Analysis of Non Suburban Passenger Coaching Stock Utilization

G. Raghuram
Rishita Digar
Chandni Jain

W.P. No. 2009-07-03
July 2009

INDIAN INSTITUTE OF MANAGEMENT
AHMEDABAD-380 015
INDIA

Analysis of Non Suburban Passenger Coaching Stock Utilization[1]

Abstract

In 2007-08, Indian Railways (IR) carried 6.5 billion passengers (highest in the world as a single system, and second highest in the world as a country after Japan at 9.0 billion passengers), serviced 770 billion passenger kms (second highest in the world, close to China at 773 billion passenger kms) and passenger earnings were Rs 19,783 crores. Of this, 43% of the passengers, 84% of the passenger kms and 92% earnings were from the non suburban sector.

The actual passenger kms for 2007-08 was higher than the capacity of the IR. Such overuse can be reduced by increasing the coaching stock, or by improving the utilization of coaches. The former method proves to be an expensive one for IR. Hence, this calls for an improvement in the coaching stock utilization.

In this paper, we assess the utilization of coaches on the parameters % of runtime, kms/day, and average speed of rakes servicing express/mails and passenger trains in the South Central Railway (SCR), taking into consideration the rake linking involved. This is done by analyzing every rake link used in the SCR as given in their rake link booklet.

[1] Prepared by G Raghuram, Rishita Digar and Chandni Jain, Indian Institute of Management, Ahmedabad. Email : graghu@iimahd.ernet.in

Research assistance provided by Samantha Bastian is acknowledged.

Analysis of Non Suburban Passenger Coaching Stock Utilization

Significance

- In 2007-08, Indian Railways (IR) carried 6.5 billion passengers (highest in the world as a single system, and second highest in the world as a country after Japan at 9.0 billion passengers), serviced 770 billion passenger kms (second highest in the world, close to China at 773 billion passenger kms) and passenger earnings were Rs 19,783 crores. Of this, 43% of the passengers, 84% of the passenger kms and 92% earnings were from the non suburban sector.

- In 2007-08, IR carried 17.9 million (m) passengers daily over its network spread over 63,273 route kms. Of this, 10.1m were suburban and 7.8m were non suburban passengers.

- During 2007-08, IR transported 2,835m non suburban passengers as against 2,705m in 2006-07, with an increase of 5%. (Table 1)

- Passenger earnings in 2007-08 were Rs 19,783 crores. Of this, Rs 1,570 crores were suburban and Rs 18,214 crores were non suburban earnings, which was 92% of the total earnings.

- During 2007-08, IR earned Rs 18,214 crores from non suburban passengers as against Rs 15,749 crores in 2005-06, with an increase of 16%. (Table 1)

- Some basic non suburban passenger statistics are given below:

Table 1

Non suburban	**2006-07**	**2007-08**
Passengers originating (m)	2,705	2,835
Passenger kms (m)	582,867	650,114
Avg lead (kms)	215	229
Revenue (Rs crores)	15,749	18,214

[Source: Indian Railways Year Book 2007-08]

- The total number of non suburban passenger trains in 2006-07 was 5,737 with 5,076 broad gauge. The details are given in Table 2.

Table 2

Types of trains (broad gauge)	**2006-07**	**2007-08**
Express/mail	1,964	2,077
Ordinary passenger and mixed	2,923	2,999
Total	4,887	5,076

[Source: Indian Railways Year Book 2007-08]

- The number of passenger coaches over select years is given in Table 3.

Table 3

Year (31st March)	Passenger coaches		DMU/DHMU		Other coaching vehicles
	Number	Capacity	Number	Capacity	
1951	13,109	854,678	-	-	6,059
1991	28,701	1,864,136	-	-	6,668
2004	35,691	2,566,917	316	30,232	5,519
2005	37,125	2,668,841	559	52,767	5,600
2006	38,199	2,756,726	578	53,859	5,612
2007	38,905	2,875,972	692	60,132	5,949
2008	40,734	2,994,206	764	66,172	6,180

[Source: Indian Railways Year Book 2007-08]

- The parameter for coach utilization used by the IR was kilometers run per day by a coach. The average coach utilization in 2007-08 was 510 kms/day for broad gauge. The coach utilization for select years is given in Table 4.

Table 4

Year	Broad gauge (kms/day)
1950-51	264
1990-91	408
2003-04	470
2004-05	457
2005-06	491
2006-07	501
2007-08	510

[Source: Indian Railways Year Book 2007-08]

- As seen from the above data, for 2007-08, a coach does on an average 510 kms/day for 365 days which amounts to 186,150 kms for the year (Table 4). The average total capacity across all coaches for 2006-07 works out to be 2,998,241.

  (The average total capacity is calculated by using the values for passenger coaches capacity and DHMU/DMU capacity for the period 1st April 2007 to 31st March 2008. For this, we take an average for the sum of 2,875,972 (passenger coaches) and 60,132 (DHMU/DMU) as on 1st April 2007, and for the sum of 2,994,206 (passenger coaches) and 66,172 (DHMU/DMU) as on 31st March 2008 (Table 3).This works out to be 2,998,241.)

  This multiplied by the 186,150 kms/year gives the 'available capacity kms' for 2007-08 as 558,123m. However, the actual passenger kms for 2007-08 was 609,166m (Table 1). This amounts to a 109% usage of capacity.

- The utilization of coaches is 109% in the year 2007-08. This calls for more coaches. However, coaches can cost anywhere between Rs 50 to 100 lakhs. This calls for an improvement in the coaching stock utilization. The objective of this paper is to examine the scope for increasing utilization of coaches.

Key Definitions

- **Rake**: The empty set of coaches which service a train.
- **Rake link**: The set of trains that a rake services sequentially before repeating.
- **Rake link booklet**: The set of rake links that serve all the trains running on a zonal railway.
- **Rake cycle:** All the coaches of a rake may not complete the entire link. The cycle completed by a set of coaches that is a sub-set of a rake is called a rake cycle.

Objective

- The objective of this paper is to analyze the utilization of coaches of trains in the South-Central Railway (SCR) as given in the rake link booklet. [SCR, 2008]
- We assess the utilization of a coach, *as part of a rake cycle,* by the following parameters:
    1. % of runtime
    2. Kms/day
    3. Average speed
- We assess the utilization of coaches, *across all rake cycles*, by the following parameters:
    1. Weighted average and distribution of % of runtime.
    2. Weighted average and distribution of kms/day

Rake Link Booklet Data

- The rake link booklet contains rake links for trains which are categorized as
    1. Daily express/mail (3,559 coaches)
    2. Weekly express/mail (2,217 coaches)
    3. Passenger daily (1,278 coaches)
    4. Passenger weekly (15 coaches)
- We begin with a focus on the express/mail trains, which account for 82% of all coaches.
- For every pair of **express/mail** trains that passes through the SCR, the rake link servicing the pair of trains is provided in the booklet. [SCR, July 2008]
- Since a rake may service more than 1 pair of trains, there is a recurrence of links in the booklet. There are upto 3 recurrences, since there are links servicing upto 4 pairs of trains.
- The trainwise rake links (150) are reduced to distinct rake links (116) after omitting recurring links .These distinct rake links are then converted into rake cycles (150).
- The 150 rake cycles form the unit of analysis. They constitute 73 daily (Exhibit 1(a)) and 77 weekly (Exhibit 1(b)) rake cycles.

- Every link in the rake link booklet is described by the following segments:

    1. Train description
    2. Rake description
    3. Schematic link diagram
    4. Parameters of rake link
    5. Section wise parameters

    These segments are explained as under.

    1. **Train description**: The details of the pair of trains serviced by the rake are given here.
        - Train number
        - Up/down
        - Origin
        - Destination
        - Frequency
        - Days of service

    2. **Rake description**:
        - Stock (vacuum or airbrake)
        - Composition of rake (number and type of coaches)

    3. **Schematic link diagram**:
        - Train number
        - Departure location, time and day of servicing
        - Arrival location, time and day of servicing
        - Distances
        - Primary maintenance location
        - Secondary maintenance location (if applicable)
        - Turn round attention (if applicable)
        - Empty run (if applicable)

    4. **Rake link description**:
        - Number of rakes and owning railway
        - Primary maintenance location
        - Secondary maintenance location (if applicable)
        - Turn round attention location (if applicable)
        - Trip kms
        - Link kms

    5. **Sectionwise parameters**:
        - Sections of the journey
        - Types of locomotive used on various sections
        - Permissible loads (maximum and normal for various sections)
        - Section speed

- Apart from the rake links, the booklet has many other details like primary maintenance centrewise coach holdings, list of clean train stations, etc.

Calculations

For each rake cycle,

% of runtime		=	**(hours on run)/(total hours) x100%**
• Hours on run		=	sum of hours of the trains serviced by the rake cycle.
• Total hours		=	24 x number of rakes (for daily trains)
	or	=	(24x7) x number of rakes (for weekly trains)
• Number of rakes		=	the number of rakes (or subset of coaches, as applicable) required to service the trains over a complete rake cycle, as given in the booklet.
Kms/day		=	**(link kms)/(number of days of the rake cycle)**
• Link kms		=	the distance covered in one rake cycle
• Number of days of the rake cycle			number of rakes (daily)
	or	=	7 x number of rakes (weekly)
Average speed		=	**(link kms)/(hours on run)**

Across all rake cycles,

Weighted average for % of runtime	=	**(total coach % of runtime)/(total coaches)**
Across all rake cycles,		
• Total coach % of runtime	=	sum of (coach % of runtime)
• Total coaches	=	sum of (number of coaches)
For each rake cycle,		
• Coach % of runtime	=	(number of coaches) x (% of runtime)
• Number of coaches	=	(coaches) x (number of rakes)
• Coaches	=	number of coaches in one rake
Weighted average for kms/day		**(total coach kms/day)/(total coaches)**
Across all rake cycles,		
• Total coach kms/day	=	sum of (coach kms/day)
For each rake cycle,		
• Coach kms/day	=	(number of coaches) x (kms/day)

Examples

We give examples of the calculations for:
1. A daily express/mail link
2. A weekly express/mail link
3. A link having more than one rake cycle

1. A daily express/mail link:

- Link no 6

	BZA		MAS	KMs
Day 1 06.00	2711		13.00 Day 1	428
Day 3 21.10	2712		14.05 Day 1	428
Day 1 06.00	2711	Repeat		

Number of rakes and owning railway	1 SCR
Primary maintenance	BZA
Link kms	856

For link 6:

- The link services the pair of trains 2711, 2722 that runs daily.
- The rake runs a total of 856 kms.
- The rake completes 2 continuous trips, covering 428 kms in each trip.
- The rake cycle is serviced by one rake with 24 coaches per rake. Therefore, the total coaches in the link are 24.
- The rake is on the run for 14 hours 10 minutes, out of 24 hours. Therefore, the percentage on the run amounts to 58.68%.
- It travels 856 kms/day.
- It maintains an average speed of 60.78 kms/hr.
- To enable weighted average calculations across rake cycles, two intermediate calculations are done :
  Given 24 coaches, coach kms/day is calculated to be 20,544, and

coach % of runtime is 1,408.

