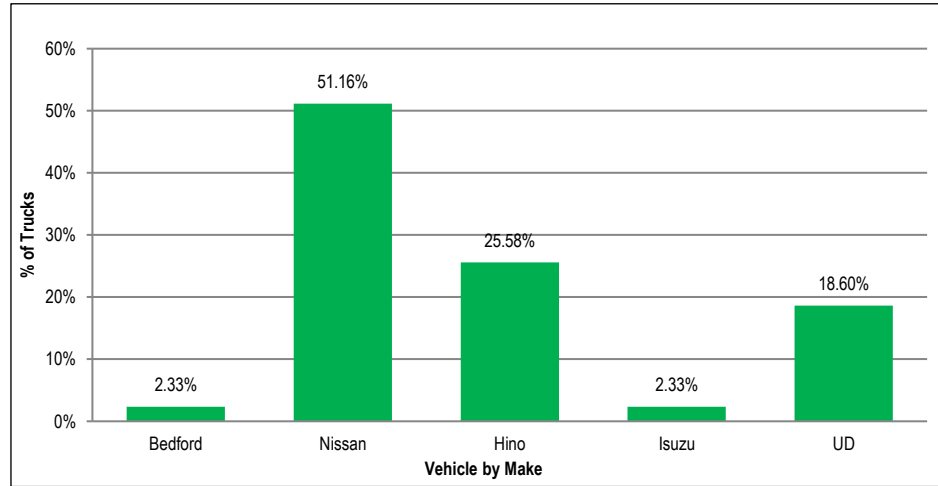


Figure 9-37: Percentage of Vehicles w.r.t Make Type on IDP

9.7.6 Analysis by Make Type on IDP

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to make type is presented in Table 9-58. The results depict that:

In case of **4 Axle Single Tandem**, Nissan constitutes maximum percentage of 62.07%, with average gross load of 32.69 ton, followed by Hino with percentage of 24.14%, carrying average gross load of 37.45 ton.

In case of **5 Axle Single Tridem**, UD constitutes maximum percentage of 50%, with average gross load of 46.19 ton, followed by Nissan with percentage of 37.5%, carrying average gross load of 44.33 ton.

In case of **6 Axle Tandem Tridem**, Hino constitutes maximum percentage of 66.67%, with average gross load of 66.5 ton.

Table 9-58: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Make Type for major Axle Configuration on IDP

Sr.No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)					Total	
						Front	Rear 1	Rear 2	Rear 3	Rear 4		Rear 5
1	3 Axle Tandem	Bedford	1	50.00%	Min. Load	6.53	11.57	11.57				29.66
					Max. Load	6.53	11.57	11.57				29.66
					Avg. Load	6.53	11.57	11.57				29.66
					Standard Deviation	-	-	-				-
					Variance	-	-	-				-
		Hino	1	50.00%	Min. Load	8.64	15.31	15.31				39.26
					Max. Load	8.64	15.31	15.31				39.26
					Avg. Load	8.64	15.31	15.31				39.26
					Standard Deviation	-	-	-				-
					Variance	-	-	-				-
Total		2	100.00%									
2	4 Axle Single Tandem	Hino	7	24.14%	Min. Load	4.30	7.85	6.08	7.09			25.32
					Max. Load	8.57	15.64	12.11	14.12			50.44
					Avg. Load	6.37	11.61	8.99	10.49			37.45
					Standard Deviation	1.58	2.89	2.24	2.61			9.32
					Variance	2.51	8.35	5.01	6.81			86.89
		Isuzu	1	3.45%	Min. Load	7.55	13.76	10.66	12.43			44.40
					Max. Load	7.55	13.76	10.66	12.43			44.40
					Avg. Load	7.55	13.76	10.66	12.43			44.40
					Standard Deviation	-	-	-	-			-
					Variance	-	-	-	-			-

Sr.No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)							
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total	
		Nissan	18	62.07%	Standard Deviation	-	-	-	-	-	-	-	-
					Variance	-	-	-	-	-	-	-	-
					Min. Load	3.98	7.26	5.62	6.56			23.42	
					Max. Load	6.88	12.54	9.71	11.33			40.46	
					Avg. Load	5.56	10.13	7.84	9.15			32.69	
					Standard Deviation	1.01	1.84	1.42	1.66			5.93	
		UD	3	10.34%	Variance	1.02	3.38	2.03	2.76			35.16	
					Min. Load	7.81	14.24	11.03	12.86			45.94	
					Max. Load	8.54	15.57	12.05	14.06			50.22	
					Avg. Load	8.23	15.00	11.61	13.55			48.39	
					Standard Deviation	0.38	0.68	0.53	0.62			2.21	
					Variance	0.14	0.47	0.28	0.38			4.87	
		Total	29	100.00%									
		3	5 Axle Single Tridem	Hino	1	12.50%	Min. Load	5.62	9.94	8.64	9.07	9.94	
Max. Load	5.62						9.94	8.64	9.07	9.94		43.20	
Avg. Load	5.62						9.94	8.64	9.07	9.94		43.20	
Standard Deviation	-						-	-	-	-		-	
Nissan	3			37.50%	Variance	-	-	-	-	-	-		-
					Min. Load	5.68	10.05	8.74	9.17	10.05		43.69	
					Max. Load	5.89	10.42	9.06	9.52	10.42		45.32	
					Avg. Load	5.76	10.20	8.87	9.31	10.20		44.33	
UD	4			50.00%	Standard Deviation	0.11	0.20	0.17	0.18	0.20		0.87	
					Variance	0.01	0.04	0.03	0.03	0.04		0.75	
					Min. Load	4.69	8.30	7.22	7.58	8.30		36.09	
					Max. Load	6.67	11.80	10.26	10.78	11.80		51.31	
Total	8			100.00%	Avg. Load	6.00	10.62	9.24	9.70	10.62		46.19	
					Standard Deviation	0.91	1.60	1.39	1.46	1.60		6.96	
		Variance	0.82		2.56	1.94	2.14	2.56		48.47			
4	5 Axle Tandem Tandem	UD	1	100.00%	Min. Load	6.92	11.72	10.65	11.18	12.78		53.25	
					Max. Load	6.92	11.72	10.65	11.18	12.78		53.25	
					Avg. Load	6.92	11.72	10.65	11.18	12.78		53.25	
					Standard Deviation	-	-	-	-	-		-	
					Variance	-	-	-	-	-		-	
Total	1	100.00%											
5	6 Axle Tandem Tridem	Hino	2	66.67%	Min. Load	5.40	9.18	9.72	8.64	9.72	11.34	53.99	
					Max. Load	7.90	13.43	14.22	12.64	14.22	16.59	79.00	
					Avg. Load	6.65	11.30	11.97	10.64	11.97	13.96	66.50	
					Standard Deviation	1.77	3.01	3.18	2.83	3.18	3.71	17.68	
		Nissan	1	33.33%	Variance	3.13	9.04	10.13	8.01	10.13	13.79	312.75	
					Min. Load	7.00	11.89	12.59	11.20	12.59	14.69	69.97	
					Max. Load	7.00	11.89	12.59	11.20	12.59	14.69	69.97	
					Avg. Load	7.00	11.89	12.59	11.20	12.59	14.69	69.97	
		Total	3	100.00%	Standard Deviation	-	-	-	-	-	-	-	
					Variance	-	-	-	-	-	-	-	

9.7.7 Distribution of Vehicles by Body Type on IDP

The percentage of vehicles with respect to Body Type i.e. Flat, Half, Full & Container plying on IDP is tabulated in Table 9-59 and is graphically presented in Figure 9-38.

Table 9-59: Percentage of Vehicles w.r.t Body Type on IDP

Sr. No.	Body Type	Count	Percentage
1	Container	44	100.00%
	Total	44	100.00%

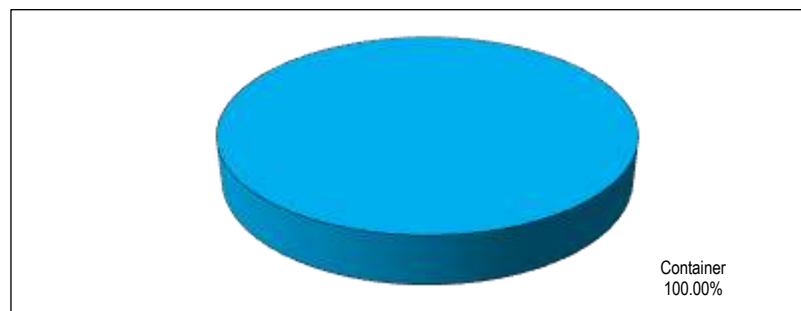


Figure 9-38 : Percentage of Vehicles w.r.t Body Type on IDP

9.7.8 Analysis by Body Type on IDP

The statistical analysis comprising minimum, maximum and average loads per axle

carried by trucks of major axle configuration along with standard deviation and variance with respect to body type is presented in Table 9-60. The results depict that:

In case of **3 Axle Tandem**, container body type constitutes maximum percentage of 100%, with average gross load of 30.46 ton.

