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SHAKTI SUSTAINABLE ENERGY FOUNDATION

MOVING TOWARDS A LOW-CARBON TRANSPORT FUTURE

Increasing **Rail Share** in Freight Transport in India

Working Paper – Cement

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About Shakti: Shakti Sustainable Energy Foundation works to strengthen the energy security of India by aiding the design and implementation of policies that support energy efficiency, renewable energy and sustainable mobility.

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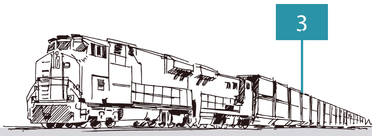

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CEMENT TRANSPORTATION

Global Cement Industry

More than 150 countries around the world produce cement. In 2016 and 2017, the global cement production was estimated to be around 4,200 million tonnes (MT), a substantial increase from 3,300 MT in 2010. Production, however, has seen a slump over the last three years, staying largely flat since 2013.

China is the leading cement producer in the world, accounting for over half of the global cement production—approximately 2,400 MT in 2017 (USGAa, 2018)—whilst India has the second-highest production at 270 MT. Though cement production in the remaining eight highest-cement-producing countries is significantly lower than that in both China and India, these countries still represent large cement industries, with exceptional production levels in both China and India. The top ten cement-producing countries together represent 76% of the global cement production, which reflects the extent of infrastructure that is yet to be built in these countries.

Increasing population and economic growth are the key global drivers of cement demand, and therefore, often there is a strong positive correlation between a country's GDP growth and its cement consumption. It is important for developing countries and emerging economies, which have high cement consumption, to have a strong domestic cement industry, as it reduces the dependence on imports, cuts down construction costs owing to reduced transportation costs, and facilitates further economic growth through the development of domestic industry and creation of subsequent employment. There is, therefore, a strong correlation between the countries with high cement consumption and the size of their respective domestic cement industries.

In a similar pattern to country-level production levels, China is undoubtedly the world's leading cement consumer, consuming 2,511 MT of cement in 2015–16, followed by India at 280 MT. Other major cement-consuming countries include Brazil, Russia, and the USA.

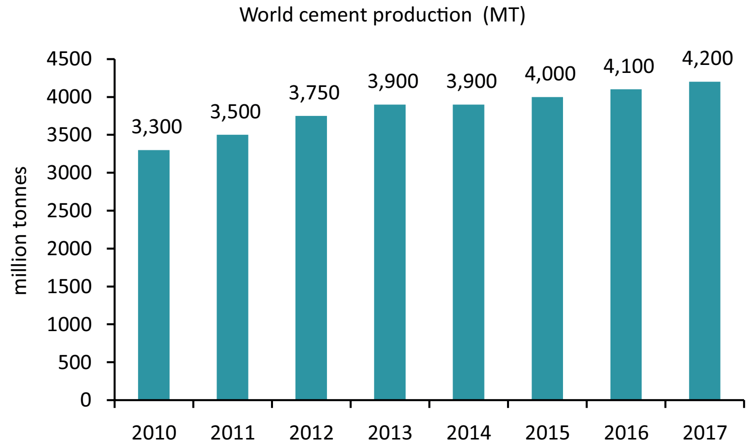


Figure 1: World cement production and consumption (2010–2017)
Source: USGS, 2018

[1]*See https://minerals.usgs.gov/minerals/pubs/commodity/cement/mcs-2018-cemen.pdf.*

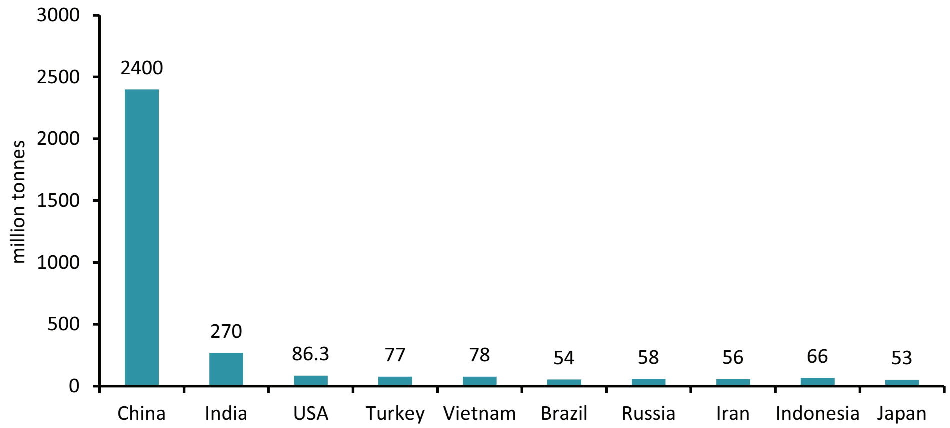


Figure 2: Top cement producers in 2017 (MT)
Source: USGAa, 2018

Indian Cement Sector

Cement Production and Capacity Trends

With nearly 285 MT of cement production in 2015–16, the Indian cement industry is the second-largest in the world, with production increasing between FY07 and FY15 at a compound average growth rate (CAGR) of about 7%, to 270 MT. According to the 12th Five Year Plan, cement production is expected to reach 407 MT by 2017 (Figure 3), which would represent a CAGR of about 10%. While the estimated production of 407 MT by 2017 does not appear feasible considering the current production and consumption levels, cement firms expect demand to continue to increase in the coming years[2], with a subsequent increase in the cement-transportation requirements.

Top Cement Manufacturers in India

The Indian cement industry is dominated by a small number of companies, with the top 20 cement companies accounting for almost 70% of the total cement production of the country (Table 1). UltraTech Cement is by far the biggest cement producer in the country, with 13 integrated units and 16 grinding units spread across India.[3]

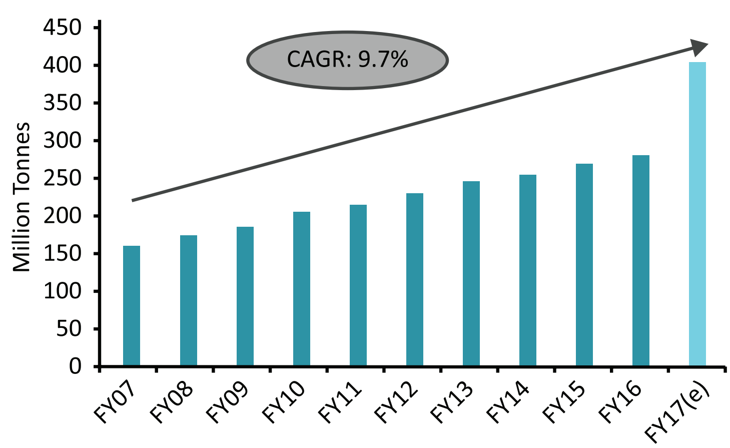


Figure 3: Cement production in India (million tonnes)
Source: IBEF, 2016

[2] *See http://www.livemint.com/Consumer/EmqzLK6W5kDZAGZbL6mmQJ/The-coming-binge.html.*

[3] *See https://www.ultratechcement.com/common/images/downloads/UltraTech%20AR%20-%202016-17%20-%20Web.pdf*

Table 1: Top twelve cement producers in India (ranked as per their installed integrated cement-production capacity)			
Sr. no.	**Company**	**Capacity in MTPA:* 2016**	**Capacity in MTPA: 2017**
1	UltraTech Cement	64.65	66.25
2	ACC	31.5	33.41
3	Ambuja	29.7	29.65
4	Shree Cement	27.2	34.9
5	Dalmia Cement	21.8	25
6	Ramco Cements	16.5	16.5
7	India Cements	15.5	15.5
8	Birla Corporation	9.8	15.5
9	JK Lakshmi Cement	8.6	10.9
10	Century Textiles	7.8	7.8
11	Kesoram	7.3	7.25
12	Heidelberg Cement	5.4	5.4
Source: Annual reports of the respective companies			
** MTPA: Million tonnes per annum*			

Seasonality in Production

Characterized by heavy seasonality, cement production in India generally peaks in the last quarter and is at the lowest in the second quarter of the financial year (Figure 4). Seasonality of production has subsequent implications for the transport sector. The effect of demonetization is clearly visible in the figure, as the industry witnessed a slowdown in production and demand, primarily due to decline in real-estate activity. The production, however, picked up post February 2017.

Excess Capacity

The cement industry in India is currently facing significant unfulfilled production capacity, with the cement capacity-utilization rate actually remaining almost constant at around 70% over the last five years. There have been improvements in the production capacity utilization more recently. Also, there is significant potential for the Indian cement industry to increase its production from the production facilities currently available, thus providing a degree of certainty as to the likely transportation origins in the coming years.

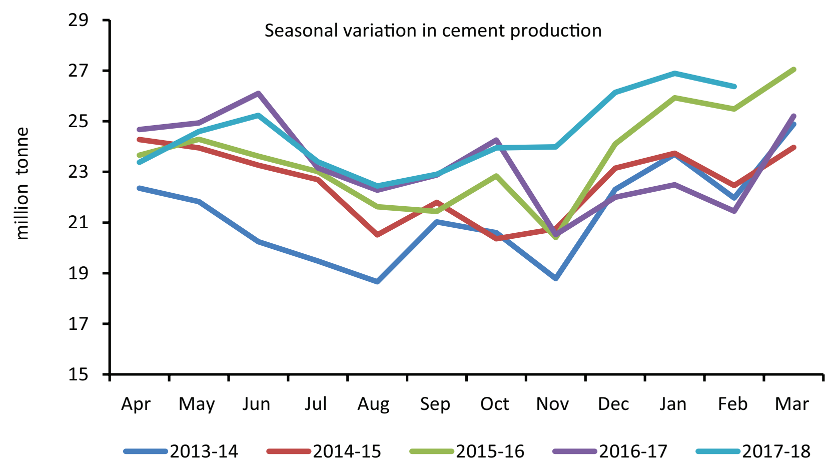
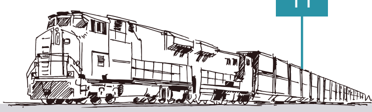


Figure 4: Monthly cement-production trends in India ('000 tonnes)
Source: DIPP, 2018



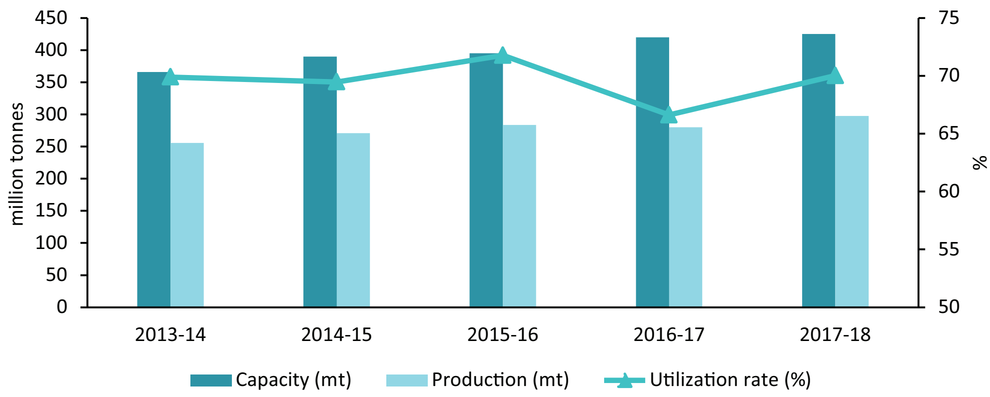


Figure 5: Cement capacity-utilization rate (2013–14 to 2017–18)
Source: Department of Industrial Policy & Promotion

Consumption Trends and Drivers

India's per capita cement consumption is currently around 220 kg, which is significantly lower than in the other emerging economies, particularly compared to the recent levels seen in China of up to 1,770 kg per capita (IEA, 2015). This indicates a significant potential for growth in the Indian cement industry. Whilst specific locations are difficult to identify, growth in cement demand is expected to predominantly come from urban areas. This expected increase in demand will increase the need for cement to be moved from production locations to points of consumption, with rail freight being the most naturally suited transport mode.

Cement Production and Consumption Locations

Locations of Cement Production Plants and Capacities

The cement industry is extremely location-specific and heavily reliant on the availability of raw materials. Cement plants have been traditionally located in clusters and pockets because the core raw material, limestone, is available only at a select few locations across the country. Whilst the cement plant may be located close to limestone deposits, other raw materials including gypsum, fly ash, and slag often need to be transported from other locations to the cement-production plants.

Changes in Production Plant Strategy

Bagged cement has increased in popularity over bulk. To meet this changing nature of demand, the manufacturing and delivery process has evolved to increasingly produce an intermediate clinker product for shipping, which is easier to transport. Rather than shipping the final cement product from the integrated plants located at limestone heads, the industry has started creating grinding units nearer to the points of consumption. These grinding units are mostly located near urban agglomerations where most of the final cement consumption takes place. Clinker has a reduced volume compared to the final cement product, which reduces freight-transport requirements. The subsequent changes to the volume and pattern of cement-freight movement have reduced the demand for railway movement of the final cement product, while creating a demand for the movement of clinker from plant to grinding units.

To increase the energy efficiency of the production process, the cement industry has also increased the share of blast-surface slag as well as fly ash as a supplementary cementing material in the production of Portland cement. This, too, had huge implications for the movement requirements of the cement industry. The cement industry has made efforts to further reduce the mobility requirements for its input raw materials by relocating plants closer to thermal power plants—the source of fly ash.