Train numbers	Link kms	No of trips	Avg run kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Hrs idle	% of runtime	Coach % of runtime	Kms/ day	Coach kms/ day	Avg speed
2711, 2712	856	2	428	24	1	24	24	14.08	9.92	58.68	1,408	856	20,544	60.78

2. A weekly express/mail link:

- Link no 52

	HYB	CSTM	KMs
Fri Day 1 18.15	7610	04.00 Day 3 Sun	1748
Tue Day 3 07.00	7609	23.00 Day 3 Sun	1748
Fri Day 1 18.15	7610 Repeat		

Number of rakes and owning railway	1 SCR
Primary maintenance	PAU
Link kms	3496

For link 52:

- The link services the pair of trains 7609, 7610 that runs weekly.
- The rake runs a total of 3,496 kms.
- The rake completes 2 continuous trips, covering 1,748 kms in each trip.
- The rake cycle is serviced by one rake with 12 coaches per rake. Therefore, the total coaches in the link are 12.
- The rake is on the run for 65 hours 45 minutes, out of 168 hours. Therefore, the percentage on the run amounts to 39.14%.
- It travels 499 kms/day.
- It maintains an average speed of 53.17 kms/hr.
- To enable weighted average calculations across rake cycles, two intermediate calculations are made :
  Given 12 coaches in total, coach kms/day is calculated to be 5,993, and
  coach % of runtime is 469.

Train numbers	Link kms	No of trips	Avg run kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Hrs idle	% of runtime	Coach % of runtime	Kms / day	Coach kms/ day	Avg speed
7609, 7610	3,496	2	1,748	12	1	12	168	65.75	102.25	39.14	469	499	5,993	53.17

3. A link having more than one rake cycle:

- Link no 43

	TPTY		GDV	NS	MTM	KMs
Day1 18.10	7401		Day2 03.30			431
	Day2 04.10		7401		Day2 05.20	37
	Day2 03.40	7401A		Day2 06.00		95
	Day2 20.05	7402A		Day2 17.15		95
	Day2 19.55		7402		Day2 19.00	37
Day3 04.35	7402		Day2 20.25			431
Day1 19.40	7401		Repeat			

Number of rakes and owning railway	2 SCR
Primary maintenance	TPTY
Link kms	1052

For Link 43, two pairs of trains run weekly. Conceptually, the link is broken up into 2 rake cycles, 43(a) and 43(b). Each rake cycle is completed by two sets of 9 coaches.

Rake cycle 43(a)

	TPTY	GDV	NS	KMs
Day1 18.15	7401	Day2 03.30		431
	Day2 03.40	7401A	Day2 06.00	95
	Day2 20.05	7402A	Day2 17.15	95
Day3 04.35	7402	Day2 20.25		431
Day1 19.40	7401	Repeat		

Rake cycle 43(b)

	TPTY	GDV	MTM	KMs
Day1 18.15	7401		Day2 05.20	468
Day3 04.35	7402		Day2 19.00	468
Day1 19.40	7401	Repeat		

For rake cycle 43(a):

- It follows the route TPTY-GDV-NS-GDV-TPTY and services the two pairs of trains 7401, 7402, 7401A, 7402A.
- It runs a total of 1,052 kms.
- The set of coaches completes 2 continuous trips, covering 526 kms in each trip.
- The rake cycle is serviced by two set of coaches with 9 coaches per set. Therefore, the total coaches in the link are 18.
- The rake is on the run for 21 hours 30 minutes, out of 48 hours. Therefore, the percentage of runtime run amounts to 44.79%.
- It travels 526 kms/day.
- It maintains an average speed of 48.93 km/hr.
- To enable weighted average calculations across rake cycles, two intermediates calculations are made:
  Given 18 coaches in total, the coach km/day is calculated to be 9,468, and
  coach % of runtime is 806.

For rake cycle 43(b):

- It follows the route TPTY-GDV-MTM-TPTY and services the pair 7401 and 7402.
- It runs a total of 936 kms.
- The rake completes 2 continuous trips, covering 468 kms in each trip.
- The rake cycle is serviced by two set of coaches with 9 coaches per set. Therefore, the total coaches in the link are 18.
- The rake is on the run for 19 hours 30 mins, out of 48 hours. Therefore, the percentage of runtime amounts to 40.63%.
- It travels 468 kms/day.
- It maintains an average speed of 48.00 kms/hr.
- To enable weighted average calculations across rake cycles, two intermediates calculations are made:
  Given 18 coaches in total, the coach km/day is calculated to be 8,424, and
  coach % of runtime is 731.

Train numbers	Link kms	No of trips	Avg run kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Hrs idle	% of runtime	Coach % of runtime	Kms/ day	Coach kms/day	Avg speed
7401, 7402, 7401A, 7402A	1,052	2	526	9	2	18	48	21.50	26.50	44.79	806	526	9,468	48.93
7401, 7402	936	2	468	9	2	18	48	19.50	28.50	40.63	731	468	8,424	48.00

All of these calculations are done for every distinct rake cycle for daily and weekly express/mails in Exhibit 2 and Exhibit 3 respectively.

Results

Weighted averages

The weighted averages for rake utilization, across all rake cycles, by each category of trains in this zone are:

1. Daily express/mails (Exhibit 2)
   a) Weighted average for % of runtime = 62.56 %
   b) Weighted average for kms/day = 811.50

2. Weekly express/mails (Exhibit 3)
   a) Weighted average for % of runtime = 59.30 %
   b) Weighted average for kms/day = 776.95

The combined weighted averages are (Exhibit 3):
   a) Weighted average for % of runtime = 61.29 %
   b) Weighted average for kms/day = 798.09

Ranges of parameters

Daily express/mail:

- % of runtime, across 72 rake cycles servicing a daily express/mail in the SCR, is in the range 25-85% where 29% coaches lie in the modal range of 60-70%. (Exhibit 4(a))
- Kms/day is in the range 300-1100 where 36% coaches lie in the modal range of 800-900 kms/day. (Exhibit 4(b))
- The average speed is in the range 40-60 kms/hr where 38% coaches lie in the modal range of 55-60 kms/hr. (Exhibit 4(c))

Weekly express/mail:

- % of runtime across 77 rake cycles servicing a weekly express/mail in the SCR is in the range 25-85% where 21% coaches lie in the modal range of 50-55%. (Exhibit 5(a))
- Kms/day is in the range 375-1200 where 28% coaches lie in the modal range of 700-800 kms/day. (Exhibit 5(b))
- The average speed is in the range 40-80 kms/hr where 37% coaches lie in the modal range of 50-55 kms/hr. (Exhibit 5(c))

Passenger Trains

- A similar analysis is done for passenger trains as done for the express/mail trains.
- Every rake link used by the SCR to service its passenger trains is provided individually in the booklet. Hence, there are no recurrences in this case.
- There are 41 distinct rake links given in the booklet which are converted into 50 rake cycles. (Exhibit 6)

- Exhibit 7 tabulates the results of the rake cycle analysis for passenger trains.
- Every link for the passenger trains is described by the following segments:
  a. Rake description
  b. Schematic link diagram
  c. Parameters of rake link
- The description of these segments is same as for the express trains.

Weighted averages

- The weighted averages for rake utilization by passenger trains (Exhibit 7) in this zone are
  Weighted average for % of runtime = 56.86%
  Weighted average for kms/day = 493.49

Ranges of parameters

- % of runtime of a rake servicing a passenger train in the SCR is in the range 10-80% where 26.45% coaches lie in the modal range of 70-75%. (Exhibit 8(a))
- Kms/day is in the range 50-700 where 16.63% coaches lie in the modal range of 350-400 kms/day. (Exhibit 8(b))
- The average speed lies in the range 20-45 kms/hr where 40.68% coaches lie in the modal range of 30-35 kms/hr. (Exhibit 8(c))

Implications

- As seen from the ranges and distribution of various parameters for express/mails, coaches for daily express/mails are running for as little as 25% and for as much as 85% of the total time. Coaches are utilized over a wide range of 300 to1100 kms/day. Similar ranges for weekly express/mails are 25% to 85% and 375 to1200 kms/day. While there does not seem to be a difference in the ranges for daily and weekly express/mails, the weighted average for daily is marginally higher than weekly. The combined weighted average across all express/mails which use 5776 coaches is 61% of run time and 798 kms/day.
- For passenger trains which use 1293 coaches, the weighted average is 57% of run time and 493 kms/day.
- The weighted average across express/mails and passenger trains is 742 kms/day. In 2007-08, the national average was 510 kms/day [MOR 2007-08]. The SCR performance is significantly higher than the national average, partly because the coaches in express/mails are relatively higher than passenger trains.
- In 2007-08, the number of passenger coaches used were 40,734, which can possibly be brought down by 50% to 27,156, if the average utilization of 510 kms/day can be increased by 50% to 775kms/day. This is a substantial saving for the IR, amounting to at least Rs 7,000 crores.

  The average can be improved by increasing the low end utilization, both in coaches for express/mails and passenger trains. (Even in SCR, only 52% of the coaches for express/mails yield a utilization of more than 800 kms/day.) This can happen by improving the rake linking. Various studies [[Ramani and Raghuram, 1980], [Ramani and Mandal, 1992] and [Rangaraj et al,

2006]] on the scope and methodology for this in the context of IR are available. Standardization of rake compositions across a category of trains would be an important step to enable this. For passenger trains, in addition to rake linking, minimizing layover at terminals by rescheduling services (but without compromising on passenger demand) could be an approach.

- Even with the attempt to increase the average, low end utilization would continue. In such a context, it becomes important to have systems which allocate older coaches for the low end utilization.
- Exhibit 9 and 10 show that for higher cycle kms and higher average train run serviced by a rake, the kms/day generally increases. This implies that long haul trains and rake links which service more than one train with a focus on faster terminal turnaround yield better utilization.

  A comparison between daily and weekly services shows that the kms/day is higher for daily trains, since the scope of terminal layover is less, not being subject to specific day of the week departures.
- The approach used here to assess utilization of coaches can be applied to other railway zones.

References

1. MOR (2009). *'Year Book 2007-08,'* Ministry of Railways, Government of India, New Delhi.
2. Ramani KV and Raghuram G (1980). *'Utilization of Transportation Units: An Optimal Allocation Study,'* Opsearch, Vol 17, No 1.
3. Ramani KV, Mandal BK (1992). *'Operational Planning of Passenger Trains in Indian Railways,'*Interfaces, Journal of INFORMS, USA, Vol 22, No 5.
4. Rangaraj N, Sohoni M, Puniya P and Garg J (2006). *'Rake Linking for Suburban Train Services,'* Indian Institute of Technology, Bombay.
5. SCR (July 2008). *'Rake Link Booklet,'* South Central Railway, Secunderabad.
6. SZ (2008). *'Southern Zone Timetable,'* Southern Zone.

List of Exhibits

Exhibit 1(a): Matching of 'links in booklet' with 'rake cycles in list' for daily express/mails

Rake cycles: 72
Links in booklet: 70

Duplicates

Link numbers		addition
1	25	1
2	14	2
3	51	0
5	29	0
10	109	2
38	42	2
45	46	1
53	57	1
55	56	1
61	62	1
105	106	1
122	123	0
141	142	2
No of duplicates		**additions**
13		14

Special set

Link no	
28	passenger
additions	**1**

Broken into two

Link no
43
116
additions
2

Quadruplets

Link numbers				addition
32	39	40	41	1
No of quadruplets				**additions**
1				**1**

Matching of 'rake cycles' with 'links in booklet'

No of links in rake link booklet	**70**
- (No of duplicates)	13
- (2xNo of triplicates)	0
- (3xNo of quadruplets)	3
Distinct rake cycles	**54**
+ additional duplicates	14
+ additional triplicates	0
+ additional quadruplets	1
+ special sets	1
+ broken into two	2
No of rake cycles in list	**72**

Additions: The number of new rake cycles formed from that link.
Special set: The rake cycle services one pair of express trains as well as one pair of passenger trains
Note: There are no triplicates for daily express/mails in the rake link booklet
[Source: Rake link booklet, South Central Railway]

Exhibit 1(b): Matching of 'links in booklet' with 'rake cycles in list' for weekly express/mails

Rake cycles: 72
Links in booklet: 70

Duplicates

Link numbers		addition
33	34	0
35	37	1
47	48	1
71	72	0
74	78	1
94	145	1
103	107	0
121	124	1
137	140	0
No of duplicates		**additions**
9		**5**

Broken into two

Link no
65
99
100
128
144
additions
5

Triplicates

Link numbers			addition
76	81	82	1
98	133	134	1
113	114	115	0
No of triplicates			**additions**
3			**2**

Quadruplets

Link numbers				addition
90	129	130	131	2
No of quadruplets				**additions**
1				**2**

Special set

Link numbers					**addition**
19	22	24	27	31	**1**

Matching of 'rake cycles in list' with 'links in booklet'

No of links in rake link booklet	**80**
- (No of duplicates)	9
- (2xNo of triplicates)	6
- (3xNo of quadruplets)	3
Distinct rake cycles	**62**
+ additional duplicates	5
+ additional triplicates	2
+ additional quadruplets	2
+ special sets	1
+ broken into two	5
No of rake cycles in list	**77**

Additions: The number of new rake cycles formed from that link.