In case of **4 Axle Single Tandem**, container body type constitutes maximum percentage of 100%, with average gross load of 35.87 ton.

In case of **5 Axle Single Tridem**, container body type constitutes maximum percentage of 100%, with average gross load of 45.12 ton.

In case of **6 Axle Tandem Tridem**, container body type constitutes maximum percentage of 100%, with average gross load of 67.65 ton.

Table 9-60: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Body Type for major Axle Configuration on IDP

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	3 Axle Tandem	Container	3	100.00%	Min. Load	4.94	8.76	8.76				22.45
					Max. Load	8.64	15.31	15.31				39.26
					Avg. Load	6.70	11.88	11.88				30.46
					Standard Deviation	1.86	3.29	3.29				8.43
					Variance	3.44	10.82	10.82				71.12
		Total			3	100.00%						
2	4 Axle Single Tandem	Container	29	100.00%	Min. Load	3.98	7.26	5.62	6.56			23.42
					Max. Load	8.57	15.64	12.11	14.12			50.44
					Avg. Load	6.10	11.12	8.61	10.04			35.87
					Standard Deviation	1.39	2.53	1.96	2.29			-
					Variance	1.93	6.43	3.85	5.24			66.86
		Total			29	100.00%						
3	5 Axle Single Tridem	Container	8	100.00%	Min. Load	4.69	8.30	7.22	7.58	8.30		36.09
					Max. Load	6.67	11.80	10.26	10.78	11.80		51.31
					Avg. Load	5.87	10.38	9.02	9.47	10.38		45.12
					Standard Deviation	0.62	1.09	0.95	0.99	1.09		4.74
					Variance	0.38	1.19	0.90	0.99	1.19		22.43
		Total			8	100.00%						
4	5 Axle Tandem Tandem	Container	1	100.00%	Min. Load	6.92	11.72	10.65	11.18	12.78		53.25
					Max. Load	6.92	11.72	10.65	11.18	12.78		53.25
					Avg. Load	6.92	11.72	10.65	11.18	12.78		53.25
					Standard Deviation	-	-	-	-	-		-
					Variance	-	-	-	-	-		-
		Total			1	100.00%						
5	6 Axle Tandem Tridem	Container	3	100.00%	Min. Load	5.40	9.18	9.72	8.64	9.72	11.34	53.99
					Max. Load	7.90	13.43	-	12.64	14.22	16.59	79.00
					Avg. Load	6.77	11.50	12.18	10.82	12.18	14.21	67.65
					Standard Deviation	1.27	2.15	2.28	2.03	2.28	2.66	12.66
					Variance	1.60	4.64	5.20	4.11	5.20	7.07	160.40
		Total			3	100.00%						

9.7.9 Distribution of Vehicles by Type on IDP

The percentage of vehicles with respect to Type i.e. Truck, Semi-Trailer and Tanker plying on IDP is tabulated in Table 9-61 and is graphically presented in Figure 9-39.

Table 9-61: Percentage of Vehicles w.r.t Type on IDP

Sr. No.	Vehicle Type	Count	Percentage
1	Truck	3	6.82%
2	Semi-Trailer	41	93.18%
	Total	44	100.00%

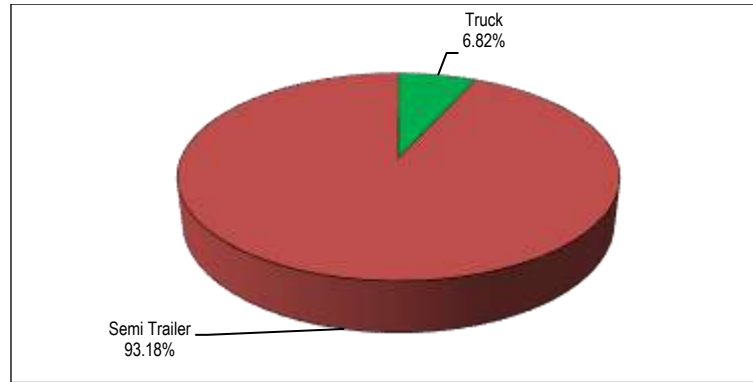


Figure 9-39: Percentage of Vehicles w.r.t Type on IDP

9.7.10 Analysis by Vehicle Type on IDP

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to truck type is presented in Table 9-62. The results depict that:

In case of **3 Axle Tandem**, truck type constitutes maximum percentage of 100%, with average gross load of 30.46 ton.

In case of **4 Axle Single Tandem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 35.87 ton.

In case of **5 Axle Single Tridem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 45.12 ton.

In case of **6 Axle Tandem Tridem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 67.65 ton.

Table 9-62: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Type for major Axle Configuration on IDP

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)							
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total	
1	3 Axle Tandem	Truck	3	100.00%	Min. Load	4.94	8.76	8.76					22.45
					Max. Load	8.64	15.31	15.31					39.26
					Avg. Load	6.70	11.88	11.88					30.46
					Standard Deviation	1.86	3.29	3.29					8.43
					Variance	3.44	10.82	10.82					71.12
	Total		3	100.00%									
2	4 Axle Single Tandem	Semi-Trailer	29	100.00%	Min. Load	3.98	7.26	5.62	6.56	0.00			23.42
					Max. Load	8.57	15.64	12.11	14.12	0.00			50.44
					Avg. Load	6.10	11.12	8.61	10.04	-			35.87
					Standard Deviation	1.39	-	1.96	2.29	0.00			8.18
					Variance	1.93	6.43	3.85	5.24	0.00			66.86
	Total		29	100.00%									
3	5 Axle Single Tridem	Semi-Trailer	8	100.00%	Min. Load	4.69	8.30	7.22	7.58	8.30			36.09
					Max. Load	6.67	11.80	10.26	10.78	11.80			51.31
					Avg. Load	5.87	10.38	9.02	9.47	10.38			45.12
					Standard Deviation	0.62	1.09	0.95	0.99	1.09			4.74
					Variance	0.38	1.19	0.90	0.99	1.19			22.43
	Total		8	100.00%									
4	5 Axle Tandem Tandem	Semi-Trailer	1	100.00%	Min. Load	6.92	11.72	10.65	11.18	12.78			53.25
					Max. Load	6.92	11.72	10.65	11.18	12.78			53.25
					Avg. Load	6.92	11.72	10.65	11.18	12.78			53.25
					Standard Deviation	-	-	-	-	-			-
					Variance	-	-	-	-	-			-
	Total		1	100.00%									
5	6 Axle Tandem Tridem	Semi-Trailer	3	100.00%	Min. Load	5.40	9.18	9.72	8.64	9.72	11.34		53.99
					Max. Load	7.90	13.43	14.22	12.64	14.22	16.59		79.00
					Avg. Load	6.77	11.50	12.18	10.82	12.18	14.21		67.65
					Standard Deviation	1.27	2.15	2.28	2.03	2.28	2.66		12.66
					Variance	1.60	4.64	5.20	4.11	5.20	7.07		160.40
	Total		3	100.00%									

9.7.11 Commodities carried by vehicles on IDP

The percentage of major commodities carried by heavy vehicles on IDP is tabulated in

Table 9-63 and is graphically presented in Figure 9-40. For the sake of analysis, each commodity is assigned a code; details are attached in Annex – 2.

Table 9-63: Percentage of Vehicle w.r.t Commodities on IDP

Sr. No.	Commodity Type	Code	Count	Percentage
1	Raw Materials	400	11	25.00%
2	Bulk Manufactures	500	5	11.36%
3	Basic Manufactures	600	18	40.91%
4	Miscellaneous Manufactures	700	1	2.27%
5	Miscellaneous Goods not Classified	A00	9	20.45%
Total			44	100.00%

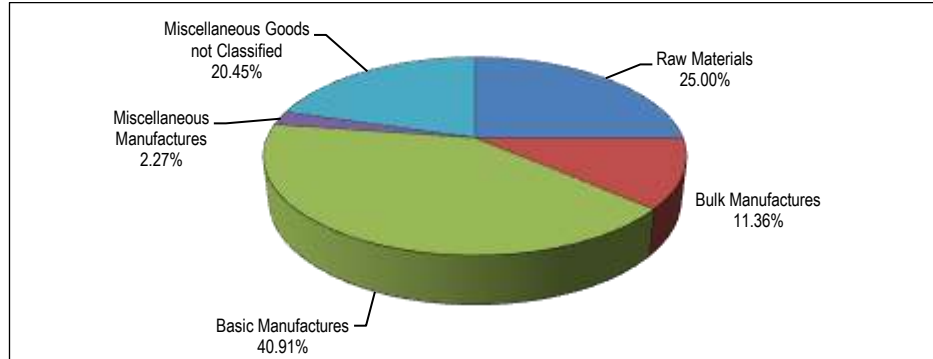


Figure 9-40: Percentage of Vehicles w.r.t Commodities on IDP

9.7.12 Analysis based on Commodities on IDP

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to commodities carried by trucks is presented in Table 9-64. The results depict that:

Major commodity carried by **3 Axle Tandem** is basic manufactures, covering 66.67% of the total, with average gross load of 34.46 ton.