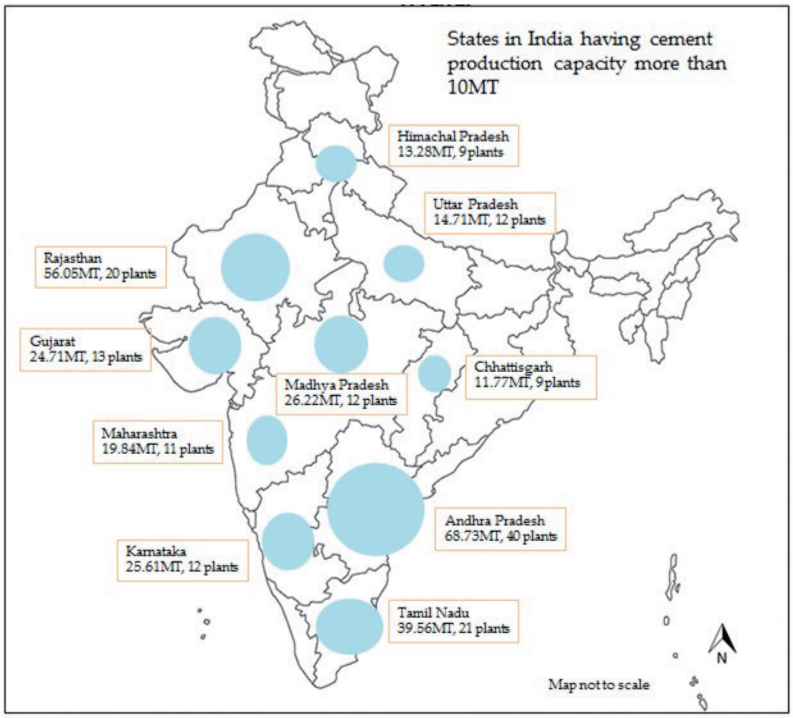


Figure 6: States with more than 10 MT production capacity (2013–14)
Source: Map created based on data from CMIE, 2016

Points of Consumption

The housing sector in India is the leading demand driver of cement, accounting for around 67% of the total cement consumption (Figure 7) in India and a CAGR of 17.2% between 2011 and 2015, driven by increasing urbanization. Other drivers include major infrastructure projects, including the Government of India's Smart Cities programme. With numerous current and upcoming urban agglomerations, it is possible to deduce the approximate locations of upcoming consumption centres, despite major urban areas being increasingly dispersed and decentralized.

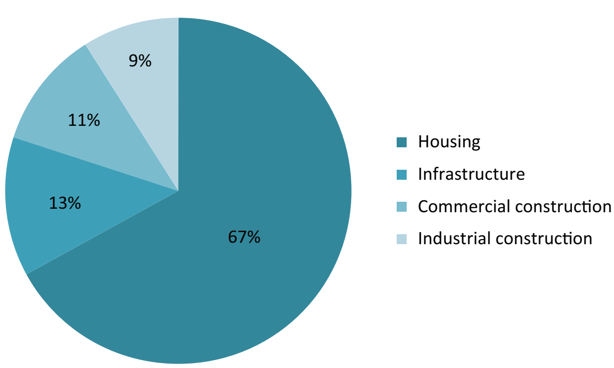


Figure 7: Cement drivers by sector
Source: Ministry of External Affairs, 2016

Movement of Cement

As detailed previously, the relatively small number of cement production plants compared to the dispersed points of cement consumption across India point to a major disparity. Transportation is, consequently, of huge importance in providing a link between the points of production and consumption, as well as for transporting the raw materials for cement to production plants. Given the usually long leads and volumes of movement, this also means that historically the transportation costs have always been a significant component of the operating costs for cement plants and the final landed price of cement. Estimates suggest that transportation accounts for about one-third of the total variable costs involved in manufacturing the product (CMA, 2016).

The Cement Manufacturers' Association (CMA) suggests that the average leads for outward cement movement from plants to dealerships is around 600 km, while the movement of raw materials such as coal and gypsum are in the ranges of about 1,000 and 750 km, respectively (CMA, 2016).

Modal Options for Cement Movement

The overall share of freight transported by Indian Railways (IR) has reduced substantially since 1950. The share of the total freight moved by rail has fallen from more than 85% in 1950–51 to around 30% by 2015–16 (NCAER, 2016). Despite the rail being naturally suited to movement of cement, road-transport modes have been quick to adapt to changes in the requirements of the Indian cement industry and have been able to respond to the ever-changing needs of the industry given their inherent flexibility of operations and reducing capital costs. Railways, on the other hand, has been relatively slower in catching up with industry changes, and have, under many circumstances, become uncompetitive in the movement of cement. Substantial investment in the Indian road network, along with low diesel prices, has also helped road freight to take a dominant share of cement freight. This has led to a reduction in the share of cement dispatch by railways over the decades.

Coastal and waterway shipping of cement has emerged as a competitor for the railways, as it is highly economical for companies located near coastal areas. Inland waterways also have a significant potential for cement movement. Around 70% of cement movement worldwide currently takes place by sea, compared to the less than 2% in India. However, without significant investment and better connectivity between port and the consuming centre, the gains are likely to be minimal.

Historic Trends of Cement Movement

The Indian cement industry is over 100 years old and, as highlighted earlier, one of the most efficient in the world. From a production volume of barely 1.5 million tons of cement and just 18 cement plants at the time of independence (Kothari Enterprises, 1992), the industry has grown to over 270 million tons as of 2015. While almost all the cement movement over long distances historically used to take place by Railways, there has been a gradual increase in the share of cement movement by roads over the years.

The other key feature of the post-Independence era was the fact that a large share of the cement demand was for national projects located in specific locations. Construction of dams, reservoirs, and academic and industrial establishments, mostly supported by the government, consumed large volumes of cement. This demand for movement was almost entirely met by Railways in 'bulk' form, from plant to point of consumption, often at large distances. Infrastructure growth in a highly controlled environment remained the trend all the way up to the 1960s, allowing Railways to retain a near monopoly over the bulk movement of cement.

The gradual deregulation of the cement industry through the 1980s saw the entry of a large number of cement manufacturers into the sector. The 1990s saw the emergence of large plants with capacities to produce more than 1 million tons of cement every year and the formation of cement-production clusters. There was, however, a shift in the cement demand from large government projects to relatively smaller infrastructure projects, mostly in urban centres. The form in which cement was consumed underwent a change, form bulk to bag. The average size of consignments decreased, resulting in a gradual shift of dispatch shares from rail to road.

This process was augmented by the liberalization of the Indian economy, which led to a sudden burst of cement demand. Given that the road-transport sector also benefited from liberalization, there was also an increased availability of trucks, creating a highly fragmented and competitive market for road-based freight mobility. The National Highway Development Programme (NHDP), focused on increasing the National Highway penetration in India, further boosted the trucking industry making road mobility more competitive. Since the parcel size for cement was declining, the easy availability of trucks led to a major shift in the cement logistics industry in the last couple of decades.

Cement Movement Trends

By organizing the Indian states into regional zones (North, South, East, West, and Central), an analysis of inter-region cement movement can be made, showing a changing pattern in the national flows of cement. With the increase in cement-production capacities across different states throughout the previous decade, the demand for inter-region movement of cement has seen a decline (Table 2), since most of the regional plants were able to meet their intra-region cement demand. However, consolidation in the industry over the last few years and spatial reorganization (as detailed previously) have again led to a demand for inter-region cement movement. Despite this, almost 80% of the cement consumed is produced within the same region.

The historic region-wise trends up to 2011–12 show a changing pattern in inter-region cement dispatches, with increasing dispatch shares from northern, southern, and central regions (Figure 8).

Since inter-regional freight movement usually represents very long transportation distances, such journeys, in principle, should almost all be undertaken by more energy-efficient modes, such as railways and waterways.

Table 2: Inter-region and intra-region cement movement

Flow	2005–06	2006–07	2007–08	2008–09	2009–10	2010–11	2011–12
Inter	16%	14%	14%	14%	16%	18%	18%
Intra	84%	86%	86%	86%	84%	82%	82%

Source: Calculated from various CMA publications

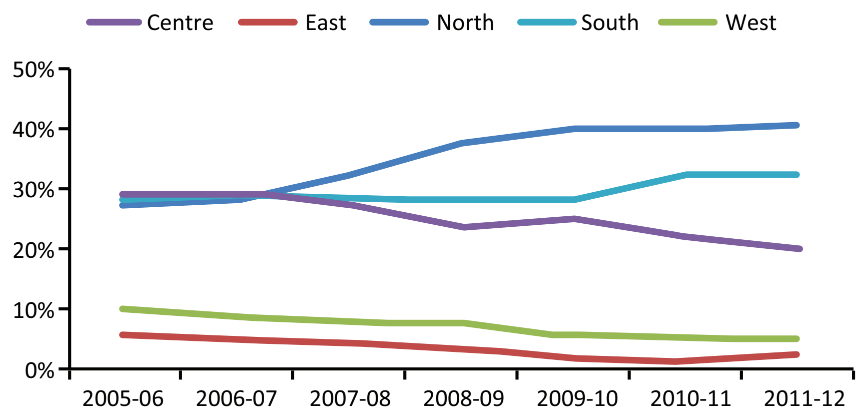


Figure 8: Shares in inter-regional dispatch volumes of cement
Source: Calculated from various CMA publications

An Important Sector for the Railways

The railways are well-suited for transporting cement, owing to the latter's heavy, bulky nature, as well as the long distances often covered while transporting it to the point of consumption. The cement industry is, consequently, an important customer of Indian Railways, its third-highest freight revenue generating sector, accounting for around 10% of Railway's revenue. Depleting shares, and even declining absolute volumes of cement sector traffic, not only affects the country's energy bills but also critically affects the Indian Railway's business. There has been an increase in cement loading onto railways, which could primarily be on account of long-term tariff contracts signed by Indian Railways with key cement producers. Details about the policy on long-term tariff are given in this report's recommendations section.

Cement Dispatches on Railways

Of the 209 large cement plants (Annexure 1) currently in India, around 170 are connected to the rail network (Railway Board, 2016), and these account for over 75% of the total cement production in 2014–15 (Figure 10). While the reason as to why a significant number of plants are not rail-connected is an area of further potential exploration, the focus of the following analysis will be on rail-connected cement plants.

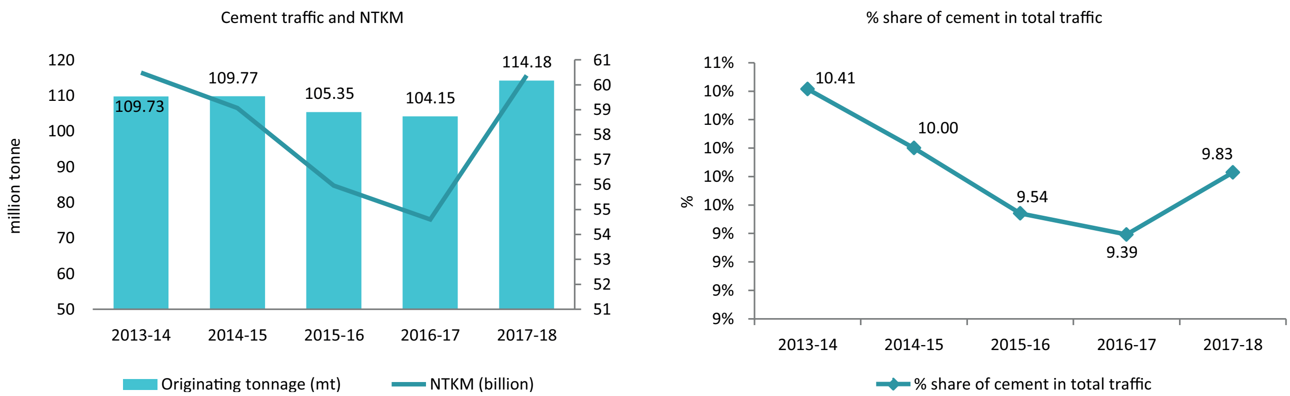


Figure 9: Cement traffic on Indian Railways (2013–14 to 2017–18)
Note: 2017–18 figures are provisional
Source: Indian Railways

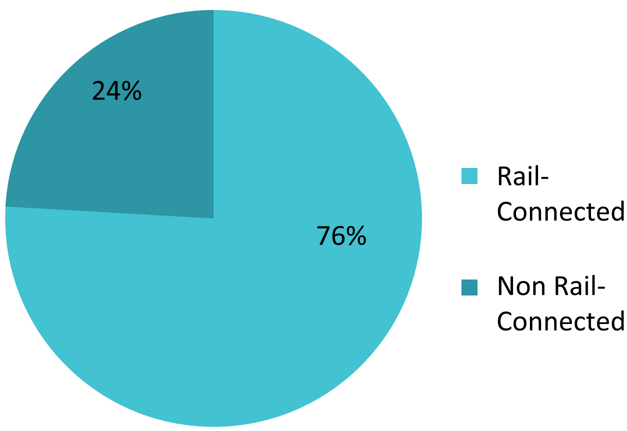


Figure 10: Cement-production volumes of rail-connected plants
Source: Railway Board, 2016

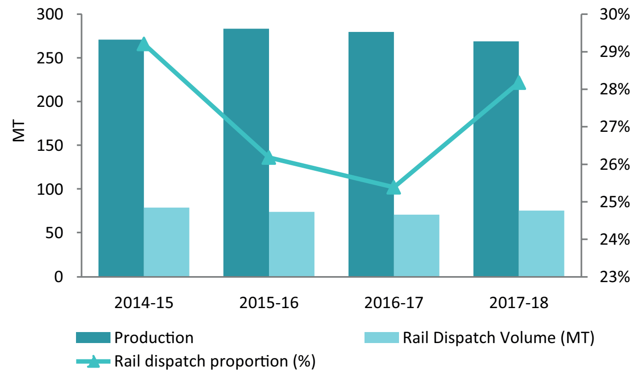


Figure 11: Dispatch volumes and cement shares
Source: Railway Board, 2018

The rail-connected plants witnessed a continued fall in the share of cement being dispatched by rail between 2014–15 and 2016–17; however, the share increased again in 2017–18 (Figure 11). The last year's increase could be explained by the long-term tariff-contract scheme Indian Railways offered to the major cement manufacturers. Even though cement production has remained almost constant between 2014–15 and 2017–18, at about 270 MT, the cement dispatched by Railways has actually declined from 79 MT in 2014–15 to 75.8 MT in 2017–18.