[Source: Rake link booklet, South Central Railway]

Exhibit 2: Rake cycle analysis for daily express/mails

S no	Link numbers	No of trains	Train numbers	No of terminals	Link kms	No of trips	Avg run kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Idle Hrs	% of runtime	Coach % of runtime	Kms/Day	Coach kms/Day	Avg speed	Owning railway	Primary maintenance
1	1+25	2	2702, 7031	2	1,580	2	790	17	2	34	48	30.75	17.25	64.06	2,178	790	26,860	51.38	SCR	HYB
2	1+25	2	7032, 2701	2	1,580	2	790	17	2	34	48	31.51	16.49	65.64	2,232	790	26,860	50.15	SCR	HYB
3	2+14	4	2733, 2704, 2703, 2734	3	4,402	2	2,201	22	5	110	120	75.92	44.08	63.26	6,959	880	96,844	57.98	SCR	TPTY
4	2+14	2	2704, 2703	2	3,080	2	1,540	1	3	3	72	51.92	20.08	72.11	216	1,027	3,080	59.33	SCR	TPTY
5	2+14	2	2733, 2734	2	1,322	2	661	1	2	2	48	24.00	24.00	50.00	100	661	1,322	55.08	SCR	TPTY
6	3+51	4	2706, 2705, 7607, 7608	3	1,250	4	313	18	2	36	48	22.81	25.19	47.52	1,711	625	22,500	54.80	SCR	SC
7	5+29	4	2710, 2709, 7058, 7057	3	3,044	4	761	16	4	64	96	56.50	39.50	58.85	3,767	761	48,704	53.88	SCR	SC
8	6	2	2711, 2712	2	856	2	428	24	1	24	24	14.08	9.92	58.68	1,408	856	20,544	60.78	SCR	BZA
9	7	2	2713, 2714	2	700	2	350	20	1	20	24	11.17	12.83	46.53	931	700	14,000	62.69	SCR	BZA
10	8	2	2715, 2716	2	4,114	2	2,057	22	4	88	96	68.83	27.17	71.70	6,310	1,029	90,508	59.77	SCR	NED
11	9	2	2718, 2717	2	700	2	350	24	1	24	24	11.83	12.17	49.29	1,183	700	16,800	59.17	SCR	BZA
12	10+109	2	2721, 2722	3	3,342	2	1,671	15	4	60	96	59.08	36.92	61.54	3,693	836	50,130	56.57	SCR	HYB, VSKP
13	10+109	4	2861, 2862, 2721, 2722	3	4,202	2	2,101	6	5	30	120	73.17	46.83	60.97	1,829	840	25,212	57.43	SCR	HYB, VSKP
14	10+109	2	2861, 2862	2	1,140	2	570	5	2	10	48	20.00	28.00	41.67	417	570	5,700	57.00	SCR	HYB

S no	Link numbers	No of trains	Train numbers	No of terminals	Link kms	No of trips	Avg run kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Idle Hrs	% of runtime	Coach % of runtime	Kms/Day	Coach kms/Day	Avg speed	Owning railway	Primary maintenance
15	11	2	2723, 2724	2	3,350	2	1,675	24	3	72	72	52.92	19.08	73.50	5,292	1,117	80,400	63.31	SCR	HYB
16	12	2	2728, 2727	2	1,420	2	710	24	2	48	48	25.67	22.33	53.47	2,567	710	34,080	55.32	SCR	HYB
17	16	2	2737, 2738	2	1,130	2	565	24	2	48	48	20.50	27.50	42.71	2,050	565	27,120	55.12	SCR	COA
18	17	2	2747, 2748	2	702	2	351	17	1	17	24	12.67	11.33	52.78	897	702	11,934	55.42	SCR	GNT
19	18	2	2759, 2760	2	1,576	2	788	24	2	48	48	27.58	20.42	57.46	2,758	788	37,824	57.14	SCR	HYB
20	20	2	2785, 2786	2	1,238	2	619	24	2	48	48	22.68	25.32	47.25	2,268	619	29,712	54.59	SCR	KCG
21	21	2	2797, 2798	2	1,410	2	705	21	2	42	48	25.66	22.34	53.46	2,245	705	29,610	54.95	SCR	KCG
22	23	2	7015, 7016	2	2,266	2	1,133	18	3	54	72	45.25	26.75	62.85	3,394	755	40,788	50.08	SCR	SC
23	26	2	7035, 7036	2	628	2	314	22	1	22	24	12.00	12.00	50.00	1,100	628	13,816	52.33	SCR	SC
24	28+P	4	7050, 7049, 339, 340	3	656	2	328	8	2	16	48	12.25	35.75	25.52	408	328	5,248	53.55	SCR	SC
25	28+P	2	7050, 7049	3	856	2	428	16	2	32	48	17.50	30.50	36.46	1,167	428	13,696	48.91	SCR	SC
26	30	2	7064, 7063	2	1,240	2	620	20	2	40	48	24.67	23.33	51.40	2,056	620	24,800	50.26	SCR	SC
27	32+ 39+ 40+ 41	4	7239, 7240,7241, 7242	3	596	2	298	5	2	10	48	13.66	34.34	28.46	285	298	2,980	43.63	SCR	GNT
28	32+ 39+ 40+ 41	4	7201, 7202, 7233, 7234	3	1,392	4	348	2	2	4	48	28.00	20.00	58.33	233	696	2,784	49.71	SCR	GNT

S no	Link numbers	No of trains	Train numbers	No of terminals	Link kms	No of trips	Avg run kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Idle Hrs	% of runtime	Coach % of runtime	Kms/Day	Coach kms/Day	Avg speed	Owning railway	Primary maintenance
29	32+39+40+41	6	7201, 7202, 7233, 7234, 7239, 7240	5	2,156	6	359	16	4	64	96	47.50	48.50	49.48	3,167	539	34,496	45.39	SCR	GNT, NS
30	36	2	7209, 7210	2	1,915	2	958	17	2	34	48	38.50	9.50	80.21	2,727	958	32,555	49.74	SCR	COA
31	38+42	4	7255, 7256, 7230, 7229	3	4,130	2	2,065	21	5	105	120	84.09	35.91	70.08	7,358	826	86,730	49.11	SCR	NS
32	38+42	2	7229, 7230	2	3,136	2	1,568	1	4	4	96	61.42	34.58	63.98	256	784	3,136	51.06	SCR	NS
33	38+42	2	7255, 7256	2	994	2	497	1	2	2	48	20.92	27.08	43.58	87	497	994	47.51	SCR	NS
34	43	4	7401, 7402, 7401A, 7402A	3	1,052	2	526	9	2	18	48	21.50	26.50	44.79	806	526	9,468	48.93	SCR	TPTY, RBPC
35	43	2	7401, 7402	3	936	2	468	9	2	18	48	19.50	28.50	40.63	731	468	8,424	48.00	SCR	TPTY, RBPC
36	44	2	7405, 7406	2	1,788	2	894	18	2	36	48	37.50	10.50	78.13	2,813	894	32,184	47.68	SCR	TPTY
37	45+46	4	7416, 7430, 7429, 7415	3	1,996	2	998	7	3	21	72	45.33	26.67	62.95	1,322	665	13,972	44.04	SCR	HYB, TPTY
38	45+46	4	7416, 7430, 7429, 7415	3	1,806	2	903	10	3	30	72	39.50	32.50	54.86	1,646	602	18,060	45.73	SCR	HYB, TPTY
39	49	2	7487, 7488	2	1,472	2	736	24	2	48	48	29.25	18.75	60.94	2,925	736	35,328	50.32	SCR	TPTY
40	50	2	7603, 7604	2	1,322	2	661	16	2	32	48	26.00	22.00	54.17	1,733	661	21,152	50.85	SCR	KCG
41	53+57	4	7688, 7687, 7618, 7610	4	2,204	4	551	13	3	39	72	43.33	28.67	60.18	2,347	735	28,652	50.87	SCR	NED

S no	Link numbers	No of trains	Train numbers	No of terminals	Link kms	No of trips	Avg run kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Idle Hrs	% of runtime	Coach % of runtime	Kms/Day	Coach kms/Day	Avg speed	Owning railway	Primary maintenance
42	53+57	2	7618, 7617	2	1,218	2	609	1	2	2	48	23.25	24.75	48.44	97	609	1,218	52.39	SCR	NED
43	54	2	7639, 7640	2	556	2	278	15	1	15	24	11.83	12.17	49.31	740	556	8,340	46.99	SCR	KCG
44	55+56	4	7643, 7644 , 7652, 7651	3	2,826	2	1,413	15	4	60	96	61.17	34.83	63.72	3,823	707	42,390	46.20	SCR	KCG
45	55+56	2	7643, 7644	2	1,314	2	657	1	2	2	48	32.00	16.00	66.67	133	657	1,314	41.06	SCR	KCG
46	58	2	1005, 1006	2	1,650	2	825	11	2	22	48	33.00	15.00	68.75	1,513	825	18,150	50.00	CR	CSTM
47	59	2	1013, 1014	2	3,152	2	1,576	20	3	60	72	62.50	9.50	86.81	5,208	1,051	63,040	50.43	CR	LT(T)
48	60	2	1019, 1020	2	3,866	2	1,933	20	4	80	96	72.08	23.92	75.09	6,007	967	77,320	53.63	CR	CSTM
49	61+62	2	1027, 1042	2	2,550	2	1,275	18	3	54	72	55.50	16.50	77.08	4,163	850	45,900	45.95	SR	CSTM
50	61+62	2	1027, 1042	2	2,550	2	1,275	18	3	54	72	54.75	17.25	76.04	4,106	850	45,900	46.58	SR	CSTM
51	64	2	1401, 1402	2	2,382	2	1,191	12	3	36	72	49.42	22.58	68.64	2,471	794	28,584	48.20	CR	NGP
52	68	2	2163, 2164	2	2,558	2	1,279	17	3	51	72	46.42	25.58	64.47	3,288	853	43,486	55.11	CR	DR
53	83	4	2603, 2604, 6669, 6670	3	2,216	2	1,108	23	4	92	96	41.58	54.42	43.32	3,985	554	50,968	53.29	SR	ED
54	85	2	2615, 2616	2	4,366	2	2,183	24	4	96	96	70.75	25.25	73.70	7,075	1,092	104,784	61.71	SR	MAS
55	86	2	2621, 2622	2	4,366	2	2,183	24	4	96	96	65.67	30.33	68.41	6,567	1,092	104,784	66.48	SR	MAS
56	87	2	2625, 2626	2	6,102	2	3,051	24	7	168	168	100.92	67.08	60.07	10,092	872	146,448	60.47	SR	MAS
57	88	2	2627, 2628	2	4,920	2	2,460	24	6	144	144	79.67	64.33	55.32	7,967	820	118,080	61.76	WR	SBC

