Uttarakhand Metro Rail, Urban Infrastructure & Building Construction Corporation Limited

Feasibility Report for construction of Ropeways at Har ki Pauri, Haridwar & Rishikesh

Volume 1

Prepared by

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Summary of abbreviations used in feasibility report

Abbreviations	Description
RTO	Regional Transport Office
OD data	Original – Destination data
FIRR	Financial internal rate of return
NPV	Net present value
WTTC	World Travel and Tourism Council
CSR	Corporate social responsibility
GDP	Gross Domestic Product
UTP/ LTP	Upper terminal point/ Lower terminal point
PPH	Person per hour
PPHPD	Person per hour per direction
KVA	Kilo Volt Ampere
AC/ DC	Alternating current/ Direct Current
PLC	Programmable Logic Controller
IRR	Internal rate of return
CEN	European Committee for Standardization
FCA	Forest clearance
FRA	Forest right act
NPV	Net present value
CA land	Compensatory afforestation land
O&M	Operation and Maintenance
CPI	Consumer price index
HVAC	Heating, ventilation and air conditioning
STP	Sewage treatment plant
NOC	No Objection Certificate
LC	Letter of credit
BG	Bank guarantee
PPP	Public-private partnership
EIA	Environmental Impact assessment

EC	Environmental clearance
EMP	Environmental management plan
MoEF	Ministry of Environment and Forests
CRZ	Coastal Regulation Zone
EAC	Expert Appraisal committee
TOR	Term of Reference
SPCB	State Pollution Control Board
UTPCC	Union Territory Pollution Control Committee
SEAC	State Expert Appraisal Committee
SEIAA	State Environment Impact Assessment Authority
RMC	Ropeway monitoring committee
DPR	Detail project report
SOP	Standard operating procedure

Uttarakhand Metro Rail, Urban Infrastructure & Building Construction Corporation Limited

1
Executive Summary

1. EXECUTIVE SUMMARY

1.1. Project

Technical Consultancy to Prepare Feasibility Report for construction of ropeway connecting Har ki Pauri to Chandi Devi Mandir at Haridwar.

1.2. Objective

Uttarakhand Metro Rail, Urban Infrastructure & Buildings Construction Corporation Limited awarded Usha Breco Limited an assignment as Technical Consultant to prepare Feasibility Report for Construction of Ropeway at Haridwar.

Specifically, this study explores the potential and feasibility of Ropeways, also called Aerial Ropeway Transit, to address the transportation problems in Haridwar.

Ropeway technology is spreading very fast throughout the world due to its various innovative features and applicability. In past few years only, systems using this technology have been implemented in several countries around the world such as USA, Hong Kong, Peru, Columbia, Venezuela, Brazil, Algeria and many other countries.

Therefore, the objective of this study is to explore the feasibility and potential of developing ropeway in the city of Haridwar by developing and analysing various alignment alternatives and suitable technology keeping in view all the criteria applicable.

The Consultant shall be responsible for conducting Technical & Financial Feasibility study, and Structuring of the project under various options.

1.3. Scope of Work

With reference to the assignment, the tasks to be carried out by the consultant are as given below:

- Preparing a methodology along with a timeframe for the study;
- Primary Data Collection.
- Secondary Data Collection.
- Case study of international cities that have implemented Cable cars / Ropeways outlining its benefits, technologies used the financial viability and the outcome of the projects.
- Analysis of data and identification of issues and gaps.
- Demand assessment.
- Network plan for the cable car.
- Technology selection.
- Institutional and legal framework.
- Environmental Impact.
- Socio-Economic Impact Assessment.
- Economic and Financial Viability Plan and the proposed method of funding.
- Implementation plan.

1.4. Ropeway technology

To find a viable Aerial Ropeway system at Haridwar, it is important first to understand the characteristics and features of this technology, to later define its role and possible application at Haridwar.

The ropeway is a type of Aerial Transportation Mode in which passengers are transported in cabins that are suspended and pulled by cables. Recently, ropeways have gained more attention worldwide, and now is being considered one of the most popular, energy-efficient transit modes for urban areas with topographical barriers and limited space.

The basic components of any ropeway include carriers (cabins), a drive and a return terminal, towers (to support ropes between terminals and stations), and ropes (which may be haulage or track ropes).

At present, ropeway technologies that have been used as mass transit modes in urban areas include five technologies:

- Aerial Tramways
- Dual-Haul Aerial Tramways
- Mono-cable Detachable Gondolas (MDG)
- Bi-cable Detachable Gondolas (BDG)
- Tri-cable Detachable Gondolas (TDG)

Different technologies are used as per suitability in different terrain and as per capacity requirements, terrain constraint, passenger comfort, financial viability, climatic conditions and other factors.

1.5. Present Transport Conditions

Few of the challenges faced in Haridwar cities are listed below:-

- High-density land use.
- Limited space for additional road and surface transit infrastructure.
- Variable activity concentration and travel demand by time of year.
- Insufficient transport supply during peak.
- Substantial future growth of demand.
- The insufficient capacity at a desirable level of service or even with a future expansion plan of the radial and centrally-oriented design of the mass transit system.

The issues and challenges mentioned above have serious impacts on mobility, accessibility, safety, security, sustainability and the economy.

Several initiatives have been recommended, proposed or underway to address some of these challenging issues. Several efforts are underway to develop comprehensive transportation and land use plans for the city of Haridwar as a whole, for its central area and peripheral area, considering strategies for rapid and semi-rapid transit networks, like flyover, widening of National Highway etc.

But considering the increasing demand of traffic inside and peripheral areas, it is apparent that these challenges can only be addressed by building a multi-modal transport system that includes conventional technologies such as road network, in addition to innovative and modern transportation technologies (such as Ropeway) to help solve some unique transportation problems.

1.6. Planning and evaluation process of ropeway

The study team developed, screened and evaluated several alternate Ropeway technologies and routings through a methodology that was based on public transit planning.

The team's research began with comprehensive consultations with Ropeway and public transit experts, Uttarakhand Metro Rail, Urban Infrastructure & Building Construction Corporation Limited experts and local representative initially and further a workshop was organized in Haridwar under Chairmanship of Hon'ble Minister (Urban Development) on 9 December 2019 at Haridwar to discuss the system in details.

In addition, the team surveyed the existing literature and gathered information regarding Ropeway implementation and best practices.

Discussion with the team from Usha Breco Limited who had visited Urban Transportation Ropeway system in Europe and Algeria, for the study of various details like:-

- Planning and evaluation method for Ropeway
- Method to integrate the ropeway Transportation system with existing modes of Transportation.
- Details of Existing system: Capacity, Technology, Embarkation & Disembarkation stations, Ticketing and access control systems, safety systems, passenger movement systems
- System capacity.
- Costing: Project Capital and Operating.
- Change in Socio-economic condition after installation of the system.
- Challenges faced during implementation.
- Present challenges/constraints.
- Benefits to the users.
- The commercial viability of the project.
- Scope for future extension of the transportation lines.

Subsequently, the team proceeded with identifying the potential for and the possible role of Ropeway in Haridwar; developing and evaluating several alignment alternatives; determining the referred achievable ropeway alternative, and conducting the feasibility study.

The potential for Ropeway as a complementary transit mode that would contribute to solving transportation challenges in Haridwar was investigated by identifying the major Ropeway user groups (i.e. pilgrims, local commuters, traffic police and groups of visitors with various purposes) and determining which spatial areas (i.e. pilgrim attractions, geographically constrained areas, or high demand corridors in cities) and service seasons (i.e. peak hours and non-peak hours) would be most relevant for each user group.

Accordingly, an initial set of Ropeway concepts were developed based on the characteristics of this role, which include the provision of Ropeway service (supplementary to Auto ride, bus service) between geographically challenged or naturally constrained areas and possibly along high demand corridors; the use of existing Ropeway technology (including Aerial Tramways and Mono-cable, Bi-cable and Tri-cable Detachable Gondolas).

The initial screening and evaluation process was based on criteria that reflected the characteristics, benefits and objectives of Ropeway in the context of Haridwar.

1.7. Identification and evaluation of the initial set of metro cable car concepts

The existing concepts for Ropeway service worldwide were servicing geographically challenged locations within cities; pairs of locations impeded by mountainous barriers; commercial facilities and passenger drop-off locations; commercial facilities and buildings/hotels in the central area.

The initial screening and evaluation process of the proposed ropeway at Haridwar involved the following criteria: user benefits/attitude, transportation system benefits, costs and efficiency, Environmental impacts, socio-economic impact and other characteristics.

Each evaluation criterion was assessed based on its potential positive impact. The final alternative, i.e. service between Har Ki Pauri and Chandi Devi Temple, was found to have the positive potential and was investigated in the economic feasibility study.

1.8. Preferred concept alignment, specifications and impacts

In order to identify the preferred alignment and its impact, several factors have to be taken into account.

- The first factor is the local context in which the transit system will be implemented and its associated challenges and constraints (i.e. constraints due to location).
- The second factor is the type of technology used and the associated technical constraints that could prevent it from being implemented in certain contexts (i.e. technology constraints).
- The third factor is the user's comfort and ease of traffic congestion based on O-D study & travel pattern of users.
- The fourth factor is the economic viability of the system. The cost-effectiveness and commercial viability of each alignment is of utmost importance keeping in view the long term sustainability of the system.
- The fifth factor is the expandability of the existing system. Since, due to constraints in development inside the city, there will a requirement to expand in new peripheral areas coming up in future. Hence the system needs to be connected to these new peripheral areas in future.
- The sixth factor is connectivity to the existing traffic gathering.
- The constraints due to location included topography, impact on flora & fauna, footprint on the ground, available space and observed travel patterns.

All of these constraints were taken into account in preparing the feasibility report.

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2
Scope of assignment

2. SCOPE OF ASSIGNMENT

With reference to the assignment, the tasks to be carried out by the consultant are as given below:

Task 1.

Preparing a methodology along with a timeframe for the study;

This stage involves understanding the scope of work, identifying the objective and developing a detailed methodology and detailed work plan for the study for preparing the techno-economic feasibility report of Cable car/Ropeway for the areas of Haridwar Municipal Corporation.

Task 2.

Primary Data Collection – following are the primary survey that needs to be conducted for the study.

- Reconnaissance Survey
- Traffic volume count
- Topographical survey
- Willingness to pay and shift
- Origin –Destination Survey
- Tourist Survey
- Travel speed survey
- Any other new surveys required to fill the data gap has to be carried out by consultants

Task 3.

Secondary Data Collection: Secondary Data collection would include the following:

- Demographic characteristics,
- Socio-economic characteristics
- Urban growth scenario
- Existing and proposed Road network characteristics,
- Existing and proposed traffic and transport system including the study of the existing cable car
- Travel demand behaviour of people (O-D Matrix)
- Land use of land falling in proposed alignment
- Environmental data
- Any other relevant data that consultant feels necessary to collect These data would be collected from Departments like RTO, Municipal Corporation, Development Authorities and other agencies related to transport to understand the existing transport situation of the city.

Task 4.

Case study of international cities that have implemented Cable cars / Ropeways outlining its benefits, technologies used the financial viability and the outcome of the projects.

Task 5.

Analysis of data and identification of issues and gaps

This stage includes the analysis of data collection and identification of mobility gaps and issues of the city.

Task 6.

Identification of potential areas of demand

To identify the zones or areas of demand in the city for the successful running of the system based on the data collected from primary and secondary sources.

Task 7.

Network plan for the cable car

The route plan should consist of three parts:

a) The network proposed - To study the feasibility of the already proposed network in terms of ridership, revenue collection, accessibility and connectivity to areas in the city.

b) Ridership estimation- To conduct the traffic volume count, willingness survey data and OD data collected through primary and secondary sources for estimating the ridership in the future years.

The best network selected and feasible is to be identified by the consultant.

Task 8.

An alternative analysis of technology:

To study the various technologies used in cable cars in India and abroad and then suggest the best-suited technology for the cable cars as per design standards that can be easily integrated with the stations and the city.

Task 9.

Institutional and legal framework:

Identifying the authority and institutional set up for the proposed cable car infrastructure. It also involves the identification of detail functions and structure of the organization. The consultant also needs to specify the legal framework that would mandate the operations and maintenance of the cable car.

Task 10.

Environmental Impact and Socio-Economic Impact Assessment:

A basic environmental impact assessment will be done to compare the emissions caused by cable cars and other means of transport. Also, a general socio-economic impact assessment needs to be carried out to anticipate looking into the requirements laid down by the Ministry of Environment & Forest

with regard to projects on the cable car and suggesting the framework to be adopted during the project phase.

Task 11.

Economical and Financial Viability Plan and the proposed method of funding:

Preparation of financial model to estimate the financial implications on the implementing agency (*in terms of capital and operating cost*) and various ways to decrease the financial risks through various innovative methods of funding like advertisement revenue, third party funding, viability gap funding etc.

To ascertain the financial viability of the proposed system in terms of FIRR and NPV. To ascertain economic viability would evaluate the economic benefit of moving people via cable car in the region.

Propose various modals/methods of financing and final recommendation.

Task 12.

Implementation plan

Prepare different stages/steps for implementation of the project.

Steps to being prepared to keep in view the latest technology/innovations in the passenger ropeway systems and conceptualize a technically and financially viable model to meet the needs of providing safe, reliable, efficient solution.

The concept should also keep in view the tourism potential of the system to make it sustainable and create the unique ride experience to the passengers with positive ecological and architectural footprint.

2.2. Approach and methodology

To appreciate the study area characteristics, identify issues, constraints and opportunities, develop a database for system planning, design and operation, extensive surveys and studies have been carried out.

Extensive data and information covering physical, geological, climatological, customer preference, socio-economic and other characteristics of Haridwar have been collected from several sources. Primary surveys have been carried out to elicit traffic, travel, socio-economic network, transport system and characteristics.

Usha Breco is planning a holistic project at Haridwar which will be a transport and entertainment solution for tourists and locals. To design the scope of the project, relevant data has been captured from multiple sources. The sources are as follows:-

- The survey conducted by Usha Breco: Various stakeholders were surveyed to estimate the demand and expectations from a ropeway. The survey form is attached as **Annexure – (Survey Form).**

- Information from government sources: State government agencies were approached to discuss the depth of the problems faced at Haridwar and acquire some demographic data about the city to assist our analysis.
- Site survey: The site survey was conducted to get a sense of Haridwar's city plan, geography and topography. The visualization of the ropeway site allowed us to plan the ropeway alignment and assess the techno-economic viability of the ropeway.
- Secondary data

This information was used to ascertain the feasibility, need and scope of a Ropeway at Haridwar. The parameters of analysis and the result of the data collection helped us arrive at the following details for the project:-

- Traffic management plan in Haridwar.
- Ropeway alignment plan.
- To establish the need for the ropeway.
- To assess the demand and design the capacity of the ropeway.
- Stakeholder's needs Assessment.
- Demand estimation and designed capacity.
- Pricing.
- Ropeway infrastructural needs.
- Future expansion scope

2.3. Ropeway alignment planning:

While considering the alignment, following approach & methodology has been adopted for selecting the most favourable alignment. Following guidelines have been considered:-

1. Reduce traffic congestion on high traffic demand corridors.
2. Easy connectivity with the traffic nodes.
3. Availability of adequate space for proposed terminals.
4. Minimum Possible infringement.
5. Minimum rehabilitation and minimum tree cutting.
6. Feasibility in the realm of construction and technical requirements.
7. Feasible for ropeway system able to handle projected traffic.
8. Comfort to tourists and locals.
9. Ease in Crowd Management.
10. Maximum utilization of public transport leading to a reduction in traffic and pollution.

In order to choose the preferred Aerial Ropeway Transit alternative, a screening and evaluation process to evaluate all possible corridors was needed. Several criteria were considered, the evaluation criteria reflect the specific characteristics, requirements, benefits, and objectives of ropeway in the context of Haridwar. Accordingly, a series of qualitative evaluation measures were developed to assess the potential of ropeway alignment alternatives (concepts). In general, four major evaluation criteria were identified:-

- User Benefits / Attitude
- Transportation System Benefits
- Environment / Landscape Impacts
- Other Characteristics

2.4. Demand assessment

Data and information covering traffic characteristics of Haridwar have been collected from several sources. Primary surveys have been carried out to elicit traffic, travel, socio-economic network, transport system and characteristics.

The demand and revenue for the ropeway were assessed. Several primary and secondary data were used to develop a conventional demand forecasting model Like:-

- Commuters flow data
- Data related to trip patterns to various establishments
- Using existing public transit services for estimating ridership
- Traditional demand model

Nevertheless, a realistic and reasonable demand forecasting method was also developed based on the following propositions:-

- The team's knowledge about the local transport conditions and challenges (including temporal variations) sufficed for the development of realistic demand assumptions.
- Demand growth by the proposed ropeway.

Forecasting techniques were used to determine the relative demand volumes of the proposed ropeway alignments, a sensitivity analysis was conducted, and realistic assumptions were used.

The assumptions for the values of several general service and operational variables are presented and justified in the report. They include the division of the year into travel periods, the daily operating hours, the peak and off-peak hours, and the associated load factors. The demand estimation methodology involved developing estimates for a Base Case Scenario for the base (last) year and using these estimates to build ridership estimates for the remaining cases based on past trends.

2.5. Project capital and operating cost

The total capital, operation and maintenance costs for the preferred ropeway alternative are based on consultations with ropeway vendors and experts. The land acquisition costs are just approximated in the estimates. However, the approximation is done for a number of reasons including the scope of this project i.e. Land demand may vary depending on final designing of the master plan for ropeway land acquisition is proposed to be done by government while the developer will pay for NPV and acquisition cost. There is also potential use of existing rights-of-way in the alignment, which again required to be facilitated by the Government.

The items included in capital and project investment costs are the drive and return station equipment, infrastructure & line equipment, Terminal costs, infrastructure civil works (including soil tests, basic facilities and foundations etc.), Material ropeway, back-up generator, local material transportation, all taxes and duties, project management and contingency costs. The cost also includes basic facilities for customers at ropeway terminals.

The key cost drivers for any Ropeway system are the technology type (MDG and TDG), line length, and the number of intermediate stations. ***The technology chosen should comply with the best technical standards and conforming to the most stringent quality and manufacturing standards keeping in view the safety and reliability of the Transit system.***

The technology chosen in Haridwar is **Monocable Detachable Ropeway system conforming to latest ropeway standards.**

The operation and maintenance of a ropeway system include spare consumption, energy consumption, human resources (Managers, Station attendants/operators), maintenance & servicing expenses, insurance and Capital Reserve Fund.

2.6. Project institutional framework

Implementation of Hardwar ropeway is an opportunity to identify and strengthen the institutions responsible for Planning, Development, Operation and Management (PDOM) of the city transport system and build capacity in them to integrate under the Comprehensive Mobility Plan which also envisages short term and long term plan, policies and program through public institutions on / or private sector participation.

To prepare and implement the Transport System Development Plan on a coordinated, comprehensive and continuous basis, a proper institutional arrangement is very important.

UKMRC will be responsible for bidding of the project. The Policy level decision will be taken by the Government through its agency.

The implementation of the ropeway project shall be monitored by the Ropeway Advisory board enacted by Uttarakhand Ropeway Act.

Role of Government.

1. Execution of Agreement for Ropeway installation.
2. General administration of policy measures.
3. Co-ordination between various departments for facilitating project implementation.
4. Acquisition of land for ropeway station – Right of Use / Right of way (payment to be done by concessionaire).
5. Facilitation for statutory clearances.
6. Facilitation for the availability of utilities at stations.
7. Permission for commercial operation.

Role of the developer.

1. Conceptualization
2. Designing
3. Financing
4. Built
5. Operate
6. Maintenance
7. All statutory permissions and clearances
8. NPV for land
9. Collection of user charges
10. Insurances
11. Revenue sharing

2.7. Socio-economic impact of ropeway

The main objective of the Aerial Passenger Ropeway will be to provide safe and reliable transportation to people Har Ki Pauri bypassing bridge across river Ganges. In doing so, the following objectives will be served:

- Reduction of vehicular traffic.
- Reduction in Traffic blockage.
- Reduction in pollution.
- Reduction in travel time.
- Reduction in parking problems.
- Boost to the Tourism sector.
- Time-saving and cost-effective mode of transport for pilgrims.
- Enhancing the socio-economic condition of locals.

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3
Introduction

3. INTRODUCTION

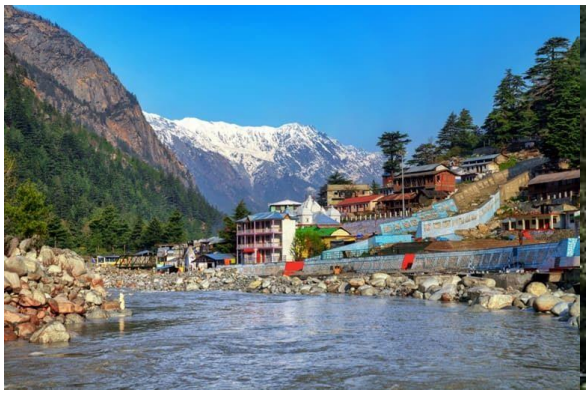
3.1. General

Popularly known as the '*Dev Bhoomi*' – "Land of the Gods", Uttarakhand is a beautiful hill state in India, nestled in the north-west region of western Himalayas. The state is landlocked with the Himachal Pradesh to the north, Uttar Pradesh to the west and Nepal in the East. The state stands apart from its neighbours in terms of its sheer topographic diversity. From vast tracts of high-altitude Trans-Himalayan desert to dense green deodar forests, from apple orchards to cultivated terraces, from snow-capped high Himalayan mountain ranges to snow fed lakes and gushing rivers, Uttarakhand offers breath-taking Pristine beauty.

Being the Religious hub of Hindu mythology, Uttarakhand is not the only place of divine 'Chaar Dhaam' but also home for India's 2nd highest mountain peak 'Nanda Devi'. 'Chaar Dhaam Yatra' attracts lakhs of pilgrims every year.

Kedar Nath Dhaam

Badri Nath Dhaam



Gangotri Dhaam

Yamunotri Dhaam

Tourism in Uttarakhand has been recognized as one of the most important sectors of the economy as it is being realized as a major engine of growth of the State. The state is endowed with all the basic resources necessary for thriving tourism activity like geographical and cultural diversity, clean, peaceful and beautiful streams, sacred shrines, historic monuments and the friendly and hospitable people.

Tourism Industry in Uttarakhand has been given very high priority and the Government has developed appropriate infrastructure for its development which includes the provision of public utility services, roads, communication network, airports, transport facilities, water supply and civic amenities etc.

Uttarakhand Tourism Policy, 2017 was launched in 2017, which aims to set up new amusements parks and install new ropeways that would be exempt from payment of entertainment tax. To promote tourism and develop it as a major source of employment and revenue generation in the state.

Haridwar is the gateway of Chaar Dhaam, Hemkund Sahib, Valley of Flowers and other destinations.

3.2. About Haridwar:

Haridwar, is an ancient city and municipality in the Haridwar district of Uttarakhand, India. According to legend, it was here that Goddess Ganga descended when Lord Shiva released the mighty river from the locks of his hair. The River Ganga, after flowing for 253 kilometres (157 mi) from its source at Gaumukh at the edge of the Gangotri Glacier, enters the Gangetic Plain for the first time at Haridwar, which gave the city its ancient name, Gangadwára.

Haridwar or Hardwar is regarded as one of the seven holiest places (Sapta Puri) to Hindus.

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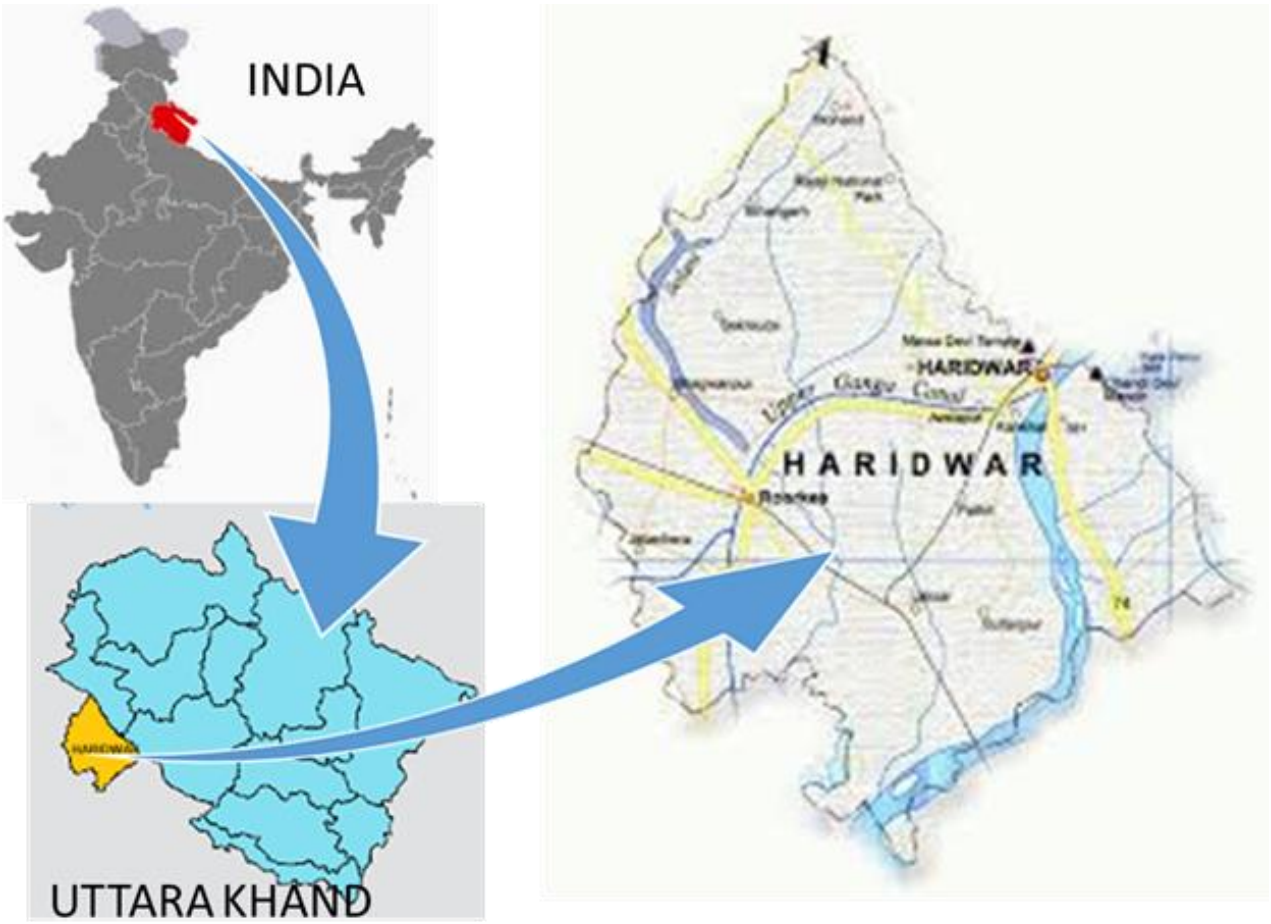
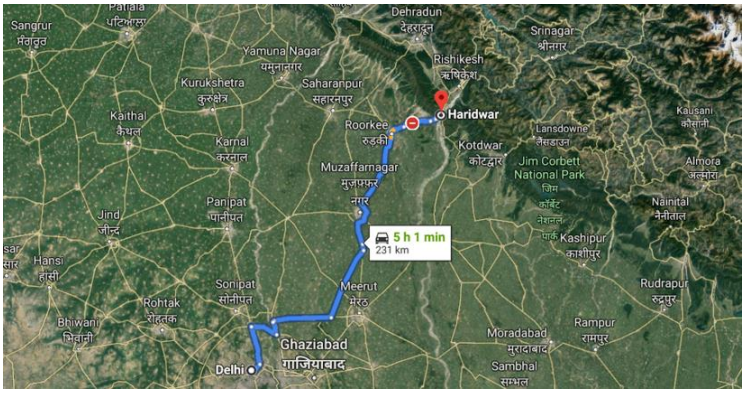
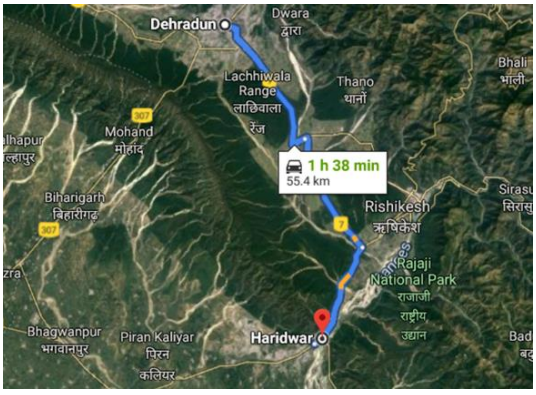


Haridwar is about 230 Km from National Capital New Delhi and about 55 Km from State Capital, Dehradun. Haridwar is well connected with road and Indian Rail network. Nearest Airport is Jolly Grant, which is about 35 Km from Hardwar.



Road Map New Delhi to Haridwar



Road Map Dehradun to Haridwar

3.3 About Har ki Pauri

According to the Samudra Manthan, Haridwar along with Ujjain, Nasik and Prayagraj (Allahabad) is one of four sites where drops of Amrit, the elixir of immortality, accidentally spilt over from the pitcher while being carried by the celestial bird Garuda. This is manifested in the Kumbh Mela, which is celebrated every 12 years in Haridwar. During the Haridwar Kumbh Mela, millions of pilgrims, devotees, and tourists congregate in Haridwar to perform ritualistic bathing on the banks of the river Ganges to wash away their sins to attain Moksha. Brahma Kund, the spot where the Amrit fell, is located at Har ki Pauri (literally, "footsteps of the Lord") and is considered to be the most sacred ghat of Haridwar. It is also the primary centre of the Kanwar pilgrimage, in which millions of participants gather sacred water from the Ganga and carry it across hundreds of miles to dispense as offerings in Siva shrines. Har Ki Pauri hosts a nightly Ganga Aarti (river-worshipping ceremony) in which tiny flickering lamps are floated off the steps. Worshipers fill the city during major festivals including the annual Kanwar Mela.

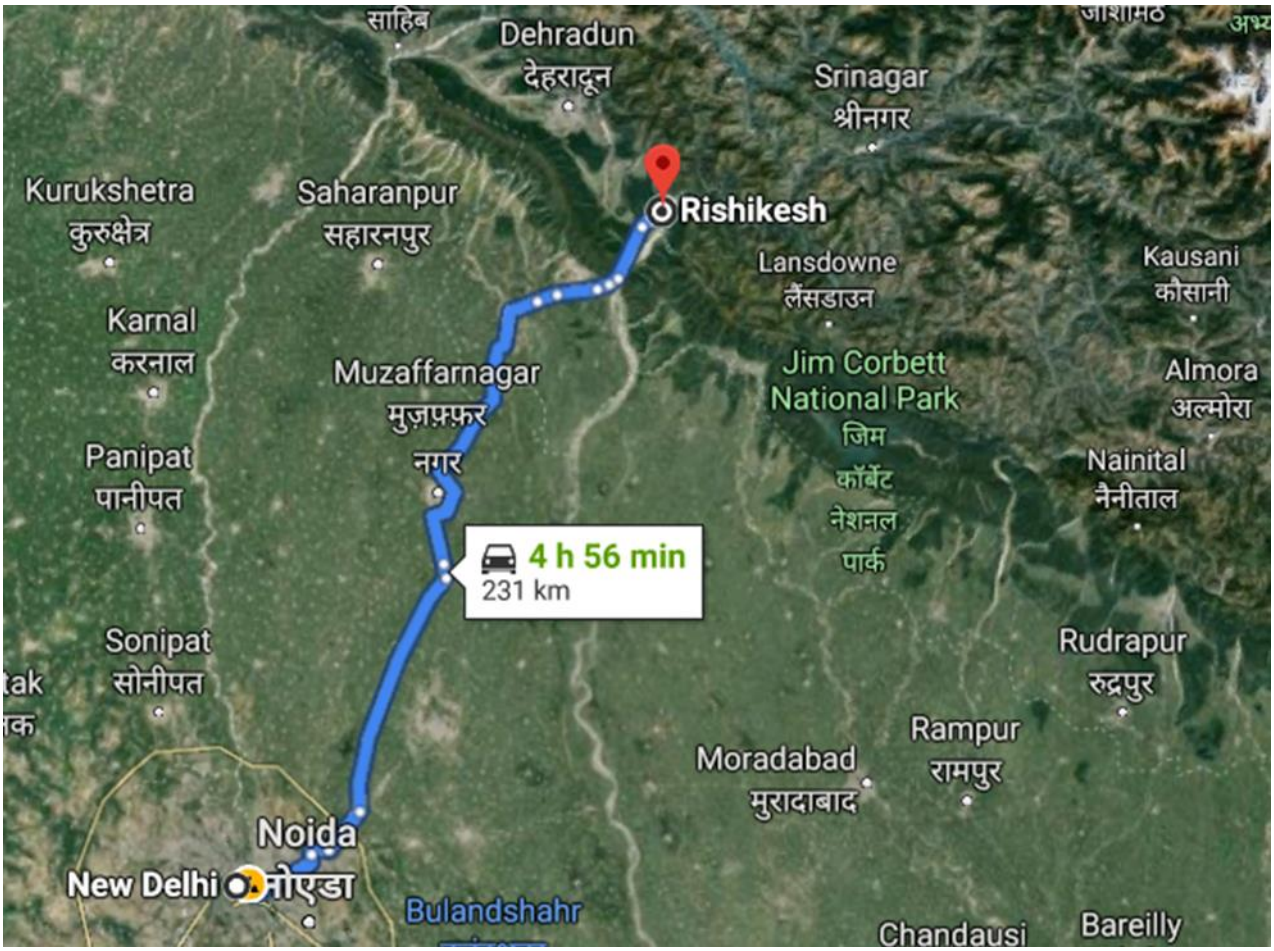
Har ki Pauri is a famous ghat on the banks of the Ganges in Haridwar in the Indian state of Uttarakhand. This revered place is the major landmark of the holy city of Haridwar. Literally, "Har" means "Lord Shiva" who is the god according to Shaivite Rishav Bhagwan school of Hindu theology, "Ki" means "of" and "Pauri" means "steps". Lord Shiva and Lord Vishnu are believed to have visited the Brahmakund in Har Ki Pauri in the Vedic times.

It is believed that it is a precise spot where the Ganges leaves the mountains and enters the plains. The ghat is on the west bank of Ganges canal through which the Ganges is diverted just to the north. Har Ki Pauri is also the area where thousands of pilgrims converge and the festivities commence during the Kumbh, which takes place every twelve years, and the Ardh Kumbh Mela, which takes place every six years and the Punjabi festival of Vaisakhi, a harvest festival occurring every year in April.

3.4 About Chandi Devi Temple

Chandi Devi temple is a Hindu temple dedicated to Goddess Chandi Devi in the holy city of Haridwar in the Uttarakhand state of India. The temple is situated atop the Neel Parvat on the Eastern summit of the Shiwalik Hills, the southernmost mountain chain of the Himalayas. Chandi Devi Temple was built in 1929 by Suchat Singh in his reign as the King of Kashmir. However, the main murti of Chandi Devi at the temple is said to have been installed in the 8th century by Adi Shankaracharya, one of the greatest priests of Hindu religion. The temple is also known as Neel Parvat Theerth is one of the Panch Thirth (Five Pilgrimages) located within Haridwar.

The Temple is located at a distance of 4 kilometres (2.5 mi) from Har ki Pauri. To reach the temple one has to either follow the three-kilometre trekking route from Chandi ghat and reach the shrine by climbing several steps or through rope-way (cable car) service. The rope-way service known as Chandi Devi Udan Khatola was introduced for the benefit of the pilgrims and it caters to the pilgrims also to the nearby located Mansa Devi shrine. The rope-way carries the pilgrims from the lower station located near Gauri Shankar Temple on the Najibabad Road directly to the Chandi Devi Temple located at an altitude of 2,900 metres (9,500 ft.). The total length of the ropeway route is about 740 metres (2,430 ft.) and height is 208 metres (682 ft.). There is a dense forest on the other side of the hill and the ropeway offers scenic views of the Ganges River and Haridwar.



Road Map New Delhi to Haridwar

3.5. Existing challenges.

Haridwar is a city with limited space in terms of roads and parking and limited public transport. To add to the problems, Haridwar is witnessing an unprecedented rate of urbanization & industrialization, increase in population growth and tourist inflow (CAGR 3.07% in the last 5 years). It has a unique characteristic where its annual tourist inflow is much greater than the number of its resident population.

The total annual tourist inflow in Haridwar is multiple times of Haridwar's resident population. Being a city constraint by hills, river and dense development, there are natural limitations to the expansion of road and parking capacity. This is resulting in two major problems such as:

- Congestion problem.
- Pollution.
- Slow mobility during peak seasons.
- Traffic Jam during festival & Snan days
- Problem to pilgrims & locals.

In view of the challenges noted above, The State Government is initiating several reforms but considering the increasing demand of traffic inside and peripheral areas, it is apparent that these challenges can only be addressed by building a multi-modal transport system that includes conventional technologies such as rail and road network, in addition to innovative and modern transportation technologies (such as Metro Cable Car / Ropeway) to help solve some unique transportation problems.

3.6. Aerial Ropeway Technology.

Aerial Ropeway Transportation is an aerial public Transportation technology in which cabins (also called carriers, vehicles or cars) are suspended and propelled from above by ropes.

The underlying technology of ropeway has been around for almost a century, where it has been applied mostly in terrain-challenged hills for pilgrim transportation and also, in recreational contexts (e.g. in ski resorts) to transport skiers and tourists from the bottom to the top of the mountains and vice versa.

In recent years, however, the same technologies used in these hills have been adopted and implemented in urban regions as a mode of urban Transportation in geographically-constrained urban areas, where conventional Transportation service was deemed very difficult or infeasible to implement. Aerial Ropeway Transit System is a high-quality, customer-orientated transit that delivers fast, comfortable and low-cost urban mobility.

3.7. Planning of ropeway

Various parameters and factors have been considered while preparing the report including:

- Planning and evaluation method for Urban Transport Ropeway systems.
- Method to integrate the ropeway Transportation system with existing modes of Transportation
- Details of Existing system: Capacity, Technology, Embarkation & Disembarkation stations, Ticketing and access control systems, safety systems, passenger movement systems.
- Costing: Project Capital and Operating.
- Change in Socio-economic condition after installation of the system.
- Challenges faced during implementation.
- Present challenges/constraints.
- Benefits to the users.
- The commercial viability of the project.
- Project Impact.

4
Need of ropeway

4. Need of ropeway

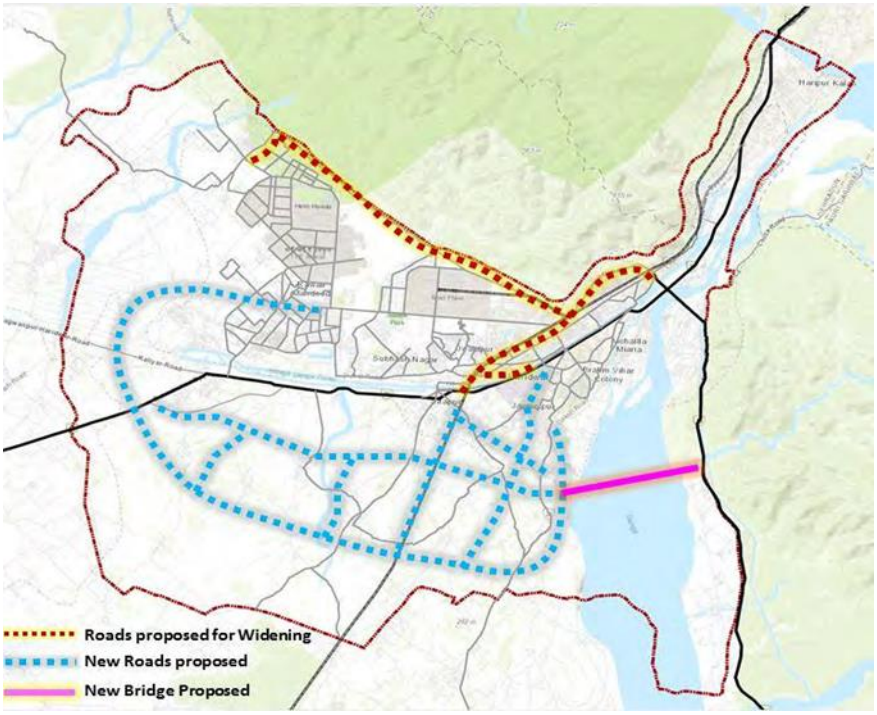
Haridwar is a city with limited space in terms of roads, parking and limited public transport means. To add to the problems, Haridwar witness various challenges including religious congregations (Kumbh & Kawad), festivals, Snans and other religious activities causing unprecedented growth of pilgrims visiting the city, increase in population growth and tourist inflow during Char Dham etc.

It has a unique characteristic where its annual tourist inflow is much greater than the number of its resident population. In addition, there are natural limitations to the expansion of road and parking capacity. This is resulting in two major problems such as:

- **Congestion problem**: Long traffic jams on arterial roads of Haridwar thus leading to big traffic jams.
- **Pollution**: Due to the rise in the vehicular emission from the increasing number of tourist vehicles, the air quality is getting degraded and also leading to a rise in the minimum temperature.

In view of the challenges noted above, The State Government of Uttarakhand and other agencies have responded by initiating several reforms including road widening & construction of flyovers.

In order to ease of the movement, within Haridwar, three roads are proposed for widening in Haridwar area. The Haridwar Bypass and Kankhal Jwalapur road are heavily congested as these are major arterials in the city. Hillock bypass road which starts from Shivlok Nagar to Haridwar Jail area needs to be widened as the new development are coming along this road and faces congestion.



Source : ukmrc.org

However, considering the increasing demand of traffic inside and peripheral areas, it is evident that these challenges can only be addressed by building a multi-modal transport system inlcuding conventional methods, as well as innovative and modern transportation technologies (such as Ropeway) to help solve some unique transportation problems.

In view of above, the proposed solution is to run an urban transportation ropeway connecting Har Ki Pauri to Maa Chandidevi Temple one of the most frequented pilgrimage centres in Haridwar.

The ropeway will provide a direct mode of transport to The Temple which is currently accessed by an existing ropeway on another side of river Ganges and pathway.

In cities like Haridwar, with burgeoning pilgrim/tourist traffic and not much scope for expansion of road network, a ropeway can serve the dual purpose of being a convenient mode of transportation as well as a most eco-friendly mode of transport. With minimal space requirement and no damage to the ecology of the region, the ropeway project becomes even more attractive.

Keeping in view the growing importance of the transport sector in the city's physical, social, economic and environmental fabric, Aerial Ropeway transport system will establish as a viable mode of transportation in Haridwar.

Through this project, Uttarakhand Metro Rail, Urban Infrastructure & Building Construction Corporation Limited seeks to contribute to the improvement of public transport and facilitate the use of the non-motorized mode of transport, to reduce congestion and to prevent environmental damage due to unabated pollution. This project seeks to reduce road travel demand by providing an integrated mode of transport which is well integrated with the existing setup, by proper land use planning and transport planning. It also seeks to adopt the use of cleaner technology.

Passenger ropeway connecting Har ki Pauri to Chandi Devi Temple is proposed keeping in view:

1) For Chandi Devi at **Haridwar**, presently tourists have to cover a major part of the journey by road from Har ki Pauri to either at Chandi Ghat or Gauri Shankar Mandir at Najibabad road. They have two options, first is by foot from Chandi Ghat, which is difficult and lengthy. Second is existing ropeway, starting from Gauri Shankar Temple at Najibabad road.
2) Introduction of an alternate ropeway directly from Har ki Pauri will not only be convenient to pilgrims/tourists but also time-saving.

This project will provide better mobility to the people travelling to the city of Haridwar.

4.1. Major advantages of the project

Comfort

- Reduces the traffic jam
- Offers frequent service
- Fast as it takes most of the direct routes
- Flexible operating schedule and better service frequency
- Easy access

- Allows goods transportation as well
- Helps in overall decongestion on roads

Environment friendly

- Non-polluting for the atmosphere
- Zero degrees of noise
- Non- Hazardous by-products
- Non-Cutting of trees
- Does not contribute towards Global Warming

Can be used as

- A system extension
- An additional branch line to existing public transport systems;
- An independent transport system;
- Shuttle service to Transport nodes or commercial zones.
- Helps to create an Integrated Transport Hub having ropeways, public transport buses, rail stations.

Reliability

- Most reliable in terms of service
- Most adaptable in any terrain
- Reduced and minimal land requirement
- Reduced installation time.

The impact of the ropeway project will be as follows:-

- Reduced Congestion.
- Reduction in travel time.
- There will be an increase in the utilization of parking capacity around the ropeway terminals.
- **Reduced pollution:**
  - Ropeways have a minimum adverse impact on the environment.
- **Socio-economic benefits:**
  - It will meet the city's need for a fast & eco-friendly mode of transport.
  - It will encourage economic activity around the ropeway stations for example shops, restaurants, hotels, connecting transport services. It will provide higher employment opportunities in the city as well as services to the tourists and locals.
- **Added attraction for visitors**
  - Ease of travel would put these religious and picturesque destinations on the international map.
  - Ropeway systems being a state of the art technology providing a panoramic view of the nearby landscape would be an added attraction for tourists.

- Further, the Aerial Passenger Ropeway will provide safe and reliable transportation to pilgrims visiting at these locations. Main impacts are as below.
    - The large seasonal inflow of tourists and pilgrims lead to traffic congestion and overbearing foot load thus causing a lot of inconvenience for local population and visitors including doubling of the commuting time.