An assessment of all rail-connected cement plants identified the individual plants which were experiencing a fall in the share of cement dispatched by rail between 2016–17 and 2017–18. The data of these plants was then mapped, wherever possible, against data from the railway database, which provides the data for station-level rail dispatch between 2016–17 and 2017–18 for cement, and also includes source and destination stations as well as freight distances. Individual cement plants could then be contacted for their perspectives and insights.

The remaining plants were ranked according to their maximum annual production over the past two years, allowing them to be categorized into three production parameters. From conducting this analysis, it was possible to identify some key trends between categories of production.

Table 3 shows the variation in cement production, rail-dispatch values, and the subsequent rail-dispatch shares. The rail-dispatch share is progressively falling as plant-production values increase, with plants producing less than 1 MT experiencing a 28% fall in the rail-dispatch share compared to 24% fall for plants producing in the range of 1–2.5 MT. On the other hand, the rail-dispatch share has increased from the plants producing more than 2.5 MT, which also account for the majority of cement

Table 3: Production category split of rail-connected cement plants with falling rail-dispatch share

	No. of plants (2016–17)	No. of plants (2017–18)	Cement production (2016–17)	Cement production (2017–18)	Change in production volume	Rail-dispatch volume (2016–17)	Rail-dispatch volume (2017–18)	Change in rail-dispatch volume	Change in rail-dispatch share
Less than 1 MT	33	33	17.1	18.0	5%	4.8	3.6	-24	-28%
1–2.5 MT	65	62	109.4	98.1	-10%	37.7	25.8	-32	-24%
>2.5 MT	37	41	149.0	153.4	3%	57.9	66.6	15	12%

Source: Railway Board, 2018

production. This analysis suggests that by targeting the larger plants the rail-share dispatch could be kept at a higher level; however, the medium and small cement plants need more attention from the Indian Railways.

Cement Rail-Freight Movement Trends

When compared to the analysis of the overall inter-zonal cement movement, there is a significantly greater share of cement that moves between regions by rail, around 56% in 2015–16 (Table 4), compared to less than 20% when considering all modes of transport. The share of inter-zonal cement movement has increased from 52% in 2012–13 to 56% in 2015–16. This increase in rail movement is expected considering the natural suitability of rail freight for longer distances, and the diminishing suitability of road transport for the same.

Table 4: Proportion of inter-zonal and intra-zonal cement and clinker rail movement

Zonal movement	2013–14	2014–15	2015–16
Intra	44%	49%	44%
Inter	56%	51%	56%

Source: FOIS, 2016

Figure 12 illustrates the significant potential of Railways to increase the share of cement freight through inter-zonal movement. Since Railways should be achieving nearly 100% of the inter-zonal cement freight, there is an additional potential for increasing inter-zonal rail movement of cement by nearly 14 MT. However, this is minimal compared to the potential for increasing intra-zonal rail freight, with 184.5 MT of cement that currently moves by a non-rail freight mode. Whilst inter-zonal movement is, clearly, likely to represent large movement distances, it is also likely to be the case for intra-zonal movement due to the vast size of each of the five identified regions of India. Even if intra-zonal movement were to represent smaller movement distances, this shows that Railways should not be purely focused on longer freight-movement opportunities, and should ensure viability for shorter distances also. Based on the interactions with the stakeholders, it could be inferred that the share of inter-zonal and intra-zonal movement of cement for 2015–16 can be taken as the same as that of 2014–15 (Figure 12). (Refer to Annexure 2 and Annexure 3 for state-wise cement source and dispatch.)

When analysing the distance (lead) travelled by these rail dispatches, the number of rail dispatches that travel less than 500 km has declined significantly from 55% to 49% between 2012–13 and 2015–16, with subsequent increases in the share of rail-dispatch volume of more than 500-km lead (Figure 13). This again reiterates the direction in which Indian Railways is focusing: towards the movement of cement and related commodities over long distances (>500 km) with short-lead traffic going down.

However, when weighting the distance travelled with the tonnage that is moved, the picture changes markedly (Table 5). Once the tonnage carried is considered, the weighted average lead in 2015–16 falls marginally for both <500-km and >1000-km categories, whereas there is a marginal (0.4%) increase for the '500–1000-km' category. This seems to support the analysis of inter and intra-regional movements, with average lead distance getting shorter and shorter.

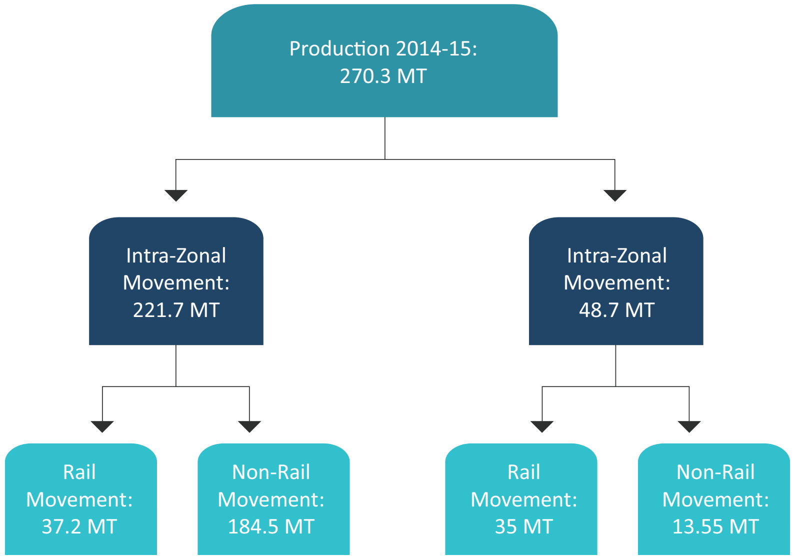


Figure 12: Intra–inter region cement production and movement by rail and non-rail (2014–15)
Source: Based on data from FOIS, 2016, and Railway Board, 2016

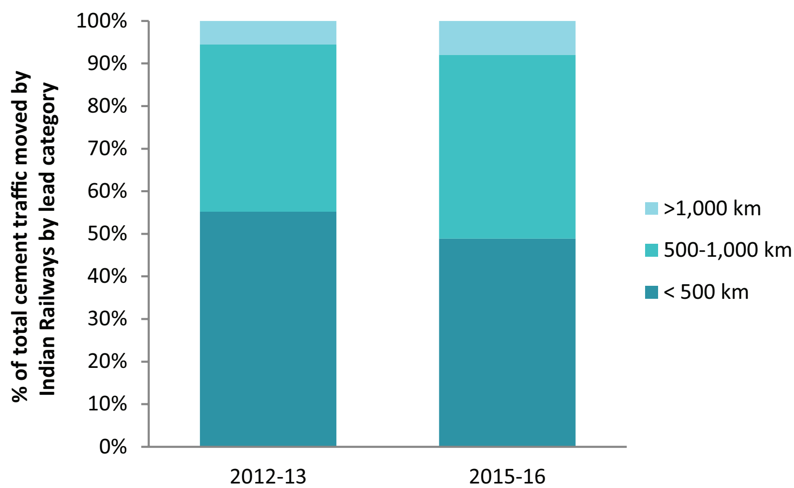


Figure 13: Share of rail dispatch of cement and related commodities by category of lead (2012–13 and 2015–16)
Source: Based on data from FOIS, 2016

Table 5: Distance travelled by rail, cement, and clinker (2012–13 and 2015–16)

Lead category	2012–13 weighted average lead	2015–16 weighted average lead	% change 2012–13—2015–16
< 500 km	308.6	303.1	-1.78%
500–1,000 km	695.3	698.1	0.40%
>1,000 km	1,267.7	1,231.8	-2.83%

Source: FOIS, 2016

The aforementioned findings are further supported by the average lead distance trends (Railway Board, 2018), which are weighted according to the tonnage of cement transported (Figure 14). This shows a continuing trend of declining cement movement distances over the years. This further highlights the importance of Railways maintaining and improving its attractiveness and suitability for shorter freight distances for cement, whilst also continuing to dominate longer cement/clinker freight distances. (Refer to Annexure 5 for the average lead of cement-related commodities.)

An analysis of the flow of inter-zonal rail freight movement for both cement and clinker shows that there has been a significant increase (49%) in the volume of the cement transported from the central to the eastern region to more than 21 MT in 2014–15. This reflects a similar trend identified for the overall movement of cement in the earlier section, suggesting an increase in capacity for the central region. The eastern zone has also increasingly been the destination for cement and clinker from the southern and northern regions, increasing by 39% and 19%, respectively, although from a much smaller base. Another key rail-movement trend is from the southern to the eastern region. As with the central region, the southern region appears to be witnessing an increase in the production capacity. Unlike the analysis of cement movement by all transport modes, the western region has seen a significant fall of 30% in receiving cement and clinker from rail, although much of this appears to be due to the falling inter-zonal cement rail dispatches in the western region.

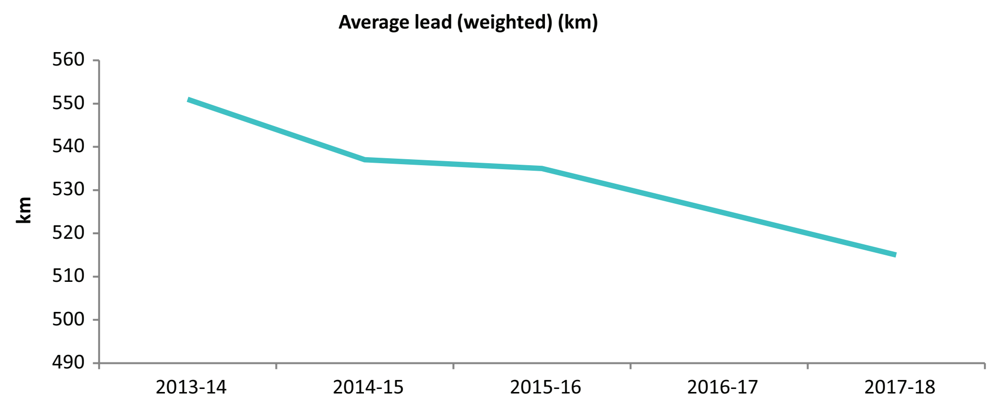


Figure 14: Average weighted lead for cement dispatches by rail
Source: Railway Board, 2018

Table 6: Key proportional changes in zonal movement of cement and clinker by rail between 2014–15 and 2015–16 (%)

	Receiving regions						
	Region	**Central**	**Eastern**	**Northern**	**Southern**	**Western**	**Grand total**
Dispatch regions	Central	22%	49%	-30%	-73%	65%	14%
	Southern	-40%	39%	-51%	25%	-17%	12%
	Western	17%	-9%	-7%	-12%	-43%	-27%
	Total	**14%**	**25%**	**-12%**	**7%**	**-30%**	**1%**

Source: FOIS, 2016

The top 10 zonal railways accounted for 95% of the originating cement and clinker traffic during 2017–18. Of these, SCR, WCR, SEC, WR, and SER accounted for three-fourths of the originating traffic. The top destination zones for cement and clinker traffic include NR, serving the entire North India's consumption demand, followed by CR and ECR. The top 5 receiving zonal railways accounted for 54% of the total cement and clinker unloading during 2017–18.

