NEWSLETTER

Department of Roads DoR

E-mail: mis@dor.gov.np
Website: www.dor.gov.np

Vol. 26
March 2021

Table of Contents

1. Appointment of new Director General

Er. Arjun Jung Thapa has been appointed as a new Director General (DG) of DoR and welcomed by DoR staffs in DoR meeting hall on 17th February, 2021. In the meantime, former DG Er. Keshab Kumar Sharma was bade farewell who has been transferred to Ministry of Physical Infrastructure and Transport (MoPIT) in the position of Joint Secretary. In the program the new DG has expressed that DoR will have following priorities in his tenure.

1. Revival of Bio-engineering by establishing nurseries and implementing slope stabilization works in every road under Divisions and Project Offices.
2. Planning, designing and constructing modern office buildings in all Federal Monitoring Offices and Road Divisions Offices.
3. Strengthen Laboratory facilities in all Road Divisions and Projects Offices to enhance quality of construction and maintenance works.
4. Revival of DoR Newsletter and publish it bi-annually.
5. Accelerate publication work of different guidelines and manuals that are useful for design, construction, supervision and maintenance works.
6. Finalize O&M Survey and make necessary plans for strengthening human resources.
7. Accelerate the preparation of typical Designs/Drawings for short and long span bridges.
8. Establish DoR's own state of art training Center at Gajuri with modern facilities.
9. Focus on Road Assets Management works of DoR.
10. Development of curriculum for training in different areas.

2. Major achievements during tenure (2019/4/01-2021/02/16) of former DG Er. Keshab Kumar Sharma.

1. Initiation of Strategic Road Connectivity and Trade Improvement Project (SRCTIP).
2. Commencement of constructions work in Nagdhunga Tunnel Road Project.
3. Completion of Mugling(deck arch bridge) & Dhobikhola (Network arch bridge) bridge.
4. Approval of Consulting Norms for Detail Feasibility Study of Tunnel Works, and approval of Specification and Norms for Tunnel Construction works in Engineering, Procurement and Construction (EPC) modality.
5. Initiation of Kamala-Kanchanpur Road Project.
6. Starting of Mugling-Pokhara road extension project under SASEC Mugling Pokhara Highway Improvemnet Project, (SMPHIP-ADB Project No. 52097-002)
7. Mobilaization of the Consultant for preparation of Detail Project Report for Pakali Kakarbhitta and Pathalaiya Narayanghat Road.
8. Improvement of road condition in Kathmandu valley.
9. Initiation of Organization & Management (O & M) survey of staffs and submitted for approval.
10. Initiation of detail design of grade separated intersections along the ring road, at Gwarko, Satdobato & Ekantakuna Chowk.
11. Started the prompt uploading of the staff transfer decision in web site.
12. Completion of significant number of bridge.

3. Progress in Fiscal Year (F.Y) 2076/077

S. N	Details	Units	Annual Target	Progress	Progress (%)
1	Blacktop Road	Km	1200	729	60.75
2	Gravel Road	Km	1200	757	63.08
3	Earthen Road	Km	500	365	73.00
3	Reconstruction and Rehabilitation of blacktop Road	Km	200	270	100
4	Periodic Maintenance	Km	524	360	68.7
5	Bridge Construction	Nos	300	210	70.00
Financial Progress:		54.66%			

4. Progress in current F.Y. 2077/078 (up to Poush)

S. N	Details	Units	Annual Target	Progress	Progress (%)
1	Blacktop Road	Km	1800	496	27.56
2	Gravel Road	Km	1000	330	33.00
3	Earthen Road	Km	500	152	30.40
4	Reconstruction and Rehabilitation of blacktop roads	Km	334	167	50.00
5	Periodic maintenance	Km	729	156	21.40
6	Bridge construction	Nos.	300	77	25.67
Financial Progress:		23%			

5. Ongoing National Pride Projects under DoR

S.N	Name of Projects	Total Length (Km)	Physical Progress (%)	Financial Progress (%)
1.	Pushpalal (Midhill) Highway	1879	73.23	72.46
2.	Postal Highway	1792	70.45	58.26
3.	North-South Highway			
a)	Kaligandaki Corridor	444	51.81	51.61
b)	Koshi Corridor	385	71.1	75.59
c)	Karnali Corridor	682	32.53	74.89
4.	Galchhi-Trishuli-Mailung-Syafrubesi-Rashuwagadhi Road Project	82	35.0	32.00

6. Falling Weight Deflectometer (FWD)

6.1 Introduction

Millennium Challenge Account Nepal (MCA-Nepal) has recently provided the Falling Weight Deflectometer (FWD) equipment's to DoR (Fig.1). FWD is designed to impart a load pulse to the pavement surface simulating the load produced by a rolling vehicle wheel. The load is produced by dropping a large weight onto a set of rubber buffers on a bracket connected to a circular load plate. A load cell mounted on top of the plate measures the imparted load.

Fig1: Falling Weight Deflectometer (FWD)

Deflection sensors (geophones) mounted radially from the center of the load plate measures the deformation of the pavement in response to the load. The pavement response is analyzed with Dynatest's ELMOD (Evaluation of Layer Moduli and Overlay Design) software to determine the elastic moduli, stresses and strains of each modeled layer based on the impact load and surface deflections basin. ELMOD reports the weakest layer of failure, residual life and determines the optimum rehabilitation alternatives. The results can effectively be used for the evaluation of pavement structural condition and overlay design based on empirical or mechanistic – empirical pavement design guides.

6.2 Features of the Dynatest Falling Weight Deflectometer

- Non-destructive structural testing device operated by single person.
- Automated and rapid structural pavement testing machine applicable to pavements all over the world.
- Determines the layer of failure, rather than simply determining the bearing capacity.
- Quality assurance and quality control of newly built pavements.
- Compares a range of rehabilitation options, including plane off and recycling rather than just applying overlays.
- The use of the FWD provides accurate, reproducible and repeatable structural data.
- Uses mechanistic-empirical analysis applicable to most of pavement structures.
- The FWD is used worldwide from the hottest and driest deserts, to the humid tropics and the cooler Polar Regions.
- Wide loading range (4–120 kN), suitable for testing a variety of paved and unpaved roadways, parking lots and airfield surfaces.
- Accommodating up to 15 deflection sensors (Geophones)
- Up to 60 test points per hour

6.3 Parts of the FWD System

FWD System consists of following three parts:

a) Trailer Control and Data Collection Electronics
b) Field program
c) Software Analysis (ELMOD program)

(a) Trailer Control and Data Collection Electronics

In this stage of FWD system, it is assured that all the parts of the equipment are fitted properly. A single-mass falling weight/ buffer subassembly system is furnished which directly transfers the full energy of the single falling mass to the loading plate

through the proper configuration of buffers to achieve a loading time of 25 to 30 msec, for any falling mass and drop height. This loading system is hydraulically operated and designed so, that at least, four different configurations of mass and rubber buffers may be employed. All mass configurations produce a transient load pulse approximately half sine wave formed and 25 to 30 msec in duration, with a rise time of 10 to 15 msec for any falling height for all loads. All measured load and deflection data can be displayed for comparison purposes (e.g., repeatability), and no "averaging" or semi-frequent data anomalies occurs. The equipment allows up to 15 deflection sensors (geophones) to be used simultaneously.

(b) Field Program

With the help of Software DDC (Dynatest Data Collection) the required data are collected in the field. The Software is designed to operate as a native program in the Windows 10 environment on the system computer. The System Software is GUI (Graphical User Interface) based and allow flexible layout and resizable windows. The optional Geographic Position Data (GPS or DGPS) can be viewed in a numeric format or the position viewed transposed on a map to allow easy identification of position. One man can handle the field program fitting equipment with suitable vehicle. The software allows to:

- Graphical and numerical displays for the air, mid asphalt and surface temperature
- Plots the load and deflections time history
- Calculates and graphically plots the surface modulus and Elastic values along a section as the data is collected, to allow the operator to assess the data.
- Displays the video from an optional camera, mounted to determine exact location while testing on jointed concrete pavements, removing the requirement to have two display screens within the vehicle cabin
- Both voice and text feedback for error and warning messages is present in the software.

