Transportation Management

Lesson 3

Freight (Goods) Operation

Introduction

3.101 Transportation of goods from one place to other is a basic necessity for the economic and industrial progress of a country. Railways play a vital role in the surface transport and carry bulk of essential commodities from producing to consuming areas. Without rail transport the thermal power houses, steel plants, oil refineries, cement and fertilizer plants and practically all other industries will come to a grinding halt. Also the transportation of agricultural products from surplus to deficit areas will become extremely difficult. Hence, the Indian Railways constitute a very vital basic infra-structure for fulfilling the objective of having a prosperous and social welfare state.

Growth of Freight Traffic on the Indian Railway

3.102 The growth of freight traffic on the Indian Railways has been spectacular as will be seen from table 3.102 given below:-

Table 3.102

Revenue Earning Traffic on the Indian Railways(excl. KRCL)						
Year	**Tonnes (Millions)**	**Index (1950-51 =100)**	**Net tonne kms (Million)**	**Index (1950-51 =100)**	**lead (kms.)**	**Index (1950-51) =100)**
1950-51	73.20	100.0	37,565	100.0	513	100.0
1960-61	119.80	163.7	72,333	192.6	603	117.6
1970-71	167.90	229.4	110,696	294.7	659	128.5
1980-81	195.90	267.6	147,652	393.1	754	147.0
1990-91	318.40	435.0	235,785	627.7	741	144.4
2000-01	473.50	646.9	312,371	831.5	660	128.7
2001-02	492.50	672.8	333,228	887.1	677	132.0
2012-13	1,008.09	1,377.2	649,645	1,729.4	644	125.5
2013-14	1,051.64	1,436.7	665,810	1,772.4	633	123.4
2014-15	1,095.26	1,496.3	681,696	1,814.7	622	121.2
2015-16	1,101.51	1,504.80	654,481	1,742.26	594	115.79

(Source: Indian Railways Year Book 2015-16)

Main Commodities Carried

3.103 Essential commodities constitute bulk of freight traffic on the Indian Railways as will be seen from table 3.103

Table 3.103

Commodity-wise Tonnagae of revenue Traffic loaded in 2012-16

	Tonnes carried* (Millions)		Absolute Variation over last year	Percentage to total
	2014-15	**2015-16**		
Coal				
i) for steel plants	53.91	**52.06**	-1.85	4.73
ii) for washeries	0.99	**1.09**	0.1	0.10
iii) for thermal power houses	367.29	**371.81**	4.52	33.75
iv) for other public users	123.62	**126.87**	3.25	11.52
Total	545.81	**551.83**	6.02	50.10
Raw material for steel plants except iron ore	18.28	**20.29**	2.01	1.84
Pig iron and finished steel				
i) from steel plants	28.25	**29.59**	1.34	2.69
ii) from other points	14.59	**15.20**	0.61	1.38
Total	42.84	**44.79**	1.95	4.07
Iron ore				
i) for export	2.49	**2.13**	-0.36	0.19
ii) for steel plants	69.43	**78.63**	9.2	7.14
iii) for other domestic users	40.85	**36.18**	-4.67	3.28
Total	112.77	**116.94**	4.17	10.62
Cement	109.80	**105.35**	-4.45	9.56
Foodgrains	55.47	**45.73**	-9.74	4.15
Fertilizers	47.41	**52.23**	4.82	4.74
Mineral Oil (POL)	41.10	**43.24**	2.14	3.93
Container service				
i) Domestic containers	10.50	**9.04**	-1.46	0.82
ii) EXIM containers	37.88	**36.79**	-1.09	3.34
Total	48.38	**45.83**	-2.55	4.16
Balance other goods	73.40	**75.28**	1.88	6.83
Total	1095.26	**1101.51**	6.25	100

* Excludes loading on Konkan Railway.

Railway, a Superior Mode of Surface Transport

3.104 Railways are a superior mode of surface transport as compared to road transport, especially for bulk commodities in train-loads, for the following reasons:

(a) Railways are more energy efficient:-
Railways can carry six times the traffic with the same diesel oil as compared to road vehicles. Also during 2008-09; 56.5% of gross tonne-kms were carried by electric traction saving huge quantity of precious diesel oil.
(b) Railways causes less pollution.
(c) Railways make better land use.

Investments for Developing Transport Capacity of Indian Railways

3.105 It is, therefore, in overall interest of the country that the railways carry maximum quantum of freight traffic which is economical to be carried by rail. Hence it will be in the national interest to make necessary investments in increasing transportation capacity of railways to meet the growing demands of freight traffic adequately.

Changing Pattern of Freight Traffic

3.106 Earlier the percentage of general goods traffic was appreciable, and considerable quantum of freight traffic was carried in piecemeal wagon loads. Even small traffic, i.e. less than wagon load traffic carried by rail was substantial. Booking and transport of smalls, and piecemeal wagon load traffic was not economical for the railways. Hence with progressive growth of freight traffic, railways are now carrying most of the freight traffic in point-to-point train loads. Bulk commodities viz. Coal, Iron Ore and other Ores, Iron and Steel, cement, POL, Fertilizers, Limestone and Dolomite, Stones, Food grains, Salt and Sugar constituted 91.12% of total tonnes-originating traffic during 2008-09 (Source : Indian Railways year Book 2008-09). So far as smalls traffic is concerned, Indian Railways have completely discontinued booking of the same since December 1994.

3.107 Even the quantum of piecemeal wagon-load traffic has come down drastically. Collection, movement and distribution of such traffic meant lot of shunting operations at loading/unloading points and at intermediate goods marshalling yards. These wagons suffered lot of detentions in yards which were also nicknamed as graveyard of wagons. Railways are, therefore, now concentrating more and more on moving the freight traffic in point-to-point train loads needing no shunting at intermediate yards. The importance of goods marshalling yards has very much come down during the recent past years and many of such yards have already been closed down.

Areas of Freight Operation

3.108 The main areas of management of freight operation on a rail-road system are:-
(a) Loading/unloading points.
(b) Sections where the trains are run.

(c) Intermediate yards.
(d) Control organization

The management of these areas is discussed hereafter.

3.2 Units of Loading and Kinds of Goods Trains.

3.201 Railways now accept goods traffic for booking in the following modes:-

(a) In wagon loads.

(b) In train loads.

