No. 2019/SD-2/22/7/11 Pt.

REPORT

ON

UPDATION/REVISION OF

MANUAL FOR STANDARDS AND SPECIFICATIONS FOR RAILWAY STATIONS 2009

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COST OPTIMISATION STRATEGIES FOR STATION REDEVELOPMENT PROJECTS

SEPTEMBER, 2020

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Executive Summary

1. **Background:** A Manual of Standards and Specifications for Railway Stations (MSSR) was issued by the Ministry of Railways (Railway Board) in June 2009. This manual is currently being used for design of redeveloped stations. The manual has been issued for development of World class stations through Public Private Partnership. This was the first attempt at setting benchmarks for development of world class railway stations in India. Since then, work of redeveloping stations has been started on PPP mode at Habibganj and EPC mode at Gandhinagar, Gomti Nagar, Anand Vihar, Chandigarh and Bijwasan. Further, planning has been done at several other stations and tenders have been called for 8 stations by RLDA and IRSDC (Tirupati, Nellore, Puducherry, Dehradun, Gwalior, Nagpur, Amritsar and Sabarmati). The experience gained from the planning done at so many stations has revealed several aspects where use of MSSR is creating practical difficulties.

2. **Constitution of Committee:** Recognizing the above fact, Ministry of Railways constituted a committee vide letter no ERB/I/2020/23/17 Dated 01.07.2020 constituting of the following:

    a. Sh. A. K. Sinha, ED/LA Railway Board, Covener
    b. Sh. Naveen Agrawal, ED RLDA, Member
    c. Sh. V. B. Sood, CGM/Civil IRSDC, Member
    d. Sh. H. K. Barjatya, GGM/Architecture RVNL Member

The Terms of Reference of the committee is as follows:

(i) Review and updation/revision of "Manual of Standards and Specifications for Railway Stations - 2009"
(ii) Measures for arriving at optimum cost for Redevelopment of stations
(iii) Norms/ scale of facilities to be provided at a redeveloped station, based on peak hourly passenger load.

The committee was asked to submit its report within 2 weeks from the date of its constitution.

3. **Deliberations by the Committee:** The committee kicked off its work with preliminary meeting on 01.07.2020, followed by meetings on 11.07.2020, 31.07.2020, 04.08.20, 07.08.20, 25.08.20, 02.09.20 and 08.09.2020. It was decided to co-opt Sh Anish Kumar, Director/SD Railway Board as member during the meeting dated 11.07.2020 and Sh Anish Kumar has kindly consented to the same. The committee took assistance from Sh Deep Kumar Sharma, AGM/C IRSDC, and is thankful to him for his services.

4. **Methodology followed:** The committee held its deliberations on the Terms of Reference as follows:

    a. The planning done at few of the existing stations by IRSDC/RLDA was studied and the local issues that affect the planning were identified.

b. Strategies which can be adopted for rationalization of expenses at stations were discussed.
c. The issues related to MSSR faced by consultants while carrying out the planning process were discussed.
d. Latest policy changes and the codal changes since the MSSR was prepared were discussed.

5. **Recommendations:** Based on the various discussions, the committee has given the following broad recommendations:

a. **Review and updation/revision of "Manual for Standards and Specifications for Railway Stations - 2009":**

i. The committee has gone through the MSSR and is of the opinion that the MSSR is mostly aligned with the requirements of the redeveloped stations.

ii. There are several places where the provisions of MSSR are not aligned with the current arrangement in MCA for the PPP projects. The committee has ~~provided~~ the necessary ~~guidance~~ on adoption of such provisions in current set of projects.

iii. Station redevelopment works are being implemented at a number of places and few tenders are awarded/ called. **There will be a wonderful opportunity to study the implications of the provisions of MSSR at these redeveloped stations and a comprehensive review of MSSR shall be carried out thereafter.**

b. **Measures for arriving at optimum cost for Redevelopment of stations:**

i. The committee has given several recommendations to arrive at optimum design which includes judicious selection of the design parameters such as Level of Service, horizon year and peak hourly traffic.

ii. The recommendations related to design parameters are covered in chapter 2.

iii. The recommendations related to design principles to be followed for vehicles and for the passenger flows are covered in chapter 3.

iv. The recommendations related to design principles to be followed for Level of Service are covered in chapter 4.

v. The recommendations for cost optimisation strategies are given in Chapter 7. Separate recommendations are given for smaller stations where the chances of over-design are higher.

c. **Norms/ scale of facilities to be provided at a redeveloped station, based on peak hourly passenger load:**

i. The committee has seen that the provisions of MSSR are reasonable for the redeveloped stations and recommends adoption of the same except that the latest provisions related to Universal Accessibility, Municipal Solid Waste Management, Green Building norms and NBC 2016 shall be adopted.

ii. The features associated with redeveloped stations are covered in brief in chapter 6.

6. **Provisions where the report clarifies/amends provisions of MSSR:**

a. **Para 1.3(d) Environment Friendly Development** which aims to reduce the energy and water requirements, promotes natural ventilation, renewable energy, use of recycled/local

materials and is compliant with GRIHA 3 star rating on overall basis provided that all new construction shall be compliant with GRIHA 4 star rating requirements. (Reference: Guidelines no DSO / WKS / 2017 / 3 on "*Sustainable development of new & transformation of existing building to Green building on Indian Railways*" issued by Works directorate of RDSO, November 2017).

b. **Para 1.3 (e) Modularity** shall be aimed so that the facilities can be expanded (horizontally as well as vertically) whenever there is increase in traffic/ demand at a station.

c. **Para 2.1:** The approach to be followed for redeveloped stations shall be to provide the facilities at the concourse for the peak hourly passengers forecast, and check the adequacy of the arrangements for the peak number of passengers expected during the special occasions, termed as 'Mela Load' (Unusual surge load). The design shall be checked during the Mela Load at a lower 'Level of Service' (LoS) as compared with the routine peak hourly traffic which is likely to be encountered frequently.

d. **Para 2.6 (b) (i)** The space required for station facilities for 40 years time horizon shall not be given for long term lease to third parties.

e. **Para 2.6 (d):** Level of Service to be targeted:

i) For the horizon year, LoS C may be targeted. However, subject to technical feasibility, the actual mandatory construction may be limited to LoS A for passenger traffic expected within 8 years. Any further construction/ facilities shall be included suitably as Station Augmentation.

ii) The station shall be checked for the Mela Load and it shall be possible to safely handle the extra rush with LoS D. The ingress/egress/passenger flow facilities in station shall be checked for the Mela Load. The Mela Load shall be worked out on the basis of usage characteristics of the station, but shall not be less than 35% higher than the PHT.

f. **Para 2.6 (e)** Passenger Waiting Facilities:

i) The passenger waiting facilities shall be adequate to provide comfortable seated experience to passengers who arrive at the station at least 30 minutes prior to their train time. Rest of the passengers shall be provided suitable passages so that they can comfortably pass through to their desired platforms.

ii) At PHT, the seating facilities shall be provided for 70% of the passengers after accounting for reasonable no of passengers expected to wait in commercial areas. For balance 30% passengers, standing space shall be provided.

g. **Para 3.3.2: Drop offs:** Free time may be limited to travel time + 10 minutes to ensure that the vehicles quickly drop-off and go so that the drop off lanes are kept free to the extent possible.

h. **Para 3.3.3 Pick Ups:** the pick-ups shall have generous space as compared with drop-offs. It is preferable to have pick-ups in parking to the extent possible and the VCEs/corridors from exit may directly go to the parking so that it is more convenient to the passengers to be picked up from the parking rather than from pick-up lanes.

i. **Para 4.1: Level of Service:** The queueing space is given in table 1 as well as table 3 of posts 4.5.3 of MSSR. The committee recommends that table 1 shall be used for queueing space.

j. **Para 4.4: Design optimisation and performance assessment based on LoS** *(The matrix given in the para shall be adopted.)*

k. **Para 5.1:** CPWD's "Manual on Accessible Built Environment" (latest revision is of 2019)shall be used for barrier free environment in all new construction, but in case there is some provision is not available, ADAAG manual may be referred.

l. **Para 5.3.6: Advertisement Conflict:**

- Wherever advertising is part of the same sign panel and plane as that of a sign, its area shall not be more than 25% of the total area, and must be different color contrast.
- In case the same panel is dynamically used for advertisement as well as signage purposes, then the time for which advertisements are also permitted subject to meeting the requirements of conveying requisite information to the passenger.

m. **Para 5.5.1:** Currently, MSSR gives priority to the NFPA however, with the inclusion of the fire norms in NBC 2016, it is recommended that the priority of codes shall be as follows:

a) NBC 2016 provisions for metro stations
b) NFPA codes
c) MSSR

Para 5.5.2: Occupant Load: It is recommended that, in absence of detailed calculations, for long distance trains 1800 passengers and for local trains in suburban sections, 300 passengers per coach shall be considered for design. Further, 50% of combined train capacities shall be considered as waiting passengers for design.

n. **Para 5.5.3 Egress provisions:** Egress provisions from stations shall be designed to facilitate evacuation of a pre-defined platform occupant load to a designated point of safety in pre-defined emergency scenario by system authority. The evacuation times shall be as follows:

- Evacuation time from Platform: Enough egress capacity to evacuate Platform Occupant Load within 4 minutes from enclosed station and within 5.5 minutes from open station.

- Evacuation time to point of Safety: Station design shall permit evacuation of remotest person on platform to a point of safety within 6 minutes from enclosed station and within 8 minutes from open station.