Major commodities carried by **4 Axle Single Tandem** are raw materials, covering 37.93% of the total, with average gross load of 42.70 ton, followed by miscellaneous goods not classified, having percentage of 27.59% in total, with average gross load of 34.75 ton.

Major commodity carried by **5 Axle Single Tridem** is basic manufactures, covering 100% of the total, with average gross load of 45.12 ton.

Major commodity carried by **6 Axle Tandem Tridem** is basic manufactures, covering 100% of the total, with average gross load of 67.65 ton.

Table 9-64: Stdev. Var., Min., Max. & Avg. Load Comparison w.r.t Commodities for major Axle Configuration on IDP

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	3 Axle Tandem	Basic Manufactures	600	2	66.67%	Min. Load	6.53	11.57	11.57				29.66
						Max. Load	8.64	15.31	15.31				39.26
						Avg. Load	7.58	13.44	13.44				34.46
						Standard Deviation	1.49	2.65	2.65				6.79
						Variance	2.23	7.01	7.01				46.08
		Miscellaneous Goods not Classified	A00	1	33.33%	Min. Load	4.94	8.76	8.76				22.45
						Max. Load	4.94	8.76	8.76				22.45
						Avg. Load	4.94	8.76	8.76				22.45
						Standard Deviation	-	-	-				-
						Variance	-	-	-				-
Total				3	100.00%								
2	4 Axle Single Tandem	Raw Materials	400	11	37.93%	Min. Load	6.10	11.13	8.61	10.05			35.89
						Max. Load	8.57	15.64	12.11	14.12			50.44
						Avg. Load	7.26	13.24	10.25	11.96			42.70
						Standard Deviation	0.93	1.70	1.32	1.54			5.49
						Variance	0.87	2.90	1.74	2.37			30.19
		Bulk Manufactures	500	5	17.24%	Min. Load	4.24	7.73	5.99	6.99			24.95

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
		Bulk Manufactures				Max. Load	5.94	10.84	8.39	9.79			34.97
						Avg. Load	4.95	9.03	6.99	8.16			29.14
						Standard Deviation	0.69	1.27	0.98	1.14			4.08
						Variance	0.48	1.60	0.96	1.31			16.67
		Min. Load				3.98	7.26	5.62	6.56			23.42	
		Max. Load				6.20	11.31	8.75	10.21			36.47	
		Avg. Load				5.17	9.43	7.30	8.52			30.43	
		Standard Deviation				0.91	1.66	1.29	1.50			5.36	
		Variance				0.83	2.76	1.65	2.25			28.70	
		Min. Load				4.24	7.74	5.99	6.99			24.97	
		Max. Load				4.24	7.74	5.99	6.99			24.97	
		Avg. Load				4.24	7.74	5.99	6.99			24.97	
		Standard Deviation				-	-	-	-			-	
		Variance				-	-	-	-			-	
		Min. Load				4.30	7.85	6.08	7.09			25.32	
		Max. Load				8.25	15.05	11.65	13.59			48.55	
Avg. Load	5.91	10.77	8.34	9.73			34.75						
Standard Deviation	1.33	2.43	1.88	2.20			7.85						
Variance	1.78	5.91	3.55	4.83			61.55						
Total				29	100.00%								
3	5 Axle Single Tridem	Basic Manufactures	600	8	100.00%	Min. Load	4.69	8.30	7.22	7.58	8.30		36.09
						Max. Load	6.67	11.80	10.26	10.78	11.80		51.31
						Avg. Load	5.87	10.38	9.02	9.47	10.38		45.12
						Standard Deviation	0.62	1.09	0.95	0.99	1.09		4.74
						Variance	0.38	1.19	0.90	0.99	1.19		22.43
Total				8	100.00%								
4	5 Axle Tandem Tandem	Basic Manufactures	600	1	100.00%	Min. Load	6.92	11.72	10.65	11.18	12.78		53.25
						Max. Load	6.92	11.72	10.65	11.18	12.78		53.25
						Avg. Load	6.92	11.72	10.65	11.18	12.78		53.25
						Standard Deviation	-	-	-	-	-		-
						Variance	-	-	-	-	-		-
Total				1	100.00%								
5	6 Axle Tandem Tridem	Basic Manufactures	600	3	100.00%	Min. Load	5.40	9.18	9.72	8.64	9.72	11.34	53.99
						Max. Load	7.90	13.43	14.22	12.64	14.22	16.59	79.00
						Avg. Load	6.77	11.50	12.18	10.82	12.18	14.21	67.65
						Standard Deviation	1.27	2.15	2.28	2.03	2.28	2.66	12.66
						Variance	1.60	4.64	5.20	4.11	5.20	7.07	160.40
Total				3	100.00%								

9.7.13 Damage Factor for major Axle Configuration on IDP

The average damage factors calculated for major axle configuration are presented in Table 9-65.

Table 9-65: Damage Factor for each Axle Configuration on IDP

Sr. No.	Axle Configuration	Code	Damage Factor (2020)	
			Road Note 40	AASHTO 1993
1	3 Axle Tandem	1.22	15.68	8.48
2	4 Axle Single Tandem	1.2-22	11.31	7.53
3	5 Axle Single Tridem	1.2-222	10.14	6.62
4	5 Axle Tandem Tandem	1.22-22	20.09	10.42
5	6 Axle Tandem Tridem	1.22-222	37.95	15.20

9.8 Peshawar Dry Port (PDP)

The results of axle load survey performed on PDP are discussed in subsequent sub-sections.

9.8.1 Distribution of Vehicles by Axle Configuration on PDP

The percentage of trucks for major axle configurations surveyed on PDP is summarized in Table 9-66 and is graphically presented in Figure 9-41.

Table 9-66: Percentage of Vehicle w.r.t Axle Configuration on PDP

Sr. No.	Axle Configuration	Code	Total Number of Trucks	%age
1	4 Axle Single Tandem	1.2-22	26	68.42%
2	5 Axle Single Tridem	1.2-222	11	28.95%
3	6 Axle Tandem Tridem	1.22-222	1	2.63%
Total			38	100.00%

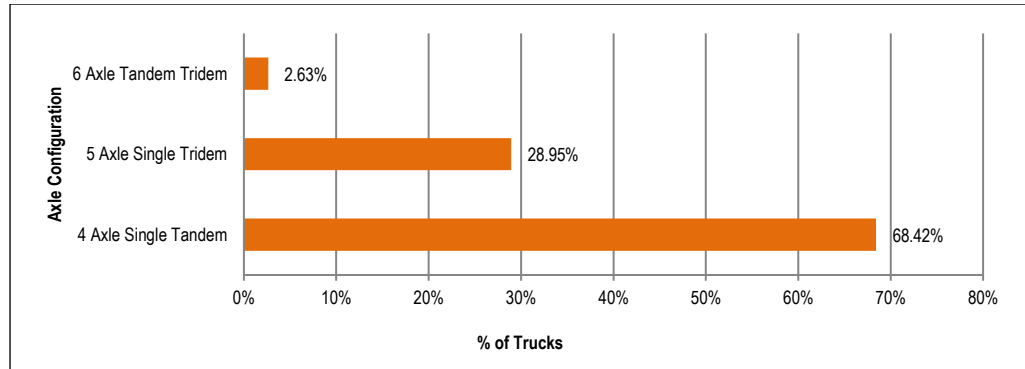


Figure 9-41: Percentage of Vehicles w.r.t Axle Configuration on PDP

9.8.2 Analysis by Axle Configuration on PDP

The analysis comprising minimum, maximum and average loads per axle carried by trucks on PDP along with standard deviation and variance is presented in Table 9-67. The minimum, maximum and average loads are graphically presented in Figure 9-42 and Figure 9-43 respectively.

In case of **4 Axle Single Tandem**, maximum load of 46.09 ton with average load of 39.71 ton was recorded.

In case of **5 Axle Single Tridem**, maximum load of 54.13 ton with average load of 47.81 ton was recorded.