(c) Analysis software

After collecting data, the analysis software, ELMOD, is able to analyze the FWD data by the following modules:

1. A Finite Element Module, FEM, which makes use of an axial symmetric finite element program
2. A Linear Elastic Theory (LET) option makes use of the Waterways Experiment Station's program, (WESLA)
3. The Method of Equivalent Thicknesses (MET)

6.4 Observations and Conclusion:

MCA Nepal have conducted three weeks training program of Dynatest Falling Weight Deflectometer with participants from DOR and Pulchowk Engineering College. The first week was dedicated to know the equipment and its parts properly. Participants themselves calibrated equipment with the help of trainer from Denmark (Mr. Jan Winterskov, Senior Technical Specialist). Trainer also taught about the DDC software for collecting the data in field. In second week, there was a field work in Dhankhola-Lamahi-Shivakhola (76 km) section of East West Highway (pilot project). Participants took data of left lane wheel path and right lane wheel path at every 400m chainage. After collecting all required data, it was imported in analyzing software ELMOD to evaluate the road section. All the measured raw data imported from DDC software to the ELMOD were overviewed and changed as per requirement of ELMOD. Pavement layer thicknesses, measured temperature, traffic data and their distributions were adopted according to site condition. Some design parameters are adopted from the ASTM and European standard. ELMOD showed different responses in different road sections and chainages under the same design parameter setup. From the results obtained from this software with proper engineering judgment it was found that the road section is inhomogeneous. In some section, the particular road has got severe failure from sub grade level and in some section, there is failure in top layer only. Also, it showed that some portion of road is stiff enough to bear the assumed traffic for design life of 20 years.

Since it was trial attempt for trainees and there was limited time to go through the process, the data measured is only suitable for network level planning. For detail design and recommendation, further detail investigation and tests in the intervals as suggested by ASTM, 10 m to 100 m distance is required. But from the overview of analysis, it can be said that the road section needs to go for maintenance and rehabilitation as soon as possible. From this training, participant gained in depth knowledge of use of FWD and they have got confident that they can conduct FWD test themselves in future.

7. Quality Research and Development Centre (QRDC)

QRDC has been establishment in DoR in 2019 A.D that consist of Innovation (Tunnel and Alternative Transport) Unit, Research & Development (R & D) Unit, Road Sector Skill Development Unit (RSSDU), Central Road Laboratory, Administration Section and Finance Section. On its leadership, the Consulting Norms for Detail Feasibility Study of Tunnel Works and Specifications and Norms for construction of Tunnels in Engineering, Procurement and Construction (EPC) modality has been developed and later approved by cabinet. QRDC is preparing bid document for construction of Siddababa road tunnel. Similarly, feasibility study of Dharan Leuti, Khutiya-B.P Nagar-Dipayal tunnel and Godaworikunda-Kabhre-Manechour Tunnel is undergoing. QRDC has been conducting detail design of grade separated intersection along ring road, at Gwarko, Satdobato & Ekanta Kuna Chowk.

8. Dudhkoshi Motorable Suspension Bridge

-Dr Bijaya Jaishi, Director, QRDC

8.1 Introduction

The bridge site is located in Jayaramghat, Okhaldhunga-Khotang border. The google co-ordinate of bridge site is $27^0$10'36.4"N, $86^0$28'24.7"E.

Fig.1 Google map of bridge site

The Google image of bridge site is shown in Fig.1. Before construction of this bridge, there used to be a temporary bailey bridge in winter season for traffic operation and during summer season there had been no connectivity. With the completion of the bridge in 2074 Kartik, the Khotang district has been linked to the national road network. The contract was awarded in 2066/03/23 as a design and build contract. The contractor was Kalika/ Hulas JV, Maharajganj, Kathmandu. After some years of contract award, the highway was declared as Mid-Hill highway. This is the first motorable suspention bridge designed by Nepalese as per IRC loading and constructed by Nepalese Contractor. Suspension bridge has unique advantage in Nepalese topography since the construction does not demand

construction of pier in the middle of deep channel and work can be carried out in all seasons.

8.2 Salient feature:

The elevation and plan of bridge is shown in Fig.2. The salient feature of bridge is presented below:

Span (L) =122.5 m
Tower height from road level =14.706 m
Diameter of cable =44 mm
Number of cable each side =19
Diameter of suspender = 40mm
Truss camber =0.5 m
Height of road surface from center line of top chord = 0.5 m
Width of tower at its base, along the bridge axis = 2 m
Truss length ignoring camber =120 m
C/C spacing of hangars = 6.0 m
Total number of Hangers = 20
C/C Height of truss = 2.50 m
Carriageway:4.25m
Contract amount: NRs. 99,619,000.00

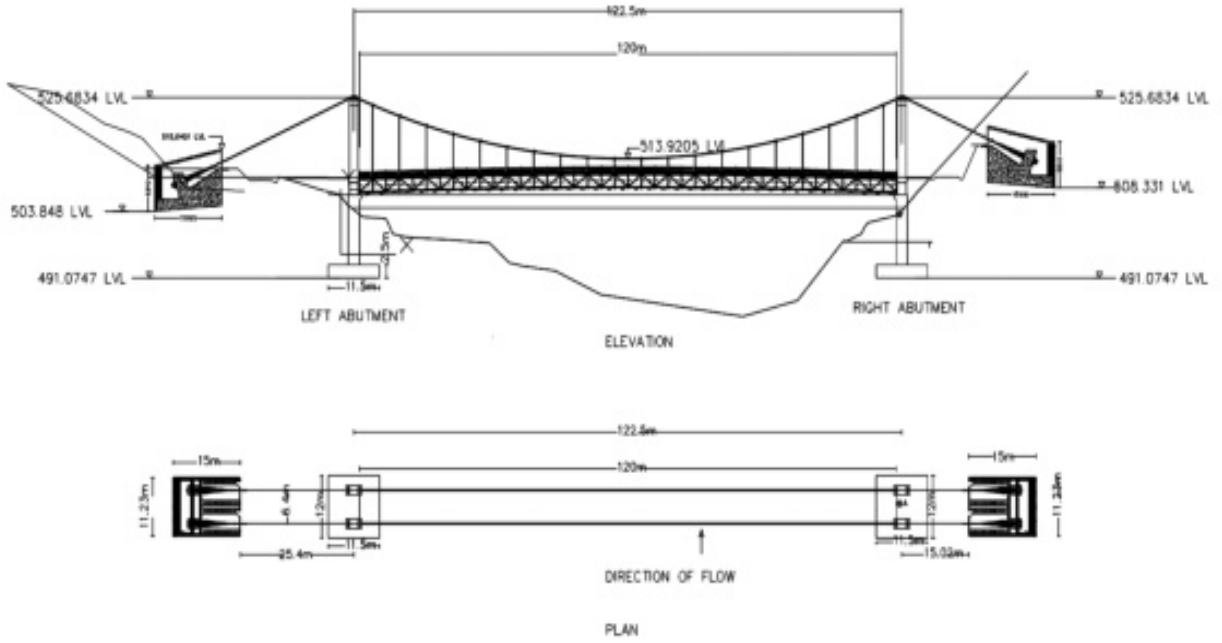


Fig.2- Elevation and plan of bridge

8.3 Design

The bridge is designed as per IRC design code and specification. The main loads considered in design are (i) Dead load (ii) Moving load (iii) Braking load (iv) Wind load (v) Earthquake load. The main design steps are:

(a) Design of slab
(b) Design of stringer
(c) Design of cross girder
(d) Design of connection between stringer and cross girder
(e) Design of main cable
(f) Design of suspender
(g) Design of connection between suspender and top chord of truss
(h) Design of pin connection between suspender and main cable
(i) Design of stiffening truss
(j) Design of connection of stiffening truss
(k) Design of tower and connecting beam
(l) Design of anchorage chamber
(m) Design of tower footing (combined footing)

