Mass Urban Transport Projects
8th BIMSTEC Training Course on Design and Maintenance of Passenger Coaches
Railway Staff College, Vadodara

Presentation on

# Mumbai Urban Transport Project

**Dr. P. C. Sehgal**

**Managing Director**

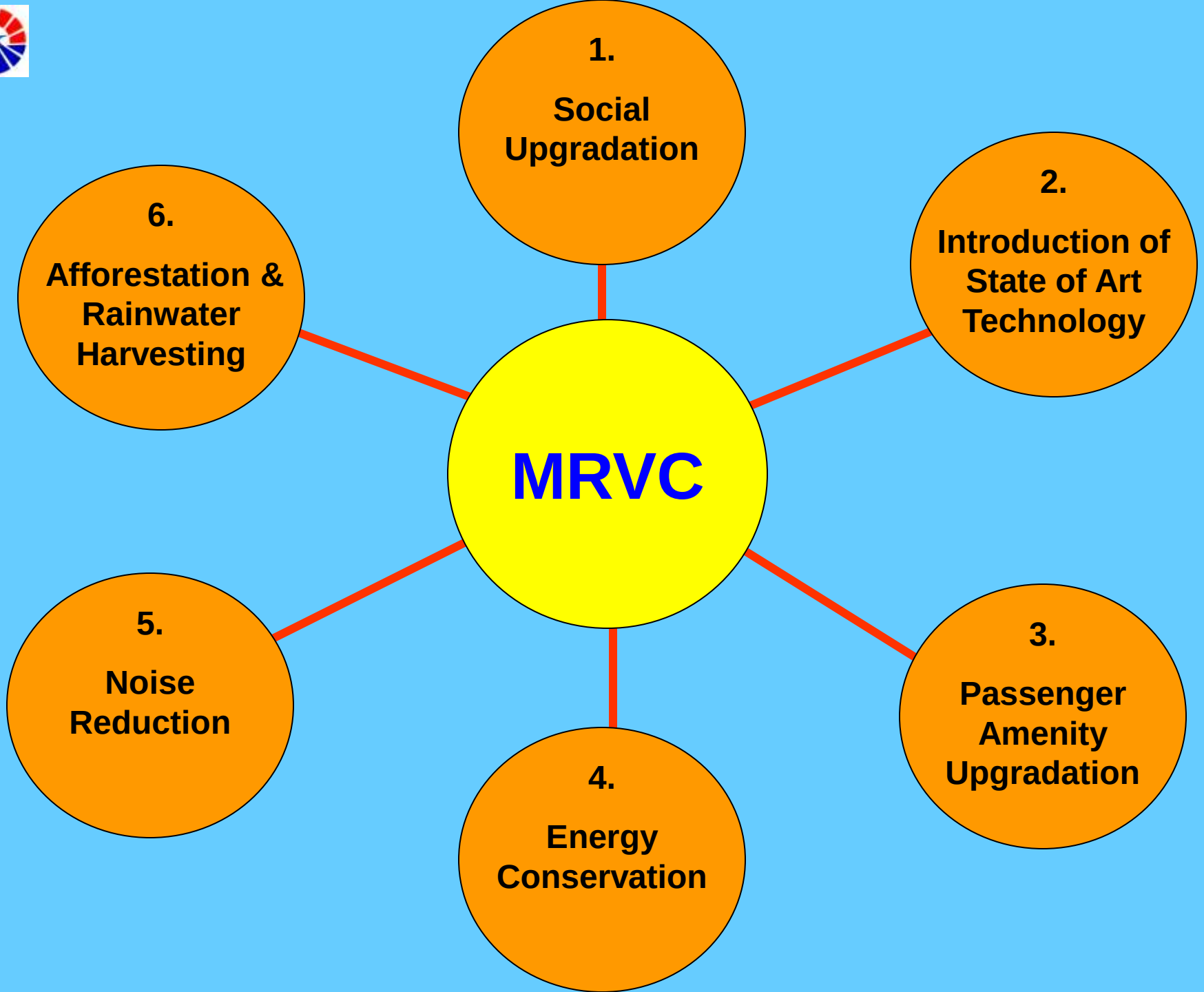
**Mumbai Railway Vikas Corporation**

2nd September 2008

# Details of Presentations

MRVC will make the following three presentations:

| Speaker | Subject | Details |
|---|---|---|
| Dr. P. C. Sehgal<br>Managing Director | Mass Urban Transport Projects | Details of projects, funding arrangements, salient achievements, etc. |
| Shri Alok Kapoor<br>Dy. Chief Electrical Engineer | Latest Developments in EMUs | Will cover specific technical details of EMUs being procured by MRVC for Mumbai suburban system |
| Shri Rajeev Sharma<br>Chief Signal & Telecom Engr. | On Board Radio Communication System through GPS and Train Management System | Details of signaling system being planned for Mumbai suburban system |


1.
Social Upgradation
2.
Introduction of State of Art Technology
3.
Passenger Amenity Upgradation
4.
Energy Conservation
5.
Noise Reduction
6.
Afforestation & Rainwater Harvesting
MRVC

# Mumbai Suburban Railway System
## Background

- Mumbai has been the commercial capital of India since pre-independence days
- Due to its peninsular geography, the city has grown linearly
- Britishers realized that only an efficient suburban railway system can become the prime mover of growth
- Suburban railway system set up in 1925
- Latest technologies of 1500v DC traction and DC Electric Multiple Units available at that time used.

# Mumbai Suburban Railway System

Greater Mumbai

Area: 445 Sq Kms

# Mumbai Suburban Railway System
## An Overview

- 319 route Kms.
- 876 Track Kms (including 52 Kms already added in MUTP).
- 6.3 million passengers per day.
- 2385 trains per day
- Fleet of  227 rakes (9 car eq.) which are run in 9 and 12 car compositions.
- Mumbai Suburban Railway System is a part of Indian Railways which is a department of the Central government.

# Mumbai Suburban Railway System

- The designed carrying capacity per nine-car train is 1,800 passengers (900 sitting and 900 standing) and as against this figure, at present in a nine-car train, during the peak period 5,000 passengers (900 sitting plus more than 4,000 people in standing condition) travel.
- This has resulted in, what is known as, practical super dense crush loading conditions in Mumbai.
- Loading of 16 passengers per square metre, which is highest in the world, is obtained.

# Mumbai Suburban Railway System
## Existing Major Problems

- Overcrowding/overloading
- Lack of investment
- Obsolete technology
- Encroachments
- Limitation of carrying capacity
- Ventilation and jerking problems

# Mumbai Suburban Railway System
## Overcrowding

# Overcrowded Stations

# Difficult Entry & Exit

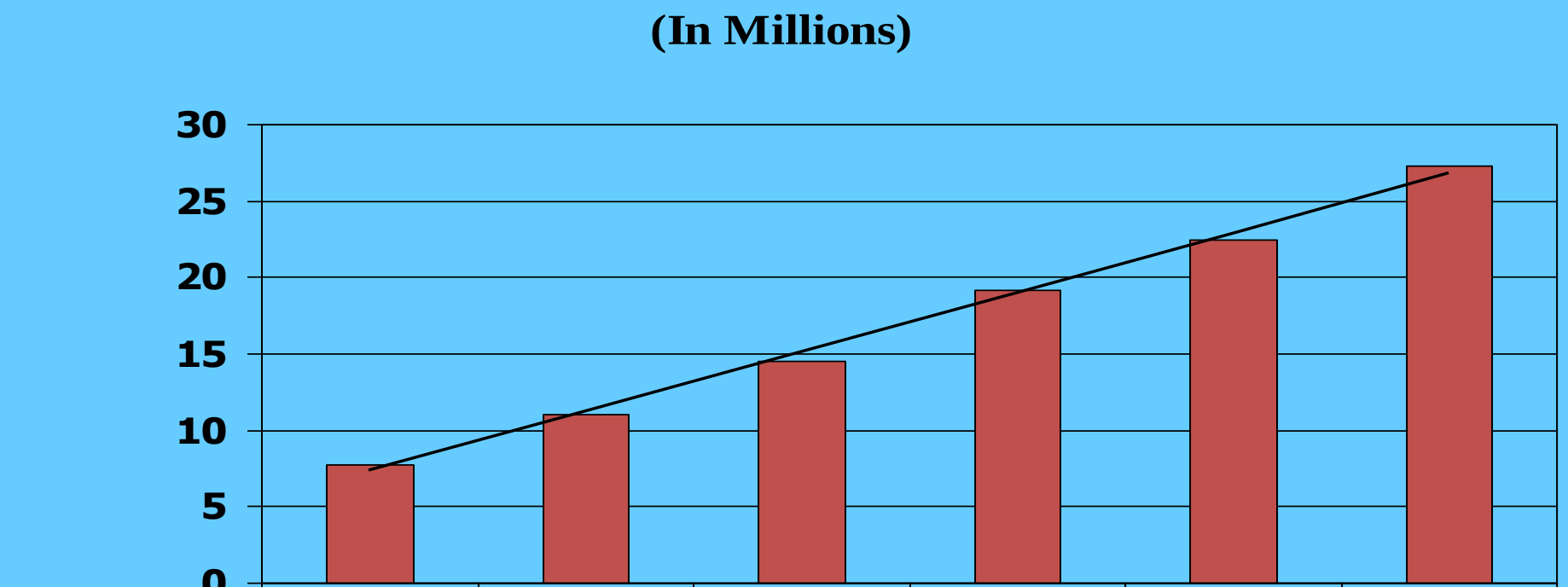
# Mumbai Suburban Railway System
## Overloading in trains

- Mumbai is the commercial capital of India and has ample employment opportunities.
- Large number of people were attracted to Mumbai for livelihood.
- Abnormal increase in population.
- Growth of suburban traffic leading to overloading in the trains.