Para 5.5.4: The evacuation times shall be subject to the following:

- **Refuge area on the platforms:** For platforms on ground and which are not enclosed, 50% area shall be considered as not affected by the fire incidence and consequently shall be a safe refuge, with passengers holding of this area being computed as per LoS E. In this situation, the requirement of a VCE every 100m as per codal provisions shall not be applicable.
- **Spacing of Vertical Circulation Elements:** The requirements for spacing of Vertical Circulation Elements on platforms given in NBC/NFPA shall not be mandatory for the platforms which are on ground and which are not enclosed.

o. **Para 5.5.9: Emergency Power Backup:** Sufficient capacity of emergency power back up shall be provided to cater to all critical loads of emergency lighting, emergency signages, communication system, fire station and control room and emergency lifts provided for evacuation. For critical safety items, uninterruptible power shall be available for 2 hours and for other items such as computers, normal signages, 25% of normal lighting/fans etc the backup shall be available for 30 minutes.

p. **Para 5.6.3: Vibrations:** *(New para has been added)*

q. **Para 5.7: Baggage scanning, DFMDs and frisking:** Space planning shall be done to ensure that the 100% of persons entering the station are frisked, they pass through Door Frame Metal Detectors and all baggage is scanned. Additionally, waiting space shall be planned assuming 100% surge in 15 minutes during PHT.

r. **Chapter 6: KPIs:** *New chapter added including revised passenger charter. The following are the headings:*

   i. *Key Performance Indicators*

   ii. *KPI - Capacity Management/ Augmentation*

   iii. *KPI - Reliability- equipment*

   iv. *KPI - Customer Experience and satisfaction*

   v. *KPI - Impact*

s. **Chapter 7: Cost Optimisation Strategies:** *New chapter added including general strategies as well as strategies for the smaller stations. The following are the headings:*

7.2 General Strategies

i. *Utilising existing infrastructure*

ii. *Adopting appropriate solutions*

iii. *Optimum targeted Level of Service*

iv. *Proper location of Concourse*

v. *Optimum size of concourse*

vi. *Life Cycle cost approach*

vii. *Innovative approach to good architecture*

viii. *Economical structural arrangement*

ix. *Approach to air Conditioning*

x. *Checks on over-investment*

xi. *Provisions for future expansion*

7.3 Cost Optimising Strategies For Smaller Stations

i. *Optimum Segregation*

ii. *Optimum Facilities for Universal Accessibility*

iii. *Location of Concourse*

7. **Conclusions:** The work done by this committee is in the nature of a commentary on the provisions of Manual for Standards and Specifications for Railway Stations - 2009. Recommendations for revision of provisions of MSSR are given in the report. The recommendations cover both administrative as well as the technical aspects.

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Chapter 1 - Redeveloped Station: Basics

1.1 Why redevelopment of stations?

Redevelopment of railway stations is an integrated program with land monetisation with the idea that the station and surrounding land shall be monetised and the amenities at railway stations shall be enhanced to provide much better ambience and facilities. The main benefits expected from redevelopment of stations in order of reducing priority are:

a) **Enhance Passenger comfort and experience** by providing State of the Art amenities to the passengers.
b) **Safer Stations** - Properly designed commercial development around stations leads to vibrant public spaces and enhances safety for passengers especially during odd hours or when the traffic is low.
c) **Improve viability of stations** - Commercial activities yield better returns in well designed places. Reduced losses on stations as a standalone activity also leads to lesser expenditure and improves the bottomline of railways even if the redeveloped stations are not fully viable on standalone basis.
d) **Additional Revenues to the railways** - Utilisation of land for commercial use around stations shall yield revenues to Indian Railways and help supplement its revenues.
e) **Safeguard passenger business** - This issue attains importance since the commissioning of dedicated freight corridors will free up lots of capacity and focus shall shift to passenger operations as a viable business. With Metros, RRTS and high speed coming in, the public perception and aspirations from a railway station shall also undergo fundamental change in time to come and in order to ensure that railways don't lose out on passenger traffic on this account, redevelopment of stations to proper design is very important.
f) **Improve the image of railways** - leading to more traffic being attracted towards railways as a mode of transportation. This is especially important looking at the challenges from airports, and bus ports which have been improving steadily over the last 2 decades.

1.2 What is a redeveloped station?

A redeveloped station is one which has the following features:

a) Iconic structure with modern state of the art amenities.
b) Segregation of arrival and departure passengers - no conflict between incoming and outgoing passengers.
c) Adequate concourse for waiting - generally above platforms/lines.
d) All essential amenities at concourse level.
e) User friendly international signages understandable by all sections of passengers.
f) Additional facilities like retail, shopping, hospitality, food courts etc.
g) Medical facilities
h) Well illuminated circulating area and sufficient provision for drop off, pick up and parking.

i) Green buildings, with optimum use of natural ventilation and lighting.
j) While designing the station, future expansion of platforms/lines etc to be provided.

1.3 Essential Features of Redeveloped Stations: The committee has gone through the requirements which are given in the para 1.1, and the provisions of MSSR. Further, the Model Concession Agreement which is currently being used for tenders related to redevelopment of stations and experience of MoR/RLDA/IRSDC in tenders related to the station redevelopment have been studied. Based on the same, the following are identified as essential features of redeveloped stations

a) **Iconic Design** which attracts people from outside and creates a welcome impression of the station as a city center and as a gateway to the city.
b) **Well designed complex** which takes care of passenger functions like drop offs/pick ups/ parking, station entry, waiting, exit from station etc; with the railway operational requirements like track/OHE/signalling maintenance, access to operating staff/ commercial staff/crew etc; requirements of ancillary operations like handling parcels/post, on board catering, supplies like bed rolls, train cleaning etc; any other railway functions including offices, residences and other facilities in station premises; Station management functions including cleanliness; Commercial development of assets to provide facilities like retail, shopping, hospitality, food courts etc; integration of station with city to facilitate entry/exit from the station.
c) **Well functional complex** which provides clear and direct movement paths to vehicles, passengers and other users with aim to avoid/minimise conflict with other movements. A visit to the redeveloped station shall be enjoyable due to logical placement of all facilities, adequate waiting spaces, good lighting, user friendly international signages understandable by all sections of passengers and where all new construction is universally accessible. At redeveloped station, it is equally important to ensure attention to details like good aural environment so that the noise from trains is reduced, an audio system that is well designed to ensure that the announcements are easily heard/understood and care is taken in design so that the vibrations due to passing trains don't create too much noise/vibrations in the structure etc.
d) **Environment Friendly Development** which aims to reduce the energy and water requirements, promotes natural ventilation, renewable energy, use of recycled/local materials and is compliant with GRIHA 3 star rating on overall basis provided that all new construction shall be compliant with GRIHA 4 star rating requirements. (Reference: Guidelines no DSO / WKS / 2017 / 3 on "*Sustainable development of new & transformation of existing building to Green building on Indian Railways*" issued by Works directorate of RDSO, November 2017)
e) **Modularity** shall be aimed so that the facilities can be expanded (horizontally as well as vertically) whenever there is increase in traffic/ demand at a station.

1.4 Optional features of Redeveloped Stations: There are several features associated with redeveloped stations, but these may or may not be there in all the stations:

a) **Yard remodelling including platform widening** may not be a part of concessionaire's scope of work. However, all design must cater to the possibility of future yard remodelling including change in platform width/ configuration.
b) Facilities for parcel handling with the aim to provide modern logistic facilities and aim to minimise parcel movement across the length of platforms.
c) Support facilities for train services like base kitchens, catering, bed roll handling etc.
d) Medical facilities beyond the emergency medical assistance/ first aid.

Chapter 2 - Design Parameters

2.1 Target Traffic: The stations shall be designed to safely handle the peak passenger traffic expected and provide a reasonable level of service to the passengers coming to the station. For handling traffic, the movement paths and the vertical circulation elements (VCEs) are important, and for providing comfort to the passengers, not only the movement paths and VCEs but also the seating space and facilities like toilets, drinking water and even retail areas are important. The absolute peak number of passengers occur when there is some special demand due to holidays/festivals, or when there is a political rally, recruitment, exam, religious gathering etc. It is not just costly, but also counterproductive to target the comfort for the absolute maximum passenger numbers expected. The expectations of passengers at such extreme traffic events are lower and passengers are more interested in securing their berth in trains. At absolutely unprecedented rush times, the expectations are even lower.

This contrasts with the normal times when passengers expect to not just travel but also to be taken care of - the passengers wish to enjoy the facilities at railway stations and utilise the opportunity of travel to add varied experiences. These expectations change with the purpose of journey - leisure/ business/ commute/ medical etc - but the expectations are surely there.

The approach to be followed for redeveloped stations shall be to provide the facilities at the concourse for the peak hourly passengers forecast, and check the adequacy of the arrangements for the peak number of passengers expected during the special occasions, termed as 'Mela Load' (Unusual surge load). The design shall be checked during the Mela Load at a lower 'Level of Service' (LoS) as compared with the routine peak hourly traffic which is likely to be encountered frequently.

2.2 Horizon year: An important component of planning is to determine the horizon year for designing the station. It is a trade off between spending the money for future requirements today itself versus spending the money when the need arises. Forecasts are, by nature uncertain, and there may be events not known today which may impact the forecast positively or negatively. If the forecast is on higher side, there will be over-investment and the assets will be under-utilised. On the other hand, if the forecast is on lower side, there will be requirement for fresh investment to tackle the additional requirements. Another important aspect is that the chances of forecasts going wrong are higher as the horizon year increases. This would suggest that we should keep the horizon year close by so that the right investment is made. However, there is the other aspect of engineering challenges and passenger comfort. If we keep the horizon year too short, there will be requirement for the station to be augmented frequently. And every time we do any work, the passengers are discomforted due to the noise, dust and equipment movement etc. Also, there are several aspects of station design which cannot be easily augmented and it makes sense to provide for a larger capacity at initial stage itself. These include the entry/ exit buildings where providing the facilities like toilets, staircases etc for enhanced traffic might disturb the entire layout and passenger flows. Even for such

elements, it makes sense to provide space but save on the finishing cost or on equipment like escalators etc. We can use this space for alternate purposes till the time these facilities are required.