Uttarakhand Metro Rail, Urban Infrastructure & Building Construction Corporation Limited

5
Primary and secondary data analysis

5. Primary and secondary data analysis.

5.1. Preliminary reconnaissance and discussions.

Team of experts including ropeway specialist, transport planner, surveyor, UKMRC officials and others jointly visited the site at various instances, to take up following objectives:

(a) To physically understand the nature of the terrain and trek condition.
(b) To identify alternate alignments which are technically possible with minimum hindrance to the existing infrastructure, roads, pathways, parking facility, visitors assemble area and natural habitat.
(c) To identify probable locations for terminal stations & intermediate towers based on land availability, footfall, forest cover, etc.
(d) To assess the pilgrim/tourist flow and availability of basic infrastructure facilities and utilities.
(e) To undertake consultations with UKMRC & local authorities for their views and feedback.
(f) To assess the traffic issues/mobility in the region.

Consultations have been carried out with the following:

(a) Local people, tourists at Haridwar.
(b) Local administration officials.
(c) Forest officials.
(d) Uttarakhand Metro Rail, Urban Infrastructure & Buildings Construction Corporation Limited officials.

5.2. Contour Survey.

Detailed engineering topographic survey using a differential GPS / Total Station Instrument along the proposed ropeway corridor; picking up the details of all features of the region within a distance of 20 m on each side of the centre line of ropeway was carried out.

The Topographical Survey was carried out to map the topographical features and physical features of the ropeway alignment and abutting areas. It is aimed at preparation of the Base map of the area, to facilitate review of alignment layout and preparation of the plan for Ropeway. Ropeway design is carried out based on a topography survey sheet prepared by the surveyor.

The boundaries of different kinds of National Highway, pathways, forest, building, river channel, river mainstream, transmission lines (11 KV & 33 KV), electric poles, etc. have also been marked on the plan.

A copy of the Contour Survey plan is placed as **Annexure "Contour".**

5.3. Physiography of the District.

The topography is undulating in the northern part and more or less plain towards the south. The altitude ranges from 869 to 232m. In the vicinity of Shiwalik Hills, the gradient is steep.

Geomorphologically Hardwar district can be divided into four geomorphic units. These are flood plain, lower piedmont plain, upper piedmont plain and structural hills. The flood plain area is relatively flat, low lying and adjacent to Solani River. Lt comprises unconsolidated, coarse to fine sand with silt and clay. The area is repeatedly inundated during the floods. The lower piedmont plain is flat to undulating with a gradient towards southwest having microrelief. The sediments vary from fine clastic to coarse clastic manifesting in variable runoff and infiltration.

The upper piedmont zone is narrow, southerly sloping upland adjoining the Siwalik Hills in varying lateral and areal extent formed at the foothills by the coalescence of several alluvial fans comprising unsorted coarse clastic sediments (boulders, pebbles, gravels sand and clay). It has a high gradient (about 10 m/km) in the northern part to about 0.4 m/km i11 the southern part close to Tarai. In this zone, most of the ephemeral rivers draining the area disappear. There is the high moisture content in the upper piedmont zone which support dense forest and lies to the south of Bhabar zone.

Structural hills show high relief and deeply incised drainage with the steep and sharp hill is lopes and well-defined crest line (the northern boundary of the block). This unit shows rugged topog1 ·aphy and homogenous lithology. The vegetation is dense indicating the presence of loose alluvial material.

5.4 Geographical Data

- Latitude: 22°30' N
- Longitude: 78°10' E
- Geographical Area: Hectares 236000

5.5 Climatic Data

Rainfall: month-wise

District Hardwar experiences moderate subtropical to humid climate with distinct season's viz. summer followed by rainy and winter seasons.

The temperature begins to rise from March (29.1 0C) and reaches to its maximum in May (39.20C), with the commencement of monsoon season by mid-June, the temperature begins to fall. During the winter season in November to February the temperature ranges between 10.50C and 6.10C.

The relative humidity is highest in the monsoon season (85% in the morning and 79% in the evening). The lowest humidity is observed during April and May i.e. 24% (in the evening) and 40% in May (in the morning).

The mean monthly wind speed is highest in the summer season when it goes up to 7.4 and 7.2 km/hour in May and June and the minimum wind speed is 26 observed during winter when it is 2.6 km/hour in October.

The potential evapotranspiration is maximum in May 198.9 mm and a minimum of 38.5 mm in December.

The average normal annual rainfall in Hardwar district is 1174.3 mm, out of which 84% is received during monsoon season and only 16% occurs during non -monsoon period.

The district receives the heaviest rainfall in the northern part. The rainfall gradually decreases towards the south. The monthly distribution of rainfall during the monsoon season over the district shows that July and August are the wettest months in the district having a rainfall

329.3 and 393.8 mm, respectively. The rainfall during July and August is more or less the same. The monsoons retreat in the first fortnight of October giving a meagre rainfall of about 31 to 34 mm. Maximum rainfall occurs in the foothills of Himalayas and gradually decreases towards the south.

YEAR		2014	2015	2016	2017	2018
JAN	R/F	92.6	31	2.2	27.7	4.6
	%DEP	181	-6	-93	-16	-86
FEB	R/F	71.8	10.7	12.8	7.7	3.9
	%DEP	100	-70	-64	-79	-89
MAR	R/F	46	126.6	21.1	24.8	3.4
	%DEP	51	316	-31	-18	-89
APR	R/F	8.9	52.7	0.5	46.1	21.6
	%DEP	-27	332	-96	278	77
MAY	R/F	12.8	15.5	63.5	8.6	13.7
	%DEP	-41	-29	191	-61	-37
JUN	R/F	52.6	160.3	134.7	170.3	119.8
	%DEP	-50	52	27	61	13
JUL	R/F	389.5	237.1	573.7	112	316.9
	%DEP	17	-29	73	-66	-5
AUG	R/F	203.8	325.2	216.5	290.9	587.4
	%DEP	-44	-11	-41	-21	60
SEPT	R/F	125.4	38.4	75.3	354	200.2
	%DEP	-20	-76	-52	126	28
OCT	R/F	14.9	16.1	2.5	0	11.1
	%DEP	-50	-46	-91	-100	-63
NOV	R/F	0	4.5	0	0	4.9
	%DEP	-100	2	-100	-100	11
DEC	R/F	17.3	0.8	1.4	13.7	0
	%DEP	18	-95	-90	-6	-100

5.6. Geological data.

Geologically the area may be divided into three zones viz. Shiwalik, Bhabar and Gangetic Alluvial Plains from North to South.

Siwalik Range: This forms the outermost part of Himalaya and comprises Tertiary Group of rocks. In Bhagwanpur block only Upper and Middle Shiwalik are exposed. The Upper Shiwalik is constituted of boulders, pebbles, sand and clay. The boulders and pebbles are mostly of quartzite. Middle Shiwalik comprises mainly grey micaceous sandstone and siltstone.

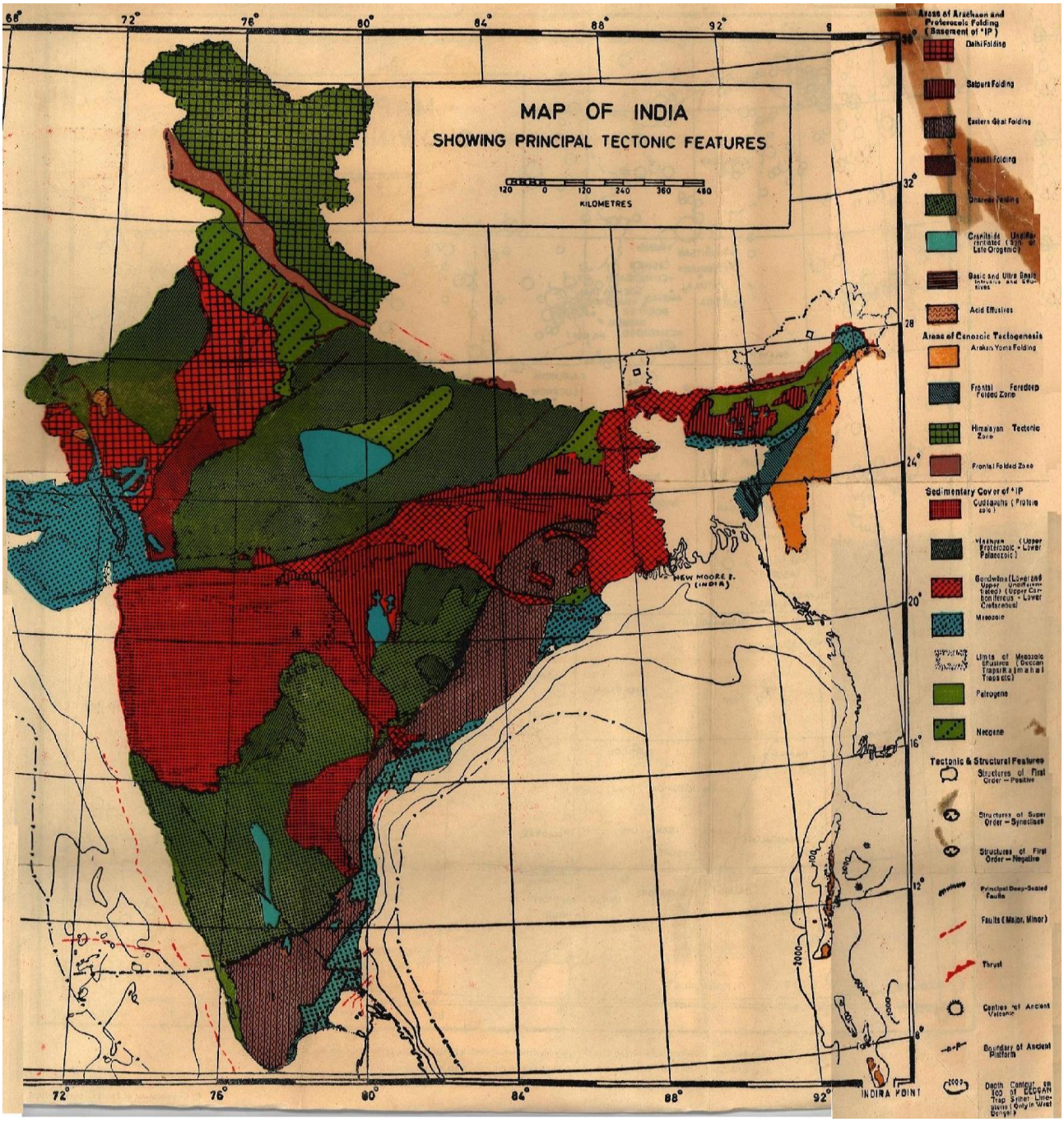
Older Alluvium (Piedmont Plains or Bhabar): The Piedmont Plains are formed along the foothills of Shiwalik. It is formed by flooding hill torrents and nallahs (locally termed as 'Rao'). Alluvial fans in the piedmont zones are wider and longer when formed along mature streams. The Older Alluvium consists of a polycyclic sequence of brown to grey silt, clay with boulders and pebbles.

Gangetic Alluvial Plains: The region south of the piedmont plains occupied by Gangetic Alluvial Plains, forms a major part of the Bhagwanpur block: Lithologically, the alluvium is formed of unconsolidated to semi-consolidated deposits of sand, silt, clay and kankar.

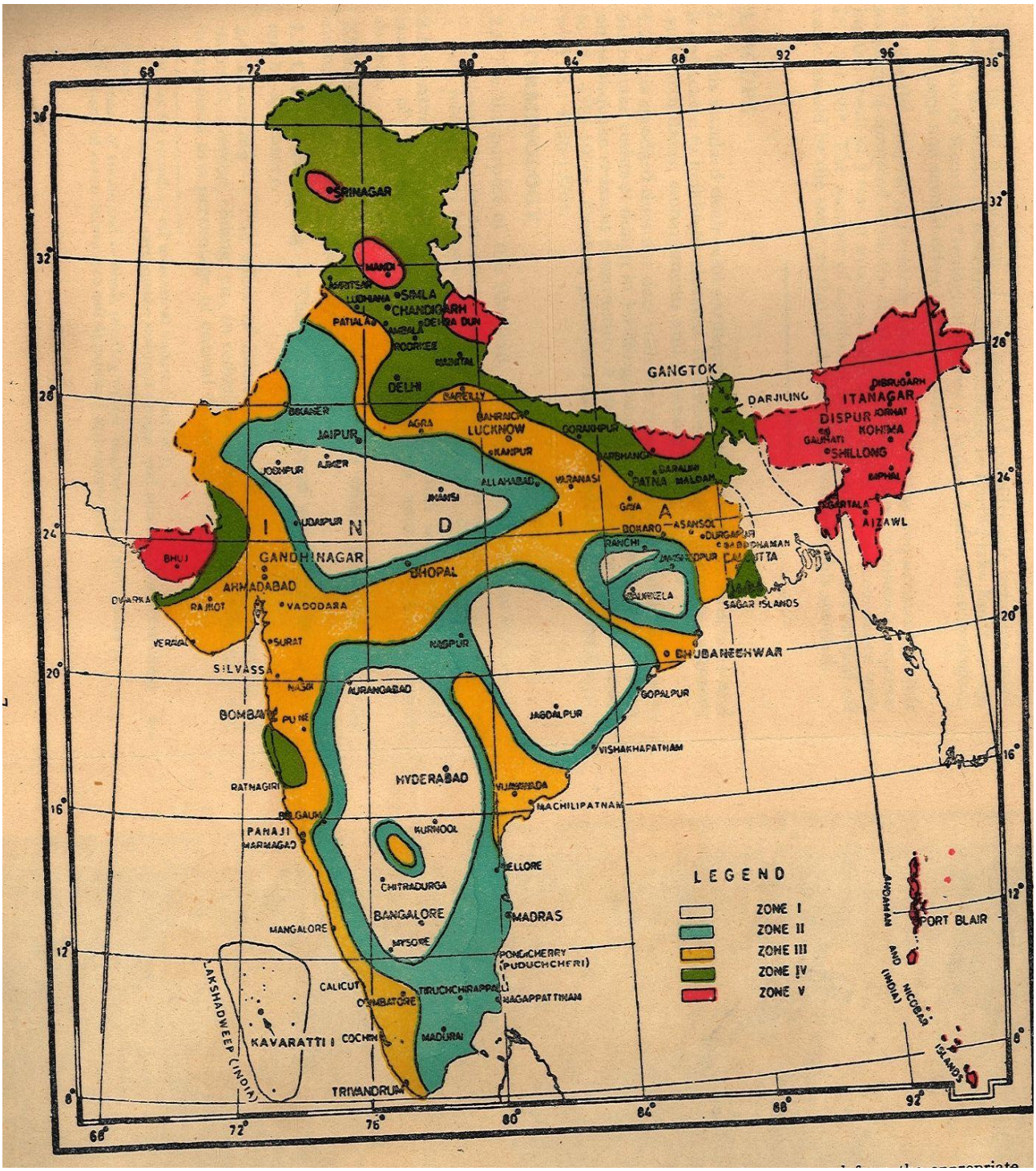
5.7. Groundwater scenario.

Haridwar district comes under the Ganga river system. The main tributaries of the Ganges like Solani, Ratmau Rao and Banganga and their feeding nallahs drain the area. These tributaries are ephemeral. As far as canal irrigation is concerned, the western part of the district is well covered with 300 km length canal network.

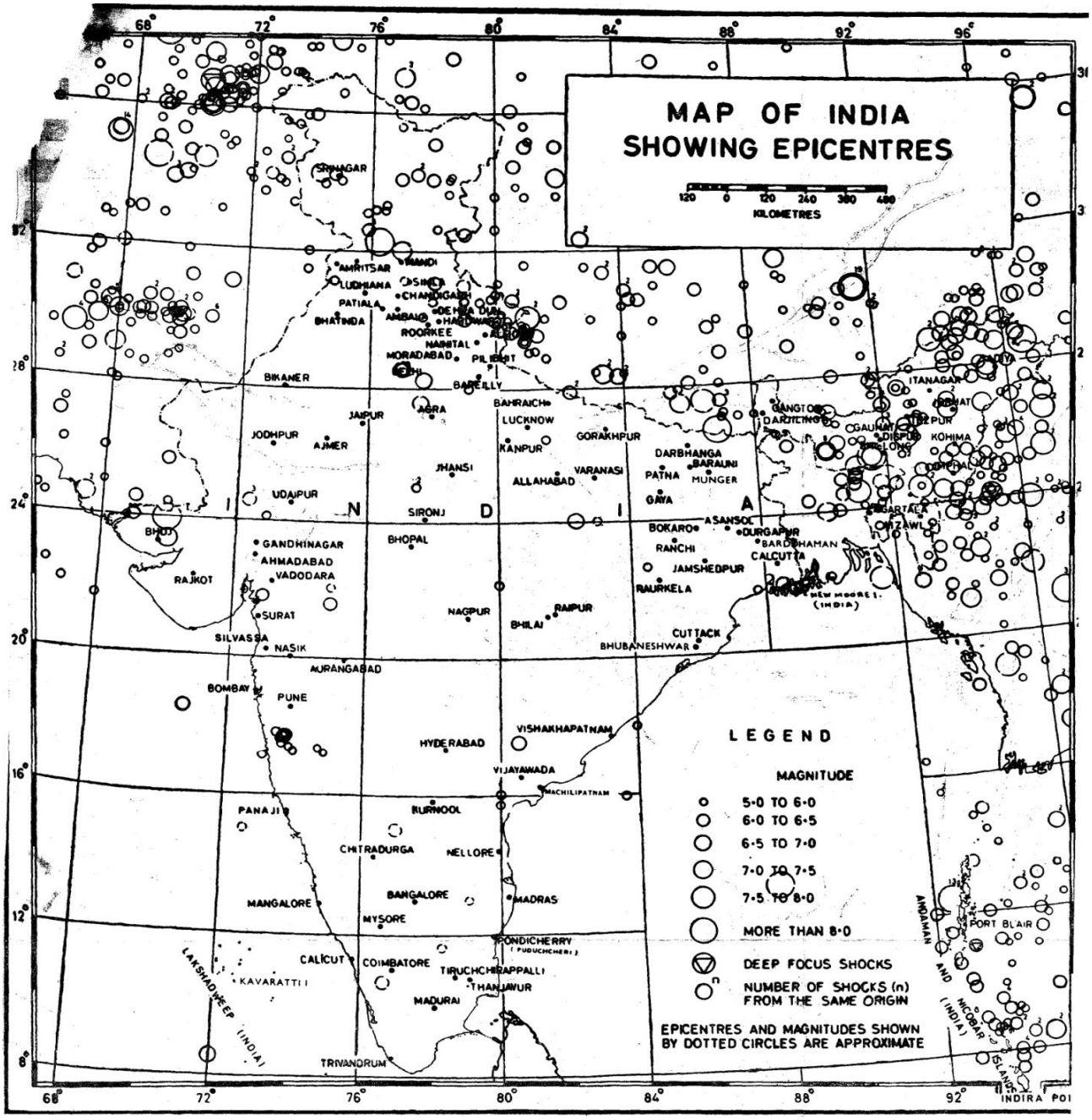
5.8 Tectonic features.



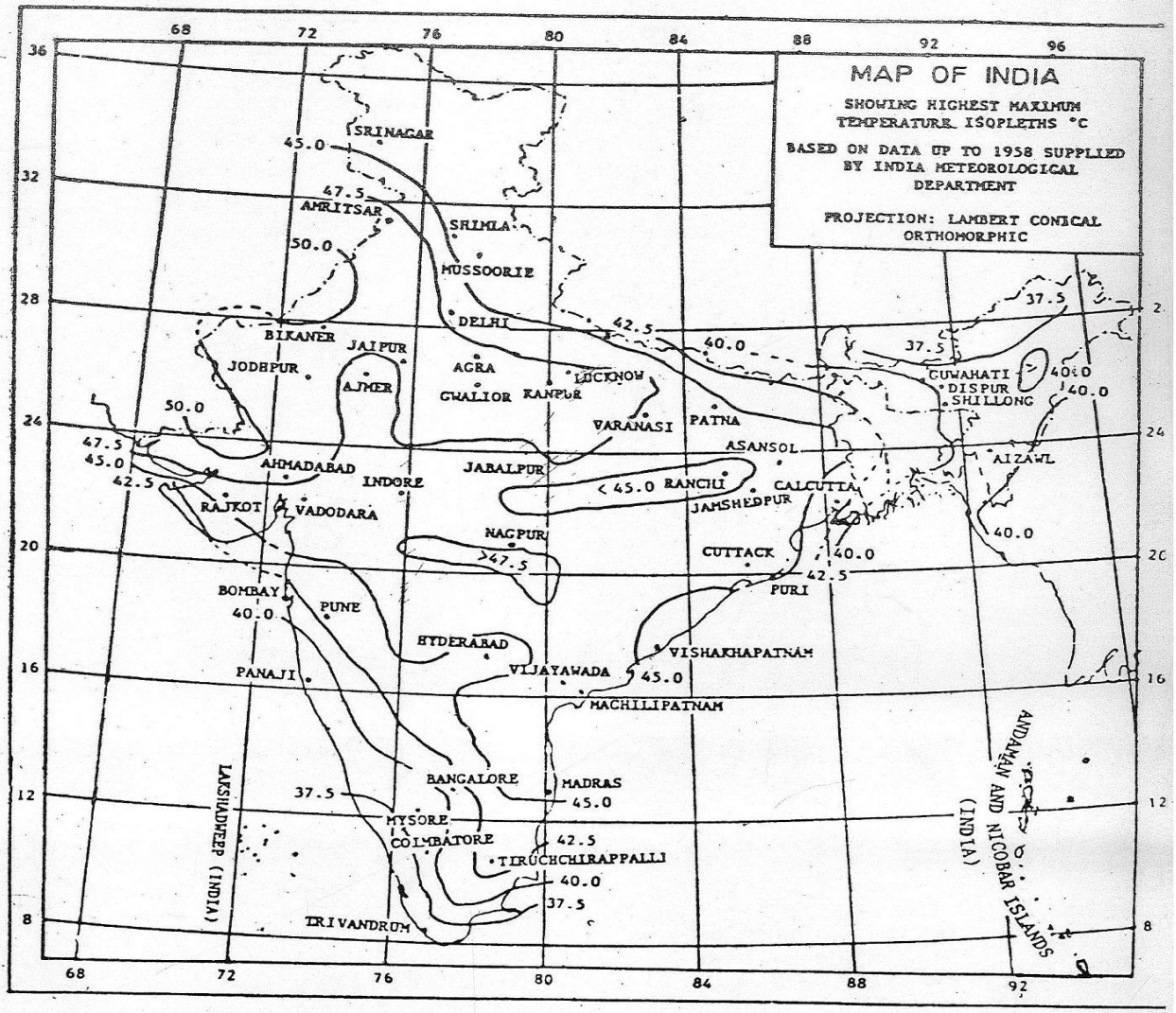
5.9. Seismic zones



5.10. Epicentres



5.11. Highest maximum temperature



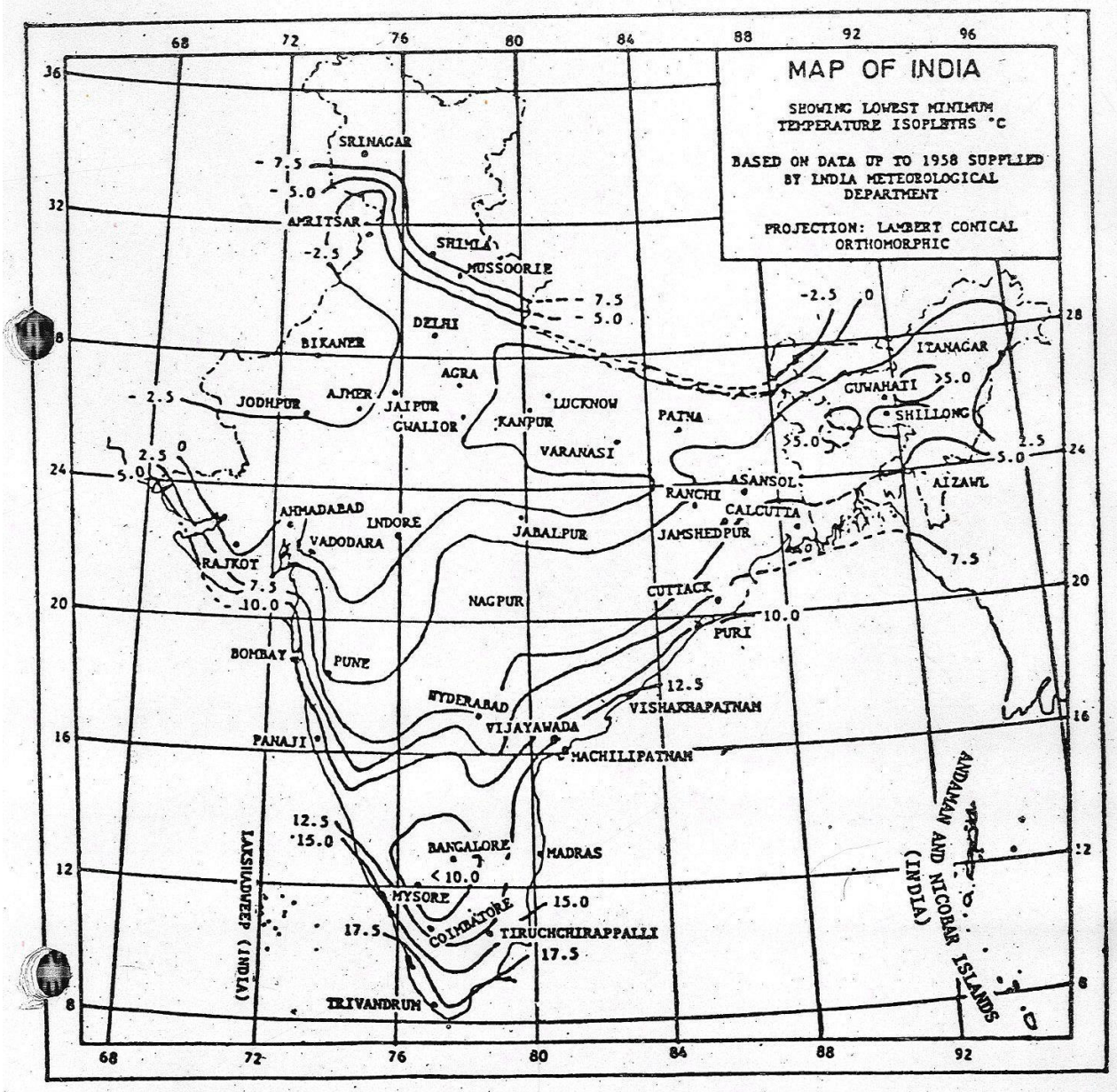
The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.

Based upon Survey of India map with the permission of the Surveyor General of India.

Responsibility for the correctness of internal details rests with the publishers.

FIG. 1 CHART SHOWING HIGHEST MAXIMUM TEMPERATURE

5.12. Lowest minimum temperature



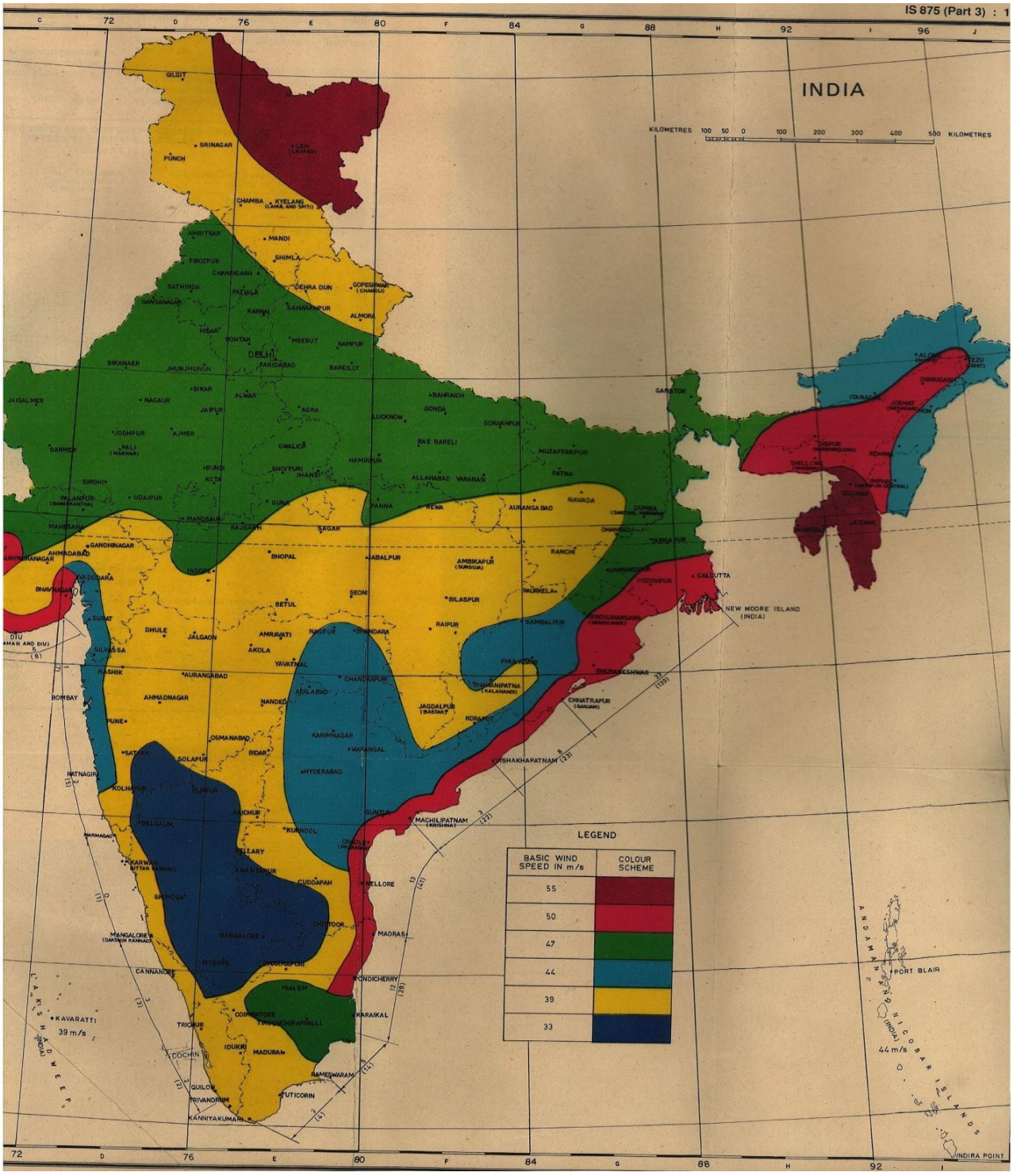
The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.

Based upon Survey of India map with the permission of the Surveyor General of India.

Responsibility for the correctness of internal details rests with the publishers.

FIG. 2 CHART SHOWING LOWEST MINIMUM TEMPERATURE

5.13. Wind effect



Basic Wind Speed

APPENDIX A

(*Clause* 5.2)

BASIC WIND SPEED AT 10 m HEIGHT FOR SOME IMPORTANT CITIES/TOWNS

City/Town	*Basic Wind Speed* (m/s)	*City/Town*	*Basic Wind Speed* (m/s)
Agra	47	Jhansi	47
Ahmadabad	39	Jodhpur	47
Ajmer	47	Kanpur	47
Almora	47	Kohima	44
Amritsar	47	Kurnool	39
Asansol	47	Lakshadweep	39
Aurangabad	39	Lucknow	47
Bahraich	47	Ludhiana	47
Bangalore	33	Madras	50
Barauni	47	Madurai	39
Bareilly	47	Mandi	39
Bhatinda	47	Mangalore	39
Bhilai	39	Moradabad	47
Bhopal	39	Mysore	33
Bhubaneshwar	50	Nagpur	44
Bhuj	50	Nainital	47
Bikaner	47	Nasik	39
Bokaro	47	Nellore	50
Bombay	44	Panjim	39
Calcutta	50	Patiala	47
Calicut	39	Patna	47
Chandigarh	47	Pondicherry	50
Coimbatore	39	Port Blair	44
Cuttack	50	Pune	39
Darbhanga	55	Raipur	39
Darjeeling	47	Rajkot	39
Dehra Dun	47	Ranchi	39
Delhi	47	Roorkee	39
Durgapur	47	Rourkela	39
Gangtok	47	Simla	39
Gauhati	50	Srinagar	39
Gaya	39	Surat	44
Gorakhpur	47	Tiruchchirrappalli	47
Hyderabad	44	Trivandrum	39
Imphal	47	Udaipur	47
Jabalpur	47	Vadodara	44
Jaipur	47	Varanasi	47
Jamshedpur	47	Vijaywada	50
		Visakhapatnam	50

Uttarakhand Metro Rail, Urban Infrastructure & Building Construction Corporation Limited

6
Case study of existing ropeway systems

6. Case study of existing ropeway systems

The aerial ropeway is a unique and ingenious mechanical system, which facilitates the transportation of man and material over difficult and peculiar terrain bringing about comparative ease and economy vis-à-vis other means of transport.

There are various types of Ropeway systems in the world. Based on the capacity of the system, ground terrain, and length of the system, the selection of the Ropeway system is done.

Hereunder are some of the most common ropeways in the urban context that are operating in the world.

Ropeway systems have been successfully employed for several years in material transport and transport of passengers in hilly, mountainous and remote areas.

Application of ropeways in public transportation is a cost-effective, pollution-free and environment-friendly solution especially for townships located around hilly terrain. Main advantages of application of ropeways in public transportation are;

- Most energy efficient
- Low land requirement
- High Gradability
- Low power requirements
- Pollution-free
- Adaptability
- Easy to integrate
- Low footprint
- Unique ride experience

This chapter gives a brief overview of some of the ropeways used as urban transport.

6.1. Bolzano, Italy

The Funivia Del Renon, also known as the Rittner Seilbahn, was built in 1966. Following a minor update in 1986, the system was completely overhauled to a modern 3S system in 2009. The system is a two-station line connecting Bolzano, on the edge of the Alps, to the small town of Renon (Rittner in German), located on a plateau high above the city.

Although the cable car primarily serves the tourist market, it also provides an important transit link for the residents of Renon.

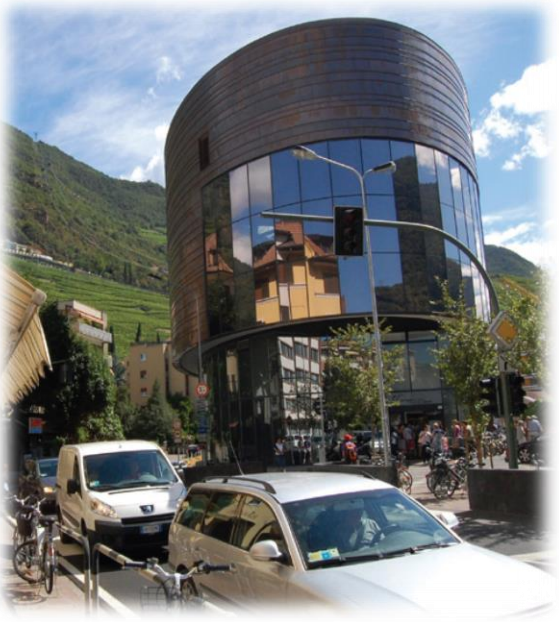
Cabin descending into Bolzano

The Route

The system offers riders an amazing view of the mountains and valley while serving as a direct route between the towns of Bolzano and Renon/Rittner.

System Stats

Technology:	3S
Year:	2009
Length:	4.5 km
Stations:	2
Cabin capacity:	35 persons
Trip time:	12 minutes



Salient points

- **The most notable feature of the Funivia Del Renon is the station architecture, which is fully integrated into the urban fabric**. Externally, the building bears no resemblance to a ski lift station. With its sleek curves and modern window panels, it seamlessly blends into the surrounding urban landscape.
- Vehicles come to a complete stop in the stations, easing boarding and alighting procedures.

6.2. Koblenz, Germany

About

The Koblenz Rheinseilbahn is a 3S system. It is located in Koblenz, Germany as Metro Cable Car of the 2011 bi-annual BUGA horticultural show. The line, which consists of two slim profile stations, showcases several styles of 35+ person cabins, including the first-ever "Urban Concept" cabins.

A one-way ride on the Rheinseilbahn takes about 4 minutes, travelling between downtown Koblenz and the Ehrenbreitstein Mountain Fortress.

Route

The Koblenz Rheinseilbahn carries passengers over the Rhine River to the BUGA festival grounds. The system traverses a UNESCO heritage site, which was able to maintain its status due to the low impact of the gondola.

System stats

Technology	3S
Year	2010
Length	0.9 km
Stations	2
Cabin capacity	35 persons
Trip time	minutes

Salient points

The station architecture of this system is simple and elegant. **Both structures have small footprint bases** and customized rooftop styles made of white stretched fabric. Since the system is designed to be disassembled on-site, the construction required little disruption to the surrounding area.

Station Design

Tower Design

- Initial reports indicate that the Rheinseilbahn is moving tens of thousands of people per day.
- The new Urban Concept cabins look and feel like transit. There is plenty of sitting and standing space as well as bars to grab hold of and room for bikes or strollers.

Urban Concept Cabin - interior and exterior views

6.3. Medellín, Colombia

About

The Medellín Metrocable Linea J in Colombia is the city's second ropeway system. Similar to the Medellín Linea K Metrocable, Linea J serves several hillside communities. However, unlike its predecessor, located in well-established barrios, Linea J has constructed Metro Cable Car in areas currently undergoing massive development. Both station design and cabin size and style are similar to those on the Linea K system.

The route

Linea J serves the San Javier district, which includes the barrios of Vallejuelos and La Aurora, with an integrated transfer to the urban rail line located at the San Javier Station.

System stats

Technology	MDG
Year	2009
Length	2.6 km
Stations	4
Cabin capacity	10 persons
Trip time	10 minutes

Salient points

Similar to Metro cable Linea K, this line has benefited the community in many ways, including decreased travel/commuting times and increased property value.

The system is fully integrated into the city's rail system, making it is easy to transfer between the two, both physically and fare-wise.

6.4. Medellin, Colombia

About

The Medellin Metro cable's Linea K is generally considered the world's first fully-integrated urban ropeway system. As the city expanded, much of the growth spread organically into the surrounding

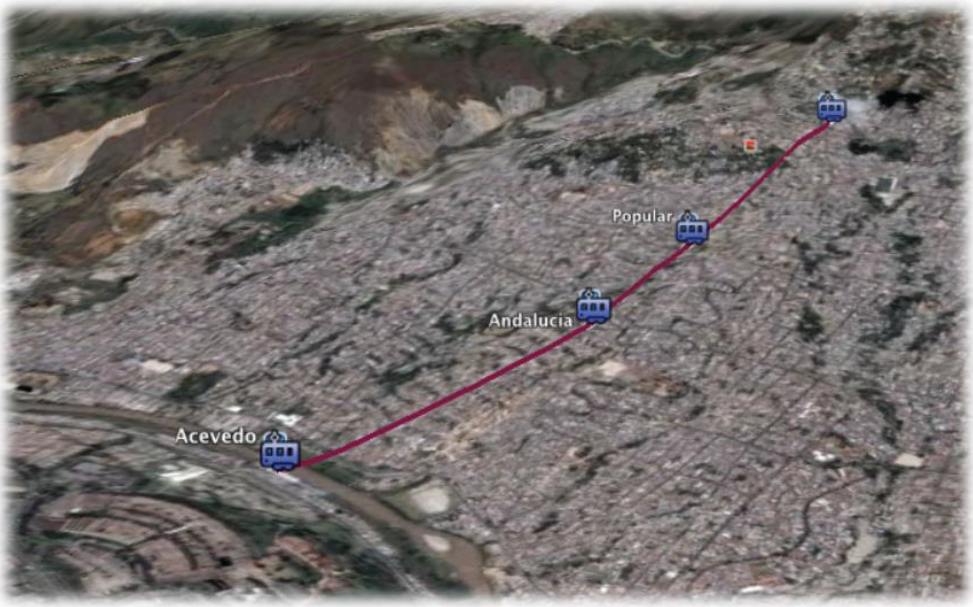
mountain range. Linea K, which was constructed in 2004, connects several of these neighbourhoods to one of the city's above-ground rail lines.

The success of this line led to the construction of other lines.

Santo Domingo from below.

The route

Linea K serves the communities of Santo Domingo, Popular and Santa Cruz, with an integrated transfer to the urban rail line located at Acevedo Station.



System stats

Technology	MDG
Year	2004
Length	2 km
Stations	4
Cabin capacity	10 persons
Trip time	7 minutes

Salient points

Fully integrated into the city's rail system, Metro cable Linea K is considered hugely successful. It moves over 40,000 riders per day and has severely reduced travel times for thousands of residents.

6.5. Hong Kong

About

The Ngong Ping Cable Car began as the Tung Chung Cable Car Project in 2004. It is pMetro Cable Car of a larger tourism initiative on Lantau Island in Hong Kong. Rebranded in 2005, the cable car opened in 2006 to carry passengers from the city to Ngong Ping Village. Riders can choose between the standard cable cars or, for an additional fair, the VIP "Crystal Cabins," complete with glass floors.

Crossing Tung Chung Bay.

The route

The Ngong Ping Cable Car provides riders views of such landmarks as Ngong Ping Plateau, Hong Kong International Airport, Tung Chung Valley and the South China Sea.

There are two turning stations en route but neither boarding nor alighting is allowed at either.

System stats

Technology	BDG
Year	2006
Length	5.7 km
Stations	2
Cabin capacity	17 persons
Trip time	25 minutes

Salient points

The glass floor bottoms on the Crystal Cabins provide passengers with unique riding experience. At the same time, having an option to choose between clear and opaque is also a plus.

The Ngong Ping Cable Car is easily accessible via a short walk from Hong Kong's Tung Chung subway station. Since it is a tourist-oriented cable lift, a separate fare is required to ride the system.

6.6. Portland, USA

About

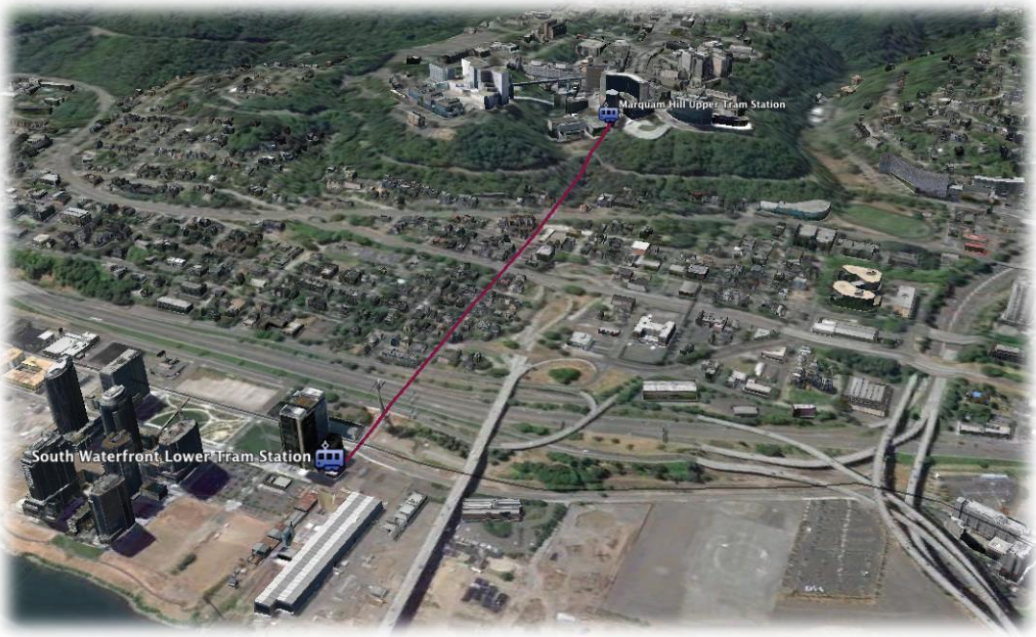
The Portland Aerial Tram is a 1km system that stemmed from the growth and development of the Oregon Health and Science University (OHSU), which is located on a plateau. Today, it provides a vital connection between Marquam Hill and the city's South Waterfront District. While the tram is

infamous for exceeding initial budgets, the Aerial Tram is internationally renowned for its architectural achievements and is often recognized as a symbol of Portland's urban landscape.

Arriving at Marquam Hill Station

The route

Students and employees of OHSU ride the tram for free but other riders must pay. The route passes over a large highway, a historical district, and a largely residential area, which caused a great amount of controversy.



SYSTEM STATS

Technology	Aerial Tram
Year	2007
Length	1 km
Stations	2
Cabin capacity	78 persons
Trip time	3 minutes

Salient Points

The system is known for being highly customized, with its two "bubble" cabins and a one-of-a-kind tower design. The stations were designed to evoke an open and airy feel. The Marquam Hill station was specially engineered to stand separately from the connecting building, so while passengers can walk between the two, they are physically separate. **This was done largely due to seismology and earthquake damage concerns.**

Vehicle arriving at Marquam Hill Station.