# Mumbai Suburban Railway System
## Overloading in trains

- Monthly season ticket in Mumbai suburban service is quite affordable i.e. in one US$, 500 Kms is covered by passengers.
- Railway suburban transport system became the main mode of transport for the people.
- Increase in suburban trains in Mumbai did not keep pace with the passenger demand .
- Loading in the existing suburban trains increased.
- The traveling conditions in trains became unbearable.

# Mumbai Suburban Railway System
## Overloading in trains




| | 1971 | 1981 | 1991 | 2001 | 2011* | 2021* |
|---|---|---|---|---|---|---|
| Mumbai | 7.78 | 11.08 | 14.53 | 19.2 | 22.45 | 27.26 |

* Estimated

# Mumbai Suburban Railway System
## Overloading in trains

| | 1951-52 | 1961-62 | 1971-72 | 1981-82 | 1991-92 | 2001-02 | 2004-05 | % increase from 1951-52 |
|---|---|---|---|---|---|---|---|---|
| Passenger carried (millions) | 292 | 454 | 915 | 1459 | 1795 | 2275 | 2314 | 792% |
| Average trip length (Kms) | 13.8 | 14.0 | 16.5 | 18.8 | 22.5 | 26.9 | 29.6 | 214% |
| Passenger Kilometers (millions) | 4031 | 6365 | 15123 | 27392 | 40462 | 61195 | 68632 | 1695% |
| No. of trains | 741 | 960 | 1161 | 1577 | 1889 | 2055 | 2441 | 329% |

# Mumbai Suburban Railway System
## Lack of Investment

- All over the world, traditionally the suburban/metro network operation, including the buses, is being looked after by the local and state governments.

- In Mumbai, the rail based suburban network was operated by the Central Government and the operating loses were also absorbed by the Central Government.

# Mumbai Suburban Railway System
## Lack of Investment

- The development charges collected by the State Government were not used for the expansion of suburban systems in Mumbai.

- As a consequence, the existing suburban system was neither patronized by Central Government nor by State Government, mainly due to requirement of huge amount of funds.

# Mumbai Suburban Railway System
## Obsolete technology

- Mumbai suburban railway system is being operated on 1500V DC traction system, introduced since 1925.
- With the increase in loading, each 12-car train draws 5,000 Amps.

# Mumbai Suburban Railway System
## Obsolete technology

- When two trains are leaving and two trains are reaching Churchgate station, approximately 10000 to 15000 Amps current is drawn from the system.
- Due to drawal of heavy current, large number of traction substations have been set up.
- Practically at each station, traction substation is existing.

# Mumbai Suburban Railway System
## Obsolete technology

- For increasing the suburban services and number of coaches per train, additional substations have to be set up, which is not considered advisable from the technical safety consideration.
- It became difficult to increase the number of trains and to add additional number of coaches.
- Need to have 25000V traction system was felt.

# Mumbai Suburban Railway System
## Encroachments

- When large number of people migrated to Mumbai from other cities and rural areas of Maharashtra and other States, the surplus vacant railway land available in Mumbai suburban sections became the soft target for encroachment.
- Thus when the need was felt to increase the number of railway corridors in Mumbai, it became difficult to get the encroached railway land vacated from encroachers.

# Mumbai Suburban Railway System
## Encroachments

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# Mumbai Suburban Railway System
## Encroachments

Since the encroachers were staying near the existing railway tracks, the train speeds was reduced to 30 K/ph from safety considerations and this led to reduction in line capacity.

# Mumbai Suburban Railway System
## Limitation of carrying capacity

- On the existing corridors, mail/express, freight, passenger and suburban trains are operated and existing corridors are being utilized to their full capacity and it has been difficult to increase the number of services in the existing system.

- In order to create extra carrying capacity to run additional trains, new additional corridors had to be set up.

# Mumbai Suburban Railway System
## Ventilation and jerking problems

- Lack of ventilation is a major problem in Mumbai suburban trains. During peak periods, $CO_2$ level inside the coaches is as high as 2500 ppm.

- Experience of jerks during braking and during run as starting and stopping of the trains is not smooth.

# Mumbai Suburban Railway System

## Strategy to solve the problems

# Mumbai Suburban Railway System
## Strategy to solve the problems

- Formation of Mumbai Railway Vikas Corporation to implement the railway projects in Mumbai with World Bank assistance.
- Resettlement and Rehabilitation of 15,000 project affected households to get the encroached railway land vacated.
- Introduction of new traction technology at 25 kV AC converting from 1500V DC system.
- Increasing the length of trains from 9 to 12 car, thus creating 33% extra carrying capacity.
- Introduction of rakes with new technology having IGBT based traction control system with regenerative braking.

# Mumbai Suburban Railway System
## Strategy to solve the problems

To take care of deteriorating traveling conditions in the suburban railway system of Mumbai, Govt. of Maharashtra and Indian Railways came forward and Mumbai Railway Vikas Corporation Ltd (MRVC) was set up with the following main objectives:

- Bringing down the over crowding in peak hour peak direction 9-car train to 3000 passengers as against existing around 5000.
- Segregate the suburban train operation from the main line passenger and freight services.

# Mumbai Suburban Railway System
## Strategy to solve the problems

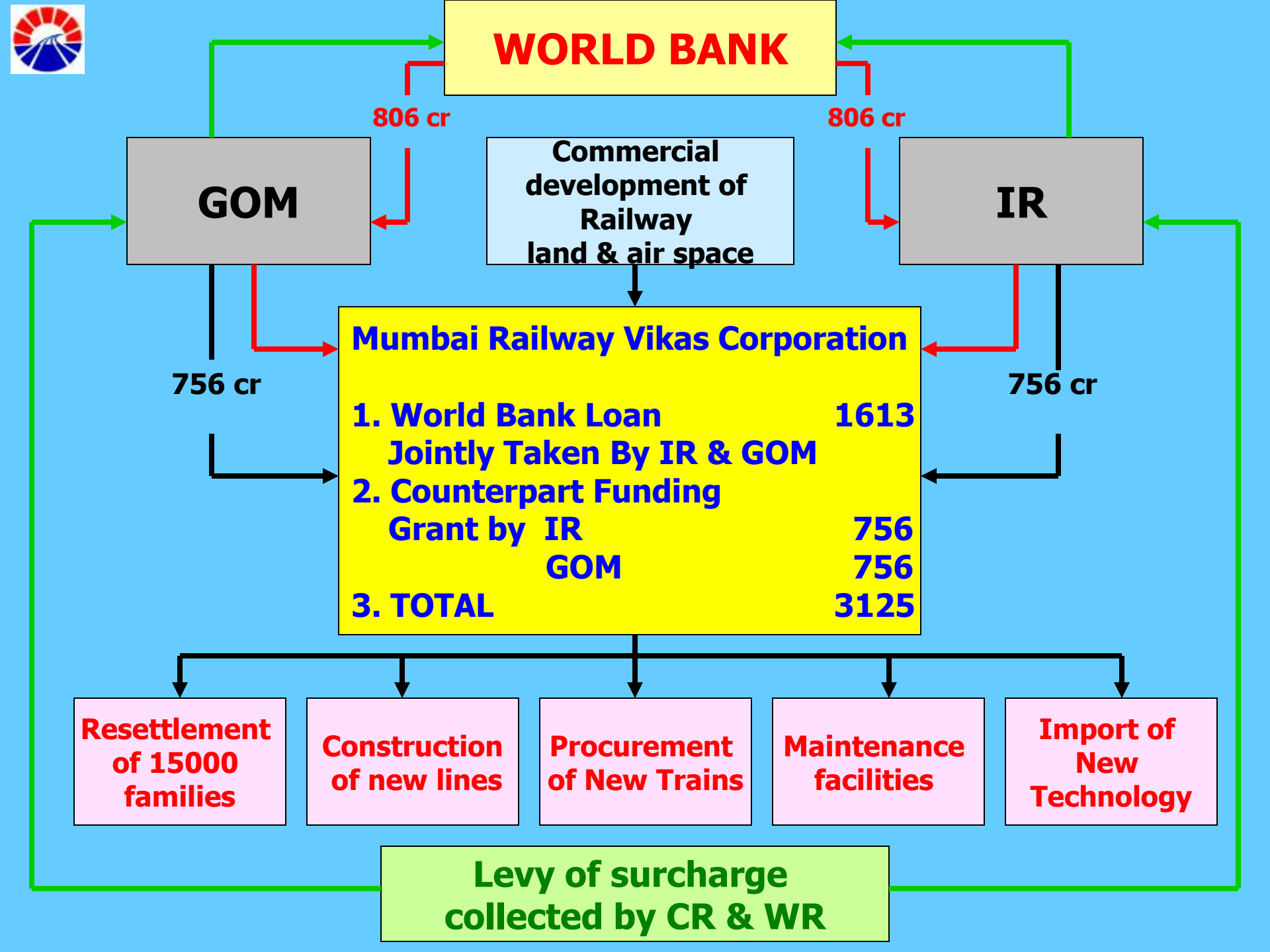
- To achieve the above objectives, works requiring investment of Rs. 10,000 crores (US$ 2.5 billion) approximately were identified. It was decided to undertake the capacity enhancement works in Mumbai in three phases.