The finite element model is developed in SAP2000 (Fig.3) to find out the internal stresses in different elements. Cables, towers are modeled with frame elements, deck is modeled with shell element, suspender is modeled with strut element and trusses are modeled with frame element with end release. Linear static analysis, non-linear static analysis and response spectrum analysis has been carried out. The main design features are:

Type of suspension bridge=Stiffening suspension bridge
Maximum sag due to self-weight =11.762 m
Cable hoisting sag=11.28m
Design loads: IRC-6, live load: IRC Class A
Ultimate tensile strength of Main cables, hangers=1570 N/mm2
Factor of safety of cable=3
Grade of reinforcement: 415 N/mm2
Grade of structural steel: 250 N/mm2

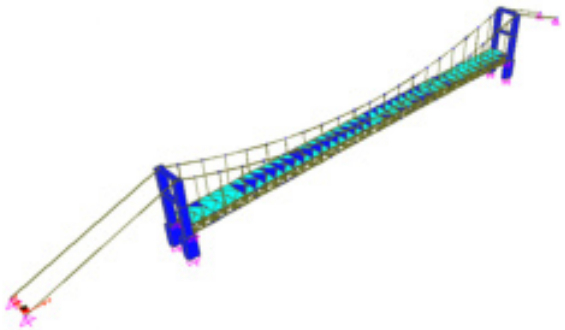


Fig.3- Finite element model of bridge

8.4 Construction Sequence

The construction sequence adopted are presented below. The construction of superstructure portion of bridge had been aided by three Chinese Engineers/technicians. They spent about 3 months in site assisting for the following activities.

(a) Tower construction
(b) Anchorage block construction
(c) Cat walk rope construction
(d) Saddle placement

(e) Cable hoisting
(f) Hanger placement
(g) Stiffening truss bearing construction
(h) Stiffening truss construction
(i) Concrete deck construction

The construction sequences and completed bridge are demonstrated in Fig.4. There are few important observations that are learnt during construction of bridge. (a) While constructing stiffening truss, the pylon's movement should be carefully monitored since it leans towards river while load increases. As soon as it reaches some value as per calculation, the pylon should be pulled back in position by some means (b) the sag should be measured in night in hot places and temperature less than 25^0c, preferably between 12 PM-5 AM.

(a)Pylon/ Tower construction | (b)Right Pylon

(c)Anchor block construction | (d)Saddle construction

(e) Cat walk rope construction/cable hoisting/Suspender construction | (f) Stiffening truss bearing construction

(g) Stiffening truss construction | (h) Concrete deck construction

(i) Completed Bridge

Fig.4- Bridge Construction Sequence

8.5 Conclusion

Although bridge construction took long time, successful construction of this bridge is the milestone for construction of motorable suspension bridge in Nepal. The Nepalese Engineers has gained a lot of knowledge and confidence after constructing this bridge. The replication of construction of such type of bridge in other locations is highly recommended.

9. Web-based Applications in DOR

1	Web Server
2	FMIS (Financial Management Information System)
3	CMS (Contract Monitoring System)
4	Progress Monitoring Information System (PMIS)
5	BMIS (Bridge Management Information System)
6	RMIS (Road Inventory Management System)
7	ARMP (Annual Road Maintenance Project)
8	SSRN (Statistics of Strategic Road Network)
9	GRMS (Grievance Redress Management System)
10	EIS (Emergency Information System)
11	Distance Calculator
12	Store Inventory System
13	Document Management System
14	Central Authentication System

10. Strategic Road Connectivity & Trade Improvement Project (SRCTIP)

The Government of Nepal has received financing from the World Bank toward the cost of Strategic Road Connectivity & Trade Improvement Project (SRCTIP). This project will help to improve roads of regional importance and set the course for post-COVID-19 economic recovery through greater cross-border trade, more jobs, and better road safety. The Project will enhance regional road connectivity by improving the Nagdhunga-Naubise-Mugling and upgrading the Kamala-Dhalkebar-Pathlaiya road section along East West Highway. Both are crucial to Nepal's connectivity and trade with India and other countries. The project will also enhance infrastructure, facilities, and sanitation at border crossing points to ease trade constraints and spur agricultural exports.

The project will strengthen the National Road Safety Council and the Department of Roads and support periodic maintenance of high-traffic roads within the Strategic Road Network. It also includes a contingency emergency response component to reallocate project funds to support emergency response and recovery.

The project will reduce the time and cost of moving goods and boost Nepal's trade, which accounts for about 40 percent of the country's economic output. The project includes best practices in safety, climate resilience, road asset management, gender equality, social inclusion and citizen engagement, which the federal, provincial and local governments can take on.

The project is well-aligned with the past and ongoing efforts of Nepal and its regional partners to achieve the full potential for trade in the eastern sub-region of South Asia. It is a part of the World Bank's Eastern Corridor Connectivity Program, which since 2013, has financed a continually evolving regional program to improve connectivity and trade in Bangladesh, Bhutan, India, and Nepal.

Projcet Development Objectives (PDO) statement of the Project is to improve the efficiency and safety of select transport infrastructure, improve the efficiency of cross-border trade, and strengthen capacity for strategic road network management in Nepal.

Project Components

The project will have four components as detailed below.

Component 1: Trade Facilitation. The objective of this component is to: (i) reduce the time taken for goods transit at selected border crossing points; (ii) improve capacity and efficiency for sanitary and phyto-sanitary (SPS) management at selected locations and for targeted products; and (iii) enhance capacity for managing trade.

Component 2: Regional Road Connectivity. The objective of this component is to improve efficiency, climate resilience and safety of movement of goods and people across two roads within two transport corridors that are key for Nepal's connectivity and trade with India and other countries. The component comprises three sub-components:

(a) Improvement of the existing Nagdhunga-Naubise-Mugling road to two lanes, with one-meter paved shoulders.
(b) Upgrading of the Kamala-Dhalkebar-Pathlaiya road from two lanes to four lanes.
(c) A safe corridor demonstration program (SCDP), with support for road safety improvement initiatives including enforcement and post-crash response, covering a length of about 250 km.
(d) Support for implementation, coordination, monitoring and supervision of this Component 2 of the Project.

Component 3: Institutional Strengthening. The objective of this component is to improve the capacity for management of the strategic road network in Nepal, with a focus on road safety, road asset management, training and periodic maintenance, as well as support for training of local women in finding skilled employment and livelihoods. This component comprises three sub-components:

(a) Support for the National Road Safety Council through, inter alia:
    (i) establishment of an interim secretariat with seed funding in the form of staffing and equipment; and
    (ii) support for prioritized activities from the National Road Safety Action Plan (RSAP), including coordinating, monitoring and evaluating measures under the SCDP; monitoring the working of Management Information Systems and equipment service providers; supporting nation-wide roll-out of the web-based Road Accident Information Management System (RAIMS); and supporting training and peer-exchange programs.
(b) Capacity enhancement of DoR for improved management of SRN through:
    (i) development and mainstreaming of the road asset management system;
    (ii) support for training facilities and training in selected priority areas, including network-level safety assessments, quality, procurement, design of advanced structures, and management of environmental and social risks and impacts; and
    (iii) support for training of local women to find skilled employment and livelihood opportunities.
(c) Support for periodic maintenance of the Core Road

Network (CRN).

(d) Support for implementation, coordination, monitoring and supervision of this Component 3 of the Project.

(e) Training and placement support for local women is aimed at supporting the training of 500 women from the project areas, with a target of facilitation suitable employment or livelihoods opportunities for 50 participants. The Periodic maintenance activity is designed to strengthen the capacity of DoR to plan and undertake works to cover the significant backlog in periodic maintenance of the SRN, focusing on 'high traffic' roads. The project will support periodic maintenance of about 3,400 Lane-km of high-traffic roads within the SRN, that would be notified by the Department of Roads as the Core Road Network (CRN).