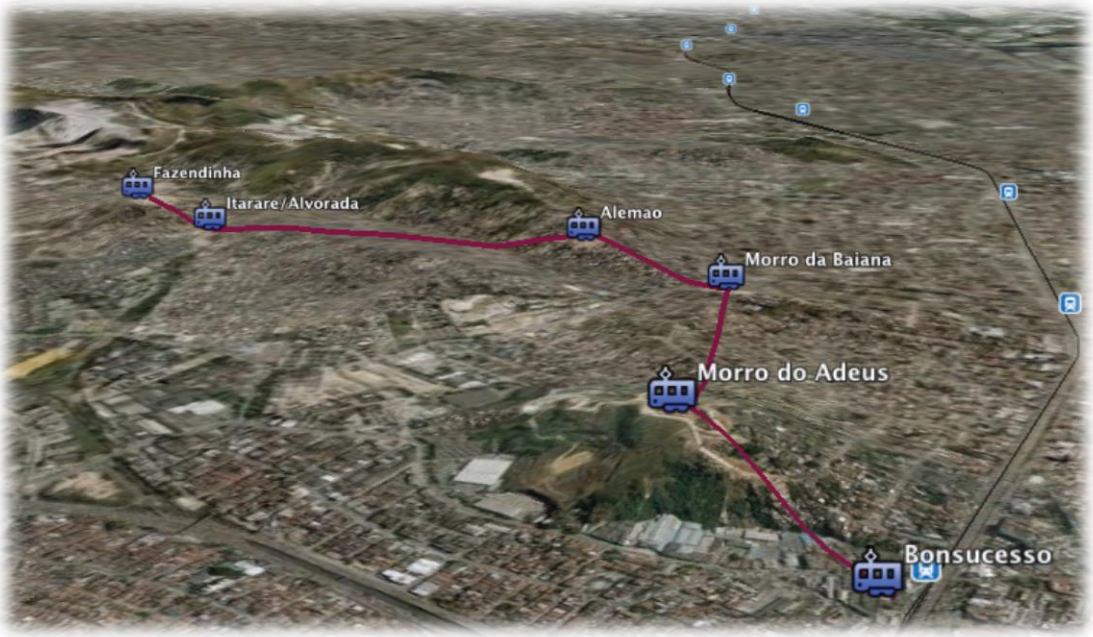
Neighbourhood view from the aerial tram.

6.7. Rio de Janeiro, Brazil

About

The Complexo do Alemão is one of Rio de Janeiro's largest favelas. Similar to the Metrocable communities in Medellín and Caracas, it is made up of informal hillside communities. The Teleférico do Alemão was constructed as Metro Cable Car of the Brazilian infrastructure development plan known as the Growth Acceleration Program (PAC, in Portuguese). This six-station gondola system is meant to improve mobility for residents, connecting directly to one of Rio's suburban rail lines.

The route



System stats

Technology	MDG
Year	2011
Length	3.5 km
Stations	6
Cabin capacity	10 persons
Trip time	16:00

Salient points

- The route itself seems extensive and far-reaching, although an actual assessment is not yet available as the system just opened for full operation in the fall of 2011.
- It is assumed that the system will and has substantially reduce commute times for many residents by connecting directly to one of Rio de Janeiro's suburban rail lines.
- Residents can apply for a RioCard which grant them two free trips per day on the teleferico. This could boast system popularity, offering residents increased opportunities through mobility.

Similar to Caracas Metrocable, the system's stations are grandiose and are located on hilltops which could make it difficult for residents to easily access the system.

6.8. New York City, USA

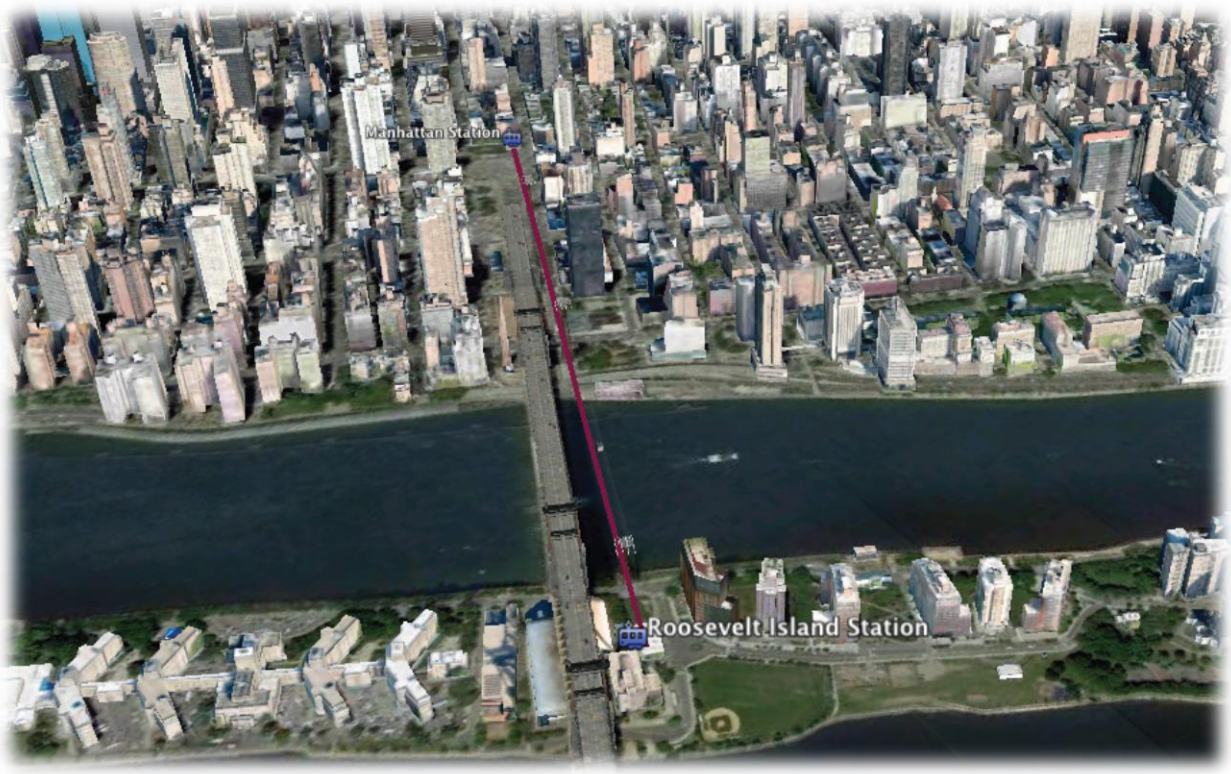
About

The Roosevelt Island Tram (RIT) began operation in 1976. The tram preceded the existing subway line and was the first fixed link connection between Roosevelt Island and Manhattan. In 2010 RIT was rebuilt as a dual haul aerial tram which allows each cabin to run independently of each other. The upgrade also increased speed and capacity for the system and enables it to run nearly round-the-clock.

Metro Cable Car in Manhattan.

The route

The Tram runs along the north side of the Ed Koch Queensboro Bridge and directly over the East River. The Manhattan terminal allows passengers to easily transfer to the subway.



System stats

Technology	Aerial Tram (dual haul)
Year	1976 / 2010 rebuild
Length	1 km
Stations	2
Cabin capacity	109 persons
Trip time	3:00

Salient points

- The new dual-haul technology enables the system to run nearly continuously. While most cable systems require daily stoppages for service, the dual haul configuration allows one cabin to remain in operation during off-peak hours while the other is being serviced.
- Originally the only Manhattan connection for Roosevelt Island residents, the tram arguably became redundant when the subway opened in 1990. Yet, since full fare integration with the NYC subway in the mid-2000s ridership has increased substantially making it the preferred mode of travel for island residents.

6.9. Singapore Cable Car

About

The Singapore Cable Car was built in 1974 as a BDG system and then reconstructed in 2010 as an MDG. This tourist system offers visitors a unique ride from the mainland to Sentosa Island, a former military base that had been converted into a major resort.

This cable system was the first to incorporate a mid-station within a pre-existing high rise building — a strong demonstration of cable's ability to adapt to the existing urban form. The Singapore Cable Car was also the first system to span a major harbour.

Entering the mid-station at Keppel Harbour Station, located inside an office building.

The route

The Cable Car travels from Mount Faber to Sentosa Island, with one mid-station at Keppel Harbour.

System stats

Technology	MDG
Year	1974 (2010 rebuild)
Length	1.7 km
Stations	3
Cabin capacity	8 persons
Trip time	12:00

Salient points

- The ability to engineer a mid-station within a pre-existing, high-rise structure is a true testament to the technology's flexibility. This could be adapted into an urban context, allowing for fast and efficient transfers between transit modes and stations in dense urban areas.

Uttarakhand Metro Rail, Urban Infrastructure & Building Construction Corporation Limited

7
Visit to installations and discussion with stakeholders

7. Visit to installations and discussion with stakeholders

Usha Breco Limited team, in past, have visited two Urban Transportation Ropeway installations in Algeria. Algeria has installed several ropeway systems for transportation in many of its main towns owing to the challenges prevailing there.

The main Ropeway systems in Algeria:-

a. Constantine
b. Tlemcen
c. Skidata
d. Algiers

We visited ropeway systems in Constantine and Tlemcen.

A brief is given for reference:

7.1. Constantine Ropeway

Constantine is the third largest city in Algeria and is hugely crowded. It took for us to cross from one station to another about 30 minutes while it took only 7 minutes by Ropeway.

Constantine, a city of a half million residents located on the plateau. Due to the extreme congestion and difficult topography, the Constantine Télécabine was designed to connect two residential neighbourhoods with an area of high employment. This has resulted in greatly reduced travel times and increased tourism.

The Constantine Télécabine allows commuters to traverse the town in *7 minutes, as compared to the 45 minutes it could take in a car.*

Technology:	**Monocable Detachable Ropeway**
Year:	2008
Length:	1.68 Kilometre
Stations:	3
Cabin capacity:	15 Passenger (9 sitting, 6 standing)
Trip time:	7 minutes
Capacity:	2400 PPH
Peak Load;	550 Kw
Speed:	6 m/s
Cabin Interval:	22.5 Second
No. of Cabins:	40
No. of Tower:	13
Max. Tower height:	30 m

7.2. Tlemcen Ropeway

Tlemcen, a city of 140,000 people, is situated on a limestone ridge. The stations in this system were inspired by traditional local styles, with both the design and construction assigned to local architects and contractors.

This system connects several areas of the city, including an amusement park, hotel and zoo, serving both tourists and locals. The final stop of the Tlemcen Télécabine offers riders a view of the city and surrounding area.

Technology:	**Monocable Detachable Ropeway**
Year:	2009
Length:	1.72 Kilometre
Stations:	3
Cabin capacity:	15 Passenger (9 sitting, 6 standing)
Trip time:	7 minutes
Capacity:	1000 PPH
Peak Load;	350 kW
Speed:	6 m/s
Cabin Interval:	22.5 Second
No. of Cabins:	18 nos
No. of towers:	15

Discussion with technology providers - Mr Tahar – Director, Algeria Garaventa

CONSTANTINE ROPEWAY		
	QUESTION ASKED	**ANSWER**
1.	Why the need for this system was felt	After the war, urban population increased manifolds in Constantine and there was congestion and frequent traffic jams in town and the terrain did not allow any other system viable. Also, the relocation of habitants was not feasible. The ropeway has no such constraints. They are the most cost economic also.

2.	What needs it caters to	Ropeway connects the city centre to a hospital at mid-station and several residential complexes. People come to the city centre which is connected to different public transport systems.
3.	What is annual ridership in the ropeway	Constantine has transported about 15 million in the first 5 years
4.	Cost of Ticket	20 Dinar
5.	Advantages to passengers	Total journey duration is reduced from 45 minutes to 7 minutes. The pollution level has come down.
6.	Investment is done by	All cost of construction is born by Government
7.	Operation time	7:00 AM – 11:00 PM
8.	User group	Residents, School Children, Patients

Mr. Tahar – Director, Algeria Garaventa

TLEMCEN ROPEWAY		
	QUESTION ASKED	**ANSWER**
1.	Why the need for this system was felt	Tlemcen town has a population of 1, 50,000. This town is a tourist attraction. Most of the tourist attractions like an amusement park, National park, Children park, viewing tower, resorts and hotels are located at the hill. Also, there are several villages located at the station at the hilltop. The ropeway was conceptualized to provide the connectivity to tourists and the villagers to the main city.
2.	What needs it caters to	It caters to the needs of tourists as well as villagers/ residents.
3.	What is annual ridership in the ropeway	Constantine has transported about 7 million in 3 years
4.	Cost of Ticket	20 Dinar
5.	Advantages to passengers	Total journey duration is reduced from 30 minutes to 7 minutes. It has become a viable public transport system.
6.	Investment is done by	All cost of construction is born by Government
7.	Operation time	7:00 AM – 11:00 PM (Night operation during Ramadan)
8.	User Group	Residents, Tourists, Students, Labours

Uttarakhand Metro Rail, Urban Infrastructure & Building Construction Corporation Limited

8
Case Study of Metro-cable Gondola in Medellin, Colombia

8. Case Study of Metro-cable Gondola in Medellin, Colombia

Following case study of Medellin city that has implemented Cable cars/Ropeways will demonstrate its benefits.

Often considered the world's first integrated urban gondola system, the ever-growing Metro-cable system in Medellin, Colombia is a multi-line system that connects the city centre with outlying, less affluent areas on the hillsides.

The first line opened in 2004 with four different stations, while subsequent lines stretch across other parts of the city. In addition to reducing travel times across the city, the gondola system has been credited with reducing poverty and violent crime.

According to Colombia's National Statistics Department, the number of people living below the poverty line in Medellin fell to 14.3 per cent in 2015, from 22 per cent in 2010. There were 495 homicides in 2015, down from 1,649 in 2011, which was also down from the peak of 6,349 in 1991.

9
Traffic survey, analysis and forecasting

9. Traffic survey, analysis and forecasting

This chapter deals with various traffic studies carried out and the analysis of the data obtained from these studies. In the planning and design of a Ropeway, an appreciation of the existing traffic and traffic expected to use the highway is important. This is to assess the capacity requirements, identify present and likely future traffic conditions and to have provisions for future improvements. As part of this study, a systematic methodology has been followed to assess the characteristics of the traffic on the ropeway project.

Traffic count surveys carried out to establish the base year for traffic. The baseline traffic characteristics are very important for the assessment of future traffic and travel pattern.

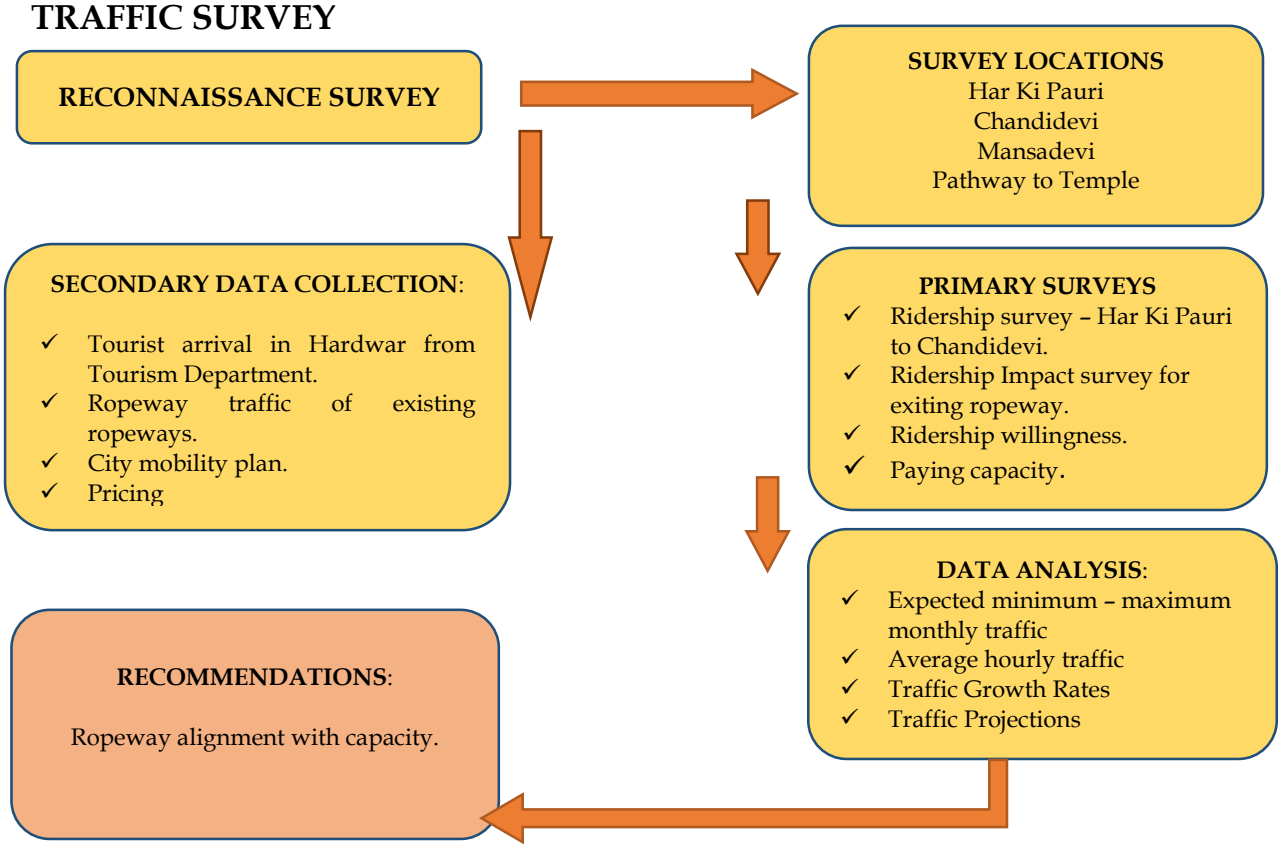
9.1. Traffic survey and study methodology

Comprehensive data have been collected from various departments/Organizations/agencies/ institutions and other sources related to the Traffic census & socio-economic indicators. The Classified Traffic Volume Count surveys have been conducted for seven (7) days. **The Detailed Methodology is pictorially depicted in Figure**.

A team of officers was mobilized to carry out the traffic analysis at various traffic nodes.

A large amount of secondary and primary data is collected to analyse the transportation requirements in the cities and also to optimize the ropeway capacity of different sections to have optimum utilization of ropeway sections.

TRAFFIC SURVEY



Methodology for traffic survey

9.2. Traffic Survey Details

9.2.1 Haridwar tourist number of last five year (Table 9.1)

Following is the monthly data of tourists visited Haridwar, during the Last Five Years:

S. NO	MONTH	YEAR 2015			YEAR 2016		
		INDIAN	FOREIGNER	TOTAL	INDIAN	FOREIGNER	TOTAL
1	**JANUARY**	780575	1499	**782074**	895500	1295	**896795**
2	**FEBRUARY**	910750	1671	**912421**	1125750	2295	**1128045**
3	**MARCH**	1070425	2897	**1073322**	1225250	3203	**1228453**
4	**APRIL**	1245750	1867	**1247617**	1950500	1921	**1952421**
5	**MAY**	1670500	903	**1671403**	1755250	1390	**1756640**
6	**JUNE**	1750750	847	**1751597**	1780775	800	**1781575**
7	**JULY**	2875250	1050	**2876300**	3150750	1214	**3151964**
8	**AUGUST**	2855750	1302	**2857052**	2910500	1433	**2911933**
9	**SEPTEMBER**	1575500	1369	**1576869**	1580750	1625	**1582375**
10	**OCTOBER**	1875500	1844	**1877344**	1890750	2020	**1892770**
11	**NOVEMBER**	1495775	1767	**1497542**	1310500	2148	**1312648**
12	**DECEMBER**	1225500	1599	**1227099**	910500	1978	**912478**
Total		19332025	18615	**19350640**	20486775	21322	**20508097**

S. NO	MONTH	YEAR 2017			YEAR 2018		
		INDIAN	FOREIGNER	TOTAL	INDIAN	FOREIGNER	TOTAL
1	**JANUARY**	905250	1436	**906686**	910500	1715	**912215**
2	**FEBRUARY**	1140500	2201	**1142701**	1148750	2399	**1151149**
3	**MARCH**	1230750	3029	**1233779**	1235500	2824	**1238324**
4	**APRIL**	1955750	2036	**1957786**	1975500	2358	**1977858**
5	**MAY**	1775500	1291	**1776791**	1860750	1354	**1862104**
6	**JUNE**	1790000	962	**1790962**	1815000	932	**1815932**
7	**JULY**	3375500	1516	**3377016**	3550750	1487	**3552237**
8	**AUGUST**	3020750	1736	**3022486**	3140500	1395	**3141895**
9	**SEPTEMBER**	1615500	1664	**1617164**	1630750	1686	**1632436**
10	**OCTOBER**	1905500	2270	**1907770**	1975750	1925	**1977675**
11	**NOVEMBER**	1325750	2473	**1328223**	1360500	2464	**1362964**
12	**DECEMBER**	945225	2509	**947734**	950750	2044	**952794**
Total		20985975	23123	**21009098**	21555000	22583	**21577583**

S.NO	MONTH	YEAR 2019		
		INDIAN	FOREIGNER	TOTAL
1	**JANUARY**	912750	1455	**914205**
2	**FEBRUARY**	1150500	2078	**1152578**
3	**MARCH**	1245750	2315	**1248065**
4	**APRIL**	1980225	1612	**1981837**
5	**MAY**	1875500	1052	**1876552**
6	**JUNE**	1895500	1641	**1897141**
7	**JULY**	3875650	1465	**3877115**
8	**AUGUST**	2875750	1266	**2877016**
9	**SEPTEMBER**	1636500	1271	**1637771**
10	**OCTOBER**	1977450	1896	**1979346**
11	**NOVEMBER**	1371350	2497	**1373847**
12	**DECEMBER**	0	0	**1010026**
Total		20796925	18548	**21825499**

Note:

1. Source of data – Department of Tourism, Haridwar
2. December 2019 Traffic data was not available hence it is considered an average of last four year

9.2.2 Growth of tourists visiting Haridwar (Table 9.2)

SN	Year	Number of Tourist Visited Haridwar	Growth	Growth in Percentage (%)
1	2015	19350640		
2	2016	20508097	1157457	5.98
3	2017	21009098	501001	2.44
4	2018	21577583	568485	2.71
5	2019	21825499	247916	1.15
			Average	**3.07**

Projection of Haridwar visiting Tourists at the growth rate of 3.07% for the next 30 Years

SN	Year	Traffic Projection Considering 3.07 % growth
	2019	**21825499**
1	2020	22495542
2	2021	23186155
3	2022	23897970
4	2023	24631638
5	2024	25387829
6	2025	26167235
7	2026	26970569
8	2027	27798566
9	2028	28651982
10	2029	29531598
11	**2030**	**30438218**
12	2031	31372671
13	2032	32335812
14	2033	33328521
15	2034	34351707

SN	Year	Traffic Projection Considering 3.07 % growth
16	2035	35406304
17	2036	36493278
18	2037	37613622
19	2038	38768360
20	2039	39958548
21	**2040**	**41185276**
22	2041	42449664
23	2042	43752868
24	2043	45096082
25	2044	46480531
26	2045	47907484
27	2046	49378243
28	2047	50894155
29	2048	52456606
30	2049	54067024
31	2050	55726881

9.2.3 Study of the traffic of existing Chandi Devi ropeway (Table 9.3)

Month wise traffic of Chandi Devi Passenger Ropeway for last 5 years:

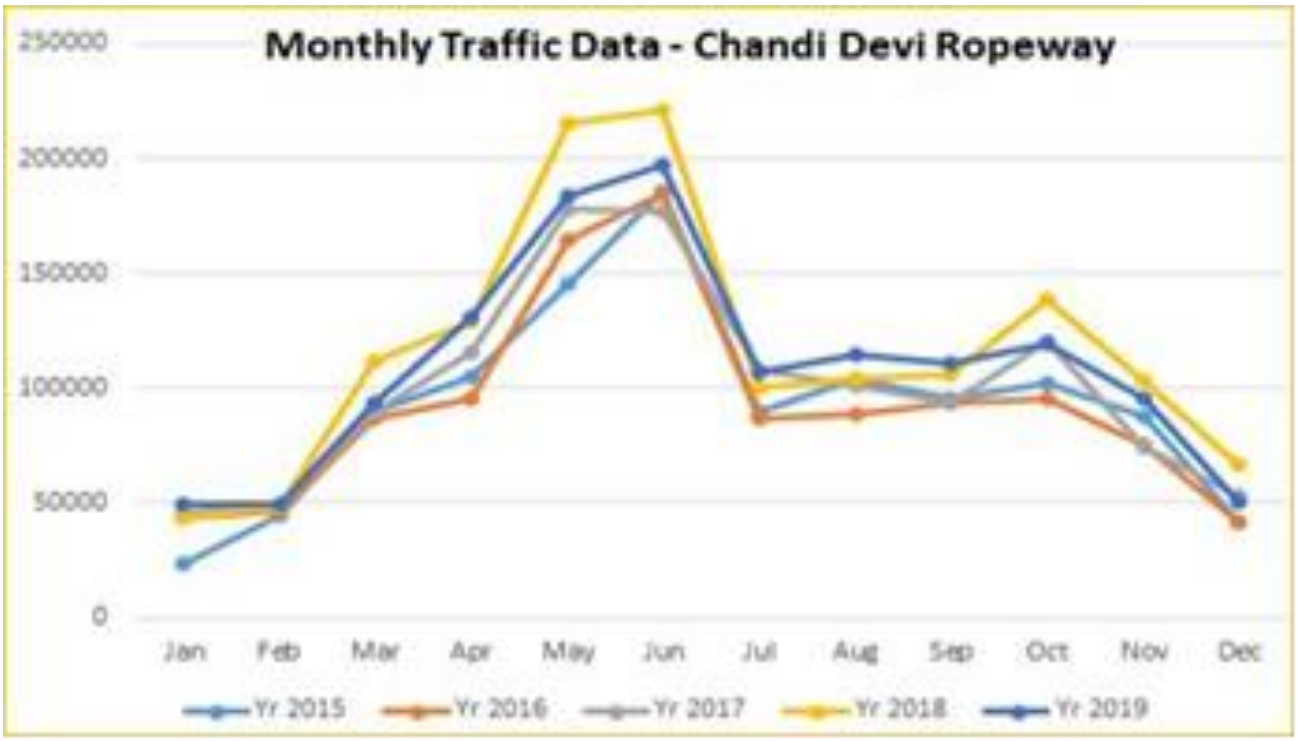
Month	2015	2016	2017	2018	2019	Average
January	23374	43711	45982	44147	49776	41398 (Avg. Minimum)
February	44227	46191	49247	48908	49778	47670

Month	2015	2016	2017	2018	2019	Average
March	89978	86921	89950	111860	93211	94384
April	105024	95541	116002	129460	130564	115318
May	145488	164832	177933	215504	183501	177452
June	185355	184922	176661	221309	197405	193130 (Avg. Maximum)
July	89851	86605	108085	100314	107437	98458
August	104425	88655	101665	104390	115106	102848
September	95119	93246	94032	105653	111266	99863
October	102067	95558	120429	138446	119578	115216
November	87808	75685	74218	103276	95346	87267
December	41944	41880	53398	66810	49983	50803
Total	**1114660**	**1103747**	**1207602**	**1390077**	**1302951**	**1223807**

Source: Usha Breco Limited, Chandi Devi Udan Khatola, Haridwar

Considering the trend of the passengers at existing ropeway, we observed that minimum and maximum traffic, using ropeway is for January and June, respectively.

- Minimum average traffic in any month = 41398 which is **3.38% of average annual traffic**
- Maximum average traffic in any month = 193130, which is **15.78% of average annual traffic**



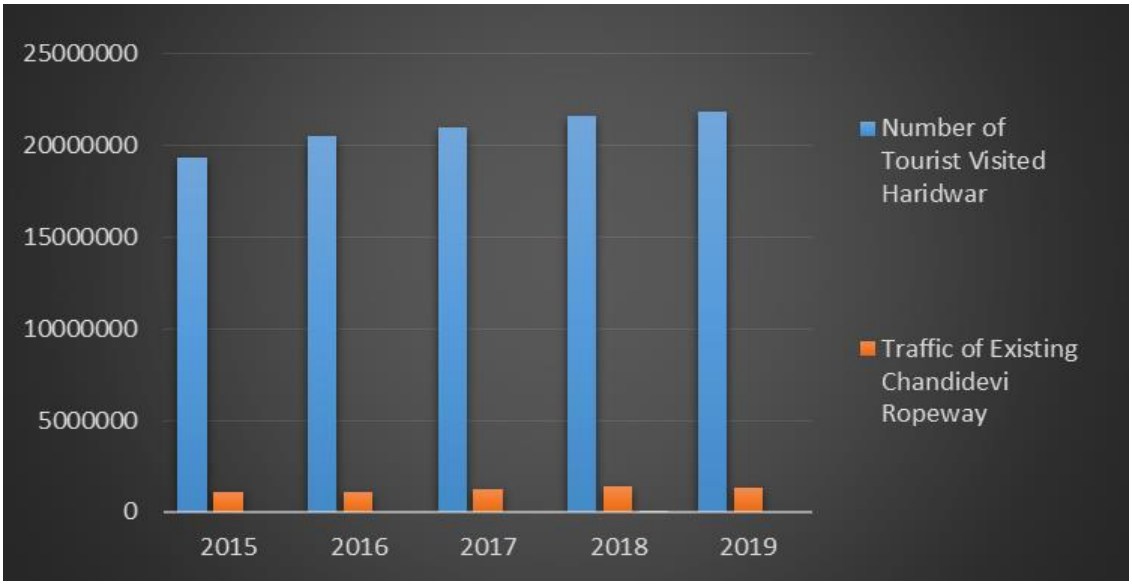
Month wise traffic of Chandi Devi Passenger Ropeway for last 5 years

The growth rate of traffic at Chandi Devi Ropeway (Table 9.4):

SN	Year	Traffic of Existing Chandi Devi Ropeway	Growth	Growth in Percentage (%)
1	2014	1180159		
2	2015	1114660	-65499	-5.55
3	2016	1103747	-10913	-0.98
4	2017	1207602	103855	9.41
5	2018	1390077	182475	15.11
6	2019	1302951	-87126	-6.27
			Average	**2.34**

Percentage of Haridwar tourists visited existing Chandi Devi Ropeway (Table 9.5):

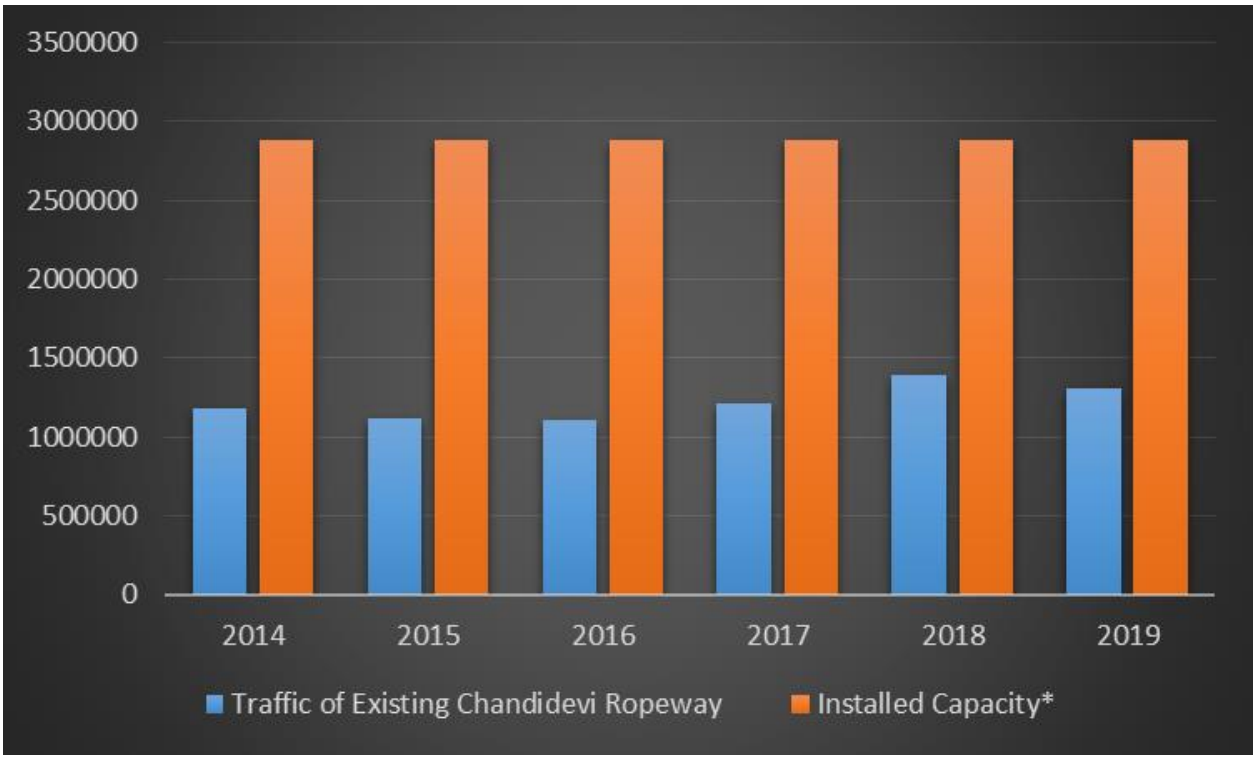
SN	Year	Number of Tourist Visited Haridwar	Traffic of Existing Chandi Devi Ropeway	Percentage of Tourist Visited Chandi Devi Ropeway
1	2015	19350640	1114660	5.76
2	2016	20508097	1103747	5.38
3	2017	21009098	1207602	5.75
4	2018	21577583	1390077	6.44
5	2019	21825499	1302951	5.97
			Average	5.86



Percentage of Haridwar Tourists, Visited Existing Chandi Devi Ropeway

Utilization of installed capacity of Chandi Devi Ropeway (Table 9.6):

SN	Year	Traffic of Existing Chandi Devi Ropeway	Installed annual Capacity*	Capacity Utilization
1	2014	1180159	2880000	40.98
2	2015	1114660	2880000	38.70
3	2016	1103747	2880000	38.32
4	2017	1207602	2880000	41.93
5	2018	1390077	2880000	48.27
6	2019	1302951	2880000	45.24
			Average	42.24

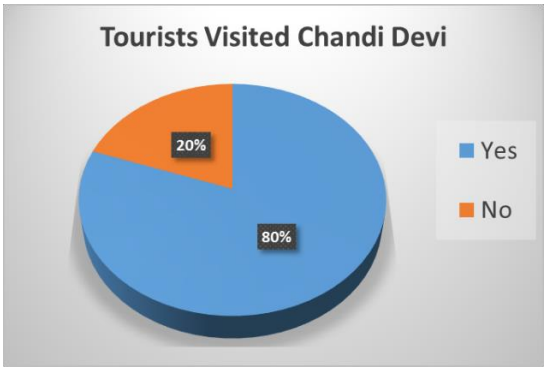


Utilization of installed capacity of Chandi Devi Ropeway

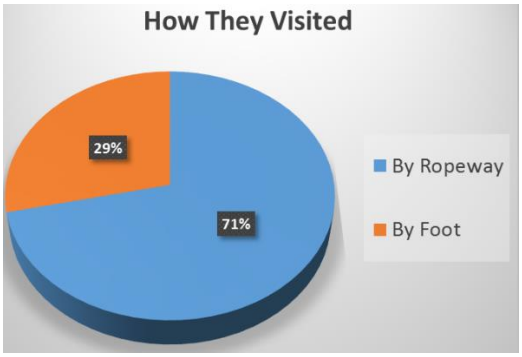
9.2.4. Ridership survey for Har ki Pauri to Chandi Devi ropeway (Table 9.7):

Number of Surveys	Total Group\ Team size	Total Count					
		Have You Visited Chandi Devi?		**If Yes,** How you Visited?		Would you Visit If Ropeway is Constructed from Har Ki Pauri	
		Yes	No	Ropeway	By Foot	Yes	No
3000	**13679**	**11006**	**2673**	**7868**	**3138**	**12211**	**1468**

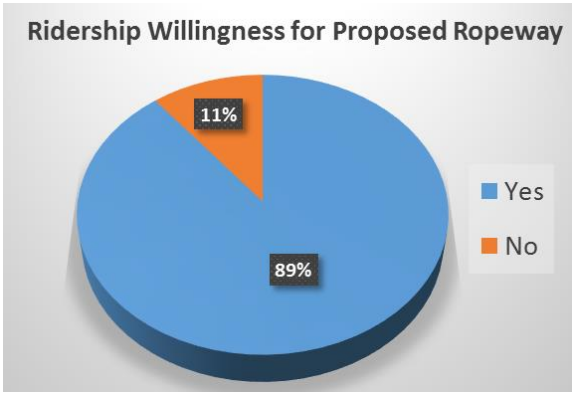
Tourists Visited Chandi Devi		
Survey Sample Size	Yes	No
13679	**11006**	**2673**
Percentage	80.46%	19.54%



How They Visited?		
Chandi Devi Visiting Tourists	By Ropeway	By Foot
11006	**7868**	**3138**
Percentage	71.49%	28.51%



Ridership Willingness for Proposed Ropeway		
Survey Sample Size	Yes	No
13679	**12211**	**1468**
Percentage	89.27%	10.73%



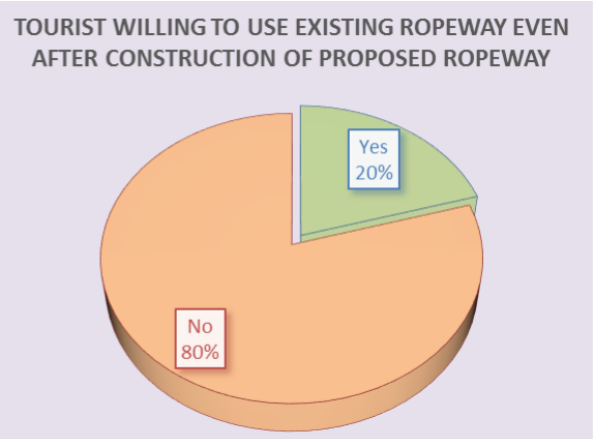
From the above data, the following inference may be drawn:

A	Percentage of Surveyed Tourists, visiting Chandi Devi (A =11006/13679X100)	80.46%
B	Percentage of Surveyed Tourists, visiting Chandi Devi by Existing Ropeway (B = 7868/13679X100)	57.52%
C	Percentage of Chandi Devi Going Tourists who use Ropeway (C = 7868/11006X100)	71.49%
D	Percentage of Surveyed Tourists, Willing to visit Chandi Devi by Proposed Ropeway (D = 12211/13679X100)	89.27%
E	As per the willingness survey, expected increase in Ropeway Using Tourists due to Proposed Ropeway E = (12211-7868)/7868	55.20%
F	Growth of Surveyed Tourist, willing to visit Chandi Devi Temple by proposed Ropeway as compared to present Ropeway F = (D-B)	31.75%

Table - 1

9.2.5. Ridership impact survey for existing Chandi Devi ropeway.

SN	Sample Size	Tourists like to use Existing Ropeway to Chandi Devi, even if new Ropeway is Constructed from Har ki pauri	
		Yes	No
Number	4886	999	3887
Percentage %		20.45	79.55



9.3. Traffic estimation for proposed ropeway from Har Ki Pauri to Chandi Devi Temple

From the above data we can observe that:

Case-1

Average of last five year annual Traffic of existing Chandi Devi Ropeway	1223807
Percentage of surveyed tourists visiting existing Chandi Devi Ropeway	57.52%

Considering Corresponding survey traffic of ropeway user is average annual traffic of existing Chandi Devi Ropeway means 7868 (57.52% Table - 5.11) is equivalent to 1223807	57.52% = 1223807
If 57.52% = 1223807 then corresponding 100% tourist =1223807/57.52X100	2127612
Total ridership willingness is 89.27% (89.27% of 2127612)	**1899326**

Case-2

As per Row E of above Table-5.11, expected increase in ropeway user traffic due to proposed ropeway is 55.2% of the existing Chandi Devi ropeway user. Therefore corresponding increase = 55.2% of 1223807	675541
Considering surveyed ropeway user traffic (57.52%) is equivalent to actual ropeway traffic	1223807
Therefore the total expected traffic (including an increase of 55.2%)	**1899348**

Taking a maximum of the above two cases, expected traffic as per survey data = 1899348.

(Corresponding to existing ropeway traffic – Table 5.14)

Now as per the outcome of the survey for ridership impact on existing Chandidevi Ropeway, traffic of existing Chandidevi ropeway will be reduced to 20.45% (Table – 5.12). That means out of expected traffic, 20% of existing ropeway traffic will continue to use existing ropeway. Accordingly, there will be an expected reduction of traffic, equal to 20% of existing Chandidevi ropeway i.e. 1223807.

20% of 1223807 = 244761

Expected annual traffic = 1899348 – 244761 = **1654587 (**during year 2019-20**)**

FOLLOWING IS THE SUMMARY OF THE TRAFFIC ANALYSIS:

1. **Expected Annual Traffic** = **1654587 (**Year 2019-20**)**
2. **%age Ropeway User of Tourist Visiting** = **7.58%** (of 21825499, 2019 Haridwar Tourist)
3. **Expected Average Monthly Traffic** = **1654587/12 = 137882**
4. **Expected Minimum Monthly Traffic** = **1654587 x 3.38% = 55925** (3.38% of annual expected traffic)
5. **Expected Maximum Monthly Traffic** = **1654587 x 15.78% = 261094** (15.78% of annual expected traffic)
6. **Expected growth of traffic** = **3.07% (Traffic growth of Haridwar)**
7. **Expected Annual Traffic** by year 2030 - 31 = **2307516**
8. **Exp. Min. Monthly Traffic** by year 2030 - 31 = **77994**
9. **Exp. Max. Monthly Traffic** by year 2030 - 31 = **364126**
10. **Expected Annual Traffic** by year 2050 - 51 = **4224644**
11. **Exp. Min. Monthly Traffic** by year 2050 - 51 = **142793**
12. **Exp. Max. Monthly Traffic** by year 2050 - 51 = **666649**

9.4. Estimation of the capacity of proposed ropeway from Har ki Pauri to Chandi Devi Temple

From the analysis of the traffic trend and projected growth, the following is the worked-out capacity:

Present Scenario:

- Expected maximum traffic on a single day = 261094/30 = 8703
- Expected minimum traffic on a single day = 55925/30 = 1864

If we consider 12 hours of operations,

- The hourly capacity requirement will be 8703/12 = 725 Passengers.

We have considered the growth of passenger @ 3.07% per year. Therefore maximum hourly traffic by 2030-31 will be 364126/30/12 = 1011 Passenger.

Similarly projected hourly traffic by 2050-51 will be 666649/30/12 = 1851 Passengers

Recommended optimum capacity of the system, should have designed capacity of 1800 Passengers Per Hour Per Direction (PPHPD) and initially, the system should be equipped with of cabins will be taken according to 1000 PPHPD. Capacity can be increased up to 1800 PPHPD by adding more number of cabins.

Working of traffic & tariff in first year of commercial operation (Table 9.8):

Growth (%)	**3.07%**	**5.17%**
	1.0307	**1.0517**
	Traffic	Tariff
FY 2019-20	**16.55**	**200.00**
FY 2020-21	17.06	210.34
FY 2021-22	17.58	221.21
FY 2022-23	18.12	232.65
FY 2023-24	18.68	244.68
FY 2024-25	**19.25**	**257.33**

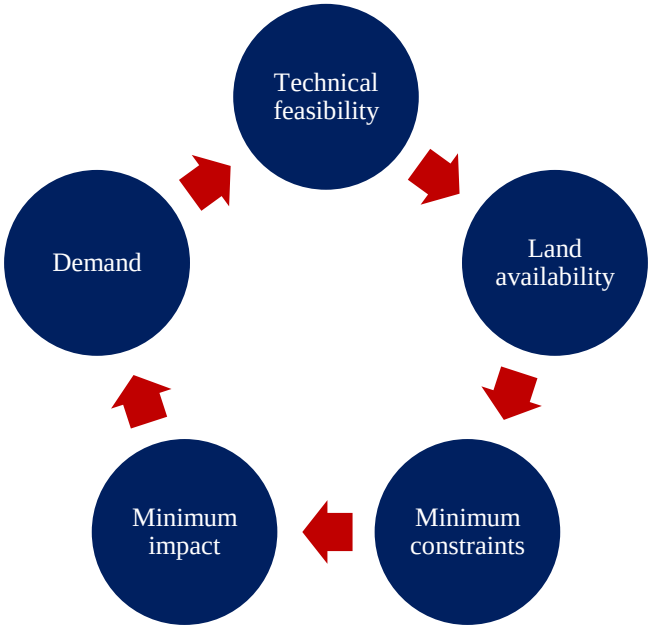
10
Study of ropeway alignments

10. STUDY OF ROPEWAY ALIGNMENTS

Usha Breco Limited team visited the site and detailed study was conducted for various possible alignments. Selected alignments were also visited by officials of UKMRC. The alternatives have been selected based on the site visits and the data collected from the various sources.

While selecting the appropriate alignment, the following approach & methodology has been adopted. This was also discussed with officials at the site and following guidelines has been considered:

- Technical feasibility or selection of suitable ropeway system matching with traffic projections.
- Availability of adequate space for proposed UTP/LTP for the system.
- Ease in land acquisition.
- Minimum possible infringement.
- Easy connectivity to the existing traffic nodes.
- Minimum rehabilitation.
- Ease in construction
- Demand



In order to choose the preferred ropeway alternative, a screening and evaluation process to evaluate all ropeway alternatives was needed. Several criteria were considered, the evaluation criteria reflect the specific characteristics, requirements, benefits, and objectives of ropeway in the context of Haridwar. Accordingly, a series of qualitative evaluation measures were developed to assess the potential of ropeway alternatives (alignments). In general, four major evaluation criteria were identified:

- User benefits
- Transportation system benefits

- Environment / Landscape impacts
- Connectivity with existing traffic nodes.

Each evaluation criterion was assessed based on its potential positive impact.

The proposed alignments are in areas where there is a significant demand for transportation services, especially during the peak seasons. In terms of transportation system benefits, again the proposed alignment has the preference as they are implemented in areas (central area) where there is an opportunity for modal shift to transit and reduction in traffic congestion.

In terms of costs and savings, all alternatives have a relatively similar score as all alternatives will use the same low-cost technology, and thus will be able to help reduce roadway costs.

