(2B) Stage 1 Survey and Design

Presentation for LRN Training

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Presentation Contents

- Walkover Survey
- Stage 1 Survey Procedures
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- Lessons Learned from Year 1 Stage 1 Design and Estimates

Introduction

- Carried out along the best route recommended in the walkover survey
- First level, detailed survey in which necessary measurements/details are taken for subsequent design
- Serves as a guiding document for construction of 2.5 m track opening
- Cost estimate based on the design is taken as a basis for overall resource/budget planning

WALKOVER SURVEY

Walkover Survey

- A form of pre-feasibility study in which various alternative alignments are explored and the best one is recommended
- Desk study includes:
  - Study of DTMP
  - Explore and draw alternative possible routes on topo map (1:25,000 or 1:50,000)

Walkover Survey Contd.

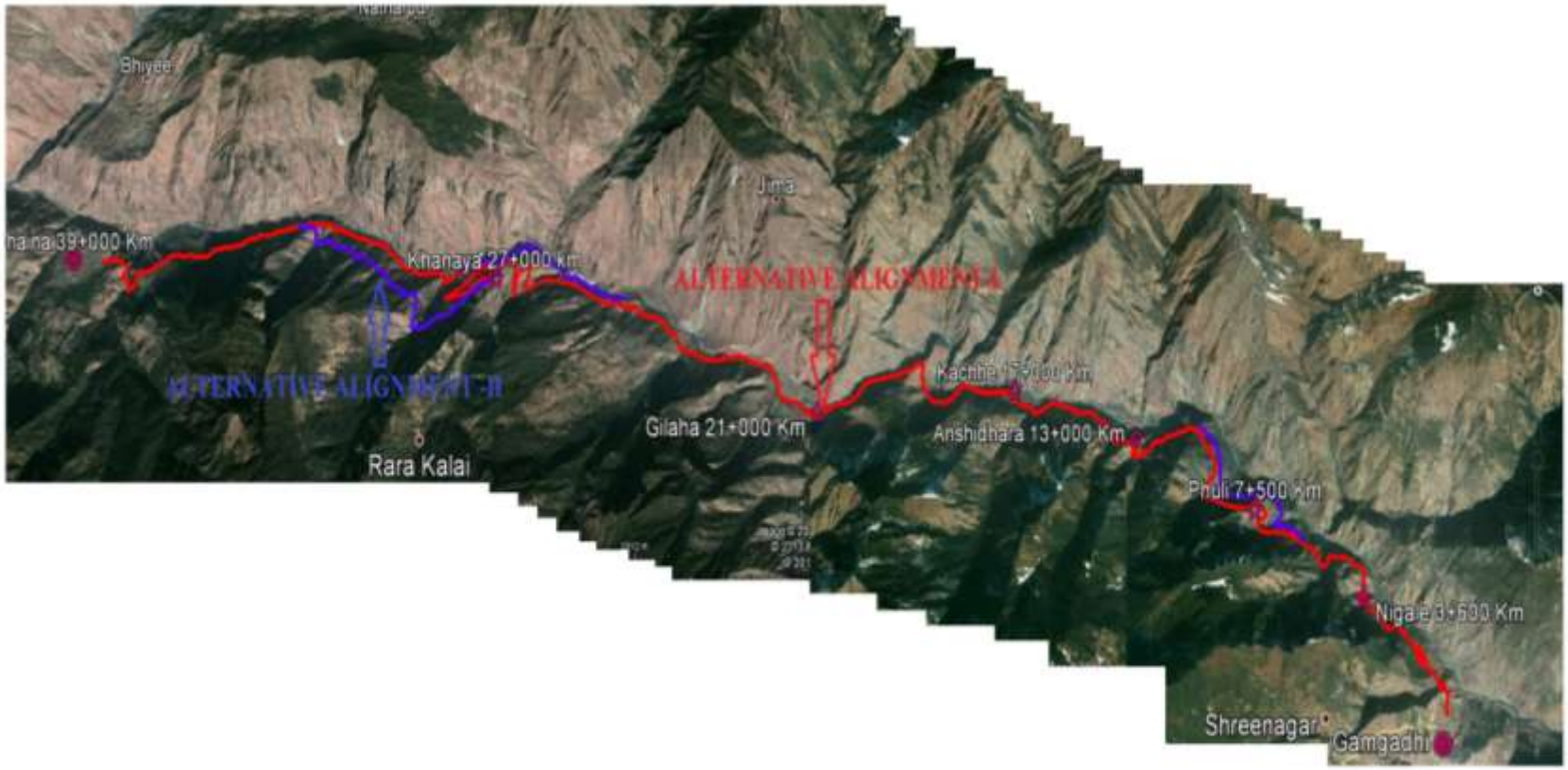
- While drawing alignments on topo sheet:
  - Keep the gradient <7%; (5-7)
  - Avoid unstable areas/steep slopes/dense forests based on the info provided on the map
  - Identify/set obligatory points