(c) In Domestic and ISO containers

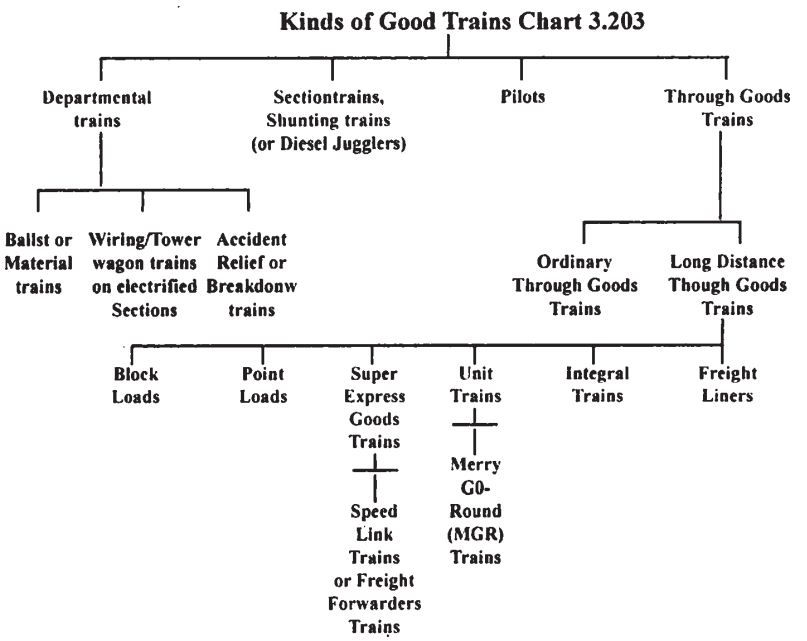
As has been mentioned earlier, prior to Dec. 1994, Indian Railways were also accepting booking of smalls (less than wagon_load traffic). This being very cumbersome and uneconomical for the railways has since been discontinued.

Freight Forwarders

3.202 Railways appoint Freight Forwarders who can collect goods traffic from such merchants who are not in a position to offer full wagon load or train load traffic. The Freight Forwarders can then group such traffic into full wagon or train loads. Railways provide suitable monetary incentives to the Freight Forwarders to organize such traffic. This helps the railways to convert piecemeal traffic in wagon loads and train-loads traffic which is more economical for railways to carry.

Kinds of Goods Trains

3.203 The various types of goods trains are indicated in the chart 3.203 below:



3.204 Trains carrying goods traffic are described here briefly:-

(a) **Shunting Trains/ Diesel Jugglers :** Earlier, when smalls were allowed to be booked from roadside stations, they were cleared by Smalls Quick Transit (SQT) trains. These trains were also called 'Section and Trainship' trains. As booking of smalls has now been discontinued wagons from intermediate stations are now cleared by diesel loco operated shunting trains which are know as diesel jugglers. These trains also clear any sick/hot axle wagons detached from through goods trains at roadside stations.

(b) **Pilots :** These are trains which supply or clear a string of wagons to and from sidings to the nearest goods yard. It may be a purely shunting move if no block working is involved.

(c) **Through Goods Trains :** These are goods trains which do not require any shunting at intermediate stations between terminals or yards. These can be further classified as follows:-

(1) **Block Trains :** Such a train by – passes one or more marshalling yards without any shunting.

(2) **Point Load :** In this case the entire train is booked for unloading at a particular point, such as a coal train to a power house.

(3) **Speedlink and Freight Forwarder Trains :-** Such trains consolidate piecemeal wagon load traffic into full train loads between specified pair of stations.Through such trains railways can attract high rated wagon load traffic which would otherwise be moved by road.

(4) **Unit Trains :-** Such trains are quite popular in U.S. Railroads. Here the railways enter into agreement with major bulk users who are required to offer a minimum guaranteed traffic between a pair of points. Railways clear such traffic by trains which run to a fixed schedule between the pair of points. The wagons may be of special type and may be owned by the rail user himself. The railways charge the rail user a special rate mutually agreed upon for haulage of such traffic. Loading/unloading at both terminals is mechanized. The wagon utilization on such trains is very high and as such cost of transportation as well as inventory carrying costs by rail users are minimized. In case of Integral trains, even the locomotives are the integral part of such trains.

(5) **Freightliners :-** These are trains which carry only container traffic between Inland container Depots and ports. They can also be run from port to port. These are important trains for export and import traffic in ISO containers.

3.3 Line Or Section Capacity

3.301 With progressive growth of traffic the railways are required to run more and more number of trains on various sections. However, there is a limit to the number of trains that could be

run on a given section, i.e. a given section has capacity to run only a limited number of trains and we call this as the section or Line Capacity of the given section. Formal definition of the Line/Section Capacity is, however, given below:-

Definition of Line or Section Capacity

3.302 Line capacity is defined as "the number of trains which can be run on a given section in 24 hours".

Calculation of Line Capacity

3.303 A section for which we calculate the line capacity is a portion of railway route between two yards or major terminals. A section will, therefore, have several block stations and block sections between its two ends. The intermediate block sections may vary in lengths and grades and may, therefore, have varying running times for the same train. The intermediate block section which the trains take maximum (longest) time to cover (negotiate or pass) is known as the 'Critical Block Section'.

Scott's Formula

3.304 Scott's Formula, which is the simplest and perhaps the oldest for calculating the line capacity, is given below:

$$C = \frac{1440}{T+t} E$$

Here, C = Section Capacity of the given section.

T = Time taken in minutes by the slowest train to cover the 'Critical Block Section'

t = Block operation time.

E = Efficiency Factor

3.3.05 On Single Line sections E is normally taken as 70% and the capacity C by the above formula gives total number of trains that can be run in 24 hrs. over the given section taking the sum of both Up and Down direction trains.

3.306 On Double line section, E is taken as 80% and C gives number of trains that can be run in each direction separately.

3.307 There are other mathematical formulae such as Ex-GIP formula, Steinback Formula etc. which could be used for calculating line capacity. However, for practical purposes none of these formulae are normally used and in practice the line capacity is calculated by 'Charting Method'.

Charting Method for Calculating Line Capacity

3.308 According to the Charting Method, the Scheduled Mail/Express and Passenger trains are first plotted on a Time-Distance graph by experienced controllers for the section

concerned. After that as many goods train paths are inserted as possible. Paths which may take unduly long time and may be very uneconomical are not considered for inclusion.Time allowances and tolerances for various operations involved in trains working are duly taken into account while charting these paths. However, as per Railway Board's directive the line capacity arrived at by charting method should not be less than calculated by the simple Scott's formula.

Computer Simulation

3.309 The RDSO has evolved Computer Simulation method for calculating line capacity of a given section. In the long run this should provide us good guidance for determining line capacities for various sections on the Indian Railways. Computer Simulation methods are now being used all over the world, specially for planning purposes.

Measures for Increasing Line Capacity

3.310 We can easily observe from the Scott's Formula that the line capacityof a given section could be increased by:-

(a) Reducing 'T'

(b) Reducing 't'

(c) Increasing 'E'

Reducing 'T'

3.311 'T' is the running line of slowest train over the Critical Block Section. It can be reduced by following measures:-

(a) Increasing speeds of trains by dieselization, electrification and by improvements in track and signalling.