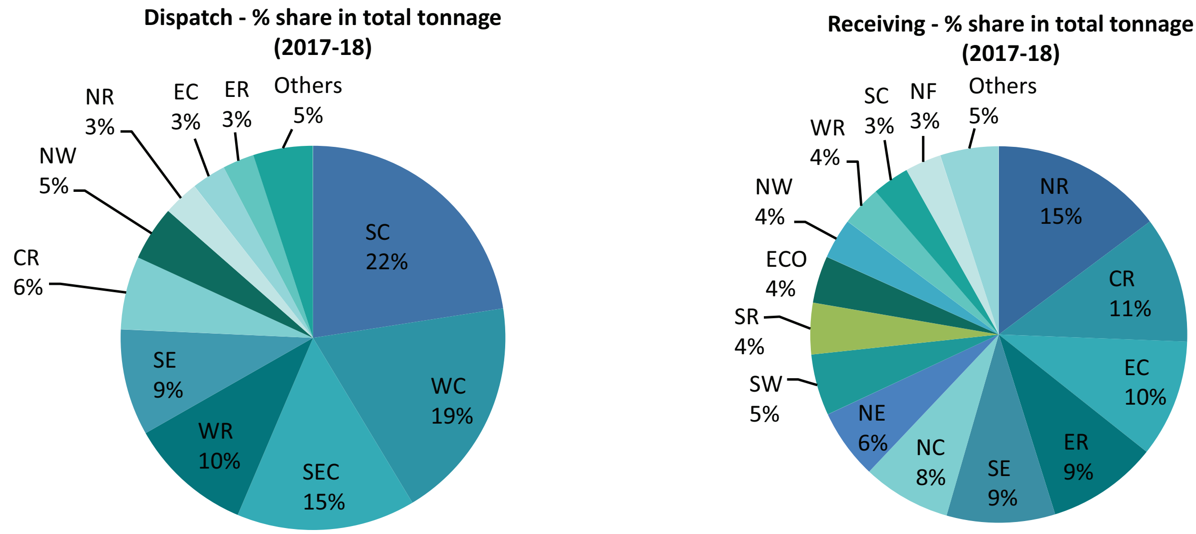


Figure 15: Regional cement proportions dispatched and received by rail (2017–18)
Source: FOIS, 2018

Loading of Cement and Clinker

It is not only the final product—cement—for which this sector requires transportation. The sector generates transport demand for its input raw materials such as clinker, coal, gypsum, fly ash, and slag. Of these, the share of commodities other than clinker is very low. Among the major commodities (cement and clinker), the share of cement declined from 78% in 2013–14 to 67% in 2017–18, while that of clinker increased significantly from 22% to 33% during the same period.

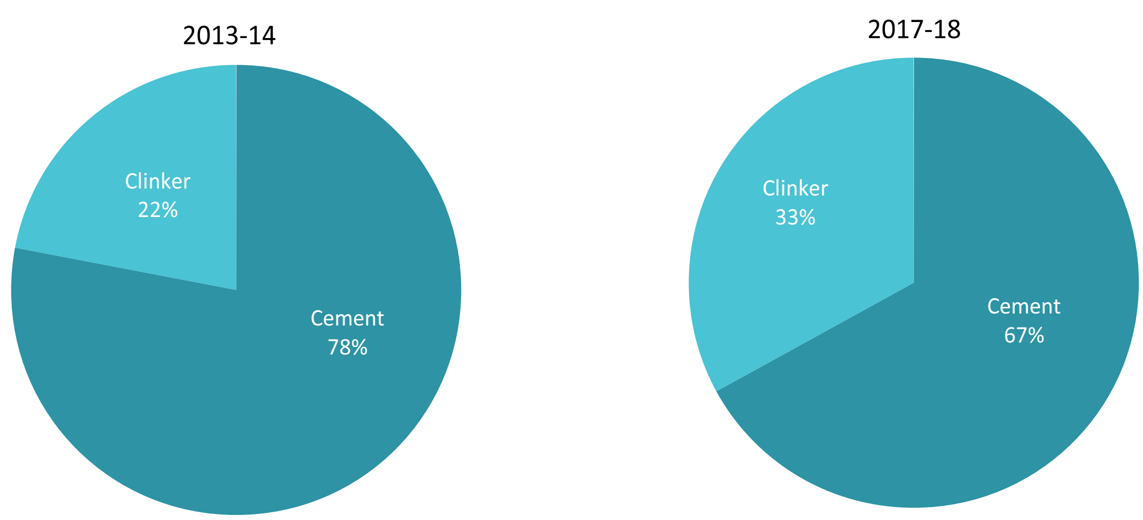


Figure 16: Share of loading of cement and related commodities on Railways (2013–14 and 2017–18)
Source: FOIS, 2018

Given the bulk nature of all these related products, these, too, are typically moved by Railways. An analysis of the rail traffic and loading information throws some light on the movement trends of these commodities.

In terms of the volumes of traffic loaded, there was a declining trend for cement and clinker from April 2013 till March 2016. Post this, the loading for both the commodities increased. For cement, however, the loading increased during 2016–17 and then declined again during 2017–18. This is in line with the changes in movement trends currently being experienced by the cement industry.

Rail Wagons

Railways employ a large number of different types of wagons, covered and uncovered, to transport cement and related commodities (Table 7).

Of these, the most widely used wagon type for the cement sector is the BCN wagon, which is a covered wagon specifically designed for cement movement. The lower number of BCNHL type of wagons deployed for cement and clinker movement also indicates that IR's initiative to introduce high-capacity rolling stock has inherent loading/unloading issues, especially in the case of manual handling. (Refer to Annexure 4 for details.)

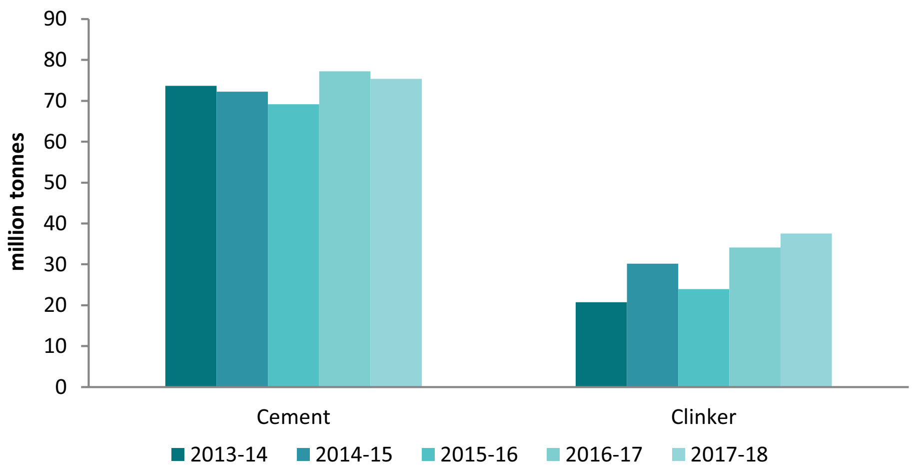


Figure 17: Rail dispatches of cement and clinker (2013–14 and 2017–18)
Source: FOIS, 2018

Table 7: Wagon types used by the cement industry for different commodities

Rake	Commodity
BCN	Cement, fly ash, clinker, gypsum, slag
BOXN	Cement, fly ash, clinker, gypsum, slag
BCNHL	Cement
BOXNHL	Cement, fly ash, clinker, gypsum, slag
BCCW	Cement, Fly ash
BOST	Cement, fly ash, clinker, gypsum, slag
SHRN	Cement, clinker, gypsum, slag
BOXNEL	Cement, clinker, gypsum, slag
BCFC	Cement, fly ash
BRN	Clinker, slag
BC	Cement
BOBYN	Slag
BOXNR	Clinker, gypsum, slag

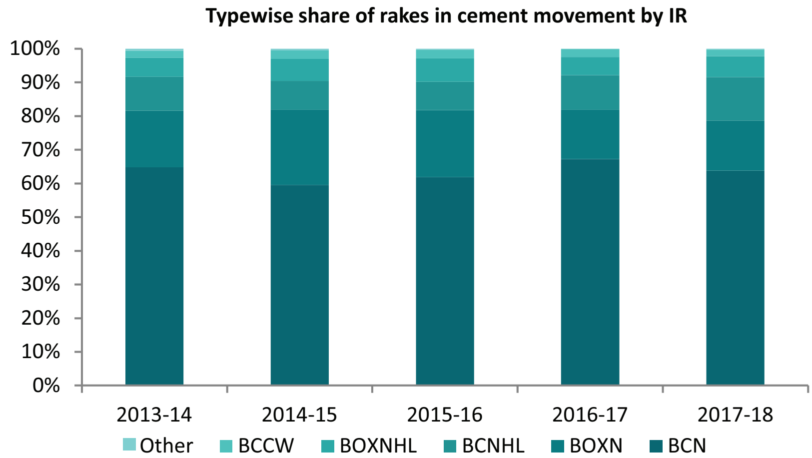


Figure 18: Type-wise share in the total number of rakes used in cement and clinker movement by rail
Source: FOIS, 2018

An analysis of the railway rake movement and loading information highlights that the share of BCN rakes in cement and clinker loading declined from 55% in 2013–14 to 47% in 2017–18. The share of BOXN and BCNHL rakes in the total cement and clinker carried increased from 22% to 25% and 13% to 14%, respectively, during the same period. This primarily indicates that BCN continues to be the preferred rolling stock for cement and clinker movement.

Findings from the Analysis

Increased Focus on Intra-Zonal Freight

Whilst cement (excluding clinker) rail freight accounts for a much larger proportion of inter-zonal movement than when considering all modes of freight movement, there is a clear potential for an increase (of around 55%) in the inter-region rail freight. The inter-region movement could, therefore, increase by around 19 MT per year. This potential is likely to increase further as the cement industry continues to transition to increased use of fly ash and locate grinding units closer to the points of consumption. This also shows that Indian Railways has successfully maintained a large proportion of inter-region cement freight movement, of around 64%. However, whilst Railways should be achieving close to 100% of inter-freight movement due to its natural suitability, the majority of cement freight still travels intra-region when considering all transport modes. This pattern is still likely to represent long leads due to the

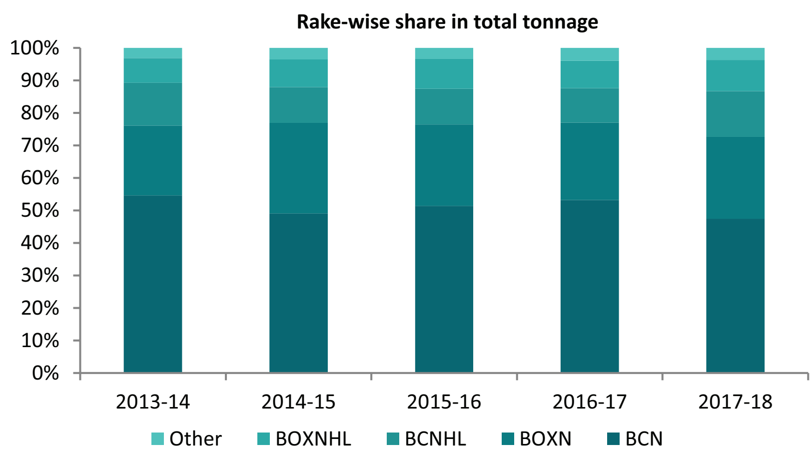


Figure 19: Rake-wise share in the total tonnage of cement and clinker movement by rail
Source: FOIS, 2016

vast size of each region. Therefore, whilst the inter-zonal potential for rail freight increases appears relatively small compared to the total, all-modal cement movement, the potential for increases in intra-region freight movement certainly exists.

Increased Focus on Shorter Lead Movements

Not only does most cement movement take place within the same region where it is produced, but the distance that cement moves by rail has also been falling consistently for several years and is currently as low as 531 km (2015–16), when weighted according to the tonnage of cement carried. Therefore, the suitability of rail for longer distances should not be overemphasized, since more efforts are required to make rail competitive with road transport for shorter distances. This is particularly true since around 50% of cement- movement journeys by rail are less than 500 km in distance.

Carrying Capacity Should Be Increased

There is evidence of capacity constraints when analysing the cement plants that are experiencing a falling dispatch share by rail. These plants are experiencing an overall increase in production as well as in the volume of cement and clinker being dispatched by rail. However, because cement production is increasing at a faster rate than dispatch volume, these plants are seeing a fall in their dispatch share.

Eastern Region Should Be Prioritized

The eastern region has only a few limestone deposits and is, therefore, a negligible producer of cement. However, it accounted for 30% of the total movement in 2014–15, the second-highest proportion of all regions. The eastern region also experienced a 25% increase in the receipt of cement between 2012–13 and 2014–15. This clearly shows the east to be a growth region in terms of spending on housing and infrastructure. Since cement is likely to be moving to the east across long leads, the rail network should be prioritizing this key movement pattern.

IR Initiatives

Indian Railways has undertaken a series of initiatives to increase its share in cement traffic. However, the impact of these initiatives is questionable as the overall loading in tonnages as well NTKM has not increased significantly. In fact, despite the reclassification of cement rates from Class 150 to Class 140, we do not see a significant increase in cement loading; IR reported a decline in loading as well as NTKM between 2014–15 and 2016–17 (Figure 9). This indicates the inelasticity of cement with respect to the rates charged by IR.

Discrepancies between Data Sources

The analysis in this chapter utilizes several different data sets, including from the CMA, the Railway Board, and the Railway Database (FOIS). Each data set provides overlapping but not identical data points. Where data sets do overlap, there is a degree of variance between the figures provided. However, the general trend across all data sources points to an increasing volume of cement being moved across India, including by rail. There is also a consistent decline in the share of cement moved by rail. For instance, while the CMA estimates point to the fact that the share of Railways in the total cement dispatches declined between 2009–10 and 2010–11, from 36% to 35%, the Indian Railways figures suggest a fall in rail-dispatch share in the total production from 45.8% in 2012–13 to 37.3% in 2015–16. Therefore, whilst specific estimates may be difficult to calculate given the data available, we can correlate the different data sets to develop insights into the current trends of cement movement by rail in India.