Walkover Survey Contd.

- Verify various alignment options identified in desk study
- A team comprising road engineer and geologist conduct complete walkover of all routes and come up with a best feasible alignment
- Set intermediate points with abney level within 7% grade and record coordinates using GPS to be transferred later onto Topo map

Walkover Survey Contd.

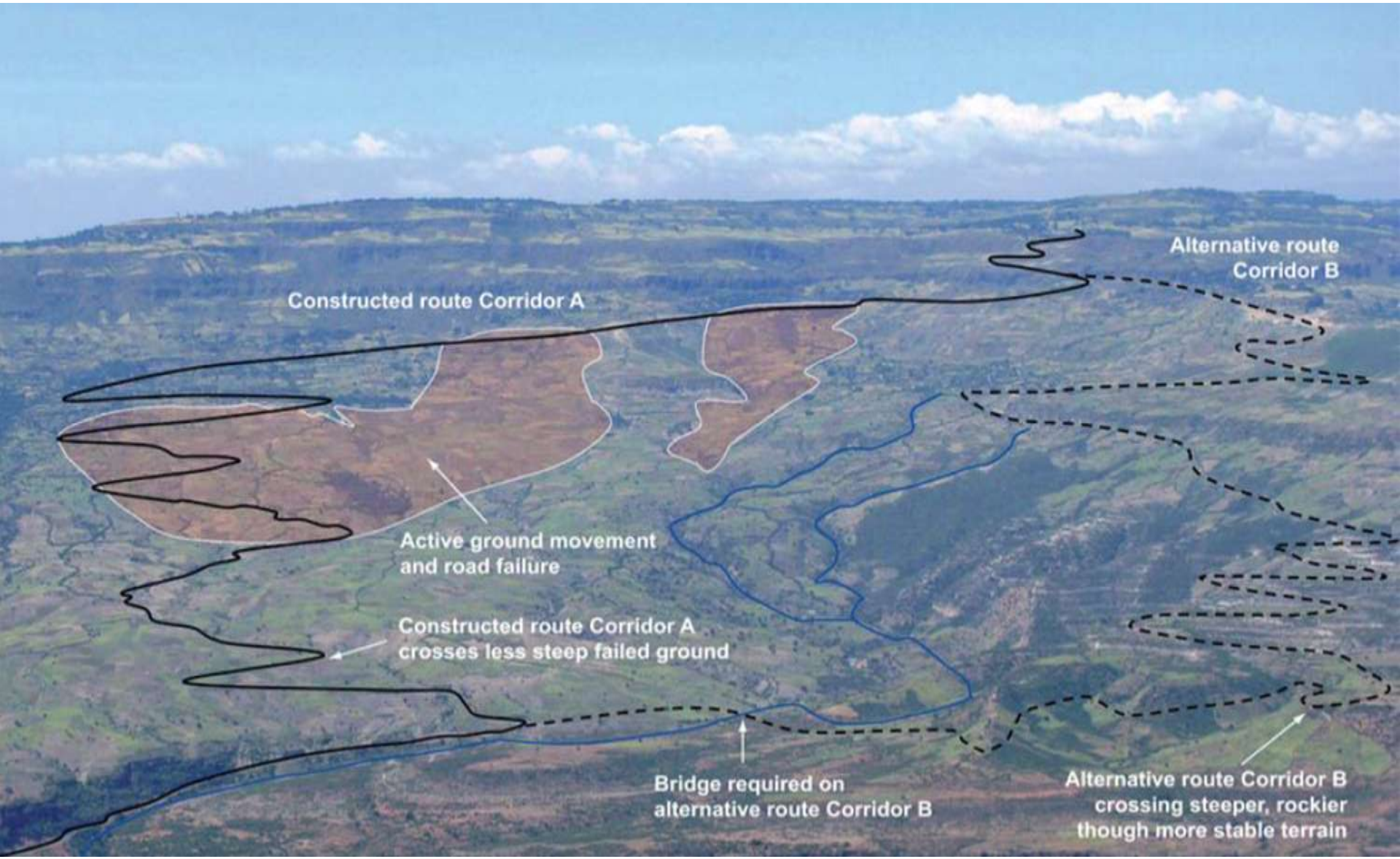
- Major criteria governing alignment selection are:
  - Shortest length
  - Avoidance of rocky cliff and locate best sites for river crossing
  - Favour ridges and barren land
  - Geologically more stable
  - Minimum disputes among roadside neighbours
  - Environmentally less sensitive and minimal negative impacts