(b) Reducing running time by providing additional crossing stations on single line and by providing 'C' class stations on Double line. In case the Critical Block Section is located on a track which is having continuous gradient, a crossing station with ghat type layout may be provided, as given in the diagram below:-

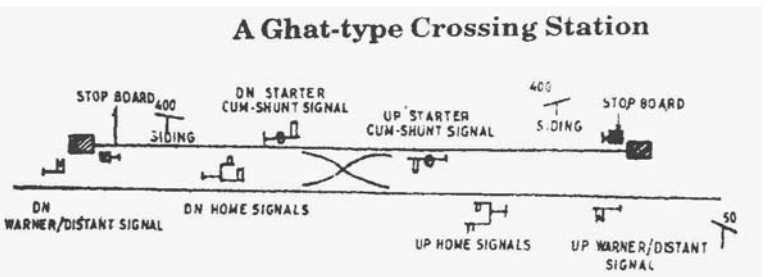


FIG. ghat type station

A Ghat-type Crossing Station

Reducing 't'

3.312 't' is the block operation time. This can be reduced by the following measures:-

(a) Providing token less block working.

(b) Providing Panel interlocking.

(c) Providing Centralised Traffic Control.

(d) Providing Automatic Signalling.

Increasing 'E'

3.313 'E' is the efficiency factor. This can be improved by the following measures:-

(a) Improving efficiency of staff by better training, better leadership and management.

(b) Bringing about time table improvements such as cutting out loose timings, grouping of similar speed trains.

(c) Improving station layouts and providing additional loop lines wherever required.

Saturated Sections

3.314 When the utilization of section capacity of over 80%, the section should be considered as saturated as any further increase in the number of trains results in drastic drop in average speeds, and there area frequent congestions.

3.315 On a single line section when measures described above have already been taken and the traffic is still increasing, we then have to go for patch-doubling or full doubling of the section.

3.316 Investments on increasing line capacity may often be quite high and, therefore, before embarking upon such an expenditure, a careful financial appraisal must be done and the alternative which gives best returns in the long run should be adopted.

3.317 It is desirable to adopt following sequence in taking measures to increase line capacity:-

(i) Bringing about organizational improvements.

(ii) Bringing about signaling and interlocking improvements such as standard III interlocking, token-less working, panel interlocking etc.

(iii Providing additional crossing stations.

(iv) Patch-doubling or full doubling.

3.4 Throughput

3.401 In a developing economy railways are required to handle progressively increasing quantum of traffic. This could be achieved by running more and more number of

trains and also by increasing the 'load per train'. Often huge investments on line capacity works can be avoided by running longer and heavier trains. In simple words we are not concerned merely with the number of trains but with the total quantum of traffic which we carry on a given section.

Definition of Throughput

3.402 Throughput (per day) of a given section is defined as the total quantum of traffic that can be carried on the section in 24 hours. The through put of goods traffic could be measured in terms of :-

(i) Number of wagons (4 wheelers equivalent)

(ii) Gross tonne-Kms.

(iii) Net tonne-Kms.

3.403 For day to day working we normally talk in terms of number of wagons. However, as a commercial undertaking our emphasis is on net-tonne kms. Of freight traffic.

3.404 Passenger traffic through put may be expressed in terms of number of passengers or in terms of passenger-Kms. Carried over the section in 24 hours.

Increasing Throughput

3.405 Throughput of a given section can be increased by:-

(a) Running more number of trains.

(b) Increasing load per train.

We have already discussed (a) earlier when dealing with line capacity. Here we will discuss increasing load per train.

Increasing Load per Train

3.406 Load per train could be increased by:-

(a) Using more powerful locomotives or multiple locomotives.

(b) Using high capacity wagons.

(c) Strengthening track.

(d) Increasing loop capacities.

Using Powerful/Multiple locomotives

3.407 Freight traffic on Indian Railways now entirely being hauled by diesel or electric traction. Diesel traction which, accounted for 43.5% of gross tonne-kms in 2008-09 uses WDM2 & WDG4 locomotives. The Horse power of WDM2 Loco is 2600 and of WDM4 is 4000 HP. Inbetween other WDG locos have 3100 HP.

3.408 WAG4, WAG5, WAG7 & WAG 9 are most widely used electric locomotives on the

Indian Railways. Their horse powers are 3150, 4000, 5000 & 6000 respectively.

3.409 Very heavy train loads can be carried by multiple operations of diesel or electric locomotives, but the constraints are loop capacities, strength of couplings, braking and signaling systems and the communications between the drivers.

Using High Capacity Wagons

3.410 There has been tremendous progress on the Indian Railways in improving the wagon designs. We are now producing high capacity wagons with CBC couplings and air braking systems. A train with box 'N' Mark II or BOBR-Mark II can carry as much as 5400 t gross load within the standard loop capacity of 686 metres in flat territory and loop capacity of 715 m in graded sections. BOX 'N' (open), BCN (Covered), BOBR and other new type of Wagons are equipped with CBC and air brakes and have helped greatly in increasing the throughput on important routes. Now BOXN HL wagons are designed for 25 tonnes axle load and carry 5900 tonnes trailing load in a train. They are presently used for transportation of iron ore.

Strengthening the Track

3.411 Track improvements will include the following:-

(a) Increasing Axle load restrictions from 20.3t to 22.9t on very heavy density routes. For running rolling stock with 22.9t axle loads at 80 Km per hour speed we require the track to be laid with minimum 60 Kg rails (LWR) with sleeper density of 1660/Km. These can help us to design and run still higher capacity wagons on heavy density routes. Most of high density routes are laid with such track design.

(b) Track loading capacity:- Presently on BG main routes the track loading density is restricted to 7.67t per metre. High capacity wagons such as BOX 'N' and BOB 'R' have been designed to conform to this. This will increase to 8.25 tonnes/ meter for 25 tonnes axle load.

(c) Easing gradients can also help in running heavier loads.

(d) The bridges have also to be strengthened for taking heavier loads at maximum permissible speeds.

(e) Liberalising standard moving dimensions.

Increasing Loop Capacities

3.412 Presently, on the BG, we are having 686m as the standard loop CSR. We can run longer trains if the loop capacities could be increased. However, this will need extensive remodeling of stations and yards all over the railway system which will involve massive investments. We have, perhaps, to live with this constraint for quite some time to come.

Conclusion

3.413 Considerable savings on line capacity words could be achieved by running heavier train loads. Indian Railways have done good work in designing high capacity wagons and going in for more powerful locomotives. There is, however, considerable scope for going further in this direction.

3.5 Goods Marshalling Yards

What is a Goods Marshalling Yard (Definition)

3.501 A Goods Marshalling Yard is a place where goods trains are received, sorted out, reformed and dispatched.

3.502 Example of a few bigger yards on the Indian Railways are Moghul Sarai, Andal, Bhusaval, Itarsi, New Katni, Tughlakabad, Bondamunda, Bhilai, Vijayawada etc. However with running of unit trains most of these yards have been closed.

Declining Importance of Goods marshalling Yards

3.503 In the past when substantial quantum of freight traffic was being carried in piecemeal wagon loads, such yards played very important role in sorting and reforming goods trains carrying wagons for different destinations. However, now the railways are carrying most of the traffic in point-to-point train loads which do not require any sorting or marshalling enroute. Hence most of the yards have since been closed down.