Some of the key measures are highlighted below.

- IR came up with its freight incentive scheme in 2009 with the 'aim to generate additional traffic volumes'.[4] It involved incentives for bagged commodities in terms of discounts, and schemes for empty flow direction and incremental traffic.
- In 2014, IR introduced the revised Liberalized Wagon Investment Scheme (LWIS) to boost private participation in rolling-stock acquisition.
- In 2016, IR undertook policy initiatives for 'permitting loading of covered rakes for two point/multipoint and mini rakes in both BCN and BCNHL rakes and increasing the distance limit for loading mini rakes up to 600 km'.[5]
- Initiatives concerning the tariff rate:
    - Reclassification of cement from Class 150 to Class 140 in 2015
    - IR issued guidelines for station-to-station rate policy in 2016. It involved discount on incremental cement traffic (maximum of 30%) and retention of traffic (maximum of 15%).[6]
    - No hike in freight rate for cement movement since 2015
    - Rebate for the movement of bagged commodities in BOXN wagons as well as on bulk cement (2007)[7]
    - IR also extended the automatic freight rebate scheme till March 2018 in order to incentivize loading on to the empty flow direction and maximize earnings and utilization.
- Increase in the permissible carrying capacity of BOXN/BOBR/BOBRN wagons to CC+6 tonnes (2006).[8]
- IR (through zonal railways) signed Long Term Tariff Contracts (LTTCs)[9,10], with 21 companies, including cement and steel manufacturers, in 2017. Through this, both the parties agree to a predetermined price-escalation principle, where cement companies can avail freight rebate on incremental loading/revenue. The key cement manufacturers that have signed the contract with zonal railways include UltraTech Cement, India Cements, JK Cement, Ambuja Cement, and ACC.

Since the launch of this unique initiative by IR, rail traffic, specifically of cement, has witnessed a rise. In terms of tonnages, cement loading increased from 104 MT in 2016–17 to 114 MT in 2017–18, while in the NTKM terms, cement witnessed 60 billion NTKM during 2017–18 as against 55 billion NTKM during 2016-17.

IR's Initiative for Increased Cement Loading: Policy on Long Term Tariff (Issued in March 2017)[11]

As we have seen earlier in the data-analysis section, the increase in cement loading onto railways and that in earnings per NTKM could be explained by the proactive role IR played in collaborating with the industry. A dedicated policy on long-term tariff contracts was issued in March 2017, which resulted in cement manufacturers signing contracts with IR. Details of the contract have been given below.

- Discounts offered by IR based on incremental growth in gross freight revenue (GFR) in return for commitment to provide the minimum guaranteed quantity of traffic.

[4] *See http://www.indianrailways.gov.in/railwayboard/uploads/directorate/traffic_comm/FREIGHT_RATE-2K9/RC%20No.%2062%20of%202009.pdf*

[5] *See http://pib.nic.in/newsite/PrintRelease.aspx?relid=137976*

[6] *See http://164.100.47.194/Loksabha/Questions/QResult15.aspx?qref=51736&lsno=16*

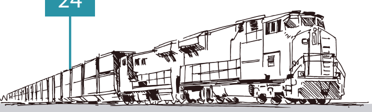
[7] *See http://www.indianrailways.gov.in/railwayboard/uploads/directorate/traffic_comm/freight_rate-2k7/RC-78.pdf*

[8] *See http://www.indianrailways.gov.in/railwayboard/uploads/directorate/traffic_comm/freight_rate-2k6/rate_inst_27-2k6.pdf*

[9] *See http://pib.nic.in/newsite/PrintRelease.aspx?relid=167436*

[10] *See http://www.indianrailways.gov.in/railwayboard/uploads/directorate/traffic_comm/Freight_Rate_2017/RC_14_2017_30032017.pdf*

[11] *See http://pib.nic.in/newsite/PrintRelease.aspx?relid=158793*



  - Rebate ranges from 1.5–35% based on incremental growth in GFR
  - The consigner should offer a minimum traffic volume of 1 MT per annum.
  - The contract is valid for a period of at least 3 years, which could extend up to 5 years.
  - New customers are required to load over 3 MT onto Railways during the contract period, of which 1 MT should be loaded during the first year of the contract period.

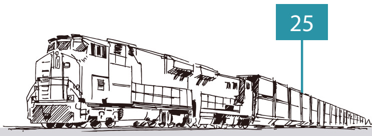
- For those consigners who already load more than 5 MT onto Railways, discount would be granted on the basis of absolute GFR corresponding to the total volume of traffic offered by the company during the previous 12 months, subject to the same GFR being maintained over the period of the agreement.
  - Rebate ranges from 0.5% to 5% according to the volume of traffic.
- The long-term tariff policy does not offer benefit to movers of commodities classified below Class 100, coal and coke, military traffic, and railway material consignment.
- Under the predetermined price-escalation principle, any revision in freight rates will be applicable from the start of the following year of the agreement.
- Discount in freight under this scheme will be given as refund within 45 days.
- Contracts are to be executed at the zonal railway level. In a scenario where multi- zones are involved, the contract will be executed by the zonal railway that witnesses the highest traffic.
- Consigners are allowed to make multiple contracts with different zonal railways.

One of the key benefits of this kind of initiative is the ironing out of the uncertainty often associated with IR, which has also been mentioned in the issues section (Policy and Governance). Another benefit of such initiative is the certainty in loading and revenue stream. Similar customer-centric approach by IR, not only for bulk 'loaders' but also non-bulk movers, should be adopted, which will ultimately help increase IR's share in freight movement.

Concerns of Cement Manufacturers Regarding LTTC

Lately, difficulties and a certain degree of confusion have emerged with regard to this scheme, which need to be resolved to keep the momentum of increased traffic going. TERI interacted with key cement manufacturers who have signed the LTTC to understand the issues faced under the scheme. These have been highlighted below.

- The understanding of the clauses/content of the LTTC scheme circular varies across zonal railways. The understanding of the commodities being accounted under the LTTC scheme of the Centre for Railway Information Systems (CRIS) while generating the revenue receipt (RR) is vague. Instead of the broad category of the commodity to be selected by the CRIS — in this case, cement— it considers the subcategory of cement like Pozzolona cement, Portland cement, and so on. This creates confusion, as in many cases the manufacturer may not be moving a specific type of cement by different zonal railways.
- The approach to benchmark the earnings of cement manufacturers is taken differently by different zones: some zonal railways take the CRIS data, while others take data captured by the respective zonal railway.
- There is a lack of clarity with regard to inward and outward movement of commodities. For instance, slag could be considered as an outward movement by a steel plant but an inward movement as raw material for cement plants. This could result in double accounting of tariff benefit when both the steel and cement manufacturers have signed the LTTC with the zonal railway.



Recommendations to Resolve the Concerns

- The aforementioned issues could be resolved through clarification from the IR to all the stakeholders: zonal railways and customers.
    - IR should assess the volume/freight of customers carried under the LTTC as consignor or consignee in the last one year. Based on the share of volume carried by the consignors or consignees, decision could be taken so as to make the LTTC scheme a consignor-based or consignee-based scheme. IR has already clarified in the LTTC scheme (Para 6.8 of the RC_14_2017 circular) that in case 'both consignor and consignee are LTTC, then the concession for that RR shall be granted only to the consignor'. Otherwise, IR could explore the possibility of issuing a dual revenue receipt to the consignor and consignee based on which they could claim rebate on tariff.
    - While generating RR, the CRIS should consider the broad commodity category code (cement) instead of the specific commodity code (Portland cement, Pozzolana cement, and so on).
    - While benchmarking, the actual gross freight revenue (AGFR) adjustment provision should be made in the accounts of the customer in case his existing consignor or a consignee (who has not signed the LTTC contract previously) enters into a fresh LTTC contract with the zonal railways.
    - In case of minor differences in the volumes/AGFR numbers between zonal railways and the CRIS data, allowances should be made for necessary data corrections/reconciliations based on the CRIS/TMS.

Cement Industry Concerns

CMA Concerns

Interactions with the CMA revealed that the cement industry has not responded positively to the increasing use of the high-capacity BCNHL wagons. The industry cites two main reasons:

1. The BCNHL wagons, owing to their design dimensions, are taller than the BCN wagons, making it difficult to fill them up to the top by manual processes. This leads to a less-than-optimal use of the high-capacity rakes.
2. Higher-capacity rakes mean that the cement plant could now pack in more of its production in one rake. However, the volume of cement demanded at the destination is often less than a rake load, making it difficult for the plant to optimally use these high-capacity BCNHL rakes.

Additionally, the association has submitted the following concerns:

- Inadequate availability of rakes for cement and clinker movement is a major issue.
- BCNHL and BOXN wagons are in a poor condition.
- Inadequate infrastructure facilities at terminals like platform, double line, access road, and so on.
- The overall cost of transporting cement by rail is much higher than by road.
- Frequent congestion on certain routes and stations
- Major rail heads are facing road restrictions.
- Rail freight not economical versus road freight at less than 500 km.

Key Recommendations of the Association

- Clinker should be classified as two classes lower than cement, that is, Class 120.
- Similarly, classification of pet coke should be fixed at par with fly ash—that is, Class 120—since both have a similar density.
- A freight rebate of 25–30% should be considered for short-lead cement movement.
- Busy-season charge, development charge, and congestion charge should be waived off.
- The Railway Board may upgrade and mechanize all the major terminals handling cement to improve the turnaround of wagons. Additionally, roll on–roll off (Ro-Ro) facility may be introduced by IR.
- Regular and consistent supply of rakes to the cement industry

CII Concerns

The representatives from the cement industry who are a part of the Confederation of Indian Industries (CII) have presented the following concerns:

- Loading time for BCNHL in new sidings needs to be reviewed.
- Frequent congestion, both on certain routes and stations
- The classification of clinker and pet coke may be downgraded to Class 130 and Class 120, respectively.
- Unavailability of fly ash

Concerns of Industry Representatives

The concerns and recommendations highlighted by the CII and the CMA were used as a basis for further meetings and dialogue with the cement-sector stakeholders, where more specific issues and suggested improvements were identified and explored.

Figure 20: Sidings are often too short to accommodate the length of rakes and make unloading more difficult
Source: Site visit, TERI

Terminal Hard Infrastructure

- Poorly maintained terminals: Several issues related to the condition of railway sidings have been put forth by the cement industry. These include holes in the roofing at the sidings and goods sheds, poor vehicle access, ineffective lighting, uneven surfaces, and a lack of basic amenities such as drinking water, sanitation, and electricity. This leads to poor working conditions, product damage, and inefficient loading and unloading of the product.
- Poorly designed and unsuitable terminal facilities: There is a lack of adequate facilities at many terminals that limits their suitability for handling large amounts of cement. Issues relating to the provision, design, and quality of terminals include unavailability of storage facilities within close proximity of the platform and small platforms that can't accommodate the full length of a rake, or are not designed to accommodate any form of mechanization for loading and unloading of rakes (Figure 20). These issues prevent efficient operation at sidings and increase the complexity and hassle for cement manufacturers using the rail network.
- Access to terminals: Access and provision of parking bays for waiting trucks is often inadequate at terminals, leading to haphazard and disorganized use of land at terminals. This reduces the efficiency of terminal facilities as well as the safety of railway facilities, especially considering the fact that there are often a significant number of unorganized/ encroached settlements within close proximity of the railway terminals.

Terminal Operation

- Handling charges: The labour force present at sidings is currently largely informal, which neither the cement manufacturers nor IR take responsibility for. This has led to the imposition of so-called 'unions', who have largely taken control of the labour force and determine the costs and conditions they will work under. Since labour unions currently face no competition, they are free to determine the handling costs of loading and unloading the rakes. These handling charges are becoming increasingly exorbitant and represent a significant cost factor for rail freight. One cement manufacturer suggested that the handling costs at sidings now represent up to 40%

of the entire cost of cement movement by rail. There is little evidence, however, that the union heads are considering the welfare of the workforce, since only a small portion of the income raised from handling charges is likely to go to the workers themselves.

- Health and safety: Many terminals lack any form of amenities for workers and offer very poor working conditions, such as a lack of clean drinking water, sanitation, lighting, and clean air (Figure 21). This is particularly troublesome considering the very physical nature of much of the work at rail freight terminals.

Figure 21: Lack of suitable footwear, protective masks and accumulation of cement dust in the air and on the platform have major side effects for the workers
Source: Site visit, TERI

- Terminal security: There is often a limited provision of security measures at railway terminals, making product theft possible. It is also easy for individuals who do not work at the terminal to access terminal facilities, which has implications for health and safety and the terminals' ability to provide basic amenities to its workforce.
- Product damage during loading and unloading of rakes: A significant damage is caused to the cement product due to the methods employed at the sidings for loading and unloading rakes (Figure 22). Since there is no form of mechanization at the sidings, labourers use hooks to manoeuvre the cement bags, which weigh as much as 50 kg, with two labourers using two hooks each to move a cement bag. For each hook used, a hole is created in the cement bag leading to a significant loss of the product and further tearing of the bags. This, therefore, represents a significant indirect cost of using the railways for cement manufacturers.