Component 4: Contingency Emergency Response. This component will provide immediate response to an eligible crisis or emergency, as needed. In the event of an eligible crisis or emergency, the World Bank to re-allocate project funds to support emergency response and recovery.

(a) Climate related measures. In view of the critical vulnerability context, the project will be implementing a comprehensive approach – from resilient construction and maintenance, to improved planning and contingency planning – to increase the efficiency of targeted corridors and reduce negative economic impacts due to climate related incidents. Other components and activities too will support specific climate related measures.

Component-wise Project Costs and Funding from GoN and IDA (in $ mn)

Comp.	Sub-component	Total ($ mn)	IDA ($ mn)	Percent Financing
1	**Trade Facilitation**	**42.0**	**29.4**	**70%**
a	Facilities at border-points	32.0	22.4	70%
b	Sanitary and Phyto-Sanitary Mgmt	8.0	5.6	70%
c	Knowledge Support	2.0	1.4	70%
2	**Regional Road Connectivity**	**659.0**	**350.1**	**53%**
a	Nagdhunga-Naubise-Mugling Road	174.0	121.8	70%
b	Kamala-Dhalkebar-Pathlaiya Road	440.0	202.4	46%
c	Supervision Costs	29.0	20.3	70%
d	Land acqusition, Resettlment, Utility Shifting	8.0	0.0	0%
e	Safe Corridor Demonstration Pilots	8.0	5.6	70%
3	**Institutional Strengthening**	**100.1**	**70.1**	**70%**
a	Support for NRSC	4.0	2.8	70%
b	Capacity enhancement of DoR	6.0	4.2	70%
c	Periodic Maintenance	80.0	56.0	70%
d	Incremental Operation Cost	10.1	7.1	70%
4	Contingency Emergency Response	0.0	0.0	70%
5	Front-end Fee(*)	0.375	0.4	100%
TOTAL		**801.5**	**450.0**	**56%**

(b) Project Financing. IDA credit financing for the project will be through a combination of Nepal IDA (US$100 million), Regional IDA (US$200 million), and Scale Up Facility (SUF, US$150 million). GoN will finance its share directly, and if the Modified Annuity Model (MAM)/ Hybrid Annuity (HAM) model is adopted, also through deferred payment obligations towards financing from the private sector.

11. Nagdhunga tunnel construction project

11.1 Project details

The Government of Nepal, Ministry of Physical Infrastructure and Transport, DoR has initiated the study of Nagdhunga tunnel construction project since February 2013 on the basis of various phases of the survey. The main objective of this project is to improve the road by constructing a tunnel at Nagdhunga Bhanjyang (Chandragiri Municipality on the east, Kathmandu District and Dhunibesi Municipality, Dhading District on the west) in Narayanghat Muglin Naubise section of the main road entering the Kathmandu Valley. After the construction of the proposed tunnel, the condition of the road in Nagdhunga Bhanjyang will be improved, as a result of which the transport connectivity with other places and major cities of the country will be reliable, efficient, economic & safe. The main components of the proposed Nagdhunga tunnel project are;

a) Roads and tunnels

1. Tunnel - Length 2.68 km, 2 lanes each with 3.5 m width, 1.5 m wide in the middle (Rumble Strip), 0.5 m on both sides drainage facility. The typical tunnel cross section is shown in Fig.1.
2. Approach Road, East - Length 2.32 km, Approach Road, West - Length 0.565 km
3. East Portal/West Portal
4. Bridges -3 Nos.
5. Underpass – 2 Nos.
6. Overpass - 1 No.
7. Flyover – 1 No.
8. Toll structures on both sides.
9. 24 Hrs Ventilation (Jet Fan) and Lighting System
10. Drainage Structures
11. Emergency rescue system
12. Telephone Facilities, Fire Hydrants

b) Control room and operations office

Control room and operations office are located on both the east and west sides, from where every activity inside and outside the tunnel will be monitored by CCTV and a rescue team will be immediately deployed in case of any emergency.

c) Others

Road Side service center, rest rooms, restaurants, parking lots, shops 11KV Transmission Line, 4.14 Km long.

11.2 Financial resources

A soft loan agreement has been signed between the Government of Nepal and the Government of Japan on December 22, 2016 for the construction of the proposed Nagdhunga Tunnel. Out of the total cost of the project of about Rs. 20.6 billion, the donor JICA has contributed about Rs. 15.8 billion that will be provided through loan with interest rate of 0.01 percent and the remaining about Rs. 4.8 billion is to be borne by the Government of Nepal.

11.3 Contract details

Name of Consultant: JV of NK-EJEC-NCC in Association with GEOCE & ITECO Nepal
Contractor Name: HAZAMA Ando Corporation, Japan
Contract Agreement Date: September 23, 2019
Commencement date: November 14, 2019
Construction to be completed : April 26, 2023
Contract amount: NRS: 5,500,213,019.29
Physical progress: 8%

11.4 Ongoing construction work:

1. Excavation of evacuation tunnel, drilling and blasting method in West Portal. So far, 135 meters of excavation work has been done and shotcrete and steel ribs support system has been installed in the excavated tunnels.
2. Soil cutting, retaining wall construction, road widening and embankment filling and diversion canal works are underway in Dhading section.
3. Both main and evacuation tunnel are being excavated in two shifts, day and night. So far, 43 meters of main tunnel and 36 meters of evacuation tunnel in the east are being excavated where shotcrete and steel ribs support system has also been installed.
4. Crib wall is being constructed for slope protection in East portal.
5. Approach road works are constructing on both East and West sides.
6. Overpass, Underpass, and Culverts are under construction.
7. Water supply related construction works are underway.