- In Phase I, works worth Rs. 3125 crores (US$ 781 million) were identified and it was decided to take a loan upto 50% of requirement from World Bank..

# Mumbai Suburban Railway System
## Strategy to solve the problems

- The loan would be repaid by levy of surcharge in three stages on the existing passenger tickets.

- Apart from that, a non-refundable grant was to be given by Govt. of Maharashtra and Indian Railways.


WORLD BANK
806 cr
806 cr
GOM
Commercial development of Railway land & air space
IR
756 cr
756 cr
Mumbai Railway Vikas Corporation
1. World Bank Loan 1613
Jointly Taken By IR & GOM
2. Counterpart Funding
Grant by IR 756
GOM 756
3. TOTAL 3125
Resettlement of 15000 families
Construction of new lines
Procurement of New Trains
Maintenance facilities
Import of New Technology
Levy of surcharge collected by CR & WR

# MUTP Phase I (Rail Component)

| | INR | US$ (million) |
|---|---|---|
| New Lines: | | |
| Quadrupling of Borivali-Virar section | 416.0 cr. | 109 |
| WR 5th line Santacruz-Mahim | 59.0 cr. | 15 |
| Kurla Thane Additional pair of lines | 166.0 cr. | 42 |
| Sub-Total (New Lines) | 641.0 cr. | 166 |
| EMU procurement & manufacture: | 1359.2 cr. | 340 |
| DC to AC Conversion | 380.4 cr. | 95 |
| Resettlement & Rehabilitation: | 290.0 cr. | 73 |
| Optimisation & Other Works: | | |
| Optimisation of Western Railway | 50.1 cr. | 13 |
| Optimisation of Central Railway | 99.5 cr. | 100 |
| Optimisation of Harbour line | 19.7 cr | 5 |
| Virar Car Shed | 93.0 cr | 18 |
| Maintenance facilities for EMUs | 64.3 cr. | 16 |
| Stabling lines for EMUs | 48.5 cr. | 12 |
| Track Machines | 31.3 cr. | 8 |
| Institutional strengthening & studies | 48.2 cr. | 12 |
| Sub-Total | 454.6 cr. | 184 |
| Grand Total | 3125.2 cr | 781 |

# Mumbai Suburban Railway System

## Resettlement & Rehabilitation

# Mumbai Suburban Railway System
## Resettlement & Rehabilitation

- For getting the encroached railway land free for implementing the railway projects, it was decided that each and every project affected households will be given a house of 225 sq. ft. at different locations.

- 15,000 new flats have been constructed and all the project affected households have been resettled.

# Mumbai Suburban Railway System
## Resettlement & Rehabilitation

- All the resettled people are happy and they are feeling socially upgraded and their standard of living has also been upgraded substantially.

- MRVC has spent Rs. 400 crores (US$ 100 million) to take care of the social obligations.

# Mumbai Suburban Railway System
## Resettlement & Rehabilitation

- With removal of encroachments, 3.2 lakhs sq. mtrs. of encroached railway land both on Central and Western Railways has been vacated.

- With the completion of this important task, the work of laying of additional tracks between Borivali and Virar was completed and the section was dedicated to the nation on 7th July 2007.

- For laying of additional tracks between Kurla and Thane, the work is in progress.

# Mumbai Suburban Railway System
## Resettlement & Rehabilitation

- Mr Robert B. Zoellick, President, World Bank, during his visit to Mumbai had inspected the resettlement sites and appreciated the efforts put in by Railways and Govt. of Maharashtra in rehabilitating the project affected households.

- He has also mentioned about this important issue during his address in the recently concluded SDN Workshop held in World Bank's HQ in Washington DC in February 2008.

# Mumbai Suburban Railway System
## Resettlement & Rehabilitation

# Mumbai Suburban Railway System
## Resettlement & Rehabilitation

# Mumbai Suburban Railway System
## Resettlement & Rehabilitation

# Mumbai Suburban Railway System

## EMU Procurement

# EMU Procurement

- Total No. of rakes - 174, 9 Car.
  - MRVC Contract - 101, 9 Car.
  - GP-194 - 56, 9 Car.
  - GP-194 (30%) - 17, 9 Car.

129, 12-car + 2, 9-car

# Mumbai Suburban Railway System

- In next 3 to 4 years, Mumbai suburban system will get 129 12-car rakes with passenger amenity features.
- It is felt that with the provision of passenger friendly improved features overall upgradation of passenger amenities will take place.
- The main important feature of the new EMU trains which public has liked the most is that the $CO_2$ level inside the coaches had been reduced from 2500 ppm to 1400 ppm during the peak period.

# Progress

| | |
|---|---|
| 1st Rake | 12th Nov. 2007 (W.R.) |
| 2nd Rake | 17 Dec. 2007 (W.R.) |
| 3rd Rake | 13th Jan. 2008 (W.R.) |
| 4th Rake | 21st Feb. 2008 (C.R) |
| 5th Rake | 7th April 2008 (C.R) |
| 6th Rake | 13th May 2008 (CR) |
| 7th Rake | 26th May 2008 (CR) |
| 8th Rake | 13th June 2008 (CR) |
| 9th Rake | 4th July 2008 (CR) |
| 10th Rake | 31st July 2008 (CR) |

# Progress

| | |
|---|---|
| 11th Rake | 8th Aug 2008 (C.R.) |
| 12th Rake | 17th Aug. 2008 (C.R.) |
| 13th Rake | 23rd Aug. 2008 (C.R.) |
| 14th Rake | Under commissioning (C.R.) |
| 15th Rake | Under commissioning (C.R.) |

With the introduction of new rakes

- 126 additional services (74,12 car & 52, 9-car)
- 123 services earlier running with 9-car have been converted to 12-car

# New Rake in Public Service (WR)

# Introduction of new EMU rake in public service (CR)


21-02-08


# Passenger Information System Display

## Stainless Steel Grab Handles & Partitions

# 2nd Class Polycarbonate Seats and improved interiors

# Ergonomic Motorman Driving Desk

# External Air Blowers for forced ventilation

# Air Springs for Better Riding

# INTRODUCTION OF NEW TECHNOLOGY EMU RAKES : IMPROVED FEATURES

- Use of 3 Ph AC Traction motor having 20% higher horse power.
- Higher speed potential of 100 Kmph as against existing 80 Kmph.
- Higher acceleration and deceleration of 0.54 $m/s^2$ and 0.76 $m/s^2$.
- Reduction in journey time of about 4 to 5 minutes in a typical Churchgate-Borivali or CSTM-Thane section.

# INTRODUCTION OF NEW TECHNOLOGY EMU RAKES : IMPROVED FEATURES

- Forced Ventilation System
- Computerized passenger information system with LED display.
- Station announcement on running trains using Global Positioning System (GPS) technology.