2.3 Peak Hourly Traffic: MSSR provides for design of station for peak passenger numbers for departure/arrival in the morning/evening peak hours subject to a minimum 10% of the average daily passengers as the peak hourly traffic (Cl 1.5.1). The actual peak hourly traffic may be more than 10% of average daily traffic depending on the nature of traffic. The peak hourly traffic to be taken in design shall be worked out on the basis of passenger survey. The stations with predominantly originating trains will have prominent peaks in morning/evening whereas the stations with large number of passing trains will have comparatively diffused peak hours. The current time table provides good guidance regarding the assessment of peak hourly traffic. While carrying out the design, suitable allowance shall be made for the visitors, coolies, train operation staff, the station management staff, Facility Management staff etc also in computations for spaces/ VCEs. For arrivals, normally, for end platforms one train and for island platforms two simultaneous trains are to be considered in design. The exit path/ end block shall cater to passengers coming from more than one platform simultaneously.

2.4 Unusually heavy traffic: The capacity of any element is closely linked with the LoS. If lower LoS is accepted, more number of people can be handled. Several times a year, for example on the eve of Diwali/Holi, for a political rally, major exams etc the entire railway system has to take up extra load. This unusually heavy traffic is also linked with fairs or 'mela' and may be termed as Mela Load. During Mela Load times, the capacity of the VCEs, access control gates, security check equipment and passages shall be adequate at the reduced LoS.

2.5 Passenger Waiting Facilities: The seating in waiting spaces is an important feature of any railway station. The current waiting experience on Indian Railway stations suffers in part because the waiting rooms are small in size and distributed amongst different categories (AC/1st class, 2nd Class, ladies etc). The passengers actually use the platforms as waiting areas and Indian Railways provide seats, fans, drinking water and toilets etc on platforms to cater to the passenger needs. In redeveloped stations, effort shall be to create a common covered seating area (concourse) where all passengers can wait till their train is expected. The facilities in this common waiting area, or concourse, can be used by all passengers and creating separate facilities at multiple locations may not be required. With high roofs, the concourse shall provide comfort against noise, dust, rain and smells to form the core of passenger experience in redeveloped railway stations. The ideal location for the concourse is above the tracks so that passengers are near the platforms, can see the trains for themselves and can wait without anxiety. However, well designed waiting areas on end/other platforms can equally serve the purpose. During peak hour, it shall be aimed to provide seating for reasonable number of passengers. No separate waiting areas shall be provided for AC passengers in concourse, however planning shall be done to provide exclusive lounges with superior experience away from common waiting area, which shall be available to the AC passengers.

2.6 Recommendations for Design parameters to be adopted for redeveloped stations: Based on above discussions, the committee recommends the following:

a) **Target Traffic:** Based on city population growth projections, railway traffic growth, railway modernization/ upgradation and the general trends like urbanization/ changes in passenger preferences etc, reasonable estimated target traffic shall be worked out for 40 years' time horizon.

b) **Horizon Year:**
   i) As per Cl 1.5.1 of MSSR, the planning of station shall be for 40 years time horizon and the space for parking, drop offs/pickups, station facilities etc shall be provided accordingly. **Therefore, the space required for station facilities for 40 years time horizon shall not be given for long term lease to third parties.**
   ii) As per MSSR Cl 1.5.1, the facilities to be provided for next 5 years (with initial phase or increment being for 8 years). The actual facilities shall be provided for 8 years at initial construction or increment. Balance facilities shall be included as augmentation.

c) **Peak Hourly Traffic:**
   i) Shall be worked out on the basis of passenger survey, and studying the time table/ trends of ticket sales at the station at any time in a week. The upgradation/ modernization of the railway system shall also be included in any estimate for the peak hourly traffic.
   ii) PHT shall not be less that 10% of average daily passenger numbers.
   iii) Suitable allowance shall be made for visitors and other support staff while designing the VCEs, facilities and movement paths etc.

d) **Level of Service to be targeted:**
   i) For the horizon year, LoS C may be targeted. However, subject to technical feasibility, the actual mandatory construction may be limited to LoS A for passenger traffic expected within 8 years. Any further construction/ facilities shall be included suitably as Station Augmentation.
   ii) The station shall be checked for the Mela Load and it shall be possible to safely handle the extra rush with LoS D. The ingress/egress/passenger flow facilities in station shall be checked for the Mela Load. The Mela Load shall be worked out on the basis of usage characteristics of the station, but shall not be less than 35% higher than the PHT.

e) **Passenger Waiting Facilities:**
   i) The passenger waiting facilities shall be adequate to provide comfortable seated experience to passengers who arrive at the station at least 30 minutes prior to their train time. Rest of the passengers shall be provided suitable passages so that they can comfortably pass through to their desired platforms.
   ii) At PHT, the seating facilities shall be provided for 70% of the passengers after accounting for reasonable no of passengers expected to wait in commercial areas. For balance 30% passengers, standing space shall be provided.

Chapter 3 - Vehicle and Passenger Flows

3.1 Basic principles: The master planning exercise at a station shall aim the following:

a) To provide direct movement path (to the extent possible) for passengers/vehicles to reach target location without any ambiguity or disorientation. Ideal situation is to have a single point of drop off/ pickup and entry/exit from station. This ensures that the passengers or vehicles follow others ahead of them and reach their target location without looking for guidance/ signages etc.

b) If there are any decision points, these shall be logical and easy to understand. Minimum decision points and appropriate signages to guide people at these locations will ensure that people don't miss the decision points.

c) Unnecessary change in levels for the pedestrians/passengers shall be avoided. For example, passengers who are exiting from the station through Foot Over Bridges shall not be required to get down and take another FOB to reach other facilities like metro station etc.

d) Green vehicles like pedestrians, non-motorized vehicles and electric vehicles shall be given priority in design and shall be promoted. If possible, efforts may be made to ensure that the pedestrians are not required to cross the vehicle movement paths. Wherever the pedestrians have to cross the road, table top crossings shall be provided.

e) To reduce the overall traffic demand, public transport like metros, buses etc shall be prioritised. Similarly, the Intermediate Public Transport (IPT) i.e. Taxis, autos and e-rickshaws etc shall be given higher priority as compared to private vehicles.

f) Facilities for Divyang people shall be provided at convenient and prominent locations.

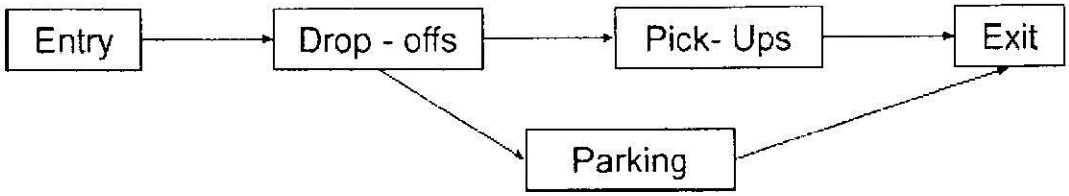
g) Parking and other requirements of staff, VIPs, bulk users like Army/colleges etc shall be integrated in planning.

h) To ensure that there are minimum cross-flows and the vehicles are not required to overtake from wrong side.

3.2 Design vehicle numbers and mix - for station and for commercial development: Survey shall be done to determine the modes of transport that people are taking to reach the station, and the design of lanes, parking etc shall be done to meet the demand in the horizon year. The changes expected in the people's preference for modes of transport over the years shall be taken into account while making the provision for different modes of transport. Regional and city transport plans shall be studied and suitably included in the traffic studies. The planning shall make it easy for people taking any mode of transport to conveniently access the station or their preferred mode of transport, with public transport and IPT being given preference in design over the private vehicles.

3.3 Layout of Drop-offs, pick-ups and Parking: Layout shall be such as to ensure that the people can quickly enter and exit the railway station.

3.3.1 The generic arrangement for traffic movement in station area suggested is to have the entry, then drop offs, then pick ups and then exit, with suitably located parking entries/exits:



The generic layout indicates that the Pick-Ups shall be after drop-offs for the following reasons:

a) The entry will not get choked if there are vehicles waiting in pick-up for the passengers to arrive. This is especially important when the train operation gets disturbed and trains bunch together.
b) The drop-offs getting the priority reduces the chances of people missing their trains due to traffic delays.
c) The taxis and autos prefer to drop-off passengers and then stand in queue to pick up passengers. If the layout is different from the generic layout suggested, then the IPTs may be required to make a round to reach the pick-ups, thus increasing traffic in the station area.

It may be noted that the generic layout is not always possible to be implemented in field. The space constraints, the traffic pattern and the nature/capacity of road(s) in front of station shall affect the layout. As long as the aims of traffic planning are met, there shall be no issue.

3.3.2 Drop-offs at railway stations shall be quick affair for most, except those who have to purchase a ticket or those who need assistance with wheel chair or heavy luggage etc. The design shall be done to ensure that people who need to stay longer go to the parking and only the people who have to merely drop-and-go enter into drop-off lanes. Free time may be limited to travel time + 10 minutes to ensure that the vehicles quickly drop-off and go so that the drop off lanes are kept free to the extent possible.

3.3.3 Pick-Ups are generally time consuming because the people take time coming out from the railway station and there is some amount of confusion locating the vehicle. Therefore, the pick-ups shall have generous space as compared with drop-offs. It is preferable to have pick-ups in parking to the extent possible and the VCEs/corridors from exit may directly go to the parking so that it is more convenient to the passengers to be picked up from the parking rather than from pick-up lanes.

3.3.4 In order to make it convenient to take the public transport, integration of metro/bus stations may be done such that there is no need to cross the vehicle paths and unnecessary change of levels is avoided. Suitable skywalks, subways etc shall be constructed for the purpose. The lanes near the entry/exit shall be reserved for the IPTs.

3.3.4 The movement paths for vehicles into and out of commercial development shall, as far as possible, be separate from the entry/exit to the railway station to minimise inconvenience to the

passengers. For commercial development also, the integration with public transport including the railway station shall be done.

3.4 Entry into station: The entry into station shall be restricted to bonafide passengers or authorized railway/facility manager/ other staff only. It shall be aimed to check 100% people for the authority like ticket, pass etc that they are carrying to enter the stations. QR code or any other technology adopted by Railways shall be used for providing access control to the stations. The space planning shall be done such that adequate number of access control gates including divyang friendly gates can be provided. Even if the access control gates are not provided initially, space shall be planned for the same. The facilities like ticketing, train enquiry etc shall, however, be in non-access controlled/ unpaid area.