Table 9-67: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Axle Configuration on PDP

Sr. No.	Axle Configuration	Permissible Load Limits	Parameters	Load (Tons)						
				Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	4 Axle Single Tandem	39.5	Min. Load	3.79	6.90	5.34	6.24			22.27
			Max. Load	7.83	14.29	11.06	12.90			46.09
			Avg. Load	6.75	12.31	9.53	11.12			39.71
			Standard Deviation	0.96	1.74	1.35	1.58			5.63
			Variance	0.92	3.04	1.82	2.48			31.68
2	5 Axle Single Tridem	48.5	Min. Load	5.78	10.23	8.90	9.34	10.23		44.49
			Max. Load	7.04	12.45	10.83	11.37	12.45		54.13
			Avg. Load	6.22	11.00	9.56	10.04	11.00		47.81
			Standard Deviation	0.33	0.59	0.51	0.54	0.59		2.57
			Variance	0.11	0.35	0.26	0.29	0.35		6.62
3	6 Axle Tandem Tridem	58.5	Min. Load	4.69	7.98	8.45	7.51	8.45	9.86	46.93
			Max. Load	4.69	7.98	8.45	7.51	8.45	9.86	46.93
			Avg. Load	4.69	7.98	8.45	7.51	8.45	9.86	46.93
			Standard Deviation	-	-	-	-	-	-	-
			Variance	-	-	-	-	-	-	-

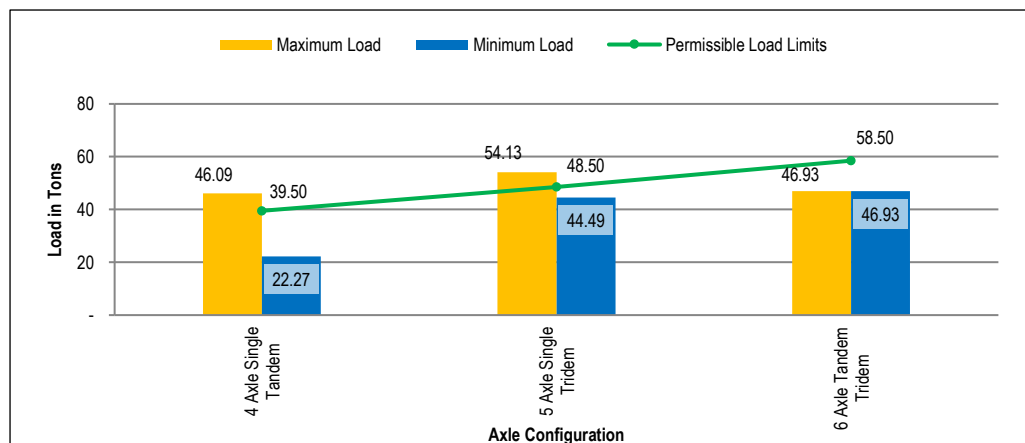


Figure 9-42: Min. & Max. Load Comparison w.r.t Axle Configuration on PDP

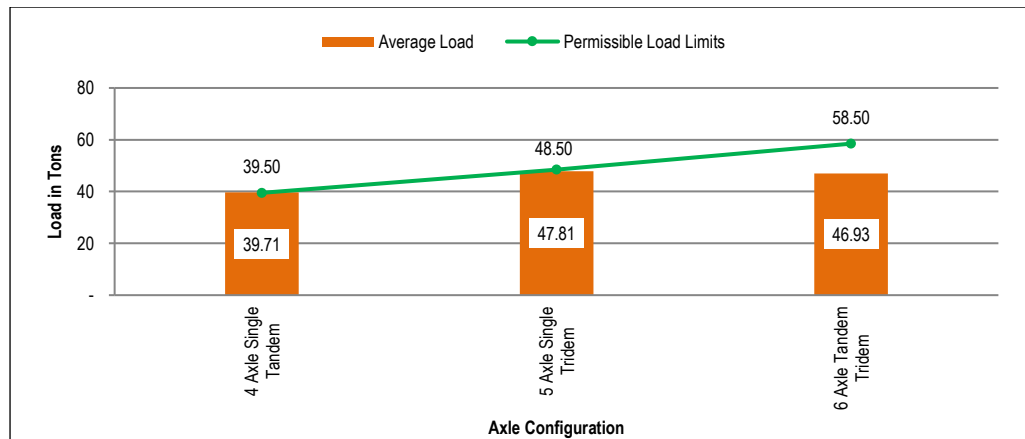


Figure 9-43: Avg. Load Comparison w.r.t Axle Configuration on PDP

9.8.3 Load Spectrum by Axle Configuration on PDP

The major cause of pavement failure is due to excessive overloading. The axle load survey data was organized in a way to identify the number of vehicles carrying load above and below permissible limits. Furthermore, load spectrums were identified and number of vehicles carrying load in specified spectrums were calculated. The results are tabulated in Table 9-68 which illustrates that:

In case of **4 Axle Single Tandem**, 38.46% of trucks/semi-trailers carried load under permissible limits. Whereas, 3.85% of the trucks/semi-trailers carried load more than 15% of permissible load limits.

In case of **5 Axle Single Tridem**, 72.73% of semi-trailers carried load under permissible limits.

The percentage of trucks for major axle configuration carrying load above and below permissible limits on PDP is graphically presented in Figure 9-44.

Table 9-68: Load Spectrum w.r.t Axle Configuration on PDP

Sr. No.	Axle Configuration	Under Permissible Limit	Over Permissible Limit					Total	
			15.00%	30.00%	50.00%	75.00%	>75%		
1	4 Axle Single Tandem	Max. Load (Tons)	39.5	45.4	51.4	59.3	69.1		
		Average Load (Tons)	34.26	42.93	46.09	-	-	-	
		No. of Trucks	10	15	1	0	0	0	26
		Percentage	38.46%	57.69%	3.85%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	38.46%	96.15%	100.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	61.54%	3.85%	0.00%	0.00%	0.00%	0.00%	
2	5 Axle Single Tridem	Max. Load (Tons)	48.5	55.8	63.1	72.8	84.9		
		Average Load (Tons)	46.61	51.01	-	-	-	-	
		No. of Trucks	8	3	0	0	0	0	11
		Percentage	72.73%	27.27%	0.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	72.73%	100.00%	100.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	27.27%	0.00%	0.00%	0.00%	0.00%	0.00%	
3	6 Axle Tandem Tridem	Max. Load (Tons)	58.5	67.3	76.1	87.8	102.4		
		Average Load (Tons)	46.93	-	-	-	-	-	
		No. of Trucks	1	0	0	0	0	0	1
		Percentage	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%
		Cumulative Percentage	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	
		Percentage above Range Value	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	

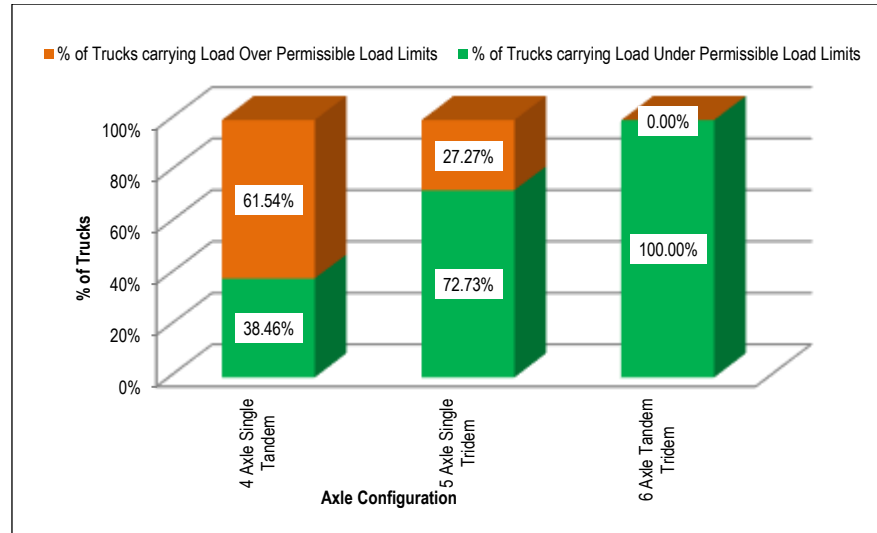


Figure 9-44: Percentage of Vehicles carrying Load above and below Permissible Limits on PDP

9.8.4 Front & Rear Axle Load Spectrum on PDP

The spectrum of front and rear axle loads for major axle configurations is presented in Table 9-69.

Table 9-69: Front & Rear Axle Load Spectrum on PDP

Sr. No.	Range (Tonnes)	Total	Percentage	Cum. Percentage	%age above Range Value
Front Axle Load Spectrum					
1	0 - 2.99	0	0.00%	0.00%	100.00%
2	3 - 5.49	4	10.53%	10.53%	89.47%
3	5.5 - 6.99	21	55.26%	65.79%	34.21%
4	7 - 8.99	13	34.21%	100.00%	0.00%
5	9 - 10.99	0	0.00%	100.00%	0.00%
6	11 - 12.99	0	0.00%	100.00%	0.00%
7	13 - 14.99	0	0.00%	100.00%	0.00%
8	15 - 16.99	0	0.00%	100.00%	0.00%
9	17 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Single)					
1	0 - 8.16	8	6.30%	6.30%	93.70%
2	8.17 - 9.99	35	27.56%	33.86%	66.14%
3	10 - 10.99	36	28.35%	62.20%	37.80%
4	11 - 11.99	17	13.39%	75.59%	24.41%
5	12 - 12.99	19	14.96%	90.55%	9.45%
6	13 - 13.99	11	8.66%	99.21%	0.79%
7	14 - 14.99	1	0.79%	100.00%	0.00%
8	15 - 19.99	0	0.00%	100.00%	0.00%
9	20 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Tandem)					
1	0 - 11.99	1	3.70%	3.70%	96.30%
2	12 - 14.99	1	3.70%	7.41%	92.59%
3	15 - 19.99	7	25.93%	33.33%	66.67%
4	20 - 21.99	6	22.22%	55.56%	44.44%
5	22 - 23.99	12	44.44%	100.00%	0.00%
6	24 - 25.99	0	0.00%	100.00%	0.00%
7	26 - 27.99	0	0.00%	100.00%	0.00%
8	28 - 29.99	0	0.00%	100.00%	0.00%
9	30 & Above	0	0.00%	100.00%	0.00%
Rear Axle Load Spectrum (Tridem)					
1	0 - 14.99	0	0.00%	0.00%	100.00%
2	15 - 30.99	9	75.00%	75.00%	25.00%
3	31 - 32.99	2	16.67%	91.67%	8.33%
4	33 - 34.99	1	8.33%	100.00%	0.00%
5	35 - 36.99	0	0.00%	100.00%	0.00%
6	37 - 38.99	0	0.00%	100.00%	0.00%
7	39 - 40.99	0	0.00%	100.00%	0.00%
8	41 - 42.99	0	0.00%	100.00%	0.00%
9	43 & Above	0	0.00%	100.00%	0.00%

9.8.5 Distribution of Vehicles by Make Type on PDP

The distribution of trucks as per make type is illustrated in Table 9-70 and is graphically presented in Figure 9-45. The results depict that Hino has maximum percentage of 63.16% on PDP.