A brief about the impact of alignment on various criteria is given below:

USAGES.

EVALUATION CRITERIA	REMARK
Benefits Haridwar Residents	✓
Benefits Pilgrims	✓
Benefit commuters	✓
Benefits Tourists	✓
Expected Demand/Usage	✓
Favourable Public Attitude Toward Concept	✓

TRANSPORTATION SYSTEM BENEFITS EVALUATION MEASURES

EVALUATION CRITERIA	REMARK
The opportunity of Service utilization whole year.	✓
Potential for Future Enhancements (Extension)	✓
Opportunity for Integration with Other Modes	✓
Opportunity for Traffic Congestion Reduction	✓

ENVIRONMENT / LANDSCAPE IMPACTS EVALUATION MEASURES

EVALUATION CRITERIA	REMARK
Overcome Topographical Barriers.	✓
Space Availability for Stations	✓
Low Impact on Privacy	✓
Low Impact on flora and fauna	✓

OTHER CHARACTERISTICS EVALUATION MEASURES

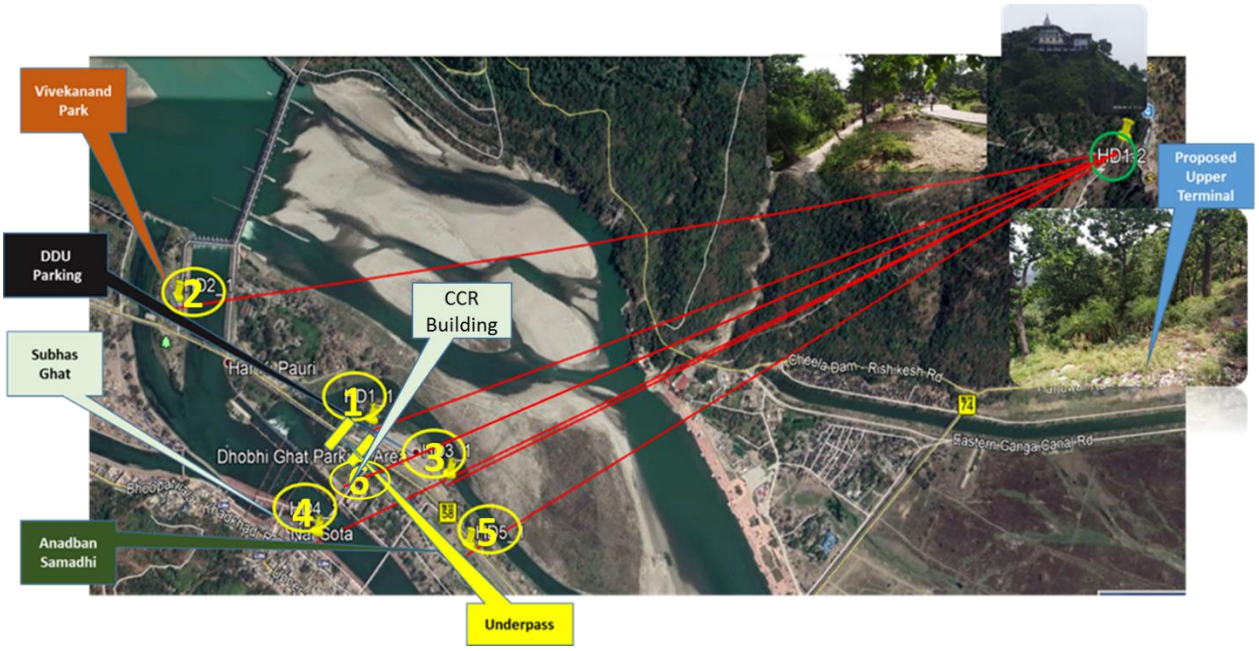
EVALUATION CRITERIA	REMARK
Opportunity for Hillside / Mountainous areas development	✓
Do similar Worldwide Applications exist?	✓
The opportunity of Use in Emergencies	✓
Reduction in emission of green gases	✓
Reduction in consumption of fossil fuel	✓

10.1. Alternative for connecting Har ki Pauri to Chandi Devi Temple

Following six different alignments were identified:

1. Starts adjacent to Deen Dyal Upadhyay (DDU) parking area at NH 58 (North end).
2. Starts from Swami Vivekanand Park at NH 58
3. Starts from Deen Dyal Upadhyay (DDU) parking area at NH 58 (South end).
4. Starts from Subhash Ghat (Har Ki Pauri).
5. Starts from Rodi Belwala near Anand Ban Samadhi at NH58.
6. Starting from the right side of the watchtower (CCR Building), near Har ki Pauri

These alignments are shown in the following drawing:



Details of these six alignments are as under (Table 10.1):

Option	Ropeway Starting Point	Length m	Elevation Difference m	Starting Terminal Coordinates	End Terminal Coordinates
1	Adjascent to Deen Dyal Upadhay (DDU) parking area at NH 58 **(North End)**.	2300	200	29°57'13.18"N 78°10'23.76"E	29°56'2.23"N 78°10'50.37"E
2	Swami Vivekanand Park at NH 58	2770	203	29°57'31.80" N 78°10'34.96" E	29°56'2.23"N 78°10'50.37"E
3	Deen Dyal Upadhay (DDU) parking area at NH 58 **(South End)**.	2100	201	29°57'5.52" N 78°10'18.43" E	29°56'2.23"N 78°10'50.37"E
4	Subhash Ghat (Har Ki Pauri).	2520	194	29°57'18.01" N 78°10'12.75" E	29°56'2.23"N 78°10'50.37"E
5	Rodi Belwala near Anand Ban Samadhi at NH58.	2130	198	29°57'3.57" N 78°10'11.77"E	29°56'2.23"N 78°10'50.37"E
6	At north sideof CCR Building (watch tower), near Har ki Pauri	2400	202	29°57'14.86"N 78°10'18.24"E	29°56'2.23"N 78°10'50.37"E

Further Study:

After the joint visit with a team of UKMRC officials, out of above six alignments, Alignment no.1 and 6 were found suitable in terms of approach, ease of construction, availability of space, tourist survey for alignment choice etc.

Details of these 2 alignments are given below.

Alignment-1: Starting from Deen Dyal Upadhyay Parking (North End)

Alignment-6: Starting from Northside of CCR Building (Watch Tower)

Plan of the Alignment – 1 and 6:

10.2. Details of Alignment - 1

Location of Lower Terminal:

- Starts from location, adjacent to Deen Dyal Upadhyay (DDU) parking (North end) at NH 58.

Nature of Land:

- Irrigation Department / Tourism Department

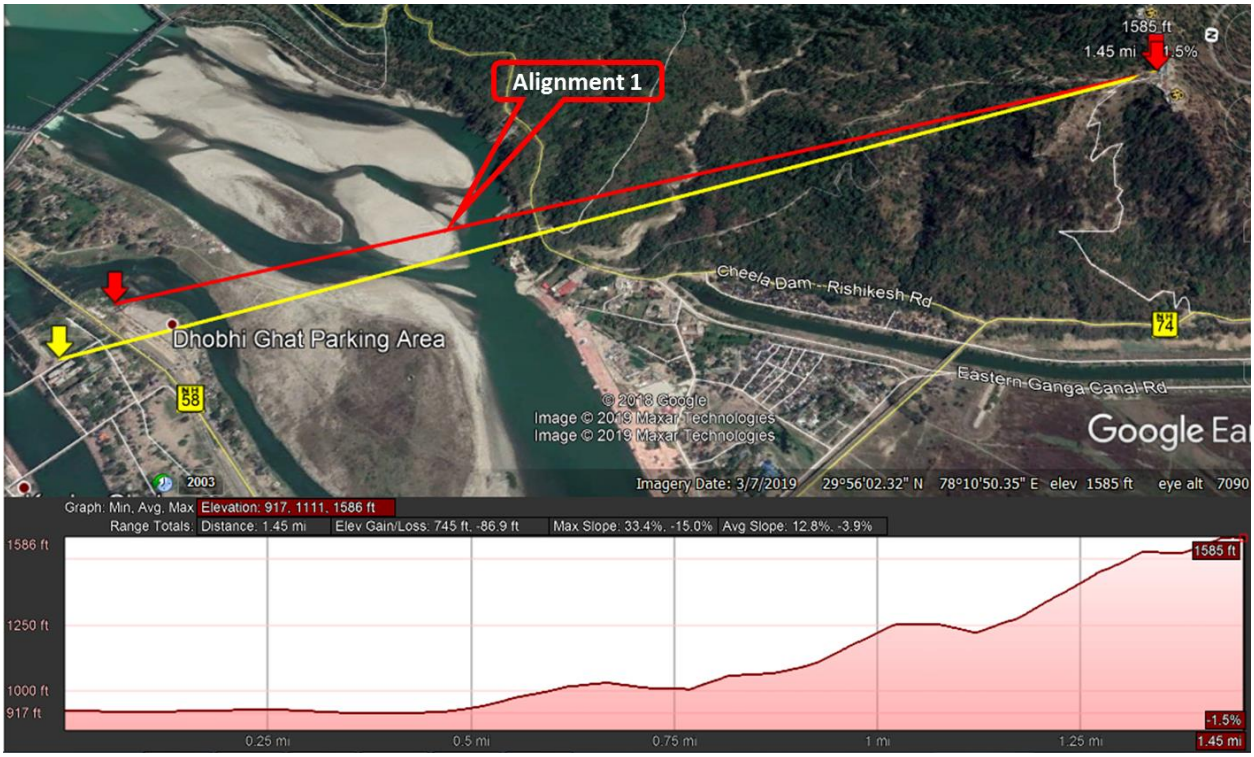
Location of Upper Terminal:

- Near Chandi Devi Temple, at the junction point of pedestrian path, way to Chandi Devi Temple and way to Anjani Mata Mandir, as shown in the following drawing.

Nature of Land:

- Forest Department

Elevation Profile of the Alignment – 1



Nature of Land of Corridor:

- Forest Department and Irrigation Department

Advantages of Alignment 1:

- The starting point is next to NH 58.
- Integration with existing parking (DDU parking).

- Easy connectivity with Har ki Pauri through the subway.
- The ropeway is not crossing the National Highway (NH), therefore clearance & protection over NH is not required.
- During construction and operation & maintenance of ropeway, there will be no interference with the NH.

Limitations of Alignment 1:

- About 300m away from Har ki Pauri.
- Being the bank of the river, due care to be taken for construction of terminal building & foundation.

Technical Details of Ropeway Proposed for Alignment – 1 (Table 10.2):

Details	Value	Unit
Layout		
Location of drive station	Bottom	--
Location of return station	Top	--
Location of the tensioning system	Bottom	--
Type of tensioning	Hydraulic	--
Direction of rotation	clockwise	--
Dimension		
Horizontal length	2281	m
Vertical rise	209.35	m
Inclined length	2305	m
Track width	5	m
Transport Capacity		
Hourly capacity per direction	1800	PPH
Uphill transportation	100	%
Downhill transportation	100	%
Drive speed, infinitely adjustable	1.0~5.0	m/s
Trip time at max speed	~ 8	min
Station speed	0.25 – 0.3	m/s
Main Drive		
Drive Machinery, Type	Overhead	
Electric main drive:		
Continuous Power Rating	300	kW
Starting Power rating	360	kW
Voltage	380 / 440	V

Details	Value	Unit
Frequency	50	Hz
Evacuation Drive		Unit
Evacuation drive 1 (diesel hydraulic)	100	kW
Evacuation drive 2 (electric)	~ 25	KW
Evacuation speed, max.	~ 1.0	m/s
Carriers		
Carrier spacing	60	m
Carrier interval	12	Sec
Passengers per carrier	6	P
Number of carriers	90	Nos.
The number of other carriers:		
Service Carrier	1	Nos.
Freight Carrier	0	Nos.
Towers		
Number of towers	13	Nos.
Haulage rope		
Diameter	41	mm
Actual Breaking Strength	1086	kN
Tensile Strength	1860	N/mm2
Tension Force	400	KN

Highest Flood level (HFL) of Haridwar

Site Name: Haridwar
District Name : Haridwar
Warning Level (WL): 293.0 Meters (m)
River Name: Ganga
Danger Level (DL): 294.0 Meters (m)
Basin Name: GANGA
Division Name: Himalayan Ganga Division (HGD), Dehradun
Highest Flood Level (HFL): 296.3 Meters (m)

HFL Attained date: 19-09-2010

Source-Website of Central Water Commission (www.india-water.gov.in)

10.3 Details of Alignment - 6

Location of Lower Terminal:

- Starting from the north side of CCR Building (watchtower), near Har ki Pauri

Nature of Land:

- Irrigation Department (Reserve/restricted land for Kumbh Mela)

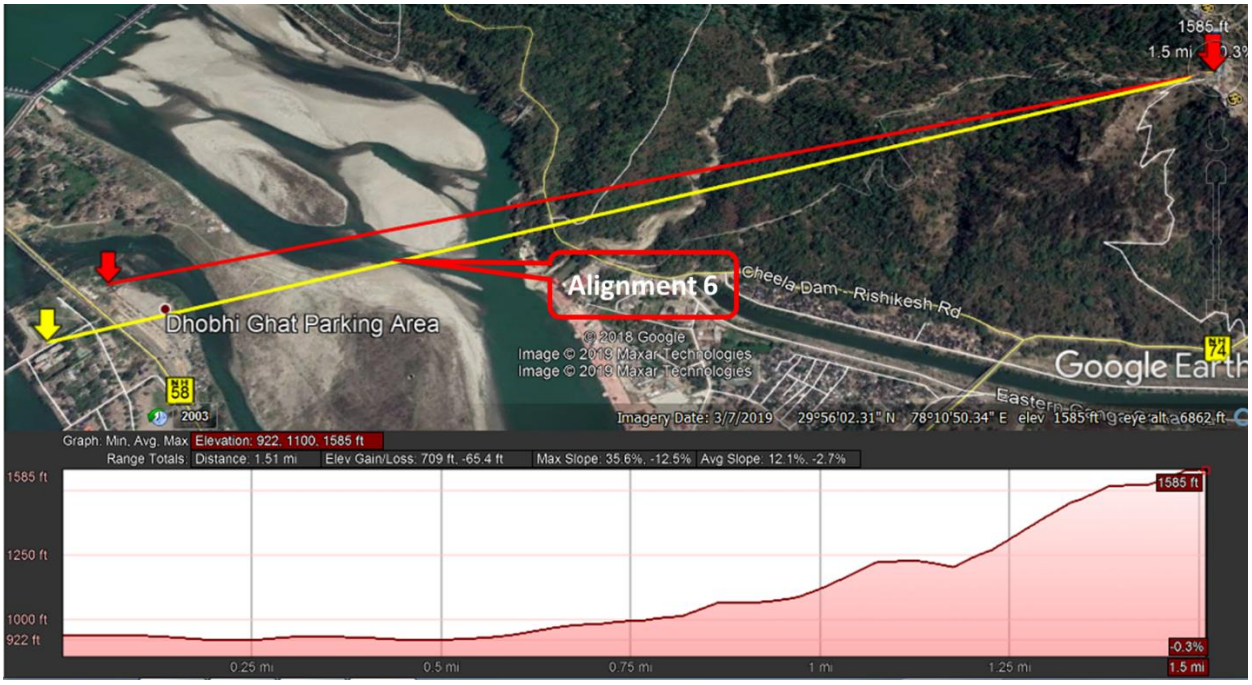
Upper Terminal for all the alignments:

- Near Chandi Devi Temple, at the junction point of pedestrian path, way to Chandi Devi Temple and way to Anjani Mata Mandir, as shown in the following drawing.

Nature of Land:

- Forest Department

Elevation Profile of the Alignment – 6



Nature of Land for Corridor: Forest Department and Irrigation Department

Advantages of Alignment 6:

- The starting point is closer to Har ki Pauri
- Location is well connected with Har ki Pauri.
- Adequate land is available for the development of the terminal station.
- Parking is available at 100m distance

Limitations of Alignment 6:

- The ropeway is crossing the NH, therefore clearance of NH will be required.
- At the same time, operation and maintenance will interfere with the NH. Suitable protection will be required.

Technical Details of Ropeway Proposed for Alignment – 6 (Table 10.3)

Details	Value	Unit
Layout		
Location of drive station	Valley	
Location of return station	Top	
Location of the tensioning system	Valley	
Type of tensioning	Hydraulic	
Direction of rotation	clockwise	
Dimension		
Horizontal length	2402	m
Vertical rise	207.05	m
Inclined length	2425.36	m
Track width	5	m
Transport Capacity		
Hourly capacity per direction	1800	PPH
Uphill transportation	100	%
Downhill transportation	100	%
Drive speed, infinitely adjustable	1.0~5.0	m/s
Trip time at max speed	~ 8.3	min
Station speed	0.25 – 0.3	m/s
Main Drive		
Drive Machinery, Type	Overhead	
Electric main drive:		
Continuous Power Rating	300	kW
Starting Power rating	360	kW
Voltage	380 / 440	V
Frequency	50	Hz
Evacuation Drive		Unit
Evacuation drive 1 (diesel hydraulic)	100	kW
Evacuation drive 2 (electric)	~ 25	KW

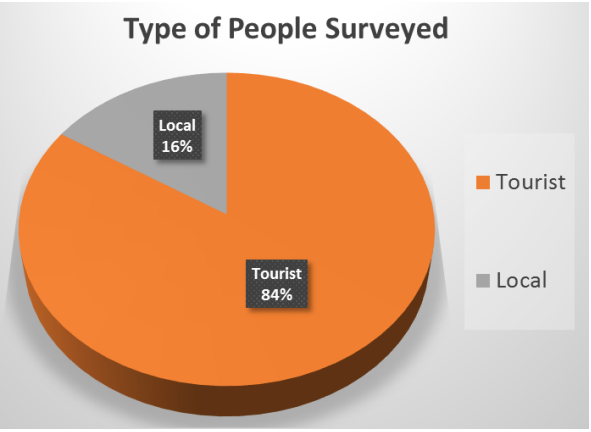
Details	Value	Unit
Evacuation speed, max.	~ 1.0	m/s
Carriers		
Carrier spacing	60	m
Carrier interval	12	sec
Passengers per carrier	6	P
Number of carriers	90	pcs.
Number of other carriers:		
Service Carrier	1	pcs.
Freight Carrier	0	pcs.
Towers		
Number of towers	13	pcs.
Haulage Rope		
Diameter	41	mm
Actual Breaking Strength	1086	kN
Tensile Strength	1860	N/mm2
Tension Force	400	KN

10.4. Final alignment evaluation

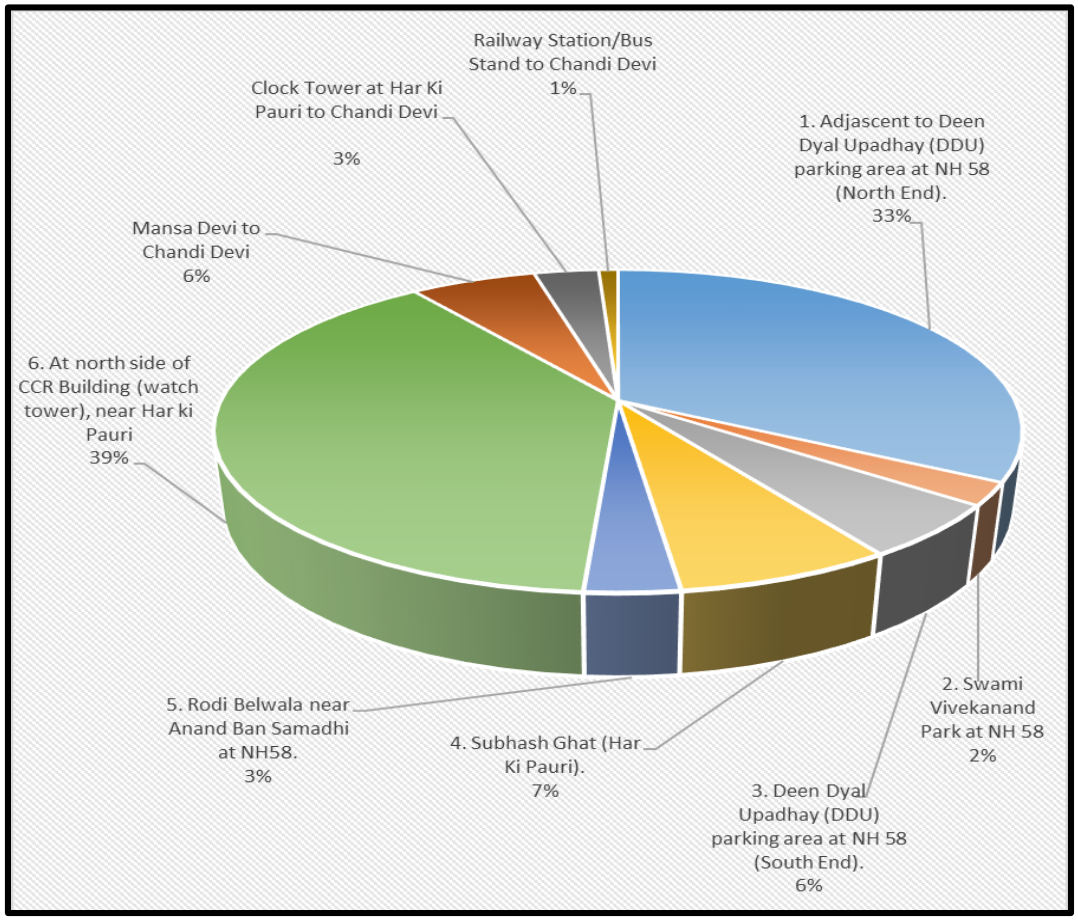
After the assessment, various exercises were carried out to finalize the ropeway alignment.

- An extensive customer survey was carried out to understand the preference of potential users. A customer survey was conducted for the choice of alignment, Alignment-1 and Alignment-6 has a maximum preference which is 33% and 39% respectively, as per the following survey details:

SN	Type of People Surveyed	Number	Percentage (%)
1	Tourist	2524	84
2	Local	476	16
Total (Sample Size)		3000	100



Choice Of Alignment For Har Ki Pauri to Chandi Devi		Number	Percentage (%)
1	Adjacent to Deen Dyal Upadhyay parking area at NH 58 (North End).	989	33
2	Swami Vivekanand Park at NH 58	68	2
3	Deen Dyal Upadhyay (DDU) parking area at NH 58 (South End).	162	5
4	Subhash Ghat (Har Ki Pauri).	219	7
5	Rodi Belwala near Anand Ban Samadhi at NH58.	96	3
6	At the north side of CCR Building (watchtower), near Har ki Pauri	1164	39
Others:			
A.	Mansa Devi to Chandi Devi	181	6
B.	Clock Tower at Har Ki Pauri to Chandi Devi	93	3
C.	Railway Station/Bus Stand to Chandi Devi	28	1
	Total	**3000**	**100**



- Detailed Technical Feasibility Study was conducted and found that both the alignments are technically feasible.
- It is recommended to convert part of existing DDU Parking into the terminal station:
  a. The northern part of existing parking can be converted in to lower terminal by demolishing the required portion.
  b. At the Ground and First floor, new parking can be constructed and Ropeway station will be on the top floor
  c. Number of parking affected can be compensated with newly constructed parking

Advantages:

- Availability of developed area and stable soil conditions.
- Permissions from various departments will be easy because parking is already constructed (permanent construction) on the land. Approval of the Tourism department will be required.

Limitations:

- Part of the parking will be affected during construction.

Details of the Parking is as under:

Owner	:	Tourism Department
	:	Outsources O&M for three years to Private Agency
Area of the Parking	:	120m X 80m = 9600 SQM

The capacity of the parking: 811 LMV

Parking Charges per day: INR (Inclusive of 18% GST)

Car/Taxi/Jeep/Maxi	:	71/-
Scooter / Motor Cycle:		35/-
Tractor Trolley:		94/-
Auto Rickshaw:		47/-
Cycle	:	24/-

Capacity Utilization:

Jan	45%	Jul	90%
Feb	45%	Aug	75%
Mar	65%	Sep	60%
Apr	85%	Oct	55%
May	95%	Nov	45%
Jun	100%	Dec	35%

Source: Tourism Department, Haridwar

Final Alignment selection:

Based on various surveys, feasibility study, ease of construction, ease of operation and discussion with other stakeholders, Alignment no 1 has been selected as the final preferred alignment.

11
Alternative analysis of technology and selection of ropeway system/technology

11. Alternative analysis of technology and selection of ropeway system/technology

The ropeway is an innovative transportation mode in Urban Transportation context.

The ropeway is a type of Aerial Transportation mode in which passengers are transported in cabins that are attached and pulled by the cables (Ropes). Ropeways were earlier used in tourism related activities like skiing and transportation to Hilltop etc. all over the world. Recently, however, Cable Car systems have gained more attention worldwide and, now is being considered as one of the most popular and energy-efficient transportation modes in urban areas with topographical barriers and limited space.

11.1. Ropeway system components

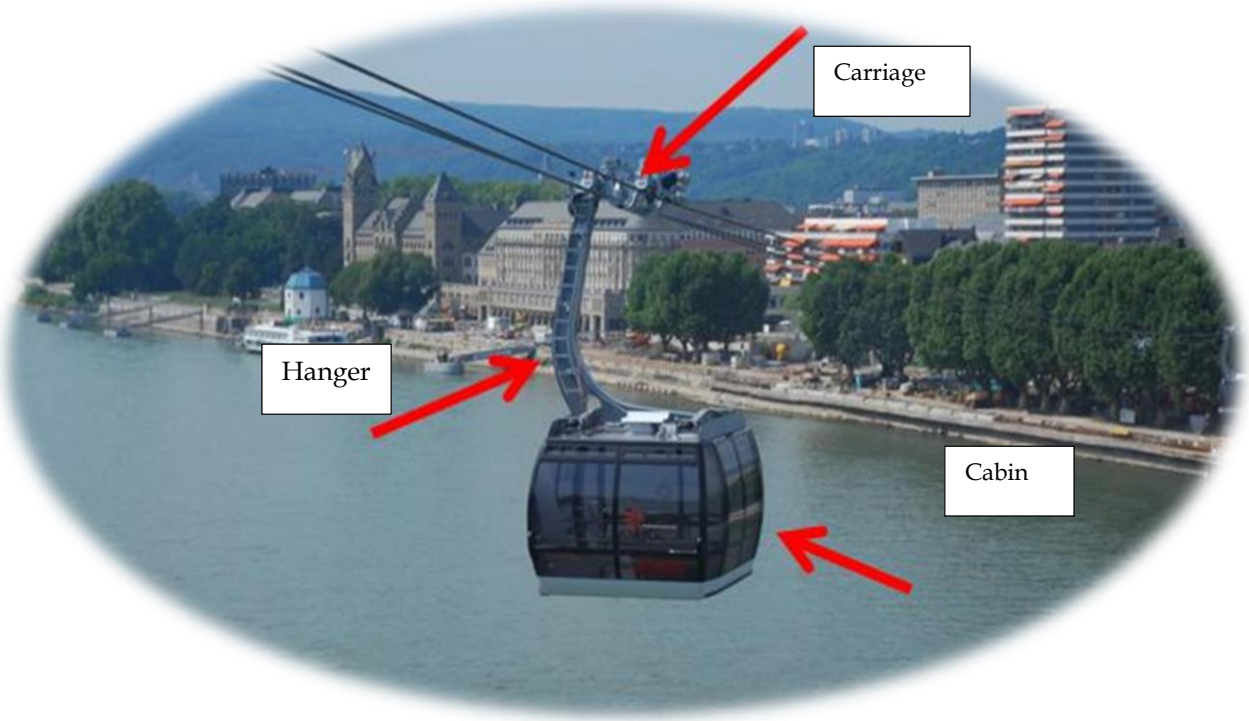
Almost all ropeway systems have the same basic components, irrespective of the technology used. The basic components of any ropeway system include carriers (cabins), terminals, towers, ropes, and evacuation and rescue system. The following is a discussion of each component.

Carriers (Cabins):

Carriers are defined as the structural and mechanical assemblage in whom the passenger(s) of a ropeway system are transported. The carrier includes the carriage or grip, hanger, and the passenger cabin (see Figure). The carriers can consist of large cabins as in the case of Aerial Tramways, or small and medium cabins as in the case of Gondolas. The carriers are usually described by capacity (e.g. 80-passenger cabins on an Aerial Tramway system, 15-passenger Gondola cabins, etc.). The cabins are semi-closed or enclosed and have a standing room to reach full capacity.

Terminals (Stations)

Virtually all ropeway systems have two terminals: a drive terminal and a return (idle) terminal. If a vertical change takes place, the terminals are called the upper and lower terminals. The bull wheel in the drive terminal can operate as the drive wheel, and the bull wheel at the return terminal acts as a fixed return mechanism. The driving machinery may be installed overhead or in an underground vault. For detached grip Gondola operations, a separate area for slowing down and loading is needed in the terminals and is often electronically monitored for safety. Some systems that use Gondolas might have few intermediate stations as well to pick up and drop off passengers between the drive and return terminals.



Components of Ropeway Carrier

Station Building

Towers

Towers are intermediate structures that support the track and haulage ropes between terminals. They are often steel-framed and are sometimes pylon-shaped. The tower's primary function is to support track ropes and haulage ropes on saddles and line sheaves, respectively. Towers must also have guides to keep carriages from hitting them for safety (see Figure). Towers might not always be necessary depending on the length of the system. For long systems, intermediate towers are necessary to provide support to the system and therefore eliminating the need for long spans.

Ropes (Cables)

The rope (cable) is the heart of any Ropeway system. The rope is formed by inter-twining individual wires to form a strand and then the strands to form a rope (cable). There are many variations of the processes used in manufacturing ropes and in choosing the appropriate rope for any given application. One critical point is to specify whether the rope is a haulage rope or a track rope (Aerial Tramways) or if one rope supports both functions (Gondolas).

Tower Supporting a Ropeway System & Rope

11.2. Available metro cable car technologies

At present, ropeway technologies that have been used as mass transit modes in urban areas include five technologies:

- Aerial Tramways

- Dual-Haul Aerial Tramways
- Mono-cable Detachable Gondolas (MDG)
- Bi-cable Detachable Gondolas (BDG)
- Tri-cable Detachable Gondolas (TDG)

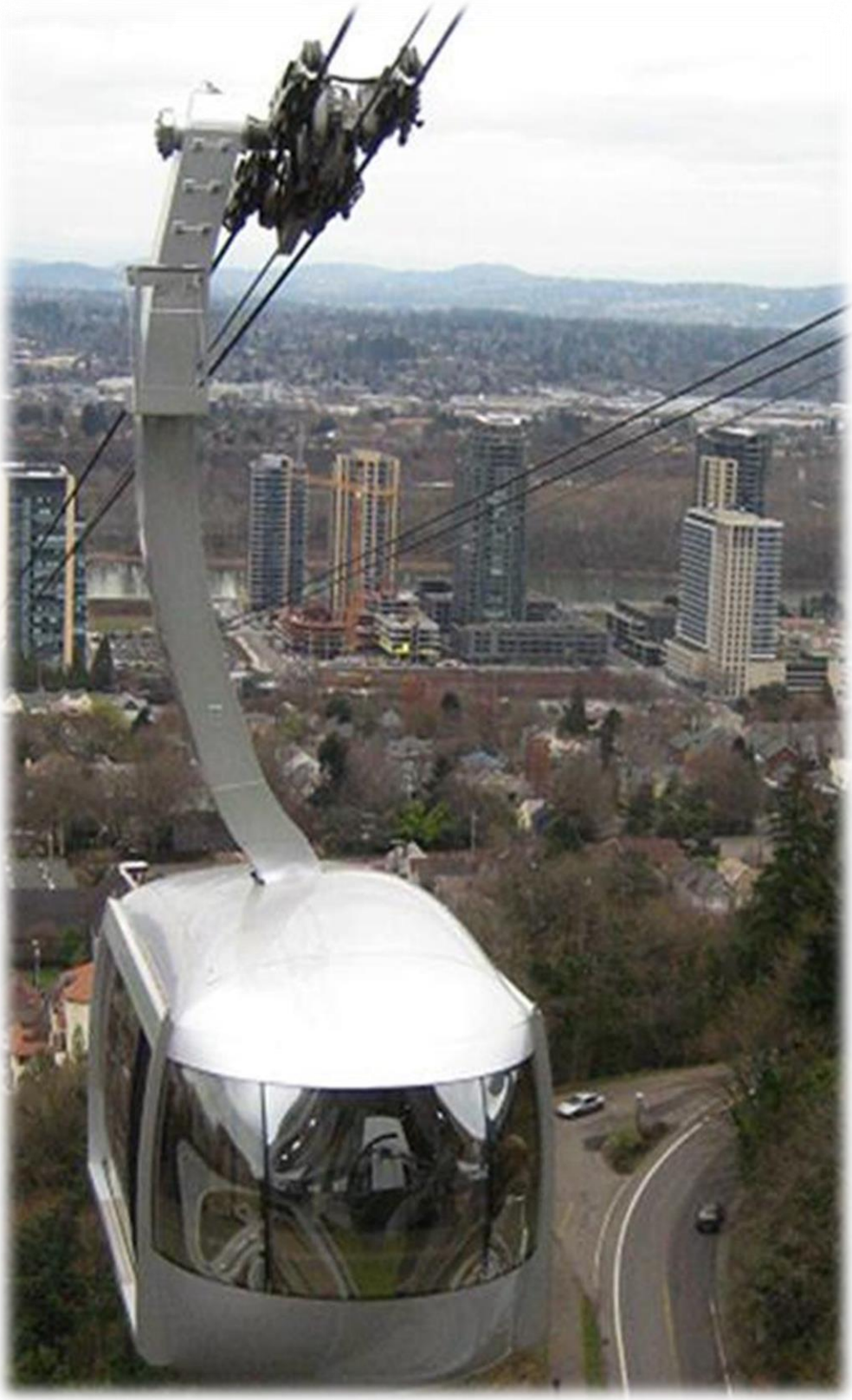
Aerial Tramways

An Aerial Tramway (also called Reversible Ropeway or Jig-back Ropeway) is a type of aerial lift in which two passenger cabins (vehicles) are suspended from one or more fixed cables (called "track cables") and are pulled by another cable (called a "haulage rope"). The fixed cables provide the support for the cabins, while the haulage rope, through a grip, is solidly connected to the truck (the wheelset that rolls on the track cables). The haulage rope is usually driven by an electric motor and is connected to the cabins, moves the cabins from one end to the other.

They are called **Jig Back** because the power source and electric engine at the bottom of the line effectively pulls one carrier down using the weight to push the other carrier up. A similar concept is used in funicular railways. The two-passenger cabins are situated at opposite ends of the loops of cable. Thus, while one is coming up, the other is going down the mountain, and they pass each other midway on the cable span.

Aerial tramways usually have big cabins that can carry from 20 to 200 people (see Figure) at speeds of up to 12 meters per second (43.2 km/h) and will pass each other mid-span each time due to the reversible operation of the ropeway.

Depending on the size of the car, line speed, and line length, transport capacities vary between 500 and 2,000 persons per hour. Some aerial trams have only one cabin, which lends itself better to systems with small elevation changes along the cable run.



Example of an Aerial Tramway Cabin

The technology is originally developed for ski resorts but was also adopted in other locations as a transit mode. Two examples of using Aerial Tramways as a transit mode exist in Portland and New York (USA). The table below provides a summary of the service and technology characteristics of Aerial Tramway systems.

Service and Technology Characteristics of Aerial Tramways:

System Characteristics	Aerial Tramway Specifications
Cable Configuration	Cabins are suspended from one or more fixed cable (called "track ropes") and are pulled by another cable (called a "haulage rope")
Detachability	The two cabins cannot be detached from the moving cable (the movement of the two cabins is synchronized)
Maximum # of Passenger Cabins	2 Cabins
Max # of Stations	3 stations
Max Distance between Towers	Less than 1000 m
Cabin Capacity	High capacity (up to 200 pass/cabin)
Maximum Transport Capacity	2000 pass/h
Speed	Up to 43.2 km/h

Dual-Haul Aerial Tramways

Dual-Haul Aerial Tramways are a relatively new ropeway technology that is built to improve some of the characteristics of Aerial Tramways. Similar to Aerial Tramways, this system consists of two reversible cabins that run on parallel tracks. However, unlike Aerial Tramways which have fixed ropes and a haulage rope loop for the two cabins, the Dual-Haul system has two guide ropes and a haul rope loop per cabin.

At the top of each track, the haul rope for that track loops back to the bottom instead of looping over to serve the other track as occurs with a normal Aerial Tramway. This feature allows for a single cabin operation when demand warrants. The independent drive also allows for evacuations to occur through a bridge connection between the two adjacent cabins. Another advantage of the Dual-Haul system is its stability in high wind conditions owing to the horizontal distance between the two guide ropes comprising each track. Refer to Table below for a summary of the service characteristics of Dual-Haul Aerial Tramways.

Example of an Aerial Tramway Cabin

SERVICE AND TECHNOLOGY CHARACTERISTICS OF DUAL-HAUL AERIAL TRAMWAYS:

System Characteristics	Dual-Haul Aerial Tramway Specifications
Cable Configuration	Cabins are suspended from two fixed cables and pulled by another cable
Detachability	Cabins can't be detached from the moving cable (however, the movement of the cabins is NOT synchronized; each cabin operates independently)
Maximum # of Passenger Cabins	2 Cabins
Max # of Stations	3 stations
Max Distance between Towers	Less than 1000 m
Cabin Capacity	High capacity (up to 100 pass/cabin)
Maximum Transport Capacity	2800 pass/h
Speed	Up to 27 km/h

Mono-cable Detachable Gondolas (MDG)

A Gondola Lift, or as it is technically known as Monocable Detachable Gondola (MDG), is a type of aerial lift in which the cabin is suspended from a moving loop of steel cable that is strung between two terminals, sometimes over intermediate supporting towers.

An Example of MDG Cabins

The cable is driven by a bull-wheel in the terminal, which is connected to an engine or electric motor. Gondolas have small cabins, set at regularly-spaced close intervals. The systems are continuously circulating with cabins passing around the terminal bull-wheels. Cabins detach from the hauling rope at terminals, are decelerated and carried through the unloading and reloading areas at a very slow speed, then accelerated for reattaching to the haulage rope for high speed travel "on the line" between terminals. Cabin capacity of MDG systems varies from 4 to 15 persons per cabin and system capacity can be as much as 3,600 PPHPD (persons per hour per direction). The table below provides a summary of the service and technology characteristics of MDG systems.

Service and Technology Characteristics of MDG Systems

System Characteristics	MDG Specifications
Cable Configuration	Cabins are suspended and pulled by the same cable (a moving loop of cable)
Detachability	Cabins are set at regularly-spaced intervals and they detach from the cable at the terminal for unloading and loading
Maximum # of Passenger Cabins	Depends on line length and headway; can have 100+ cabins
Max # of Stations	Can have multiple stations
Max Distance between Towers	350 m
Cabin Capacity	Low capacity (up to 15 pass/cabin)
Maximum Transport Capacity	3600 pass/h
Speed	Up to 21.6 km/h

Bi-cable Detachable Gondola (BDG):

BDG systems combine features of both Gondola and Reversible Ropeway systems. On the one hand, they use the reversible ropeway technology in their operation (i.e. separate ropes serve the two functions: static support ropes or "track cables" and a moving "haul rope"), which allow the system to have long spans, and therefore overcome difficult terrain conditions (see Figure). On the other hand, the system is detachable (like Gondolas), which allows the system to have a high capacity similar to the capacity of detachable circulating systems and similar operations at the terminals.

The difference between a BDG and an MDG system is that unlike MDG systems, which are both propelled and suspended by the same cable, BDG systems have two separate cables for the two functions. Cabin and transport capacities of BDG systems are similar to those of MDG systems, with cabin capacities ranging from 4 to 15 persons per cabin and transport capacity of up to 3,600 PPHPD. The table below provides a summary of the service characteristics of BDG systems. Successful implementations of BDG technology as a transit mode exist in Hong Kong and Singapore. The BDG system in Singapore was originally an MDG system but was rebuilt in 2010 and converted to a BDG system.

An Example of a BDG Cabin

Service and Technology Characteristics of BDG Systems:

System Characteristics	BDG Specifications
Cable Configuration	Cabins are suspended from one fixed cable and are pulled by another cable (similar to Aerial Tramways)
Detachability	Cabins are set at regularly-spaced intervals and they detach from the cable at the terminal (similar to MDG)
Maximum # of Passenger Cabins	Depends on line length and headway; can have 100+ cabins
Max # of Stations	Can have multiple stations
Max Distance between Towers	700 m
Cabin Capacity	Low capacity (up to 15 pass/cabin)
Maximum Transport Capacity	3600 pass/h
Speed	Up to 21.6 km/h

Tri-cable Detachable Gondolas (TDG)

Similar to BDG systems, TDG systems (sometimes referred to as 3S technology) combine features of both Gondola and Reversible Ropeway systems (i.e. separate ropes serve the two functions: static support ropes or "track cables" and a moving "haul rope"), and detachable gondolas. Unlike BDG systems, however, TDG systems have two stationary cables that support the cabins instead of one as in BDG systems (see Figure).

Although TDG systems are more expensive than both MDG and BDG systems, this added cost is more than offset by their advantages, as these detachable circulating ropeways can carry more passengers with higher speeds. TDG systems operate with carrier capacities of up to 35 passengers for a maximum system capacity of 6,000 PPHPD. Table 2-5 provides a summary of the service characteristics of Aerial Tramways.

Other advantages of TDG systems include their outstanding wind stability, low power consumption and the use of very long spans of up to 3,000 m. Successful implementation of TDG technology in the urban environment exists in the city of Koblenz (Germany), as discussed later in this chapter. The system is mainly tourist-based, but its implementation within the City of Koblenz provides evidence of the ability to use TDG technologies in urban areas.

An Example of a Tri-cable Detachable Gondola Technology

TDG Service and Technology Characteristics:

System Characteristics	TDG Specifications
Cable Configuration	Cabins are suspended from two fixed cables and are pulled by another cable
Detachability	Cabins are set at regularly-spaced intervals and they detach from the cable at the terminal for unloading and loading
Maximum # of Passenger Cabins	Depends on line length and headway; can have 100+ cabins
Max # of Stations	Can have multiple stations;
Max Distance between Towers	3000 m
Cabin Capacity	Medium capacity (up to 38 pass/cabin)
Maximum Transport Capacity	6000 pass/h
Speed	Up to 30.6 km/h

Other Ropeway Technologies:

In addition to the above-mentioned Ropeway technologies, there are a few other technologies produced by the main vendors of Ropeway that are just variations of the two basic technologies (Aerial Tramways and Detachable Gondolas). At present, these technologies have been used mainly in ski resorts and tourist attractions.

However, similar to Aerial Tramways and Gondolas, these technologies, depending on their applicability, might be transferred to the urban environment as a mass transit mode.

These technologies include Pulsed-movement Aerial Ropeways, Funitel, and Funifor.

11.3. System selection:

Service and performance characteristics of individual ropeway technologies vary from one technology to another. Some individual ropeway system performance characteristics can sometimes be deceiving as they do not necessarily reflect the overall performance of the system. This feature is because the ropeway system's performance relies heavily on the type of technology, its limitations and type of operation.

Selection of the ropeway system largely depends on the following:

1. Profile and terrain
2. Capacity
3. Flexibility to accommodate the increase in capacity due to the increase in traffic.
4. Climatic conditions

11.4. Capacity:

While deciding capacity, apart from the estimated traffic, we need to keep various factors in mind. Some of them are:

1. The capacity of originating point infrastructure like approach road, parking facility, area available for passenger movement etc.
2. The capacity of terminating point infrastructure like area available for passenger movement, approach road etc.
3. Chandi Devi Temple is located at the hilltop, the area available is limited. The capacity of the temple to accommodate the pilgrims is also important.
4. We should consider the fluctuation of traffic as well. Ropeway system should be designed for optimal traffic conditions so that we can meet most of the peak traffic demand, at the same time during lean traffic demand, operation of the system should also be economical.

As per traffic analysis, estimated capacity is as under:

1. For Haridwar it is 1800 PPHPD

Now considering the above capacity and smooth profile/terrain in different sections, the stability of the cabin is not a major factor, as far as prevailing wind conditions of this area is concerned.

Occasionally, for a very short duration, gusty wind appears but it is safe and economical to shut down the operation of that period, instead of going for bi-cable system or tri-cable which is considerably costly as compared to the mono-cable system.

11.5 Other Considerations

Further following considerations have been made to decide other parameters:

A. Monocable Fixed Grip Constantly Rotating Gondola System is ruled out because of the following reasons:

a. Boarding/de-boarding needs to be carried out when the system is running. This may lead to some problem particularly in peak seasons for elderly persons and children.

b. Being Fixed Grip system, the ropeway speed will be less. Therefore considering the length of the ropeway and the recommended capacity, a large number of cabins need to be installed permanently and it will add to unwanted loading on the system.

B. Monocable Jig Back System is also ruled out because of the following reasons:

a. Capacity cannot be increased to cater to future requirement.

b. In jig back system a group of passengers need to wait till cabin (having large capacity) travels back to the station at either side.

c. Being the big occupied cabin, point load on the rope will be there and sag will be more on the cabin location.

d. In case of break down in any of the carriage/cabin system, whole ropeway system will be unavailable.

C. Monocable Fixed Grip Pulsed Gondola System is ruled out because of the following reasons:

a. In this system, multiple number or cluster of cabins will be in line always due to this during the non-operation period or night or idle time few cabins will be hung in line on haulage rope since it's a hilly terrain the wind velocity can be high any time which will cause unnecessary load on the system and may cause derailment of rope from the trestle.

b. Climatic conditions like rain and hail storm are more likely at this location, it will affect the life of the fixed cabins/carriage system, exposed to adversity.

c. The journey will be time taking because the speed of the ropeway will reduce when one cluster of cabin reaches the station for boarding and de-boarding.