Figure 22: Split cement bags lead to a significant loss of the product
Source: Site visit, TERI

- Seasonal labour availability and unavailability of labour at night for loading/unloading of rakes at sidings: Whilst most sidings in India have been converted to operate for 24 hours a day throughout the year, much of the labour force only works during daylight hours. It is, therefore, common for rakes to arrive at a siding in the evening or at night, when the labour force is unavailable for unloading. Labour availability also fluctuates between seasons, as workers leave the vicinity of the terminal and return to their homes. Rakes are, therefore, stationed at sidings for lengthy periods of time, with the subsequent likelihood of accumulating further charges. This problem is often exacerbated since many cities place restrictions on the movement of trucks during the day. Cement products may therefore be unloaded from the rake only to be stranded at the sidings until trucks are allowed to move the product to its final destination.

Rail Links

- Major cement-production centres not connected to the rail network: As identified previously, a significant proportion of cement plants are yet to be connected to the rail network. Despite this, many plants that are close enough to the rail network would have historically still moved significant volumes of cement on the rail network using trucks to move cement from plant to siding. However, ever since the road infrastructure has improved and expanded, this is becoming increasingly uncompetitive. Thus, the rail network should be expanded to within close proximity of cement plants to provide sufficient connection and continued use by the cement industry.

Rolling Stock

- Poor maintenance of wagons: A common complaint of the cement industry regarding railways is the poor state of repair of many wagons. Cement manufacturers have been forced to allocate dedicated teams to repair wagons prior to loading in order to prevent damage and loss of cement. One manufacturer estimated that it had lost around 20,000 tonnes of cement in one region in the last three to four months due to poor-quality wagons. Poor maintenance of wagons is a primary cause of delays in rakes leaving terminals, with cement manufacturers paying significant penalties.
- Poor design of wagons: The BCNHL wagon has been speically highlighted for its design deficiencies. Whilst the BCNHL wagon type, in theory, has greater storage capacity, its poor design jeopardizes the labourers' safety while loading and prevents the wagon from being fully loaded. Additionally, faults with the door design of various wagon types mean that there are often significant gaps for water to enter the wagon and damage the cement product. Cement manufacturers have subsequently hired teams to seal the wagons prior to transit in order to minimize the loss of cement during transit. This causes delays to the rakes and adds additional cost. Additionally, many of the wagons are not designed to accommodate any form of mechanized loading and unloading.

Figure 23: Ill-fitting wagon doors lead to product damage during transit

Source: Site visit, TERI

Policy and Governance

- IR's inconsistent policies: Policy uncertainty has arguably emerged as the primary challenge for cement manufacturers in dealing with IR. The frequent imposition and removal of policies on a short-term basis by IR creates uncertainty regarding the future costs and availability of railway services, preventing the cement industry from undertaking long-term planning and investment. The capital expenditure required by cement manufacturers for railway infrastructure such as private sidings and goods sheds is extremely high. One manufacturer gave an estimated cost of Rs 25–30 crores to develop a connecting siding for one of its goods sheds. Cement manufacturers regard the short-term nature of many of IR's policies as an example of its monopolistic behaviour, using the perceived lack of competitive freight options for the cement industry to make short-term profits. Many cement manufacturers have commented that they are actively following a road-based freight strategy for future cement plants and grinding units due to the greater certainty associated with road freight.

Railway Pricing

- Uncompetitive freight charges for railways: Cement manufacturers regularly cite IR's uncompetitive freight charges as a key reason why significant amounts of cement freight have moved away from Railways. In recent years, there has been significant investment and subsequent improvement in the road infrastructure in India, including expansion of the road network, increasing availability and capacity of trucks, as well as improvements in the quality of roads. The increasing competitiveness of the road haulage industry, along with factors such as the falling cost of diesel in recent years, has led to a drastic reduction in the cost of moving cement by road. Cement manufacturers regularly cite 2012 as a year when freight costs imposed by IR increased dramatically.

  One cement manufacturer informed that the freight charge for one transit route increased by 46% in a single year, with no explanation given for such a large increase. Another cement manufacturer indicated that it will be difficult for IR to offer competitive rates as compared to road transport for leads less than 350–400 km, unless high volume becomes the determining factor to choose railways over road transport.

Besides haulage charge, the overall rail transport cost for moving commodities also depends upon the last mile–first mile costs, ease of loading/unloading at terminals and warehouses (terminal costs), and availability of workforce at terminals/originating point. Another component which plays a significant part in the choice of mode is the damage caused during transit or during handling at terminals. In case of cement movement, damages during handling at terminals or during transit due to faulty wagons are a major issue. Cement companies deduct the amount associated with transit damages from the total cost claimed by road transporters, which is not the case with IR.

TERI analysed the cost components of transporting cement between two sample ODs through railways, which indicates that about 50–63% of the transport cost is accounted for by IR's haulage charge, followed by last-mile movement by road at about 18–23%. About 26% of the total transport cost is accounted for by the terminal-related charges/costs. Another 1% is accounted for the damages during handling and transit, which is not covered by IR. However, when we compare the rail cost with that of road transport, which requires lesser handling, the road cost comes out to be 2–11% cheaper for the two ODs considered under the analysis.

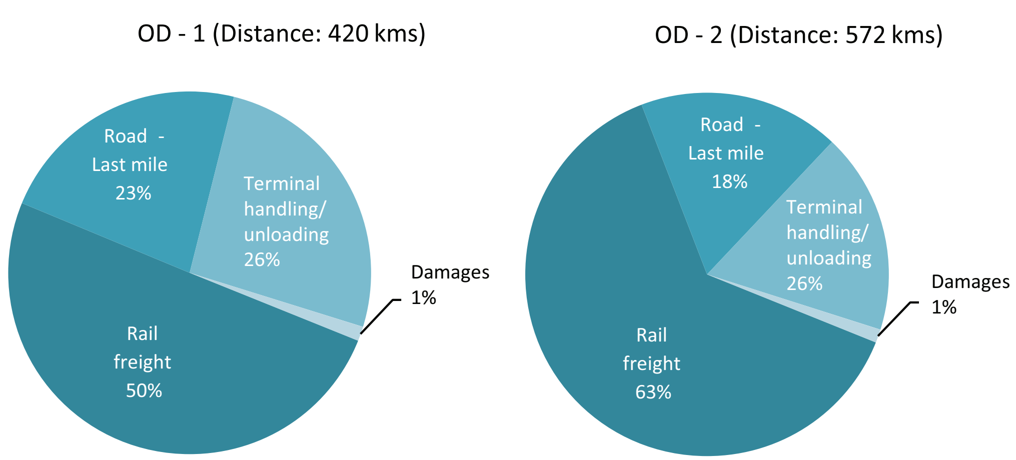


Figure 24: Cost components of rail transportation of cement (%)
Note: Excluding the cost of assets, depreciation, and other charges
Source: Industry sources

- Pan-India pricing: IR determines pricing on a pan-India level. This approach creates a lack of flexibility in pricing that is detrimental to the railways according to the cement industry, since cement freight transport is extremely location- and route- specific. For instance, as compared to the western region of India, the lower quality of road infrastructure in the east makes road freight less competitive with the railways. Therefore, whilst a reduction in the rail-freight cost across India may increase the share of cement that travels by rail in the west, it is likely to have little impact on the railway coefficient in the east, and will instead lead to reduced revenues for IR in the east. Road haulage companies, on the other hand, may only operate on a single route or within certain regions, leading to a strong price differential across India.
- IR is not currently following an industry-wide strategy: The removal of the 15% busy-season surcharge on the movement of finished cement products, but not on intermediate clinker products, highlights IR's lack of an industry-wide strategy for the cement sector. The cement sector, in particular, has strong forward and backward linkages for rail movement, with over 40% of the raw-material inputs moving inwards by rail and a large volume of bulk intermediate output moving out in the form of clinker. Movement of these commodities, however, is not considered as cement traffic since busy-season surcharges are applied based on the wagon type. It has, therefore, become more expensive to move clinker by rail than finished cement products. Thus, cement manufacturers are closing grinding units and instead processing clinker at their integrated plants to be moved as the final cement product. Due to the lower-movement volume requirements of the intermediate product, clinker should almost entirely be transported by rail.

Case Studies

As part of the study, TERI interacted with a number of stakeholders from the industry as well as with IR. Site visits were made to understand the ground-level operational issues and challenges, which have also been highlighted earlier in this chapter. Some of these site visits and information emerging from the interactions with the cement-industry players have been included here as part of case studies.

Shakurbasti Cement Siding, New Delhi

Shakurbasti cement siding is located in the northwest of New Delhi and is part of a much larger complex that includes both passenger and freight terminals. The cement siding has three tracks and three platforms and is a key terminal for delivering cement into central Delhi. At the complex there are siding facilities belonging to both IR and the Central Railside Warehouse Company (CRWC), with only the CRWC providing goods sheds to store the cement after it has been unloaded. Despite sitting on a large area, informal settlements cover much of the land which allows for a limited space for loading and unloading. The entire freight terminal is characterized as being in extremely poor condition, although unlike many other sidings, some basic amenities, such as running water, are provided for workers by the union heads.

Table 8: Photographs from the site visit at Shakurbasti Cement Siding

	The Shakurbasti freight terminal can be accessed through a narrow, uneven track. There is very poor visibility and no signage to direct freight traffic at the entrance to the complex. Encroachment from parked trucks and informal settlements further limit accessibility.

Table 8: Photographs from the site visit at Shakurbasti Cement Siding

	Disused belt conveyers for loading and unloading cement bags. Despite being newly purchased (manufactured in 2015), the lack of suitability of the rail platforms was cited as the primary reason why the conveyers were not used.
	There is very limited space for trucks to park at the siding. Haphazard parking is evident all around the complex, causing encroachment and bottlenecks along the access roads. The large amounts of cement dust accumulated during the unloading of cement bags is clearly visible at the platform, creating a sloped bank next to the platform, with the end of the platform barely visible due to the build-up.
	The platforms at Shakurbasti are incredibly narrow and not suitable for any form of mechanization, inhibiting siding efficiency and the quality of service.
	Much of the facility is in a poor state of repair, with damaged roof and poor-quality lighting for workers at night.

Source: Site visit, TERI

Route Rationalization from ACC Kymore Cement Plant to ACC Tikaria Grinding Unit

ACC has been moving up to 1.5 MT of intermediate product clinker per annum by rail, from its production plant in Kymore (Madhya Pradesh), to its grinding unit in Tikaria (Uttar Pradesh) since the last 18 years. The Tikaria grinding plant, with a capacity of 2.5 MT, serves ACC's entire Uttar Pradesh market. Prior to February 2014, this route was 393 km in distance, following a largely direct route from source to destination.

Without prior discussion with ACC and other stakeholders, IR issued a circular in February 2014 requiring the future rakes to take an alternate route to Tikaria, going via Banda station, with IR citing route congestion as the reason to switch from the more direct route. This change of route represents a 51% increase in the distance of the journey. ACC has lost approximately Rs 50 crore annually since this circular was issued.

Whilst IR may receive higher revenue in the short term from the various route rationalizations it makes as well as through increasing freight charges, ACC have indicated that the long-term effect will be to reduce IR's revenues due to cement manufacturers opting for road freight instead of rail. For instance, ACC has advised that the future clinker movement between Kymore and Tikaria will eventually happen by road, since trucks can take a more direct route of approximately 375 km that will be more competitive than rail.

Further losses in revenue for IR from this particular route rationalization are expected in the future. In addition, ACC were in the final approval stages of increasing the grinding capacity at Tikaria by a further 1.5 MT, with plans for additional clinker to be moved by rail from Jamul in Chhattisgarh at a rail-freight rate of Rs 1,600 per tonne. These plans have now been shelved due to the lack of IR's cost competitiveness and uncertainties associated with the future railway policy. This could potentially result in a loss of up to Rs 200 crores to IR in lost revenue.

Rail Connectivity for JK Cement's Muddapur Cement Plant, Karnataka

The Muddapur cement plant in Karnataka is operated by JK Cement and serves the markets of western Maharashtra, Karnataka, Goa, and northern Kerala. The plant is not currently connected to the rail network, with the nearest rail terminal located around 60 km away at Bagalkot. Therefore, moving the cement product by rail requires the use of road freight to bridge the distance between the plant and the rail terminal. This involves manual handling and becomes increasingly economically unviable due to the additional costs associated with multimodal freight movement. The cement product from the Bagalkot plant has experienced a declining rail co-efficient and moves predominantly by road.