Table 9-70: Percentage of Vehicles w.r.t Make Type on PDP

Sr. No.	Make	Count	Percentage
1	Nissan	14	36.84%
2	Hino	24	63.16%
Total		38	100.00%

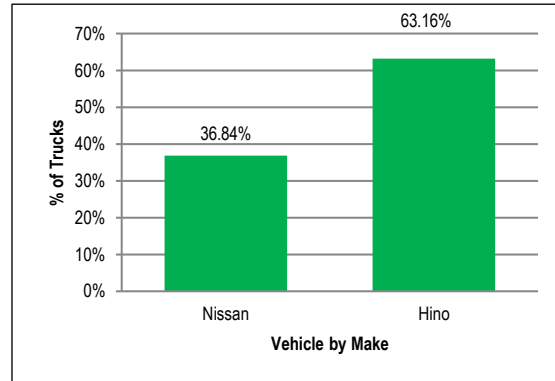


Figure 9-45: Percentage of Vehicles w.r.t Make Type on PDP

9.8.6 Analysis by Make Type on PDP

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to make type is presented in Table 9-71. The results depict that:

In case of **4 Axle Single Tandem**, Hino constitutes maximum percentage of 61.54% with average gross load of 39.27 ton, followed by Nissan with percentage of 38.46%, carrying average gross load of 40.42 ton.

In case of **5 Axle Single Tridem**, Hino constitutes maximum percentage of 63.64% with average gross load of 47.85 ton, followed by Nissan with percentage of 36.36%, carrying average gross load of 47.74 ton.

Table 9-71: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Make Type for major Axle Configuration on PDP

Sr.No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	4 Axle Single Tandem	Hino	16	61.54%	Min. Load	3.79	6.90	5.34	6.24			22.27
					Max. Load	7.83	14.29	11.06	12.90			46.09
					Avg. Load	6.68	12.17	9.42	11.00			39.27
					Standard Deviation	1.09	1.98	1.53	1.79			6.39
					Variance	1.18	3.92	2.35	3.20			40.84
		Nissan	10	38.46%	Min. Load	5.42	9.88	7.65	8.92			31.86
					Max. Load	7.64	13.93	10.79	12.58			44.94
					Avg. Load	6.87	12.53	9.70	11.32			40.42
					Standard Deviation	0.74	1.35	1.05	1.22			4.36
					Variance	0.55	1.83	1.10	1.49			19.02
Total	26	100.00%										
2	5 Axle Single Tridem	Hino	7	63.64%	Min. Load	5.78	10.23	8.90	9.34	10.23		44.49
					Max. Load	7.04	12.45	10.83	11.37	12.45		54.13
					Avg. Load	6.22	11.01	9.57	10.05	11.01		47.85
					Standard Deviation	0.41	0.72	0.63	0.66	0.72		3.13
					Variance	0.17	0.52	0.39	0.43	0.52		9.78
		Nissan	4	36.36%	Min. Load	5.99	10.60	9.22	9.68	10.60		46.10
					Max. Load	6.47	11.44	9.95	10.45	11.44		49.74
					Avg. Load	6.21	10.98	9.55	10.03	10.98		47.74
					Standard Deviation	0.21	0.36	0.32	0.33	0.36		1.58
					Variance	0.04	0.13	0.10	0.11	0.13		2.49
Total	11	100.00%										
3	6 Axle Tandem Tridem	Hino	1	100.00%	Min. Load	4.69	7.98	8.45	7.51	8.45	9.86	46.93
					Max. Load	4.69	7.98	8.45	7.51	8.45	9.86	46.93
					Avg. Load	4.69	7.98	8.45	7.51	8.45	9.86	46.93

Sr.No.	Axle Configuration	Make	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
					Standard Deviation	-	-	-	-	-	-	-
					Variance	-	-	-	-	-	-	-
			Total	1	100.00%							

9.8.7 Distribution of Vehicles by Body Type on PDP

The percentage of vehicles with respect to Body Type i.e. Flat, Half, Full & Container plying on PDP is tabulated in Table 9-72 and is graphically presented in Figure 9-46.

Table 9-72: Percentage of Vehicles w.r.t Body Type on PDP

Sr. No.	Body Type	Count	%age
1	Container	38	100.00%
	Total	38	100.00%

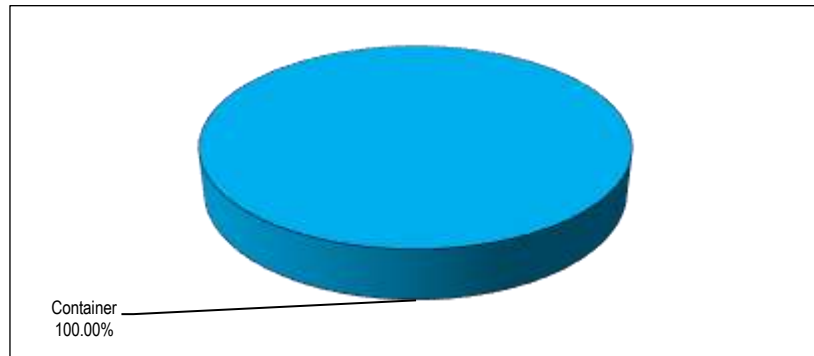


Figure 9-46 : Percentage of Vehicles w.r.t Body Type on PDP

9.8.8 Analysis by Body Type on PDP

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to body type is presented in Table 9-73. The results depict that:

In case of **4 Axle Single Tandem**, container body type constitutes maximum percentage of 100%, with average gross load of 39.71 ton.

In case of **5 Axle Single Tridem**, container body type constitutes overall percentage of 100%, with average gross load of 47.81 ton.

Table 9-73: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Body Type for major Axle Configuration on PDP

Sr. No.	Axle Configuration	Body Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	4 Axle Single Tandem	Container	26	100.00%	Min. Load	3.79	6.90	5.34	6.24			22.27
					Max. Load	7.83	14.29	11.06	12.90			46.09
					Avg. Load	6.75	12.31	9.53	11.12			39.71
					Standard Deviation	0.96	1.74	1.35	1.58			-
					Variance	0.92	3.04	1.82	2.48			31.68
	Total		26	100.00%								
2	5 Axle Single Tridem	Container	11	100.00%	Min. Load	5.78	10.23	8.90	9.34	10.23		44.49
					Max. Load	7.04	12.45	10.83	11.37	12.45		54.13
					Avg. Load	6.22	11.00	9.56	10.04	11.00		47.81
					Standard Deviation	0.33	0.59	0.51	0.54	0.59		2.57
					Variance	0.11	0.35	0.26	0.29	0.35		6.62
	Total		11	100.00%								
3	6 Axle Tandem Tridem	Container	1	100.00%	Min. Load	4.69	7.98	8.45	7.51	8.45	9.86	46.93
					Max. Load	4.69	7.98	8.45	7.51	8.45	9.86	46.93
					Avg. Load	4.69	7.98	8.45	7.51	8.45	9.86	46.93
					Standard Deviation	-	-	-	-	-	-	-
					Variance	-	-	-	-	-	-	-
	Total		1	100.00%								

9.8.9 Distribution of Vehicles by Type on PDP

The percentage of vehicles with respect to Type i.e., Truck and Semi-Trailer plying on PDP is tabulated in Table 9-74 and is graphically presented in Figure 9-47.

Table 9-74: Percentage of Vehicles w.r.t Type on PDP

Sr. No.	Vehicle Type	Count	Percentage
1	Truck	1	2.63%
2	Semi-Trailer	37	97.37%
Total		38	100.00%

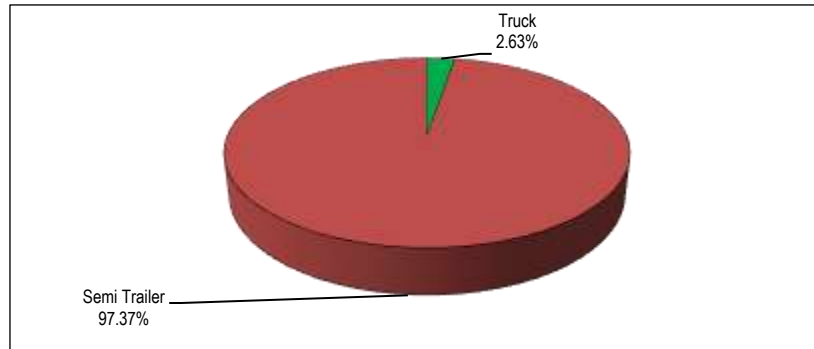


Figure 9-47: Percentage of Vehicles w.r.t Type on PDP

9.8.10 Analysis by Vehicle Type on PDP

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to truck type is presented in Table 9-75. The results depict that:

In case of **4 Axle Single Tandem**, semi-trailer type constitutes maximum percentage of 96.15%, with average gross load of 39.68 ton.