S no	Link numbers	No of trains	Train numbers	No of terminals	Link kms	No of trips	Avg run kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Idle Hrs	% of runtime	Coach % of runtime	Kms/Day	Coach kms/Day	Avg speed	Owning railway	Primary maintenance
58	95	4	2655, 2656, 2673, 2674	3	4,782	2	2,391	24	5	120	120	83.67	36.33	69.72	8,367	956	114,768	57.16	SR	MAS
59	102	2	2805, 2806	2	1,376	2	688	22	2	44	48	24.84	23.16	51.75	2,277	688	30,272	55.39	E.Co	VSKP
60	105+106	2	2840, 2841	2	3,314	2	1,657	24	4	96	96	55.00	41.00	57.29	5,500	829	79,536	60.25	SER	SRC
61	105+106	2	2839, 2842	2	3,314	2	1,657	24	4	96	96	55.00	41.00	57.29	5,500	829	79,536	60.25	SER	SRC
62	110	2	2863, 2864	2	3,924	2	1,962	24	4	96	96	69.92	26.08	72.84	6,992	981	94,176	56.12	SER	SRC
63	116	2	3351, 3352	3	5,080	2	2,540	12	6	72	144	114.00	30.00	79.17	5,700	847	60,960	44.56	SCR	DHN/TATA
64	116	4	3351, 3352, 8189, 8190	3	4,724	2	2,362	9	6	54	144	104.00	40.00	72.22	3,900	787	42,516	45.42	SCR	DHN/TATA
65	122+123	4	6053, 6054, 6057, 6058	2	604	4	151	12	1	12	24	12.58	11.42	52.43	629	604	7,248	48.00	SR	MAS
66	126	4	213, 214, 6203, 6204	3	1,292	2	646	18	4	72	96	29.67	66.33	30.90	2,225	323	23,256	43.55	SWR	MYS
67	136	2	6381, 6382	2	4,270	2	2,135	17	5	85	120	91.83	28.17	76.53	6,505	854	72,590	46.50	SR	CAPE
68	139	2	6529, 6530	2	2,424	2	1,212	22	3	66	72	52.83	19.17	73.38	4,843	808	53,328	45.88	SWR	SBC
69	141+142	2	6594, 6593	2	1,838	2	919	1	2	2	48	32.33	15.67	67.36	135	919	1,838	56.84	SWR	SBC
70	141+142	2	6592, 6591	3	1,696	2	848	13	2	26	48	25.59	22.41	53.31	1,386	848	22,048	66.28	SWR	SBC
71	141+142	4	6592, 6591, 6594, 6593	3	2,804	2	1,402	9	3	27	72	46.42	25.58	64.47	1,741	935	25,236	60.40	SWR	SBC

S no	Link numbers	No of trains	Train numbers	No of terminals	Link kms	No of trips	Avg run kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Idle Hrs	% of runtime	Coach % of runtime	Kms/Day	Coach kms/Day	Avg speed	Owning railway	Primary maintenance
72	148	2	8463, 8464	2	3,244	2	1,622	21	3	63	72	60.67	11.33	84.26	5,308	1,081	68,124	53.47	E.Co	BBS
73	150	4	8615, 8616, 8645, 8646	3	4,028	2	2,014	21	5	105	120	78.75	41.25	65.63	6,891	806	84,588	51.15	SER	HTE
TOTAL										**3,559**					**222,702**		**2,889,733**			

Total coaches	**=**	**3,559**
Total coach kms/day	**=**	**2,889,733**
Total coach % of runtime	=	**222,702**
Daily weighted average for kms/day	**=**	**811.95**
Daily weighted average for % of runtime	**=**	**62.57**

Exhibit 3: Rake cycle analysis for weekly express/mails

S no	Link numbers	No of trains	Train numbers	No of terminals	Link kms	No of trips	Avg run kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Idle Hrs	% of runtime	Coach % of runtime	Kms/ day	Coach kms/day	Avg speed	Owning railway	Primary maintenance
1	4	2	2707, 2708	2	14,250	6	2,375	16	2	32	336	223.25	112.75	66.44	2,126	1,018	32,571	63.83	SCR	TPTY
2	13	2	2729, 2730	2	2,580	4	645	8	1	8	168	48.00	120.00	28.57	229	369	2,949	53.75	SCR	NED
3	15	2	2735, 2736	2	4,386	6	731	16	1	16	168	70.74	97.26	42.11	674	627	10,025	62.00	SCR	SC
4	19+ 31	4	2763, 2764, 7091, 7092	3	11,024	12	919	17	2	34	336	196.08	139.92	58.36	1,984	787	26,773	56.22	SCR	SC
5	19+ 31	2	7091, 7092	2	3,684	2	1,842	1	1	1	168	72.00	96.00	42.86	43	526	526	51.17	SCR	SC
6	22+ 31	4	7001, 7002, 7091, 7092	3	5,092	4	1,273	16	1	16	168	101.00	67.00	60.12	962	727	11,639	50.42	SCR	SC
7	22+ 31	2	7091, 7092	2	3,684	2	1,842	2	1	2	168	72.00	96.00	42.86	86	526	1,053	51.17	SCR	SC
8	22+ 24+ 27	6	7001, 7002, 7017, 7018, 7037, 7038	4	14,508	10	1,451	20	3	60	672	288.67	383.33	42.96	2,577	518	31,089	50.26	SCR	SC
9	22+ 24+ 27	4	7017, 7018, 7037, 7038	3	13,100	8	1,638	1	3	3	672	259.75	412.25	38.65	116	468	1,404	50.43	SCR	SC
10	33+ 34	4	7203, 7204, 7205, 7206	3	6,764	4	1,691	17	1	17	168	131.42	36.58	78.22	1,330	966	16,427	51.47	SCR	COA

S no	Link numbers	No of trains	Train numbers	No of terminals	Link kms	No of trips	Avg run kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Idle Hrs	% of runtime	Coach % of runtime	Kms/ day	Coach kms/day	Avg speed	Owning railway	Primary maintenance
11	35+ 37	2	7225, 7226	2	2,760	4	690	15	1	15	168	59.33	108.67	35.32	530	394	5,914	46.52	SCR	BZA
12	35+ 37	4	7225, 7226, 7207, 7208	3	3,488	4	872	15	1	15	168	71.44	96.56	42.53	638	498	7,474	48.82	SCR	BZA
13	47+ 48	4	7479, 7480, 7481, 7482	3	17,184	14	1,227	10	4	4	672	405.67	266.33	60.37	241	614	2,455	42.36	SCR	TPTY
14	47+ 48	2	7479, 7480	2	11,580	10	1,158	1	4	4	672	281.67	390.33	41.91	168	414	1,654	41.11	SCR	TPTY
15	52	2	7609, 7610	2	3,496	2	1,748	12	1	12	168	65.75	102.25	39.14	470	499	5,993	53.17	SCR	PAU
16	63	6	1043, 1044, 1069, 1070, 2145, 2146	4	13,046	8	1,631	17	3	51	504	276.50	227.50	54.86	2,798	621	31,683	47.18	CR	LT(T)
17	65	4	1405, 1406, C/7480, C/7481	3	5,732	2	2,866	5	1	5	168	119.82	48.18	71.32	357	819	4,094	47.84	CR	MMR
18	65	2	1405, 1406	3	5,080	2	2,540	13	1	13	168	120.00	48.00	71.43	929	726	9,434	42.33	CR	MMR
19	66	2	2071, 2072	2	8,976	24	374	9	2	18	336	162.00	174.00	48.21	868	641	11,541	55.41	CR	CSTM
20	67	2	2077, 2078	2	5,136	12	428	8	1	8	168	79.00	89.00	47.03	376	734	5,870	65.01	SR	MAS
21	69	4	2251, 2252, 6527, 6528	3	4,466	4	1,117	21	1	21	168	89.42	78.58	53.22	1,118	638	13,398	49.95	SWR	YPR
22	70	2	2295, 2296	2	10,864	4	2,716	19	2	38	336	194.17	141.83	57.79	2,196	776	29,488	55.95	SWR	SBC

S no	Link numbers	No of trains	Train numbers	No of terminals	Link kms	No of trips	Avg run kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Idle Hrs	% of runtime	Coach % of runtime	Kms/ day	Coach kms/day	Avg speed	Owning railway	Primary maintenance
23	71+72	6	2429, 2430, 2431, 2432, 2433, 2434	4	39,396	16	2,462	17	5	85	840	549.00	291.00	65.36	5,555	1,126	95,676	71.76	NR	NZM
24	73	2	2425, 2426, 2437, 2438	4	4,510	4	1,128	18	1	18	168	61.58	106.42	36.65	660	644	11,597	73.24	NR	NZM
25	74+78	6	2508, 2507, 2515, 2516, 5635, 5636	4	20,840	6	3,473	21	4	84	672	384.33	287.67	57.19	4,804	744	62,520	54.22	NFR	GHY
26	74+78	2	2515, 2516	2	7,104	2	3,552	1	1	1	168	130.00	38.00	77.38	77	1,015	1,015	54.65	NFR	GHY
27	75	2	2509, 2510	2	18,096	6	3,016	21	3	63	504	323.00	181.00	64.09	4,038	862	54,288	56.02	NFR	GHY
28	76+81+82	6	2511, 2512, 2589, 2590, 2591, 2592	4	21,922	8	2,740	23	3	69	504	393.92	110.08	78.16	5,393	1,044	72,029	55.65	NER	GKP
29	76+81+82	2	2511, 2512	2	6,520	2	3,260	23	1	23	168	117.42	50.58	69.89	1,607	931	21,423	55.53	NER	GKP
30	77	2	2513, 2514	2	5,160	2	2,580	22	1	22	168	92.15	75.85	54.85	1,207	737	16,217	55.99	NER	GKP
31	79	2	2521, 2522	2	7,272	2	3,636	19	1	19	168	116.42	51.58	69.30	1,317	1,039	19,738	62.46	ECR	BJU
32	80	2	2577, 2578	2	5,510	2	2,755	21	1	21	168	105.00	63.00	62.50	1,313	787	16,530	52.48	ECR	BBG
33	84	2	2611, 2612	2	4,352	2	2,176	18	1	18	168	56.33	111.67	33.53	604	622	11,191	77.25	SR	MAS
34	89	2	2641,	2	6,320	2	3,160	16	1	16	168	97.58	70.42	58.08	929	903	14,446	64.77	SR	CAPE