The cement plant at Muddapur was established following a 2006–07 railway notification which stated that a rail connection between Bagalkot and Kudachi was to be

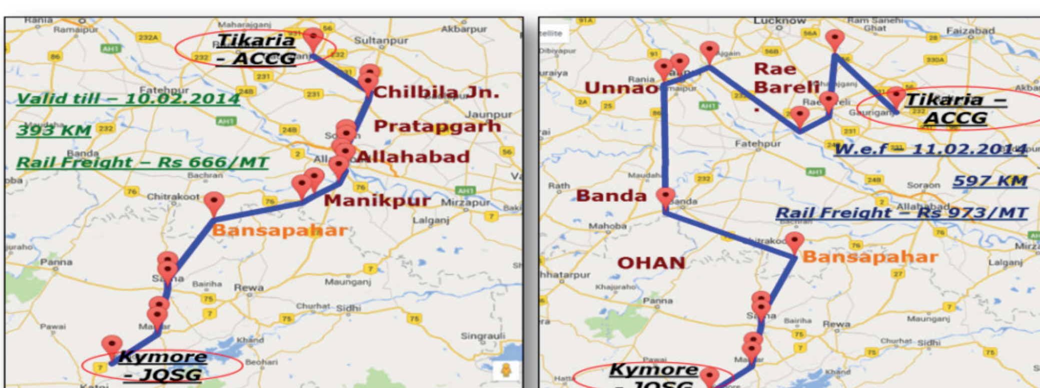


Figure 25: Change of rail route between ACC's Kymore and Tikaria facilities following route rationalization issued in the February 2014 circular
Source: TERI Analysis

established in 2010–11, which would subsequently allow the Muddapur plant to be connected to the rail network. JK Cement estimates that 40–45% of plant production would move by rail with the commissioning of rail connection, which would represent a significant increase from the current rail coefficient in 2015–16. Additionally, product from other cement and agricultural product from the region would likely move by rail if the line between Bagalkot and Kudachi were complete, leading to a significant regional shift of freight movement from road to rail. However, despite the 2006–07 notification, the line has still not been built as of 2016. Indecision regarding the route of the line has been blamed as the predominant cause for the delay, with only around 35 km of the 60 km line confirmed.

Cement Transportation to Kerala from JK Cement's Gotan plant, Rajasthan

JK Cement operates a white cement plant at Gotan, Rajasthan, that serves markets in the down south, such as Kerala. Due to the high costs of moving the cement from plant to the point of consumption by rail, JK Cement follows a multimodal movement pattern. From the Gotan plant, rakes are loaded and sent to Mundra Port in Gujarat. The cement product is then transferred to a ship and transported by sea to southern points, where it is reloaded onto land-based freight modes (road/rail) for the final part of the journey. Despite this complex process that involves significant additional handling between the different modes of transport, it is around 30–34% cheaper than following a single mode method of using rail from the plant to the point of consumption. Additionally, it also takes much less time from the start to the end of the journey.

Recommendations to IR

Terminal Hard Infrastructure

Recommendations for Immediate Implementation

- **Sidings quality/standards**: IR needs to take proactive steps to ensure that sidings—the gateway of accessing railway services—are maintained to meet the necessary industry quality requirements. The current standard of the railway sidings must be improved through regular maintenance and upkeep. This includes repairing platform and warehouse roofs, providing effective lighting for workers, upgrading the platform surfaces and those of the surrounding areas, as well as regular sweeping of platforms and goods sheds to prevent the build-up of product residue.
- **Terminal-access facilities**: Vehicle access should be planned in accordance with the kind of traffic handled at the respective siding based on a siding-assessment survey across the IR network.
    - Vehicle access to the railway sidings needs to be upgraded, including wider roads with smooth, permanent surfaces and the provision of lighting for traffic.
    - The provision of a sufficient number of organized parking bays at the terminal is required for the waiting trucks.

Medium-Term Recommendations

- **Suitability of sidings**: IR needs to carry out an assessment of the kind of rolling stock handled at different sidings and, wherever necessary, the length of platforms and capabilities of facilities (such as accommodating forklifts and others) should be customized to ensure fast turnaround times and reduce handling and operation costs. This will improve the capacity and effectiveness of sidings.
- **Terminal standards**: Detailed guidelines and specifications for terminals should be developed based on a standardized set of requirements for all the major railway terminals (allowing for a certain level of customization depending on the commodities handled). Guidelines should include provisions for future conversion of terminals to accommodate bulk movement, mechanized loading and unloading, and longer-term storage facilities.

Long-Term Recommendations

- Increasing competition at sidings: The possibility for the provision of private freight terminals should be explored with the aim of providing increased competition with regard to the cost, standard, and availability of siding facilities compared with IR's.

- Increasing the terminal capacity to handle the bulk movement of cement: Moving cement in bulk has potential as a much more cost-effective method of cement movement and is likely to be competitive versus road, even for shorter distances. Increasing the bulk movement of cement, therefore, needs to be increasingly incorporated into the future rail-freight strategies as a way of competing with road for ever shorter distances. This includes ensuring that the major terminals have the capacity to incorporate the infrastructure for handling bulk product in the future.

Terminal Operation

Recommendations for Immediate Implementation

- **Terminal security**: Security needs to be improved to ensure that only facility workers can access railway facilities. There should be increased planning to ensure that freight sidings, like freight warehouses, are adequately secured so as to ensure the safety of material and products from rail sidings and provision of facilities/amenities dedicated to workers should be made. All labourers who work at the railway facilities should be registered with IR and provided with appropriate identification, whilst security fences and increased number of security guards will ensure that the terminal perimeter is effectively secured.
- **Labour management**: The study has clearly highlighted the need for IR to take greater responsibility of the labour force working at the railway sidings. IR needs to assume this responsibility not only to ensure the health and safety conditions of workers at railway sidings, but also to increase the efficiency of services they offer. A greater role of IR in management of siding workers would lead to improved productivity and lower turnaround times and costs at sidings. It would also be necessary for IR to determine the appropriate wages for the labour force to ensure a fair income for the workers as well as to make sure that the handling charges offer value to the facility users.
- **Health and safety at terminals**: Adequate health and safety standards are urgently required at many railway sidings, which prioritize access to clean, drinkable water as well as the provision of sufficient sanitation and good air quality. The aforementioned recommendation for improved facility security will ensure that only facility workers have access to these amenities. Face masks should be offered to all workers to combat the presence of cement dust suspended in the air.
- **Labour training**: Workers should be given site induction and information sessions to convey the appropriate facility information, including health and safety advice (such as the health benefits of using face masks and correct handling techniques).

Medium-Term Recommendations

- **Handling at terminals**: The current use of hooks to move cement bags must end. This will require the development of an effective alternative for loading and unloading cement bags from rakes and trucks which does not compromise worker health and safety. This may require some form of mechanization at the sidings, as well as a possible redesigning of the cement bags themselves. The primary role of any mechanization at the sidings should be to increase the speed and quality of rake loading and unloading, rather than to reduce the size of the workforce.
- **Facility labour force**: IR should explore the possibility of contracting out the operations and management of terminal facilities to third-party entities in order to create a competitive dynamic based on cost, service quality, and welfare of the workforce. Contracts should be awarded periodically through competitive bidding and assessment of the past contractor performance.

Rolling Stock

Recommendations for Immediate Implementation

- Maintenance of wagons: IR should undertake regular wagon checks to rectify any defects preventing their full utilization, including repairing holes in the roof, floor, and walls; removing product residue built up in the wagons, and ensuring that the wagon doors operate properly.

Medium-Term Recommendations

- Use of rail- and road-compatible wagons for cement use: Increased use of wagons that can be used for moving cement in bulk by either road or rail should be evaluated as a medium-term approach for transitioning to a bulk-based model for cement movement (Figure 27).

Figure 26: Cement tank for bulk movement of cement by either road or rail

Long-Term Recommendations

- Design of rolling stock: The rolling stock is not suited to meet the requirements of the cement industry and needs to be redesigned, with new wagons being phased in gradually. The new wagon design should be such that the wagons could be filled to their stated capacity, should provide an effective seal that protects the cement product, and should be able to accommodate mechanized loading and unloading.
- Increased focus on wagons for bulk movement: Design requirements for new models of rolling stock should be established such that they can effectively handle increased bulk movement of cement in the future. IR should consult the manufacturers, customers, and operators to develop a blueprint and allow for timely introduction of suitable rakes in the future, thereby increasing the efficiency and cost-effectiveness of cement movement by rail.

Policy and Governance

Recommendations for Immediate Implementation

- Policy certainty: Improved certainty should be provided to the cement sector through stable, long-term, and well-designed policies and pricing structures. This would enable the key rail stakeholders to make longer-term rail-based planning and ensure that they have a stable investment environment for increased utilization of the railway network.
- Policy communication: IR should enhance the communication of changes and amendments to freight charges and policy through an easy-to-use, internet-based platform that sends automated updates to the affected parties.

Medium-Term and Long-Term Recommendations

- **Measurement of operational performance of railway zones**: A system of measuring the service performance for each terminal, railway zone, and region should be developed. The key performance indicators (KPIs) should include rake loading and unloading time at terminals, accurate commodity-specific rail-coefficient measurements, complaints made regarding the service quality and sanctity of contracts, and availability of wagons.
- **Development of commodity-specific targets and strategies for cement movement**: Short-term action plans and long-term visions should be developed to provide guidance to railway managers as to the future requirements and expectations of IR. This includes transparent targets of the expected quantities of each commodity that IR should be moving each year, with clear responsibilities given to the appropriate managers. Detailed responsibility matrices will determine regional accountabilities for all railway functions to ensure that standards are adhered to and targets achieved.
- **Imposition of a complaints resolution board**: An independent committee should be established to investigate complaints made by railway users with regard to breaches of contracts to ensure the continued sanctity of contracts and pricing agreements.
- **Internal competition**: A mechanism should be introduced to encourage competition between railway zones on measured KPIs as a way of improving performance and standards across IR's functions.
- **Distance-dependent strategies for cement movement**: IR should develop commodity-specific strategies according to different distance classifications since rail is less competitive for shorter

leads. This may be in the form of price incentives or prioritization for rakes moving shorter distances.

Railway Pricing

Recommendations for Immediate Implementation

- **Competitive pricing**: IR should offer more competitive freight charges versus road freight, appreciating the existence of competition for business. Pricing structures should consider the increased handling charges, product damage, and reduced ease-of-business currently associated with rail freight.
- **Industry-consistent pricing**: IR should follow industry-wide/commodity-wise pricing strategies rather than charging according to the specific wagon types. This should include the removal of the busy-season surcharge on clinker. IR should put in place commodity-specific pricing to incentivize the cement industry to move back to rail.

Medium-Term Recommendations

- **Pan-India pricing**: IR should follow a more dynamic pricing strategy that considers the location- and route-specific nature of many freight competitors and infrastructure standards, thus implementing freight charges that are genuinely competitive with the road freight in a particular region.

Rail Connectivity

Long-Term Recommendations

- **Improving rail links**: There should be a continued focus on expanding the rail network to provide for additional capacity and improvements to service. As detailed previously, around 25% of cement production is not currently rail-connected. A priority order for providing rail links should be established based on scientific evidence, prioritizing the connection of industry clusters.

Conclusion

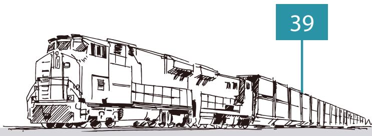
The volume of cement loading onto IR could be increased significantly, provided concerted efforts are made towards resolving the issues and concerns of the cement manufacturers as well as improving the infrastructure and rolling-stock condition. Recent initiatives like the Long Term Tariff Contract scheme and the enthusiastic support of the industry indicate that the industry is keen to move cement through railways. IR should continue to play a supportive role to boost cement traffic, which would ultimately lead to higher traffic earnings.

ANNEXURE 1 INCREASING SHARE OF RAIL IN FREIGHT TRANSPORT IN INDIA: WORKING PAPER – CEMENT

List of cement plants with rail connectivity

Railway zone	Division	Plant	Serving station
CR	BSL	Orient Cement	Bhadli
CR	NGP	ACC	Ghugus
CR	SUR	UltraTech	Hotgi
CR	SUR	ACC	Wadi
ECR	DHN	Dala Cement	Salaibanwa
ECR	DHN	ACC	Sindri
ECR	MGS	KCL	Son Nagar
ECR	MGS	Bangur Cement	Aurangabad
ER	ASN	DCW, Durgapur	Durgapur
ER	ASN	UltraTech	Durgapur
ER	ASN	Lafarge India	Raniganj
ER	MLDT	Ambuja Cement	Tildanga
ER	MLDT	MCCS	Sonar Bangla
ECoR	SBP	ACC	Bargarh
NR	UMB	Ambuja Cement	Roop Nagar
NR	UMB	ACC	Kirat Nagar Sahib
NR	UMB	Ambuja Cement/D. Ghat	Kirat Nagar Sahib
NR	UMB	Ambuja Cement	Bharat Garh
NR	UMB	Ambuja Cement	Bhatinda Jn.
NR	UMB	JP Cement	Bharat Garh
NR	FZP	VBCG	Lehra Mohabbat
NR	LKO	JP Cement	Tanda
NR	LKO	ACC	Gauri Ganj
NR	LKO	Birla Cement	Raebareli
NR	MB	Shree Cement	Laksar
NR	MB	Ambuja Cement	Roorkee
NCR	ALD	JP Cement	Chunar
NCR	JHS	Diamond Cement	Parichha