3.5 Entry to platforms: The passengers shall be provided direct path, to the extent possible, so that they can reach their platforms conveniently and quickly subject to checks for security and access control. The entry to concourse/waiting spaces shall be conveniently located along the movement path so that the passengers can directly move to the waiting area, if they so desire, without any disorientation. The layout shall be such that it meets the desired LoS while ensuring that the passage does not get blocked during service for any reason, including by other users.

3.6 Exit from station: The passengers exiting from the railway station are generally in a hurry to reach their destination - be it their home, their place of work, their place of meeting or their hotel etc. The exit shall aim to meet this objective of the passengers and it shall be aimed to provide as direct a path to exit as possible, and with the exception of access control for ticket checking, there shall be no obstruction. Too much retail activity in the path of exiting passengers is also not desirable. Facilities like the information booth, taxi booking, gift shops etc may, however, be provided near exit path to make it convenient for the passengers to meet their requirements immediately after exiting the railway station. For exit from stations, either Foot Over Bridges or subways shall be provided.

Subway / Underpass

- The clear height of subway should be at least 3.3 metres and minimum clear width of subway to be 4 metres (desirable 7.5 metres).
- Provision of adequate lighting and drainage system and also ensures security and safety for Subway.

Foot Over Bridges/ Concourse:

- When planning for FOBs/ Concourse, the clearance as per IRSOD shall be provided. Provision for traffic actually planned i.e. double stack containers or DFC etc shall also be kept.
- Where the width of FOB/Concourse goes up and it is not possible to provide OHE on conventional poles, then the provisions of report on 'Modification of OHE in connection with redevelopment of stations Final report' approved by RDSO vide TI/OHE/IRSDCL/2017 Dated

31.10.2017 shall be used. The report is available at the following link: http://irsdc.in/ohe-reports-consourse-height-0.

3.7 General Guidelines for vertical circulation elements: The provisions for design of vertical circulation elements are given in MSSR and shall be followed. Wherever NBC provides for any different values, the same shall be followed. Few important provisions are mentioned below:

3.7.1 Lift / Elevators

- The size of lift shall be sufficient to accommodate large volume of luggage, wheel chair etc.
- Capacity – A minimum size elevator (1.5m * 2.5m) may carry 13 passengers and move fully loaded at approximately 1 m per second.
- The elevator landing depth (the queuing and discharge space at the elevator door) shall be a minimum clear distance to any obstruction equal to one and a half times the depth of the car or 3.048 m, whichever is greater.
- Elevator landings shall be positioned so that the elevator queuing area does not impede general circulation, is clearly visible and has adequate queuing space.

General Considerations

- Platform level elevators shall not open in the direction of the platform edge.
- Consideration shall be given to servicing and replacing elevators and elevator equipment during station operations. Elevators shall be designed so that routine operations and maintenance can be easily performed without disrupting normal station operations. Provisions shall be made for replacing the elevator cab, motors, hydraulics, drive mechanisms, etc., as required after their effective life.
- Elevators shall comply with Indian Disability Act and ADAAG for all regulations on operation, controlling heights, and identification and emergency communication while using a larger car as described.

3.7.2 Escalators:

Features shall include:

- Escalators shall be provided wherever vertical path of travel exceeds 3.658 m.
- The minimum distance between working points of escalators working in opposing directions is 17 m.
- All escalators shall be of the heavy-duty reversible type with a design maximum practical capacity of 90 persons per minute based on a service speed of 0.65 m/sec.

The following requirements are given for general planning purposes:

- Inclination = 30 degrees
- Step speed = 0.65 m/s
- Step width (min) = 1000 mm

- Number of flat steps at upper landing 4 (min)
- Number of flat steps at lower landing 4 (min)
- 1219 mm nominal (two-lane) escalator.
- Capacity: Approximately 90 persons per minute.

General Considerations

- Consideration shall be given to servicing and replacing escalators and escalator equipment during station operations. Escalators shall be designed so that routine operations and maintenance can be performed while minimizing any disruption of normal station operations. Provisions shall be made for replacing the escalator treads, motors, trusses, drive mechanisms, etc. as required after the effective life of the escalator.
- Natural light penetration above escalators creates visual contact between ground level and stair.
- Consider new technologies for escalators and elevators that may take up less space (including machine rooms), use less energy, have longer life spans and/or require less maintenance. Model the energy consumption in order to select most efficient equipment. Use control systems that allow for flexibility to adjust to variations in the number of users and in the peak direction of traffic.

3.7.3 Ramps:

- Preferred gradient 1:20
- Maximum gradient 1:12
- Rest platforms should provide a level area 1800mm long at intervals of approximately 10m.
- Ramps shall be a minimum width of 1200mm for unidirectional movement and 1500mm for bi-directional movement.

Chapter 4 - Level of Service

4.1 Level of Service (LoS): LoS performance standard provides a method of sizing passenger circulation elements. Station facilities required for processing (ticketing/ access control/ security check), passenger holding (concourse/ waiting halls/ lounge) and vertical circulation elements (lifts/ escalators/ stairs/ walking corridors) are optimally designed based on the LoS concept.

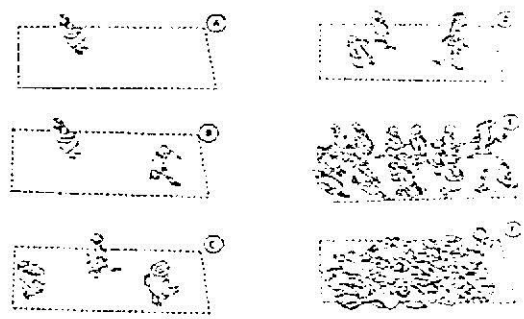
LoS often relates to the degree of congestion or crowding experienced by passengers. It is therefore a measure of the quantum of space (area) provided for amenities or amount of waiting or processing time required for using passenger facilities. Level of Services are thus defined in space domain (area per passenger) or in time domain (time in minutes). For space domain, Level of Services are defined on a six-level scale (A-F) ranging from Excellent to System Breakdown. Under normal circumstances, LoS-C (Good) or above shall be ensured for a redeveloped station. In time domain, LoS are defined in three level scale (A-C) where A being the fastest category. An example showing the LoS for waiting area as per table 3 of 4.5.3 in MSSR is as follows:

LEVEL OF SERVICE

Manual of Standards and Specifications for World Class Railway Stations 2009 – Para 4.5.3.3

Space available per passenger

Indicative of comfort to passengers



A	2.61	Free circulation
B	2.25	Restricted circulation
C	1.80	Personal comfort
D	1.44	No-touch
E	0.99	Touch
F	System Breakdown	Body Ellipse

4.2 LOS definitions in space domain are as follows:

LoS A: Excellent, free flow, no delays, direct routes.

LoS B: High, stable flow, very few delays.

LoS C: Good, stable flow, acceptable throughput.

LoS D: Unstable flow, causes delay, condition acceptable for short period only.

LoS E: Inadequate, unstable flow, unacceptable delays.

LoS F: Unacceptable, system breakdown, unacceptable congestion and delays.

4.3 LoS Requirements for various station elements: The committee has examined the provisions of MSSR and has seen that the tables 1 (Queueing) and 2 (Circulation Flow) of para 4.5.3 are based on J J Fruin's work. The table 3 of para 4.5.3 for terminal area is based on IATA provisions.

The committee has seen that the space given is reasonable. However, the queueing space is given in table 1 as well as table 3. The committee recommends that table 1 shall be used for queueing space.

Acceptable Flow rate for Platform / concourse shall be as per provisions of NBC 2016. The following is reproduced for ready reference:

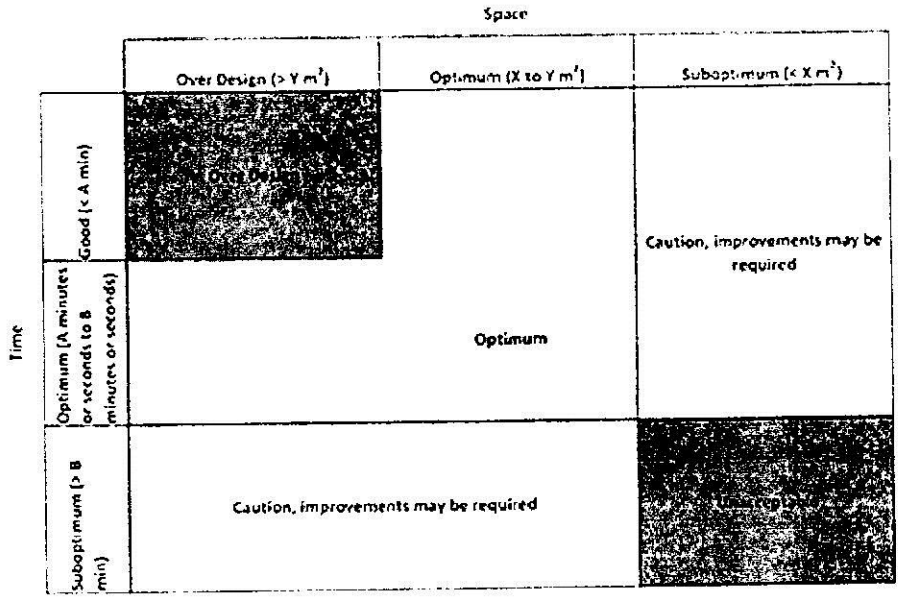
- One way = 50 passenger /min / meter width
- Two way = 40 passenger/ min/ meter width

Acceptable Flow rate for Stairs

- One way = 35 passenger /min / meter width
- Two way = 28 passenger/ min/ meter width

4.4 Design optimization and performance assessment based on LoS

Following matrix may be used for design optimization during the planning stage and also to assess the overall performance standard of a redeveloped station in terms of LoS in space and time domain (i.e space standards and waiting time), while in operation.