Recent tunnel photographs and 3D computer model of portals are shown in Fig. 2

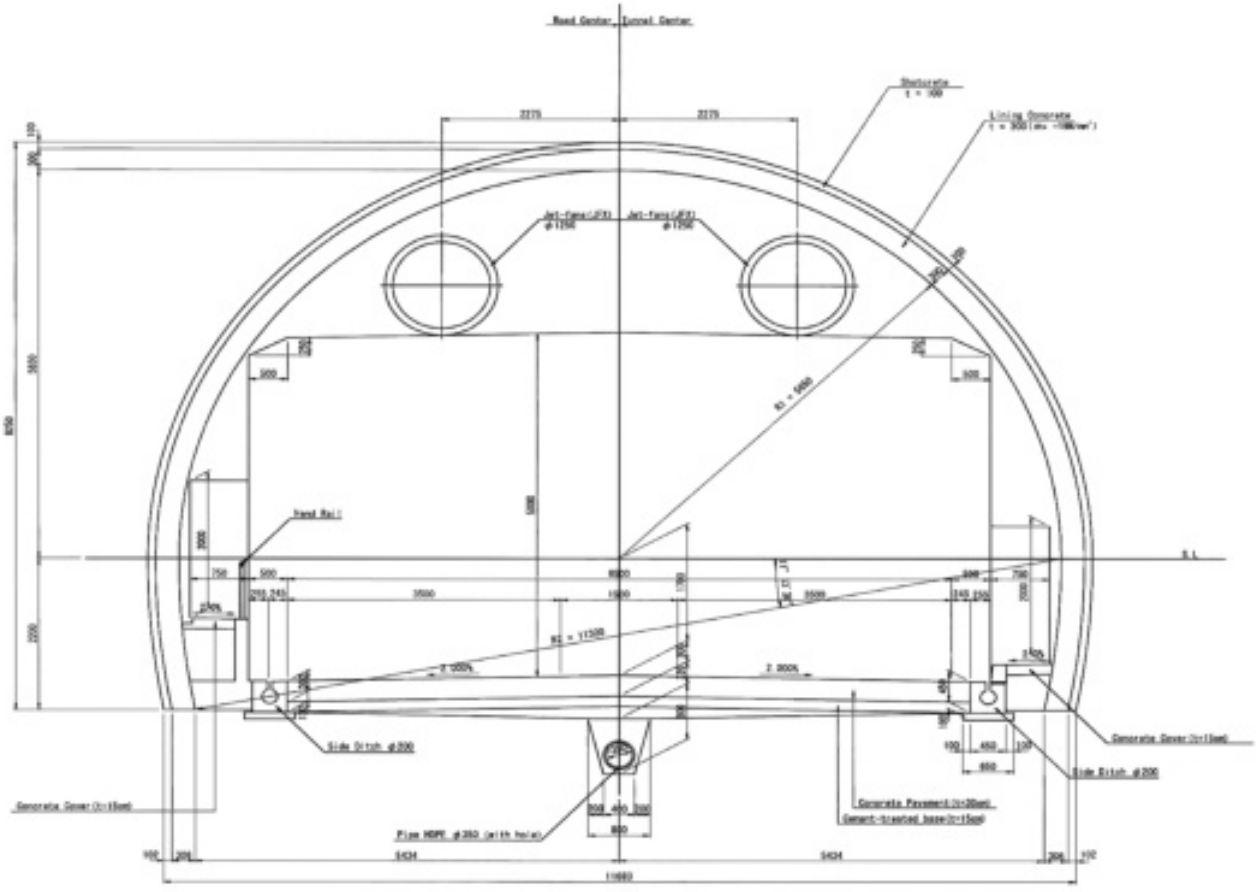


Fig 1: Typical Cross- section of Main Tunnel (all dimensions are in mm)

11.5 Problems and issues in the construction work

1. Difficulty in approach road construction as locals have not demolished houses in the East (Portal) area even after compensation. Although discussions with the concerned locals have yielded positive results, some structures are yet to be demolished.
2. A sub-committee has been formed to acquire land for construction of Balambu Flyover and the process of fixation of the rate is in the final stage. Due to the unnatural rate of the locals, the sub-committee could not reach an agreement for a long time (about 6 months).
3. On the east side (Chandragiri) as in Dhading, there is a demand for equal treatment of half of the Guthi land compensation to public.
4. Road Construction materials could not be stored at the Road Side Service Station in the West (Portal) area due to the refusal of the locals to remove houses and tents which were constructed illegally and under investigation by the authorities.

(a) Main Tunnel, East

(b) Crib Wall, East

(c) East Portal

(d)Two parallel Tunnels at East Portal

(e) Model of East Portal

(f) Model of Two parallel Tunnels at East Portal

Fig 2: Recent tunnel photographs and 3D computer model of portals

12. Recent Road Safety Activities

Road Safety and Traffic unit (RSTU) is established in DoR to carry out road safety related activities. In Road safety sector, DoR is responsible for Pillar 2 of Road Safety Action Plan 2013-2020. Dedicated budget head is allocated for road safety works in DoR and about 300 million rupees is allocated for the current fiscal year. The major activities to be performed on Road Safety area are construction of Crash Barrier, use of Road Markings, installation of Traffic Signals, construction of Delineator posts and Railing, Intersection Improvement, Traffic Studies, Road safety Audit/Inspection etc.The road safety works carried out in different highways are shown in Figs 1-6.

Fig 1: Koteswor-Satdobat, Ringroad

Fig 2: Harkpur-Okhaldhunga Road

Fig 3: Ratnapark-Bhadrakali Road, Ktm.

Fig 4: Baluwatar Road

Fig 5: Water Jetting on Kerbstone & Edge line

Fig 6: Bhadrakali-Singhdarbar Roads

Some activities performed on Road Safety sector in this F.Y. 077/78 are:

(a) Traffic Signal Light maintenance, Installation and operation at 14 Intersections and Installation work running at additional 5 Intersections with 8 Pedestrian crossings in Kathmandu Valley.
(b) 6047 Sqm Road Marking works within Road Division Kathmandu, Road Marking and Kerb Stone marking 9.5 km along Kalanki-Satdobato Koteswor Ring Road from Road Division Lalitpur, about 5.5 km Railing Works installed in Kathmandu Valley and About 5700 m, W-Beam Crash Barrier along Ghurmi-Okhaldhunga-Salleri Road Section from RSTU.
(c) Preparation of Revised Road Safety Action Plan 2021-2030 is in process from MoPIT and procurement of consultant is in process for Design Review of Intelligent Traffic Signal Light System prepared from KSUTP at about 44 locations in Kathmandu Valley from RSTU.

13. The list of National Highways that are approved by the Government of Nepal, Cabinet of Ministers on B.S. 2076-02-06 are;

S.N	Highway Node	Name of Roads	Length (K.m)
1	NH01	East-West (Mahendra) Highway	1028
2	NH02	Kechna-Chandragadhi-Charaali-Ilam-Fidim, Ganeshchowk-Taplejung-Olangchungola (Mechi Highway)	352
3	NH03	Pushpalal (Mid Hill) Highway	1787
4	NH04	Birtamod-Chandragadhi-Bhadrapur-Mechi bridge	15
5	NH05	Postal Highway	1016
6	NH06	Chatara-Mulghat-Majhitar-Amarapurdanda-Ganeshchowk (Tamor Corridor)	135
7	NH07	Pakli-New Koshipul-Rupnagar, Pakli-Nadaha-Koshipul-Chatra	66
8	NH08	Rani-Biratnagar-Itahari-Dharan-Dhankuta-Hile, Leghuwaghat-Tumlingtar-Khandwari-Num-Kimathanka (Koshi Highway)	320

S.N	Highway Node	Name of Roads	Length (K.m)
9	NH09	Bahundangi-Shantinagar-Dharan-Chatraa-Gaighat-Katari-Sindhulimadi-Hetauda, Gaindakot-Rampur-Ramdi-Ridi-Balkot-Sandhikharka-Bijuwar-Sitalpati-Surkhet, Baddichaur-Sahajpur-Budar-Jogbudha-Rupal (Madan Bhandari Highway)	1200
10	NH10	Deurali-Mudhe-Chainpur-Bohratar	92
11	NH11	Fikal-Shriantu-Chhabise Ilam	19
12	NH12	Ghurmi-Chatara-Udaipur	163
13	NH13	Bardibas-Sindhuli-Khurkot-Dhulikhel (BP Highway)	160
14	NH14	Gaighat-Maahuli Khola-Rupani-Kunauli-Rajbiraj-Chhinnamasta Niur, Kunauli Rajbiraj Kanchanpur Barrier-Fatehchaur-Basaha Udaypur	100
15	NH15	Gwarko-Lubhu-Lakuribhanjyang-Kushadevi-Panauti-Dahaltar	128
16	NH16	Thandi-Bhagwanpur-Lahan, Kadmahchok-Gaighat-Mahure-Kharpa-Solu	144
17	NH17	Naubise-Muglin-Pokhara (Prithvi Highway)	173
18	NH18	Balaju-Trishuli-Dhunche-Syaphrubeshi	65
19	NH19	Ridi-Balkot-Hanspur-Pyuthan, Pyuthan-Surkhet road	220
20	NH20	Madar-Chaurahawa, Golbazar Siraha Sanghure Udaipur, Mirchaiya-Katari-Ghurmi, Hilepani-Okhaldhunga-Salleri	193
21	NH21	Sitapaila-dharke	24
22	NH22	Dhalkewar-Janakpur-Jatahi, Ghorghans-Nimchaur-Thalahighat-Akaraharghat	48
23	NH23	Diktel-Solu-Junbensi-Khahare-Jiri Bazar-Tamakoshi-Charikot-Khadichaur	291
24	NH24	Lalgad-Ranibaas (R. T. O. Road) -Bishmat-Bahunmara-B.P. Highway	29
25	NH25	Dumre-Beshisahar-Chame	108
26	NH26	Jamuniwas-Bateshwar-Santipur-Kurtha-Janakpur	19
27	NH27	Sitalpati Salyan Kubhinde Baluwa Sangrahi	40
28	NH28	Bhittamod-Jaleshwar-Bardivas, Khurkot-Manthali-Tamakoshi-Singti-Lamabagar-Lapchegaun	281
29	NH29	Kanchanban-Janaki Medical College-Mithileshwar Sabaila-Siraha-Naktajhij-Ramlaxmanchowk-Healthpost Mahendra Highway	30
30	NH30	Janakpur (Mujelia) -Dhanushadham-Dharapani Ramayana Circuit, Tarapatti-Pathara M.R.M. Pushpalpur	36
31	NH31	Dolalghat Chautara	25
32	NH32	Nawalpur-Malangwa-Shonvarsha	30
33	NH33	Nijgadh-Kathmandu	76
34	NH34	Kathmandu-Dhulikhel-Dolalghat-Khadichaur-Kodari (Araniko Highway)	112
35	NH35	Piluhawa-Manamat-Kalaiya-Martihwa	25
36	NH36	Chandranigahpur Gaur	45
37	NH37	Hetauda-Bagmati-Tikabhairav-Bhaisepati-Ekantakuna (Kanti Rajpath)	86
38	NH38	Roundabout outside Kathmandu	68
39	NH39	Kathmandu Ring Road	27
40	NH40	Samakhushi-Tokha-Gurje-Bidur	26
41	NH41	Sirsiya-Pathlaiya, Hetauda-Bhaise-Palung-Naubise-Kathmandu (Tribhuvan Highway)	155
42	NH42	Thori-Bhandara-Malekhu, Galchi-Trishuli-Betrawati-Mailung-Syaphrubesi-Rasuwagadhi	197
43	NH43	Malekhu Dhading Salyantar	57
44	NH44	Thori-Bharatpur-Mugling, Aabukhaireni-Gorkha-Ghyampesal, Arughat-Sirdiwas-Roila Bhanjyang	300
45	NH45	Khairanitar Bhimaad Kawasoti	106
46	NH46	Bhumhi-parasi	9
47	NH47	Belahiya-Bhairahawa-Butwal-bhartung-Ramdi-Syangja-Pokhara (Siddhartha Highway)	184
48	NH48	Tansen-Ridi-Korla	254
49	NH49	Bartung Tansen Reidi Vamitaksar Kharwang	98
50	NH50	Jitpur-Toulihawa-Khunuwa	30