Types of Goods Yards

3.504 Goods yards may be classified as:-

(a) Flat Yards.

(b) Hump yards.

(c) Gravity yards.

3.505 In flat yards sorting is done by pull and push method. On the metre gauge such yards are common. In hump yards, a hump having suitable profile, is provided. For sorting of wagons on a train, a shunting locomotive pushes the train over the hump from where the wagons roll down on the nominated sorting lines with the force of gravity.

3.506 Gravity yards area yards having natural slope and sorting could be done by gravity itself.

Functions of a Marashalling Yard

3.507 The following functions are carried out in a goods yard:-

(a) Reception of incoming trains or pilots.

(b) Sorting of wagons destination or direction wise.

(c) Reformation of outgoing trains.

(d) Despatch of trains.

(e) Reception and despatch of through Block trains.

(f) Formation of section trains.

Reception of Trains

3.508 Trains are received in the yard following the procedure laid down in the 'Station Working Order' for the yard. If it is not a bypass block load, the train engine is released and the Number Taking Staff (TNCs) note down the tally of wagons destination wise. The Train Examiners (TXRs) carryout inspection of wagons and note down repairs required, if any.

Sorting of Trains

3.509 In case mixed loads, a shunting memo is prepared which indicates the sorting line number for each wagon or group of wagons, including sick wagons. Wagons are then uncoupled accordingly and a shunting loco then pushes the load over the hump at a slow regulated speed as per signals shown to him (In flat yards push and pull method is adopted).

3.510 The uncoupled wagons roll down the hump. Appropriate route is set for each cut so that the same rolls down on the sorting line nominated for it as per the shunting memo. Speed on the sorting lines is checked with the help of skids and hand brakes. In mechanised marshalling yards mechanical retarders are used to check the speed suitably as the wagons roll down the hump.

Reformation of Outgoing Trains

3.511 Wagons collected on the nominated sorting lines are coupled up. Outgoing train's formation is completed according to prescribed marshalling orders and a goods brake-van is attached in the rear. If there is a separate departure yard the load is pulled to a vacant departure line.

Despatch of Reformed Trains

3.512 Trains are dispatched as per Trains Notice given by the control and following activities are involved:-

(a) Number taking of wagons and preparation of outgoing 'Vehicle Guidance' by the Trains Clerks (TNCs).

(b) Carriage and Wagon examination by TXR Staff. This will include ensuring minimum prescribed brake power on train. Vacuum exhausters are generally provided on the departure lines for this purpose.

(c) Attaching the outgoing locomotive on the load and creating minimum prescribed vacuum. Checking the continuity of vacuum.

(d) Taking charge of the train by the outgoing crew viz. the Driver and the Guard including loading of their boxes on the train.

(e) Obtaining line clear and starting the train following the procedure prescribed in the Station Working Orders.

Reception and Despatch of Through Block Trains:-

3.513 As mentioned earlier, most of the goods traffic on Indian Railways is now moving in point-to-point train loads. Such trains do not require any shunting at intermediate yards. Also if the load has been examined intensively at the starting point, no carriage and wagon examination need normally be done at an intermediate yard. The only activities for such trains at intermediate yards may include change of train crew, changing of locomotive, if required, or refueling of diesel loco.

Placement and Removal of Local Wagons

3.514 Local wagons will include sick wagons, load adjustment wagons, goods-shed or transship shed wagons, wagons for sidings served by the yard etc. Such wagons are generally collected on nominated sorting line or lines and if required sorting is carried out in a separate grid yard, if provided. It is desirable to have a proper time table for placement and removal of local wagons.

Formation of Section Trains

3.515 Hardly any section trains are run now because loading of piecemeal wagons has been curtailed drastically. However, diesel jugglers are required to be run for clearing off sick wagons or some stray special type wagons from intermediate stations, and for supply of empty wagons, if required for transhipment of sick detached wagons. Earlier section trains used to be formed according to the geographical order of stations on a section. However, in view of reduced quantum of such traffic such marshalling is not in practice now.

Area Control

3.516 Major yards on Indian Railways have been provided with 'Area Control' organisation. Area control is generally located on the top floor of the central building in the marshalling yard. One can have the bird's eye view of the entire yard from the 'Area Control' office. That is why sometimes its location is also called as the 'Crow nest'.

3.517 Area controllers in the Area Control office are connected telephonically to adjacent section control lines as well as on the administrative truck line to officers on the Division and HQs office. Local telephone net work connects them to other local officers, e.g. sick lines, loco shed etc.

3.518 Main job of Area Controllers is to keep a close laison with adjoining control boards, Deputy Controllers, Yard Masters and loco-shed etc. for reception and despatch of trains, connecting locomotives and ordering trains including train crews.

Layouts of Goods Marshalling Yards

3.519 As mentioned earlier, most of the smaller yards have since been closed. However, major yards are still functional, though with reduced work. The various constituents of the layout of major marshalling yards are described below.

Reception Yard

3.520 The yard may have common Reception lines for reception of mixed as well as through loads. Or it may have a separate bypass (or through) yards for reception and dispatch of through loads. Number of reception lines to be provided depends on the average number of trains received in 24 hours, catering for 4 to 6 hours occupation of a line per train. An engine run–round line is generally provided or nominated for movement of shunting locomotive. Length (CSR) of a reception line should be about 7% more than the CSR of loop lines on the sections. Reception lines are generally provided with Stop Boards as the yards are treated as terminal yards. In such a case line is to be kept clear upto the 'Stop Board' of the reception line while receiving a train on it.

Hump and Sorting Lines

3.521 A major yard dealing with more than 500 wagons per day on the BG, is generally provided with a hump. It is desirable to have reception lines, hump and sorting lines in longitudinal alignment so that the sorting could be done by forward movement only. Height of the hump is such that even the worst rolling wagon could roll down upto the trailing points of the sorting lines.

3.522 Number of sorting lines provided and used depends on the number of direction wises grouping of wagons required as well as on the requirement of local and sick wagons.

Departure Yard

3.523 It is desirable to have a separate departure yard in a major marshalling yard. After formation of a full train load on a sorting line the same can be pulled on to a departure line thus giving relief to the sorting lines. Outward number taking and C & W examination could also be done more safely and properly on separate departure lines. Number of departure lines will again depend on the average number of trains per day to be dispatched from the departure yard. Normally 4 to 6 hours occupation of a line per train should be enough.

Grid Yard

3.524 A separate Grid Yard may be provided in a major marshalling yard to sort out local wagons including sick wagons. Such a yard is generally provided at the trailing end of the sorting lines.

Single vis-à-vis Double Yards

3.525 A goods marshalling yard may have either separate Up and Down Yards or a single yard dealing both Up and Dn. traffic. It is more economical to have a single yard.

Apart from economy in layout and operation, a single yard also avoids the problem of dealing with cross traffic between Up and Dn. yards.

Bypass or Through Yard

3.526 With the preponderance of intensively examined through block loads, the importance of bypass or through yards has increased substantially. It is desirable to provide fuelling facility for diesel locos on all the lines in a bypass yard. A spur for detaching sick wagons is also desirable.