RURAL ACCESS PROGRAMME (RAP) PHASE-3 MUGU	ALIGNMENT SELECTION/FEASIBILITY SURVEY GAMGADHI - DHAINA - DULACHAUR DISTRICT ROAD	PLAN GOOGLE MAP	1

Walkover Survey Contd.

- Review the geology, environmental and engineering aspects of each of the alignment
- Make a comparative analysis of all possible candidate alignments based on technical and socio-economic criteria
- Prepare a walkover survey report covering all aspects of the study along with comparative cost estimates of each alternative alignment and make recommendation for further course of action



Source: Dr Gareth Hearn

STAGE 1 SURVEY PROCEDURES

Stage 1 Survey Overview

- Survey of the best possible alignment identified from walkover survey
- Obligatory points & control points guide how, and where, the road alignment should pass
- CL fixation, with establishment of horizontal/vertical control, and cross-section measurement are the key activities to be undertaken

STAGE 1 SURVEY STEPS

Desk Study

- Review the walkover survey report and confirm the best alignment option recommended
- Collect the details of obligatory points that the alignment should pass

Field Survey

- Follow the best alignment from the walkover and make corrections to errors/lapses
- Mark CL with Abney Level by setting the gradients within the max. acceptable limit (i.e. 12%)
- Run traverse survey along the marked points (pegs) with Total Station
- Establish benchmarks at 500 m intervals
- Fix CL pegs at 20 m, or less, intervals and record coordinate data of adequate points a minimum of 10 m either side of CL

Field Survey Contd.

- While fixing CL with Abney Level key aspects to be considered are:
  - Alignment should not deflect sharply in or out
  - Alignment should not have deep ups and downs
  - CL should be positioned so that cut and fill can be achieved transversely as well as longitudinally
  - Ruling gradient of 7% must not be exceeded
  - If there is a need to adopt gradient above 7%, limit the length within the allowable value and provide grade recovery length as necessary

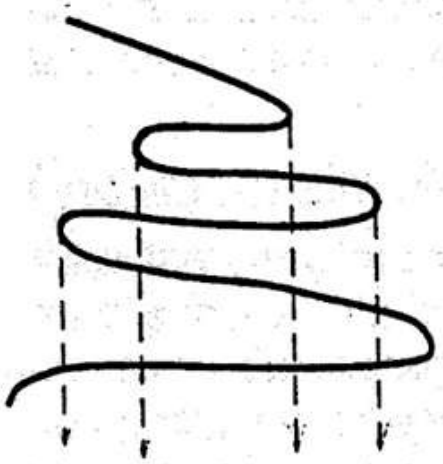
Field Survey Contd.