# INTRODUCTION OF NEW TECHNOLOGY EMU RAKES : IMPROVED FEATURES

- Energy saving of about 30% saving 20 crore (5 million) units of energy every year due to re-generative braking .
- Benchmark for $CO_2$ emission in power house is 1 Kg of $CO_2$ emission for every unit of energy.
- There would be a saving of 2 lakh tonnes of $CO_2$ emission every year.

# Carbon Credit

- The project idea note was made in consultation with Central and Western Railways and submitted to World Bank.
- It has been included in the approved list of CDM projects.

# VENTILATION Problem

# Ventilation system

- MRVC procured a portable carbon dioxide meter and measured the $CO_2$ levels inside the running trains.

- The $CO_2$ levels in the existing SDCL condition was 2500 ppm.

# Ventilation system

- Detailed study was carried out referring ANSI/ASHRAE standard to modify the RDSO specification.
- ANSI/ASHRAE standard 62-2001 recommends that the maximum indoor $CO_2$ concentration should be less than 700 ppm above the outdoor air concentration

# Ventilation system
# Fresh Air Requirement

- Passenger Loading per coach:
  - Seating Capacity 90 passengers
  - Normal standing for peak 90 passengers
  - Total passengers traveling in SDCL 570 passengers

# Ventilation system
# Fresh Air Requirement

- $CO_2$ Generated per Coach:
  - $CO_2$ generated per passenger .018 $m^3/hr$
  - $CO_2$ generated by 570 passengers in SDCL 10 $m^3/hr$
- Calculation of Fresh Air Requirement:
  - Fresh Air Required $= \frac{\text{Total } CO_2 \text{ generated}}{\text{Permissible PPM}}$

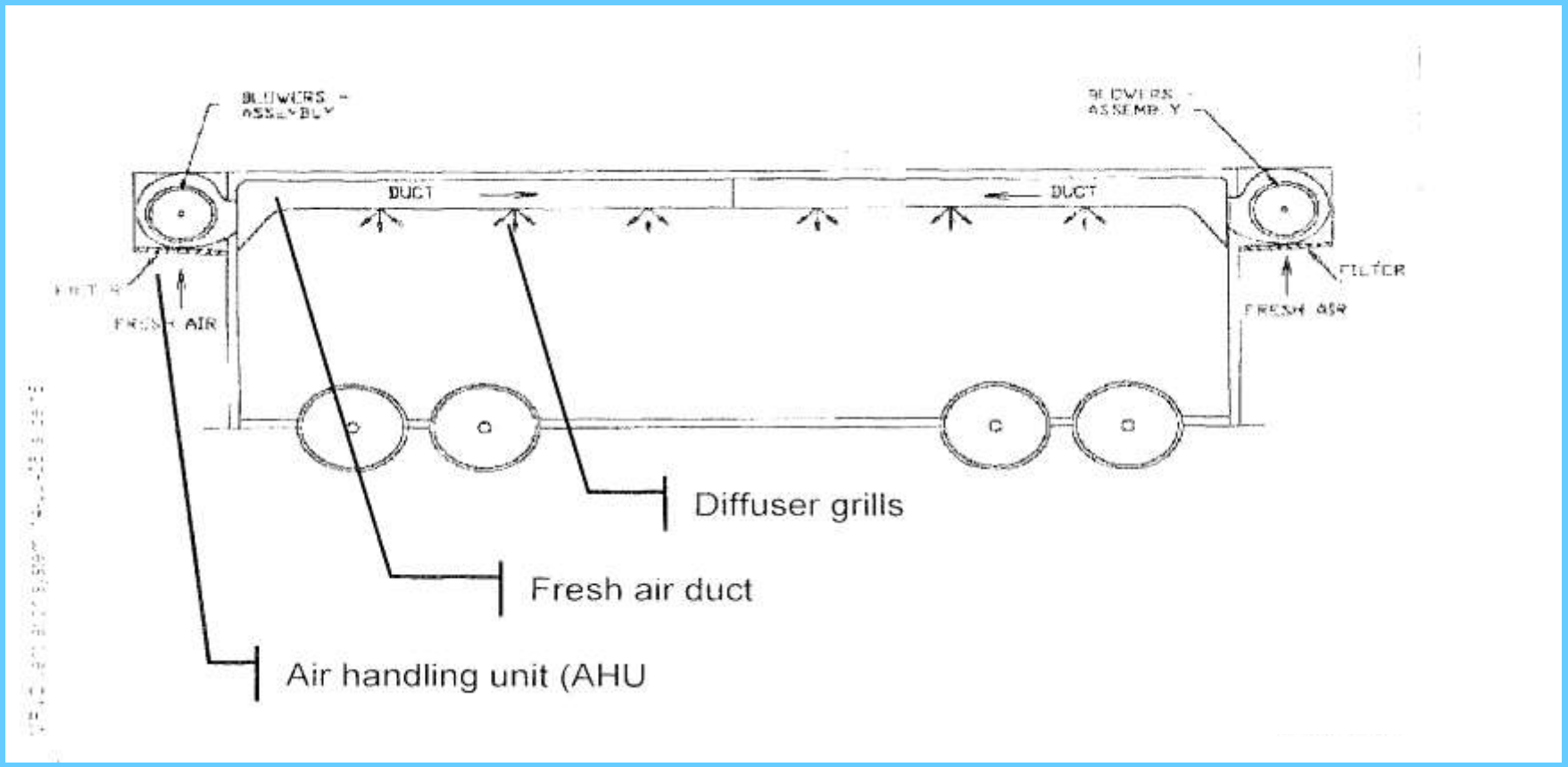
$= \frac{10\ m3/hr}{700 \times 10^{-6}}$