Space
Over Design (> Y m²)
Optimum (X to Y m²)
Suboptimum (< X m²)
Time
Good (< A min)
Optimum (A minutes or seconds to B minutes or seconds)
Suboptimum (> B min)
Over Design
Caution, improvements may be required
Optimum
Caution, improvements may be required

Chapter 5 - Features of Redeveloped stations

5.1 Divyang Friendly Environment

A barrier free environment for all sections of the passengers of all ages, sizes and physical status is one of the prime services required to be provided across all public buildings and places as per the applicable universal accessibility codal provisions. In redeveloped railway stations, barrier free provisions for all new construction shall be as per CPWD's updated and latest edition of "Manual on Accessible Built Environment".

Right from the main entrance to the station, the barrier free provisions will take effect. It will include facilities such as tactile path, signages, audible signals, ramps with railings, anti-slippery surfaces, low height information and ticket counters, wider AFC gates, protective kerb edges, braille button signs, dedicated toilets and water points, lifts & escalators with audio signals & cloth guards, Intelligible public address announcements, dedicated parking bays and emergency evacuation alarms.

CPWD's "Manual on Accessible Built Environment" (latest revision is of 2019)shall be used for barrier free environment in all new construction, but in case there is some provision is not available, ADAAG manual may be referred.

For the elements of existing stations which are retained in the redeveloped stations, efforts shall be made to retrofit the same to comply with codal provisions to the extent possible. However, the harmonized guidelines on facilities for passengers with disabilities issued by Railway Board (latest guidelines are of February 2020) must be complied with.

5.2 Green Building Norms

Sustainable development has become the non-negotiable requirement for the existence of human beings. Building complexes consume large resources, both during construction and during operation. Therefore, it is very important that a sustainable approach is accounted for, from the drawing board itself. Green building (with components including green construction and sustainable building) refers to a structure constructed using processes that are environmentally responsible and resource efficient throughout a building's life-cycle: from siting, design, construction, operation, maintenance, renovation, and demolition. The Green Building practice expands and complements the classical building design concerns of economy, utility, durability, and comfort.

The common objective is that green buildings are designed to reduce the overall impact of the built environment on human health and the natural environment by;

- Efficiently using energy, water, and other resources
- Protecting occupant health and improving employee productivity
- Reducing waste, pollution and environmental degradation

Green concepts include energy efficiency, water efficiency and comfort level for the occupants. This is defined through efficient architectural design, sustainable building materials, energy efficient equipment, indoor air quality, water conservation and prevention of wastage, construction methodology, processes and practices. It is essential that government institutions take the lead to have their buildings planned with green ratings. It is now incumbent upon government buildings and complexes to be designed at least for three star rating as per GRIHA Rating for Integrated Habitat Assessment.

The Indian Green Building Council (IGBC), part of the Confederation of Indian Industry (CII) was formed in the year 2001, on the similar lines. CII-IGBC with the support of the Environment Directorate of Indian Railway has developed the Green Railway Stations rating system. IGBC Green Railway Stations rating system is a voluntary and consensus based programme.

IGBC Green Railway Stations rating system is the first of its kind holistic rating in India to address environmental sustainability in Indian railway stations. The overarching objective of the rating is to facilitate adoption of green concepts, thereby reducing the adverse environmental impacts due to station operation & maintenance, and enhance the overall commuter experience at station. The rating system will help the station management to understand their present position with respect to the 'green performance' of the station and the measures that need to be taken to enhance the performance on a continual basis.

5.3 Signage System - Passenger Information and Guidance System

One of the various aspects contributing towards the environment and traveling experience is the systems visual interface with an entire spectrum of commuters. A well planned signage system can contribute considerably to the efficient flow of passengers and traffic at the stations. System shall be easy to understand, concise, and strategically located in the various facilities within the station buildings and surrounding areas. It is therefore essential to have a comprehensive signage guideline manual for Indian Railways.

Principal guidelines are elaborated below;

5.3.1 Categorization: The design guidelines are split into the following categories of signs.

1. **Wayfinding non-illuminated & Wayfinding illuminated**

   These sections cover all signs which direct customers and passengers to station facilities and transport interchanges within station buildings.

2. **External signs**

   This section covers all signs which direct customers and passengers to station facilities and transport interchanges as well as indicate the location of key facilities such as bus and taxi stops in external areas surrounding station buildings, adjacent roads and pavements.

3. **Station name signs**

This sign category is limited to the signs which identify the station building from a distance. Due to the variation in architectural styles used in the station design, station name signs may be designed and specified on a station to station basis.

4. **Information signs**

   This section covers all signs which display information on the use of the system, the station and its facilities.

5. **Statutory & Mandatory**

   This section covers a wide variety of signing, relating to warning, prohibition, safety and mandatory signs. These are best described as statutory signage. The signs for identifying firefighting equipment are also covered in this category.

6. **Vehicle signs**

   This section covers all the signs which direct vehicles and display the prohibition, warning mandatory information for the traffic flow in the station premises.

7. **Braille signs**

   This section covers the signs required for the visually disabled commuters to navigate through the station buildings. These shall be placed at specific locations like entrances, ticket counters, facilities and shall have their relations to tactile flooring proposed in the stations.

5.3.2 Sign referencing:

Various sign references are numbered and categorized as:

- Appearance and Specification
- Typography
- Fabrication drawings
- Fixing details & Location details
- Standard panel widths (for 1.0 and 2.0 sign types only)
- Non standard panel sizes (for 1 and 2 sign types only)

5.3.3 Fixing Heights:

For helping passengers to easily locate signs, standard fixing heights have been established for a number of generic environments. This imparts basic standardisation of basic rules for signing. All fixing heights are measured to the bottom of signs panels: this will establish a "zone of information" within the stations. The minimum clear movement space underneath the wayfinding signs are:

- Corridors & passages - 2.7 m
- Platform Area - 2.7 m
- Concourse Area - 2.7 m
- Vehicle entrances/Parking - 4.5 m

These heights are a response to the space and commuter traffic in these zones.

5.3.4 Reading Distances:

To ensure optimum legibility of signs at a range of reading distances, the Joint Mobility Units guidance on text size has been utilized in establishing the size of all signs within this document. Measurements have been given in millimeters, and refer to the cap height of the English text. Subsequent layouts based on these guides have been designed in order that the Devnagari matched the English font in Clarity and Legibility. One of the principles adopted for readability includes Font size: 10 mm for every meter of reading distance. Further, emergency exit route signs and other important wayfinding sign must continue to be used along all exit passageways to reconfirm the direction of movement. They must be repeated in a straight stretch of passageway at every 25 metres and used at every change in direction the passageway takes and at every change of level.

5.3.5 Sighting:

One of the most important aspects of good signage is sighting. If it is closer to one's natural line of sight, it is better. A useful rule of thumb is to avoid exceeding a 10° angle from the natural line of vision. If conditions require that the viewing angle exceeds 10°, the size and distance relationship may have to be adjusted. Legibility varies greatly from one symbol to another or from one type style to another. Colour relationships, lighting, spacing and viewing angle also affect legibility. Pragmatic testing of symbols and lettering on-site, or in simulated on-site conditions, is required.

5.3.6 Advertising Conflicts:

The opportunity for competition between wayfinding and advertising is due to the fact that both mediums are designed to attract and hold the passengers attention. Guidelines for the display of both wayfinding and advertising signs, shall be formulated to allow both mediums to exist in the same key locations, responding to the priority issues of an effective directional sign system, while optimizing important advertising & retail revenue opportunities.

- Signs should always be fixed at right angles to passenger flow, while advertising must always be fixed parallel to the passenger flow.
- A minimum space of 5 meters around the important emergency & information signs shall be maintained free of any advertising.
- Advertising panels shall never obstruct the viewing of a sign. Similarly, advertisement illumination mechanism shall not disturb the sign readability. Advertising panels should not cast a shadow on non-illuminated signs at night. The use of suspended or projecting advertising or retail signs shall not be encouraged.
- Advertising panels on the platform shall not be placed perpendicular to the travel direction of the train as far as possible.

- Wherever advertising is part of the same sign panel and plane as that of a sign, its area shall not be more than 25% of the total area, and must be different color contrast.
- In case the same panel is dynamically used for advertisement as well as signage purposes, then the time for which advertisements are also permitted subject to meeting the requirements of conveying requisite information to the passenger.
- All sign and advertising panels shall be designed properly from structural and electrical loads considerations and the supporting structures shall be capable of taking the loads. These shall not create unsafe conditions for the passengers and other users.

5.3.7 Performance Parameters:

Performance parameters for materials are put down as colour stability, dimension stability, UV stability, abuse resistance, life expectancy ranging between 7 to 15 years and maintenance & cleaning. These become benchmarks for selecting manufacturing processes, materials, finishes and detailing for manufacturing of the sign.

5.4 Illumination

Appropriate illumination is a key parameter in terms of giving passengers a positive experience of a station environment. It also assists in shaping the space and creates a sense of wellbeing. Lighting is a complement to natural light. The natural light shall be encouraged to the extent possible provided through openings and glazed enclosure, subject to minimising the heat gain on this account to suit the Green Building requirements. Transparency and daylight into the station, and along the way to the platform, provide passengers with the possibility of moving around and finding their way easily, while ensuring safety along the way. It is very important for passengers to see and be seen, lighting thus enables the identification of target areas and risk areas, resulting in increased safety and security. Lighting should illuminate, bind together and strengthen the platform paths and zones such as walkways, entrances and important target points for the journey. Lighting should be uniform and not dazzling, and should be designed so that the information and signs are readable even by passengers with poor eyesight. Besides general luminance, enhanced lighting at platform edge should be provided, and possibly supplemented with position lighting along the edge, which marks the security zone. The fixture must be provided on the platform, and must be easily accessible for replacement. Good lighting and daylight are a requirement as proper lighting is very important for the visually impaired. The required levels measured in lux. Technologically advance LEDs fixtures is the best efficient lighting luminaire available which has reduced the operating costs, significantly

Platform lighting is very important for safety and security. Familiarity with a platform environment by having uniform illumination at several stations creates a sense of coherence, consistency and quality.