Typical Layout of a Single Yard

5.527 The layout of a typical Single Yard is given in the diagram 3.528 below:-

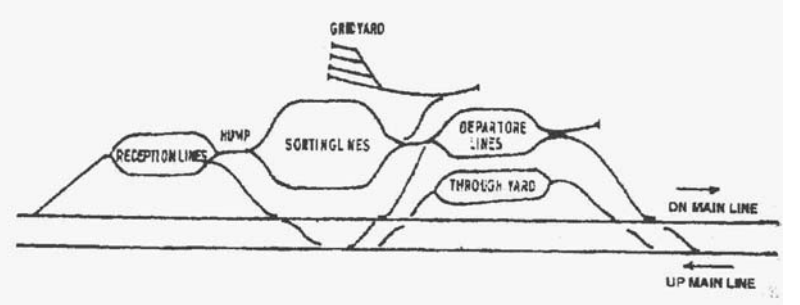


FIG. 3.527 layout of a typical un-directional single yard

Notes: (i) Ancillary lines such as engine lines, hump by-pass line, sick lines etc. have not been shown for simplicity.

(iii) Reception lines, Sorting lines, Departure lines & Through yard etc. are common for Up and Down Directions. Hence it is called a single yard, and is more economical than separate Up and Dn yards.

Mechanisation of Marshalling Yards

3.528 Mughal Sarai, Andal, Bhilai and Bondamunda are amongst the mechanised yard on the Indian Railways. Mechanization of Marshalling yards generally includes the following facilities:-

(a) Automatic route setting for sorting of trains:-

The cut-list is prepared on a perforated tape which is fed into the controlling device. The route for each shunt is set accordingly through power operated points as the cuts roll down the hump.

(b) Wagon Speed Control The speed of wagons rolling down the hump is controlled by mechanical retarders. Speed of heavy and good rolling wagons is so retarded that they do not enter the sorting lines at excessive speed.

(c) Automatic speed control of humping locomotive:-

This is not provided on the Indian Railways.

3.6 Divisional Control Organisation

Introduction

3.601 Divisional Control Organisation is the 'Nerve Centre' of Railway operation on a Division. Divisional Control office has extensive telecommunication network. There are various telecommunication channels which fix the control office to all officers on the Division, other Divisions, HQS Office, all stations, yards, loco-sheds and other significant places on the Division. Apart from Railway administrative and other telephones, the Control office is also provided with P & T telephone facilities.

Location of Divisional Control Office

3.602 Main Divisional Control office is located in the premises of the Divisional Railway Manager's office. Sometimes outlying control offices are also provided on bigger Divisions, e.g. Agra Control on Jhansi Division, Tundla Control on Allahabad Division. Entire division is divided in manageable areas and each area is controlled by a separate 'Control Board'.

3.603 The set up of Allahabad Division Control Offices given below as an example.

Functions of Divisional Control Organisataion

3.604 The main functions of Divisional Control

Organisation are listed below:-

(a) Train Control

(b) Traffic Control

(c) Power and Crew Control.

(d) Traction loco and Power Control

(e) TXR Control.

(f) Material Trains/Engineering Control.

(g) Commerical Control

(h) Security Control

(i) Safety Control

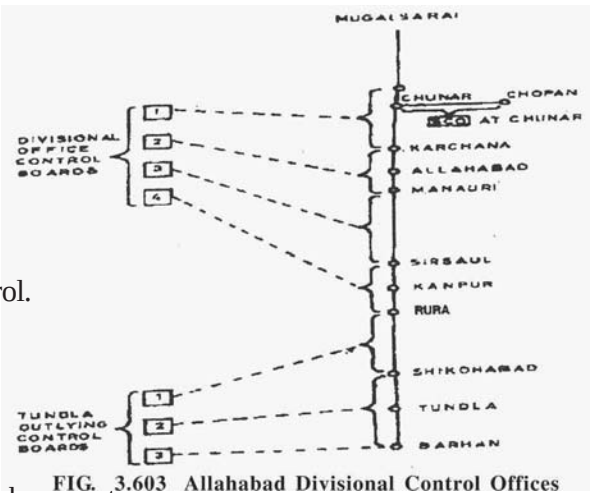


FIG. 3.603 Allahabad Divisional Control Offices

3.605 These functions are described briefly in subsequent paras.

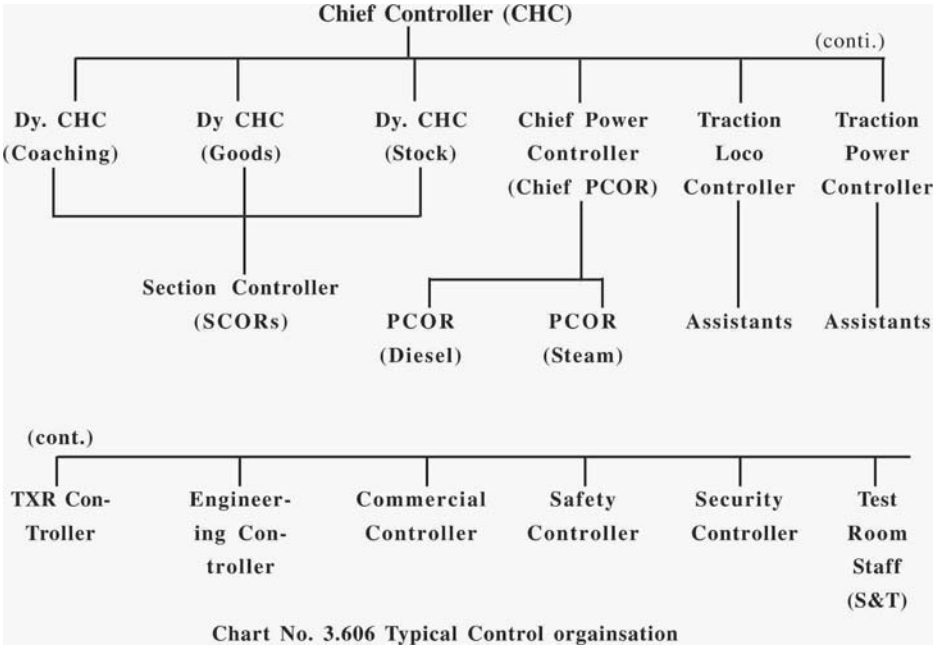


Chart No. 3.606 Typical Control orgainsation

Control Organisation

3.606 The typical organisational set up for

performing the above functions on a Division is given in the chart below:

(a) Train Control

3.607 As stated earlier, the entire Division is divided into manageable control boards. Each control board is manned round the clock by Section Controllers (SCORs) in shift duties.

3.608 A SCOR sits in a sound proof cubicle with glass fronted door. He is connected to all stations, yard cabins and other important locations under his jurisdiction on a 'Omnibus' control phone circuit. He can call a station Master of Area Controller etc. by giving the corresponding ring. However, a Station Master can just lift his control phone and talk on the same. Only one person must talk at a time to avoid confusion. An SCOR has the priority to speak and he can direct which person should speak first.