$=$ **15000 $m^3/hr$**

**ADDITIONAL FRESH AIR REQUIRED = 15000 $m^3/h$**

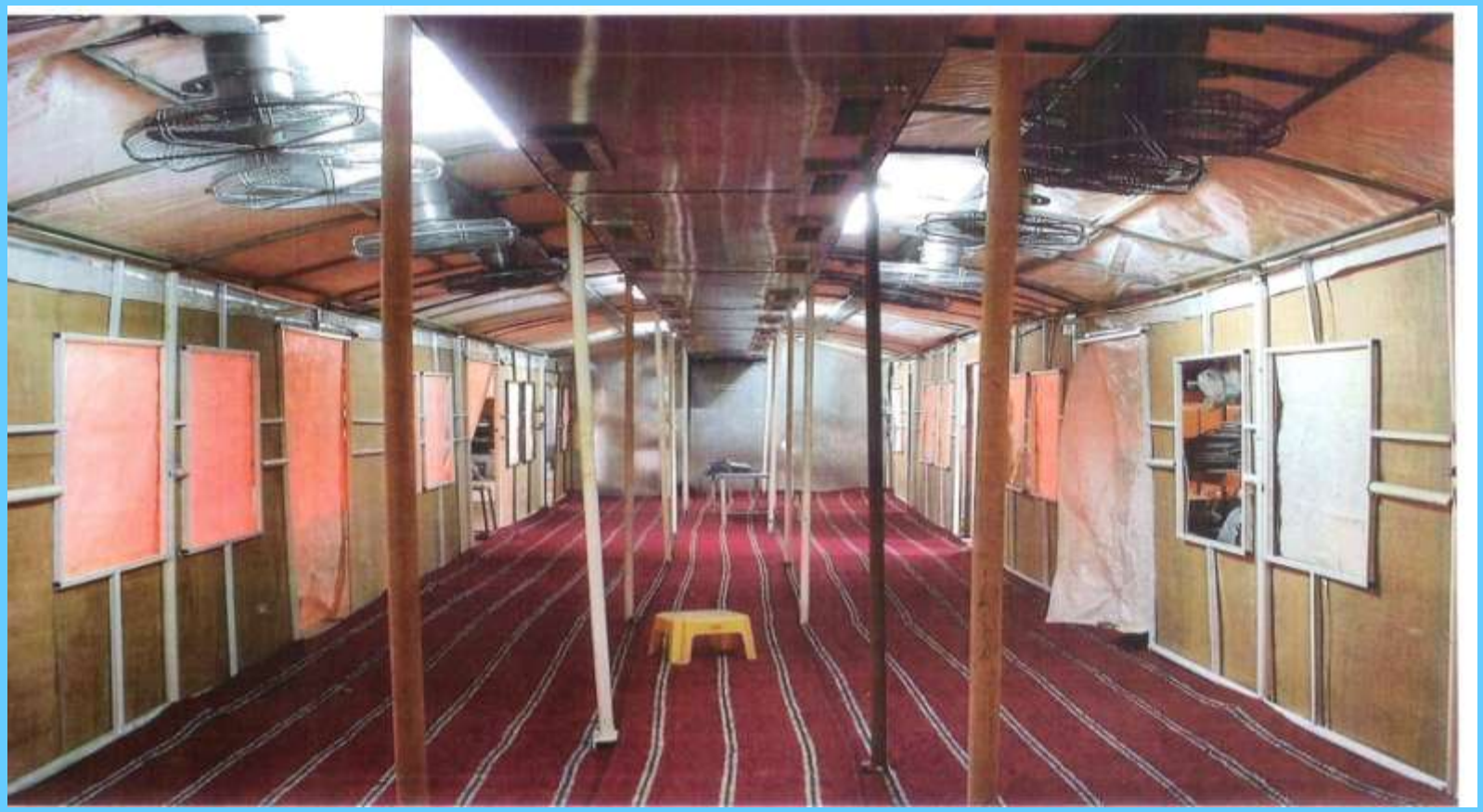
# VENTILATION SYSTEM

## The Design Concept

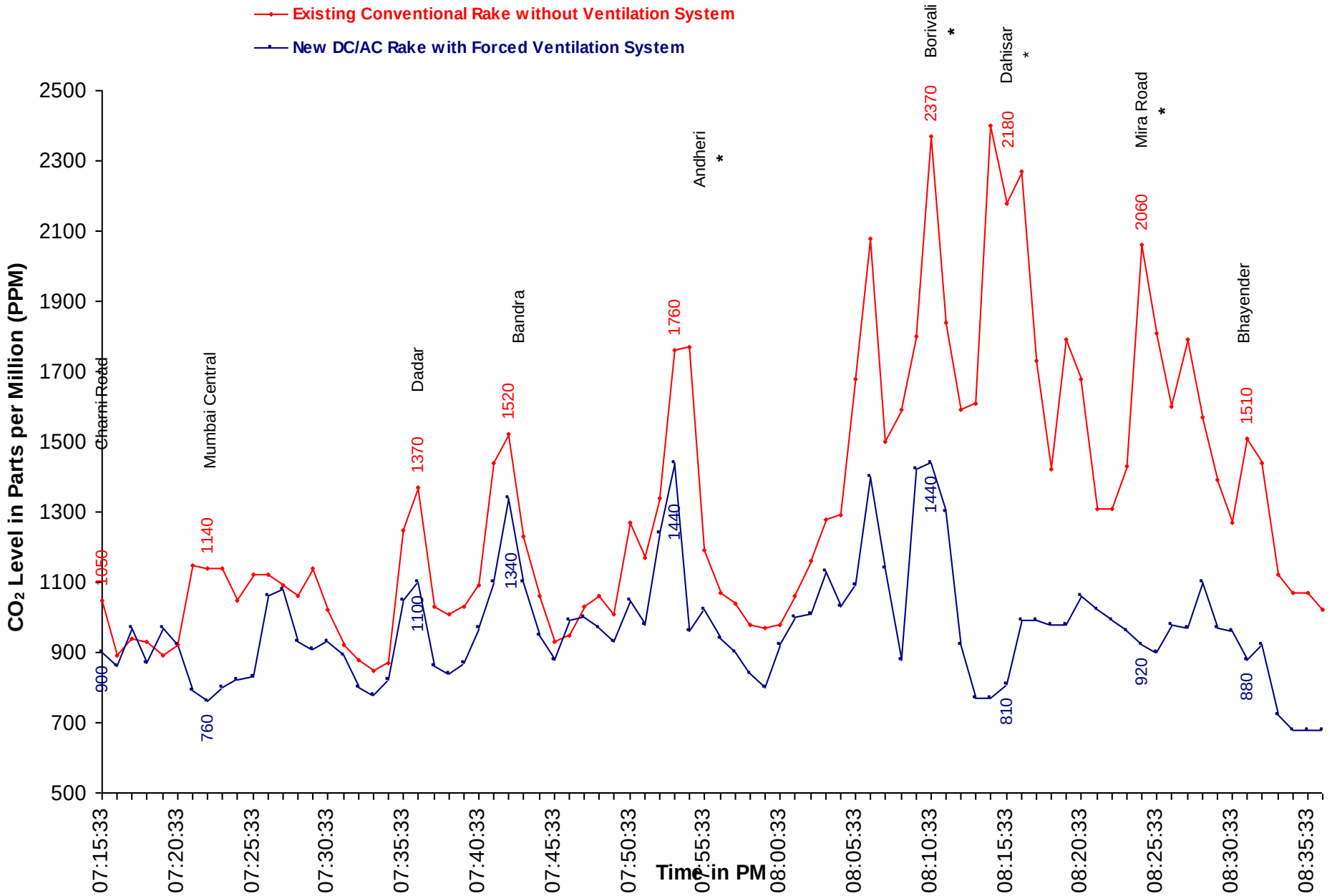


# VENTILATION SYSTEM

Photograph of Mock-Up

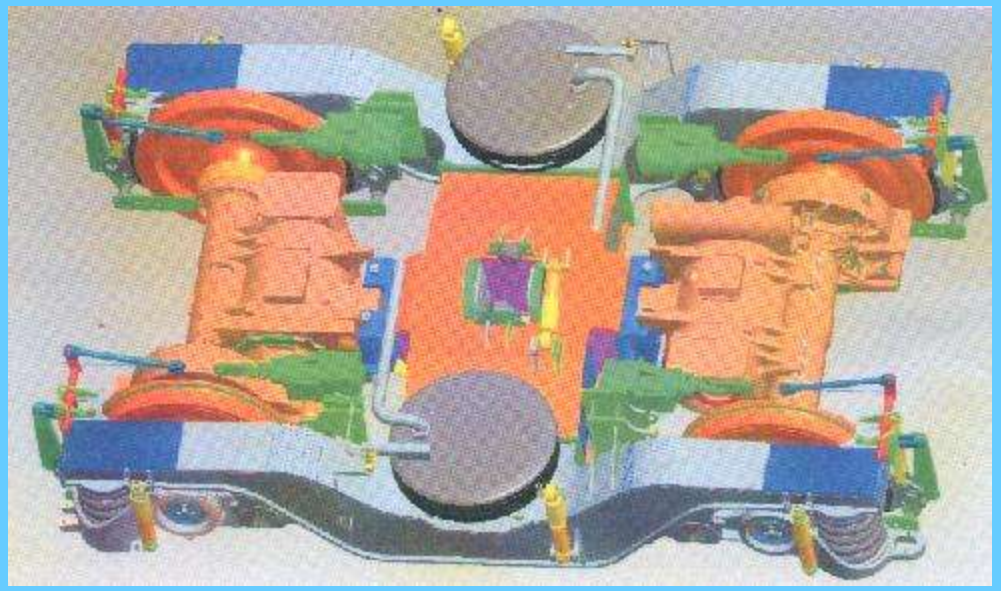


# Comparative $CO_2$ Levels In SDCL EMU Train




* Above Comparative Graph Shows an appreciable reduction in $CO_2$ level in the EMU Train fitted with Forced Ventilation System

# New EMU Bogie



Reduced Jerks & improved riding

# Mumbai Suburban Railway System

## Improved illumination level:

The lighting inside the coaches has been improved to 300 lux from present 120 lux.

# Mumbai Suburban Railway System

## Passenger Information System:

GPS based passenger information system has been provided in all the coaches with following facilities:

- Automatic announcement of approaching stations in three languages, i.e. English, Hindi and Marathi.
- Platform indicator.
- Emergency announcement by control.
- LED based head code.

# Mumbai Suburban Railway System

## Passenger Information System:


**Platform Indicator**

**LED based head code**

# Mumbai Suburban Railway System

## Reduction in number of substations

The number of traction substations on Western and Central Railways will be reduced from the existing 66 to 22.

This will also improve the voltage condition in the entire Mumbai suburban section and will enable us to increase the length of trains from 9 to 12.

# Mumbai Suburban Railway System

## Cost Reduction of EMUs

# Mumbai Suburban Railway System

The cost of MRVC (nine-car) rake is Rs. 20 crores (US$ 5 million) approximately. The cost of a fully imported nine-car rake of similar features would be around Rs. 60 crores. The cost reduction has been achieved by adopting the following strategy:

- The equipments with improved design features have been designed by M/s Siemens, Germany. Out of total ordered quantity, only 30% equipments will be got manufactured abroad and 70% are to be manufacture in the facilities to be set up by M/s Siemens in India.
- An interest free advance of Rs. 180 crores (US$ 45 million) has been given to M/s Siemens, Germany.