Station Lighting Designing Parameters

- **Design Considerations:**

  Lighting fixtures shall be so provided that these do not interfere with the signages as well as signals for trains. Lighting levels shall be graduated consistent with safety and comfort avoiding abrupt changes in illumination levels. Special care shall be taken to ensure that the enclosed areas like underground/ multilevel parking, subways, passages, service areas etc do not have any shadow areas, for example between the vehicles.

- **Glare elimination:**

  Lighting shall not be too sharp and bright. It shall be free of glare as the glare can dazzle and disorient and affect visibility for passengers and loco-pilots.

- **Enhanced Illumination Levels:**

  Some areas in station require uncompromised enhanced levels of illumination. These Areas are Platform edges, Entry points of trains, Signage, Ticket counters, Information booths, Lifts, Stairs, Escalators and Spatial structures. It contributes to ease of orientation, guidance and greater sense of security.

- **Vertical Lighting:**

  Varying direction of lighting strengthens spatial awareness and highlights shape and materials of the spaces at platforms, in waiting areas and enclosed areas. Lighting that washes the wall and floor creates spatial awareness and increases feeling of safety and security.

Station Key Area Illumination

Parking:

Parking shall have clear, functional lighting and it shall be safe to walk between the vehicles and paths. Potential shadow areas in the parking shall have adequate lighting to feel safe and avoid surprise appearance of pedestrian movement during evenings and nights.

Entrance:

It is very important for an entrance to have a welcoming ambiance. Entry and station name signs shall be illuminated prominently to give passengers required clarity about it as they head towards it. The lighting shall assist passengers to orient towards entry and the lighting level shall be enhanced along the interconnecting walkways to show passengers where they need to go. In case there is more than one entry, it is important to communicate which one is the main entry by giving the main entry a distinctive or priority prominence.

Subways:

To have a sense of security it vital to have proper illumination in the underpasses/Subways as there is a feeling of narrowness and gets accentuated if it is longer. Appropriate lighting shall enhance the sense of spaciousness and create a sense of security. Reflected indirect lighting from ceiling and

wall washer lights is a good method to create a feeling of spaciousness. It may be supplemented by direct lighting for flooring. Lighting levels shall be such that passengers should be able to clearly see the faces of fellow passengers to feel comfort and security.

Stairs, Lifts and Escalators:

Illumination at stairs and escalators shall be clear and directional so that steps and fellow passengers are visible clearly. Lighting fixtures may be provided under the steps and handrails of stairs to enhance visual ease of guidance. Soft illumination from top shall create an added feeling of spaciousness. Lift entry shall have enhanced illumination to negotiate the gap and level difference.

Foot over Bridges:

In darker hours FOBs need similar illumination as in Subways. Lighting fixtures at lower level of the bridge railing add an orienting element. It also enhances the aesthetics when the bridge is seen from a distance in overall context. FOBs are open from sides or may have more glass sections which make them glare elements and need careful illumination. The objective is to have guiding illumination which should not cause glare and dazzle.

Corridors, Passageways & Lobbies:

Once inside the buildings, ease of orientation is of utmost importance and lighting is the only medium of guiding and orienting passengers through varied illumination levels and directional light at key locations. It is also important for spatial perception to be positive and secure, and general ambient lighting can vary from ceiling reflecting, directional light to enhance walkways and key points such as converging points, seating, stairs etc. as well as wall washer on important wall sections. To make space brighter and to bring attention to signage, vertical illumination shall be made use of.

Waiting areas and Lounges:

It is important for passengers to see and be seen to feel secure and make others also feel secure in a waiting area while entering the spaces for a while. Illumination shall be directed downwards with relatively wider beam mounted on ceilings and walls. False ceiling structures may have indirect lighting.

Platform lighting:

Platform illumination is one of the important aspects of entire station lighting. Platforms are meant for movement, thus for passengers it is vital to find their way and direction in very clear terms. Also, on a platform, it is vital to know where to board the train, and where it is safe to stand/sit and wait.

On platforms there are two zones from illumination point of view. The outermost zone (Buffer zone), facing the tracks, is the zone where passengers spend the least time. At this place illumination shall be appropriate especially at the gap between the platform edge and the train. Illumination level shall be high and even to allow the visually impaired to find their way on the platform area and identify the protective zone markings (Tactile path).

The area on the platform where waiting passengers sit or stand is the quieter inner zone, near to the center(island platform) or rear of the platform(side platform). More space accentuating and welcoming light can enhance this zone with illuminated columns and uplight on the ceiling. Illumination from the ceiling helps highlight the surfaces and generates additional, indirect reflected illumination above the platform. Space-creating light can be a little richer in contrast and more dynamic than even more functional light along the edge of the platform.

Illumination Levels:

Levels of illumination should conform to the provisions for Illumination in MSSR (refer Table 4 of 4.7.3 of).

Table: Standards for Illumination in Railway Stations

(Table 4 of 4.7.3 of Manual For Standards and Specifications for Railway Stations, June 2009)

AREA	LUX Levels
GENERAL	
Interactive Areas (task location)	200
Interactive Areas (background)	150
Signs, maps, displays	200
Platform Outdoor Platforms with canopy	100
Outdoor Platforms without canopy	50
Indoor Platforms	150
Interior passageways	100
Service Corridor on Tracks (under station)	50
Site Open Parking Areas	50
Station Entrance Areas	150
Station Perimeter	30
Buildings Concourse	200
Circulating Area	50
Enquiry cum reservation office	200

Ticket Counter at counter	300
TVMs at counter	200
Waiting area	200
Offices	100
Toilets	100
Lifts Interior	100
Lifts Landing	200
Parcel/Luggage Area	150
Corridors	100
Stairs	100
Cloak Room	250
Restaurant Kitchen	300
Stores	100
Dining Hall	100

5.5 Fire and life safety requirement (Fire compliance)

For the first time NBC included the "FIRE AND LIFE SAFETY" requirement in the 2016 edition for metro stations as Annexe J, for Stations. Elevated enclosed and open stations, At-grade stations and underground stations come under its purview. These provisions may be applied to redeveloped railway stations on Indian Railways. Currently, MSSR gives priority to the NFPA however, with the inclusion of the fire norms in NBC 2016, it is recommended that the priority of codes shall be as follows:

d) NBC 2016 provisions for metro stations
e) NFPA codes
f) MSSR

As per NBC 2016 following provisions are broadly brought out below;

5.5.1 Type of construction: Shall conform to Type-I or II or combination of Type-I & II of non-combustible materials.

5.5.2 Occupant load: It is mainly platform occupant load on the basis of which life safety provisions are designed. Total occupant load shall include passengers from multiline, multilevel and multi

platform station elements. Maximum occupant load for each platform shall be considered separately for determining the egress capacity from that platform. At levels where egress routes from separate platforms converge, occupant loads of all platforms shall be considered to calculate egress capacity from that level. Simultaneous loads shall be considered for all those routes passing through each level of that station. Occupant load shall be based on the greater of the A.M. or P.M. "Peak Hour Loads" generated by system and train loads. It is recommended that, in absence of detailed calculations, for long distance trains 1800 passengers and for local trains in suburban sections, 300 passengers per coach shall be considered for design. Further, 50% of combined train capacities shall be considered as waiting passengers for design.

For suburban sections where nature of operations is similar to metro trains, alternately, platform occupant load shall take into account crush load of passengers of train on fire, two missed headways of entraining passengers waiting on peak direction platform and one headway of "Off-peak" direction platform.

5.5.3 Egress provisions: Egress provisions from stations shall be designed to facilitate evacuation of a pre-defined platform occupant load to a designated point of safety in pre-defined emergency scenario by system authority. The evacuation times shall be as follows:

- Evacuation time from Platform: Enough egress capacity to evacuate Platform Occupant Load within 4 minutes from enclosed station and within 5.5 minutes from open station.
- Evacuation time to point of Safety: Station design shall permit evacuation of remotest person on platform to a point of safety within 6 minutes from enclosed station and within 8 minutes from open station.

5.5.4 The evacuation times shall be subject to the following:

- **Refuge area on the platforms:** For platforms on ground and which are not enclosed, 50% area shall be considered as not affected by the fire incidence and consequently shall be a safe refuge, with passengers holding of this area being computed as per LoS E. In this situation, the requirement of a VCE every 100m as per codal provisions shall not be applicable.
- **Spacing of Vertical Circulation Elements:** The requirements for spacing of Vertical Circulation Elements on platforms given in NBC/NFPA shall not be mandatory for the platforms which are on ground and which are not enclosed.

5.5.5 General arrangements: Means of egress shall be equally distributed to the extent possible, in capacity and placement, throughout the length of platform. There shall be at least two means of egress remote from each other. Means of egress may converge at concourse or subsequent levels with sufficient capacity to achieve the required evacuation time. To the extent possible, emergency evacuation shall be provided with unenclosed stairs and escalators which are used for normal circulation.

5.5.6 Means of egress: Means of egress shall be allowed to merge in public means of egress. Non Transit Occupancies shall have separate means of egress to ensure independent evacuation but may be allowed to merge beyond the station concourse area. Stairways,Escalators, Lifts, Doors and Gates, AFC gates, Horizontal exits shall be designed as per the codal provisions. Access for fire brigade personnel shall be provided.

5.5.7 Fire Separation and Compartmentation: Fire and smoke compartments, fire ratings of various station occupancies and fire doors shall be as per codal provisions.

5.5.8 Other Specific provisions for safety requirements: Noncombustible materials shall be used for interior walls, ceilings and decorative features. To stop intrusion of flammable and combustible liquids and flooding of underground systems, all provisions for safety and evacuation shall be terminated at grade which shall be at 450 mm above the surrounding level or flood level, whichever is higher. All system controls shall be at one place for monitoring in the form of emergency command centre. Power backup provision for all safety provision facilities. Emergency lighting and public address system provision shall be throughout the station.

5.5.9 Emergency Power Backup: Sufficient capacity of emergency power back up shall be provided to cater to all critical loads of emergency lighting, emergency signages, communication system, fire station and control room and emergency lifts provided for evacuation. For critical safety items, uninterruptible power shall be available for 2 hours and for other items such as computers, normal signages, 25% of normal lighting/fans etc the backup shall be available for 30 minutes.