Railway zone	Division	Plant	Serving station
NWR	All	Binani Cement Ltd.	Keshavganj
NWR	All	Shree Cement	Beawar
NWR	All	JK Lakshmi Cement Ltd	Banas
NFR	LMG	Star Cement	New Guwahati
NFR	LMG	Topcem	New Guwahati
NFR	LMG	Barak Valley Cement	Badarpur Ghat
NFR	LMG	Calcom	Lanka
NFR	LMG	Adhunik Cement/Dalmia	New Guwahati
SCR	SC	UltraTech	Ghadchandur
SCR	SC	Manikgarh Cement	Ghadchandur
SCR	SC	Maratha Cements	New Pandarpani
SCR	SC	Orient Cement	Mandamarri
SCR	SC	Kesoram	Raghavpuram
SCR	SC	Ultra Tech	Malkaid
SCR	SC	Vasavadatta	Seram
SCR	SC	Cement Corp of India	Tandur
SCR	SC	India Cements	Tandur
SCR	SC	India Cements	Parli
SCR	SC	Penna Cements	Tandur
SCR	SC	Chettinad Cement	Tandur
SCR	SC	Vicat Sagar	Tandur
SCR	SC	Madras Cements/RAMCO	Jaggayyapet
SCR	SC	My Home Cements	Mellachervu
SCR	SC	JP Cement	Revvuragapuram
SCR	SC	Zuari/Vishnu Cements	Jaggayyapet
SCR	SC	KCP Cements	Jaggayyapet
SCR	SC	Bavvya	Nadikude
SCR	GNT	India Cements	Vishnupuram
SCR	GNT	Penna Cements	Janpahad
SCR	GNT	Deccan Cements	Vishnupuram
SCR	GNT	JP Cement	Nadikude
SCR	GNT	Jindal Cements	Nandyala
SCR	GNT	Sagar Cements	Miryalguda
SCR	GTL	Dalmia	Tadipatri
SCR	GTL	Zuari Cements	Yerraguntla
SCR	GTL	India Cements	Kalmalla
SCR	GTL	UltraTech	Jutur
SCR	GTL	Penna Cements	Jutur
SCR	GTL	Bharati Cements	Yerraguntla
SCR	GTL	Jindal Cements	Panyam



Railway zone	Division	Plant	Serving station
SCR	GTL	Sreejothi Cements	Betamcherla
SCR	BZA	My Home Cements	Regupalem
SCR	BZA	Nagarjuna Cements	Kondapalli
SR	PGT	ACC	Madukarai
SR	PGT	Malabar Cements	Walayar
SR	MDU	India Cements	Talaiyuthu
SR	MDU	Madras Cements	Tulukapati
SR	SA	Chettinad Cements	Virarakkiyam
SR	SA	Chettinad Cements	Palaiyam
SR	SA	India Cements	Sankaridrug
SR	TPJ	India Cements	Ariyalur
SR	TPJ	Madras Cements	Ichchangadu
SR	TPJ	Dalmia Cement	Ichchangadu
SR	TPJ	Ultra Tech	Kallakudi- Palanganatham
SR	TPJ	Tancem	Reddipalem
SR	TPJ	Madras Cements	Ariyalur
SR	TPJ	Chettinad Cements	Salamalpatti
SR	TPJ	Dalmia Cement	Ariyalur
SR	MAS	Ultra Tech	Melpakkam
SER	CKP	Lafarge India	Jojobara
SER	CKP	Grasim(Orissa) cement	Rajgangpur
SER	CKP	Ultra Tech	Dhutra
SER	CKP	ACC	Jhinkpani
SER	ADRA	ACC/Damodar Cement Sdg	Madhukunda
SER	ADRA	(Bokaro)JP Cement	Tupkadih
SER	KGP	Ambuja Cement	Abadha
SECR	BSP	Lafarge India	Akaltara
SECR	BSP	JK Cement	Kirodimal Nagar
SECR	R	UltraTech/Rawan	Hathbandh
SECR	R	UltraTech/Hirmi	Hathbandh
SECR	R	Century Cements	Tilda
SECR	R	ACC	Jamul/bhilai
SECR	R	JP Cement	Marauda
SECR	R	Ambuja Cement	Bhatapara
SECR	R	Lafarge India	Nipania
SWR	MYS	Mysore Cement	Ammasandra
SWR	SBC	ACC	Thondebhavi
SWR	UBL	Ultra Tech	Ginigera
SWR	UBL	ACC	Kudatini

Railway zone	Division	Plant	Serving station
SWR	UBL	JK Cement	Bagalkot
SWR	UBL	Jindal Cements	Toranagallu
WCR	JBP	ACC	Nanvara
WCR	JBP	Birla Cement	Satna
WCR	JBP	Maihar Cement	Maihar
WCR	JBP	DIAMOND CEMENT	Damoh
WCR	JBP	JP Cement	Turki Rd
WCR	JBP	Prism Cement siding	Hinauta ramban
WCR	KOTA	RCPB	Bhadanpur
WCR	KOTA	Mangalam Cement	Morak
WCR	KOTA	Sriram Cement	Dadhdvi
WCR	KOTA	ACC	Lakheri
WR	RTM	Birla Cement Works	Chanderia
WR	RTM	JK Cement	Nimbahera
WR	RTM	Vikram Cement	Jawad road
WR	RTM	Aditya Cement	Shambhupura
WR	RTM	Wander Cements	Gambhiri Road
WR	RTM	Lafarge India	Gambhiri Road
WR	BVC	Saurashtra Cement	Ranavav
WR	BVC	Gujrat Ambuja Cements	Adari road
WR	BVC	UltraTech	Rla
WR	BVC	Gujrat Siddhi Cements	Adari road
WR	RJT	Digvijay Cement Works	Sikka
WR	BRC	JP Cement	Godhara
WR	ADI	JP Cement	Kukma
WR	ADI	Sanghi Cements	Shanghipuram
CR	SUR	ACC	Wadi
CR	NGP	ACC	Ghughus
ECR	DHN	JP Cement	Salai banwa
NWR	AII	Binani Cement Ltd.	Keshavganj
NWR	AII	JK Laxmi Cement Ltd	Banas
NWR	AII	Shree Cement Ltd	Bangur gram
SCR	SC	Ultra Tech	Ghadchandur
SCR	SC	Manikgarh	Ghadchandur
SCR	SC	Orient	Mandamari
SCR	SC	Kesoram	Raghavpuram
SCR	SC	Ultra Tech	Malkhaid
SCR	SC	Vasavadatta	Seram
SCR	SC	India Cements	Tandur
SCR	SC	Cem Corp of Ind	Tandur

Railway zone	Division	Plant	Serving station
SCR	SC	Madras	Jaggyyapet
SCR	SC	My Home Cements	Mellachervu
SCR		JP Cement	Jaggyyapet
SCR	SC	Zuari Cements	Yerraguntla
SCR	GTL	Ultra Tech	Jutur
SCR	GTL	Jindal Cements	Panyam
SCR	GTL	Bharati Cements	Yerraguntla
SCR	BZA	My Home Cements	Regupalem
SCR	GTL	India Cements	Vishnupuram
SCR	GNT	Penna Cements	Janpahad
SER	CKP	ACC	Jojobara
SER	CKP	Grasim(Orissa) cement	Rajgangapur
SECR	BSP	Lafarge India	Akaltara
SECR	BSP	Jindal Cements	Kirodimal Nagar
SECR	R	UltraTech/Rawan	Hathbandh
SECR	R	UltraTech/Hirmi	Hathbandh
SECR	R	Century Cements	Tilda
SECR	R	ACC	Jamul
SECR	R	JP CEMENT	Marauda
SECR	R	Ambuja Cement	Bhatpara
SECR	R	Lafarge India	Nipania
SWR	MYS	Mysore Cement	Amsa
WCR	JBP	ACC	Jukehi
WCR	JBP	Birla Cement	Satna
WCR	JBP	Maihar Cement	Maihar
WCR	JBP	DIAMOND CEMENT	Damoh
WCR	JBP	JP CEMENT	Turki rd.
WCR	JBP	Prism Cement siding	Hinauta Ramban
WCR	KOTA	RCPB	Bhadapur
WCR	KOTA	Mangalam Cement	Morak
WCR	KOTA	Sriram Cement	Dadhdevi
WCR	KOTA	ACC	Lakheri
WR	RTM	Vikram Cement	Jawad Road
WR	ADI	Aditya Cement	Shambhupura
WR	ADI	JP Cement	Kukma
WR		JK Cement	Nimbahera

Source: Indian Railways

ANNEXURE 2 INCREASING SHARE OF RAIL IN FREIGHT TRANSPORT IN INDIA: WORKING PAPER – CEMENT

State-wise dispatch of cement from 2012–13 to 2015–16 (MT)

State	2012–13	2013–14	2014–15	2015–16	Grand total
Andhra Pradesh	11.11	9.79	10.83	9.19	40.92
Assam	0.28	0.56	0.42	0.27	1.53
Bihar	3.25	4.11	3.14	3.29	13.79
Chhattisgarh	10.81	11.38	13.05	11.81	47.05
Goa		0.00		0.01	0.01
Gujarat	1.96	2.71	2.09	2.24	9.01
Jharkhand	7.44	7.23	7.15	8.88	30.71
Karnataka	7.15	7.91	9.29	8.58	32.93
Kerala	0.28	0.27	0.27	0.34	1.15
Madhya Pradesh	17.26	14.21	19.90	14.32	65.69
Maharashtra	16.69	12.13	11.92	11.77	52.52
Odisha	7.35	6.87	5.91	5.67	25.80
Puducherry	0.13	0.08	0.06	0.15	0.41
Punjab	1.11	0.96	1.14	1.88	5.10
Rajasthan	13.70	16.41	15.89	14.39	60.39
Tamil Nadu	2.98	2.07	2.29	2.35	9.68
Telangana	2.17	1.74	3.09	3.88	10.88
Uttar Pradesh	7.45	4.16	5.24	4.05	20.89
Uttarakhand	0.04	0.02	0.02	0.09	0.18
West Bengal	2.53	3.36	2.78	2.57	11.24

Source: FOIS 2017

ANNEXURE 3 INCREASING SHARE OF RAIL IN FREIGHT TRANSPORT IN INDIA: WORKING PAPER – CEMENT

Destination states for cement from 2012–13 to 2015–16 (MT)

State	2012–13	2013–14	2014–15	2015–16	Grand total
Andhra Pradesh	4.02	1.84	2.23	2.34	10.43
Assam	1.65	2.03	1.45	1.44	6.57
Bihar	10.74	11.49	11.73	11.31	45.26
Chhattisgarh	3.66	3.90	4.90	4.22	16.67
Delhi	1.49	2.09	2.06	1.66	7.30
Goa	0.51	0.34	0.25	0.55	1.64
Gujarat	2.75	2.08	3.12	4.56	12.52
Haryana	1.45	1.68	2.54	1.89	7.56
Jammu and Kashmir	0.83	1.47	0.79	1.19	4.28
Jharkhand	5.91	7.50	8.78	6.57	28.76
Karnataka	6.28	4.88	10.91	9.11	31.18
Kerala	4.14	3.43	3.05	4.00	14.62
Madhya Pradesh	4.22	4.54	4.29	4.34	17.38
Maharashtra	16.03	15.21	10.61	10.05	51.91
Nagaland	0.03	0.04	0.15	0.13	0.35
Odisha	7.78	8.05	7.28	7.60	30.70
Puducherry	0.12	0.32	0.23	0.00	0.67
Punjab	1.47	0.93	1.74	2.21	6.34
Rajasthan	1.31	1.79	1.32	0.92	5.34
Tamil Nadu	6.38	3.48	4.58	4.28	18.71
Telangana	0.74	0.11	1.50	0.14	2.49
Uttar Pradesh	20.60	16.70	15.24	14.99	67.52
Uttarakhand	0.94	0.72	1.08	1.33	4.06
West Bengal	10.56	11.26	14.64	10.84	47.30

Source: FOIS 2017

ANNEXURE 4 INCREASING SHARE OF RAIL IN FREIGHT TRANSPORT IN INDIA: WORKING PAPER – CEMENT

Loading of cement by rake-type from 2013–14 to 2017–18 (in ‘000 tonnes)

	2013–14	2014–15	2015–16	2016–17	2017–18
BCN	57,863	56,169	54,341	59,254	53,574
BOXN	22,788	31,891	26,503	26,491	28,398
BCNHL	13,910	12,617	11,618	11,746	15,831
BOXNHL	8,060	9,767	9,633	9,419	10,815
Other	3,360	4,097	3,642	4,457	4,259
Total	1,05,981	1,14,542	1,05,736	1,11,367	1,12,877

Source: FOIS 2018

Loading of cement by rake type from 2013–14 and 2017–18 (no. of rakes)

	2013–14	2014–15	2015–16	2016–17	2017–18
BCN	21,868	21,228	20,537	27,961	21,269
BOXN	5,680	7,949	6,606	6,064	4,938
BCNHL	3,368	3,055	2,813	4,280	4,292
BOXNHL	1,922	2,329	2,297	2,250	2,074
BCCW	697	912	844	999	644
Other	205	169	101	26	91
Total	33,740	35,642	33,198	41,580	33,308

Source: FOIS 2018

ANNEXURE 3 INCREASING SHARE OF RAIL IN FREIGHT TRANSPORT IN INDIA: WORKING PAPER – CEMENT

Average lead of cement-related commodities from 2012–13 to 2015–16 (km)

Commodity	2012–13	2013–14	2014–15	2015–16
Fly ash	766	701	594	704
Clinker	675	697	663	634
Gypsum	823	809	833	830
Slag	315	358	353	310

Source: FOIS 2017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