S no	Link numbers	No of trains	Train numbers	No of terminals	Link kms	No of trips	Avg run kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Idle Hrs	% of runtime	Coach % of runtime	Kms/ day	Coach kms/day	Avg speed	Owning railway	Primary maintenance
			2642																	
35	90+129+130+131	8	2643, 2644, 6323, 6324, 6325, 6326, 6327, 6328	5	31,758	12	2,647	16	5	80	840	598.42	241.58	71.24	5,699	907	72,590	53.07	SR	TVC
36	90+129+130+131	6	2643, 2644, 6323, 6324, 6327, 6328	4	26,446	10	2,645	1	5	5	840	475.92	364.08	56.66	283	756	3,778	55.57	SR	TVC
37	90+129+130+131	2	6327, 6328	2	10,084	4	2,521	1	2	2	336	187.00	149.00	55.65	111	720	1,441	53.93	SR	TVC
38	91	2	2645, 2646	2	5,660	2	2,830	14	1	14	168	94.34	73.66	56.15	786	809	11,320	60.00	SR	ERS
39	92	4	2647, 2648, 2681, 2682	3	6,568	4	1,642	20	1	20	168	112.00	56.00	66.67	1,333	938	18,766	58.64	SR	CBE
40	93	4	2629, 2630, 2649, 2650	2	35,058	14	2,504	22	5	110	840	600.00	240.00	71.43	7,857	1,002	110,182	58.43	SWR	YPR
41	94+145	4	2651, 2652, 6733, 6734	3	15,566	6	2,594	13	2	26	336	245.75	90.25	73.14	1,902	1,112	28,908	63.34	SR	MDU
42	94+145	2	2651, 2652	2	11,840	4	2,960	2	2	4	336	173.17	162.83	51.54	206	846	3,383	68.37	SR	MDU
43	96	2	2659, 2669	2	5,212	2	2,606	20	1	20	168	94.00	74.00	55.95	1,119	745	14,891	55.45	SR	NCJ

S no	Link numbers	No of trains	Train numbers	No of terminals	Link kms	No of trips	Avg run kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Idle Hrs	% of runtime	Coach % of runtime	Kms/ day	Coach kms/day	Avg speed	Owning railway	Primary maintenance
44	97	2	2663, 2664	2	8,104	4	2,026	21	2	42	336	147.20	188.80	43.81	1,840	579	24,312	55.05	SR	TPJ
45	98+133+134	6	2665, 2666, 6339, 6340, 6351, 6352	4	28,362	14	2,026	18	5	90	840	557.75	282.25	66.40	5,976	810	72,931	50.85	SR	NCJ
46	98+133+134	2	2665, 2666	2	4,866	2	2,433	1	1	1	168	85.75	82.25	51.04	51	695	695	56.75	SR	NCJ
47	99	2	2669, 2670	2	4,242	2	2,121	23	1	23	168	83.50	84.50	49.70	1,143	606	13,938	50.80	SR	MAS
48	99	4	2669, 2670, 2691, 2692	3	4,952	4	1,238	23	1	23	168	94.17	73.83	56.05	1,289	707	16,271	52.59	SR	MAS
49	100	4	2687, 2688, 2687A, 2688A	3	4,986	2	2,493	9	1	9	168	84.58	83.42	50.35	453	712	6,411	58.95	SR	MAS
50	100	2	2687, 2688	3	4,994	2	2,497	10	1	10	168	85.75	82.25	51.04	510	713	7,134	58.24	SR	MAS
51	101	4	2803, 2804, 2807, 2808	2	16,060	8	2,008	18	3	54	504	271.00	233.00	53.77	2,904	765	41,297	59.26	E.Co	VSKP
52	103+107	4	2829, 2830, 2845, 2846	3	5,496	4	1,374	21	1	21	168	93.50	74.50	55.65	1,169	785	16,488	58.78	E.Co	BBS
53	104	2	2835, 2836	2	7,648	4	1,912	23	2	46	336	138.83	197.17	41.32	1,901	546	25,129	55.09	SCR	THE
54	108	2	2851, 2852	2	3,038	2	1,519	18	1	18	168	47.00	121.00	27.98	504	434	7,812	64.64	SECR	BSP
55	111	4	2889, 2890, 8103,	3	10,790	6	1,798	17	2	34	336	205.83	130.17	61.26	2,083	771	26,204	52.42	SER	TATA

S no	Link numbers	No of trains	Train numbers	No of terminals	Link kms	No of trips	Avg run kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Idle Hrs	% of runtime	Coach % of runtime	Kms/ day	Coach kms/day	Avg speed	Owning railway	Primary maintenance
			8104																	
56	112	2	2897, 2898	2	2,848	2	1,424	19	1	19	168	50.25	117.75	29.91	568	407	7,730	56.68	E.Co	BBS
57	113 + 114 + 115	6	2967, 2968, 2969, 2970, 2975, 2976	4	24,348	10	2,435	23	4	92	672	416.50	255.50	61.98	5,702	870	80,001	58.46	NWR	JP
58	117	2	5015, 5016	2	5,234	2	2,617	19	1	19	168	106.75	61.25	63.54	1,207	748	14,207	49.03	NER	GKP
59	118	2	5227, 5228	2	5,508	2	2,754	21	1	21	168	104	64.00	61.90	1,300	787	16,524	52.96	ECR	MFP
60	119	2	5629, 5630	2	5,550	2	2,775	20	1	20	168	108.58	59.42	64.63	1,293	793	15,857	51.11	NFR	GHY
61	120	2	5929, 5930	2	6,766	2	3,383	18	2	36	336	138.83	197.17	41.32	1,487	483	17,398	48.74	NFR	DBRT
62	121 + 124	4	6031, 6032, 6093, 6094	3	24,480	10	2,448	13	4	52	672	507.59	164.41	75.53	3,928	874	45,463	48.23	SR	MAS
63	121 + 124	2	6031, 6032	2	16,632	6	2,772	9	4	36	672	345.25	326.75	51.38	1,850	594	21,384	48.17	SR	MAS
64	125	4	2667, 2668, 6125, 6126	3	6,172	4	1,543	22	1	22	168	114.33	53.67	68.05	1,497	882	19,398	53.99	SR	MS
65	127	4	2683, 2684, 6309, 6310	3	12,446	6	2,074	22	2	44	336	227.34	108.66	67.66	2,977	889	39,116	54.75	SR	ERS
66	128	2	6317, 6318	3	7,456	2	3,728	11	1	11	168	141.17	26.83	84.03	924	1,065	11,717	52.82	SR	CAPE/ MDU
67	128	4	6317, 6318, 6787, 6788	3	6,508	2	3,254	8	1	8	168	127.50	40.50	75.89	607	930	7,438	51.04	SR	CAPE/ MDU

S no	Link numbers	No of trains	Train numbers	No of terminals	Link kms	No of trips	Avg run kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Idle Hrs	% of runtime	Coach % of runtime	Kms/ day	Coach kms/day	Avg speed	Owning railway	Primary maintenance
68	132	4	6321, 6322, 6331, 6332	3	5,720	4	1,430	17	1	17	168	115.58	52.42	68.80	1,170	817	13,891	49.49	SR	TVC
69	135	2	6359, 6360	2	5,586	2	2,793	18	1	18	168	138.33	29.67	82.34	1,482	798	14,364	40.38	SR	ERS
70	137 + 140	10	6501, 6502, 6505, 6506, 6507, 6508, 6509, 6510, 6531, 6532	6	29,272	14	2,091	21	5	105	840	611.43	228.57	72.79	7,643	836	87,816	47.87	SWR	SBC
71	138	2	6513, 6514	2	6,246	6	1,041	14	1	14	168	141.24	26.76	84.07	1,177	892	12,492	44.22	SWR	YPR
72	143	2	6613, 6614	2	4,614	2	2,307	19	1	19	168	90.50	77.50	53.87	1,024	659	12,524	50.98	SR	SBE
73	144	4	6687, 6688, 6787, 6788	3	6,512	2	3,256	8	1	8	168	126.67	41.33	75.40	603	930	7,442	51.41	SR	MAQ/ MDU
74	144	2	6687, 6688	3	7,296	2	3,648	10	1	10	168	135.17	32.83	80.46	805	1,042	10,423	53.98	SR	MAQ/ MDU
75	146	2	8047, 8048	2	15,424	8	1,928	23	3	69	504	309.26	194.74	61.36	4,234	734	50,679	49.87	SER	SRC
76	147	2	8401, 8402	2	5,562	2	2,781	21	1	21	168	106.08	61.92	63.14	1,326	795	16,686	52.43	E.Co	PURI
77	149	4	8507, 8508, 8509, 8510	3	18,914	10	1,891	18	4	72	672	348.00	324.00	51.79	3,729	676	48,636	54.35	E.Co	VSKP
TOTAL										**2,217**					**133,969**		**1,755,190**			SRC

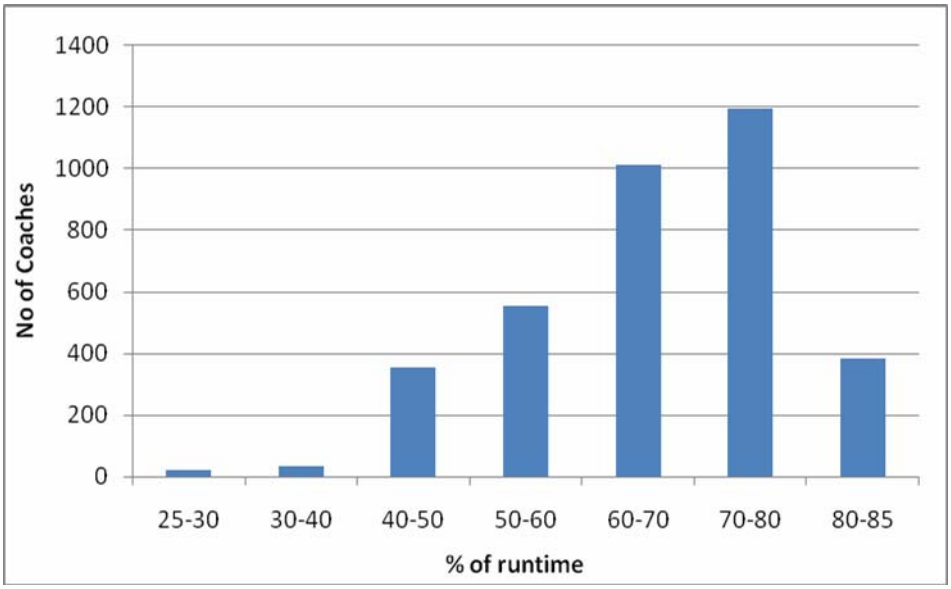
Total coaches = 2,217

Total coach kms/day	**=**	**1,755,190**
Total coach % of runtime	=	**133,969**
Daily weighted average for kms/day	**=**	**811.95**
Daily weighted average for % of runtime	**=**	**62.57**
Combined average for kms/day (daily and weekly)	**=**	**811.50**
Combined average for % of runtime (daily and weekly)	**=**	**62.56**

Exhibit 4: Distribution of parameters for daily express/mails

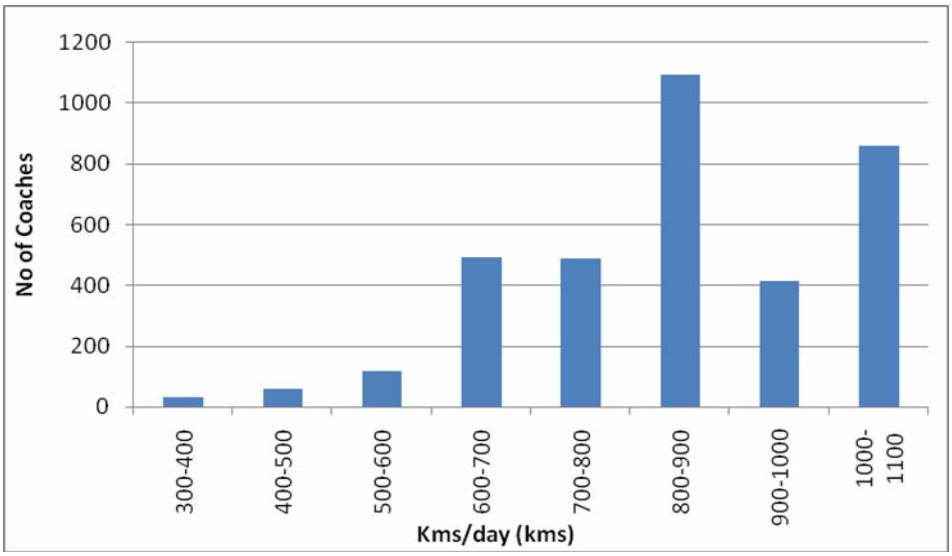
(a)