S.N	Highway Node	Name of Roads	Length (K.m)
51	NH51	Taulihawa Gorusinge Sandhikharka	83
52	NH52	Kakrahawa (India border) -Rudrapur, Saljandi-Sandhikharka-Devisthan, Burtivang-Dhorpatan	222
53	NH53	Bhaluwang Liwang Rolpa Madichaur Daarbot	130
54	NH54	Koilabas-Lamahi, Arjunkhola-Ghorahi-Holeri-Ghartigaun-Thawang-Lukum (Shahid Marg)	211
55	NH55	Amelia-Tulsipur-Shitalpati-Tharmare-Musikot (Rapti Highway)	169
56	NH56	Tharmare-Chaurajahari-Jajarkot Khalanga-Jumla Kundari-Mugu Rara (Rara Highway)	263
57	NH57	Chhinchu-Kudu-Jajarkot-Dunai-Dho-Tinje-Marim (Bheri Corridor)	317
58	NH58	Jamunaha-Nepalganj-Kohalpur-Surkhet-Khulalu-Hilsa (Karnali Highway)	538
59	NH59	Murtiya (Indian border) -Gulariya-Bhurigaon-Telpani-Surkhet-Upper Dungeshwar-Bank-Bayuli Nagma Road	154
60	NH60	Surkhet-Dailekh-Mahabulekh-Galje, Nagma-Gamgadhi-Nakchelagna	302
61	NH61	Surkhet Tallo Dungeshwar-Satkhamba-Dullu-Pipalkot-Khulalu-Manma-Nagma-Jumla Road	168
62	NH62	Khakraula-Tikapur-Lamki-Lodeghat-Bayalpata, Sanfebagar-Chainpur	228
63	NH63	Sanfebagar-Martadi-Kolti	111
64	NH64	Khodpe-Chainpur (Bajhang)	108
65	NH65	Khutiya-Dipayal-Chainpur-Urai Bhanjyang	296
66	NH66	Dhangadhi-Sahajpur-Budar-Syaule, Satbanjh-Thaktoli-Darchula-Tinker	350
67	NH67	Chandni-Bhimdatta-Brahmadev-Pancheshwar-Jhulaghat	201
68	NH68	Bhimad-Rampur-Mityal-Arung River	80
69	NH69	Jagat Bhanjyang-Mandalithan-Kebre Bhanjyang-Barikuna-Kisan-Chapakot-Gajarkot Road, Syanja	42
70	NH70	Seti Dobhan-Bejang-Panchmul-Aruchaur Ghante Deurali, Syanja	46
71	NH71	Bhaluwang-Nuwakot-Khandaha-Kharwang	170
72	NH72	Dumkibas Bahuvan Tribeni	23
73	NH73	Surunga-Sarnamati-Tangandubba-Via-Lasungunj, Jhapa	25
74	NH74	Ilam (Biplate) -Maipokhari-Sandakpur, Ilam	50
75	NH75	Golden Everest Great Ring Road (Okhaldhunga-Solu-Salleri-Khotang-Diktel-Okhaldhunga)	135
76	NH76	Damak-Chisapani-Rabi	44
77	NH77	Bharatpur Metropolitan Great Ring Road	105
78	NH78	Damak Muncipality Ring Road	100
79	NH79	Godar (Dhanusha) Chisapani-Mainawati-Kalapani-Dudhauli-Sindhuli	20
80	NH80	Mahendra Highway Bastipur chowk (Siraha) B.P. Cancer Hospital-Belsot-Katari, Udaypur	30
Total Length			**14,913.00**

14. Pile Integrity Testing

14.1 Introduction

Some information on the frequency of defective bored piles, identified through NDT inspection, can be taken from the results of surveys published in the technical literature. Davis and Dunn (1974) [1] report 9.7% defective out of a total 717 piles tested on five projects; Fleming et al (1985)[2] found 1.5% defective out of a total 5,000 piles tested and 1.9% defective out of a further 4,550 piles tested. Ellway (1987)[3] reports 4.2% defective of a total 4,400 piles tested: Thasnanipan et al (1988) [4]state 3.3% defective of a total 8,689 piles tested: Lew et al (2002) [5]report 7% defective within a population of 380 piles tested and 1.5% defective of a total 5000 piles tested. Preiss and Shapiro (1981)[6] suggest that approximately 5 % to 10% of the piles on project could be defective.

Obviously, there are numerous factors influencing the quality of the piling work in each case, some of which may be noted are:

- The variability of ground conditions across the site and with depth
- Knowledge of the specific ground conditions gained from a detailed site investigation
- Contractor skill and experience with a given pile type under similar operating conditions
- Supply of material of correct quality
- Appropriateness of construction procedures for the particular soil and groundwater conditions
- Level of workmanship and site supervision during construction
- Intensity of programme pressure on the piling work
- Effects of ground movements and site traffic during concrete hardening
- Appropriate method and care in trimming pile head to final cutoff level

According to the ASTM D5882, pile integrity refers to qualitative evaluation of the physical dimensions, continuity

of a pile, and consistency of the pile material. ASTM D5882 introduces a standard method for integrity testing of piles and deep foundations using low strain impact. This method includes generating acoustic waves using a hammer impulse and transmission of acoustic probe waves through the test area (i.e., piles or deep foundations). The transmitted waves are reflected off boundaries (e.g., pile toe) and internal anomalies, recorded by a transducer (e.g., accelerometer, geophone) on the tip of pile. The recorded signal is further analyzed using different signal analysis features (e.g., FFT, Low-Pass Filter and High-Pass Filter, etc.) to find out possible anomalies, and pile toe for pile length testing. Use of Pile Integrity Testing (PIT) has become an inherent feature of quality assurance system. Such rapid tests are carried out over and above the traditional system of load testing (also called routine pile load tests). PIT is known to analyze acoustic anomalies with respect to pile toe level, shaft restraints, over-break, cracks, reductions in section, and zones of poor-quality concrete.