D. Detachable Grip System is suitable due to the following reasons:

a. This system can accommodate an increase in capacity by adding the number of cabins as per requirement.

b. During normal operations, the cabin can be increased and decreased in line very quickly, depending on the traffic.

c. There is no waiting time as in case of Jig-back system because small capacity cabins (4 to 8 passenger per cabin) are always available for boarding.

d. Cabins can be parked in a protected environment, when not in use.

e. In case of break down in one cabin/carriage system, complete ropeway system will not come to halt and uninterrupted ropeway service will always be available. Cabin having breakdown can be taken out of line and spare cabin can be put under operation very quickly.

f. This system requires more station area for parking of Cabins.

11.6 Recommendation of the Technology

Based on the above analysis we recommend Continuously Moving, Mono Cable, Detachable grip type ropeway system for Har Ki Pauri to Chandi Devi Passenger Ropeway project.

Continuously Moving, Mono Cable, Detachable grip type ropeway system

11.7. Operational cycle of the continuously moving Mono cable detachable grip type ropeway system:

This system has one loop of rope, which continuously rotates between two big wheels (named bull Wheel), one at each terminal station. The cabin as per requirement can be put in operation at a regular interval. Cabin grips itself automatically with the moving rope (the upside of the loop), when leaves the source station and detaches itself on reaching the destination station. Same cabin after de-boarding of passenger and boarded with return passenger, leaves the other station and again grips itself with the moving rope (at the downside of the loop) and returns to the source station. The

number of cabins (depending upon required capacity, up to maximum designed capacity), keep on attaching and detaching itself at regular interval.

- The ropeway stations i.e. Tension & drive are connected by an endless haulage rope through Drive /Return sheaves followed by different rocker sheaves placed on the trestles/towers. The trestles/towers will be placed at a varying distance as per the requirement of profile to support the rope to minimize the sag.
- The haulage rope along with attached gondolas moves circularly in a specified speed.
- On approaching a particular station the gondolas automatically detach itself from the moving rope on reaching designated position. Speed of the cabin decelerates slowly to the specified speed and moves on station rail with the help of separate drive system at slow speed to facilitate safe and comfortable de-boarding and boarding of the passengers.
- The door of the cabins gets opened automatically and passenger de-boards the cabin. Cabin moves forward to another side of the station rail loop and passenger, intent to travel in another direction, boards the cabin.
- Once boarding is over the gate of the gondola gets closed automatically.
- Cabin leaves the station and slowly accelerates to achieve the speed of moving rope and gets attached with the rope.
- The number of cabins (depending on the capacity) one after another keep on detaching and attaching itself with the haulage rope. This operation keeps on repeating.

11.8 Ropeway system components

Almost all ropeway systems have the same basic components, irrespective of the technology used. The basic components of any ropeway system include carriers (cabins), terminals, towers, ropes, grip, sheave assemblies, electric drive and control systems and evacuation and rescue system. The components required at different stations are:

Drive Station: The Drive Station consists of:

1. Drive wheel/Bull wheel
2. Upper machinery frame
3. Lower machinery frame
4. Torsion shaft
5. Steel framework for launching and conveying system Gearbox
6. Main AC drive
7. Auxiliary Drive Unit
8. Diesel Engine
9. Main electric cabinets and controls with PLC
10. Frequency converter
11. Emergency drive unit

12. D.G. Set (High KVA)
13. Service and emergency brakes
14. Launching/conveying system
15. Opening and closing lines
16. Anchoring system for the overhead control cable.
17. Independent rescue system Machinery

Return Station: The return station consists of:

1. Bull wheel (Return sheave)
2. Machinery frame
3. Support steel framework for launching and conveying system
4. Emergency drive unit
5. D.G. Set (Low KVA)
6. Electrical cabinets and controls
7. Launching/conveying system
8. The hydraulic tensioning system with two hydraulic cylinders
9. Anchoring system for the overhead control cable.
10. Independent rescue system Machinery

Electrical Equipment

a. **Main Drive Equipment** - An electrical AC/DC motor of required horsepower to drive the system along with frequency converter.
b. **Diesel Generators –** Diesel Generator are required for each terminal to provide power in case of a power outage.
c. **Control Systems –** Control systems with PLC are required for main drive, emergency drive and tension unit
d. **Safety devices**, sensors and interlocking devices.
e. **Switchgear and protection –** Protection of the electrical system are provided through the use of overvoltage protection systems, circuit breakers and fuses.
f. **Wiring System –** Electric cables are used for the efficient flow of electricity to run the drive unit and the various amenities.

12
Tentative requirement of land

12. TENTATIVE REQUIREMENT OF LAND

The land requirement for terminal stations and line towers has been assessed as follows:

Lower Terminal area statement (Table 12.1):

S. No	Heads	Dimensions in Meters		Area (m^2)
1	Ropeway Station	30	15	450
2	Cabin parking	30	20	500
3	Store	5	6	30
4	Workshop	8	6	48
5	Office	5	6	30
6	Ticket Counter	3	5	15
7	Account and staff room	5	5	25
8	Toilet	6	6	36
9	Multiple shops/commercial	12	30	360
10	Queue Area	15	15	225
11	Generator Room	10	15	150
12	Open Store	10	20	200
13	Panel Room and Control Room	6	10	60
			Total	2129

Set Back 10% **220**
Say **2400 Sqm**

Upper Terminal Area Statement (Table 12.2):

S. No	Heads	Dimensions		Area (m^2)
1	Ropeway Station	30	15	450
2	Toilet	6	10	60
3	Ticket Counter and Guard Room	5	5	25
4	Multiple shops/commercial	10	20	200
5	Generator Room	8	10	80
6	Store	5	6	30
7	Electrical Panel and Control Room	5	6	30
8	Small Maintenance Area	5	5	25
			Total	900
Add 10% as set back area. Total 990 Sqm Say				1000

Proposal:

We propose 2400 Sqm land area requirement for Lower Terminal.

The building at Lower Terminal will be constructed at various levels to match the road level as station floor. Lower floors to be used for parking of the cars.

We propose 1000 Sqm land area requirement for Upper Terminal.

The building at Upper Terminal will be constructed at various levels to match the Pathway level as the station floor. Lower floors to be used for waiting area, Queue area and rest area.

Corridor

For the construction of ropeway 15m, the wide corridor along the length of ropeway shall be required.

This corridor is required for tower construction, power transmission line (if required), maintenance & rescue purposes.

Land for Towers

Approximately 15mX15m area per tower will be required for tower foundation and embankment.

Land Ownership Details –

Route 1: DDU Parking to Chandi Devi Temple
Route 6: CCR Building (watch tower) to Chandi Devi Temple
Corridor: Width 15 Meter (12 meter for Ropeway line and 3 meter for power line)

Route 1: (Table 12.3)

Chainage	Area use	Ownership	Remarks
-40 to 0m	Lower Terminal	Irrigation	Land is reserved for Kumbh Mela
0m to 15m	**Tower 1 (at 5m chainage)**	Irrigation	
15m to 130m	**Tower 2 (at 100m chainage)**	Irrigation	
130m to 170m	Corridor	NH-58	
170m to 200m	**Tower 3 (at 190m chainage)**	Irrigation & Tourism	DDU Parking area
200m to 245m	Corridor	Irrigation & Tourism	DDU Parking area
245m to 390m	**Tower 4 (at 380m chainage)**	Irrigation	Ganga River Area (chainage 275m to chainage 900m)
390m to 670m	**Tower 5 (at 660m chainage)**	Irrigation	
670m to 900m	Corridor	Irrigation	
900m to 995m	Corridor	Private	Temple area
995m to 1005m	**Tower 6 (at 1000m chainage)**	State Highway/PWD	Cheela Road

1005m to 1345m	Corridor	Forest	
1345m to 1355m	**Tower 7 (at 1050m chainage)**	Forest	
1355m to 1575m	Corridor	Forest	
1575m to 1585m	**Tower 8 (at 1580m chainage)**	Forest	132KV Line crosses at 1570m chainage
1585m to 1735m	Corridor	Forest	
1740m to 1745m	**Tower 9 (at 1740m chainage)**	Forest	
1745m to 2175m	Corridor	Forest	400KV Line crosses at 1800m chainage
2175m to 2195m	**Tower 10 (at 2180m chainage) Tower 11 (at 2190m chainage)**	Forest	
2195m to 2343m	Corridor	Forest	
2343 to 2353m	**Tower 12 (at 2348m chainage)**	Forest	
2353m to 2380m	Corridor	Forest	
2380m to 2397m	Upper Terminal	Forest	

Summary of Land :

Lower Terminal – 2400SQM – Irrigation Dept.
Tower 1 & 2 Area – 450SQM - Irrigation Dept.
Tower 3 – 225SQM - Irrigation & Tourism Dept. (Existing Parking area)
Tower 4 & 5 – 450SQM – Irrigation Dept.
Tower 6 – 225SQM – PWD (State Highway)
Tower 7 to Tower 12 - 1350SQM - Forest Dept.
Upper Terminal - 1000SQM - Forest Dept.

Total Land for Towers and Terminals – 6100SQM

Corridor - 25875SQM

- 600SQM – NH 58
- 675SQM - Irrigation & Tourism Dept. (Existing Parking area)
- 3450SQM – Irrigation (Ganga River area)
- 1425SQM - Private
- 19725SQM – Forest Dept.

Route 6 (Table 12.4):

Chainage	Area use	Ownership	Remarks
0m to 20m	Lower Terminal	Irrigation	Adjacent to Parking Toilet
20m to 25m	Corridor	Irrigation	
25m to 35m	**Tower 1 (at 30m chainage)**	Irrigation	
35m to 65m	Corridor	Irrigation	
65m to 75m	**Tower 2 (at 70m chainage**	Irrigation	
75m to 185m	Corridor	Irrigation	
185m to 195m	**Tower 3 (at 190m chainage)**	Irrigation	
195m to 335m	Corridor	Irrigation	11KV and 33KV line crossing between 215m to 230m
335m to 345m	**Tower 4 (at 340m chainage)**	Irrigation	Ganga River Area (chainage 245m to chainage 810m)
345m to 815m	Corridor	Irrigation	
815m to 825m	**Tower 5 (at 820m chainage)**	Irrigation	
825m to 1035m	Corridor	Forest / State Highway/PWD	Cheela Road (885m to 895m change)
1035m to 1045m	**Tower 6 (at 1040m chainage)**	Forest	
1045m to 1275m	Corridor	Forest	
1275m to 1285m	**Tower 7 (at 1280m chainage)**	Forest	
1285m to 1450m	Corridor	Forest	132KV Line crosses at 1445m chainage
1450m to 1460m	**Tower 8 (at 1455m chainage)**	Forest	
1460m to 1645m	Corridor	Forest	
1645m to 1665m	**Tower 9 (at 1650m chainage) Tower 10 (at 1660m chainage)**	Forest	
1665m to 2086m	Corridor	Forest	132KV and 400KV Line crosses at 1675m to 1705m chainage
2086m to 2106m	**Tower 11 (at 2091m chainage) Tower 12 (at 2101m chainage)**	Forest	

2106m to 2245m	Corridor	Forest	
2245m to 2255m	**Tower 13 (at 2250m chainage)**	Forest	
2255m to 2280m	Corridor	Forest	
2280m to 2300m	Upper Terminal	Forest	

Summary of Land :

Lower Terminal – 2400SQM – Irrigation Dept.
Tower 1 to 5 Area – 1125SQM - Irrigation Dept.
Tower 6 to 13 – 1800SQM - Forest Dept.
Upper Terminal - 1000SQM - Forest Dept.

Total Land for Towers and Terminals – 6325SQM

Corridor - 28800SQM

- 11325SQM - Irrigation Dept.
- 17475SQM – Forest Dept.

13
System description

13. SYSTEM DESCRIPTION

The ropeway system will be designed and manufactured on the base of the latest standards and guidelines of ropeway technology.

The proposed ropeway system is a continuous running detachable mono-cable type. The number of carriers, towers and other technical data is specified in chapter "Technical Data". The system is designed to transport passengers uphill and downhill at a constant speed which can be selected by the operator(s) within the minimum and maximum rope speed range.

And the state of the art ropeway control system ensures safe operation of the whole ropeway system. Ropeway line supervision system detects triggering of rope derailment switches at towers, cross-connection of wires inside communication cable as well as ground faults and cause the ropeway to stop automatically if required.

Besides the electric main drive unit, with AC/Frequency Converter drive, an independent hydrostatic evacuation drive unit is installed the operate the ropeway at reduced speed for evacuation purpose. The evacuation drive will act, independent of the main drive, directly to the drive bull wheel. A secondary bull wheel bearing set ensures a safe evacuation of the passengers in case of the primary bull wheel bearing fail be keeping the bull wheels always rotatable.

The ropeway drive is equipped with 2 individual barking systems. A service brake located between the main drive AC-Motor and Gearbox acting on a braking disc and a safety brake which is acting directly to the drive bull wheel. Both brakes are spring applied and kept open using hydraulic pressure. In case of powers supply fail, the brakes can be operated manually for evacuation purpose.

Ropeway cabins are equipped with a detachable rope clamp. The carriers will be detached automatically from the rope after entering the cableway station and will automatically be attached to the rope before leaving. After the rope is detached, the carrier will be decelerated smoothly from rope speed to station transfer speed. Easy boarding and de-boarding will be guaranteed by a carrier speed of around 02 - 0.3 m/s.

After boarding / de-boarding of the passengers, the vehicle will be accelerated smoothly to rope speed and automatically attached to the rope.

Acceleration/deceleration and transport of the cableway carriers through the station is taking place by conveyor tires, located above the rope clamp, connected by V-belts. Friction rope sheaves are transmitting the speed of the rope via V-belts to the conveyor tyres.

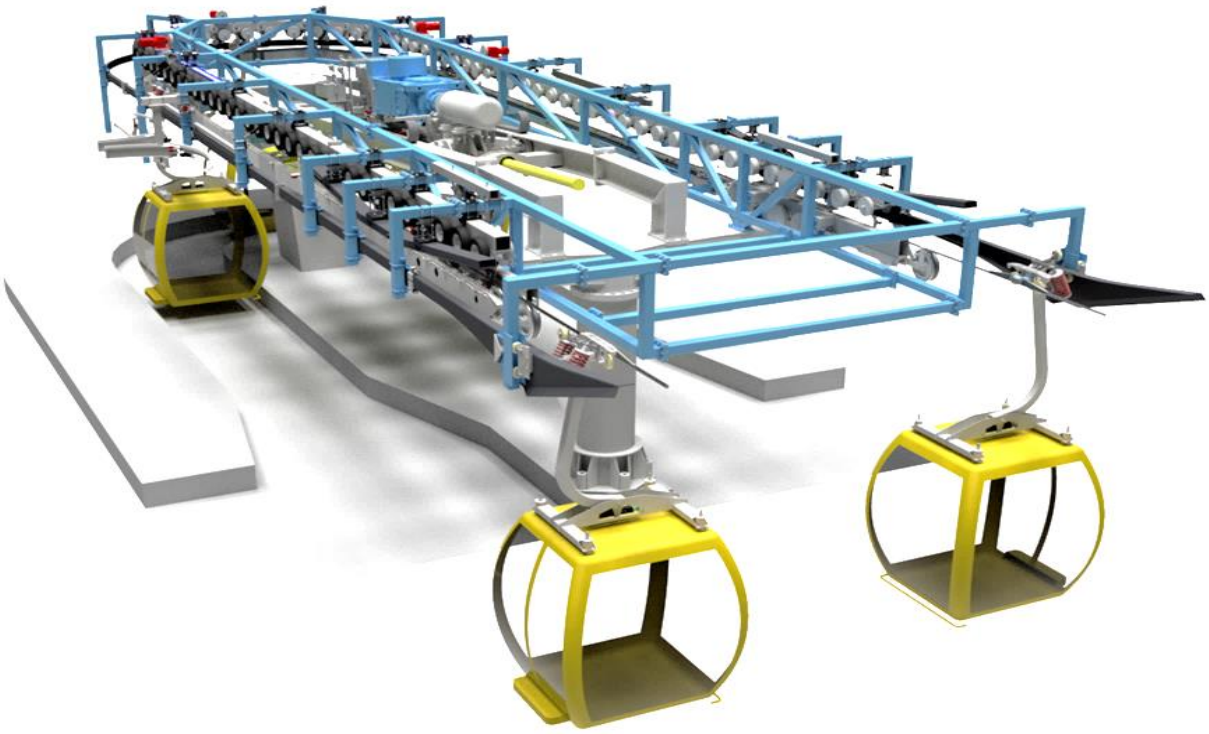
This configuration ensures positive control and synchronization of rope speed and carrier conveying speed in each station in both forward and reverse directions, irrespective of the drive selected.

Key functions of the ropeway, such as rope speed and grip opening and closing operations, tension forces of haul rope, the position of the haul rope and cabin distance are monitored and controlled by electronic safety circuits to ensure smooth operation and maximum safety. Constant rope tensioning is achieved by hydraulic cylinder(s) in the tension station automatically operated by the ropeway control system on using data of a dual tension force measuring system.

The ropeway cabins can be moved manually into the parking area by use of rail swings. A looped style parking system enables to store and restore cabins without need to change the running direction of the ropeway. Sufficient are and technical devices to store a cabin with technical fail is given in each station.

The ropeway is designed for one main direction of rotation. For special requirements, like rescue and service purpose, the reverse operation is permitted at a reduced speed.

All elements of the ropeway are mounted onto the galvanised front and rear steel cross beams which are anchored on concrete foundations or columns.



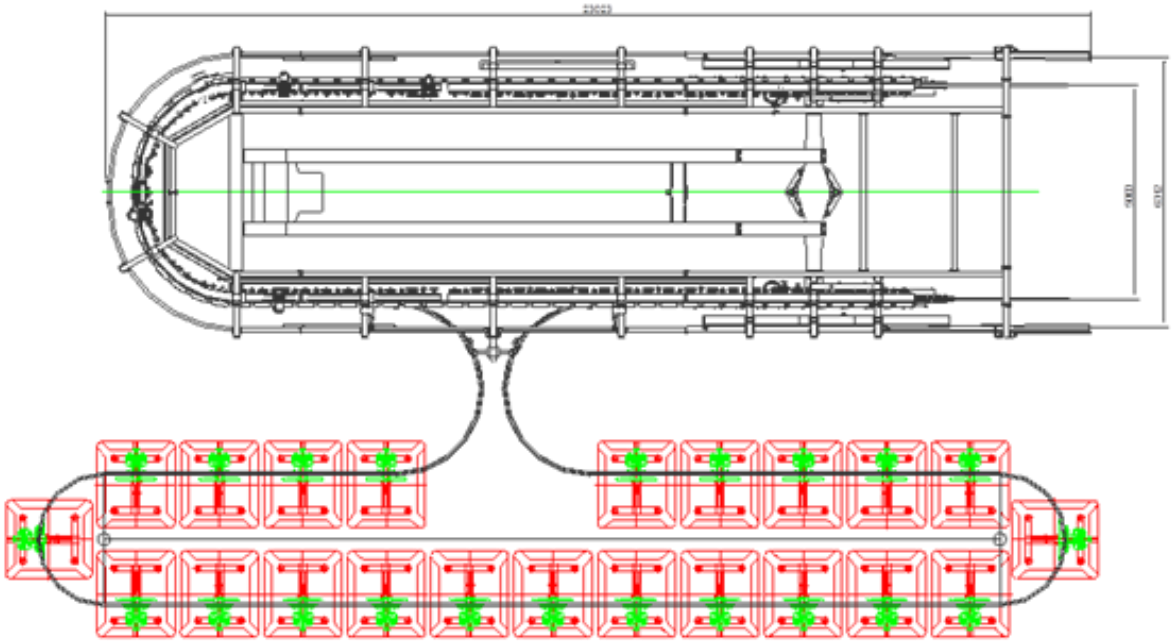
13.1. Drive/tension - station (lower)

Hot-dip galvanized supporting frame positioned on 1 concrete support as well as 1 steel support for mounting. Conveyor, cabin rail and lattice framework sandblasted and two-component coated in purchaser chosen RAL colour.

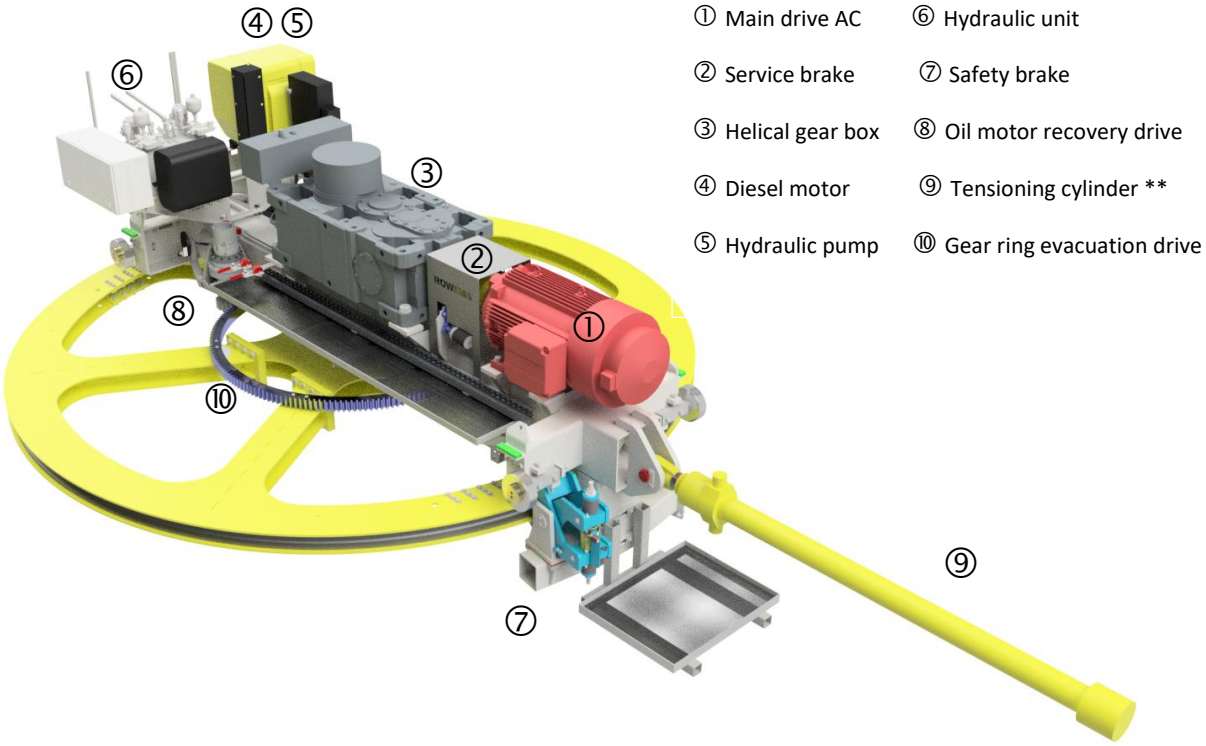
Main features:

- Machinery frame fix
- Main drive electromotor and gearbox
- Bull wheel, split design with rubber liner, rope catcher and bull wheel catcher
- Chain clutch for disengagement of the bull wheel
- Main electric cabinets and controls
- Rim gear with hydrostatic drive bypassing gearbox (evacuation drive 1)
- DG set / electric drive acting on gearbox intake (evacuation drive 2)
- Two independent working brakes, Service and emergency brakes
- Parking rails and swings for parking area, location of parking rails at the exit side
- electric wiring equipment from ropeway main cabinet to ropeway equipment
- Access platforms and handrails
- hydraulically liftable station conveyor wheels

- Tire wheels accelerator and decelerator with the mechanical drive down from carrying-hauling cable with 2 rollers
- Grip force test
- Grip force test for electronic measurement and evaluation
- The station is accessible and constructed in a very maintenance-friendly manner



Drive unit



** According to layout, tensioning cylinder for haul rope tensioning will be located in drive or return station

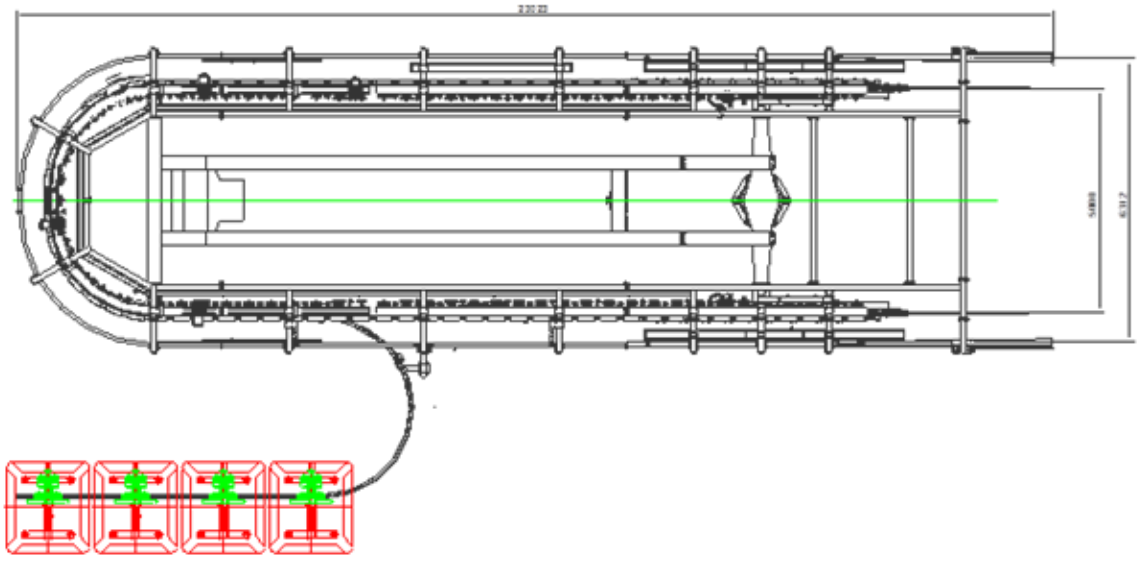
Motor, helical gear, service brakes, brake unit, diesel motor for recovery drive (bevel gear and planetary gear on the drive wheel) and safety brake are mounted on a movably supported chassis.

- Rope tensioning force and drive torque forces are kept by separate mountings. This design increases operation safety by dividing alternating loading and torsional forces to different bearing shafts.
- AC motor with frequency converter.
- Service brake, Cardan shaft with the clutch on the high-speed shaft.
- Fully adjustable safety brake for drive gear.
- Hydraulic and electric recovery drive.
- The second set of bull wheel bearing for emergency operation in case of the bull wheel bearing fail.

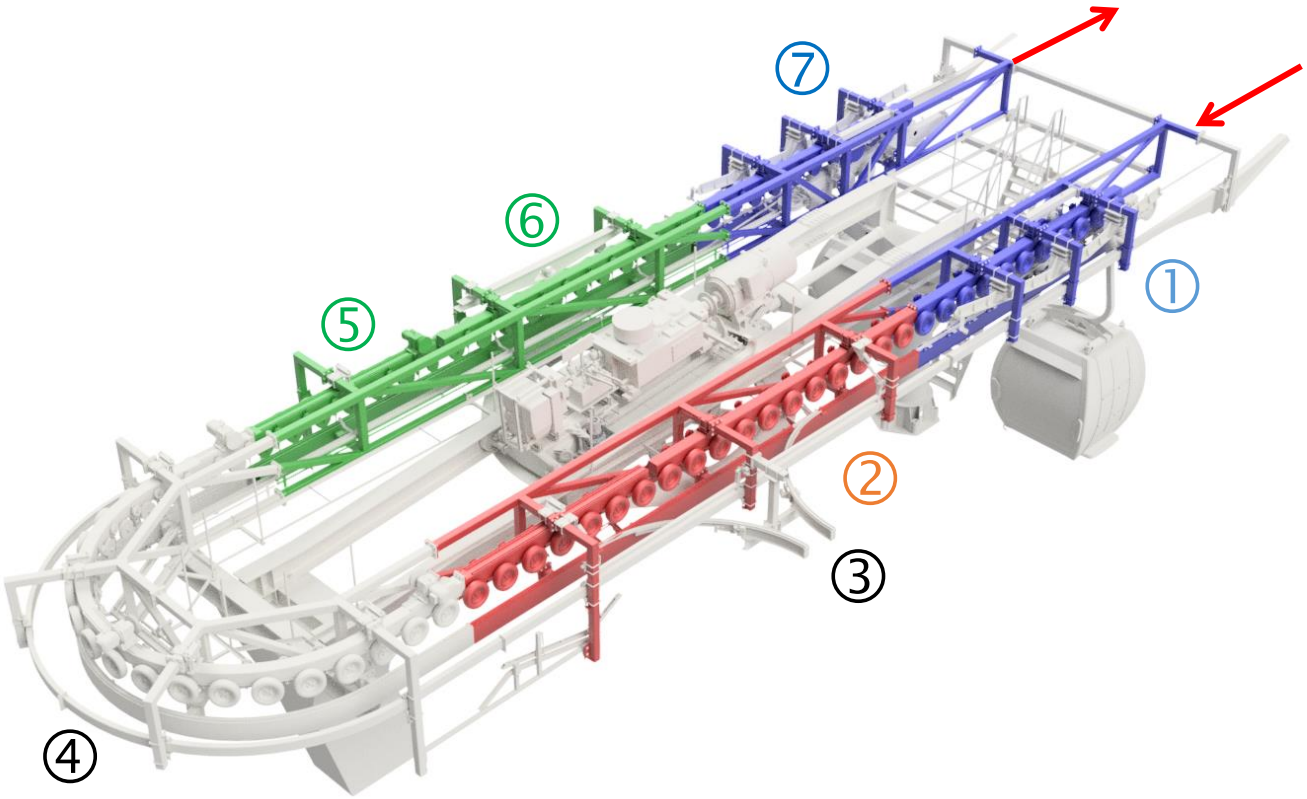
13.2. Return station (top)

Hot-dip galvanized supporting frame positioned on 1 concrete support as well as 1 steel support for mounting. Conveyor, cabin rail and lattice framework sandblasted and two-component coated in purchaser chosen RAL colour.

- Movable return bull wheel frame
- Bull wheel, split design with rubber liner, rope catcher and bull wheel catcher
- Hydraulic cylinder for manual return bull wheel relocation to equal elongation of rope, if automatic rope tension located in the drive station
- Hydraulic cylinder for automatic maintaining of rope tension, if fix mounted drive in the drive station
- Hydraulically liftable station conveyor wheels
- Access platforms and handrails
- Tire wheels accelerator and decelerator with the mechanical drive down from carrying-hauling cable with 2 rollers
- Grip force test for electronic measurement and evaluation
- The station is accessible and constructed in a very maintenance-friendly manner
- Spacer for proximity control of vehicles
- Grip force test
- The second set of bull wheel bearing for emergency operation in case of the bull wheel bearing fail



13.3. Station conveyor



① Entrance conveyor is driven directly by rope deflection pulley, the area where cabin gets detached from the rope, monitored by the control system

② Deceleration conveyor drove by frequency controlled drive, to decelerate cabin from rope speed to station speed, speed and direction automatic controlled by the control system, can be lifted for manual cabin pushing in emergency case

③ Rail switches to and from cabin circulation rail to cabin garage, controlled and monitored by the ropeway control system

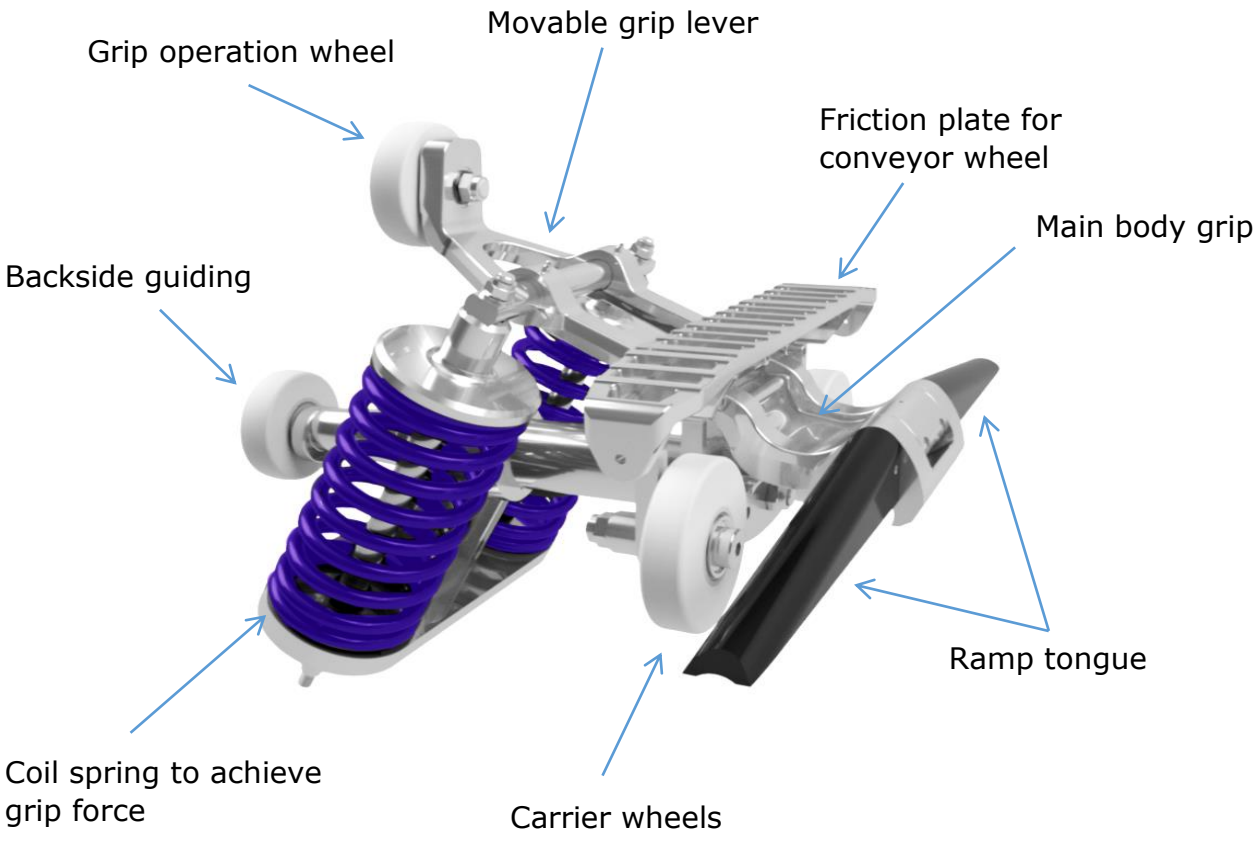
④ Curve conveyor to move cabins around the curve while people leaving and entering cabins, driven by frequency controlled drive, station speed between 2, 5 and 3.0 m/s, can be lifted for manual cabin pushing in emergency case

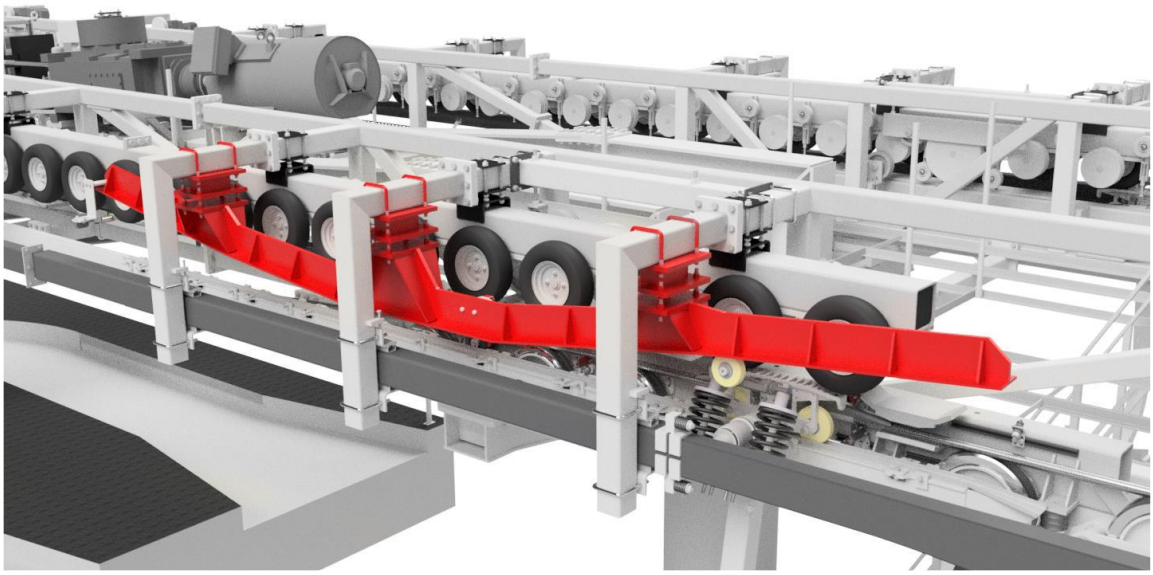
⑤ Cabin spacing area, a frequency driven drive will delay of accelerating loaded cabin to maintain the correct cabin distance set in the control system, can be lifted for manual cabin pushing in emergency case.

⑥ Acceleration conveyor to accelerate the leaving cabins from station speed to rope speed, driven by frequency controlled drive, can be lifted for manual cabin pushing in emergency case

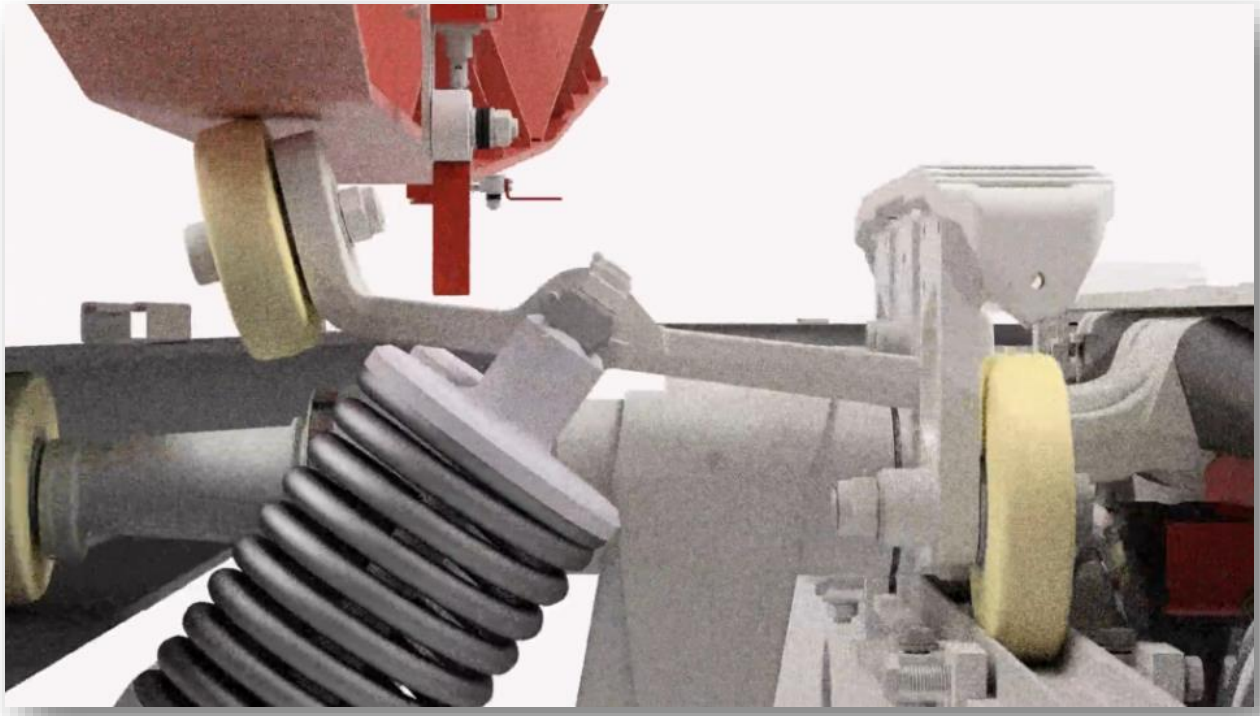
⑦ Exit conveyor is driven directly by deflection rope sheave, the area where cabin gets griped to rope, monitored by the control system

13.4 Detachable grip

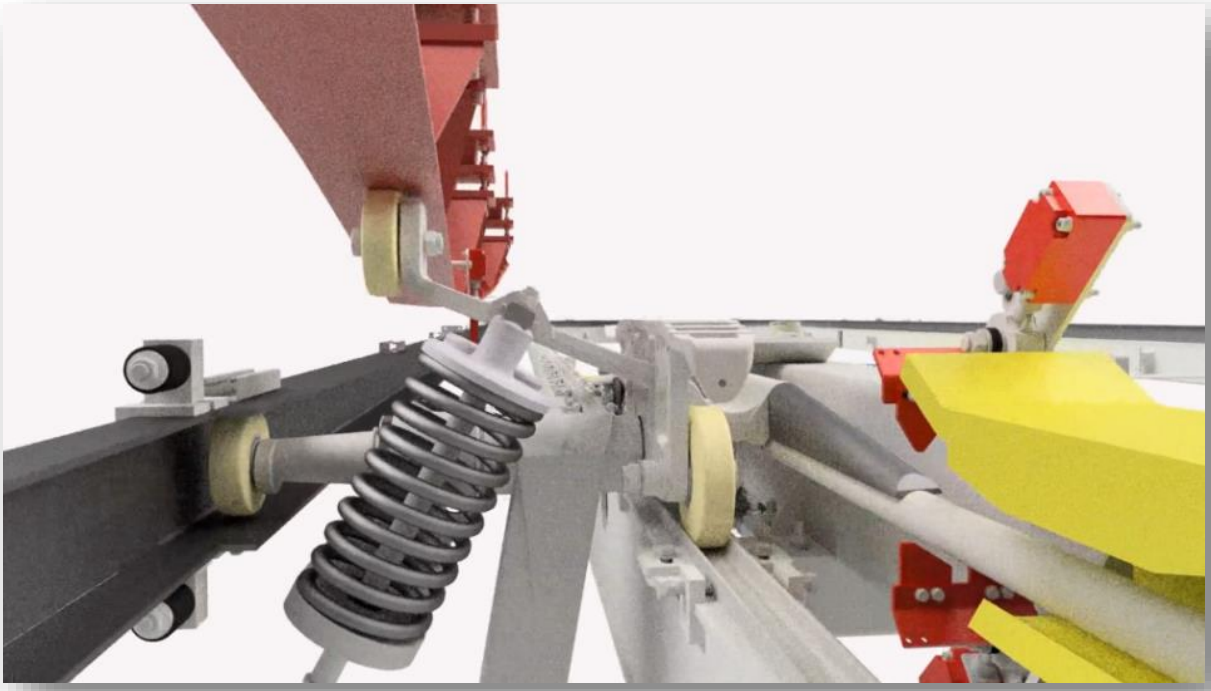




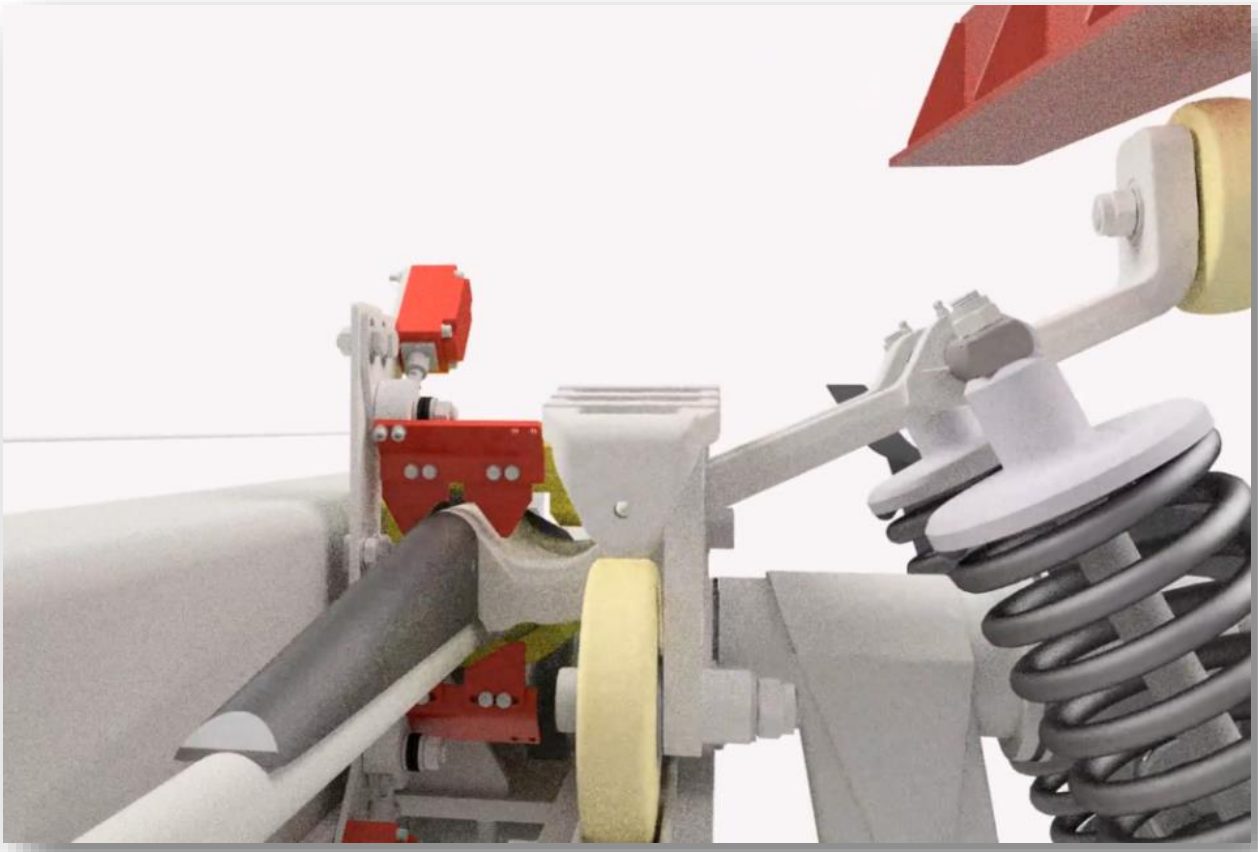
Red marked rail will press the movable grip lever down to open grip jaw to release rope which gets deflected to the downside



… Depression of movable grip lever to guide rope into grip jaws …



… After the rope is guided in grip jaws, release grip lever …



... One of the numerous grip supervision devices before leaving station…

The following operation parameter of the detachable grip is permanently monitored during operation

- Grip force, the force of the coil springs which are responsible for gripping force are monitored every time before a cabin is leaving the station
- A geometrical gauge checks the outer shape of grip jaw of the clamp before leaving the station to ensure the correct position of grip on the rope
- A geometrical gauge checks the correct position of grip lever
- A geometrical gauge checks the correct opening of the grip before attaching to rope
- Rope position detection gauges ensure the correct position of the rope for grip operation
- A geometrical gauge monitors the correct uncoupling of grip and rope
- A geometrical gauge monitors the presence of all runner wheel of the grip.
- Sensor to avoid gripping in splice areas

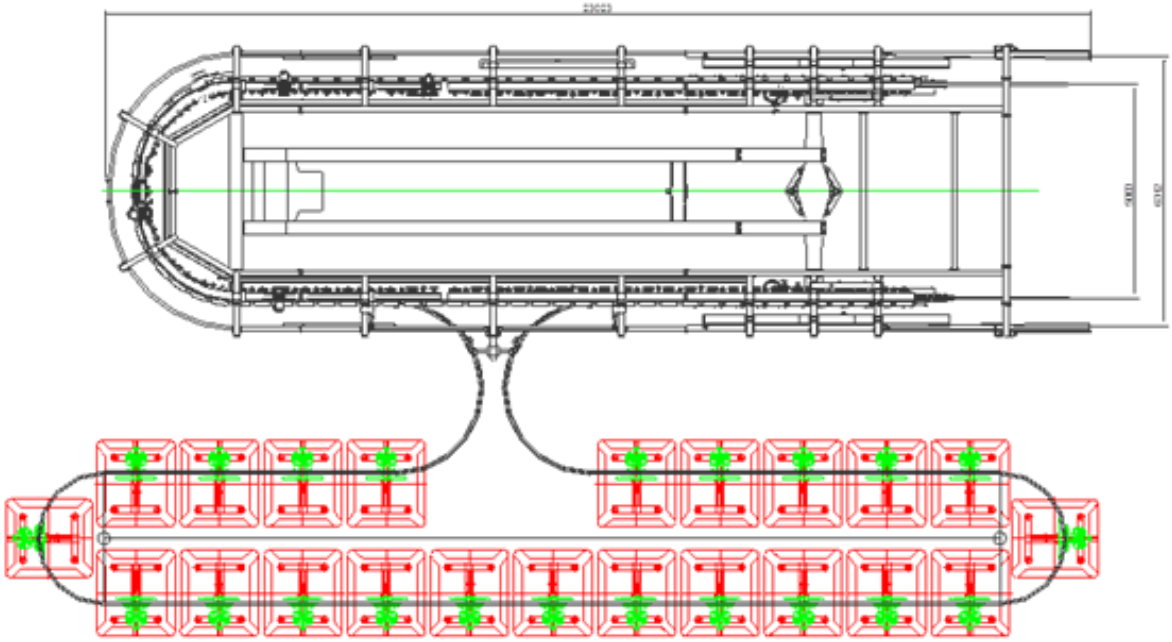
Every monitoring device is equipped with a safety related limit switch to signalise a mail function directly to the safety PLC of the ropeway control system. In the case of malfunction, the control system will stop the ropeway automatically and will show the fault in real time on screen.