% of runtime	No of coaches
25-30	68
30-40	113
40-50	591
50-60	570
60-70	1037
70-80	985
80-85	195
Total	3,559



(b)

Kms/day	No of coaches
300-400	178
400-500	41
500-600	280
600-700	533
700-800	459
800-900	1292
900-1000	330
1000-1100	446
Total	3,559



(c)

Average speed (kms/hr)	No of coaches
40-45	183
45-50	803
50-55	522
55-60	1371
60-65	512
65-70	168
Total	3,559

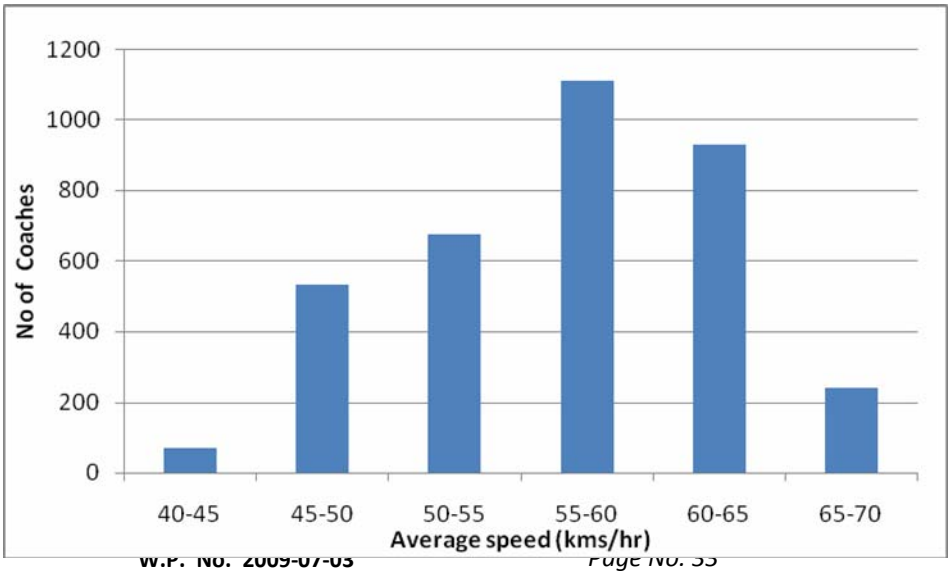
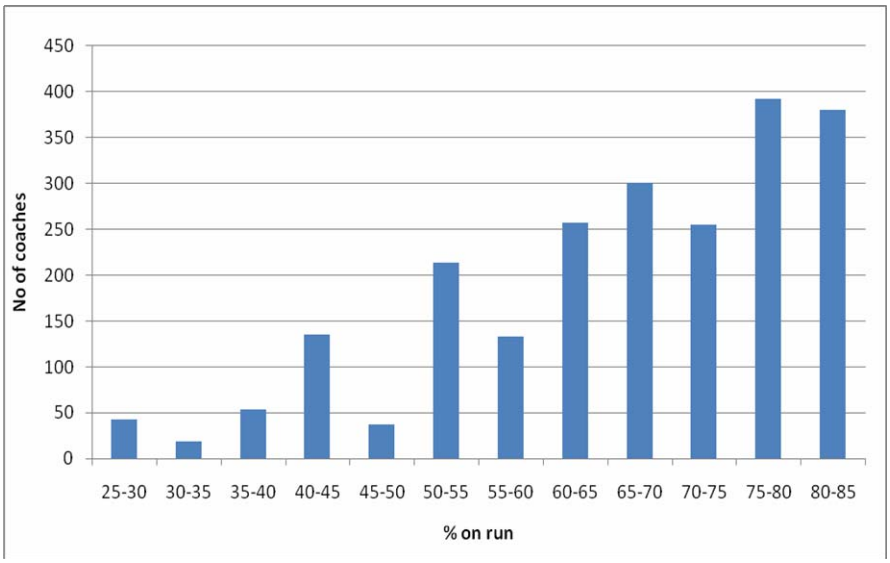


Exhibit 5: Distribution of parameters for weekly express/mails

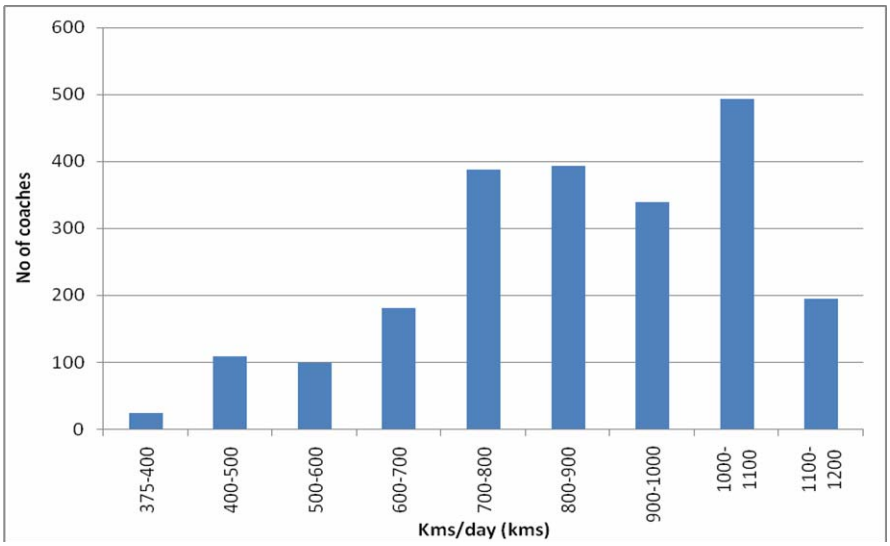
(a)

% of runtime	No of coaches
25-30	56
30-35	34
35-40	82
40-45	136
45-50	47
50-55	443
55-60	291
60-65	297
65-70	305
70-75	173
75-80	181
80-85	172
Total	2,217



(b)

Kms/day	No of coaches
375-400	40
400-500	149
500-600	101
600-700	354
700-800	648
800-900	399
900-1000	190
1000-1100	243
1100-1200	93
Total	2,217



(c)

Average speed (kms/hr)	No of coaches
40-45	91
45-50	204
50-55	950
55-60	611
60-65	181
65-70	18
70-80	162
Total	2,217

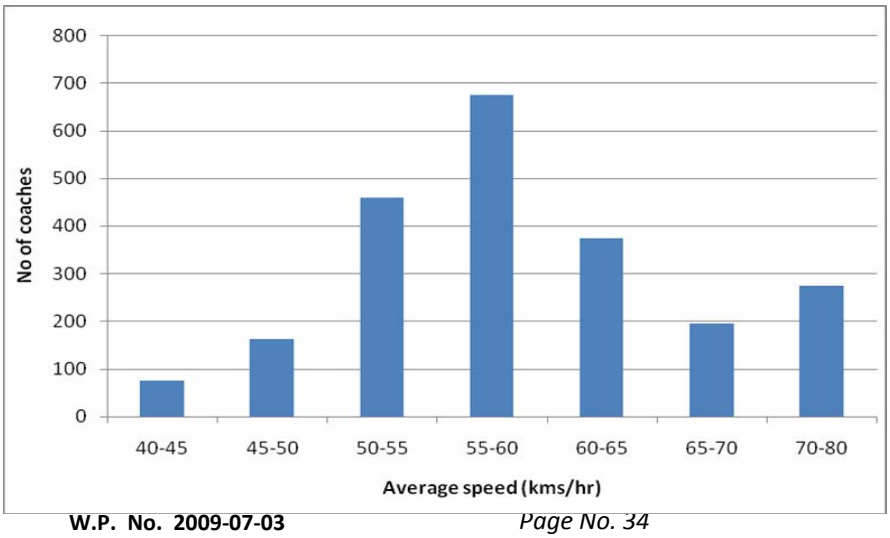


Exhibit 6: Matching of 'links in booklet' with 'rake cycles in list' for passenger trains

	Links broken into 2	**Links broken into 3**	**Link having 2 links**	**Link having 3 links**	**Link having 4 links**
Link no	167	175	185	192	189
Additions	1	2	1	2	3
Total additions	**9**				

Rake cycles in the list: 50
Links in rake link booklet: 41
Rake cycles in the list = Links in the booklet+Total additions= 50
Addition: Number of new rake cycles formed from that link.

Exhibit 7: Rake cycle analysis for passenger trains

S No	Link no	No of trains	Train numbers	Link Kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Hrs idle	% of runtime	Coach % of runtime	Kms/ day	Coach kms/day	Avg speed	Owning railway	Primary maintenance
1	151	2	355, 356	368	13	1	13	24	9.42	14.58	39.25	510	368	4,784	39.07	SCR	HYB
2	152	4	329, 330, 545, 546	1,490	11	3	33	72	50.00	22.00	69.44	2,292	497	16,390	29.80	SCR	HYB
3	153	4	321-324	1,150	19	2	38	48	28.33	19.67	59.02	2,243	575	21,850	40.59	SCR	KZJ
4	154	4	335, 336, 357, 358	1,182	15	3	45	72	34.67	37.33	48.15	2,167	394	17,730	34.09	SCR	KZJ
5	155	2	345, 346, 357, 358	268	3	2	6	48	9.42	38.58	19.63	118	134	804	28.45	SCR	KZJ
6	156	13	251-254, 522, 527, 528, 537, 538, 567-570	1,672	8	4	32	96	43.75	52.25	45.57	1,458	418	13,376	38.22	SCR	GTL
7	157	12	525, 526, SM4, MS4, 535, 536, 547-550, 573, 574	2,088	10	4	40	96	50.92	45.08	53.04	2,122	522	20,880	41.01	SCR	GTL
8	158	6	197, 198, 211, 212, 529, 530	548	5	2	10	48	14.91	33.09	31.06	311	274	2,740	36.75	SCR	TPTY
9	159	8	337, 338, 441, 442, 437, 438, 477, 478	1,572	12	4	48	96	45.51	50.49	47.41	2,276	393	18,864	34.54	SCR	BZA
10	160	2	471, 472	1,066	18	2	36	48	34.17	13.83	71.19	2,563	533	19,188	31.20	SCR	BZA
11	161	4	353, 354, 423, 424	942	11	2	22	48	25.25	22.75	52.60	1,157	471	10,362	37.31	SCR	BZA
12	162	2	431, 432	430	15	1	15	24	10.17	13.83	42.38	636	430	6,450	42.28	SCR	BZA
13	163	6	WM1-WM6	72	10	1	10	24	2.92	21.08	12.17	122	72	720	24.66	SCR	On Every Sunday
14	164	16	402, 403, 407-410, 416-420, 479, 480, 485, 486, 498	1,466	10	4	40	96	44.76	51.24	46.63	1,865	367	14,660	32.75	SCR	NS