# Mumbai Suburban Railway System

| Sr. No. | Equipment | Location of factory set up in India | Cost per motor coach | | % Saving |
|---|---|---|---|---|---|
| | | | Imported Equipment | Indigenized equipment | |
| 1. | Traction motor | Kalva | Rs. 65.40 lakhs (0.16 million US$) | Rs. 51.36 lakhs (0.12 million US$) | 21.47% |
| 2. | Power converter | Nashik | Rs. 96.14 lakhs (0.24 million US$) | Rs. 84.31 lakhs (0.21 million US$) | 12.30% |
| 3. | Auxiliary converter | Nashik | Rs. 32.87 lakhs (0.08 million US$) | Rs. 21.85 lakhs (0.06 million US$) | 33.53% |
| 4. | Power transformers | Vadodara | Rs. 30.12 lakhs (0.08 million US$) | Rs. 22.25 lakhs (0.06 million US$) | 26.13% |

# Mumbai Suburban Railway System

- Improved features of passenger amenity items were developed indigenously at ICF with the features matching with the international standards. This also led to cost reduction.
- By manufacturing the coach body and shell at ICF, which is Indian Railway's manufacturing unit, the cost of manufacture has been kept low as no profit margins have been included in the cost.
- The cost of nine-car rake built by ICF is Rs. 20 crores (US$ 5 million) approximately as against Rs. 60 crores (US$ 15 million) of imported rake with the similar features.

# Mumbai Suburban Railway System

## Eco Friendly Features

# Mumbai Suburban Railway System

In the existing trains, lot of noise is being generated on account of acceleration, braking and working of compressors, etc.

The present level of noise inside the coaches is more than 85 db.

With the use of compressor of modified design and IGBT step-less control with regenerative braking, the noise level inside the coach has been reduced to 65 to 68 db.

# Mumbai Suburban Railway System

- For laying of additional tracks between Borivali-Virar and Kurla-Thane, 3500 mangroves were cut.
- MRVC has taken up the responsibility to upgrade the environment and planted 13,000 mangroves.
- The survivability of these trees is checked at every six month by the World Bank team and I am happy to announce that the survivability rate of such mangroves is 80%.

# Mumbai Suburban Railway System

**Mangrove Plantation:**

# Mumbai Urban Transport Project Phase II

# MUTP Phase II

MUTP Phase II has been sanctioned in the Railway Budget 2008-09

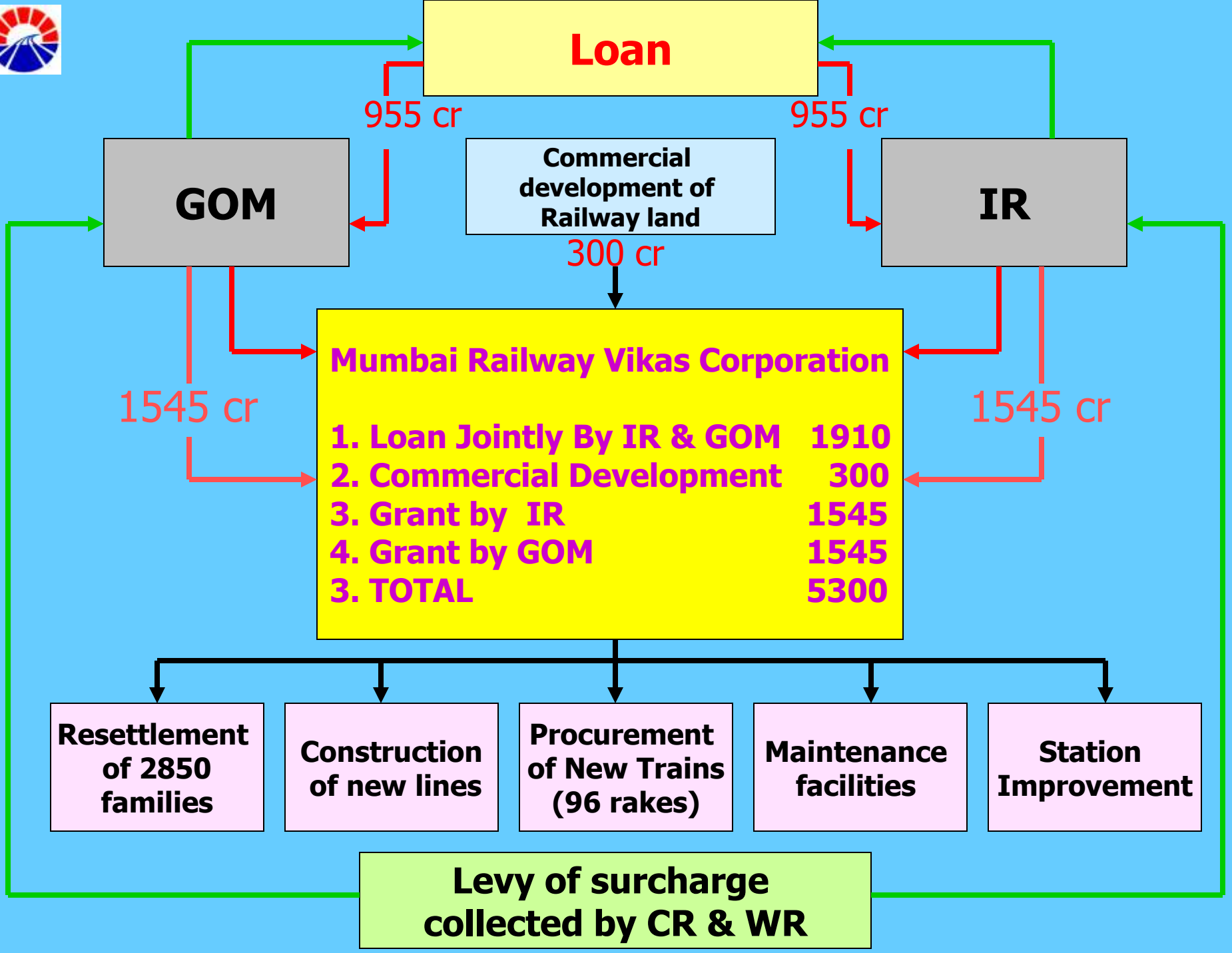
| Sr. No. | Work | Cost at Current Prices (in cr) (March 2008) | Completion Cost (in cr) (Upto 2013) |
|---|---|---|---|
| 1 | 5th & 6th Lines CSTM-Kurla | 537 | 659 |
| 2 | 5th & 6th Lines Thane-Diva | 115 | 133 |
| 3 | 6th Line Mumbai Central-Borivali | 430 | 522 |
| 4 | Extension of Harbour Line from Andheri to Goregaon | 88 | 103 |
| 5 | DC to AC Conversion | 237 | 293 |
| 6 | EMU Procurement & manufacture | 2324 | 2930 |
| 7 | Maintenance Facilities for EMUs | 167 | 205 |
| 8 | Stabling Lines for EMUs | 111 | 141 |
| 9 | Technical Assistance & Institutional Strengthening | 52 | 62 |
| 10 | Resettlement & Rehabilitation | 109 | 124 |
| 11 | Station Improvement & Trespassing Control | 111 | 128 |
| | **Grand Total** | **4281** | **5300** |

# Financing of MUTP Phase II

- Cost 5300 cr
- Grant by GOM 1545 cr
- Grant by IR 1545 cr
- Loan* 1910 cr
- Revenue from comml. development** 300 cr

*Loan to be repaid by continuation of Phase I surcharge.