In case of **5 Axle Single Tridem**, semi-trailer type constitutes maximum percentage of 100%, with average gross load of 47.81 ton.

Table 9-75: Stdev., Var., Min., Max. & Avg. Load Comparison w.r.t Type for major Axle Configuration on PDP

Sr. No.	Axle Configuration	Vehicle Type	Count	%age	Parameters	Load (Tons)						
						Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	4 Axle Single Tandem	Semi-Trailer	25	96.15%	Min. Load	3.79	6.90	5.34	6.24	0.00		22.27
					Max. Load	7.83	14.29	11.06	12.90	0.00		46.09
					Avg. Load	6.75	12.30	9.52	11.11	-		39.68
					Standard Deviation	0.98	1.78	1.38	1.61	0.00		5.74
					Variance	0.95	3.17	1.90	2.58	0.00		32.96
		Truck	1	3.85%	Min. Load	6.90	12.59	9.75	11.37	0.00		40.61
					Max. Load	6.90	12.59	-	11.37	0.00		40.61
					Avg. Load	6.90	12.59	9.75	11.37	-		40.61
					Standard Deviation	-	-	-	-	-		-
					Variance	-	-	-	-	-		-
Total		26	100.00%									
2	5 Axle Single Tridem	Semi-Trailer	11	100.00%	Min. Load	5.78	10.23	8.90	9.34	10.23		44.49
					Max. Load	7.04	12.45	10.83	11.37	12.45		54.13
					Avg. Load	6.22	11.00	9.56	10.04	11.00		47.81
					Standard Deviation	0.33	0.59	0.51	0.54	0.59		2.57
					Variance	0.11	0.35	0.26	0.29	0.35		6.62
		Total		11	100.00%							
3	6 Axle Tandem Tridem	Semi-Trailer	1	100.00%	Min. Load	4.69	7.98	8.45	7.51	8.45	9.86	46.93
					Max. Load	4.69	7.98	8.45	7.51	8.45	9.86	46.93
					Avg. Load	4.69	7.98	8.45	7.51	8.45	9.86	46.93
					Standard Deviation	-	-	-	-	-	-	-
					Variance	-	-	-	-	-	-	-
		Total		1	100.00%							

9.8.11 Commodities carried by vehicles on PDP

The percentage of major commodities carried by heavy vehicles on PDP is tabulated in Table 9-76 and is graphically presented in Figure 9-48. For the sake of analysis, each commodity is assigned a code; details are attached in Annex – 2.

Table 9-76: Percentage of Vehicle w.r.t Commodities on PDP

Sr.No.	Commodities	Code	Count	%age
1	Basic Manufactures	600	21	55.26%
2	Miscellaneous Manufactures	700	15	39.47%
3	Fuel, Lubricants (Minerals)	900	2	5.26%
Total			38	100.00%

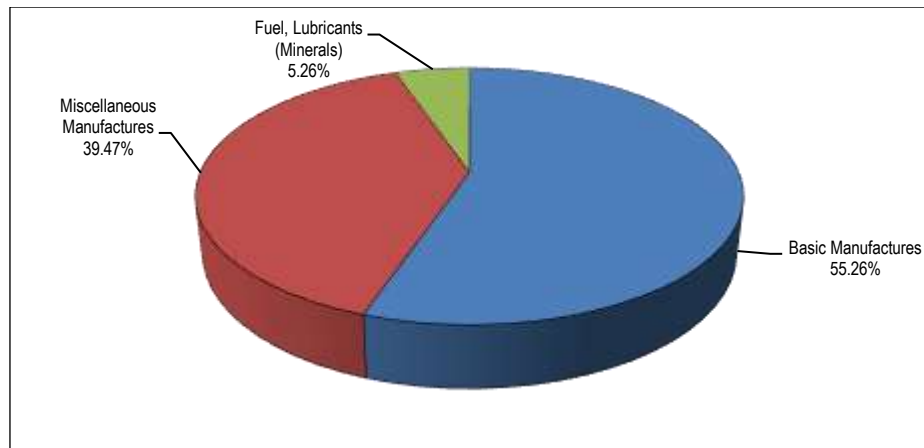


Figure 9-48: Percentage of Vehicles w.r.t Commodities on PDP

9.8.12 Analysis based on Commodities on PDP

The statistical analysis comprising minimum, maximum and average loads per axle carried by trucks of major axle configuration along with standard deviation and variance with respect to commodities carried by trucks is presented in Table 9-77. The results depict that:

Major commodities carried by **4 Axle Single Tandem** are basic manufactures, covering 61.54% of the total, with average gross load of 41.00 ton, followed by miscellaneous manufactures, having percentage of 38.46% in total, with average gross load of 37.65 ton.

Major commodities carried by **5 Axle Single Tridem** are miscellaneous manufactures, covering 45.45% of the total, with average gross load of 47.11 ton, followed by basic manufactures, having percentage of 36.36% in total, with average gross load of 49.16 ton.

Table 9-77: Stdev. Var., Min., Max. & Avg. Load Comparison w.r.t Commodities for major Axle Configuration on PDP

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
1	4 Axle Single Tandem	Basic Manufactures	600	16	61.54%	Min. Load	5.42	9.88	7.65	8.92			31.86
						Max. Load	7.83	14.29	11.06	12.90			46.09
						Avg. Load	6.97	12.71	9.84	11.48			41.00
						Standard Deviation	0.71	1.29	1.00	1.16			4.15
						Variance	0.50	1.65	0.99	1.35			17.20
		Miscellaneous Manufactures	700	10	38.46%	Min. Load	3.79	6.90	5.34	6.24			22.27
						Max. Load	7.53	13.74	10.64	12.41			44.32
						Avg. Load	6.40	11.67	9.04	10.54			37.65
						Standard Deviation	1.22	2.23	1.72	2.01			7.19
						Variance	1.49	4.96	2.98	4.05			51.66
Total			26	100.00%									
2	5 Axle Single Tridem	Basic Manufactures	600	4	36.36%	Min. Load	5.99	10.60	9.22	9.68	10.60		46.09
						Max. Load	7.04	12.45	10.83	11.37	12.45		54.13
						Avg. Load	6.39	11.31	9.83	10.32	11.31		49.16
						Standard Deviation	0.46	0.82	0.71	0.74	0.82		3.54
						Variance	0.21	0.66	0.50	0.55	0.66		12.57
		Miscellaneous Manufactures	700	5	45.45%	Min. Load	5.78	10.23	8.90	9.34	10.23		44.49
						Max. Load	6.47	11.44	9.95	10.45	11.44		49.74
						Avg. Load	6.12	10.83	9.42	9.89	10.83		47.11
						Standard Deviation	0.26	0.46	0.40	0.42	0.46		1.99
						Variance	0.07	0.21	0.16	0.17	0.21		3.94
		Fuel, Lubricants (Minerals)	900	2	18.18%	Min. Load	5.99	10.60	9.22	9.68	10.60		46.10
						Max. Load	6.20	10.96	9.53	10.01	10.96		47.66
						Avg. Load	6.09	10.78	9.38	9.84	10.78		46.88
						Standard Deviation	0.14	0.25	0.22	0.23	0.25		1.10
						Variance	0.02	0.06	0.05	0.05	0.06		1.21
Total			11	100.00%									

Sr. No.	Axle Configuration	Commodities	Code	Count	%age	Parameters	Load (Tons)						
							Front	Rear 1	Rear 2	Rear 3	Rear 4	Rear 5	Total
3	6 Axle Tandem Tridem	Basic Manufactures	600	1	100.00%	Min. Load	4.69	7.98	8.45	7.51	8.45	9.86	46.93
						Max. Load	4.69	7.98	8.45	7.51	8.45	9.86	46.93
						Avg. Load	4.69	7.98	8.45	7.51	8.45	9.86	46.93
						Standard Deviation	-	-	-	-	-	-	-
						Variance	-	-	-	-	-	-	-
Total			1	100.00%									

9.8.13 Damage Factor for major Axle Configuration on PDP

The average damage factors calculated for major axle configuration are presented in Table 9-78.