13.5. Parking

Located in the drive station:

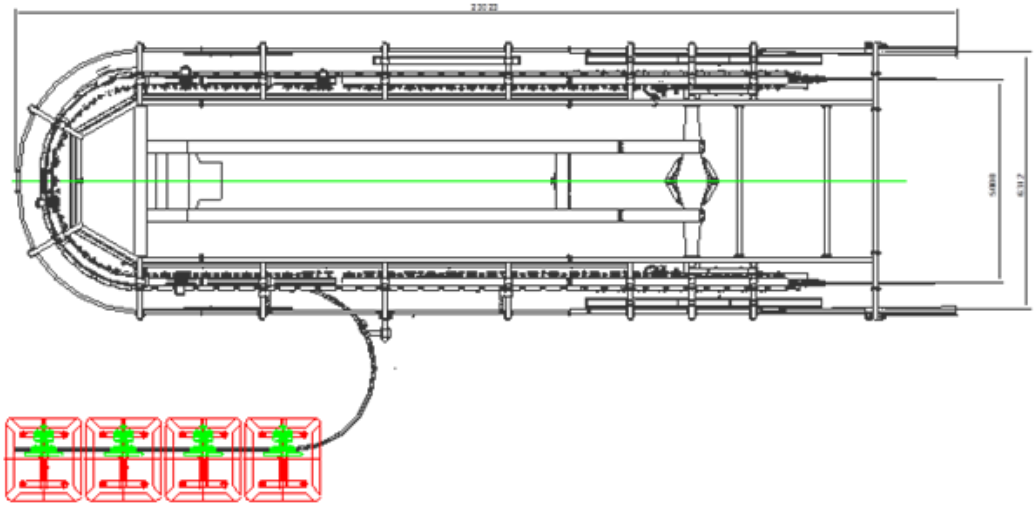
- Parking switch to transfer carrier to and from the parking area

- Cabin storage rail, loop design to avoid the reverse operation of the cableway system during parking operation
- Separate parking rail for maintenance- and VIP carrier possible
- Manual shifting of carrier
- Storage capacity 74 carrier



Located in the top station:

- Parking switch to transfer carrier to and from the parking area
- Cabin storage rail, single-rail design for temporary carrier storage
- Manual shifting of carrier
- Storage capacity for defect carrier



13.6. Carrier

- **Cabins** with the level walk-in arrangement
- 6 seated passengers
- Constructed with steel frame galvanized, aluminium shell
- 1 service carrier with hanger and grip

Cabin

13.7. TOWERS:

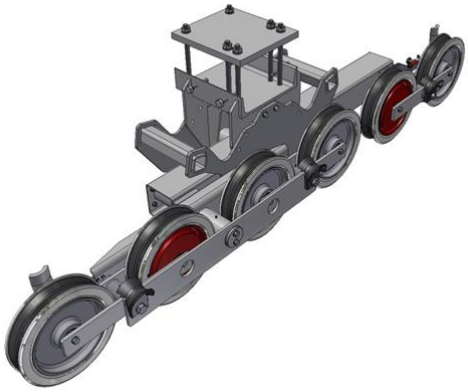
Galvanized Towers will be used with the following quality requirements.

- Hot-dip galvanized tower tube
- Access ladder with anti-fall guard
- Hot-dip galvanized crossbeam with rope lifting frame
- Maintenance platforms
- Rope calculation on the base of old tower positions
- Limit switches to monitor clearance between tower and cabin

13.8. Sheave assemblies

Hot-dip galvanized adjustable sheave assemblies with 400 mm diameter rope sheaves.

- Boltless rope sheaves with rubber liner
- Rope deflector to the inside of sheave assemblies
- Rope catcher at the outside of sheave assemblies
- Break fork switches for derailment supervision on both sides of the sheave assembly
- Rope position detection by proximity sensors
- Overturning stop to limit movement of sheave rockers



13.9 Haul rope

Galvanized steel wire rope, manufactured and spliced by Rope supplier.

13.10 Electric controls

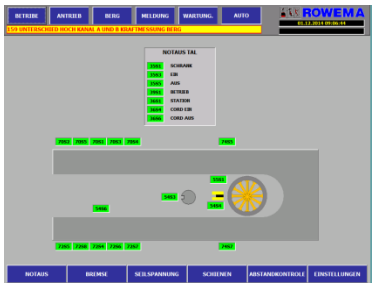
The ropeway control system is located at the drive station. Prewired enclosures contain the drive control with frequency converter and the ropeway monitoring system with the CE certified line supervision. With the aid of a touch display installed in the front of the control cabinets, all functions of the cableway can be monitored and controlled through various operating screens. Optional the same actions can be done by external desktop computer with monitor.

During operation, the most important information like,

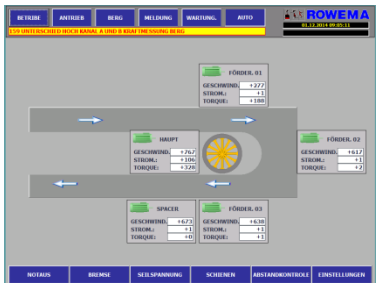
- Main power supply (under/over voltage and current)
- Main drive power consumption
- phase monitoring
- Rope speed
- Line supervision
- Emergency backup voltage
- Condition of emergency – and service brake
- wind speed
- Condition of rope tensioning system
- monitoring of rope earthing
- lightening protection
- Temperature monitoring of drive and hydraulic units
- Emergency stops on several points inside stations and towers, etc.

Are shown of the main operation screen, to give operator real-time information of ropeways operation condition. Several other screen layouts showing more detailed information which can be chosen by the operator.

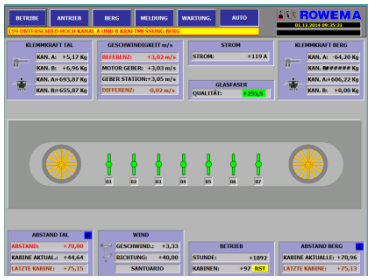
Some examples of screen layouts:



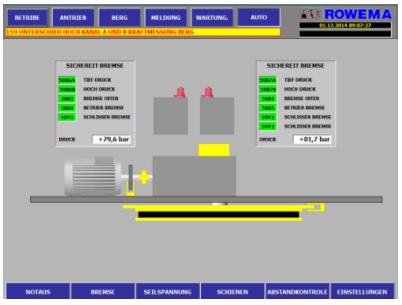
Sensor Monitoring



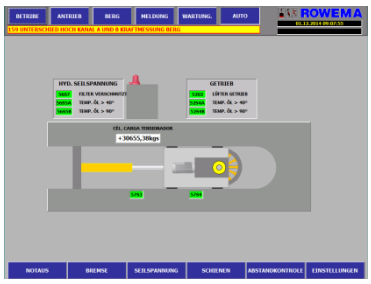
Conveyor Drives



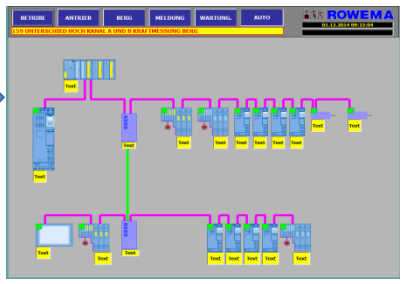
Main Screen



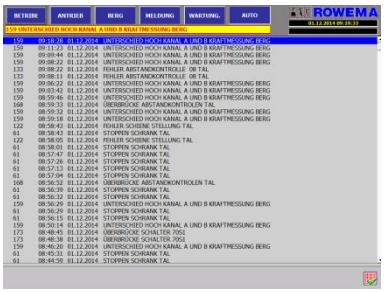
Brake System



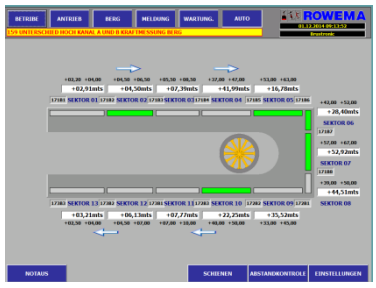
Rope Tension



Hardware Communication



Fault Memory



Cabin Distance

Some features of the control system:

- Safety frequency converter for the main drive with integrated brake chopper and external brake resistor for regenerative braking by power fail
- Frequency converter for each conveyor drive individual
- Touch screen control in all stations
- Optional desktop computer for remote control
- Wind speed meter and direction indicator
- Anti-collision control for carriers inside the station
- Fault indicators for conveyor system
- Real-time monitoring of all safety gates and switches
- Rope derailment switches (break fork switches) at towers
- Tele-maintenance module
- Redundant rope tension measuring device
- Indirect Grip force testing by supervision of spring force
- Emergency power backup of the safety system

13.11. Wiring materials

- Electric cables from the main disconnect switch of electric cabinet inside stations to the electrical equipment of the subject ropeway.
- Aerial control cable between the stations.
- Wiring boxes for towers
- All sensors with M 12 connector for easy change
- Power cable between the main drive motor and frequency converter not included

Uttarakhand Metro Rail, Urban Infrastructure & Building Construction Corporation Limited

14

Financial analysis and structuring of the project

14. FINANCIAL ANALYSIS AND STRUCTURING OF PROJECT

14.1. Key aspects of financial evaluation

Following key aspects has been taken into consideration for financial viability analysis of the Passenger Ropeway project at the proposed location:

1. The Project is considered to be awarded by 31st March 2021.
2. Financial Closure to be achieved on or before 31st March 2022.
3. Commencement Date i.e. start of construction activities shall be the Financial Closure date, considering all the Condition Precedents as per the Concession Agreement are achieved.
4. Scheduled Project Completion Date (Two Years from the commencement Date) – 31st March 2024.
5. Start of Commercial Operation – 1st April 2024.
6. The concession period is of 30 Years inclusive of an estimated Construction period of 2 Years, starting from 1st April 2022.
7. Concession Period end date – 31st March 2052 (30 Years from Commencement Date).
8. Major maintenance every 5 years.
9. Operation & Maintenance manpower expenses include Ropeway related staff, Account & Administration Staff, Other Manpower / Labour Expenses. The growth rate of expenses @ 10% for the first 20 Yrs. and 7% afterwards.
10. Other Expenses includes Machine & Equipment's maintenance charges, Power station & Generator Maintenance Expenses, Electricity & Water Expenses, Energy charges, Insurance and Other Administration Expenses every year. The expenses growth rate has been assumed as @5%.
11. Financials and Rate of Return for Project IRR & EIRR along with projections of the Project over 30 years Concession Period including two2 years of Construction Period have been analysed.
12. Regulatory Clearances - All major clearances like EIA, Forest etc. would be obtained by Government but the provision for applying all applications and upfront due amount to obtain the permission would be borne by Investor.
13. Bid Variable: Annual Concession Fee (% of revenue collection by selling ropeway tickets and other services) would be Bid variable.

14.2. Project cost analysis

14.2.1. Assumptions for the Total Project Cost (TPC):

- Cost of Ropeway equipment is assumed as per latest ropeway standard (with imported compoenns).
- Material ropeway cost is assumed as per best industrial practice, which is required for carrying out construction material and other components of Passenger Ropeway.
- Ropeway structural component including Towers, Support Structure, Mechanical Equipment etc. are assumed to be procured from indigenous suppliers.
- Cost, as mentioned in the cost sheet, is assumed for the development of Retail Outlets, Food Court, Parking, Advertisement etc.
- Interest during the Construction Period has been assumed at 11.0% and 10% (both cases analysed)

14.2.2 Land Cost:

- Considering land is provided by the Concessioning Authority on a long term lease basis.
- Land related cost includes FCA/FRA clearance, NPV of Forest Land and CA Land and Cost of tree cutting.

14.2.3 Other Major Assumptions:

- Base Year for Civil Construction Cost

  Ropeway – 2022 -23

  Land Cost – 2021 -22

  Debt Equity Ratio – 70%: 30% and 80%: 20%
- Expected Start date of Construction – 01.04.2022.
- Estimated Construction period – 2 Years
- Completion of Construction – 31.03.2024
- Number of Days of Operation of Ropeway – 350 Days.
- Major Maintenance / Cleaning Days – 15 Days

14.2.4 Taxes

Income Tax	25.2%	Basic Rate 22% + 10% Surcharge + 4% Cess
Interest Rate	11.0%	
Repayment Period	10	Years
Moratorium	2	Years (From the commencement of commercial operations)

14.3. Operating Cost Analysis

14.3.1 Operating Cost:

- Employee cost is the major cost component and assumed to grow at 10% per annum.
- Other operational expenses like O&M Cost, Administrative Cost & Advertisement Cost is likely to increase at 5% per annum.

14.3.2 Depreciation:

- It is assumed that the entire Project Cost will be divided into 3 heads i.e. Building & Civil Works, Plant & Machinery & Other Costs. Building & Civil Costs will be amortised equally over a period of years of its operations to provide for its depreciation, Plant & Machinery Cost will be amortized equally over a period of 15 years & Other Costs will be amortized equally over a period of 10 years of its operations to provide for its depreciation.
- Future up-gradation and overhauling is part of operating O&M expenses.
- The Pre -Operative expenses and interest during construction (also after construction till repayment) have been capitalized.
- Straight Line method of Depreciation has been taken into consideration.

14.3.3 Interest Rate & Loan Repayment:

- The Debt or Loan borrowed for the project will be in a phase-wise manner during the construction phase at an interest rate of 10% and 11.0%. The capitalised cost of Debt i.e. IDCP to be serviced by Debt is also included for the calculation of interest.
- The moratorium period of 2.0 years is considered and repayment period after the moratorium is 10 years for Debt borrowed.
- Repayment is structured with equal instalments.

14.4. Minimum return criteria for the project:

For any project to be viable under PPP or any of its variant, the minimum return criteria for the project is assumed based on experience and present trends in Ropeway projects. This is to ensure the attractiveness of the project and to ensure returns to the concessionaire as per the sector trends.

Following Minimum Return Criteria for the Project has been adopted:

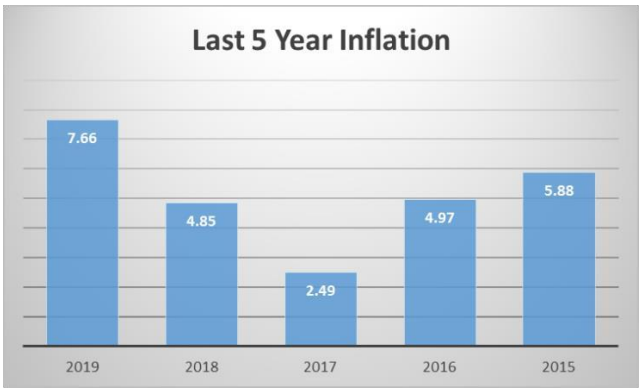
Particulars	%
Post-Tax Project IRR	15% - 18%
Equity IRR	18% - 22%
Cash Flow and Balance Sheet from starting of operations	Positive

14.5 Financial modelling for Har ki Pauri to Chandi Devi Ropeway at Haridwar:

- Ropeway working hours per day - 12 Hrs
- Capacity Initial - 1000 PPHPD.
- Capacity Final - 1800 PPHPD
- Growth in Ropeway Traffic every Year - 3.07%
- Expected start of Revenue - 01.04.2024
- Growth rate in O&M expenses - 5%
- The annualized Growth rate in Ropeway Ticket - 5.17 (Average of 5 year CPI)

Average of last 5 year CPI

Year	Inflation %
2019	7.66
2018	4.85
2017	2.49
2016	4.97
2015	5.88
Average	**5.17**



14.5.1. Revenue analysis

14.5.1.1 Proposed Passengers traffic at the Ropeway:

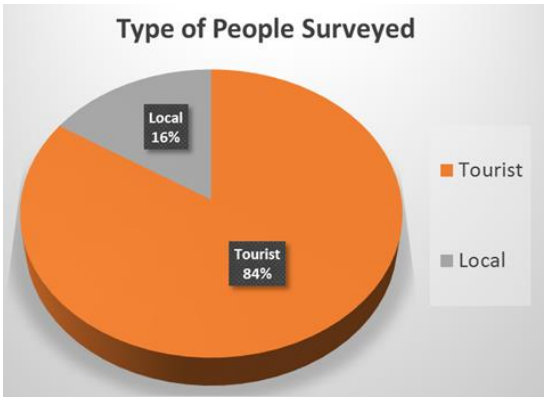
First Year Ropeway operation i.e. FY 2024-25 traffic is considered as 19.25 lakhs with Growth of 3.07% per annum, as per the outcome of traffic analysis (based on analysis, FY 19-20 traffic is 16.55 lakhs).

14.5.1.2 Ropeway Ticket Price:

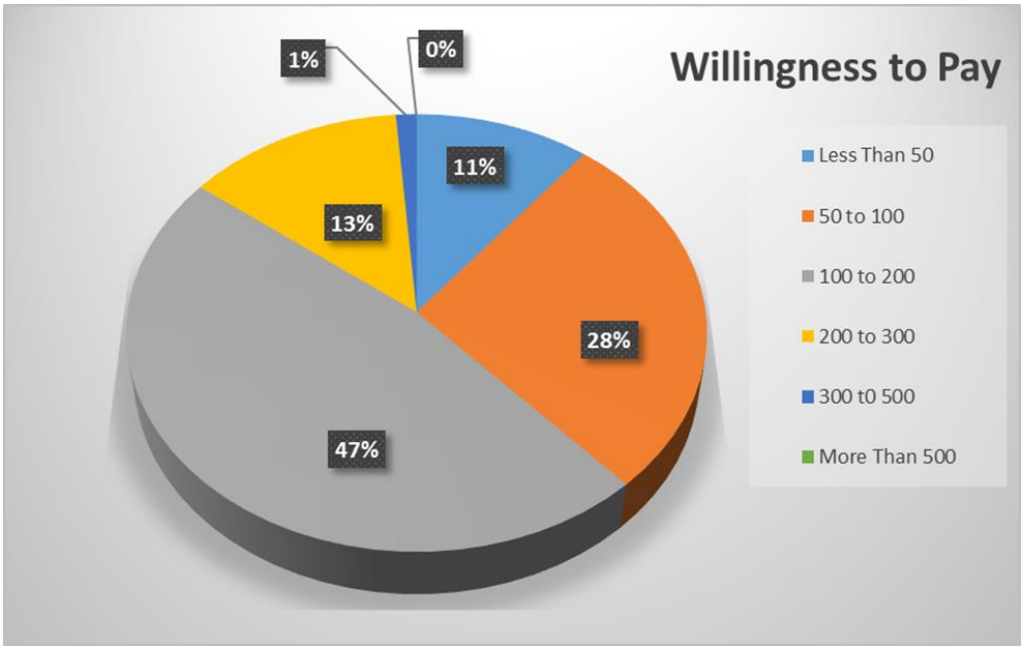
For Financial Feasibility Study Average Ticket is considered Rs.257/- per passenger, based on the following criteria:

1. **Customer Survey conducted for willingness to pay (Table 14.1):**

SN	Type of People Surveyed	Number	Percentage (%)
1	Tourist	2524	84
2	Local	476	16
Total (Sample Size)		3000	100



Willingness to Pay (INR)	Number	Percentage	Cumulative Numbers	Percentage (%)
Less Than 50	321	11	3000	100
50 to 100	826	28	2679	89
100 to 200	1416	47	1853	61
200 to 300	399	13	437	14
300 t0 500	38	1	38	1
More Than 500	0	0	0	0



2. **Ticket price should be in accordance with the existing ropeway. The current price of existing Chandi Devi ropeway is Rs.163/-**

3. **Followings are the list of the fare being charged by some of the major ropeways (Table 14.2):**

S. No.	ROPEWAYS	ROPEWAY LENGTH (METRE)	FARE INR
1	Gulmarg Gondola, Jammu & Kashmir	2,688	950
2	Auli Cable Car, Uttarakhand	3,950	750
3	Solang Valley, Manali	1,800	450
5	Darjeeling, West Bengal	2,500	200
6	Gangtok Ropeway, Sikkim	1,000	110
7	Deoghar, Jharkhand	766	50
8	Karni Mata, Rajasthan	387	103
9	Malampuzha, Kerala	626	68
14	Mahakali Pavagadh, Gujarat	763	98
16	Raigad, Pune	760	300
17	Chandi Devi, Haridwar	767	163
19	Mansadevi, Uttrakhand	576	103
21	Jivdani Temple, Maharashtra	760	150
22	Ambaji Ropeway, Gujarat	363	80
23	Saputara ropeway, Gujarat	1,000	40
24	Timber trail, Parvanoo	1,600	1,250
26	Mussoorie, Kempty Fall	150	120
27	Science City, Kolkata	500	75

4. **Growth of 5.17 % in every year.**

5. **However, the investor should be free to decide the Ropeway User Fee and further increase.**

14.5.1.3 Other Proposed Revenue streams:

- Food Court
- Retail Outlets
- Parking
- Commercial space for rent
- Advertisement etc.

Revenue from these sources is considered at an average of Rs.10/- per passenger (as per feedback from existing Chandi Devi ropeway).

14.5.2.Financial Model, Considering 0% revenue sharing to Government from First Year of Operations:

Projection of Expected Traffic and Ropeway Ticket Price for 1st April 2024

(Expected Date of Commercial Operation)

Expected Annual Traffic for 2019-20	=	16.55 Lakhs
Expected Growth Rate	=	3.07 %
Projected Traffic as on COD	=	19.25 Lakhs
Tariff as per Working for 2019-20	=	INR 200
Annual Growth Rate	=	5.17 %
Projected Tariff as on COD	=	INR 257

14.5.2.1 FINANCIAL STATEMENTS for Debt Equity Ratio of 70:30 and 11% Interest Rate:

Project Cost

SN	Particulars	Est. Cost (INR Lakhs)
1	**Land Acquisition** Forest Charges and Land Acquisition Charges. (This includes FCA clearing, CA, NPV and Cost of trees, compensatory afforestation Acquisition of private land)	1000
2	**Environment Clearance** (Includes expenses towards consultant, data collection, report preparation, Public Hearing etc.)	50
3	Survey & Investigations (Includes Survey, Geo-Technical and Geo Physics studies)	100
4	Design, Drawing and Vetting Expenses of Main Ropeway	500
5	**Main Ropeway** Equipment & technology supply including custom duty, transportation and other charges(Considering Imported equipment as per CEN standard)	4800
6	Tower and other supporting Structures (Indigenous Supply)	500
7	(**Material Ropeway**) (Design, supply, custom etc. of Material Handling Ropeway)	800

SN	Particulars	Est. Cost (INR Lakhs)
8	Testing, **Erection and Commissioning,** Tools Tackles etc.	350
9	**Civil Works** Terminal Station Building, HVAC, STP, Fire System Boundary, Building interiors, furniture, Ticketing system, Tower Foundation etc.	3200
10	Material Ropeway foundation, Stay, Anchors etc.	100
11	Arrangement of **Electric Power**, DG set, sub-station, etc. Power Line along the corridor, Fire system	500
12	Project Insurance	20
13	**Project Management**, Overheads	800
14	Overhead costs incl. marketing, accounting, etc.	100
15	Consultancy & pre-development charges (This includes NOCs, clearances, Legal and other Charges)	250
16	Other Services (Retail Outlets, Food Court, Parking, Advertisement etc.)	300
17	Contingencies	300
18	**Insurance and Bank Expenses** Interest during construction, Loan processing and legal assessment charges, LC Commission, BG Charges, Other Bank Charges etc.	1413
	Total	**15,083**

Income Projections – P&L A/C:

Rs./lakh										
Particulars / Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Months	12	12	12	12	12	12	12	12	12	12
INCOME										
No. of Passengers (in lacs)	19.3	19.8	20.5	21.1	21.7	22.4	23.1	23.8	24.5	25.3
Tariff (Rs) - Ropeway	257.0	270.3	284.3	299.0	314.4	330.7	347.8	365.7	384.7	404.5
Tariff Growth	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Restaurent & Retail Income Pe	10.0	10.5	11.0	11.6	12.2	12.8	13.4	14.1	14.8	15.5
Growth Rate		5%	5%	5%	5%	5%	5%	5%	5%	5%
Ancilliary Income	192.5	208.3	225.5	244.0	264.1	285.9	309.4	334.9	362.4	392.2
Revenue	**5,140**	**5,571**	**6,039**	**6,546**	**7,096**	**7,693**	**8,339**	**9,040**	**9,798**	**10,619**
Opearting Cost										
Employee Cost	420	462	508	559	615	676	744	818	900	990
O&M Expenses	250	263	276	289	304	319	335	352	369	388
Major Overhauling					350					350
Royalty for Ropeway	-	-	-	-	-	-	-	-	-	-
Royalty for Other Services	-	-	-	-	-	-	-	-	-	-
Advertisement Cost	50	53	55	58	61	64	67	70	74	78
Administrative Expenses	152	160	168	176	185	194	204	214	225	236
Expenses Restaurent & Retail	135	146	158	171	185	200	217	234	254	275
Total Operating Cost	**1,007**	**1,082**	**1,164**	**1,253**	**1,699**	**1,453**	**1,566**	**1,689**	**1,822**	**2,316**
Profit before Int. & Dep.	**4,133**	**4,488**	**4,874**	**5,293**	**5,397**	**6,239**	**6,773**	**7,351**	**7,976**	**8,303**
Interest on term loan	1,161	1,161	1,118	1,002	886	769	653	537	421	305
Profit before Dep.	**2,972**	**3,327**	**3,756**	**4,291**	**4,512**	**5,470**	**6,120**	**6,814**	**7,555**	**7,998**
Depreciation:										
- Building	154	154	154	154	154	154	154	154	154	154
- Plant & Machinery	478	478	478	478	478	478	478	478	478	478
- Others	287	287	287	287	287	287	287	287	287	287
Profit/(Loss) before Tax	**2,054**	**2,409**	**2,839**	**3,373**	**3,594**	**4,552**	**5,202**	**5,896**	**6,637**	**7,080**
Provision for Income Tax (noti	235	396	565	752	853	1,133	1,329	1,533	1,744	1,876
Profit after Tax	**1,818**	**2,013**	**2,273**	**2,621**	**2,741**	**3,420**	**3,873**	**4,363**	**4,894**	**5,204**

Cash Flow:

Rs./lakh

Particulars / Year		1	2	3	4	5	6	7	8	9	10
SOURCE:											
Profit Before Interest & Depreciation		4,133	4,488	4,874	5,293	5,397	6,239	6,773	7,351	7,976	8,303
Short Term Loan		-	-	-	-	-	-	-	-	-	-
Total Sources	**A**	**4,133**	**4,488**	**4,874**	**5,293**	**5,397**	**6,239**	**6,773**	**7,351**	**7,976**	**8,303**
USES:											
Repayment of Term Loan		-	-	1,056	1,056	1,056	1,056	1,056	1,056	1,056	1,056
Repayment of Short Term Loan		-	-	-	-	-	-	-	-	-	-
Payment of Interest on Term Loan		1,161	1,161	1,118	1,002	886	769	653	537	421	305
Payment of Interest on Short Term Loan		-	-	-	-	-	-	-	-	-	-
Payment of Tax		235	396	565	752	853	1,133	1,329	1,533	1,744	1,876
Total Uses	**B**	**1,397**	**1,557**	**2,739**	**2,810**	**2,794**	**2,958**	**3,038**	**3,126**	**3,221**	**3,237**
Net Cashflow during the year	**C=A-B**	**2,736**	**2,931**	**2,135**	**2,483**	**2,603**	**3,282**	**3,734**	**4,225**	**4,755**	**5,066**
Opening Balance	**D**	**-**	**2,736**	**5,667**	**7,803**	**10,286**	**12,889**	**16,170**	**19,905**	**24,130**	**28,885**
Closing Balance	**E=D+C**	**2,736**	**5,667**	**7,803**	**10,286**	**12,889**	**16,170**	**19,905**	**24,130**	**28,885**	**33,951**

Projected Balance Sheet:

Rs./lakh	Construction period											
PARTICULARS	**C1**	**C2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SOURCES OF FUNDS												
Shareholders' Fund												
Capital -Equity	2,215	4,525	4,525	4,525	4,525	4,525	4,525	4,525	4,525	4,525	4,525	4,525
Reserves & Surplus	-		1,818	3,832	6,105	8,726	11,468	14,887	18,760	23,123	28,016	33,220
	2,215	4,525	6,343	8,357	10,630	13,251	15,992	19,412	23,285	27,648	32,541	37,745
Loan Funds												
Secured Loans	5,168	10,558	10,558	10,558	9,502	8,447	7,391	6,335	5,279	4,223	3,167	2,112
Unsecured loan			-	-	-	-	-	-	-	-	-	-
	5,168	10,558	10,558	10,558	9,502	8,447	7,391	6,335	5,279	4,223	3,167	2,112
Total	**7,383**	**15,083**	**16,902**	**18,915**	**20,132**	**21,698**	**23,383**	**25,747**	**28,564**	**31,871**	**35,709**	**39,857**
APPLICATION OF FUNDS												
Fixed Assets												
Gross Block			15,083	15,083	15,083	15,083	15,083	15,083	15,083	15,083	15,083	15,083
Less: Depreciation	-		918	1,835	2,753	3,671	4,589	5,506	6,424	7,342	8,260	9,177
Net Block	-		14,165	13,248	12,330	11,412	10,494	9,577	8,659	7,741	6,824	5,906
Capital Work-in-Progr	7,383	15,083	-	-	-	-	-	-	-	-	-	-
	7,383	15,083	14,165	13,248	12,330	11,412	10,494	9,577	8,659	7,741	6,824	5,906
Investments	-		-	-	-	-	-	-	-	-	-	-
Current Assets, Loans and												
Advances												
Cash and Bank Balance	-		2,736	5,667	7,803	10,286	12,889	16,170	19,905	24,130	28,885	33,951
Current Assets, Loans and Advances	-		2,736	5,667	7,803	10,286	12,889	16,170	19,905	24,130	28,885	33,951
Less: Current Liabilities and												
Provisions												
Current Liabilitie	-											
Provision	-											
Less: Current Liabilities and Provisions	-		-	-	-	-	-	-	-	-	-	-
Net Current Assets	-		2,736	5,667	7,803	10,286	12,889	16,170	19,905	24,130	28,885	33,951
Total	**7,383**	**15,083**	**16,902**	**18,915**	**20,132**	**21,698**	**23,383**	**25,747**	**28,564**	**31,871**	**35,709**	**39,857**

RESULTS OF FINANCIAL ANALYSIS

Key Results:

- Project IRR: 28.6%
- Equity IRR: 50.7%
- Project Payback Period: 4 Yrs.
- Cash flow and balance sheet are positive and healthy. The IRR based on assumptions and criteria made is within limit cash flow and balance sheet is positive. This option is viable.

Project IRR Sensitivity of Traffic & Tariff

IRR		Traffic In Lakh				
		15.4	17.3	19.3	21.2	23.1
Tariff In INR	200	19.7%	21.7%	23.7%	25.5%	27.2%
	257	24.1%	26.4%	28.6%	30.7%	32.8%
	300	27.1%	29.7%	32.1%	34.5%	36.8%
	350	30.4%	33.3%	36.0%	38.6%	41.2%
	400	33.6%	36.7%	39.7%	42.6%	45.5%

Note: Senstivity is shown at +/- 10% and +/- 20% of estimated traffic

14.5.2.2 FINANCIAL STATEMENTS for Debt Equity Ratio of 70:30 and 10% Interest Rate

Project Cost

SN	Particulars	Cost (Lakhs)
1	**Land Acquisition** Forest Charges and Land Acquisition Charges. (This includes FCA clearing, CA, NPV and Cost of trees, compensatory afforestation Acquisition of private land)	1000
2	**Environment Clearances** (Includes expenses towards consultant, data collection, report preparation, Public Hearing etc)	50
3	Survey & Investigations (Includes Survey, Geo-Technical and Geo Physics studies)	100
4	Design, Drawing and Vetting Expenses of Main Ropeway	500
5	**Main Ropeway** equipment & technology supply (Considering Imported equipment as per CEN standard)	4800
6	Tower and other supporting Structures (Indigenous Supply)	500
7	(**Material Ropeway**) (Design, supply, custom etc. of Material Handling Ropeway)	800
8	Testing, **Erection and Commissionin**g, Tools Tackles etc.	350
9	**Civil Works** Terminal Station Building, HVAC, STP, Fire System Boundary, Building interiors, Furniture, Ticketing system, Tower Foundation etc.	3200

SN	Particulars	Cost (Lakhs)
10	Material Ropeway foundation, Stay, Anchors etc.	100
11	Arrangement of **Electric Power**, DG set, sub-station, etc. Power Line along the corridor, Fire system	500
12	Project Insurance	20
13	**Project Management**, Overheads	800
14	Overhead costs incl. marketing, accounting, etc.	100
15	Consultancy & pre-development charges (This includes NOCs, clearances, Legal and other Charges)	250
16	Other Services (Retail Outlets, Food Court, Parking, Advertisement etc.)	300
17	Contingencies	300
18	**Insurance and Bank Expenses** Interest during construction, Loan processing and legal assessment charges, LC Commission, BG Charges, Other Bank Charges etc.	1300.80
	Total	**14,970.80**

Income Projections – P&L A/C:

Rs./lakh										
Particulars / Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Months	12	12	12	12	12	12	12	12	12	12
INCOME										
No. of Passengers (in lacs)	19.3	19.8	20.5	21.1	21.7	22.4	23.1	23.8	24.5	25.3
Tariff (Rs) - Ropeway	257.0	270.3	284.3	299.0	314.4	330.7	347.8	365.7	384.7	404.5
Tariff Growth	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Restaurent & Retail Income Per Pas	10.0	10.5	11.0	11.6	12.2	12.8	13.4	14.1	14.8	15.5
Growth Rate		5%	5%	5%	5%	5%	5%	5%	5%	5%
Ancilliary Income	192.5	208.3	225.5	244.0	264.1	285.9	309.4	334.9	362.4	392.2
Revenue	**5,140**	**5,571**	**6,039**	**6,546**	**7,096**	**7,693**	**8,339**	**9,040**	**9,798**	**10,619**
Opearting Cost										
Employee Cost	420	462	508	559	615	676	744	818	900	990
O&M Expenses	250	263	276	289	304	319	335	352	369	388
Major Overhauling					350					350
Royalty for Ropeway	-	-	-	-	-	-	-	-	-	-
Royalty for Other Services	-	-	-	-	-	-	-	-	-	-
Advertisement Cost	50	53	55	58	61	64	67	70	74	78
Administrative Expenses	152	160	168	176	185	194	204	214	225	236
Expenses Restaurent & Retail	135	146	158	171	185	200	217	234	254	275
Total Operating Cost	**1,007**	**1,082**	**1,164**	**1,253**	**1,699**	**1,453**	**1,566**	**1,689**	**1,822**	**2,316**
Profit before Int. & Dep.	**4,133**	**4,488**	**4,874**	**5,293**	**5,397**	**6,239**	**6,773**	**7,351**	**7,976**	**8,303**
Interest on term loan	1,048	1,048	1,009	904	799	694	589	485	380	275
Profit before Dep.	**3,085**	**3,440**	**3,866**	**4,389**	**4,598**	**5,545**	**6,183**	**6,866**	**7,596**	**8,028**
Depreciation:										
- Building	152	152	152	152	152	152	152	152	152	152
- Plant & Machinery	474	474	474	474	474	474	474	474	474	474
- Others	284	284	284	284	284	284	284	284	284	284
Profit/(Loss) before Tax	**2,174**	**2,530**	**2,955**	**3,478**	**3,687**	**4,634**	**5,273**	**5,955**	**6,685**	**7,117**
Provision for Income Tax (notional)	268	428	595	779	877	1,153	1,347	1,547	1,755	1,885
Profit after Tax	**1,906**	**2,102**	**2,359**	**2,699**	**2,811**	**3,481**	**3,926**	**4,408**	**4,930**	**5,232**

Cash Flow:

Rs./lakh

Particulars / Year		1	2	3	4	5	6	7	8	9	10
SOURCE:											
Profit Before Interest & Depreciation		4,133	4,488	4,874	5,293	5,397	6,239	6,773	7,351	7,976	8,303
Short Term Loan		-	-	-	-	-	-	-	-	-	-
Total Sources	**A**	**4,133**	**4,488**	**4,874**	**5,293**	**5,397**	**6,239**	**6,773**	**7,351**	**7,976**	**8,303**
USES:											
Repayment of Term Loan		-	-	1,048	1,048	1,048	1,048	1,048	1,048	1,048	1,048
Repayment of Short Term Loan		-	-	-	-	-	-	-	-	-	-
Payment of Interest on Term Loan		1,048	1,048	1,009	904	799	694	589	485	380	275
Payment of Interest on Short Term Loan		-	-	-	-	-	-	-	-	-	-
Payment of Tax		268	428	595	779	877	1,153	1,347	1,547	1,755	1,885
Total Uses	**B**	**1,316**	**1,476**	**2,652**	**2,731**	**2,724**	**2,896**	**2,984**	**3,080**	**3,183**	**3,208**
Net Cashflow during the year	**C=A-B**	**2,817**	**3,013**	**2,222**	**2,562**	**2,674**	**3,344**	**3,789**	**4,271**	**4,793**	**5,095**
Opening Balance	**D**	**-**	**2,817**	**5,830**	**8,052**	**10,614**	**13,287**	**16,631**	**20,420**	**24,691**	**29,484**
Closing Balance	**E=D+C**	**2,817**	**5,830**	**8,052**	**10,614**	**13,287**	**16,631**	**20,420**	**24,691**	**29,484**	**34,578**

Projected Balance Sheet:

Rs./lakh	Construction period											
PARTICULARS	**C1**	**C2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SOURCES OF FUNDS												
Shareholders' Fund												
Capital -Equity	2,206	4,491	4,491	4,491	4,491	4,491	4,491	4,491	4,491	4,491	4,491	4,491
Reserves & Surplus	-		1,906	4,008	6,367	9,066	11,877	15,358	19,283	23,691	28,621	33,853
	2,206	4,491	6,398	8,499	10,858	13,557	16,368	19,849	23,774	28,182	33,112	38,344
Loan Funds												
Secured Loans	5,148	10,480	10,480	10,480	9,432	8,384	7,336	6,288	5,240	4,192	3,144	2,096
Unsecured loan			-	-	-	-	-	-	-	-	-	-
	5,148	10,480	10,480	10,480	9,432	8,384	7,336	6,288	5,240	4,192	3,144	2,096
Total	**7,354**	**14,971**	**16,877**	**18,979**	**20,290**	**21,941**	**23,704**	**26,137**	**29,014**	**32,374**	**36,256**	**40,440**
APPLICATION OF FUNDS												
Fixed Assets												
Gross Block			14,971	14,971	14,971	14,971	14,971	14,971	14,971	14,971	14,971	14,971
Less: Depreciation	-		911	1,822	2,733	3,644	4,555	5,465	6,376	7,287	8,198	9,109
Net Block	-		14,060	13,149	12,238	11,327	10,416	9,505	8,594	7,684	6,773	5,862
Capital Work-in-Progres	7,354	14,971	-	-	-	-	-	-	-	-	-	-
	7,354	14,971	14,060	13,149	12,238	11,327	10,416	9,505	8,594	7,684	6,773	5,862
Investments	-		-	-	-	-	-	-	-	-	-	-
Current Assets, Loans and												
Advances												
Cash and Bank Balances	-		2,817	5,830	8,052	10,614	13,287	16,631	20,420	24,691	29,484	34,578
Current Assets, Loans and Advances	-		2,817	5,830	8,052	10,614	13,287	16,631	20,420	24,691	29,484	34,578
Less: Current Liabilities and												
Provisions												
Current Liabilities	-											
Provision	-											
Less: Current Liabilities and Provisions	-		-	-	-	-	-	-	-	-	-	-
Net Current Assets	-		2,817	5,830	8,052	10,614	13,287	16,631	20,420	24,691	29,484	34,578
Total	**7,354**	**14,971**	**16,877**	**18,979**	**20,290**	**21,941**	**23,704**	**26,137**	**29,014**	**32,374**	**36,256**	**40,440**

RESULTS OF FINANCIAL ANALYSIS

Key Results:

- Project IRR: 28.6%
- Equity IRR: 52.0%
- Project Payback Period: 4 Yrs.
- Cash flow and balance sheet are positive and healthy. The IRR based on assumptions and criteria made is within limit cash flow and balance sheet is positive. This option is viable.