**Depending upon FSI realized, equal financial relief to GoM and MoR will be available.


Loan
955 cr
955 cr
GOM
Commercial development of Railway land
300 cr
IR
1545 cr
1545 cr
Mumbai Railway Vikas Corporation
1. Loan Jointly By IR & GOM 1910
2. Commercial Development 300
3. Grant by IR 1545
4. Grant by GOM 1545
3. TOTAL 5300
Resettlement of 2850 families
Construction of new lines
Procurement of New Trains (96 rakes)
Maintenance facilities
Station Improvement
Levy of surcharge collected by CR & WR

# Implementation Plan for MUTP Phase II

- MUTP Phase II is proposed for implementation in two parts.
- MUTP Phase II (a): (World Bank funded)
  - EMU procurement
  - DC to AC Conversion
  - EMU maintenance facilities
  - EMU stabling lines

# Implementation Plan for MUTP Phase II

- MUTP Phase II (b):
  - Resettlement & Rehabilitation
  - 6th Line Mumbai Central-Borivali
  - Extension of Harbour Line from Andheri to Goregaon
  - 5th & 6th Line Diva-Thane
  - 5th & 6th Line Kurla-CSTM
  - Station improvement & trespassing control

# Implementing Agency for MUTP Phase II Works

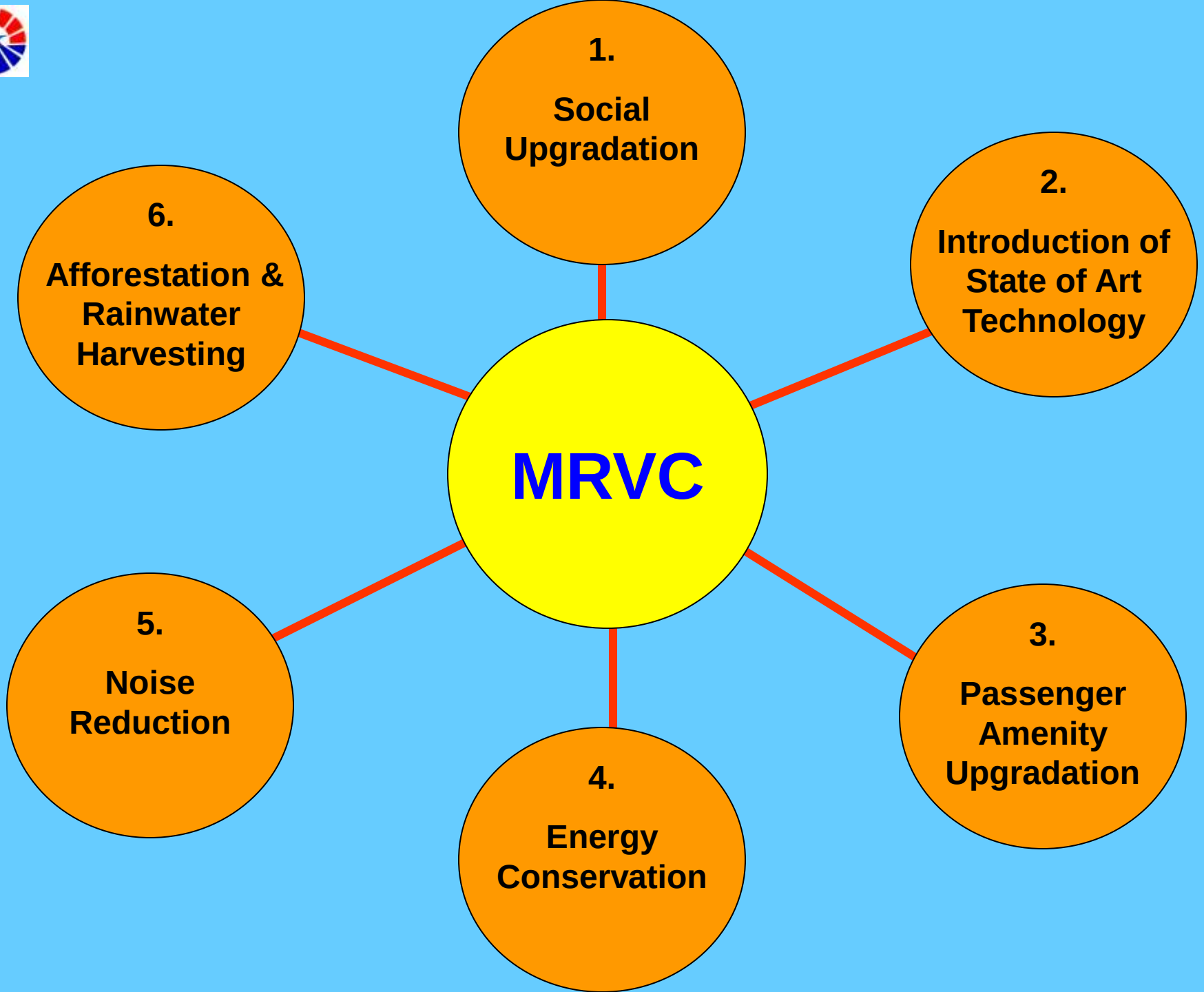
- MUTP Phase II (a): (World Bank funded)

| | |
|---|---|
| EMU procurement | MRVC/ICF/RDSO |
| DC to AC Conversion | MRVC/CR |
| EMU maintenance facilities | CR/WR |
| EMU stabling lines | CR/MRVC |

# Implementing Agency for MUTP Phase II Works

- MUTP Phase II (b):

| | |
|---|---|
| R&R | MMRDA |
| 6th line BCT-Borivali | WR |
| Extension of Harbour Line (from Andheri to Goregaon) | MRVC |
| 5th & 6th line Diva-Thane | MRVC |
| 5th & 6th Line Kurla-CSTM | CR |
| Station improvement & trespassing control | CR/WR |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Afforestation & Rainwater Harvesting
MRVC

# Progress of MUTP Phase I Works

# Traction Sub Stations

Traction Transformer Foundation
Mahalaxmi

Tower Errection Bandra

Traction Transformer Installation
Jogeshwari

# Work at Various Sectioning Posts

Kandivali -Control Room

Kandivali - Equipment Foundation

Goregaon - Control Room

Goregaon - Equip Foundation & Cable trench

# Work at Various Sectioning Posts

Mahim – Civil Engg Works

Mahim -Control Room

Mahim - Control Room inside

Mahim - Equipment Foundation

# Work at Various Sectioning Posts

Andheri

VileParle

Santacruz

Mumbai Central

# Work at Various Sectioning Posts

Goregaon -Control Room

Andheri - Equipment Foundation

Kandivali - Control Room inside

Mahim - Equipment Foundation

# Cable Laying – Through winching

# Joint Chamber for making 110 kV Cable Joint

Cable Joint Chamber

# Joint Chamber for making 110 kV Cable Joint

Inside view of Cable Joint Chamber


***AFTC***

***Equipment***

# World Bank Team's inspection at Atgaon

# Digital Axle Counter Panel at Badlapur

***First Station on Mumbai Suburban Section with only Digital Axle Counters for vehicle detection***

# Digital Axle Counters
# Kalyan 1st July 08

Submerged Tracks

DAC Working

Train arriving PF 4

DAC still Working

# Box Pushing Work in Progress at WEH

# Box coming out at other end at WEH

# Girders placed in position for carriageway at WEH

# 2nd Phase of Road commissioned

# Earthwork in progress at approach to the Mithi River Bridge

# Piling in progress for approach retaining wall

# Approach retaining wall under construction

# Fabrication of gantry for unobstructed piling work in Mithi River

# Dahanu Road FOB commissioned

# Vaitarna launching of FOB girder in progress

# DRD yard remodelling for new goods shed

# New Goods Shed at DRD commissioned

# Geo textile being laid

# Hydraulic stitcher for Prefabricated Vertical Band Drains

# PVD Band Drains

# Track Machines


# Improvements to Marine Lines and Charni Road stations

- The report for improvement for Marine Lines and Charni Road stations on Western Railway has been finalized by the National Institute of Design, Ahmedabad.
- Western Railway has sent the proposal to Railway Board.