- Record details of CL pegs on a strip map (D-card) establishing reference point for pegs on an interval of 250 m
- Identify possible disposal sites for locations where large surplus is likely
- Record soil/rock classification as per DoLIDAR's norms
- Select best location for cross-drainage structures over rivers and major Kholas
- Avoid geologically unstable areas and hazardous sections.
- Survey land use and plant availability for bioengineering

Locating Hairpin Bends

- Minimise number of hairpin bends
- Avoid stacking of hairpin bends
- Locate bends on relatively flat terrain as much as possible
- Avoid hazardous and unstable areas
- Layout configuration of a cluster of bends should be such that upper bend should extend horizontally beyond the lower one to facilitate the proper drainage

Locating Hairpin Bends Contd.



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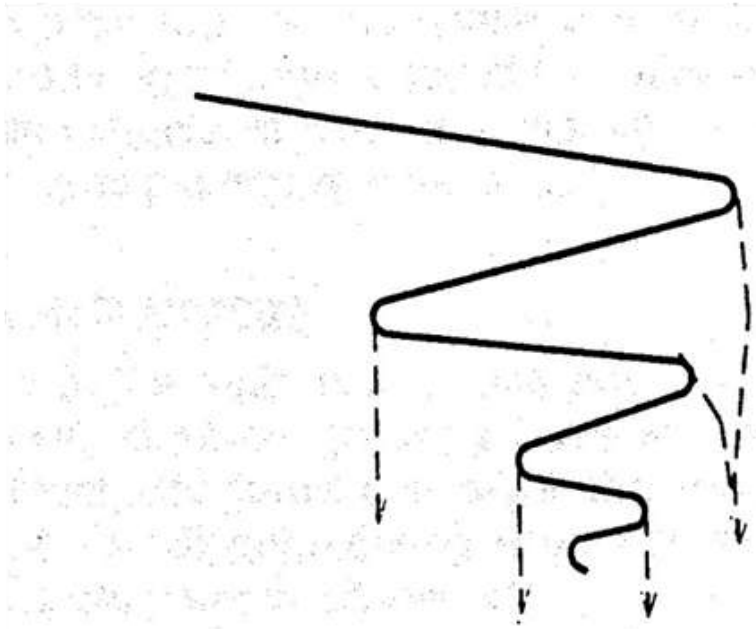


YES

Correctly Located Hairpin Bends

LESSONS LEARNED FROM YEAR 1

Lessons Learned

- Inadequate cross-section data (coordinates) for development of Digital Terrain Model (DTM)
- Fixing of CL pegs with proper consideration for permissible values and lengths of gradients in the field

STAGE 1 DESIGN AND ESTIMATES PROCEDURES

Overview

- Design principles:
  - Low cost and labour-based
  - Min. disturbance to natural profile/morphology
  - Refer to MRE hand book
  - Optimisation of cut and fill
  - Extensive use of softline (flexible) structures
- Design and estimates clearly separated for 2.5 m width (first phase) and for full completion (all phases)

STAGE 1 DESIGN AND DRAWINGS

Design

- Prepared by engineer **who** conducted the stage 1 survey
- **Horizontal Alignment** – fully define intersection points (IP) with beginning of the curve (BC), middle of the curve (MC), and end of the curve (EC)
- **Vertical Alignment** – fully define key points of vertical curve: BC, MC, EC, and highest and lowest points w.r.t. designed point of intersection
- **Mass Management** – design mass management and haulage plan (mass haul diagram) and show on profile design drawings