5.5.10 Fire Protection Facilities: Following provisions are to be made for open and at-grade stations as per NBC 2016:

- Pumping arrangement with standby pumps and Jocky pumps with electrical wiring from outside the station for firefighting.
- Extinguishers shall be provided throughout the station platforms, concourse and other station areas within the travel distance of 30 meters.
- Small Bore Hose Reels shall be provided for every 1000 sqm. of area within 45 meters of travel distance.
- Fire Alarm system: Fire Detection system in unmanned areas, above false ceilings and false floors. Manual call stations at strategic central locations at each platform near emergency stop plunger and at each of the concourses.
- Clean Agent Suppression System shall be provided in electrical panels of HT, LT and main power distribution, DG changeover and main supply panels with automatic triggering mechanism.
- Hydrant and Wet risers provision shall be made at platforms, concourses and other station areas, yards, parking areas, entrances, for covering 45 meters all around within a Fire Hydrant Cabinet containing two hose pipes of 15 m each.
- Automatic sprinkler system shall be provided in combustible storage areas.

- Exclusive Water Storage requirements shall be made available in the form of underground and overhead reservoirs as per the provisions in NBC 2016.

5.5.11 Help Point Intercoms

Provision shall be made for help point intercoms shall be installed. The HPIs shall operate through wireless technology. These shall be located at every 100 m in public areas.

5.6 Acoustics and Vibrations

5.6.1 Acoustics

Due consideration shall be given to the acoustic environment of all public areas with particular reference to the design and performance of the public address system. Noise at stations can be from the trains, the station users and public address system besides other sources of noise. The acoustic design of Station must provide a good aural environment, in which people can communicate clearly and easily, and ensure that the build-up of excessive noise is suppressed. Public Address announcements must be easily heard and understood. Further, a comfortable acoustic environment must also be provided for the employees in the non-public areas, such as in office and administration areas. The designer must provide documentation that the final station designs achieve these goals. The control of noise from source i.e. trains and modification of tracks etc to reduce the noise level/quality is not within the scope, therefore other measures shall be adopted to provide a comfortable acoustic environment including proper shapes and/or sizes of spaces and providing suitable noise barriers, selection of appropriate finishes providing effective sound absorption to control the level of reverberation etc. Care shall, however, be taken that the material adopted for acoustic treatment shall also be compliant with the fire norms.

Codes for Reference

- Noise Pollution, Regulation, and Control Rules, 2000 (India)
- The International Organization for Standardization (ISO)
- NFPA 72 – National Fire Alarm Code (USA)
- International Electro-technical commission (IEC) 60849-1998 – Sound Systems for Emergency Purposes, for speech intelligibility requirements.
- Acoustics enclosure as per CPCB norms (central pollution control norms) as per NBC part 8

Area Target	Noise Criteria
Platforms	NC 45-50

Platforms (during an emergency)	NC 45-50
Concessions	NC 40-50
Toilets	NC 40-45

5.6.2 PA speech Intelligibility

The criteria for speech intelligibility performance of the PA audio systems are as follows:

1. PA System to achieve minimum STI: 0.61

2. PA System to achieve level in range: 65 dB (A) < Lp < 85 dB (A)

5.6.3 Vibrations

The structures to be built near railway tracks need to be studied for possible effects of vibrations induced by the train movement. The study shall include:

I. Analysis of railway operation vibration levels based on vibration level measurements of existing operations and projected future operations. Vibration measurements shall include impacts of trains passing by, trains halting, trains stopped at platform etc. The analysis should take into consideration:

- All different train types - passenger and freight.
- Existing and projected future ambient vibration levels.
- Soil mobility

Train generated vibration can also excite the natural frequencies of station and nearby building structures. Finite element analysis or other modeling techniques should be used to verify the potential for negative impact. As a minimum, the natural frequencies and vibration levels in the concourse and any adjacent critical occupancy such as hotel, apartments, medical facilities, studios, etc. shall be verified.

II. Design Criteria

The ground borne vibration levels shall not exceed the noise levels indicated in the following standards:

- DIN 4150 Part 3
- VID 2719

III. Vibration Control Design Elements: If analysis indicates vibration levels will be exceeded, vibration attenuating elements shall be designed and specified. Vibration control elements shall include but not be limited to structural changes, damping elements, vibration isolation, trenches, etc. All other vibration control features must be fully analyzed before vibration isolation of the track or trenches are considered. Modification of trains and/or track shall not be under the scope.

IV. The material/elements used for vibration control must have a proven track record and shall have a minimum design life of 50 years.

V. Design Verification: Upon completion of the project, the noise measurements will be made by a qualified acoustical professional to verify that the design criteria as outlined above has been met.

VI. Codes:

- UNI-9916: Criteria for the measurements of vibrations and the assessment of their effects on buildings
- ANSI S2.47: Vibration of Buildings – Guidelines for the Measurement of Vibrations and Evaluations of their effect on buildings
- BS 7385-1 and BS 7385-2: Evaluation and measurement for vibration in buildings.
- DIN 4150-3: Vibrations in buildings Part 2: Effects on persons in buildings
- DIN 52210: Testing of acoustics in buildings, airborne impact and sound insulation
- ISO 140: Acoustics – Measurement of sound insulation in buildings and building elements.
- ISO 2631-2: Part 2: Vibration in buildings (1 Hz to 80 Hz).
- ISO 4886: Evaluation and measurement for vibrations in buildings. Guide for measurement of vibrations and evaluation of their effects on buildings.

5.7 Security: The redeveloped stations shall have adequate security arrangements. The security shall be arranged at following levels:

- **Perimeter control:** Necessary boundary walls shall be constructed to cordon off the locations from where unauthorized persons can enter the railway station. The perimeter control for area beyond the platforms shall normally not be considered a part of station. Similar control shall be exercised for vehicle entries to railway station.
- **Access control:** Facilities for checking the authorisation/ticket for all the passengers, visitors, security persons, station and operating staff, facility managers, coolies etc shall be provided. Initially the necessary space shall be planned and the facilities shall be planned as soon as the system for ensuring universal access control like QR-code etc is standardised and adopted on Indian Railways. Additionally, waiting space shall be planned assuming 100% surge in 15 minutes during PHT.
- **CCTV:** Intelligent, high resolution CCTV system with capabilities of covering the passenger movement areas of railway station premises, all entry/exit points, vehicles, parking and other points of interest from security considerations shall be provided. The CCTV feed shall be integrated with security setup as well as station management system. CCTV shall be used for enhancing the passenger experience by assisting with the lost and found, crimes like theft, eve teasing etc and for identifying the criminals, trouble mongers etc.

- **Baggage scanning, DFMDs and frisking:** Space planning shall be done to ensure that the 100% of persons entering the station are frisked, they pass through Door Frame Metal Detectors and all baggage is scanned. Additionally, waiting space shall be planned assuming 100% surge in 15 minutes during PHT.

5.8 Heritage conservation: Indian Railways, being a 150+ year old system has numerous stations which are either listed as heritage structures, or in some cases may not be listed. Heritage conservation is one of the objectives of the station redevelopment and efforts shall be made to:

- follow the archeological considerations and restrictions, if any
- follow the applicable rules of the conservation committees, if any
- enhance and showcase the living heritage
- make the heritage accessible to people

The heritage on Indian Railway stations being a living heritage shall not be considered merely as a cost which requires special efforts for maintenance and preservation, but shall be so planned as to provide additional revenues through creative use of spaces for showcasing the local history, railway history, historical artefacts etc. Any commercial monetisation in heritage structures shall also be designed to preserve and enhance the heritage aspects.

5.9 Integrating facilities for railways - operational needs and others: The station functions shall be planned in such a manner that the railway's operational functions are either seamlessly integrated or are carried out in exclusive zones. The railway's operational functions include:

- Maintaining railway infrastructure such as track, signals, OHE etc
- Attending to accidents or unusuals
- Attending to railway coaches/wagons during run or unusuals
- Coach watering
- Crew and train staff change
- Parcel handling
- Rolling in examination
- Support for on-board Catering

Chapter 6 - Key Performance Indicators & Passenger Charter

6.1 Key Performance Indicators

Key Performance Indicators are generally to be defined in terms of Output - Outcome basis, primarily from Passenger Experience perspective. Following Key Performance Indexes (KPIs) are to be met by the Concessionaire:

1. KPI – Capacity Management/ Augmentation
2. KPI – Reliability - equipment.
3. KPI – Customer Experience
4. KPI – Impact

6.2 KPI – Capacity Management / Augmentation

KPI Title	KPI Description	Stakeholders	Data Availability
Space planning for Peak Hourly Traffic	Shall meet the requisite LoS	Passengers	Existing and forecast PHT
Safety provisions for fire incidences	Shall meet the codal requirements	Passengers	Train occupancy
Seating Arrangement	For 70% of passengers waiting for more than 20 minutes during PHT	Passengers	Based on Target traffic
Universally accessible construction	As per statutory provisions	Passengers and staff	Certification by Concessionaire
Design flexibility, space availability for capacity augmentation	To be checked while approving design.	Authority	Certification by Concessionaire

6.3 KPI - Reliability - equipment

KPI Title	KPI Description	Stakeholders	Data Availability
Lift	Services to be available for 98% of time on monthly basis	Passengers	SCADA System
Escalators/ Travelator		Passengers	SCADA System
CCTV		Govt. Security Agencies for CCTV	SCADA System
Train / Coach Indicator Boards		Passengers	Electronic Logger
Passenger Announcement System		Passengers	Electronic Logger
Power supply backup	As per design	Passengers	SCADA System
Emergency services during failure	100% availability	Passengers	Emergency drill