Project IRR Sensitivity of Traffic & Tariff

IRR		Traffic In Lac				
		15.4	17.3	19.3	21.2	23.1
	200	19.7%	21.8%	23.7%	25.5%	27.2%
Tariff In IN	257	24.1%	26.4%	28.6%	30.8%	32.9%
	300	27.2%	29.7%	32.2%	34.5%	36.9%
	350	30.5%	33.3%	36.1%	38.7%	41.3%
	400	33.7%	36.8%	39.8%	42.7%	45.6%

Note: Senstivity is shown at +/- 10% and +/- 20% of estimated traffic

14.5.2.3. FINANCIAL STATEMENTS for Debt Equity Ratio of 80:20 and 11% Interest Rate

Project Cost

SN	Particulars	Est. Cost (INR Lakhs)
1	**Land Acquisition** Forest Charges and Land Acquisition Charges. (This includes FCA clearing, CA, NPV and Cost of trees, compensatory afforestation Acquisition of private land)	1000
2	**Environment Clearance** (Includes expenses towards consultant, data collection, report preparation, Public Hearing etc.)	50
3	Survey & Investigations (Includes Survey, Geo-Technical and Geo Physics studies)	100
4	Design, Drawing and Vetting Expenses of Main Ropeway	500
5	**Main Ropeway** Equipment & technology supply including custom duty, transportation and other charges(Considering Imported equipment as per CEN standard)	4800
6	Tower and other supporting Structures (Indigenous Supply)	500
7	(**Material Ropeway**) (Design, supply, custom etc. of Material Handling Ropeway)	800
8	Testing, **Erection and Commissioning,** Tools Tackles etc.	350

SN	Particulars	Est. Cost (INR Lakhs)
9	**Civil Works** Terminal Station Building, HVAC, STP, Fire System Boundary, Building interiors, furniture, Ticketing system, Tower Foundation etc.	3200
10	Material Ropeway foundation, Stay, Anchors etc.	100
11	Arrangement of **Electric Power**, DG set, sub-station, etc. Power Line along the corridor, Fire system	500
12	Project Insurance	20
13	**Project Management**, Overheads	800
14	Overhead costs incl. marketing, accounting, etc.	100
15	Consultancy & pre-development charges (This includes NOCs, clearances, Legal and other Charges)	250
16	Other Services (Retail Outlets, Food Court, Parking, Advertisement etc.)	300
17	Contingencies	300
18	**Insurance and Bank Expenses** Interest during construction, Loan processing and legal assessment charges, LC Commission, BG Charges, Other Bank Charges etc.	1637
	Total	**15,307**

Income Projections – P&L A/C:

Rs./lakh										
Particulars / Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Months	12	12	12	12	12	12	12	12	12	12
INCOME										
No. of Passengers (in lacs)	19.3	19.8	20.5	21.1	21.7	22.4	23.1	23.8	24.5	25.3
Tariff (Rs) - Ropeway	257.0	270.3	284.3	299.0	314.4	330.7	347.8	365.7	384.7	404.5
Tariff Growth	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Restaurent & Retail Income Per Passen	10.0	10.5	11.0	11.6	12.2	12.8	13.4	14.1	14.8	15.5
Growth Rate		5%	5%	5%	5%	5%	5%	5%	5%	5%
Ancilliary Income	192.5	208.3	225.5	244.0	264.1	285.9	309.4	334.9	362.4	392.2
Revenue	**5,140**	**5,571**	**6,039**	**6,546**	**7,096**	**7,693**	**8,339**	**9,040**	**9,798**	**10,619**
Opearting Cost										
Employee Cost	420	462	508	559	615	676	744	818	900	990
O&M Expenses	250	263	276	289	304	319	335	352	369	388
Major Overhauling					350					350
Royalty for Ropeway	-	-	-	-	-	-	-	-	-	-
Royalty for Other Services	-	-	-	-	-	-	-	-	-	-
Advertisement Cost	50	53	55	58	61	64	67	70	74	78
Administrative Expenses	152	160	168	176	185	194	204	214	225	236
Expenses Restaurent & Retail	135	146	158	171	185	200	217	234	254	275
Total Operating Cost	**1,007**	**1,082**	**1,164**	**1,253**	**1,699**	**1,453**	**1,566**	**1,689**	**1,822**	**2,316**
Profit before Int. & Dep.	**4,133**	**4,488**	**4,874**	**5,293**	**5,397**	**6,239**	**6,773**	**7,351**	**7,976**	**8,303**
Interest on term loan	1,347	1,347	1,297	1,162	1,027	892	758	623	488	354
Profit before Dep.	**2,786**	**3,141**	**3,578**	**4,131**	**4,370**	**5,347**	**6,015**	**6,728**	**7,488**	**7,949**
Depreciation:										
- Building	156	156	156	156	156	156	156	156	156	156
- Plant & Machinery	485	485	485	485	485	485	485	485	485	485
- Others	291	291	291	291	291	291	291	291	291	291
Profit/(Loss) before Tax	**1,855**	**2,210**	**2,646**	**3,200**	**3,439**	**4,416**	**5,084**	**5,796**	**6,556**	**7,018**
Provision for Income Tax (notional)	181	343	515	707	813	1,098	1,300	1,508	1,725	1,862
Profit after Tax	**1,674**	**1,867**	**2,132**	**2,493**	**2,626**	**3,318**	**3,784**	**4,288**	**4,832**	**5,156**

Cash Flow:

Rs./lakh

Particulars / Year		1	2	3	4	5	6	7	8	9	10
SOURCE:											
Profit Before Interest & Depreciation		4,133	4,488	4,874	5,293	5,397	6,239	6,773	7,351	7,976	8,303
Short Term Loan		-	-	-	-	-	-	-	-	-	-
Total Sources	**A**	**4,133**	**4,488**	**4,874**	**5,293**	**5,397**	**6,239**	**6,773**	**7,351**	**7,976**	**8,303**
USES:											
Repayment of Term Loan		-	-	1,225	1,225	1,225	1,225	1,225	1,225	1,225	1,225
Repayment of Short Term Loan		-	-	-	-	-	-	-	-	-	-
Payment of Interest on Term Loan		1,347	1,347	1,297	1,162	1,027	892	758	623	488	354
Payment of Interest on Short Term Loan		-	-	-	-	-	-	-	-	-	-
Payment of Tax		181	343	515	707	813	1,098	1,300	1,508	1,725	1,862
Total Uses	**B**	**1,528**	**1,690**	**3,036**	**3,093**	**3,065**	**3,215**	**3,282**	**3,356**	**3,437**	**3,440**
Net Cashflow during the year	**C=A-B**	**2,605**	**2,799**	**1,839**	**2,200**	**2,333**	**3,024**	**3,491**	**3,995**	**4,539**	**4,862**
Opening Balance	**D**	**-**	**2,605**	**5,403**	**7,242**	**9,442**	**11,774**	**14,799**	**18,289**	**22,284**	**26,823**
Closing Balance	**E=D+C**	**2,605**	**5,403**	**7,242**	**9,442**	**11,774**	**14,799**	**18,289**	**22,284**	**26,823**	**31,685**

Projected Balance Sheet:

Rs./lakh	Construction period											
PARTICULARS	**C1**	**C2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SOURCES OF FUNDS												
Shareholders' Fund												
Capital -Equity	1,494	3,061	3,061	3,061	3,061	3,061	3,061	3,061	3,061	3,061	3,061	3,061
Reserves & Surplus	-		1,674	3,541	5,673	8,165	10,791	14,109	17,893	22,181	27,013	32,168
	1,494	3,061	4,735	6,602	8,734	11,227	13,852	17,170	20,954	25,242	30,074	35,230
Loan Funds												
Secured Loans	5,976	12,246	12,246	12,246	11,021	9,796	8,572	7,347	6,123	4,898	3,674	2,449
Unsecured loan			-	-	-	-	-	-	-	-	-	-
	5,976	12,246	12,246	12,246	11,021	9,796	8,572	7,347	6,123	4,898	3,674	2,449
Total	**7,470**	**15,307**	**16,981**	**18,848**	**19,755**	**21,023**	**22,424**	**24,518**	**27,077**	**30,140**	**33,748**	**37,679**
APPLICATION OF FUNDS												
Fixed Assets												
Gross Block			15,307	15,307	15,307	15,307	15,307	15,307	15,307	15,307	15,307	15,307
Less: Depreciation	-		931	1,863	2,794	3,725	4,657	5,588	6,520	7,451	8,382	9,314
Net Block	-		14,376	13,444	12,513	11,582	10,650	9,719	8,787	7,856	6,925	5,993
Capital Work-in-Progres	7,470	15,307	-	-	-	-	-	-	-	-	-	-
	7,470	15,307	14,376	13,444	12,513	11,582	10,650	9,719	8,787	7,856	6,925	5,993
Investments	-		-	-	-	-	-	-	-	-	-	-
Current Assets, Loans and Advances												
Cash and Bank Balances	-		2,605	5,403	7,242	9,442	11,774	14,799	18,289	22,284	26,823	31,685
Current Assets, Loans and Advances	-		2,605	5,403	7,242	9,442	11,774	14,799	18,289	22,284	26,823	31,685
Less: Current Liabilities and Provisions												
Current Liabilities	-											
Provision	-											
Less: Current Liabilities and Provisions	-		-	-	-	-	-	-	-	-	-	-
Net Current Assets	-		2,605	5,403	7,242	9,442	11,774	14,799	18,289	22,284	26,823	31,685
Total	**7,470**	**15,307**	**16,981**	**18,848**	**19,755**	**21,023**	**22,424**	**24,518**	**27,077**	**30,140**	**33,748**	**37,679**

RESULTS OF FINANCIAL ANALYSIS

Key Results:

- Project IRR: 28.5%
- Equity IRR: 64.5%
- Project Payback Period: 4 Yrs.
- Cash flow and balance sheet are positive and healthy. The IRR based on assumptions and criteria made is within limit cash flow and balance sheet is positive. This option is viable.

Project IRR Sensitivity of Traffic & Tariff

IRR		Traffic In Lac				
		15.4	17.3	19.3	21.2	23.1
	200	19.6%	21.6%	23.6%	25.4%	27.1%
Tariff In INI	257	24.0%	26.3%	28.5%	30.6%	32.6%
	300	27.0%	29.5%	32.0%	34.3%	36.6%
	350	30.3%	33.1%	35.8%	38.4%	41.0%
	400	33.5%	36.5%	39.5%	42.4%	45.2%

Note: Senstivity is shown at +/- 10% and +/- 20% of estimated traffic

14.5.2.4 FINANCIAL STATEMENTS for Debt Equity Ratio of 80:20 and 10% Interest Rate

Project Cost

SN	Particulars	Cost (Lakhs)
1	**Land Acquisition** Forest Charges and Land Acquisition Charges. (This includes FCA clearing, CA, NPV and Cost of trees, compensatory afforestation Acquisition of private land)	1000
2	**Environment Clearance** (Includes expenses towards consultant, data collection, report preparation, Public Hearing etc.)	50
3	Survey & Investigations (Includes Survey, Geo-Technical and Geo Physics studies)	100
4	Design, Drawing and Vetting Expenses of Main Ropeway	500
5	**Main Ropeway** equipment & technology supply (Considering Imported equipment as per CEN standard)	4800
6	Tower and other supporting Structures (indigenous Supply)	500
7	(**Material Ropeway**) (Design, supply, custom etc. of Material Handling Ropeway)	800
8	Testing, **Erection and Commissionin**g, Tools Tackles etc.	350
9	**Civil Works** Terminal Station Building, HVAC, STP, Fire System Boundary, Building interiors, furniture, Ticketing system, Tower Foundation etc.	3200

SN	Particulars	Cost (Lakhs)
10	Material Ropeway foundation, Stay, Anchors etc.	100
11	Arrangement of **Electric Power**, DG set, sub-station, etc. Power Line along the corridor, Fire system	500
12	Project Insurance	20
13	**Project Management**, Overheads	800
14	Overhead costs incl. marketing, accounting, etc.	100
15	Consultancy & pre-development charges (This includes NOCs, clearances, Legal and other Charges)	250
16	Other Services (Retail Outlets, Food Court, Parking, Advertisement etc.)	300
17	Contingencies	300
18	**Insurance and Bank Expenses** Interest during construction, Loan processing and legal assessment charges, LC Commission, BG Charges, Other Bank Charges etc.	1505
	Total	**15,175**

Income Projections – P&L A/C:

Rs./lakh										
Particulars / Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Months	12	12	12	12	12	12	12	12	12	12
INCOME										
No. of Passengers (in lacs)	19.3	19.8	20.5	21.1	21.7	22.4	23.1	23.8	24.5	25.3
Tariff (Rs) - Ropeway	257.0	270.3	284.3	299.0	314.4	330.7	347.8	365.7	384.7	404.5
Tariff Growth	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Restaurent & Retail Income Per Passe	10.0	10.5	11.0	11.6	12.2	12.8	13.4	14.1	14.8	15.5
Growth Rate		5%	5%	5%	5%	5%	5%	5%	5%	5%
Ancilliary Income	192.5	208.3	225.5	244.0	264.1	285.9	309.4	334.9	362.4	392.2
Revenue	**5,140**	**5,571**	**6,039**	**6,546**	**7,096**	**7,693**	**8,339**	**9,040**	**9,798**	**10,619**
Opearting Cost										
Employee Cost	420	462	508	559	615	676	744	818	900	990
O&M Expenses	250	263	276	289	304	319	335	352	369	388
Major Overhauling					350					350
Royalty for Ropeway	-	-	-	-	-	-	-	-	-	-
Royalty for Other Services	-	-	-	-	-	-	-	-	-	-
Advertisement Cost	50	53	55	58	61	64	67	70	74	78
Administrative Expenses	152	160	168	176	185	194	204	214	225	236
Expenses Restaurent & Retail	135	146	158	171	185	200	217	234	254	275
Total Operating Cost	**1,007**	**1,082**	**1,164**	**1,253**	**1,699**	**1,453**	**1,566**	**1,689**	**1,822**	**2,316**
Profit before Int. & Dep.	**4,133**	**4,488**	**4,874**	**5,293**	**5,397**	**6,239**	**6,773**	**7,351**	**7,976**	**8,303**
Interest on term loan	1,214	1,214	1,169	1,047	926	804	683	561	440	319
Profit before Dep.	**2,919**	**3,274**	**3,706**	**4,246**	**4,471**	**5,435**	**6,090**	**6,789**	**7,536**	**7,984**
Depreciation:										
- Building	154	154	154	154	154	154	154	154	154	154
- Plant & Machinery	481	481	481	481	481	481	481	481	481	481
- Others	288	288	288	288	288	288	288	288	288	288
Profit/(Loss) before Tax	**1,996**	**2,351**	**2,782**	**3,322**	**3,548**	**4,512**	**5,167**	**5,866**	**6,613**	**7,061**
Provision for Income Tax (notional)	219	380	550	739	841	1,122	1,321	1,525	1,738	1,872
Profit after Tax	**1,777**	**1,971**	**2,232**	**2,584**	**2,707**	**3,389**	**3,846**	**4,340**	**4,875**	**5,189**

Cash Flow:

Rs./lakh

Particulars / Year		1	2	3	4	5	6	7	8	9	10
SOURCE:											
Profit Before Interest & Depreciation		4,133	4,488	4,874	5,293	5,397	6,239	6,773	7,351	7,976	8,303
Short Term Loan		-	-	-	-	-	-	-	-	-	-
Total Sources	**A**	**4,133**	**4,488**	**4,874**	**5,293**	**5,397**	**6,239**	**6,773**	**7,351**	**7,976**	**8,303**
USES:											
Repayment of Term Loan		-	-	1,214	1,214	1,214	1,214	1,214	1,214	1,214	1,214
Repayment of Short Term Loan		-	-	-	-	-	-	-	-	-	-
Payment of Interest on Term Loan		1,214	1,214	1,169	1,047	926	804	683	561	440	319
Payment of Interest on Short Term Loan		-	-	-	-	-	-	-	-	-	-
Payment of Tax		219	380	550	739	841	1,122	1,321	1,525	1,738	1,872
Total Uses	**B**	**1,433**	**1,594**	**2,933**	**3,000**	**2,981**	**3,141**	**3,218**	**3,301**	**3,392**	**3,405**
Net Cashflow during the year	**C=A-B**	**2,700**	**2,894**	**1,942**	**2,293**	**2,417**	**3,099**	**3,555**	**4,050**	**4,584**	**4,898**
Opening Balance	**D**	**-**	**2,700**	**5,594**	**7,536**	**9,829**	**12,245**	**15,344**	**18,900**	**22,949**	**27,533**
Closing Balance	**E=D+C**	**2,700**	**5,594**	**7,536**	**9,829**	**12,245**	**15,344**	**18,900**	**22,949**	**27,533**	**32,431**

Projected Balance Sheet:

Rs./lakh	Construction period											
PARTICULARS	**C1**	**C2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SOURCES OF FUNDS												
Shareholders' Fund												
Capital -Equity	1,487	3,035	3,035	3,035	3,035	3,035	3,035	3,035	3,035	3,035	3,035	3,035
Reserves & Surplus	-		1,777	3,748	5,980	8,563	11,271	14,660	18,506	22,847	27,721	32,910
	1,487	3,035	4,812	6,783	9,015	11,599	14,306	17,695	21,541	25,882	30,756	35,945
Loan Funds												
Secured Loans	5,949	12,140	12,140	12,140	10,926	9,712	8,498	7,284	6,070	4,856	3,642	2,428
Unsecured loan			-	-	-	-	-	-	-	-	-	-
	5,949	12,140	12,140	12,140	10,926	9,712	8,498	7,284	6,070	4,856	3,642	2,428
Total	**7,436**	**15,175**	**16,952**	**18,923**	**19,941**	**21,311**	**22,804**	**24,979**	**27,611**	**30,738**	**34,399**	**38,373**
APPLICATION OF FUNDS												
Fixed Assets												
Gross Block			15,175	15,175	15,175	15,175	15,175	15,175	15,175	15,175	15,175	15,175
Less: Depreciation	-		923	1,847	2,770	3,693	4,617	5,540	6,463	7,387	8,310	9,234
Net Block	-		14,252	13,329	12,405	11,482	10,559	9,635	8,712	7,789	6,865	5,942
Capital Work-in-Progres	7,436	15,175	-	-	-	-	-	-	-	-	-	-
	7,436	15,175	14,252	13,329	12,405	11,482	10,559	9,635	8,712	7,789	6,865	5,942
Investments	-		-	-	-	-	-	-	-	-	-	-
Current Assets, Loans and												
Advances												
Cash and Bank Balances	-		2,700	5,594	7,536	9,829	12,245	15,344	18,900	22,949	27,533	32,431
Current Assets, Loans and Advances	-		2,700	5,594	7,536	9,829	12,245	15,344	18,900	22,949	27,533	32,431
Less: Current Liabilities and												
Provisions												
Current Liabilities	-											
Provision	-											
Less: Current Liabilities and Provisions	-		-	-	-	-	-	-	-	-	-	-
Net Current Assets	-		2,700	5,594	7,536	9,829	12,245	15,344	18,900	22,949	27,533	32,431
Total	**7,436**	**15,175**	**16,952**	**18,923**	**19,941**	**21,311**	**22,804**	**24,979**	**27,611**	**30,738**	**34,399**	**38,373**

RESULTS OF FINANCIAL ANALYSIS

Key Results:

- Project IRR: 28.5%
- Equity IRR: 66.6%
- Project Payback Period: 4 Yrs.
- Cash flow and balance sheet are positive and healthy. The IRR based on assumptions and criteria made is within limit cash flow and balance sheet is positive. This option is viable.

Project IRR Sensitivity of Traffic & Tariff (Table 14.3):

IRR		Traffic In Lac				
		15.4	17.3	19.3	21.2	23.1
	200	19.6%	21.7%	23.6%	25.4%	27.1%
Tariff In INR	257	24.0%	26.3%	28.5%	30.7%	32.7%
	300	27.1%	29.6%	32.0%	34.4%	36.7%
	350	30.4%	33.2%	35.9%	38.5%	41.1%
	400	33.5%	36.6%	39.6%	42.5%	45.3%

Note: Senstivity is shown at +/- 10% and +/- 20% of estimated traffic

15

Environmental impact assessment

15. ENVIRONMENTAL IMPACT ASSESSMENT

15.1. Environmental clearance

15.1.1. Applicable Acts and Rules

The Environment (Protection) Act, 1986, amended 1991, was introduced as umbrella legislation that provides a holistic framework for the protection and improvement of the environment. In terms of responsibilities, the Act and the associated Rules requires for obtaining environmental clearances for specific types of new/expansion projects (as per Environment Impact Assessment Notification 2006) and submission of an environmental impact assessment plan.

Environmental Impact Notification S.O.1533 (E), dated 14 September 2006, as amended 2009, issued under the Environment (Protection) Act 1986, has made it mandatory to obtain environmental clearance for scheduled development projects. The notification has classified projects under two categories 'A' & 'B'. Category "A" projects (including expansion and modernization of existing projects) require clearance from Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India (GoI) and for category B from State Environmental Impact Assessment Authority (SEIAA), constituted by Government of India.

15.1.2. Applicability

All aerial ropeway projects as per the EIA notification, 2006 and its amendments of December 2009 fall under Category B. In the event, the project is located in whole or in part within 10 km from the boundary of Protected areas notified under the Wildlife (Protection Act), 1972 and if the project is located at an altitude of 1000 metre and above, the same shall be treated as Category A project.

The proposed ropeway project has been categorized under item 7 (g) and is a designated project as per Schedule and falls under category "A" as it falls within 10 Km of Rajaji National Park.

Project Activity		Category With Threshold Limit		General Conditions (GC) Apply*
		A	B	
7(g)	Aerial Ropeways	All projects located at altitude of 1000 mts and above All projects located in notified ecological sensitive areas	All projects except covered in column 3	

* "Any project or activity specified in Category 'B' will be treated as Category 'A' if located in whole or in part within 10 km from the boundary of: (i) Protected areas notified under the Wildlife (Protection) Act, 1972; (ii) Critically polluted areas as identified by the Central Pollution Control Board from time to time; (iii) Eco-sensitive areas as notified under section 3 of the Environment (Protection) Act, 1986, such as, Mahabaleswar Panchangi, Matheran, Pachmarhi, Dahanu, Doon Valley and (iv) inter-state boundaries and international boundaries

Provided that the requirement regarding distance of 10km of the inter-state boundaries can be reduced or completely done away with by an agreement between the respective states or U.Ts sharing the common boundary in the case the activity does not fall within 10 kilometers of the areas mentioned at item (i), (ii) and (iii) above

Environmental Impact Assessment (EIA) is a planning tool generally accepted as an integral component of sound decision-making. EIA is to give the environment its due place in the decision-making process by clearly evaluating the environmental consequences of the proposed activity before action is taken. Early identification and characterization of critical environmental impacts allow the public and the government to form a view about the environmental acceptability of a proposed developmental project and what conditions should apply to mitigate or reduce those risks and impacts.

Environmental Clearance (EC) for certain developmental projects has been made mandatory by the Ministry of Environment & Forests through its Notification issued on 27.01.1994 under the provisions of Environment (Protection) Act, 1986. Keeping in view a decade of experience in the Environmental Clearance process and the demands from various stakeholders, the Ministry of Environment, Forest and Climate Change (MoEFCC) issued revised Notification on EC process in September 2006 and amended it in December 2009. It was considered necessary by MoEFCC to make available EIA guidance manuals for each of the development sectors.

The EIA Notification 2006 not only re-engineered the entire EC process specified under the EIA Notification 1994 but also highlighted the need to introduce specific sectors/categories under the

sectors such as Industry and Infrastructure and also introduced new sectors such as Construction to be brought in the ambit of the EC process based on their extent of impacts on the environment.

The EIA Notification 2006 attached as **Annexure "EIA Notification 2006"** has notified 39 developmental sectors, which require prior environmental clearance. Based on the capacity, the Projects have been categorized into Category A or B which has been further categorized as B1 or B2.

The MOEFCC at the first instance decided to bring out EIA Sector Specific Manuals for 37 developmental projects and the prepared EIA Manuals of ten of these Sectors including aerial ropeways.

The manual provides information and guidance on Environmental Impact Assessment in aerial ropeway projects. Particular emphasis is given to concepts, procedures and tools that are used currently or are potentially relevant in preparing environmental impact assessment reports for clearance from regulatory agencies. EIA is a technical exercise, to predict environmental impact, assess their significance, and provide recommendations for their mitigation. The assessment covers the construction and operation of the development and future expansion. EIA report covers a wide range of technical disciplines and covers areas such as noise and vibration, air quality, ecology, water quality & hydrology, archaeology & cultural heritage, landscape & visual character, sustainability and socioeconomics. The EIA report will describe how the project has been improved through the EIA process and what alternatives are considered.

15.1.3. General information on aerial ropeways

Aerial ropeway development will have a limited impact on the environment through activities like construction work, installation and other related activities. Aerial ropeway development and operation shall, therefore, be planned with careful consideration of their environmental impact. The preparation of the EIA report and implementation of EMP is essential for effectively managing these adverse effects. The choice of a particular type of aerial ropeway will depend upon the length and topography of the route, the type and intensity of traffic and the relative inaccessibility of the site.

15.2. Passenger Ropeway Categories included in EIA Manual of Environmental Clearance (EC)

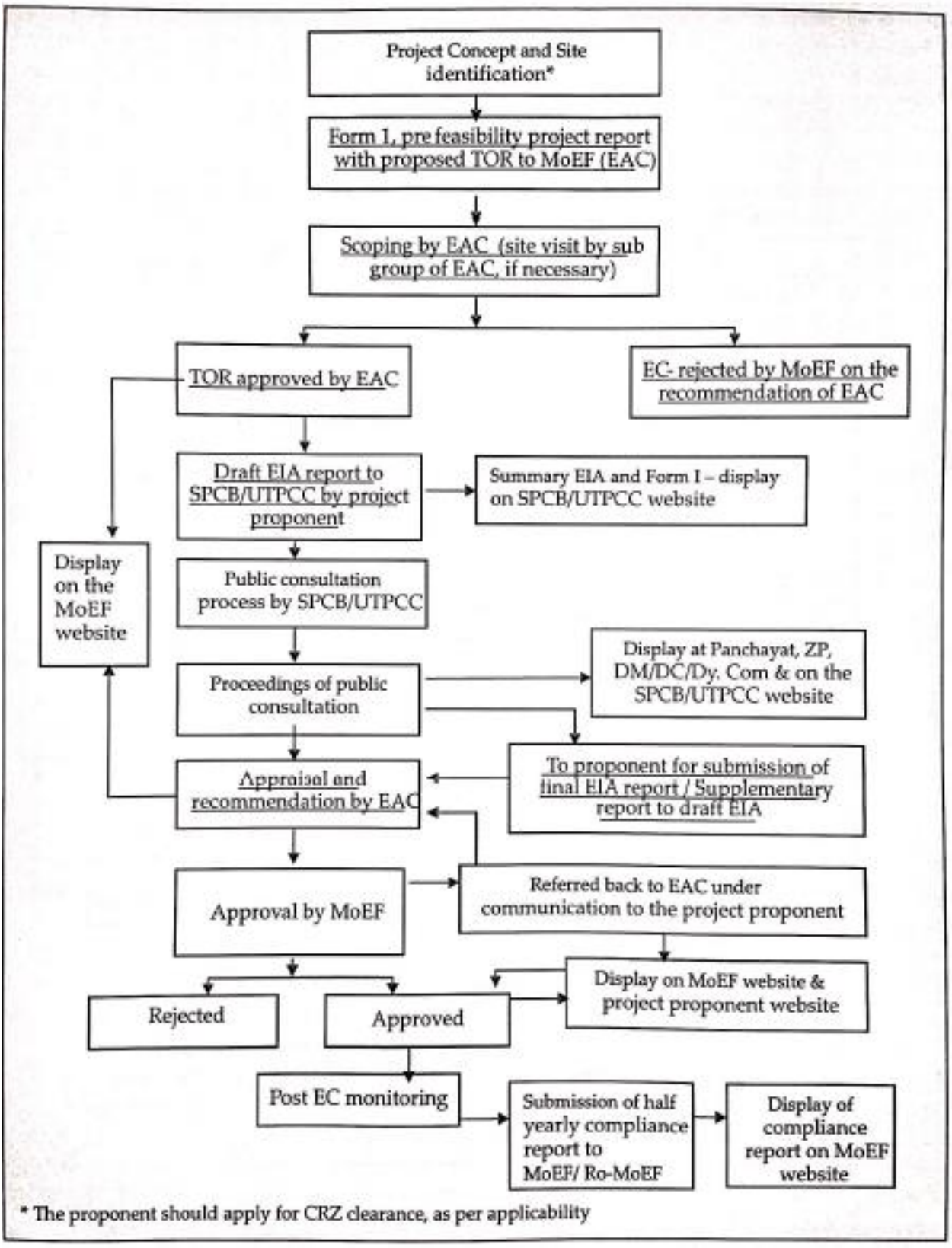
- Aerial ropeways (single and double reversible) which are defined as Ropeways on which passengers are transported in cable-supported carriers and are not in contact with the ground or snow surface, and in which the carrier(s) reciprocate between terminals. Aerial tramway systems may have a single carrier or group of carriers, that move back and forth on a single path of travel; or, two carriers, or groups of carriers, oscillating between terminals on two (usually very nearly parallel) paths of travel. The systems may be mono-cable or bi-cable.
- Aerial lifts (detachable lifts, chair lifts, and similar equipment) which are defined as Ropeways on which passengers are transported in cabins or on chairs and that circulate in one direction between terminals without reversing the travel path.

- Surface lifts (T-bar lifts, J-bar lifts, platter lifts, and similar equipment) which are defined as Ropeways on which passengers are propelled through a circulating overhead wire rope while remaining in contact with the ground or snow surface. The connection between the passengers and the wire rope is through a device attached to, and circulating with, the haul rope, known as a "towing device."

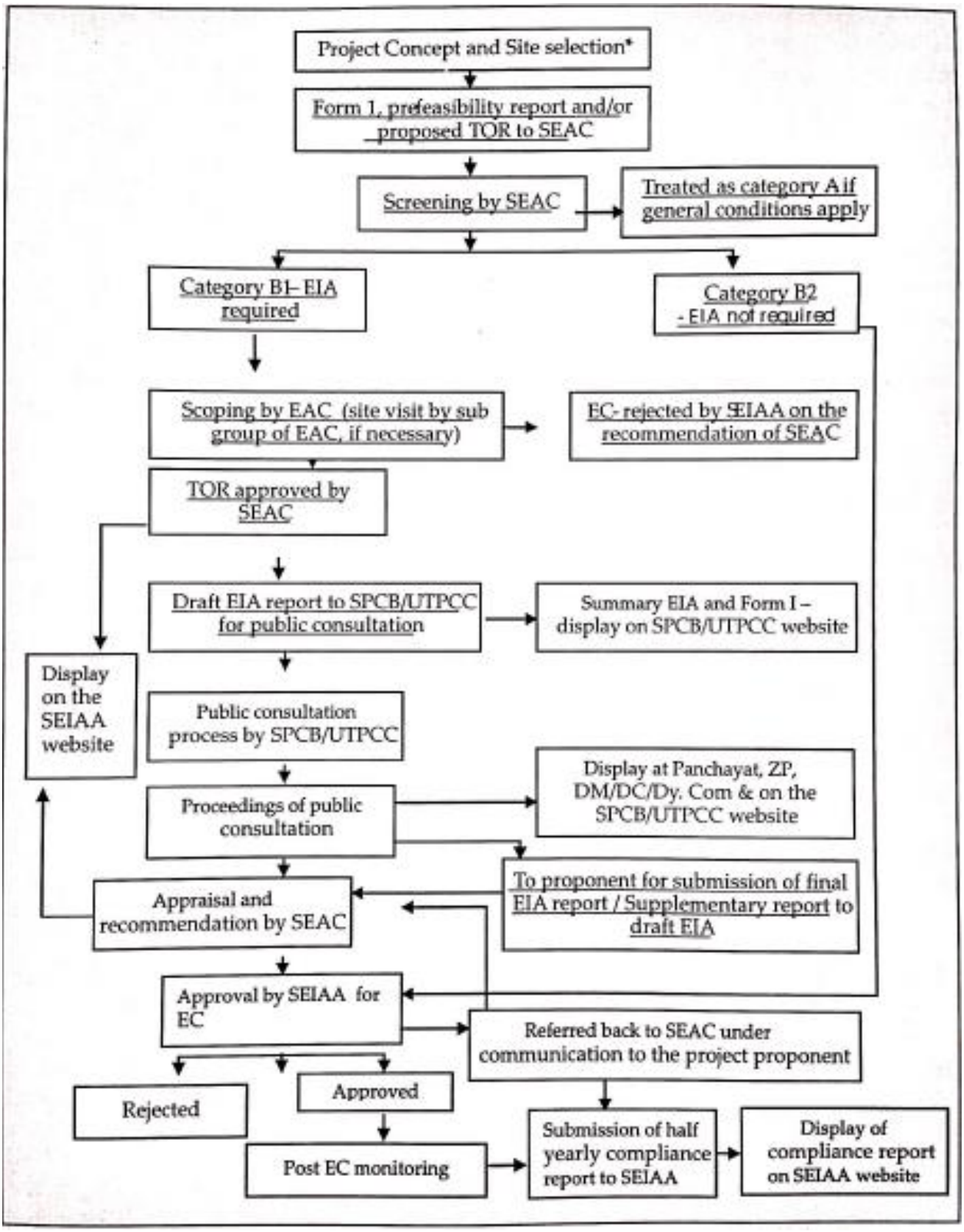
15.3. Environmental clearance process

The EC process will be as specified in the EIA Notification, 2006 and its amendments of December 2009. The suitability of the site proposed for the proposed development will be one of the primary concerns in according environmental clearance to the project.

Continue…



Environmental Clearance Process for Category A projects **(Image 15.1)**



Environmental Clearance Process for Category B projects (Image 15.2)

For the projects located within 10 km of the National Parks, Sanctuaries, Biosphere Reserves, Migratory corridors of wild animals, the project proponent shall submit the map duly authenticated by Chief Wildlife Warden showing these features vis-à-vis the project location and the recommendations or comments of the Chief Wildlife Warden thereon (at the stage of EC)

All correspondence with the Ministry of Environment & Forests including submission of application for Environmental Clearance, subsequent clarifications, as may be required from time to time, participation in the EAC meeting on behalf of the project proponent shall be made by the authorized signatory only. The authorized signatory should also submit a document in support of his claim of being an authorized signatory for the specific project.

15.4. Terms of reference

The terms of reference (TOR) pertinent to the preparation of EIA study reports for construction of aerial ropeways will be as per TOR as given in EIA Manual of the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India.

In addition, the proponent is required to identify specific issues, if any, pertinent to the project and include those issues also in the TOR for preparation of EIA and EMP report upon approval of the TOR by the Expert Appraisal Committee.

The 'TOR' will include the Environment Impact Assessment and Environment Management Plan.

- Environment impact assessment: This report will be a comprehensive document covering the project description, analysing alternative solutions to the problem the ropeway is solving and describe the overall environmental impact.
- Environmental management plan: This is a site specific plan developed to ensure that the project is implemented in an environmentally sustainable manner where all stakeholders understand the potential environmental risks arising from the project and take appropriate actions to manage that risk.

The environmental assessment process endeavours to assess the impact due to project and mitigate & prevent undesirable impacts of developmental activities. It is to guide project proponents in making the right investment in land, manpower, technology and mitigation measures to ensure that projects have the least possible impacts on the environment.

The environmental study for ropeway projects involves several steps, starting from a clear understanding of the development objectives, collection of baseline data, and evaluation of alternatives to the overall assessment of the environmental impact of the selected alternative. The involved activities are:

15.5. Steps for environment assessment study

15.5.1. Project need and advantages

The population of Hardwar city is expanding at a high rate. The situation has further deteriorated due to a limited road network and carriageway resulting in perpetual congestion on the main as well as arterial roads within the city.

The existing transportation infrastructure of Haridwar is inadequate. Considering the proposed future growth pattern of the city, it is imperative to have a reliable transport system in place and thus an aerial ropeway is proposed to provide connectivity between the Har Ki Pauri & Chandi Devi Temple.

15.5.2. Baseline data collection

The basic data collection Performa has been developed and the information is placed in the Table below:

Table – 1: Data collection during the reconnaissance		
1	Climatic condition / Meteorological Data ➢ Rainfall ➢ Temperature max & minimum ➢ Humidity ➢ Wind speed & wind direction	As per attached data in the report
2	Vegetation in the area	Growth rapid
3	Nearby ecological sensitive area– forest, reserve forest, wildlife sanctuary, wetland	Rajaji National Park
4	Geology of the area	Soil to rock
5	School, college, the hospital in the nearby area	Yes
6	Traffic on the road & traffic projection	As per Traffic survey Data
7	Connectivity of the alignment – tourist importance, connected to industrial, towns &cities, school, college, hospital, markets and port	Connectivity of alignment is to Chandi Dev Temple.
8	Source of construction water	Available
9	Status of surface water bodies – pond, river, stream in the nearby area	Not affected
10	Status of groundwater	Available
11	Disposal area/sites near the alignment to accommodate surplus earth	N.A.
12	Importance of the road to the connecting habitations	For providing socio-economical upliftment.
12	Analysis of alternatives for alignment selection	Suitable and best alignment selected
14	Air quality in the area	Good
15	Water quality in the area	Good
16	Road safety analysis	Cautionary/informative boards have been considered for provision crash barriers at

Table – 1: Data collection during the reconnaissance		
		sharp or blind curves, parapets over retaining walls
17	Soil quality	Ordinary Soil and soil mixed with Boulders to Hard Rock
18	Nature of terrain	Mountainous to steep
19	Any flood hazard	Nil
28	Erosion potential	Erosion potential has taken care of by providing soil protection measures and Vegetation turf to prevent erosion slope. However, the requirement is very little.
20	Nature of the land	Forest /Government Land
21	Displacement of households	Not required

15.6. Physical and environmental features

In order to have a complete assessment of the project, the physical and environmental features are brought out in the Table below:

Physical and environmental features		
SN	**Particulars**	**Selected Alternative**
1	Ropeway Length (Kms)	As per datasheet
2	Terrain (Plain rolling / hilly)	Hilly
3	Land width Proposed in Line (m)	15 m
4	Flood hazard (encroachment on a flood plain)	Nil
5	Erosion potential	Nil
6	Landslide potential	Nil
7	Stretch in the geologically unstable area	Nil
8	Major river crossings	1
9	No. of road intersections	1
10	No. of railway crossings	Nil
11	Number and type of utilities requiring relocation	Nil
12	Possibility of providing wayside amenities	Parking and other amenities
13	Air quality (very poor, poor, fair, good)	Good
14	Noise impact	Nil

15.7. The beneficial impact of the ropeway project

The Beneficial Impact of the proposed Ropeway Project is given in the table below. It is observed that this ropeway has much positive impact on the socio-economic aspects and the development of the region.

Beneficial impacts for ropeway project	
Employment Opportunity to People	Yes. The project offers good employment opportunity to skilled/unskilled workers and technical person.
Enhancement of Local Industry, Agriculture and Handicrafts	Yes.
Income from Visitors and Taxes	Yes. Passenger traffic will increase to enhance income and taxes
Transporting, Processing and Marketing of agricultural products	NA
Opening up of opportunities for new occupations	Yes. The fast and economical movement will open the opportunity for new occupations.
Approach to quick services and safety	Yes. Time-saving due to short length and uninterrupted movement.
Improved quality of life for people and so on	Yes. The project will substantially contribute to improvement in the quality of life.
Air quality affected by vehicular exhaust smoke with reference to SPM, NOx, CO, HC and lead	Will reduce as the project will reduce the requirement of vehicular movement in the cities.
Increase in traffic litter, noise and dust pollution	Will reduce.
Spell of toxic and hazardous chemicals from the carriers of Ropeway for transportation of such material	No
Any hazardous by product	No

15.8. Negative impact

There is no visible negative impact of this Ropeway project on spoiling and destroying environmental issues and features of the region and the project influence area.

The basic environmental parameters have been broadly brought out and are tabulated in the Table below:

Some environmental parameters associated with the transportation sector project		
	Environmental Parameters	
1	Surface Water Quality	Good; Not going to be effected
2	Air Quality	Good; Not going to be effected

Some environmental parameters associated with the transportation sector project		
	Environmental Parameters	
3	Seismology / Geology	Hard Rock area The good girth of vegetation in soil mixed with boulder area
4	Erosion	Nil
5	Fisheries	No
6	Forests	Light Forest mainly of bamboo forest.
7	Terrestrial Wildlife	Nil
8	Noise	No
9	Land use	Frequently alternated cultivation
10	Aesthetics	Beautiful and scenic
11	Industries	Nil
12	Resettlement	Nil There is no habitation requiring relocation
13	Archaeological / Historic	Nil
14	Significance	Transportation / Economical concern
15	Public Health	Not effected
16	Socio-Economic	Good prospects

15.9. Utilities/Amenities

Water

The water requirements for the proposed project will be met through the municipal source. Wastewater will be generated and will be discharged into the municipal sewer in the area.

Power

The power supply will be made available from the state electricity board.

Waste

The waste collection frequency will be daily and the waste will be handed over to the Municipal Corporation.

Manpower

The operation of the proposed project will involve the employment of about skilled and semi-skilled staff.

Parking

Parking facilities have been provided at the terminal stations. Multilevel parking may be provided to accommodate cars and two-wheelers.

15.10. Impact assessment and management plan

Adequate environmental management measures will be incorporated during planning, construction and operating stages of the project to minimize any adverse environmental impact and ensure sustainable development of the area. The impacts during the construction phase will be temporal. The summary details the pollution sources, mitigation measures for operation phase for different components.

15.11. Environment management plan

The ropeway is most Environmental Friendly mode of Transportation.

We are listing here:-

All major activities likely to impact the environment

The mitigation measures to be taken to reduce impacts on the environment

Based on this study, we have prepared the preliminary Environmental Management Plan (EMP).

However detailed Environmental Impact Assessment Study and subsequently Environmental Management Plan shall be made with the help of best available experts in the field after allocation of the project.

15.12. Identification of Environmental Activity Impact

Construction phase		
	Activity	**Proposed Management / Mitigation Measures**
1	**Air Emissions** • Dust and air emission particularly due to the excavation, construction, movement of vehicles, concrete mixing machinery, & DG set resulting in air pollution.	• Provision of spraying water to reduce dust emission. • The amount of exposed ground and stockpiles will be minimized so that re-suspension due to wind and subsequent dust fall is prevented. Heights of stock piles should control dust fall in nearby areas. • Ensuring all vehicles, generators and compressors are well maintained and regularly serviced. • The connection will be taken from State Electricity Board during the construction phase, & DG set would be kept as stand by
2	**Topography, Drainage** • The excavation and filling work may	• Construction at the site would be planned in such a way that natural drainage pattern would not get affected.

Construction phase		
	Activity	**Proposed Management / Mitigation Measures**
	change the ground level. • The stock of topsoil	• Arrangement of the soil will be such that runoff does not carry away topsoil but reaches the water bodies with which it is linked.
3	**Workforce & Arrangement** • Workers numbering 50 will be working at the site. • About 4.5m3/day of water will be required for drinking and washing purposes.	• Local workers will be employed, as far as possible. • Water will be arranged as per local rules.
4	**Soil and Groundwater contamination due to** • Contamination of soil due to leakage of oil from vehicles & equipment. • Spillage of the concrete mixture containing additives and plasticizers. • Spillage of construction material containing heavy metals, paints, coating, liners etc.	• Spillage of oil from construction vehicles and equipment will be avoided. These should be inspected by the supervisor for any leakage of oil. • The contamination of soil will be avoided by suitable soil conservation measures. • Care will be taken to compact the soil after refilling so that, soil erosion and consequent soil import is avoided • Special care will be taken during deliveries of construction materials. • Ensure that workers know what to do in the event of a spillage. It will be ensured that all deliveries are supervised by a responsible person.
	Activities	**Proposed Management / Mitigation Measures**
5.	**Noise generation** • Construction noise mainly due to excavation, plying of vehicles, operations of construction machinery, operation of DG sets etc.	• The vehicles used will be with the standard limiting noise output. • Wherever this cannot be achieved the area will be earmarked as a high noise level area requiring the use of ear protection gadget. • Regular monitoring should be done so that appropriate measures can be taken • DG set would be provided with acoustic enclosures

	Activities	Proposed Management / Mitigation Measures
6.	**Storage and Handling of Concrete**	• Storage of all potentially Polluting substances will be located on impermeable surfaces with controlled drainage. • Storage areas will be fenced off and, when not in use, locked to prevent theft and vandalism. • Cement powder will be stored under cover and kept dry to prevent wastage.
7.	**Ecology Flora** • Cutting of tree at site Diversion of forest land for non-forest purpose.	• Compensatory afforestation will be carried at the designated land as per the rules if required.
8.	**Solid Waste & Hazardous Waste Generation of the following waste** • Recyclables – Cement bags, waste paper, unusable steel scrap and cardboard packing material • Inert – Excavated earth and concrete debris • Waste oil from DG set	• Recyclables will be sold to authorized vendors/recyclers • Inert material will be used as much as possible for the internal road construction and leftover will be sold to the road contractor • Waste oil will be stored in HDPE drums and will be sold to authorized recyclers
9.	**Socio-economic environment** • Workers numbering 40 - 50 will be working temporarily at the site during construction of ropeway.	• Direct & indirect temporary employment opportunity.

Operation Phase		
	Activity	**Proposed Management / Mitigation Measures**
1.	**Soil & Groundwater** • Contamination of soil due to spillage of oil from ropeway machinery	• In planning and carrying out any works, precautions will be taken to ensure the complete protection of watercourses and groundwater against pollution.

Operation Phase		
	Activity	**Proposed Management / Mitigation Measures**
	• The stock of topsoil	• Construction at the site would be planned in such a way that natural drainage pattern would not get affected. • Arrangement of the soil will be such that runoff does not carry away topsoil but reaches the water bodies with which it is linked.
2.	**Noise** • Generation of noise due to the operation of DG sets etc. • Noise generation due to inflow of pilgrims.	• DG set would be provided with acoustic enclosures. • Pilgrims would be guided properly with signboard and queue.
3.	**Water** • Consumption of water and generation of waste	• Water will be arranged as per local rules. • Wastewater will be treated in the septic tank/soak pit system.

Social Impact Assessment

The Aerial ropeway project does not lead to the displacement of the population.

15.13. Project Benefits

- The proposed ropeway will provide a safe and comfortable means of transport and will also reduce the travel time significantly.
- Direct and indirect jobs will be generated both during construction and operation phase
- It will provide the opportunity to enhance tourist activities
- It will provide an easy and fast way for evacuation during emergencies.
- Income generation avenues will increase in area.
- View of the surrounding can be better enjoyed by a ride in the ropeway.

Comfort:

- Leave traffic Jam below them
- Offer frequent service
- Fast as they take the most direct route
- Provide no wait service
- Barrier-free access

Environment friendly:

- No Air emissions
- No Noise pollution
- No Hazardous by product
- Least Tree cutting

Easy to integrate - Ropeway can be used

- As a system extension
- As an additional branch line to existing public transport systems;
- As an independent transport system;

Reliability:

- Most reliable in terms of service
- Most adaptable in any terrain
- Least land requirement
- Least installation time.