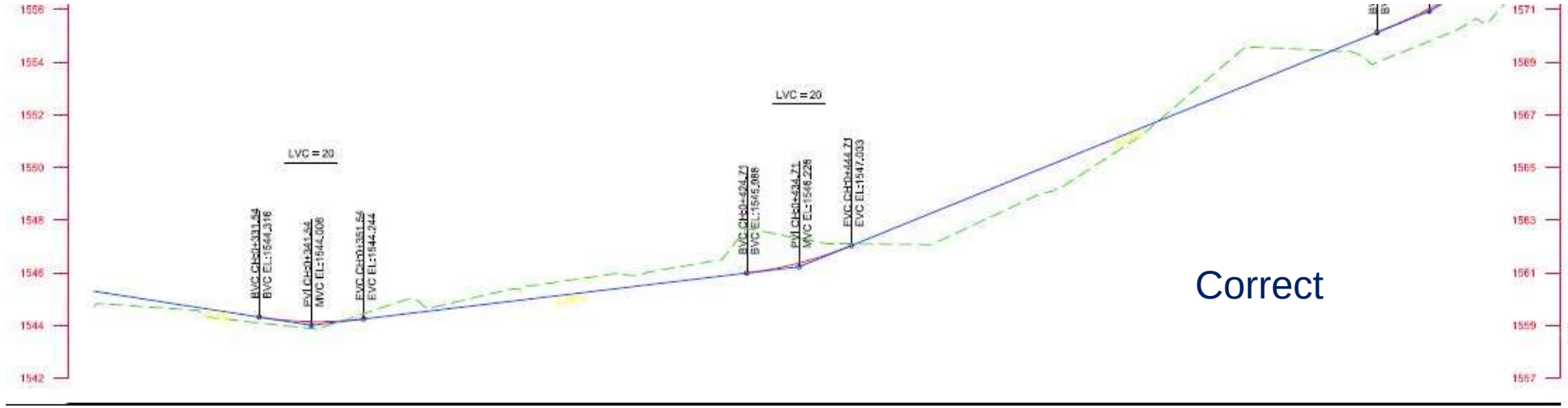
Design Contd.

- Cross-section Design
  - Minimum changes to the natural profile ensuring optimum cost
  - Define and draw various cross-section elements – roadway width, side drain, retaining and breast walls, passing bay as required
  - Show different phases work – Year **1**: 2.5 m wide track, Year **2**: 3.5 m wide track (introduce structures), Year **3**: full width 4.5 m and retain. Structure complete, and Year **4**: side drain and cross drain, additional width for passing bay, bioengineering works

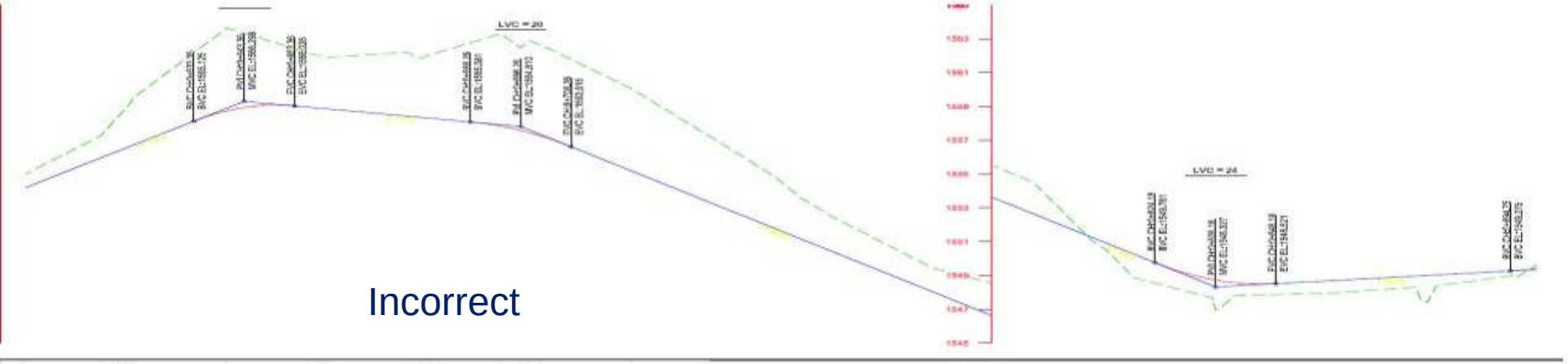
Drawings

- **Road Plan** to 1:1000 scale
- **Profile** to H1:1000 and V1:200 (for hills) and V1:100 (for plains) scale
- **Cross-section** at 25 m intervals or less covering at least 10 m on either side
- **D-card** with full details (including coordinates) of benchmark and CL reference points