## Proposed look and feel of the stations

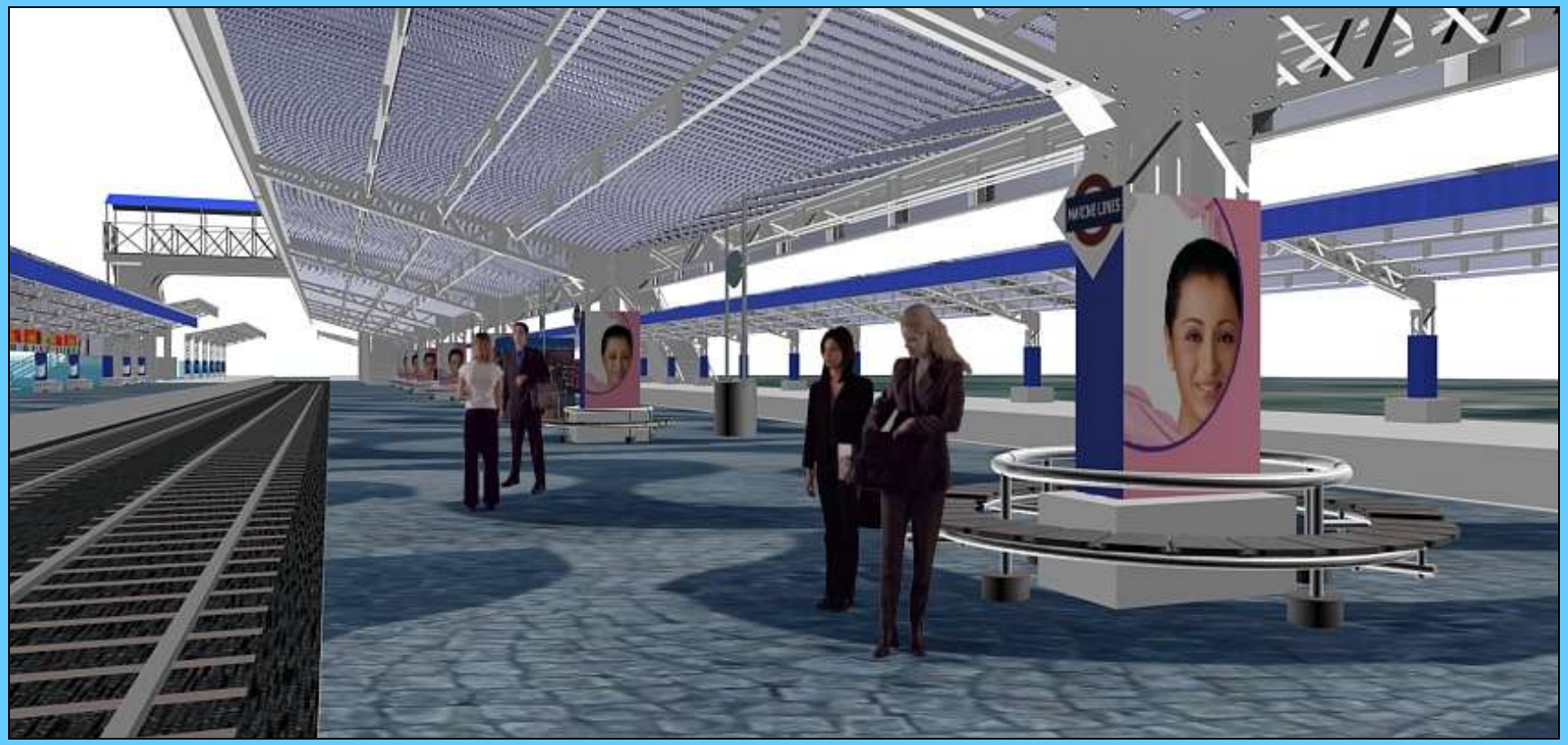
# Entrance


Pathway with Galvalume roof

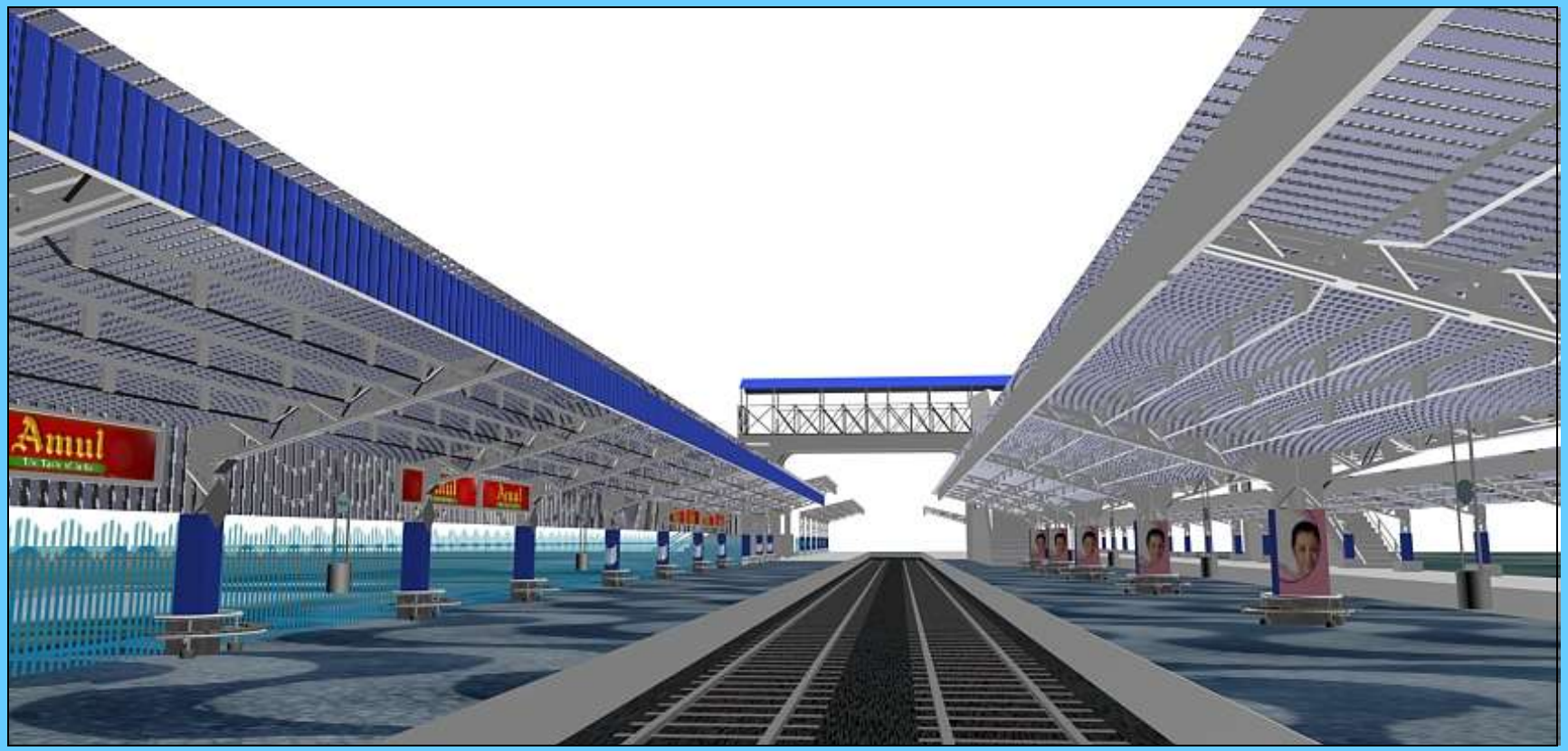

Pathway with Ferrari Technical Textile roof

# Proposed look and feel of the stations

# Proposed look and feel of the stations



# Proposed look and feel of the stations



# Construction of world-class station at Carnac Bunder (CSTM)

- The report for construction of world-class station and commercial development at Carnac Bunder has been submitted by the consultant.
- The report has been sent to Railway Board.

# Carnac Bunder

# Carnac Bunder

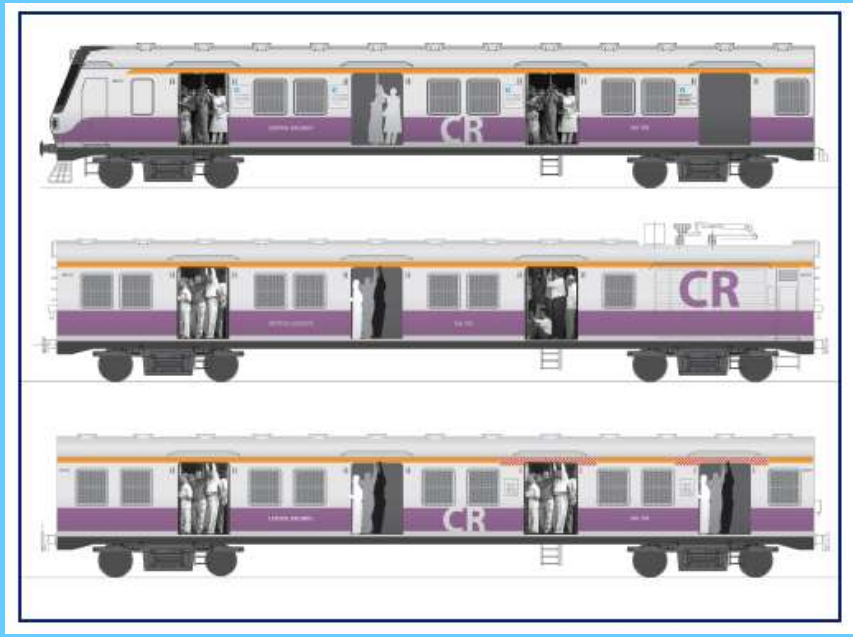
# Carnac Bunder

# Carnac Bunder

# Carnac Bunder

# Carnac Bunder

# Carnac Bunder




# THANK YOU

Website:www.mrvc.indianrail.gov.in