14.2 PIT Apparatus requirement (ASTM D5882-16)

Accelerometers shall be linear to at least 50g. For DC Device, device with frequency response up to 5 KHz with less than -3dB reduction of content. Calibrate the transducer to an accuracy of 5% throughout the applicable measurement range.

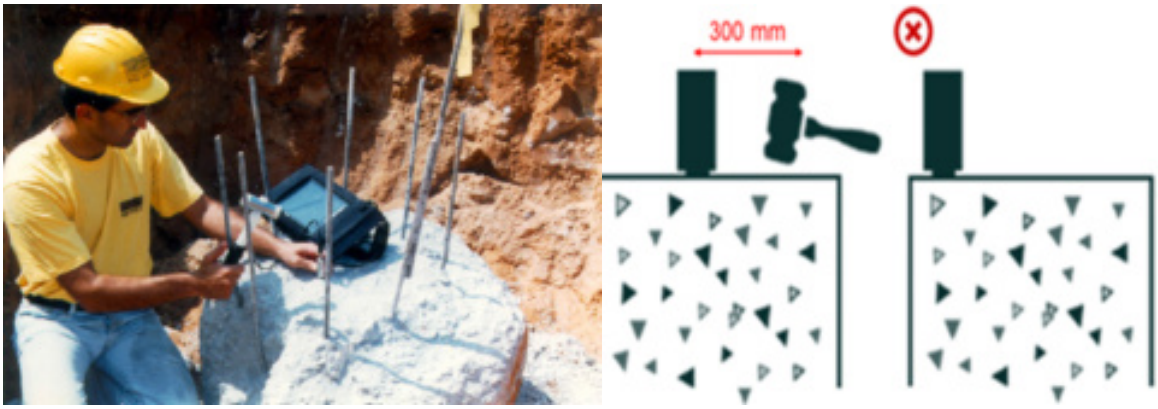


Fig. 1 Conducting PIT Test

The tests shall be conducted at 5-6 places (in no case less than 3 hammer blows; maximum distance between hammer and sensor should not exceed 300mm to cover the entire section of the pile. The typical pile load testing is shown in Fig.1.

14.3 Theoretical background and application

The time (T) between the start of the hammer blow and the time of arrival of the reflection from the pile toe is measured. The pile length (L) is calculated with: L = c.T/2, where the stress wave velocity (c) is known, where "c" is a function of the pile density "ρ" and pile materialmodulus of elasticity "E" ; c = Sqrt (E/ ρ). Selection of Wave velocity for test is shown in Table 1 and traveling of stress wave is shown in Fig. 2.

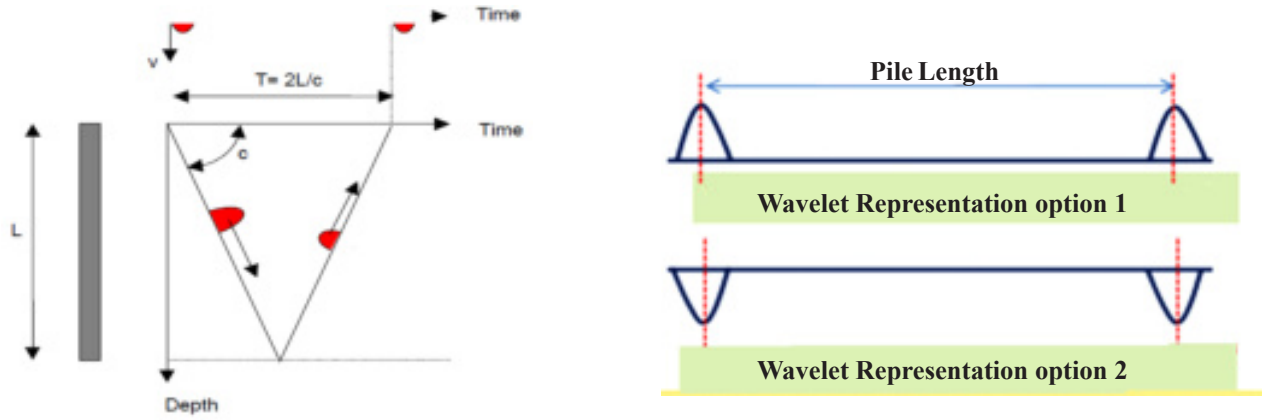


Fig. 2 Stress wave travels

To present the measuring results the time axis (t) is scaled to a length (depth) (l) axis with L= c.t/2. Due to shaft friction the toe reflection might be of small magnitude. To make the reflection visible, the measured signal is amplified. To remove noise from the signals a filter value can be applied. The result of three hammer blows is shown in Fig. 3.

Table 1 Selection of Wave velocity for test

Pile Concrete Strength, Mpa	20	25	30	35
Modulus of Elasticity,KN/m2	2.8E+07	2.9E+07	3.1E+07	3.2E+07
Density, t/m3	2.4	2.4	2.4	2.4
Wave Velocity, C m/s	3385	3476	3565	3623
Adopted Wave Velocity, C m/s	3400	3500	3600	3700

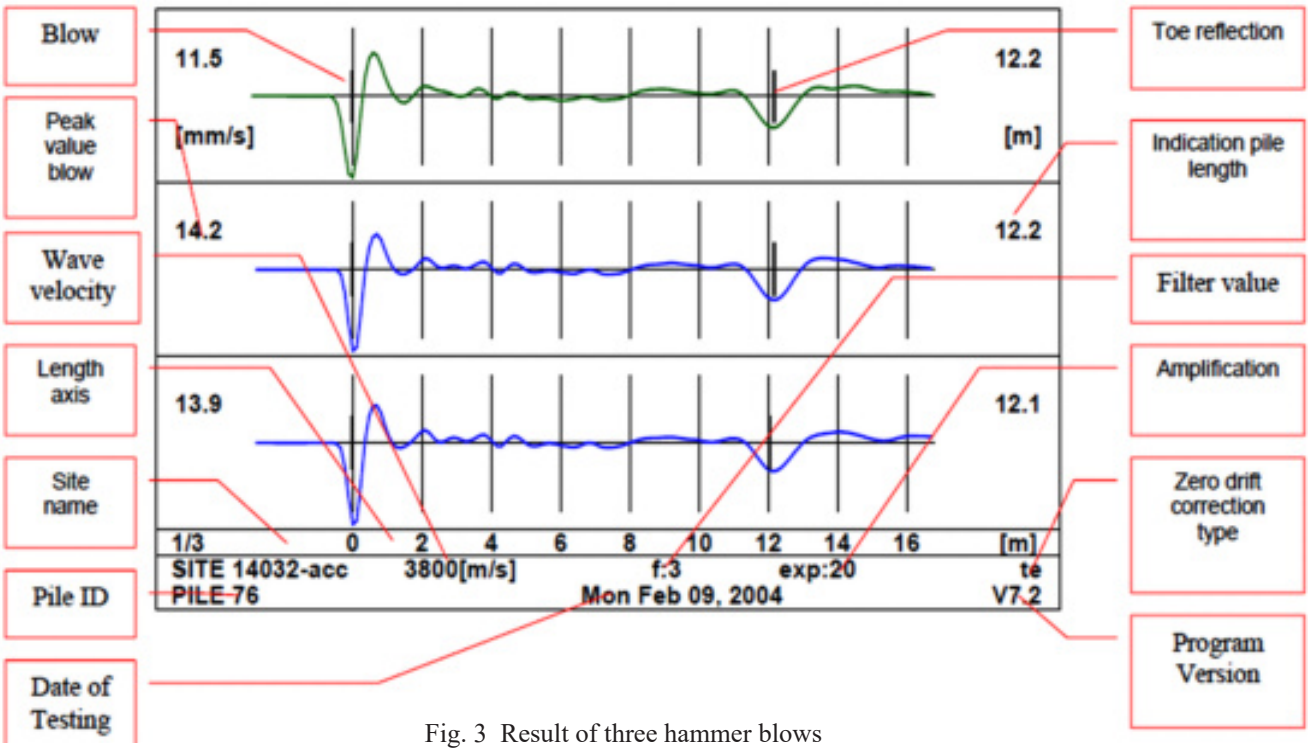


Fig. 3 Result of three hammer blows

Pile integrity testing analysis is based on the one dimensional stress wave theory. Reflections generated by impedance changes (discontinuities) travel to the pile top and are recorded and analyzed. The impedance Z is defined as

$$Z = A\sqrt{(E.\rho)} \text{ or } = EA/c,$$ In which, A = cross sectional area of pile

Any change in A, E, or ρ or a combination of them will generate a reflection from an impedance change (discontinuity). The intensity of the defect is quantified in terms of the parameter β defined as Z1/Z2. Classification of defects could be made based on the value of β (Rausche & Goble, 1979) [7]as shown in Table 2 and typical reflectograms are shown in Fig. 4. The suggested value to input during PIT tests are shown in Table 3.