S No	Link no	No of trains	Train numbers	Link Kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Hrs idle	% of runtime	Coach % of runtime	Kms/ day	Coach kms/day	Avg speed	Owning railway	Primary maintenance
15	165	8	400, 401, 435, 436, 459, 460, 462, 463	988	10	3	30	72	29.65	42.35	41.18	1,235	329	9,880	33.32	SCR	NS
16	166	4	207, 208, 273, 274	2,348	16	4	64	96	69.17	26.83	72.05	4,611	587	37,568	33.95	SCR	COA
17	167	4	425, 426, 429, 430	1,442	8	3	24	72	41.00	31.00	56.94	1,367	481	11,536	35.17	SCR	MTM & NS
18	167	6	425, 426, 429, 430, 464, 465	1,296	4	3	12	72	35.84	36.16	49.78	597	432	5,184	36.16	SCR	MTM & NS
19	168	6	319, 320, 351, 352, 357, 358	1,770	19	3	57	72	50.41	21.59	70.01	3,991	590	33,630	34.83	SCR	KCG
20	169	4	439, 440, 523, 524	2,042	12	3	36	72	58.25	13.75	80.90	2,912	681	24,504	35.06	SCR	KCG
21	170	13	328, 331, 332, 341, 342, 359, 360, 385, 386, 549, 550, BGK-BJP1, BJP-BGK1	2,285	13	4	52	96	57.52	38.48	59.92	3,116	571	29,705	38.13	SCR	KCG
22	171	8	405, 406, 427, 428, 481, 482, 571, 572	2,482	14	4	56	96	65.00	31.00	67.71	3,792	621	34,748	38.18	SCR	GNT
23	172	7	541, 542, 557, 558, 561, 562, 590	2,176	11	4	44	96	49.91	46.09	51.99	2,288	544	23,936	43.60	SCR	NED
24	173	6	501-504, 557, 558	326	3	2	6	48	9.76	38.24	20.33	122	163	978	33.40	SCR	NED

S No	Link no	No of trains	Train numbers	Link Kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Hrs idle	% of runtime	Coach % of runtime	Kms/ day	Coach kms/day	Avg speed	Owning railway	Primary maintenance
25	174	8	531, 532, 539, 540, 551-554	1,352	9	4	36	96	36.84	59.16	38.38	1,382	338	12,168	36.70	SCR	PAU
26	175	11	347-350, 512, 515, 516, 563, 564, 593, 594	4,556	11	7	77	168	123.08	44.92	73.26	5,641	651	50,116	37.02	SCR	PAU
27	175	3	512, 563, 564	683	2	2	4	48	18.75	29.25	39.06	156	342	1,366	36.43	SCR	PAU
28	175	2	349, 350	1,162	1	2	2	48	31.58	16.42	65.79	132	581	1,162	36.80	SCR	PAU
29	176	12	103-106, 115-118, 195, 196, 6115, 6116	1,598	9	4	36	96	38.90	57.10	40.52	1,459	400	14,382	41.08	SR	MS
30	177	6	303, 304, 433, 434, 581, 582	3,650	12	6	72	144	106.91	37.09	74.24	5,345	608	43,800	34.14	SWR	SBC
31	178	7	531A, 533, 534, 1321, 1322, 1551, 1552	2,550	9	4	36	96	68.92	27.08	71.79	2,584	638	22,950	37.00	CR	PUNE
32	180	2	189, 190	284	8	1	8	24	7.83	16.17	32.63	261	284	2,272	36.27	SR	MAS
33	181	2	193, 194	146	10	1	10	24	3.67	20.33	15.29	153	146	1,460	39.78	SR	MAS (FRI)
34	182	4	213, 214, 6203, 6204	1,292	18	2	36	48	32.67	15.33	68.06	2,450	646	23,256	39.55	SWR	MYS
35	183	20	M151, M153-M167, M169-M172	1,986	12	4	48	96	49.99	46.01	52.07	2,499	497	23,832	39.73	SCR	RJY
36	184	2	M179, M180	330	16	1	16	24	8.17	15.83	34.04	545	330	5,280	40.39	SCR	RJY
37	185(a)	10	D151-D160	2,142	6	1	6	168	53.52	114.48	31.86	191	306	1,836	40.02	SCR	BZA
38	185(b)	10	D151-D160	2,586	6	1	6	168	62.53	105.47	37.22	223	369	2,217	41.36	SCR	BZA
39	186	4	D145-D148	1,440	3	1	3	168	49.50	118.50	29.46	88	206	617	29.09	SCR	BZA

S No	Link no	No of trains	Train numbers	Link Kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Hrs idle	% of runtime	Coach % of runtime	Kms/ day	Coach kms/day	Avg speed	Owning railway	Primary maintenance
40	187	43	D101-D113, D113A, D114, D114A, D115-D133, D137-D144	2,413	9, 8	6	52	144	80.08	63.92	55.61	2,892	402	20,913	30.13	SCR	BZA
41	188	10	D161-D170	1,040	6	2	12	48	28.08	19.92	58.50	702	520	6,240	37.04	SCR	BZA
42	189(a)	14	SU1, SU3, UF1-UF5, FU1-FU5, US2, US3	238	3	1	3	24	7.17	16.83	29.88	90	238	714	33.19	SCR	MLY
43	189(b)	4	585, 586, SU2, US1	200	3	1	3	24	4.92	19.08	20.50	62	200	600	40.65	SCR	MLY
44	189(c)	14	SB1, SB4, SB5, BS1, BS4, BS5, SMB1, MBS1, SM3, SM5, SM6, MS3, MS5, MS6	334	3	1	3	24	12.42	11.58	51.75	155	334	1,002	26.89	SCR	MLY
45	189(d)	13	SM1, MS1, SMJ1, MJB1, BS2, BS3, SB3, SMB2-SMB4, MBS2-MBS4	358	3	1	3	24	12.50	11.50	52.08	156	358	1,074	28.64	SCR	MLY
46	190	6	575-580	424	3	1	3	24	9.75	14.25	40.63	122	424	1,272	43.49	SCR	MLY
47	191	2	RC1, RC2	90	1	1	1	24	4.00	20.00	16.67	17	90	90	22.50	SCR	CCT
48	192(a+b)	23	SF1, FL1, FL4, FL5, FL7*-FL9*, FL11, FL14, LF2, LF5, LF6, LF8*-LF10*, LF13, LF17, HL17, HL22, LS1, LS2, FH2, SH2	872	9	2	18	48	25.16	22.84	52.42	944	436	7,848	34.66	SCR	SC

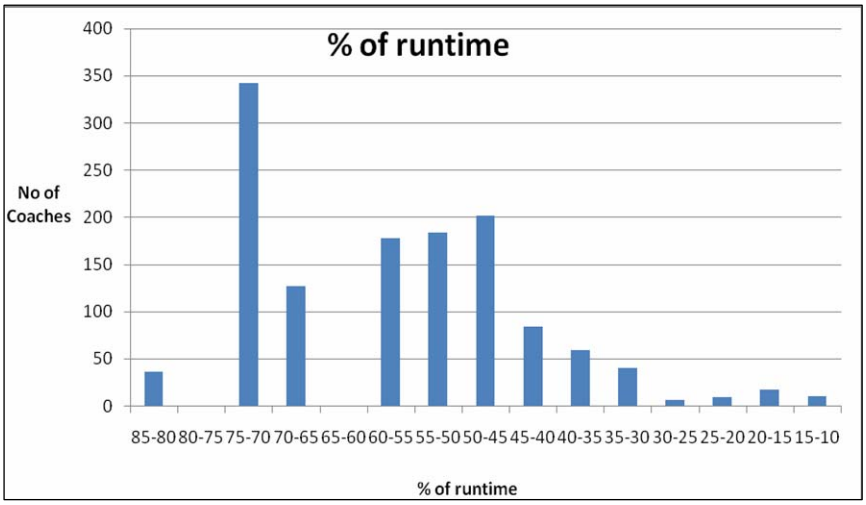
S No	Link no	No of trains	Train numbers	Link Kms	Coaches	No of rakes	No of coaches	Total hrs	Hrs on run	Hrs idle	% of runtime	Coach % of runtime	Kms/ day	Coach kms/day	Avg speed	Owning railway	Primary maintenance
49	192 (c+d +e+f)	53	SF3, FS3, FL2, FL3, FL6, FL10, FL12, FH1, FH3, HF1, FS1*, SH1*, HL1, HL2, HL4, HL5, HL7, HL8, HL10*, HL11*, HL13*, HL15, HL16, HL18, HL19*, HL20, HL21, HL23-HL25, LH2, LH3, LH5, LH6, LH8, LH9*, LH11*, LH12*, LH14-LH21 ,LF1, LF3, LF4, LF7*, LF12, LF14*, LF15	1,426	6	4	24	96	43.42	52.58	45.23	1,086	357	8,556	32.84	SCR	SC
50	192(g)	16	LH1, LH4, LH7, LH10*, LH13*, HL3, HL6, HL9*, HL12*, HL14*, FS2, SF2, FL13, FL15, LF13, LF16	432	6	1	6	24	12.75	11.25	53.13	319	432	2,592	33.88	SCR	SC
TOTAL							**1,293**					**73,521**		**638,082**			

Total coaches	**=**	**1,293**
Total coach kms/day	**=**	**638,082**
Total coach % of runtime	=	**73,521**
Daily weighted average for kms/day	**=**	**493.49**
Daily weighted average for % of runtime	**=**	**56.86**

Exhibit 8: Distribution of parameters for passenger trains

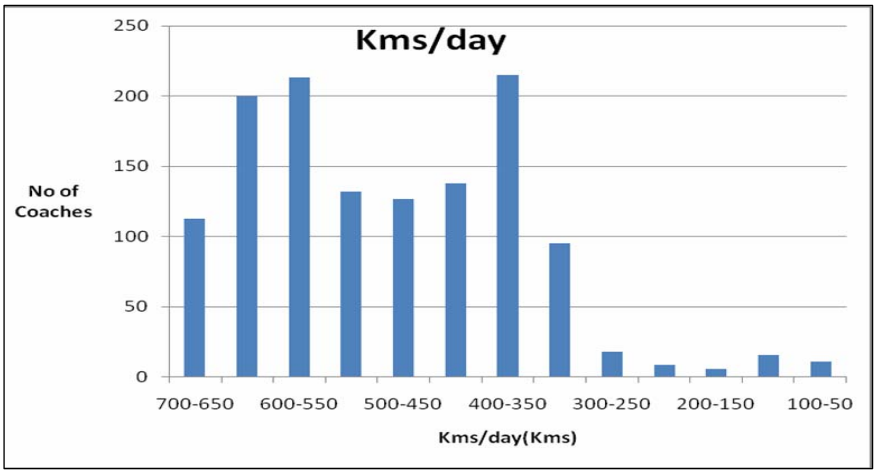
(a)

% of runtime	No of coaches
85-80	36
80-75	
75-70	342
70-65	127
65-60	
60-55	178
55-50	184
50-45	201
45-40	84
40-35	59
35-30	40
30-25	6
25-20	9
20-15	17
15-10	10
Total	1,293



(b)

Kms/day	No of coaches
700-650	113
650-600	200
600-550	213
550-500	132
500-450	127
450-400	138
400-350	215
350-300	95
300-250	18
250-200	9
200-150	6
150-100	16
100-50	11
Total	1,293



(c)

Average speed (kms/hr)	No of coaches
45-40	207
40-35	526
35-30	501
30-25	48
25-20	11
Total	1,293