3.609 The Station Masters are required to inform the SCOR the exact timings of arrivals, departures and passing through of trains soon after their occurrences. SCOR plots the movement of trains on his section on a time-distance graph based on timings repeated by the Station Masters. He also has a Master Chart displayed in front which gives the scheduled paths of all Mail, Express, Passenger and important goods trains. With the help of these charts a Section Controller plans in advance as to at what stations crossings

and precedence of trains must be arranged according to their relative priority and at the same time ensuring minimum detention to trains. He issues instructions to the Station Masters accordingly sufficiently in advance for ensuring smooth working.

3.610 Apart from arranging crossing and precedence, the SCOR also takes suitable action in cases of emergencies such as unusual occurrences, accidents, agitations, engine failures, hot axle wagons, relief of train crew, etc.

3.611 An SCOR is a vital link between the administration and the field staff he can achieve better punctuality of passenger carrying trains and higher average speeds or goods trains through efficient and intelligent planning and control.

3.612 The Control Charts plotted by the SCORs are test checked by Dy. Chief Controller (Punctuality). A few charts of difficult sections area also checked by operating officers. Shortcomings, if any, on the part of SCORs are brought to their notice for their education and improvement. Punctuality of Mail/Express and Passenger trains is a very important aspect to be kept in view by the SCORs and the operating officers.

(b)Traffic Control

3.613 'Traffic Control' is in fact the main aspect of control of freight operation on a Division. The salient features of Traffic Control are described below:-

(1)Loading on the Division

3.614 As has been explained earlier, maximizing loading of goods traffic is the main objective of freight operation. 'Smalls' booking has since been discontinued and piecemeal wagon loading is also not much encouraged in the new pattern of traffic. Hence most of the loading is now done in rake loads of BOX, BOX, 'N', BCN, BCX and CRT wagons. Conventional wagons such as 'C', 'K','CA' etc. have become quite old and as they are having brass bearing (and not roller bearings) they are normally not fit for loading of long distance traffic. Also they have screw couplings and cannot, therefore, be mixed with newer type CBC coupling wagons. Therefore, such wagons area being used in separate rakes, known as 'CC' rakes which are used for short distance closed circuit movements. Such conventional wagons which do not get formed in 'CC' rakes are used for piecemeal wagon loads.

Allotment and Supply of Wagons for loading

3.615 The rail users place their indents for loading of their goods in wagons with the SMs of the stations concerned. The control office receives the particulars of these indents every day through 16.00 hrs. 'Stock Reports' from the stations concerned. Allotment and supply of wagons has to be arranged by the Control. Keeping in view the oldest dates of registration as well as the priority of traffic as given in the 'Preferential Schedule' issued every six months by the Central Government to ensure supply of wagons to vital and essential traffic. 'Preferential Schedule' lists priority of traffic in five categories viz. A, B, C, D, and E. Priority traffic (A,B,C&D) includes important goods such as

Military traffic, Government sponsored foodgrains movement, Iodised salt, seeds to State Governments, coal from collieries and per programme given by Goal Controller, POL traffic, levy sugar, cement, fertilisers etc.Traffic not covered by categories A, B, C and D is called non-priority traffic 'E'.

3.616 As most of the traffic now moves in train loads, the control office keeps a close watch on the indents for full train loads and the availability of empty rakes for loading of such traffic. A close liaison is kept with the Zonal HQs as well as adjoining divisions to keep a track on incoming rakes so as to supply the rakes for loading as expeditiously as possible. Supply of wagons for loading piecemeal traffic 'E' is now done mostly on nominated days, maybe once a week.

(2) Ordering Goods Trains

3.617 Timely ordering of goods trains is an important duty of Traffic Control. For ordering a goods train the Dy. Chief Controller ensures the availability of-

(a) Load,

(b) Power (i.e. locomotive),

(c) Crew, and

(d) Path

3.618 He then issues a 'Train Notice' to the Station/Yard concerned, normally 3 to 4 hours in advance of scheduled departure time so that all activities such as sending call book to the train crews, proper formation offload, outgoing train examination, preparation of outgoing vehicle guidance, attaching of loco on the train, creation of required vacuum etc. could be done in time.

(3) Unloading of Traffic on the Division

3.619 Dy. Chief Controller (Tfc) must keep a close watch on the inward loaded wagons which have to be unloaded on the Division. For train loads position has to be watched almost on an hourly basis. For piecemeal wagon loads daily report is received from unloading points indicating opening balance, fresh wagons placed for unloading, wagons unloaded and balance wagons to be unloaded. If left over balance is high special efforts have to be made and the matter may have to be tackled at Sr. DOM and Sr. DCM level. Special watch has to be kept on crane consignments, over dimensioned consignments and wagons requiring transshipment.

3.620 Daily 'in-sight' figures for loaded wagons expected to arrive on the Division within next one to three or more days must be checked from HQs office and if the inflow is expected to be more than the capacity for unloading, assistance should be sought from the HQs office to regulate, divert or restrict the traffic as considered desirable for smooth flow of traffic.

3.621 Released empty wagons/rakes must be worked out expeditiously as per pattern of

traffic and the directions of the HQs and Sr. DOM.

(4) Working of Transhipment Point

3.622 If there is a break of gauge transhipment point on the Division, the Traffic Control must ensure supply of matching empties as required. Close watch must be kept to ensure that the wagons are transshipped as required utilizing full capacity of the Transhipment Shed. Placements and removals must be done in time and special watch should be dept on crane consignments.

(5) Interchange of Traffic

3.623 Interchange of goods traffic at inter-railway and local interchange points as per quotas fixed by the Railway Board and the Zonal HQs is very important for mobility (smooth flow) of traffic. Keeping in view the pattern of traffic the Railway Board lays down quotas of empty and loaded wagons to be interchanged (handed over and taken over) at the various inter railway interchange points. The Railway Board also lays down the targets of average wagon holding (empties and loaded separately) for the various Zonal Railways. Each Zonal HQs in turn lays down, target average Divisional Wagon Balance (DWB) for each division.

3.624 If the total wagons received on a division in a day is equal to number of wagons dispatched to adjoining divisions the DWB remains same. However, if the dispatches are less than receipts the DWB will increase. A reasonable variation of DWB from the target DWB may not cause concern. But if the DWB is comparatively much more than the target, without appreciable increase in loading on the Division, it is a cause for concern. Because in such a case the wagon utilization on the division will deteriorate and other divisions may run short of wagons for their loadings.

3.625 For smooth flow of traffic and for making the requisite number of wagons available for loading on the various Zonal Railways/Divisions, it is important that the Divisions ensure interchange offloaded and empty wagons at the various interchange points as per targets laid down. This is a very important aspect of Traffic control.