Table 2 Defect classification

β=Z1/Z2	Damage assessment
1.0	Uniform
0.8 – 1.0	Slight damage
0.6– 0.8	Damage
0.6>	Pile with a major discontinuity

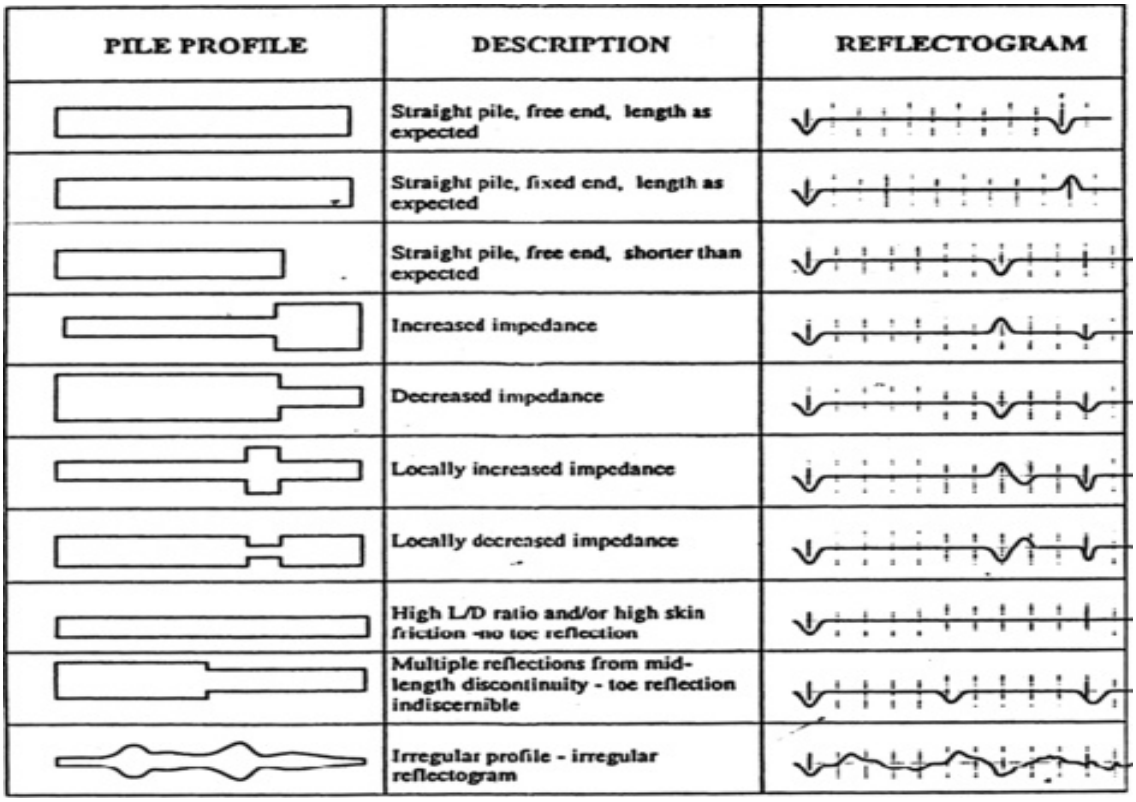


Fig. 4 Typical Reflectograms

Table 3 The suggested value to input during PIT

Wavelet	1-2 m
MD	20% of Pile Length
MA	Pile Length, m
Hi Pass Filter	0
Use of LO Pass filters is discouraged, Soildata.	

14.4 Conclusion

Integrity testing is based on the stress wave propagation concept and reflection theory. A stress wave generated by a hammer impact in a uniform rod is reflected if the wave encounters an impedance change or a strong soil effect. A structurally sound and generally uniform diameter shaft is indicated by a reflection from the pile toe with only minor variations in the velocity record amplitudes between the times of impact and toe reflection. A sound shaft is also indicated by negative velocity reflections which are often caused by so-called bulges where softer soils or auger wobble allow for an enlargement of the pile diameter. An impedance reduction is indicated by a positive velocity reflection before the pile toe. This can indicate a reduction in shaft cross section such as from a void, soil inclusion, neck-in, or crack. It can also indicate a reduction in elastic modulus which could be due to poor concrete quality, or soil or ground water mixing during installation.

References

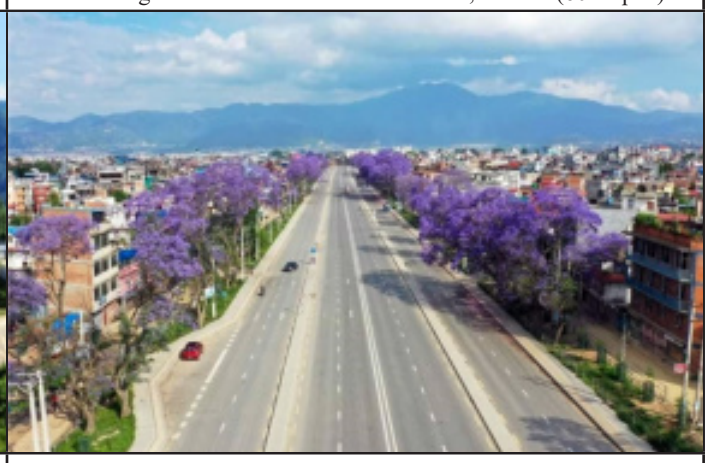
1. Davis AG and Dunn CS (1974) From theory to field experience with the non-destructive vibration testing of piles, Proceedings of the Institution of Civil Engineers, Vol. 57, Part 2, p571-593
2. Fleming WGK, Weltman AJ, Randolph MF and Elson WK (1985) Piling engineering, Surrey University Press
3. Ellway K (1987) Practical guidance on the use of integrity tests for quality control of cast insitu piles, Proceedings of the first international conference on foundations and tunnels,London, p228-234.
4. Thasnanipan N, Maung AW and Baskaran G (1988) Sonic integrity test on piles foundedin Bangkok subsoil signal characteristics and their interpretations, Proceedings of the Fourth International Conference on Case Histories in Geotechnical Engineering, StLouis, Missouri, 9-12 March, p1086-1092.
5. Lew M, Zadoorian CJ and Carpenter LD (2002) Integrity testing of drilled piles for tall buildings, Structure Magazine, National Council of Structural Engineers and the ASCE, October 2002.
6. Preiss K and Shapiro J (1979) Statistical estimation of the number of piles to be tested ona project, RILEM Commission on Non-Destructive Testing, Stockholm.
7. Rausche, F., and Goble,G.G. 1979. Determination of pile damage by top measurements. Behavior of Deep Foundations ASTM,SPT 670,American Society for Testing and Materials:500-506

15. Photographs of some major works in recent years

Mugling Arch Bridge (120m +2 * 20m)

Arch bridge over Tamakoshi River at Gumu,Dolakha(60m span)

Slope Stabilization work at BP highway



Ringroad, Kathmandu

Dhobikhola Network Arch Bridge,Kathmandu (50m span)

DoR Address: Department of Roads (DoR), Chakupat, Lalitpur, P.No. : 01-5529075

See you again with DoR Newsletter Vol. 27