6.4 KPI – Customer Experience and satisfaction

KPI Title	KPI Description	Stake holders	Data Availability
Drop offs	Travel time within station premises plus 10 minutes during PHT	Passengers	Sensor data
Availability of Parking space	80% at PHT	Passengers	Sensor data
Time taken for parking	15 minutes during PHT	Passengers	Sensor data
Platform/ unreserved Tickets	15 min during PHT	Passengers	Survey, Feedback
Help Desk performance	Above satisfactory rating by 90% users for availability of Wheelchairs, Foldable ramp, Divyang	Passengers	Survey, Feedback, Random Checks by authority.

	sahayak, 1st aid kit, emergency medical facilities		
Travel time from drop-off point to platform	Within theoretical computations as per LoS plus 2 min during PHT	Passengers	Actual survey, CCTV data
Time for security check	Within 8 min, during PHT	Passengers	Actual check, CCTV data
Time for access control	Within 8 min, during PHT	Passengers	Actual check, CCTV data
Wayfinding satisfaction	Above satisfactory rating by 90% users	Passengers	Survey, Feedback
Drinking water, toilets/ urinals	a) Above satisfactory rating by 90% users b) Safe drinking water	Passengers, Authority	Survey, Feedback, test checks as per codal provisions
Travel time for Exit by arriving passengers	Within theoretical computations as per LoS plus 2 min for 95% passengers	Passengers	Actual survey, CCTV data

6.5 KPI – Impact

KPI Title	KPI Description	Stake holders	Data Availability
Cleaning of Frequently touched/ used surfaces	a) Above satisfactory rating by 90% users b) To ensure that 80% of surface is always above 80% level of cleaned surface	Passengers	To ensure that not below 80% of the cleaned surface standards, and immediately after departure of trains
Dustbin	To be emptied when 3/4th filled.	Passengers	Actual check, CCTV data
Temperature in concourse	Minimum 10^0 C below the ambient temperature outside the station building during summer	Passengers	SCADA data

Grievance Redressal	a) First response within 2 working days b) Final reply within 25 working days	Passengers, Authority	Feedback, Electronic log.
ISO Certificate for Maintenance	ISO 9001	Concessionaire, Authority	Certificate copy with renewal records
Green Building Certificate for O & M	IGBC platinum rating	Concessionaire, Authority	Certificate copy with renewal records
Overall passenger satisfaction	Above satisfactory rating by 90% users	Passenger, Authority	Electronic log, physical record

6.6 Passenger Charter

PASSENGER CHARTER

Note: This User Charter is to be prepared by the Concessionaire based on following

Dear Passenger,

1 *We, ..., (name of concessionaire) aim to provide:*

(a) Safe and secure Station
(b) Clean and hygienic environment
(c) Availability of essential facilities
(d) Reliable and easy to understand information
(e) Polite, User friendly and helpful staff
(f) Enjoyable experience to make your visit memorable.

2 **Our standards for Service**

We will continuously toil hard to provide you with a reliable and comfortable service at our Station, covering the following:

2. 1 **Approach to the Station**

We will make all out efforts to make your approach to the Station smooth and comfortable, enabling easy entry into and exit from the Station. The drop-offs shall be possible within [.... minutes] of entering the station premises.

2. 2 **Parking of vehicles**

It will be our constant endeavor to provide adequate parking space for your vehicles. The usage of parking facilities will be available on payment of prescribed fees which may vary according to the vehicles and the duration of parking. It is our aim to ensure that you do not spend more than [.... minutes] for parking/taking out your vehicle.

2.3 **Entry to the Station Building**

We will ensure that your entry into Station Building is hassle free and when multiple entries are available, information will be suitably indicated at the relevant entrances. Security check shall be possible within [.... minutes].

2.4 **Facilities**

We will ensure clean, well lit and hygienic station premises with proper signages so that you can spend your time in a comfortable and pleasant manner. We will also endeavour that the temperature in concourse area is at least 10° C below the temperature outside the Station Building during summer. You are entitled to free facilities as listed below (Other facilities will be available on payment basis):

[Note: To be populated on the basis of the developed Station]

2.7 **Seating**

The waiting area for the users will be so planned as to ensure that at least [....% (.... per cent)] of the peak hour capacity are provided comfortable seats.

2.8 **Taxies**

We will ensure that prepaid taxies are available when you arrive. Maximum waiting time for at least 95% of the users shall not exceed [.... minutes].

3 **Persons who require assistance**

We are concerned with the needs of every person requiring assistance. We are committed to provide universally accessible premises. You may either pre-book these at [... details of telephone nos/website etc] or you may contact the helpdesk to avail the following facilities:

[Note: To be populated on the basis of the developed Station]

4 **First Aid Facilities**

First aid facilities will be available 24x7 for meeting any unforeseen medical emergencies through qualified professionals. The first aid facilities are available at [....location of facility]

5 **Maintenance Works**

We will ensure that whenever any maintenance/modification/repair works are carried out, the area is adequately cordoned off, clear signage is available and normal functioning of the Station is not materially affected.

7 **Listening to your views**

Your satisfaction is important and by listening to you we aim to continuously improve our systems and processes. You may give your feedback to [...telephone, website, e-mail, etc].

(a) When you write to us, you should hear from us within 2 working days.

(b) In case it needs a longer time to provide a full reply, we will send you an acknowledgement within seven working days and reply within 25 working days.

(c) If a full reply cannot be made within 25 working days, we will contact and update you accordingly.

8 This is your station. Together we, as a team, will make it the station that the [....] city and nation is proud of.

-0-0-0-

Chapter 7 - Cost optimisation strategies

7.1 **Basics:** Important basic purposes of station redevelopment are reiterated below:

a. The redeveloped stations shall be well designed and well functional complexes that meet the various competing demands for space. The passenger movements, vehicle movements, railway operations, parcels etc shall be integrated and the space shall be optimally utilised for the same.
b. Station redevelopment aims at providing state of the art amenities to passengers and better Level of Service.
c. Railway stations are often the identifiers and, in any case, are gateways for the city. Therefore, the redeveloped stations shall be elegant and shall strive to become icons for the city. Large volumes and large heights are important elements for public spaces.

However, while planning an eye is required to be kept on the amount of money which shall be spent on providing the facilities. The financial constraints arise from two aspects - the amount of funding which can come from the various funding sources such as user charges, land monetisation, station revenues etc; and providing uniformity of facilities across various stations in India.

7.2 Suggested Cost Optimisation strategies:

The choices made as part of design parameters outlined in Chapter 2 determine the cost to a large extent. However, while making choices amongst the possible solutions, some possible strategies that optimise the cost are listed below:

a. **Utilising existing infrastructure:** Railways have invested a lot of money into its stations. The facilities already available shall be optimally utilised/integrated into the planning for redeveloped stations.

b. **Adopting appropriate solutions:** The solutions shall be chosen keeping the passenger habits in mind. Comparing the stations with different classes such as airports, or trains in foreign countries without appreciating the actual habits of an average train passenger on Indian Railways shall not be done.

c. **Optimum targeted Level of Service:** The Level of Service shall be chosen wisely. The LoS suitable for railway stations in India are recommended, which shall be adopted for space planning.

d. **Proper location of Concourse:** The concourse shall be provided on ground/platforms to the extent possible, keeping the passenger comfort in mind. Fragmentation of the waiting areas

might create challenges in easy wayfinding which must be kept in mind while planning the concourses.

e. **Optimum size of Concourse:** Existing waiting areas are already available, the same shall be utilised if found suitable. While computing the size of concourse, the passengers who are entering through other routes (for example those entering the end platforms directly) shall be accounted for.

f. **Life Cycle Cost Approach:** Low maintenance finishes shall be chosen keeping life cycle cost approach in mind. This might result in slightly higher initial cost but is beneficial in the long run.

g. **Innovative approach to good architecture:** The architectural intent can be met with exotic materials, but equally by innovatively using the local materials or low cost ordinary materials. Utilising local artisans to provide the elements which are unique and also connected with the local arts/heritage/culture is also an excellent strategy to achieve the objectives at low cost.

h. **Economical Structural Arrangements:** Large volumes can be achieved as column free spaces which increases the cost. Almost the same effect can be obtained by permitting a few columns in between which leads to considerable savings. While choosing the structural arrangements, the block requirement/ passenger discomfort during construction shall also be kept in mind. Precast construction is an excellent solution that meets these objectives and if the works are done at scale, the precast elements don't entail extra cost in the projects.

i. **Approach to air conditioning:** Air conditioning may not ordinarily be done for concourse except at stations handling more than 2 lakh per day or where the climatic conditions warrant air conditioning. The O & M costs for providing the air conditioning shall be included suitably in the business plan so that the station remains viable after including the air conditioning. For other stations, passive arrangements for reducing the heat input, ensuring adequate air changes per hour, providing large fans and controlling the humidity etc shall be done to ensure that the temperature inside the concourse is at least 10 degrees C lower than the ambient air temperature during summers.

j. **Checks on Over-investment:** The LoS for PHT at 40 years' time horizon shall be targeted at C, with LoS targeted at D for unusual loads or 'mela load'. In order to ensure that too much investment is not done at initial stage itself, the LoS for PHT at 8th year shall not exceed A and any further areas shall be included in station augmentation.

k. **Provisions for future expansion:** The planning shall always be done keeping modularity and scalability in mind. The addition of future platforms, increasing the capacity of concourses/FOBs etc shall be kept in mind while planning/designing. From technical considerations, any element which is difficult to augment such as entries/exits shall be designed with higher LoS.

7.3 Cost Optimisation Strategies for Smaller stations: Smaller stations which don't see much crowding can be redeveloped to provide reasonable level of comfort by making some choices which lead to considerable savings:

a. **Optimum Segregation:** Complete segregation of departing and arriving passengers shall be done only where the departing passenger numbers are more than 25000 per day or PHT is more than 4000.
b. **Optimum Facilities for Universal Accessibility:** For major stations, the Universal accessibility features shall be provided in all elements. However, for relatively smaller stations, universal accessibility features can be provided at one of the Foot Over Bridges, or even through the central concourse.
c. **Location of Concourse:** For smaller stations with less than 5 platforms, concourse at ground, or completely located on platforms is a choice which provides practically the same service as a concourse across tracks and saves lots of money.