(c) Power and Crew Control

3.626 Locomotives are very precious assets of the Railways. Any shortage or imbalance of locomotives may result in hold ups and impediments to smooth flow of traffic. Power control, therefore, includes the following aspects:-

(i) Making the locos available for ordering of trains and movement of traffic without detention.

(ii) Making optimum utilization of locomotives without causing them undue detentions.

(iii) Ensuring proper maintenance of locos and avoiding locomotives failures.

(iv) Sending locomotives for their repairs and maintenance to homing sheds as per

schedules.

(v) Ensuring locomotives carry maximum loads as per their (tractive efforts) capacity.

(vi) Light running locos to be avoided as far as possible.

3.627 Working of train crews is governed by Hours of Employment Regulations (HER). The Dy. Chief and Power Controllers must ensure the following:-

(i) Crews are provided home and outstation rests as per HER.

(ii) Overtime working of crew is minimized, preferably reduced to zero.

(iii) Crews are relieved in time as per rules.

(iv) The incidence of train crews working over 10 hrs. at a stretch is kept to the very minimum.

(v) Trains do not have late starts due to late booking of train crews.

(d) Traction Loco and Power Control

3.628 So far as electric locos are concerned, the same aspects as described above have to be watched. In addition, Traction power has also to efficiently manage the supply and use of electricity to the overhead equipment (OHE) on electrified sections. Proper coordination has to be ensured with OHE maintenance staff and power blocks arranged as per their requirements.

(e) TXR Control

3.629 TXR controllers are posted in the control office for the following duties:-

(i) Ensuring quick repairs and clearance of wagons marked sick at roadside stations.

(ii) Ensuring timely placements and removal of wagons in sick lines.

(iii) Ensuring sick lines carry out repairs as per their capacity and left over sick wagons are not excessive.

(iv) Wagons are sent to workshops for POH as due.

(f) Material Trains/Engineering Control

3.630 Ballast Controllers posted in the control office maintain a close liaison with Deputy/ Section Controllers are field officials of the Engineering Department for the following:-

(i) Ballast trains run as per requirements of engineering department.

(ii) Engineering Blocks for maintenance and repairs to tracks are organized as required.

(iii) Caution orders are recorded and issued at Notice stations properly.

(iv) Detentions to trains on engineering account are closely watched and enquired into.

(v) Utilisation of mechanised track maintenance machines is properly coordinated & monitored.

(vi) Engineering labour is organised by field officials in time.

(g) Commercial Control

3.631 Commercial Controllers look into following aspects:-

(a) Detention to trains on commercial account are closely watached and enquired into.

(b) Coordination of surprise ticket checking raids.

(c) Arranging unloading of loaded sick wagons detached at roadside stations, if asked for by the C&W staff.

(e) Keep a watch on detentions in unloading of wagons at goods-sheds, goods terminals and transhipment points.

(f) Ensuring adequate stock of money value books and tickets stock at stations and helping stations in case of any emergencies.

(g) Security Control

3.632 The security control ensures proper coordination between Security Officers in the Divisional office and field staff to guard vital installations and preventing thefts of railway materials and consignments. They also coordinate with commercial department in case of surprise ticket checking and alarm chain pulling raids. They maintain a close liason with the Govt. Rly Police for ensuring proper law & order on trains & stations premises.

(h) Safety Control

3.633 This is of recent origin. Safety Controllers keep a close liaison with field staff and officers in case of unusual occurrences and accidents. They also keep a watch over supply of safety equipments and medical relief arrangements at stations.

3.7 Salient Features Of Control Of Freight (Goods) Operations At Zonal Hqs And Railway Board Level

ZONAL HQS

3.701 Chief Operating Manager (COM) assisted by other operating officers as mentioned in lesson 1, is overall in-charge of railway operations of the zone. The important aspects for coordination and control of good operation at Zonal HQs level includes the following:-

(i) Ensuring that loading of rakes/wagons on the divisions is according to the programmed targets and outstanding indents.

The supply of empty rakes for loading is monitored and close liaison is maintained with

other zonal railways and Railway Board for the purpose. Expeditious loading and clearance of train loads is closely monitored.

(ii) A close watch is kept on the receipt and unloading of inward loaded rakes. In case there is likelihood of excessive receipt of inward wagons or there are certain unusual circumstances such as accidents etc. which may lead to congestions, close coordination has to be maintained with the Railway Board and other Zonal Railways to regulate the traffic suitably.

(iii) A close watch is kept to see that inter-railway and inter-divisional intercharge of traffic is smooth and as per targets. Divisional Wagon Balances should normally be as per targets. In case any division is holding excessive DWB, reasons should be analysed and the Division should be assisted to improve the situation.

(iv) It should be watched that average hourly holding of Diesel/Electric locomotives on the Divisions is as per targets and balancing of locomotives is done as required. Locomotive utilization figures, including average speeds of goods trains, should be closely monitored.

(v) Similarly wagon utilization indices such as wagon Turn Round, Wagon Kms per Wagon Day etc. should be closely monitored division-wise.

(vi) Expeditious clearance for movement of over-Dimensional Consignments (ODCs) should be given, taking approval/sanction of other zonal railways and ACRS as required under the rules.

(vii) Planning for additional line-capacity words and additional rolling stock be done carefully to meet the future demands of traffic efficiently. The same should be pursued with the Railway Board for inclusion in the Work Programmes.

Railway Board's Level

3.702 As mentioned in Lesson 1, Member (Traffic), assisted by Additional Member (Transporation) and other officers is in overall charge of Railway Operation on the Indian Railways. Important aspects to be looked after at Railway Board's level include the following:-

(1) Fixing loading targets commodity arise for the various zonal railways. A close interaction with other ministries and major industries is maintained to fix realistic targets and origin-destination linkages.

(2) Prescribing zone-wise targets of average holding of wagons according to the pattern of traffic and loading requirements.

(3) Prescribing target holding of average hourly outage of diesel and electric locomotives on the various zonal railways.

(4) Monitoring loading/unloading and interchange of traffic zone-wises. A close watch is kept on supply of rakes for loading/unloading and their clearance. Regulating loading

and flow of traffic in case of congestions or anticipated congestion.

(5) Monitoring locomotive and wagon-utilisation figures zone wise vis-a-vis the prescribed targets.

(6) Allotment of new locomotives/wagons to various zones as per traffic plan and requirements.

(7) Planning for additional capacity including additional rolling stock for meeting future demands of traffic efficiency.

3.8 Broad Gauge Woagon Pool

Classification of Wagons

3.801 For the purpose of inter-railway movement of traffic, the wagon fleet on Indian Railways is classified in the following categories:-

(1) Local loading wagons : These should move within the prescribed local limits only i.e. within a division or within a zone. These wagons are stenciled (LL).

(2) Non-pooled wagons : These are generally special type wagons, such as POL wagons, well-trucks etc. Mark (NP) is stenciled on such wagons and they have to be returned to the owning Railways after unloading.

(3) Pooled wagons: These wagons can be loaded freely and can have interzonal movements without any impediments.