15.14 Environmental Management Cell

An environment management cell shall be created which shall perform the following functions:

- Achieve the objectives of the 'Environment Protection Policy' of the management.
- Carry out 'Projects' in each thrust area to arrive at practical solutions to environmental problems.
- Discuss the reports of study on environment and disseminate the information.
- Work out 'Action plan' for implementation of the recommendations made in the reports.
- Prepare Management Information System (MIS) reports and budget for the environmental management program.
- The Plant Manager will be responsible for environmental issues at the plant.

The responsibilities of the various members of the environment management cell are given in the table below as follows:

Environment Management cell

S#	Designation	Proposed responsibility
1.	Ropeway Head	• Overall responsibility for environmental management and decision making for all environmental issues. To identify and recommend all kinds of major improvements to be taken in a Financial year
2.	Plant In-charge	• Ensure environmental monitoring as per appropriate procedures. Ensure correct records of generation, handling, storage,

		transportation and disposal of solid hazardous wastes. To monitor and ensure the implementation of the improvements. To co-ordinate the rescue and evacuation during a disaster.

Conclusion

The proposed project is aimed at the infrastructural development of the area. The project will provide impetus to the growth of Haridwar. The project will provide a safer means of transportation to visitors.

All possible environment aspects have been adequately assessed and necessary control measures have been formulated to meet with statutory requirements, in the preparation of this EIA-EMP report. Thus implementing this project will not have any appreciable negative impacts.

Thus, it can be concluded on a positive note that after the implementation of the mitigation measures and Environmental Management Plan, the proposed project will have a negligible impact on the environment and will benefit the local people.

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Socio-Economic Impact Analysis

16. SOCIO-ECONOMIC IMPACT ANALYSIS (SEIA)

SEIA is the systematic analysis used to identify and evaluate the potential socio-economic and cultural impacts of a proposed development on the lives and circumstances of people, their families, and their communities. The idea is to ascertain, if such potential impacts are significant and adverse, SEIA can assist the developer and the government to find ways to reduce, remove or prevent these impacts, if any, from happening.

The proposed Haridwar Ropeway Project has a favourable socio-economic impact. The major facts are mentioned below:-

i. Impact on the locals/tourists:

Quick and barrier-free transport facility is available throughout the year in terms of:

- Access to better services
- Reduced travel time
- Better mobility
- Reduced pollution
- Reduced physical hardship; a safer way of travel
- Value for money

ii. Impact on the local economy:

- With increased tourist traffic due to better facilities, more economic activity will follow thus leading to direct & indirect income for locals.
- With a reduced time of transportation, a large number of transit passengers, en route to other tourist centres like Dehradun & Char Dhaam Yatra shall start visiting the Temple, thereby further improving the local economy.
- Better transportation infrastructure, improved access to and from the community.
- Improvement in living conditions of the people of the region with increased developmental activity.

iii. Impact on state government

- Addition to the existing tourist attractions in the state leading to enhancement in the number of tourists and exchequer to the state economy.
- Provision of the safe mode of transport for the people.
- Better infrastructure with private sector participation in facility creation
- An additional avenue for revenue in the form of revenue share from the operator of the ropeway
- Improved perception about the developmental work in the region
- Better crowd management
- Better monitoring
- Less pollution leading to a cleaner environment.

iv. Impact on the environment

- The minimal burden on the existing ecology
- Minimal tree cutting, no damage to the green cover
- Minimal pollution due to the use of the eco-friendly mode of transport

There are not only some of the direct impact of tourism on GDP of the state but also take into account its wider impacts, i.e. the indirect and induced impacts. Past studies at various tourist locations have also indicated that the indirect contribution of tourism to GDP is significantly higher than the direct contribution.

v. Direct Contribution of Tourism To GDP:

The direct contribution of Travel and Tourism to GDP comprises total spending within a particular country on travel and tourism by domestic and foreign tourists as well as spending by government on related services directly linked to visitors, such as cultural (e.g., museums) or recreational (e.g., national parks). According to the World Travel and Tourism Council, the direct contribution of tourism in India is forecasted to grow at a CAGR of 8 per cent over the next decade.

vi. Indirect and Induced Contribution of Tourism to GDP:

This comprises investment spending (like the construction of new hotels), government collective spending, purchases done by sectors dealing directly with the tourists, and jobs supported by the spending of people employed in the tourism industry. The indirect and induced contribution is forecasted to grow at CAGR of 9 per cent over the next decade.

In general, the impact of ropeway on city development, though generally positive, has varied outcomes, based on the route, level of integration with other modes, and characteristics of the areas served. In impoverished areas, it has been implemented in conjunction with new public facilities, spaces and services to revitalize and integrate the areas; provide significantly reduced travel times to destinations/traffic nodes.

In other areas, where ropeway was implemented primarily for tourists, it has provided a reliable, pleasant and fast means of travelling to popular destinations, without being affected by automobile and pedestrian movements. Property values have improved in impoverished areas because of improved connectivity to the area and other socio-economic benefits of ropeway implementation.

Moreover, ropeway stations/terminals will be integrated with existing parking, roads and pilgrim hubs thus increasing the value for the users. This should give users a seamless traffic flow thus addressing the problem of congestion on roads and leading to a considerable reduction in time.

Minimum footprint:

- Urban transportation ropeways have low space requirement and the ability to avoid obstacles on the way to create the shortest route.
- Ropeways provide consistent travel time, unaffected by the traffic situation or weather conditions.

- Ropeways take an exclusive route to connect destinations and hence provide a breath-taking aerial view.
- Ropeways are eco-friendly modes of transporting with no harmful emissions and are practically noiseless.

i. Reduced emission of polluting particles:

Aerial passenger ropeways have minimal environmental impacts to the surrounding ecology because of their elevated transportation and isolated/distant tower locations.

Compared to other modes of transit, especial modes that are powered by fossil fuel, the operation of aerial ropeways are environmentally benign. There is no emission of any greenhouse gas from the ropeways and there is no generation of noise and water pollution.

In hilly terrain, the weight of the descending cabins can supplement the electric power required to drive the ascending cabins, resulting in excellent energy efficiency.

This will lead to:-

1. Reduction on the emission of harmful gases.
2. Zero Noise pollution.
3. Absence of Hazardous by-products.
4. Reduced Tree cutting.

Environmental impact:

Minimal and Benign

Aerial Passenger Ropeways have minimal environmental impacts to the surrounding ecology because of their elevated transportation and isolated/distant tower locations.

A ropeway's greatest potential impacts may be associated during construction rather than during operation. The impact during construction can be minimized with careful management and mitigation measures. Material ropeway should be used for localized shifting of construction material and ropeway components.

Compared to other modes of transit, especial modes that are powered by fossil fuel, the operation of aerial ropeways are environmentally benign. There is no emission of any greenhouse gas from the ropeways and there is no generation of noise and water pollution.

For the sustainability of a ropeway project, it mustn't create any adverse effects for the community or natural eco-system. Before executing the project, we a study will be conducted to understand the impact on the environment. A plan will be designed and executed to ensure no damages to our eco-system during both construction & operation.

Social impact:

With communities surrounding new mass transit transport modes, varying concerns often arise regarding pollution, noise, aesthetics, safety, upkeep, vibration etc. among other things. Examples of aerial passenger ropeways have shown that minimal environmental impact is possible.

For commuters using an aerial ropeway system, cabin comfort and extensive views have the possibility of improving the enjoyment of a passenger's trip. These elements combined with direct and timely travel can often increase ridership through mode shift from other transportation types.

The proposed passenger ropeway system in Haridwar will have a positive impact on the environment and social aspects for residents as well as tourists.

The main benefits of envisaged are:-

1. Decongestion in the central area.
2. Safe and reliable mode of Transportation.
3. Reduction in travel time to destination.
4. Reduction in the pollution level of the city.
5. Can be integrated with the existing public transportation system.
6. Can be extended to other locations Leave traffic Jam below them.
7. Offer continuous service.
8. Fast mode of transportation by taking direct routes.
9. More flexible schedule and higher service frequency.
10. Easier access.

Integration with existing systems:

Impact on existing infrastructure is minimal as it can be easily integrated with present infrastructure and can be used as:-

1. a system extension;
2. an additional branch line to existing public transport systems;
3. an independent transport system;

With the ropeway coming up, the economic benefits to the tourism sector will be widespread.

- During the construction phase, the increase in the workforce will be both temporary (till project completion) and permanent (project team).
- During the operation phase, the ropeway development will create many jobs.
- With the tourism economy improving, the supply of hotels, restaurants and shops will also increase to service the increasing demand.

The ropeway facility will have a positive impact on the number of tourists visiting Haridwar and will lead to enhancement of Tourist activities thereby enhancing direct & indirect employment for locals. Overall, Aerial ropeway Transit system will help in improving the socio-economic status of the residents. It will also be an attraction for tourists visiting Haridwar, which again will lead to an overall enhancement in the socio-economic status of its residents.

Uttarakhand Metro Rail, Urban Infrastructure & Building Construction Corporation Limited

17

Aerial passenger ropeway safety and performance

17. AERIAL PASSENGER ROPEWAY SAFETY AND PERFORMANCE:

SAFETY FEATURES ENSURE MINIMAL RISK

Over 40,000 aerial passenger ropeways have been built and operated worldwide with an estimated 4.5 billion Passengers transported annually. Gondolas, trams and chairlifts are considered to be a safe and secure technology for the transportation of people. Travellers are 20,000 times more likely to be involved in a fatal accident in a car than they are in a gondola.

There are numerous redundancies and secondary systems designed and built into the construction and aerial passenger ropeway technologies to ensure reliability and safety. Specific safety features for a ropeway include:

- **Back-up Generators –** In the event of a primary engine failure, secondary diesel generators are typically available to continue operation.
- **Secondary Bearing System –** The main bull wheels in each terminal may have a secondary set of bearings in the event of primary bearing failure.
- **Tire Conveyor Redundancy –** Both the accelerator and decelerator conveyors have secondary lines with separate power in the event of a primary failure.
- **Recovery concept** -
  If secondary power fails and on-line rescue is required, **comprehensive evacuation guidelines** are implemented and carried out by specially trained personnel. The form of the evacuation depends on lift type and site conditions.

There are several redundant systems of rescue in a ropeway installation like:-
The rescue of stranded passengers can be carried out by the following method:-

- **Two independent hydrostatic emergency drives:-**
  - Hydraulic motor drive via ring gear on the bull wheel at the drive station.
  - Hydraulic motor drive via ring gear on the bull wheel at the return station.

In emergency cases, the passengers will normally stay in the cabins and will be brought back to the stations employing emergency drives.

- If the ropeway cannot be operated at all, the passengers stranded on the line can be evacuated in their cabins using the existing rescue device.
- There is always a trained team with required equipment in ropeway.

It will be ensured that each tower is accessible e.g. for maintenance and rescue purposes.

- In case, it is impractical to evacuate the cabins into the forest below.
- Using the recovery concept, each cabin is winched back to the terminal at slow speed and passengers are evacuated.

Boarding & De-boarding:

Safe loading and unloading of the cabins are facilitated by low cabin speeds in the terminals and as required, the lifts can be halted for short periods. The cabin floor flushes with station floor to avoid any discomfort or safety hazard to passengers during boarding and de-boarding.

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18

Institutional and legal framework

18. INSTITUTIONAL AND LEGAL FRAMEWORK

18.1. Authority and institutional set up

18.1.1.Concessioning Authority

The Concessioning Authority to grant to the selected party, a Concession to design, finance, construct, operate and maintain the Passenger Ropeway and facilities in the Specified Location, on Design, Build, Finance Operate and Transfer (DBFOT) basis.

18.1.2.Concessionaire

The selected bidder may himself become the Concessionaire or promote and incorporate Project Special Purpose Vehicle Company (a limited liability company under the Companies Act 2013) as the Concessionaire and that entity shall undertake and perform the obligations and exercise the rights of the selected bidder including the obligation to enter into Concession Agreement and execution, operation and maintenance of the Project.

18.1.3 Ropeway monitoring Committee

On the Commencement Date, the Concessioning Authority shall appoint a Ropeway Monitoring Committee (RMC). The RMC shall consist of representatives of the following and any other member duly nominated by the Concessioning Authority:

i) Two representatives of the Concessioning Authority
ii) Two representatives of the Concessionaire
iii) Any nominee of the State Government.

18.2 Functions and structure of the organisations.

18.2.1 Functions of Concessioning Authority

1. General

i. Scope of the projects
ii. Nature of Concession to be granted
iii. Period of Concession and justification for fixing the period
iv. Estimated capital cost
v. Likely construction period
vi. Conditions precedent, if any, for the concession to be effective
vii. Land acquisition.

2. Construction, Operation &Maintenance

i. Monitoring of construction; whether an independent agency/engineer is to be stipulated
ii. Standards of Operation and Maintenance

iii. Safety related provisions
iv. Environment related provisions

3. Financial

i. The maximum period for achieving financial close
ii. Nature and extent of capital grant/subsidy stipulated if any
iii. Bidding parameters
iv. Concession fee, if any, payable by the Concessionaire
v. User charges/fee to be collected by the Concessionaire
vi. Provisions, if any, for mitigating the risk of lower revenue collection.
vii. Provisions relating to the escrow account, if any
viii. Provisions relating to insurance
ix. Provisions relating to audit and certification of claims
x. Provisions relating to assignment/substitution rights
xi. Provisions, if any for compulsory buy-back of assets upon termination/ expiry

4. Subject to and in accordance with the terms and conditions set forth in the Concession Agreement, Grants and authorize the Concessionaire:

i. Right of Way and access to the Site to design, finance, construct, commission, operate, manage and maintain the Ropeway Project at the Specified Location during the Concession Period at the cost and risk of the Concessionaire;
ii. To collect fee/ tariff/ charge from the Users of any Project facilities other than the Ropeway system, at the rates to be determined by the Concessionaire on and from the commercial operation date till the transfer date;
iii. To collect the user charges from the passengers using the Ropeway.

5. Facilitate requisite government orders/gazette notifications necessary for project implementation.

6. Ensure the availability of Project Site, free of any encumbrances to the Concessionaire for development of the Project.

7. Procure all Applicable Permits including the following permits:-

i. Forest land diversion and Environmental/Forest clearances clearance based on applications and at cost of Concessionaire;
ii. Private land acquisition/procurement and land registration;
iii. Assistance in procuring clearance from State Pollution Control Board;
iv. Assistance in getting the supply of electricity & water to the ropeway projects;
v. Assistance in the diversion of transmission lines, electric poles, pipelines, etc. falling along the route alignment;
vi. Assistance in resolution of Relocation and Rehabilitation issues, if any, involved in the project;
vii. Permissions from the Local Administrative Authorities.

8. Act as a single window for providing all clearances to the Concessionaire
9. To review the progress on the ropeway projects as well as the operation of the ropeway.

18.2.2.Responsibilities of Concessionaire

1. Concessionaire shall furnish the financing plan and any other document related to the execution of the Project.
2. Concessionaire shall obtain all such Applicable Permits unconditionally or if subject to conditions then all such conditions must have satisfied in full and such Applicable Permits are and shall be kept in full force and effect for the relevant period during the subsistence of the Concession Agreement.
3. Concessionaire shall make all the necessary applications at its cost that are required for obtaining the land, forest and environment clearances and fulfil any necessary conditions as may be required. The Concessionaire shall also bear the cost of taking the Environmental/ Forest clearances/ ROW i.e. NPV of trees etc.
4. The Concessionaire shall at its cost and expense procure finance for and undertake the design, engineering, procurement, construction, operation and maintenance of the Project and observe, fulfil, comply with and perform all its obligations set out in Concession Agreement or arising out of it.
5. The Concessionaire shall comply with all Applicable Laws and Applicable Permits in the performance of its obligations under this Agreement.
6. The Concessionaire shall procure all machinery, plant and equipment and complete installation, testing and commissioning of all machinery, plant and equipment comprising the Project.
7. The Concessionaire shall commence construction within specified days of Commencement Date and achieve agreed milestones within the period specified for it.
8. The Concessionaire will commence commercial operations of the facilities after inspection, testing, full commissioning and issuance of the necessary Completion Certificate by the designated authority.
9. The Concessionaire shall implement the Area Management Plan required for the construction and operation phase of the Ropeway Project.
10. The Concessionaire shall implement the Environmental Management Plan required for the construction and operation phase of the Ropeway Project.
11. The Concessionaire shall maintain and operate the Project Assets/ facilities in accordance with the Good Industry Practices/ Prudent Utility Industry Practices & technical safety practices, and performance standards.
12. The Concessionaire shall maintain the requisite insurance in respect of the Project and the facilities comprised therein, both during construction and operations phase including but not

limited to Passenger Liability Insurance for accidents etc., in accordance with Prudent Utility Industry Practices.

13. The Concessionaire shall be solely responsible and liable, at this own cost, for all maintenance, upkeep and repairs of the Project Facilities and all its components, including ropeway system, access ways, buildings, green areas, utilities and services and allied works as per best industry practices and Applicable Laws and Applicable Permits.
14. The Concessionaire shall make timely payment of Annual Concession Fee to the Concessioning Authority.
15. The Concessionaire shall transfer the Project Assets to the Concessioning Authority or its designated agency/ authority/ nominee after the expiry/Termination of Concession Period in accordance with the provisions of the Concession Agreement.

18.3. The legal framework for operations and maintenance.

1. The Uttarakhand Ropeways Act, 2014 has been enacted by the Government of Uttarakhand and the Ropeway shall be constructed, opened, maintained and operated in accordance with the provisions of this Act.
2. Compliance with Rules and regulations of the local administrative authorities like District Administration, Municipal Corporation, water Authority etc. particularly with compliance of conditions of all applicable permits, licenses and local laws.
3. Compliance with Rules and regulations with relation to employees, like Minimum Wages Act, Payment of Wages Act, Employees Provident Fund and Miscellaneous provisions Act, Employees State Insurance Act, Contract Labour Abolition Act, Shops and Establishment Act, etc.
4. Compliance with the Direct Tax laws like the Income Tax Act as well as indirect tax laws like Goods and Service Tax etc.

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Implementation plan

19. IMPLEMENTATION PLAN

Implementation plan for a passenger ropeway includes following steps:

1. Preparation of DPR
2. Tendering and Award of contract
3. Pre-Construction Activities
4. Construction Activities
5. Operation and Maintenance

19.1. Preparation of Detailed Project Report (DPR):

The detailed Project report must be prepared. Following should be the main contents of the DPR:

1. Detailed Design of the Ropeway
2. Architectural plan and design
3. Detailed estimation of the cost
4. Estimated cash flow
5. Construction Methodology
6. Detailed Schedule of Implementation
7. Health, Safety and Environmental Management Plan
8. Quality Management Plan
9. Evaluation and framework of required statutory clearances
10. Any other important requirement.

19.2. Tendering and Award of Contract:

The tender should be floated as per standard procedure/procedure described in the DPR to select a competent technical and competitive financial bidder. Contract to be awarded after pre-bid meeting followed by bid opening and award of contract.

19.3. Pre-Construction Activities

Pre-construction activities include:

- Securing clearance as per Forest Conservation Act, 1980 for diversion of Forest Land.
- Environment Clearances as per Environment (Protection) Act, 1986.
- Getting all statutory clearances and NOC.
- Financial closure.
- Acquisition and transfer of land earmarked for the project.
- Shifting and diversion of services, if required.
- All legal compliances.
- Any other activity as per Bid document.

19.4. Construction methodology

This chapter covers all activities in detail for the design and construction of a Passenger Ropeway Project. Certain parameters as given below are to be considered.

Ropeway type:

Decided based on:

a. Technical feasibility.
b. Safety
c. Terrain constraint.
d. Passenger ease.
e. Crowd handling.
f. Operational requirement.
g. Maintenance requirement.

Ropeway capacity:

Decided based on:

a. Traffic survey
b. Peak & lean demand

Terminal Location:

Decided based on:

a. Integration with existing transportation nodes.
b. Ease in passenger movement.
c. Crowd handling ease.
d. Land availability.
e. Facilities required.
f. Minimum obstruction.
g. Minimum impact/footprints.

Ropeway alignment:

a. Technical feasibility.
b. Safety
c. Rescue ease
d. Operational & maintenance requirement
e. Minimum obstruction.
f. Minimum rehabilitation.
g. Minimum foot imprints.
h. Easy integration with existing transport nodes

19.5. Ropeway construction:

A brief of Ropeway construction activities is given below:-

Various survey, investigations and discussions were carried out to finalize the project.

- Site reconnaissance survey for alignment selection.

- Validation of alignment based on various criterion.
- Traffic survey to ascertain ropeway capacity.
- Topographical survey for ropeway profiling and designing.
- Geo-technical investigations to decide the type of suitable foundation.
- Technology selection.
- Features of the project.
- Study of litho-logical groups and tectonic features.

All aspects of Geological, Topographical, Seismic, Temperature and Meteorology are considered for design and construction of entire ropeway system.

STUDY OF LITHO LOGICAL GROUPS AND TECTONIC FEATURES:

- Provisions of IS-1893 are considered for Tectonic Features to foresee any problem in subsoil condition and check that proposed alignment is suitable for construction of ropeway.

EARTHQUAKE RESISTANT DESIGN:

- Indian Standard IS – 1893 is considered for its effect in the proposed alignment of all ropeways. As per this standard, the area comes under Zone-IV and design aspects were considered for shock and other effects.

TEMPERATURE EFFECT

- Indian Standard IS – 875 (Part 5) has been considered for the design of the ropeway system for temperature effects

WIND EFFECT

- In all basic design, relevant guidelines of IS – 875 (Part 3) for all effects of wind load and gust.

The material will be transferred with separate material ropeway during civil construction, erection and later on during operation.

- It is made up of small components for manual transportation.
- Hook capacity is 3.5 tons.
- Consists of Drive Winch, Towers and Ropes (Track & hauling).
- All the components are transported above Tree level.
- It has a noiseless operation

Material is lowered at the required location only.

Installation activities are carried out in the presence of experts from Technology supplier and in-house project team.

All activities involved in design and constructions are being detailed in proper sequence as follows:-

ACTIVITIES CONSIDERED DURING CONSTRUCTION OF ROPEWAY

Topographical Survey

The detailed topographical survey will be conducted with DGPS, Total Station and Auto Level. Bench Marks will be established at regular interval and the survey covered a strip of 50 m in width with longitudinal cross-sections taken at the required interval for designing needs. The Topographic survey information was then translated into a digital terrain model of the area using suitable mapping software.

Topographical surveys included the following:

a) Control Point Survey
b) Traversing
c) Cross-section Survey
d) Establishing Bench Mark

19.6 Geotechnical Investigation

Introduction:

A typical geotechnical engineering study begins with a review of the project needs to define the required material properties. Then follows a site investigation of soil, rock, fault distribution and bedrock properties on and below an area of interest to determine their engineering properties including how they will interact with, on or in a proposed construction. Site investigations are needed to gain an understanding of the area in or on which the engineering will take place. Investigations can include the assessment of the risk to humans, property and the environment from natural hazards such as earthquakes, landslides, sinkholes, soil liquefaction, debris flows and rockfalls.

After obtaining the laboratory test results of the samples collected from the field and analysing the subsoil parameters in a very careful manner, the net safe bearing capacities of isolated footing foundation at different depths are calculated.

The recommended bearing capacity is to be verified by Plate load test as per IS: 1888 using a plate of minimum 1.0 m square sizes after the installation of the granular pile.

The prime object of this investigation work is to find out subsoil profile, important engineering properties, the recommendation of the type of foundation, bearing capacities of subsoil etc. All works beginning from field investigation, collection of samples, laboratory testing, and interpretation of results were done as per pertinent code of practices.

The results are presented in a tabular or graphical form according to convenience.

FOUNDATIONS:

A building's foundation transmits loads from buildings and other structures to the earth. Geotechnical engineers design foundations based on the load characteristics of the structure and the properties of the soils and/or bedrock at the site. In general, geotechnical engineers:

- Estimate the magnitude and location of the loads to be supported;
- Develop an investigation plan to explore the subsurface;

- Determine necessary soil parameters through field and lab testing (e.g., consolidation test, triaxial shear test, vane shear test, standard penetration test);
- Design the foundation most safely and economically.

The primary considerations for foundation support are bearing capacity, settlement, and ground movement beneath the foundations. Bearing capacity is the ability of the site soils to support the loads imposed by buildings or structures.

Many building codes specify basic foundation design parameters for simple conditions, frequently varying by jurisdiction, but such design techniques are normally limited to certain types of construction and certain types of sites and are frequently very conservative.

All relevant BIS codes and Building Codes shall be referred to during the design of foundations.

TRAFFIC SURVEYS

To establish the traffic characteristics of the ropeway project, the following traffic surveys were carried out:

A. Classified traffic volume count.
B. Intersection Turning Movement Count Survey.

Traffic movement plan is prepared to keep in view the clutter-free movement and avoid any traffic mismanagement.

CONSTRUCTION MATERIAL:

Material survey of the area around the ropeway project is to be conducted to identify the sources of suitable construction materials like stone chips/sand/water etc. which can be used for construction.

Samples shall be collected from various sources and tested to determine their engineering properties for assessment of their suitability.

Transportation and storing of all construction material are to be considered.

SITE OFFICE AND RESIDENCES FOR STAFF

These are to be organized before construction.

Ropeway design:

The ropeway shall be built as per the latest ropeway standards including BIS, Uttarakhand Ropeway Act rules & latest ropeway technology.

Master / Building Plan design Activities

It is preferred to design the ropeway in such a way so that both the ropeway stations, queue area and electrical control room i.e. all of the basic ropeway parts are independent of all other facilities so that in future, ropeway can be modified/replaced with no effect on facilities.

An architect should be appointed for master planning the ropeway and allied facilities and a layout drawing with ropeway stations and the line are prepared.

Facilities should include adequate access, drinking water facility, toilets, waiting for hall etc. However, all details should be included in the Detailed Project Report (DPR).

Basic facilities required at present and future expansion are incorporated by the architect. The basic ropeway design is done by a technology provider and all other facility and amenities designs are done by the architect.

PURCHASE ACTIVITIES:

- Release of drawings & QAP for a quotation.
- Technical clearance of suppliers offers with the designer.
- Placement of an order on the supplier.
- Follow up with the manufacturer.
- Inspection and delivery.
- Payment to the supplier.
- Monitoring of procurement process.

Health, Safety & Environment:

HSE management plan is developed to meets the targeted HSE requirements. To ensure this, HSE management system is made. A standard process should be adopted to monitor, analyse and review the performance on HSE parameters based on site working.

Material ropeway:

A Temporary Material Ropeway shall be used during the construction and installation of Passenger Ropeway. Fixed cable cranes for material transport consist of a track cable fixed with anchors in the valley and the mountain that are fixing the track rope at the lowest and the highest point; towers along the track (the number of towers will depend on the terrain and the distance), a hauling cable, which is pulled by a winch installed at the top, and a carriage (at the other end of the hauling cable).

- All the components are generally transported above tree level.
- It has a noiseless operation
- Material is lowered at the required location only.
- All terminals will be constructed and assembled with cranes, at Terminal 2 there will be a second crane along with the elevator access building from the bus terminal.
- The above is to avoid long times where the material ropeway is occupied only with the construction work of Terminal 2.
- The system will be as a cable crane with no passenger transportation. The haul rope will be an endless loop due to the rope line layout.
- It would be good to have multiple loading points for the cable crane along the line to avoid long drive times.

- Due to the alignment, it might not be possible to install all towers completely with the cable crane. Some towers will need an additional process to be installed.
- The material ropeway won't be exactly in the centreline, it will be outside to pass already installed towers. Another option is to install the material ropeway close to the centreline.
- But then it won't be possible to pass a tower after its installation.
- Protection for the road below the cable crane shall be considered.

19.7. Project execution activities:

Civil and foundation work:

Once civil work design is finalized, site activities for the foundation and construction of facilities are started.

Steps:-

- Arrangement of accommodation for site staff and site office to be made with mess facilities.
- Arrangement of daily transport to be arranged.
- Arrangement of necessary construction power and water supply.
- Understanding all civil and foundation drawings.
- Train manpower about safety aspects and provide all safety gadgets (PPE).
- Making a consolidated list of all materials like cement, reinforcements, stone chips, sand etc. and arrangement for procurement and storing and requirement of total construction materials required with respect to time.
- Ordering for the supply of materials in sequence and storing the same safely. Particularly storing of cement must be weatherproof.
- Fixing of a civil contractor and placement of civil work order.
- The layout of all civil works with permanent reference pegs.
- If required, due site transport problem, manufacturing and erecting a temporary ropeway.
- Arrangement of necessary machinery for civil works.
- Construction work matching the schedule of different supplies of structures etc.
- Necessary supervision and quality control at all steps
- Ensure compliance with safety instructions during execution
- Construction of storage areas for erection materials delivered

Structural erection work:

Steps:-

- Understanding of all drawings and preparation of list for required erection tools.
- Arrangement of all necessary tools tackles and safety devices for erection work.
- Storing all items delivered to site in sequence of erection requirement.
- Checking of all completed foundations for its matching with structures.
- Train manpower about safety requirements and provide all safety gadgets like safety belts, helmet and shoes etc.

- Erection of structures in sequence and alignment of all complete structures.

Mechanical erection work:

Steps:-

- Storing all items delivered to site in sequence of erection requirement
- Checking of all completed foundations/structures for its matching with mechanicals
- Train manpower about safety requirements and provide all safety gadgets like safety belts, helmet and shoes etc.
- Erection of mechanicals in sequence and alignment of all erected mechanicals
- Necessary supervision and quality control at all steps

Electrical installation work:

Steps:-

- Thorough understanding of all drawings
- Checking of all supplies for completeness
- Train manpower about safety requirements and provide all safety gadgets like shoes etc.
- Preparation of installation schedule and arrangement of all tools, tackles etc
- Necessary supervision and quality control at all steps and trials/tests

Rope erection and splicing / socketing work:

Steps:-

- This is very critical work and it is undertaken by a team of experts.
- An experienced person prepares a detailed methodology with sequence along with required tools and tackles. All items are organized and supplied by experts.
- Rope erection has to be strictly done at the site as per the OEM procedure. For any problem, it must be referred to OEM for decision.

Trial run and commissioning:

Steps:-

- Take an individual trial run of all items erected.
- Take a trial run of all sub-assemblies.
- During all such trials, watch the performance and inform HO of any abnormality observed.
- Once, the erection is complete with rope, take a no-load trial in rope only condition for 3 days.
- Check rope movement and position on all sheaves and carry out necessary adjustments.
- Once satisfied with rope only trial, install only one cabin with carriage and take a trial run for at least 7 / 8 rounds, watch and adjust if necessary all / any mechanical.
- Take 3 days trial with 50% empty cabins and adjust.
- Take 7 days trial with 50% loaded cabins and adjust.
- Take 15 days trial with 100% loaded cabins and adjust

Once satisfied with all trials, do final alignment and painting.

Carry out rescue trial at all odd position.

IF SATISFIED, RELEASE FOR PUBLIC OPERATION WITH NECESSARY PERMISSION FROM STATUARY AUTHORITIES.

19.8. Operation & maintenance management:

Operation & Maintenance is the most important facet of Ropeway functioning. For long term trouble-free and safe operation of ropeways, there has to be a comprehensive schedule for checking the healthiness of the ropeway system and keeping equipment ready to operate always. Only manpower having experience in ropeway operation shall be deployed to operate and maintain the ropeways.

A brief overview of operation & maintenance plan is given below:-

- Comprehensive Operation & Maintenance Manual shall be provided by the Technology supplier.
- For all other supply, Operation & Maintenance Manual from Original Equipment Manufacturer (OEM) shall be followed.
- The Operation & Service Manual (OSM) does not replace any operation regulations set forth by the ropeway authority but is valid in its own right.
- The OSM shall apply to the ropeway equipment supplied by Technology Provider. For parts and equipment not included in the Technology Provider delivery scope, the operating instructions of the relevant manufacturer or supplier shall be followed.
- In the event of any apparent irregularity, contact shall be established with Technology Provider technical specialists immediately.
- Operation shall be undertaken by a specialist with relevant know-how and training of ropeway operation and maintenance.
- The operating company should ensure the availability of sufficient numbers of suitably trained personnel.
- Only original spare parts from OEM shall be used being tested and approved.

19.9. Facility Management:

In order to cater to different needs of the passengers, a facility management system is required with ropeway as the main service provider, along with certain facilities at the station area for customer requirement and satisfaction. Following proposed facilities at different stations points has to be developed:

1. Ropeway station, Boarding / De-boarding area.
2. Cabin Parking area
3. Maintenance Workshop
4. Store for spares and consumables.
5. Administration building
6. Ticket counters
7. Waiting hall

8. Queue area
9. Toilet/Rest Room blocks
10. Drinking water facility
11. Restaurant
12. Children play area
13. Souvenir shop
14. First Aid and Emergency area

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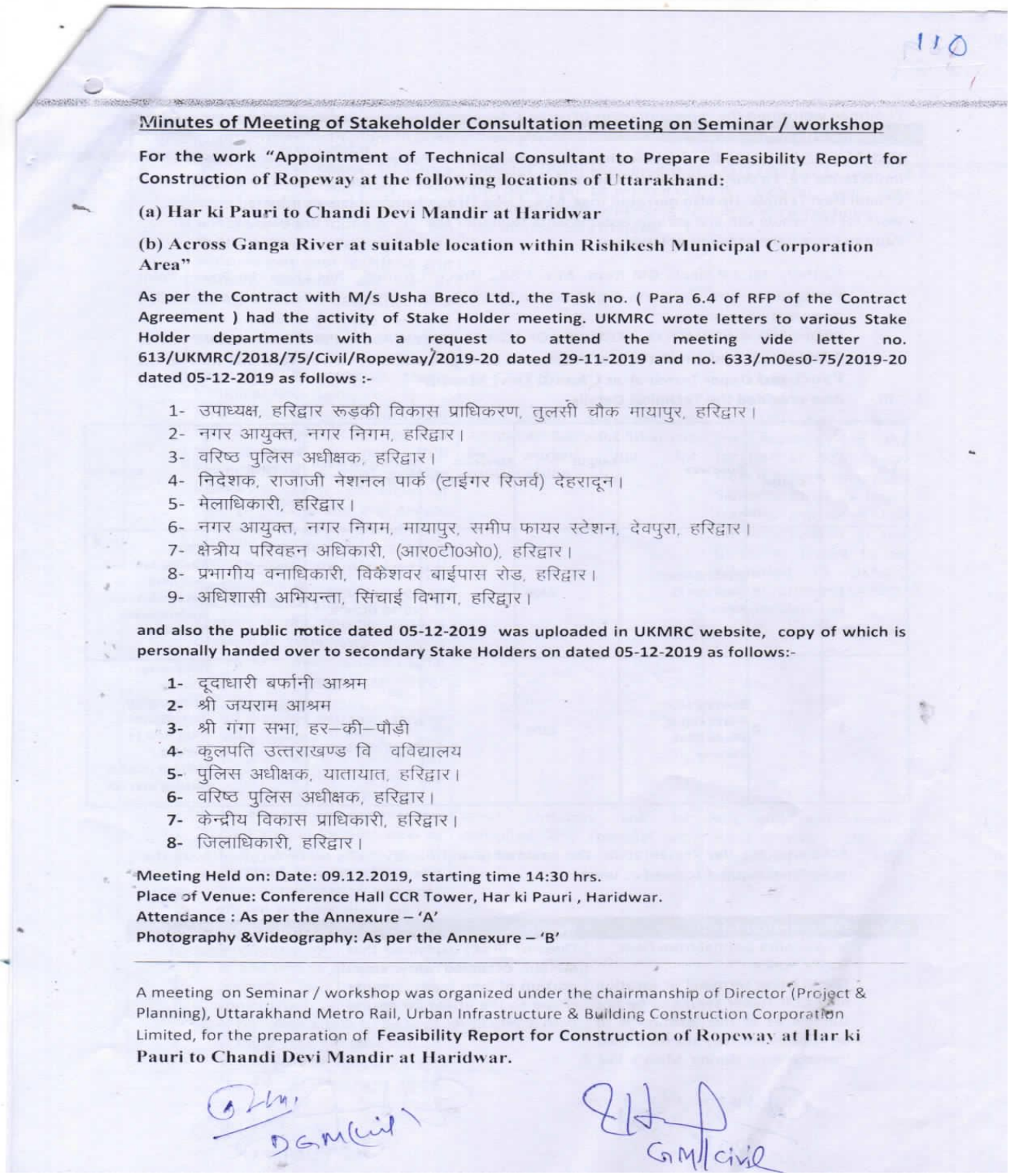
Stakeholders' meetings

20. STAKE HOLDER'S MEETING

Stake holder's meeting was conducted on 9th December 2019 and 11th December 2019 for Haridwar.

20.1. Minutes of meeting Stake Holders' Meeting, Haridwar



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Minutes of Meeting of Stakeholder Consultation meeting on Seminar / workshop

For the work "Appointment of Technical Consultant to Prepare Feasibility Report for Construction of Ropeway at the following locations of Uttarakhand:

(a) Har ki Pauri to Chandi Devi Mandir at Haridwar

(b) Across Ganga River at suitable location within Rishikesh Municipal Corporation Area"

As per the Contract with M/s Usha Breco Ltd., the Task no. (Para 6.4 of RFP of the Contract Agreement) had the activity of Stake Holder meeting. UKMRC wrote letters to various Stake Holder departments with a request to attend the meeting vide letter no. 613/UKMRC/2018/75/Civil/Ropeway/2019-20 dated 29-11-2019 and no. 633/m0es0-75/2019-20 dated 05-12-2019 as follows :-

1- उपाध्यक्ष, हरिद्वार रूड़की विकास प्राधिकरण, तुलसी चौक मायापुर, हरिद्वार।
2- नगर आयुक्त, नगर निगम, हरिद्वार।
3- वरिष्ठ पुलिस अधीक्षक, हरिद्वार।
4- निदेशक, राजाजी नेशनल पार्क (टाईगर रिजर्व) देहरादून।
5- मेलाधिकारी, हरिद्वार।
6- नगर आयुक्त, नगर निगम, मायापुर, समीप फायर स्टेशन, देवपुरा, हरिद्वार।
7- क्षेत्रीय परिवहन अधिकारी, (आर0टी0ओ0), हरिद्वार।
8- प्रभागीय वनाधिकारी, विकेशवर बाईपास रोड, हरिद्वार।
9- अधिशासी अभियन्ता, सिंचाई विभाग, हरिद्वार।

and also the public notice dated 05-12-2019 was uploaded in UKMRC website, copy of which is personally handed over to secondary Stake Holders on dated 05-12-2019 as follows:-

1- दूदाधारी बर्फानी आश्रम
2- श्री जयराम आश्रम
3- श्री गंगा सभा, हर–की–पौड़ी
4- कुलपति उत्तराखण्ड वि वविद्यालय
5- पुलिस अधीक्षक, यातायात, हरिद्वार।
6- वरिष्ठ पुलिस अधीक्षक, हरिद्वार।
7- केन्द्रीय विकास प्राधिकारी, हरिद्वार।
8- जिलाधिकारी, हरिद्वार।

Meeting Held on: Date: 09.12.2019, starting time 14:30 hrs.
Place of Venue: Conference Hall CCR Tower, Har ki Pauri , Haridwar.
Attendance : As per the Annexure – 'A'
Photography &Videography: As per the Annexure – 'B'

A meeting on Seminar / workshop was organized under the chairmanship of Director (Project & Planning), Uttarakhand Metro Rail, Urban Infrastructure & Building Construction Corporation Limited, for the preparation of **Feasibility Report for Construction of Ropeway at Har ki Pauri to Chandi Devi Mandir at Haridwar.**

DGM(Civil)

GM(Civil)

L09

Chairman welcomed the representatives of various departments, attending the Stakeholder Consultation meeting on Seminar / workshop. He gave the background for the meeting, explaining that M/s. Usha Breco Limited, has been engaged for the above noted work and explained it's importance i.e. To provide seamless approach to Tourists / Pilgrims directly from **Har- K-i Pauri to Chandi Devi Temple. He also narrated that** M/s. Usha Breco Limited has conducted survey work for the whole site and various options were found for the alignment of Rope way at Har ki Pauri to Chandi Devi Mandir at Haridwar.

I. Further, Mr J P Singh, GM from M/s. Usha Breco Limited, has given the Power Point Presentation and the team explained the following components, while making the detailed presentation includes:

II. **PROPOSED ALIGNMENTS, FEATURES OF LOWER TERMINAL OF PROPOSED ALIGNMENTS, Advantages and Limitations of Alignment 1, Alignment 2 at Lower Terminal at Har ki Pauri and Upper Terminal at Chandi Devi Mandir.**

III. **Also provided the Technical Details**

S N	Option	Ropeway	Length m	Elevation Difference m	StartingTerminal Coordinates	End Terminal Coordinates	Remarks
1	1	starting From Near Har Ki Pauri	2400	202	29°57'14.86"N 78°10'18.24"E	29°56'2.23" N 78°10'50.37 "E	Pauri Pasiing over NH Will have permission and maintenance limitations
2	2	Starting From North End of Dhobi Ghat Parking	2300	200	29°57'13.18"N 78°10'23.76"E	29°56'2.23" N 78°10'50.37 "E	100m away from as compared to first alignment. Very Next to Parking Will not require passing over NH

IV. Following are the Presentation, the comments and observations were received from the stakeholders are discussed as under:

S.No	Observation Made	Response	Action to be Taken
1	Sh. Vijendra Dobhal from Distt. Traffic Police The starting terminal at location near CCR Tower seems to be not suitable as at this location is to be kept as access path for crowd management during Mela's like	Director (P&P) explained that station occupied very small portion of land in rectangular shape so the effect for access path is very little.	No action is required.

DGM civil

GM Civil

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S.No	Observation Made	Response	Action to be Taken
	Kumbh or ArdhKumbh.		
2	Sh. TanmayVashistha, Sri Ganga Sabha General Secretary raised that crowd management of vehicle will be difficult at Din DyalUpadhaya Parking area which is just near to NH-58 and suitable location will be at location near to CCR Tower. He also suggested that the Terminal station should be under ground to manage the crowd at Har-Ki-Pauri like Raji Chowk Metro Station at New Delhi.	Director (P&P) explained that this option can be worked out and considered depending on the admissibility of fund.	M/s UBL has to work out & UKMRC will take decision accordingly.
3	Mrs. Anita Sharma, Mayor Nagar Nigam, Haridwar suggested that the location at near CCR Towerbuilding is most suitable from the point of view of children, ladies and old people who want to go to Chandi-Devi Mandir but due to transport difficulty they are deprived off the opportunity. She also reiterated that if this location is not feasible than a location at 200m away from it namely Anandvan Samadhi Sthal should be choosen as lower terminal.	The option suggested in Anandvan Samadhi Sthal can be worked out for consideration.	M/s UBL shall workout the feasibility of the location at 200m away from it namely Anandvan Samadhi Sthal as lower terminal and same shall be incorporated in the feasibility report to be submitted to UKMRC and accordingly UKMRC will take decision.
4	a) Sri Pradeep Jha, President of the Ganga Sabha, also emphasised and backed for the suggestion given by Mayer Mrs. Anita Sharma.		
	b) He also pointed out that the land area at location near to CCR Tower building is declared as Green Area and local Administation authority should be consulted for the approval before starting the work.	Local Authority will be consulted and approval will also be taken.	M/s UBL will consult along with UKMRC representative and submit the report.
	c) In addition to above he also pointed out that the construction of Ashtha Path at Haridwar city is to be kept in mind. The construction of shortly Ashtha Path will start as 20 Crore has been	-do-	-do-

DGM (civil)

GM/Civil

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S.No	Observation Made	Response	Action to be Taken
	sanctioned for it.		
5	Sri Rang Nat Pande, Sub Divisional Officer (Forest) Haridwar, pointed out that approval from the forest is required for the upper terminal at Chandi Devi Mandir as the temple of Chandi Devi Mandir is also on lease land of forest.	The Director P&P, UKMRC informed the approval from the Forest Authority will be obtained before execution.	Action to be taken for forest clearance from concerned department.
6	Sh. S.S. Rawat, Assistant Engineer, Haridwar Roorkee Development Authority pointed out that the crossing of Ropeway with NH-58 should be avoided as no halt even for 01 hour can be given to NH-58 due to Traffic Jam problem option of Toy Train etc. should be worked out to avoid crossing of NH-58.	For construction of ropeway NH-58 will not require any stoppage of traffic on NH-58.	No action required.

It was suggested by Director (Project & Planning), UKMRC, that all stakeholders shall also attend the same type of meeting on Seminar / workshop being organizedat **Conference Hall ,Rishikesh Municipal Corporation**The Meeting ended with a vote of thanks to all the participants.

DGM(civil)

GM/civil

20.2. Action on Stake Holders Meeting Points of Haridwar

SN-1	No action required
SN -2	The underground terminal station is not recommended due to the following reasons:
	1. Construction cost will be very high (in tune to almost three times) for the underground terminal.
	2. Opening to the underground station for access to passengers and ropeway will be very high. This will occupy at least 50 m long corridor for access to the underground ropeway. It is suggested to have elevated station instead. In the case on the elevated station, the area under the terminal station will be available for other purposes.
	3. Being the river bed, the water table in that area is very high, it will not be suitable for construction.
SN-3	Possibility from Anand Van Samadhi already considered and it's part of the report.
SN-4	'Kumbh Mela Adhikari' has been appraised about the proposed development of the ropeway. However, NOC will be required during the preparation and approval of the Detailed Project Report (DPR) and the implementation of the project.
SN-5	Approval to be taken under FCA during the construction of ropeway.
SN-6	No action required.