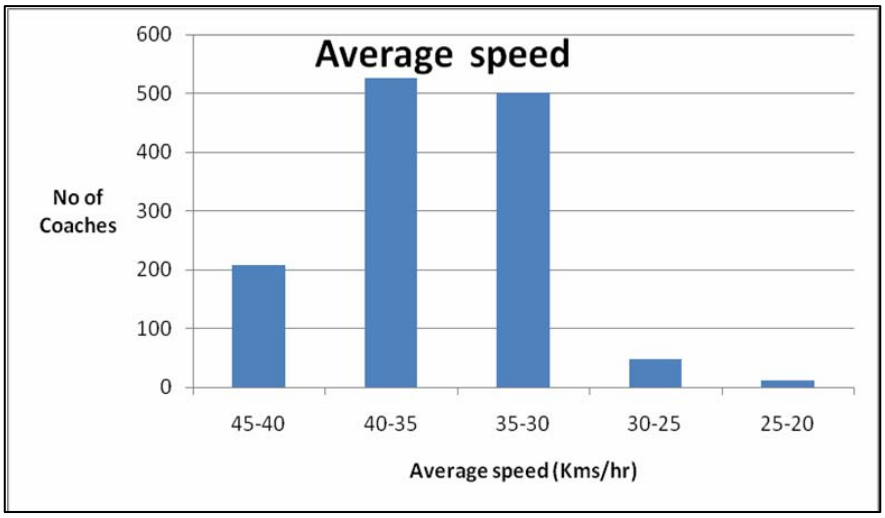
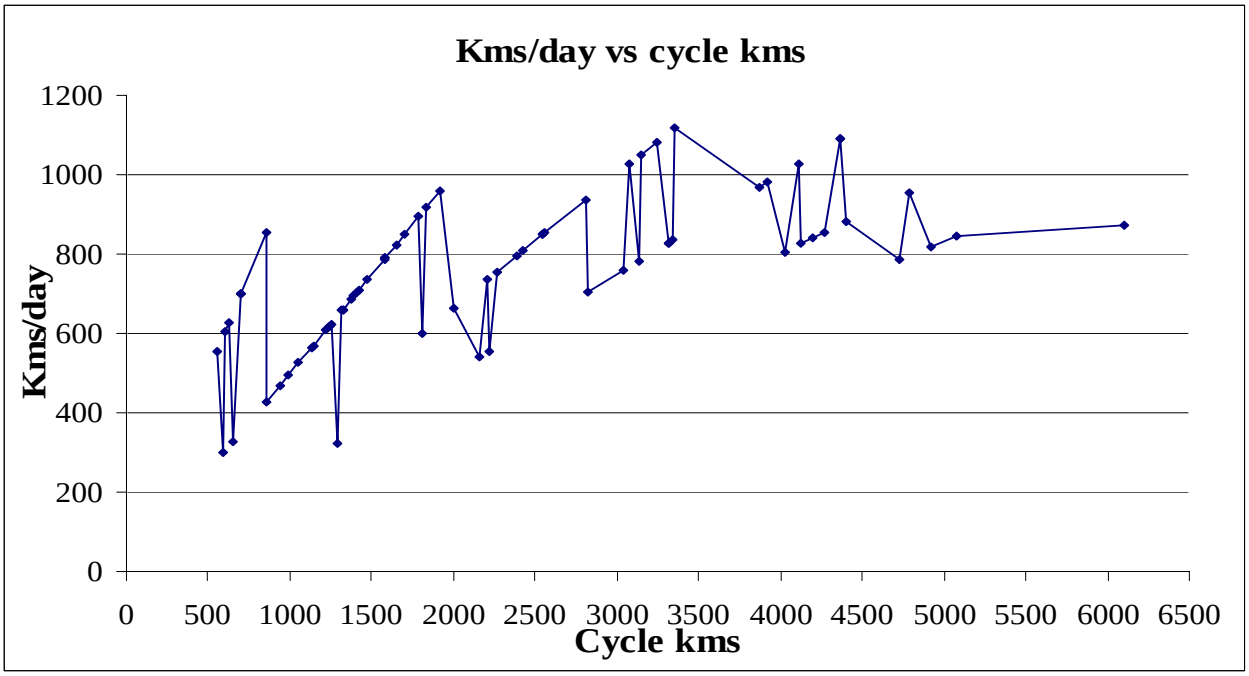


Exhibit 9:
Trend of kms/day for increasing cycle kms

Daily express/mails



Weekly express/mails

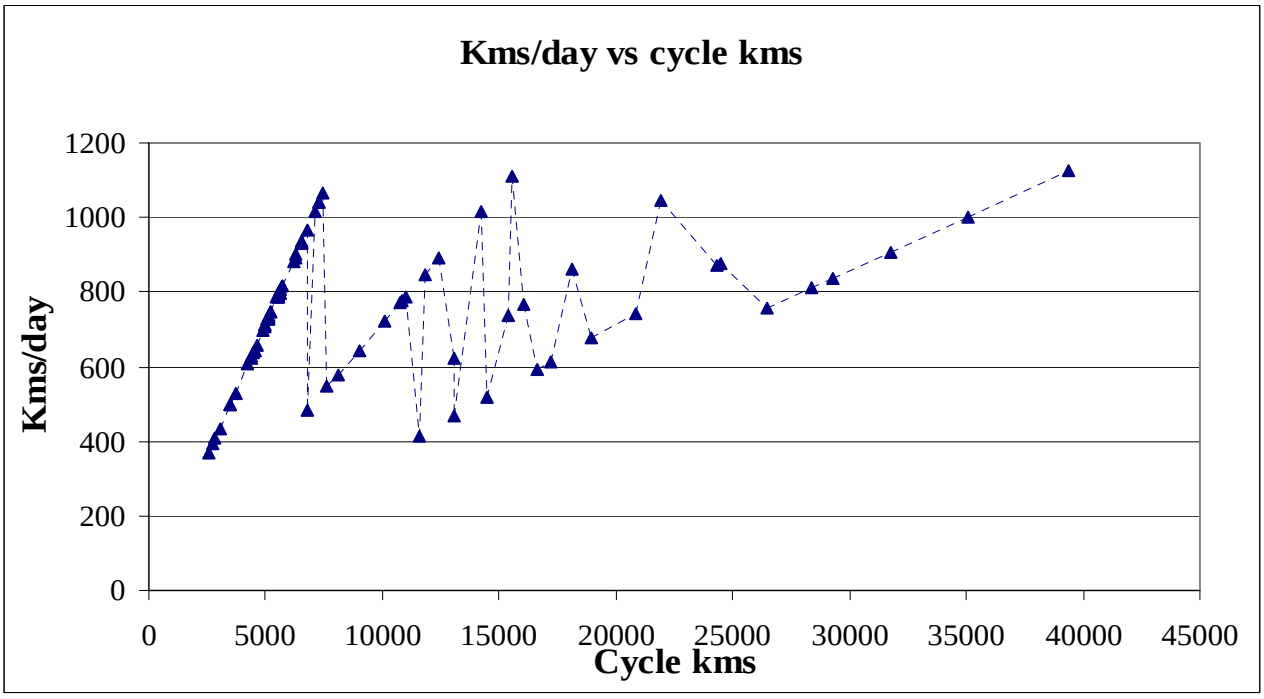
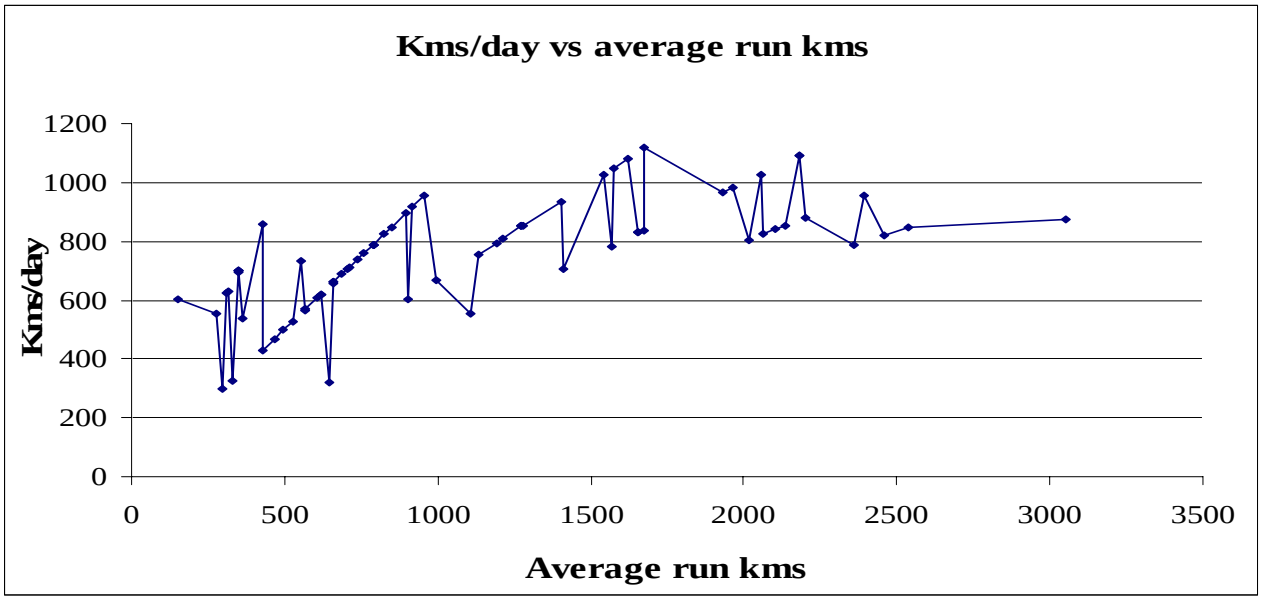


Exhibit 10:
Trend of kms/day for increasing average run

Daily express/mails



Weekly express/mails

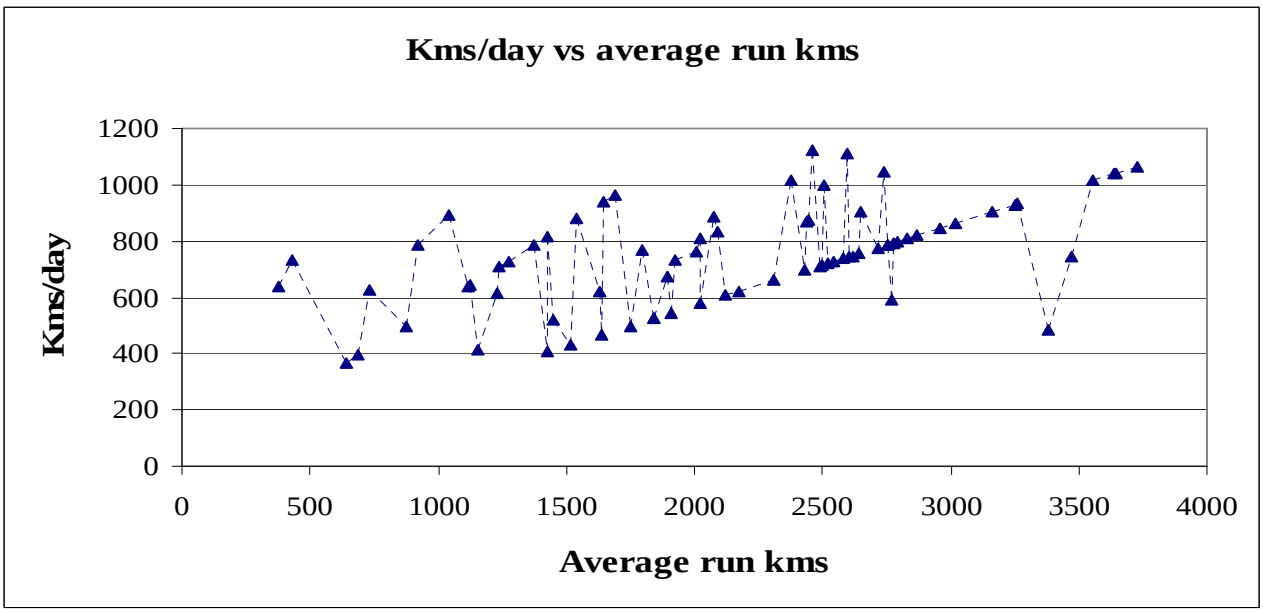


Exhibit 11:
Comparison between daily and weekly express/mails