Example of Profile Design



Correct

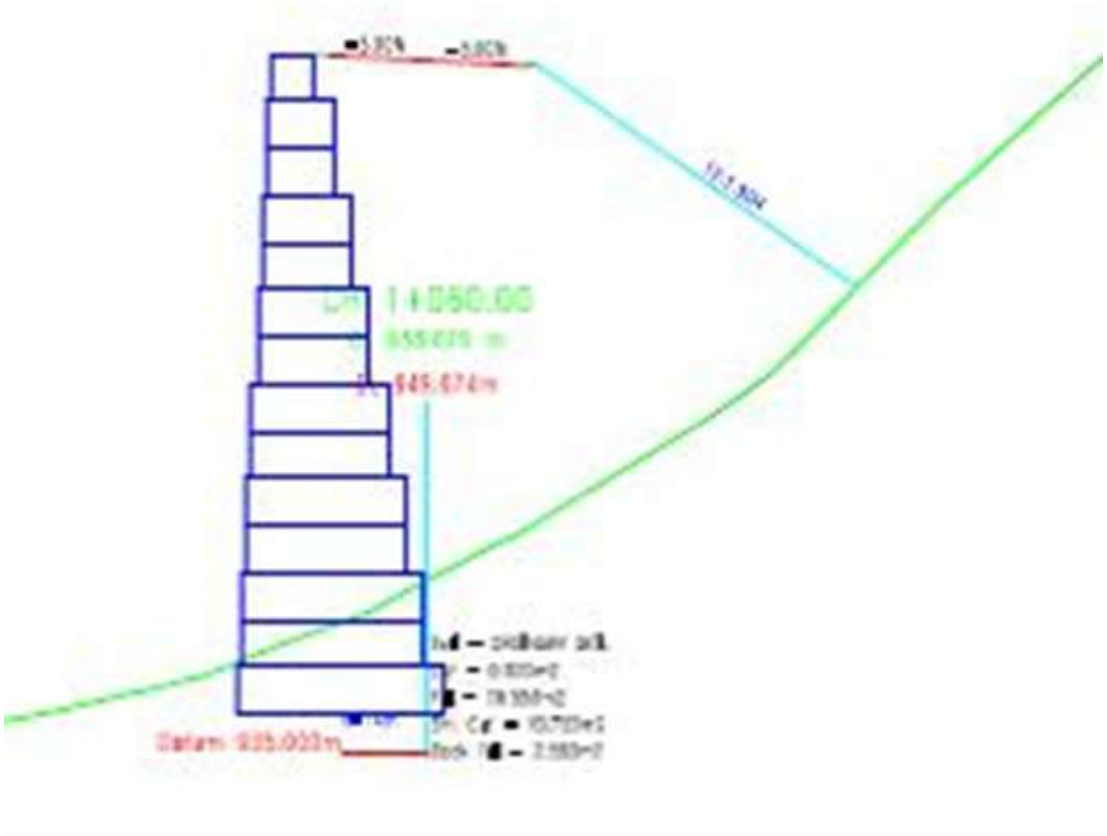


Incorrect

Example of Cross-Section Design

Correct

Example of Cross-Section Design Contd.



Incorrect

STAGE 1 ESTIMATES

Estimates

- Estimates for each phase of work
- EW in excavation to be broken down as OS, HS, OR, MR, and HR
- EW also to be categorised as cut to fill, cut to tip, and borrow to fill with required lead distances
- Estimates for different type of structures
- Estimates for quantities of stones to be quarried and collected along with the transportation lead distances

Estimates Contd.

- Rate analysis
- Abstract of Cost – total for the road and VDC/LRUC wise
- Cost estimates for bioengineering and environmental mitigation measures
- Total labour days requirements and number of RBGs to be deployed for completion

LESSONS LEARNED FROM YEAR 1

Lessons Learned

- CL setting at field and verification of design is necessary prior to start-up of construction
- Cross-section derived from DTM does not match the actual ground profile
- EW volume being significant even in phase I
- Variation in structure design between consultants
- Poor spoil management

END