Table 9-78: Damage Factor for major Axle Configuration on PDP

Sr. No.	Axle Configuration	Code	Damage Factor (2020)	
			Road Note 40	AASHTO 1993
1	4 Axle Single Tandem	1.2-22	14.19	9.57
2	5 Axle Single Tridem	1.2-222	12.53	7.58
3	6 Axle Tandem Tridem	1.22-222	6.21	3.48

10 CONCLUSIONS & RECOMMENDATIONS

10.1 Conclusions

Following are the conclusions of the study:

1. Overloading continues to be a dominant and seriously damning phenomena all over the country, despite passage of law for control of overloading some 20 years ago. It is a great challenge for sustainability of road infrastructure in Pakistan.
2. The composition of major truck traffic on Ports and Dry Ports is summarized in Table 10-1. The results depict that majority of trucks are 3- Axle Tandem and 4- Axle Single Tandem in both Ports and Dry Ports, followed by 6- Axle Tandem Tridem. Most of the flat body 2 & 3- Axle Tandem trucks dangerously carry 20-foot container in spite of the fact that their body is not designed / standardized to carry them.

Table 10-1: Composition of Truck Traffic w.r.t Axle Configuration on Ports & Dry Ports

Sr. No.	Axle Configuration	Code	Ports		Dry Ports	
			Total Number of Trucks	Percentage	Total Number of Trucks	Percentage
1	2 Axle Single	1.2	15	1.34%	28	8.62%
2	3 Axle Tandem	1.22	480	42.74%	81	24.92%
3	4 Axle Single Tandem	1.2-22	342	30.45%	114	35.08%
4	5 Axle Single Tridem	1.2-222	23	2.05%	40	12.31%
5	5 Axle Tandem Tandem	1.22-22	18	1.60%	1	0.31%
6	6 Axle Tandem Tridem	1.22-222	245	21.82%	41	12.62%
7	Others	-	-	-	20	6.15%
Total			1123	100.00%	325	100.00%

3. The percentage of each axle configuration on Ports and Dry Ports is compared with National Highways as stated in NTRC Axle Load Report, 2020 and the same is illustrated in Table 10-2. The results depict that 2- Axle Trucks are plying more on National Highways as compared to Ports and Dry Ports, whereas 4- Axle trucks are more on Ports and Dry Ports as compared to National Highways.

Table 10-2: Comparison of Truck Traffic on Ports and Dry Ports with National Highways

Sr. No.	Axle Configuration	Code	Ports & Dry Ports		National Highway (NTRC Report, 2020)	
			Total Number of Trucks	Percentage	Total Number of Trucks	Percentage
1	2 Axle Single	1.2	43	2.97%	70168	34.93%
2	3 Axle Tandem	1.22	561	38.74%	52943	26.39%
3	4 Axle Single Tandem	1.2-22	456	31.49%	26748	13.32%
4	5 Axle Single Tridem	1.2-222	63	4.35%	10652	5.30%
5	5 Axle Tandem Tandem	1.22-22	19	1.31%	7756	3.86%
6	6 Axle Tandem Tridem	1.22-222	286	19.75%	32588	16.22%
7	Others	-	20	1.38%		
Total			1448	100.00%	200855	100.00%

4. The percentage and volume distribution of multi axle trucks on Ports and Dry Ports is provided in Table 10-3.

Table 10-3: Percentage of multi axle trucks on Ports & Dry Ports

Sr. No.	Axle Configuration	Ports & Dry Ports		Ports		Dry Ports	
		Volume of traffic	Percentage of traffic	Volume of traffic	Percentage of traffic	Volume of traffic	Percentage of traffic
1	2, 3 Axle Trucks	604	42.30%	495	44.07%	109	35.73%
2	4-6 Axle Trucks	824	57.70%	628	55.93%	196	64.26%
Total		1428	100%	1123	100%	305	100%

5. The percentage of overloading on Ports and Dry Ports are presented in Table 10-4. The table also illustrates comparison of overloading on National

Highways and Ports & Dry Ports. The results depict no difference in overloading trend amongst 3- Axle Tandem and 4 & 6- Axle Tandem Tridem Trucks on Ports & Dry Ports and National Highways. The local transporters and distributors are contributing majorly in the deterioration of pavement structures by impenitently following overloading practices.

Table 10-4: Comparison of Overloading on National Highways and Ports & Dry Ports

Sr. No.	Axle Configuration	Overloading on National Highways (NTRC Axle Load Study, 2020)	Overloading on Ports & Dry Ports		
			Overall	Ports	Dry Ports
1	2 Axle Single	74.10%	46.51%	46.67%	46.43%
2	3 Axle Tandem	90.62%	84.49%	87.08%	69.14%
3	4 Axle Single Tandem	57.87%	55.26%	58.19%	46.49%
4	5 Axle Single Tridem	79.45%	33.33%	26.09%	37.50%
5	5 Axle Tandem Tandem	77.97%	94.74%	94.44%	100%
6	6 Axle Tandem Tridem	89.04%	90.56%	93.47%	73.17%

- The degree of overloading on Ports and Dry Ports i.e., excess weight by 15%, 50% and 75% is far less than that on National Highway Network. Average load, minimum, maximum, standard deviation and variance of each axle configuration plying on entire Ports & Dry Ports along with trend on Ports and Dry Ports separately is presented in Table 10-5.

Table 10-5: Avg., Min. & Max. Load with Stdev., & var. of each Axle configuration

Sr. No.	Axle Configuration	Permissible Load Limits	Average Load (Tons)	Maximum Load (Ton)	Minimum Load (Ton)	Standard Deviation	Variance
Ports & Dry Ports							
1	2 Axle Single	17.50	18.05	36.68	9.25	6.31	39.78
2	3 Axle Tandem	27.50	32.13	61.29	8.14	7.47	55.84
3	4 Axle Single Tandem	39.50	37.55	61.09	11.40	9.34	87.25
4	5 Axle Single Tridem	48.50	43.86	64.57	14.67	11.31	128.00
5	5 Axle Tandem Tandem	49.50	59.58	74.50	18.97	11.15	124.26
6	6 Axle Tandem Tridem	58.50	68.31	111.00	15.32	15.45	238.59
Ports							
1	2 Axle Single	17.50	16.66	21.26	10.82	3.10	9.59
2	3 Axle Tandem	27.50	32.08	61.29	8.14	7.42	55.04
3	4 Axle Single Tandem	39.50	37.72	61.09	11.40	9.64	92.94
4	5 Axle Single Tridem	48.50	38.86	64.57	14.67	15.51	240.63
5	5 Axle Tandem Tandem	49.50	59.93	74.50	18.97	11.36	129.08
6	6 Axle Tandem Tridem	58.50	67.68	99.99	15.32	14.71	216.40
Dry Ports							
1	2 Axle Single	17.50	18.79	36.68	9.25	7.43	55.26
2	3 Axle Tandem	27.50	32.41	44.35	14.33	7.82	61.21
3	4 Axle Single Tandem	39.50	37.03	54.92	18.39	8.40	70.48
4	5 Axle Single Tridem	48.50	46.73	58.67	30.73	6.67	44.49
5	5 Axle Tandem Tandem	49.50	53.25	53.25	53.25	-	-
6	6 Axle Tandem Tridem	58.50	72.05	111.00	45.77	19.05	363.10

- The trucks with container body type are plying more on Ports and Dry Ports having share distribution of 58.29%.
- 100% containerized traffic was recorded at Islamabad and Peshawar Dry Ports.
- The collected information during axle load survey shows that almost 100% containers on semi-trailers are secured at Ports and Dry Ports (Table 10-6).

Table 10-6: Percentage of Containers as Fully, Partially and Un-Secured on Ports and Dry Ports

Sr. No.	Description	Ports		Dry Ports	
		Count	Percentage	Count	Percentage
1	Fully Secured	474	95.75%	63	100%
2	Partially Secured	20	4.04%	0	0%
3	Un- Secured	1	0.20%	0	0%
Total		495	100.00%	63	100.00%

- Majority of the trucks carried agriculture items (19.95%) on Ports followed by basic manufactures with a percentage of 15.14%. The different types of commodities carried on Ports are shown in Figure 10-1.

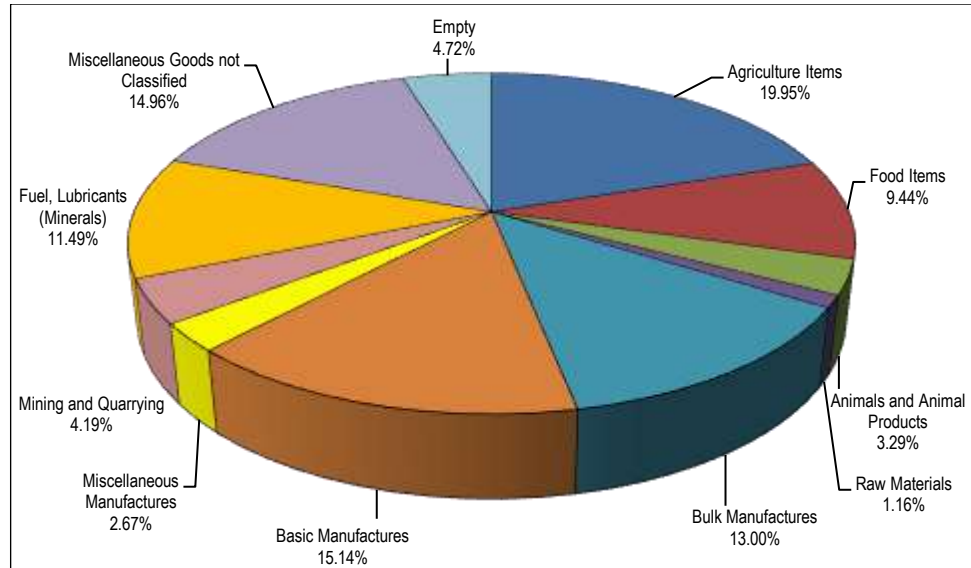


Figure 10-1: Commodities carried by trucks on Ports

11. Similarly, majority of the trucks carried miscellaneous manufactures (26.23%) on Dry Ports followed by basic manufactures with a percentage of 25.57%. The different types of commodities carried on Dry Ports are shown in Figure 10-2.