Owning Railways

3.802 Each wagon is owned by a particular Zonal railway and the name of the owning railway is stenciled on each wagon. Cost of the wagon is borne by the owning railway. Timely POH of the wagons is also the responsibility of the owning railway.

Credit and Debit Balances

3.803 The difference between the number of wagons owned and the average daily number of wagons actually held on a Zone is known as its Credit or Debit balance. If the number held is less than number owned, it is credit (+) balance and if it is more it is debit (-) balance.

3.804 The Railway Board fixes target credit/debit balances zone wise keeping in view the loading requirements and the pattern of traffic. The Zonal railways are expected to adhere to theses targets.

Wagon Hire charges

3.805 The Railway Board computer receives the particulars of daily interchange of wagons between various zonal railways. After duly checking and requisite adjustments, monthly credit and debit balances are worked out zone wise in terms of four wheeler units. The zonal railways with debit balances have to pay hire charges of extra wagons held to the

railways having credit balances.

These statements are sent monthly to the Director of Wagon Interchange, Indian Railways Conference Association (IRCA), who works out total wagon hire charge to be credited/ debited to the zonal railways as per prescribed rates.

3.9 Operating Statistics

3.901 Operating Statistics helps us to quantify the work done and assess the efficiency of our performance.

3.902 Statistical Units

(a) Primary Units : Units of distance, time, weight, money etc. e.g. Km, day, tonne, Rs.etc.

(b) Fundamental Units : Products of two primary units which gives us quantum of input or out-put e.g. wagon-days, tonne-Kms, Passenger-Kms, Train-Kms, Engine-Hours etc.

(c) Derived Units : It is the ratio; of two primary or fundamental units and gives us the idea or our efficiency of performance or productivity of resources e.g. Wagon km per wagon day, Train Kms per train Engine Hour (Average speed of trains) Net-tonne Kms per wagon day etc.

3.903 Productivity of Resources

(a) Productivity of resources is defined as the ratio of output to input. The units for measuring productivity of various resources of the railways are described below.

(a) Wagon Utilisation: The derived units for measuring the efficiency of wagon utilization include the following :-

(b) Wagon Turn Round.

(c) Wagon Kms per Wagon Day.

(d) Net tonne Kms per Wagon Day.

(e) Net tones Kms per Tonne of Wagon capacity.

Wagon Turn Round is defined as average time interval in days between two successive utilization of wagon. It is, however, statistically calculated by the following formula,

$$WTR = \frac{B}{L + R}$$

Where B = Effective Average wagon balance

L = Average daily number of wagon loaded.

R = Average daily number of loaded wagons received.

(b) Engine (Loco) Utilisation :

(i) Engine Kms per Engine day on line.

(ii) Engine Kms per Engine day in use.

(iii) Net Tone Kms per Engine Hour.

(iv) Average speed of goods trains.

(v) Average train load.

(c) Track Utilisation

(i) Net-tonne Kms per Route Km.

(ii) Passenger-Kms per Route Kms.

(iii) Gross tonne-Kms per Route Kms.

Operating Ratio

Operating Ratio helps us to assess our financial performance. It is defined as, the percentage of gross working expenses to the gross revenue recipts.

$$\text{Operating Ratio} = \frac{\text{Gross Working Expenses}}{\text{GrossRevenue Receipts}}$$

3.904 Improving (Efficiency) Productivity of various resources:

The various resources of the Railways include rolling stock, track, fuel, staff etc. The measures for improving their productivity are listed below.

(a) Wagon Utilisation:

The most comprehensive indices for measuring productivity of wagons are Net-tonne Kms per wagon-day and Net-tonne Kms carried per tonne of wagon capacity. Measures for improving the same include-

(i) Running train loads of traffic by passing intermediate yards.

(ii) Reducing detentions to wagons at loading/unloading terminals, and yards and transhipment points.

(iii) Increasing average speeds of goods trains.

(iv) Reducing percentage of ineffective wagons.

(v) Using high capacity wagons.

(vi) Increasing average load per wagon.

(vi) Reducing percentage of empty wagaon-Kms to loaded wagon-Kms.

(b) Locomotive Utilisation

Most comprehensive unit for measuring loco-utilisation is Net-tonne Kms per Engine Hour on Line. The steps to improve the same include-

(i) Running of full load trains.

(ii) Increasing average speed of goods trains.

(iii) Reducing detentions to locomotives at various points.

(iv) Minimising percentage flight engine Kms to total engine kms.

(v) Reducing percentage of ineffective locomotives.

(vi) Minimising locomotive failures.

(vii) Designing wagons with maximum pay load to tare ratio.

(c) Fuel Utilisation

(i) Educating and encouraging drivers to economise in fuel consumption.

(ii) Better maintenance of locomotives.

(iii) Eradicating theft of coal & fuel oil.

(iv) Designing locomotives with Engine fuel efficiency.

(v) Avoiding idle running of locos.

(vi) Running trains evenly on electrified sections to minimize peak loads.

(d) Track Utilisation

Track utilization is best measured in terms of net-tonne kms plus passenger-Kms per route km per annum. Measures for improving the same will include the following:-

(i) Maximising throughput by running maximum number of trains.

(ii) Maximising average net load per train.

(iii) Strengthening track and bridges to take heavier axle loads (say upto 25t on BG)

(iv) Improving track to increase maximum load per metre of track (from 7.67 tonne per metre on B.G. as at present).

(v) Removing permanent speed restrictions.

(vi) Using high speed turn outs.

(vii) Carry out remodeling of fixed structures to permit increase in maximum moving dimensions.

(e) Staff Utilisation

Net tonne Kms plus passenger kms per employee on the Indian Railways is quite low

as compared to developed countries. This could be improved by the following measures:-

(i) Proper education and training of officers and staff and developing required skills.

(ii) Adopting modern management techniques to motivate staff to give in their best. Such as encouraging, team spirit, creating a sense of belonging to the organization and sense of pride of being a railway man.

(iii) Adopting work-study and industrial engineering methods to improve productivity.

(iv) Identifying surplus staff and retraining them for absorbing in alternative jobs.

(v) Enlarging the scope of welfare measures for staff.

(vi) Streamlining the working of Personnel Department to sort our staff grievauces expeditiously.

(vii) Close coordination with recognized trade unions to improve the working conditions of staff etc.

Employees are the most precious resource of an organization. The above list gives only a few important aspects. There are many other areas which could be tackled to improve productivity of staff.

(f) Operating Ratio:

As defined earlier operating Ratio is the percentage of Gross Working Expenses to Gross Revenue Receipts.

Gross earnings could be increase by

(i) Maximising quantum of passenger and good traffic.

(ii) Adopting a rational tariff policy and minimizing losses on social burdens.

Working expenses could be reduced by-

(i) Improving productivity of resources.

(ii) Exercising economy in every aspect of railway working.

3.905 Conclusion:

Statistics is an important managerial tool. If used intelligently and properly it can help us greatly in identifying our areas of weaknesses and indicating what steps should be taken to improve our quality of service and productivity of resources.

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