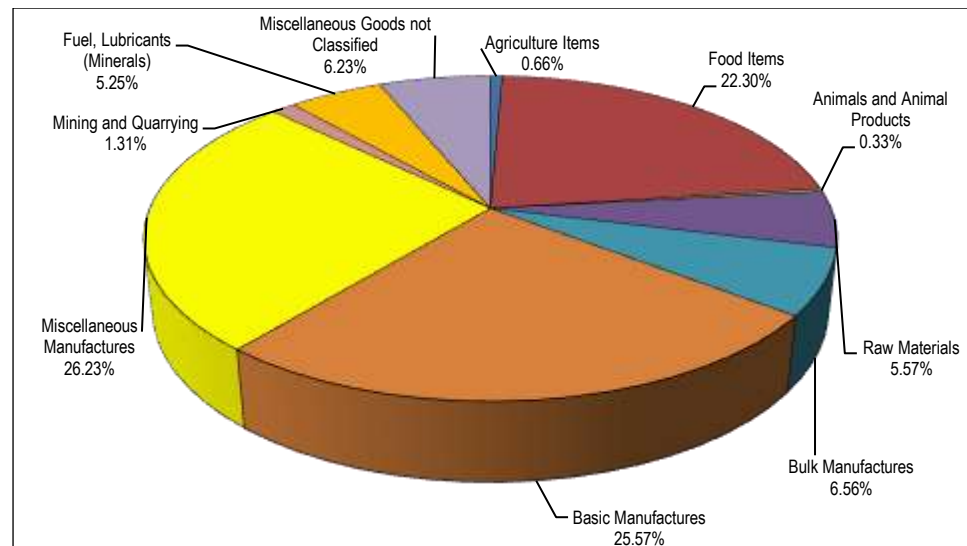


Figure 10-2: Commodities carried by trucks on Dry Ports

10.2 Recommendations

1. Overloading of vehicles beyond permissible limits is an offence under the Motor Vehicle Ordinance 1965 and National Highway Safety Ordinance 2000, punishable by fine and imprisonment. The 6th Schedule of NHTSO 2000 governing gross and axle load limits needs to be uniformly implemented all across the country.
2. At source control of overloading is important, like at Ports, Dry Ports particularly those near borders, industrial and agricultural centers etc., as it greatly limits overloading and damage inflicted to the pavement. Therefore, weigh stations should be strategically located near the load generating centers.
3. Containerized cargo helps control overloading. Therefore, inland container/ cargo / freight stations need to be established in big cities for efficient stuffing & de-stuffing, cataloguing, inspection for damage and labeling of cargo.

4. Availability of containers is a recurring challenge since maritime companies, being dominant player allocate empty containers according to their commercial requirements. Establishment of inland freight stations will ensure greater availability of containers and efficient intermodal transportation thereby reducing travel time / cost and limiting the need for overloading.
5. Truck body retrofitting / manufacturing is not regulated and unauthorized and illegal manufacturers spread all over the country, strengthen truck bodies to carry loads much beyond their rated capacity. Punitive actions should be taken against these illegal manufacturers.
6. Obsolete trucks should be removed with inclusion of latest makes in freight industry along with revised trucking policy and load regime.

Annexure

Annex – 1: Survey Questionnaire

Form No.: _____

National Transport Research Centre (NTRC) Islamabad
Axle Load Survey

1. Port		2. City	
3. Entry/Exit		4. Regn. No.	
5. Date		6. Time	
7. Origin		8. Destination	
9. Make		10. Commodities Carried	

11. Vehicle Type (Mark Relevant One)

Truck	Trailer	Tanker	Other (Specify)
1	2	3	4

12. Body Type (Mark relevant one)

Flat	Half	Full	Covered	Container
1	2	3	4	5

13. Container Loading Mechanism (If Body Type is Container)

Fully Secured	Partial Secured	Unsecured
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14. Axle Configuration (Mark Relevant One)

1	2	3	4	5	6	7	8	9	10	11	12	13
2 Axle Single	3 Axle Tandem	3 Axle Single	4 Axle Single Tandem	4 Axle Tandem Single	4 Axle Single	5 Axle Single Tridem	5 Axle Tandem Tandem	5 Axle Single Single Tandem	5 Axle Tandem Single Single	6 Axle Tandem Tridem	6 Axle Tandem Single Tandem	Any Other (Specify)
1.2/1.1	1.2.2	1.2-2	1.2-2.2	1.2.2-2	1.2+2.2	1.3-2.2.2	1.2.2-2.2	1.2+2.2.2	1.2.2+2.2	1.2.2-2.2.2	1.2.2+2.2.2	

15. Axle Loads and Tyre Pressure

Axle	Weight (Tons)	Tyre Pressure (psi)
Front		
2		
3		
4		
5		
6		
Total		

16. Remarks (if any)

Note: Any Change or Amendment in the questionnaire form would be done as per the requirement of site.

Name of Enumerator: _____

Annex – 2: Codes Assigned to Commodities

CODE	COMMODITIES	CODE	COMMODITIES
100	Agriculture Items		
110	Wheat	120	Paddy and Rice
130	Maize	140	Other Grains and Pulses
150	Sugarcane	160	Cotton
170	Jute	180	Tobacco
185	Oil Seeds	190	Grass, Fodder, Bhoosa, Moonj, Dry Spores, Straw
195	Plants		
200	Food		
210	Flour	220	Vegetables
230	Potato and Onion	240	Fruit
250	Industrial Raw Food	260	Vegetables Ghee and Refined Edible Oil
270	Sugar Refined	280	Jaggery (Gur, Shakar, Desikhaand)
290	Others		
300	Animal and Animal Products		
310	Animals	320	Meats, Eggs and Dairy Products, Fish
330	Hides and Skins	340	Wool Raw
390	Other Animal Products		
400	Raw Material		
410	Timber, Logs, Bamboos	420	Puop, Waste Paper and Molasses waste cotton
430	Other Ores except Metallic	490	Other Raw Material
500	Bulk Manufactures		
510	Cement	520	Fertilizer
530	Medicines and Drugs	540	Chemicals
550	Tea, Coffee, etc.	560	Beverage (Filled or Unfilled)
570	Animal Food Oilcake	580	Dried Milk
590	Other Bulk Goods		
600	Basic Manufactures		
610	Textile Fiber	620	Textile Manufacture
630	Jute Manufacture, Bags, Carpets	640	Leather and Leather Products
650	Wood Manufacture, Fixture	660	Rubber Manufacture
670	Iron and Steel Billets, Pipes, Tubing, Girders, Pigiro	675	Ceramics & Sanitary Goods
680	Iron and Steel Finished Products and other Metal Products	685	Cement Manufactures, Concrete Slabs, Sleepers, Pipes
690	Bricks	695	Others
700	Miscellaneous Manufacture		
710	Machinery: Other than	720	Machinery Electrical
730	Domestic Electrical appliance, Ratio, TV etc	735	Paper, Gatta Books and Other paper Products
740	Cycles and Auto cycles	750	Tractors, Cars, Auto-Rickshaws, pickup, Wagon and other Vehicles
755	Cycles and Auto cycles	760	Cigarette
770	General Merchandize	775	Soap, Detergent
777	Sports Goods	780	Pottery and Molding, Fire Bricks (Plastic, Earthen, China Clay, Glass ware products)
785	Spare Parts	790	Cans, Barrels, Drums, Tins, Jery Canes etc.
795	Others		
800	Mining and Quarrying		
810	Ballast, Gravels, Stone	820	Sand and Sand Silica
830	Lime Stones and Powder	840	Marbles and Granular
850	Gypsum	860	Salt, Rock
870	China Clay	880	Earthen Clays
890	Other Metallic Ores	895	Other Mining and Quarrying
900	Fuel, Lubricants (Minerals)		
910	Coal, Coke, Briquette	920	Bitumen, Pitch tar, Asphalt, Charcoal
930	Petrol	940	Diesel
950	Kerosene Oil	960	Furnace Oil
970	Lubricants	980	Gas Products, Cylinders
990	Fire Wood	995	Miscellaneous
A00	Miscellaneous Goods not Classified		
A10	Mails, Postal Packages etc.	A20	(Household Effects)
A30	Official Stores	A40	War Firearm Ammunition
A50	Dead Body	A60	Military Supply
A99	Unspecified Goods		

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