TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
PULCHOWK CAMPUS

DEPARTMENT OF CIVIL ENGINEERING

SURVEY INSTRUCTION COMMITTEE

B.E. Survey Camp 2081, III/I: 2078 Batch

General Instruction

Subject Code: CE 604, Credit: 4, Internal Marks = 50, Final Marks = 50, Full Marks = 100

Background

Survey camp is organized for the students of Bachelor in Civil Engineering. The main objective of the survey camp is to consolidate and update their practical as well as theoretical knowledge of Civil Engineering Survey. The specific objective of survey camp is to enhance their skill and knowledge in planning, designing and implementing of survey procedures and equipments for various engineering tasks in an integrated way.

Objectives of Survey Camp are:

- Horizontal control and vertical control survey practices with respect to National grid system and produce topographic map in coordinate system.
- Analytical resection and intersection for the transfer of coordinates through National grid system.
- Linear segment survey practice through Road Alignment Survey.
- Practices of horizontal control and vertical control survey surrounding the cross drainage area through bridge site survey.

It is expected that the survey camp will help the students in building up their confidence to conduct any type of civil engineering survey as per the required accuracy and within the given time frame under their individual leadership and work in team and produce end result.

Students are required to carry out the necessary survey works in sub – group wises so that they will get ample opportunity to take decision on planning and execution of topographical survey, detailed bridge site survey and detailed road alignment survey. Each group shall have to submit the original plotting of survey works and detailed survey camp report accordingly. In the camp, students will conduct survey field works as per the following heads:

A. Topographic survey

- Major Traverse: Horizontal control frame work of larger area traverse covering the entire area adopting high accuracy and precision.

- Minor Traverse: Detailed topographical survey of the given sub area within or outside the major traverse (as part of major traverse).

Bridge Site Survey

- Detailed bridge site survey of given river/stream/cross drainage/gorges etc according to National Standard.

Road Survey

- Detailed road alignment survey of selected corridor as per the Nepal Road Standard.

urvey Camp Schedule

urvey camp is scheduled for **10** days. First day is allocated for reconnaissance, index sketch, election of station of major traverse, eight days are allocated for field works and the last day s allocated for field evaluation and closing. It is expected that students of each groups are ndividually aware to strictly follow the daily work schedules provided to them for finishing he jobs as per the given time frame.

- Daily field works starts at **7:00 am** and ends at **7:00 pm.**
- Classes will be arranged at convenient time under every topic so that students will receive appropriate instruction through the lecture class at the site before the starting of job in the field. Faculty members will help students in solving the problems at field faced by them. Students must report their daily work progress as well as problem faced by them.

Location of Camp Site

The survey camp will be conducted at **TRIBHUVAN UNIVERSITY, Kirtipur** premises, where around 125 Hectares of semi built up landform of different terrain is available to conduct necessary activities of survey camp.

Transportation and Lunch

For transportation, three buses are hired and used daily (morning and evening), those buses pick up the students from nearby public bus stand or from hostel in time and drop at the camp site in the morning and drop the students at the respective bus stand in the evening.

Deputy coordinator, logistic will make an arrangement of transportation and lunch for students during camp period. Deputy coordinator, logistic will coordinate in choosing food items and their rates in collaboration with student's representatives and food supplier (Catering Agent). Campus Administration provides Rs. 100 per day per student for 10 working days (i.e. a total sum of Rs. 1,000 per student) for supporting food expenses. Students have to manage their expenses for food and lunch during camp period.

Alcohol is strictly prohibited in or outside the camp during camping period. Strong action would be taken if anybody found drunk at the camp site.

Attendance and Evaluation

Regular attendance will be taken in the field camp. No one is allowed to leave camp without prior permission of camp coordinator. If anybody is found absent on a particular day due to any reason there will be **deduction of 5 marks** for each and every day. Anybody who is absent for more than **3 (three) days** will not be allowed to continue the remaining camp works. Evaluation of the works completed by the students will be done on the basis as follows:

1. **Evaluation of fieldworks**
   - Scheduled fieldwork of each student will be evaluated daily and at the end of camp.
   - Daily progress report of each group will be collected in the field class at convenient time and will be evaluated accordingly.
   - Internal evaluation is done through viva-voce (group and individual) for **50 marks.**

2. **Report**
   - Each group shall have to submit one copy of **Draft Report** (Computer print copy and original drawings) in the prescribed format and scale not later than the date noticed by the 'Survey Instruction Committee'.
   - **Late report** will be accepted with deduction of **1 (one) marks** for each and every late day.
   - **Two (2) copies of Final Report** after the incorporation of necessary comments on the draft report along with the original plotted sheets should be submitted on the date noticed by 'Survey Instruction Committee'.
   - Original plotted sheets of major and minor traverse will be checked and signed at camp site.
   - Students are encouraged to develop the final detailed drawings and maps by manual method (traditional method) as well as CAD/Land Development / Auto-Civil software system etc.

3. **Final Viva Voce of Survey Camp**
   - Final exam of the camp will be conducted on the date noticed by the Institute of Engineering Examination Control Division, Chakupat, Lalitpur.

Technical Norms / Specifications for Horizontal and Vertical Control:

A. Topographic Survey

1. Conduct reconnaissance survey of the given area then formulate major traverse framework; which must be enclosed the given area then formulate the minor traverse frame work within or outside the major frame work.
2. Maintain the ratio of maximum traverse leg distance to minimum traverse leg distance less than:

   For Major traverse = 2:1
   For minor Traverse = 3:1
   Traverse angle should neither too acute nor too obtuse; avoid the straight angle ($180^0 \pm 20^0$)

3. Referencing of each traverse station is utmost necessary and should be shown in sketch.
4. **Horizontal Control** and **Vertical Control** of the given area must be conducted based upon the given **Horizontal Datum** and **Vertical Datum**. Coordinate must be transferred to the instrument station (Resection Point) from the **National Grid System** by observing to at least 3 known points **(known coordinates)**. Resection station should be selected in the system of major framework. If it is not possible, resection station must be connected by making loop to the **nearest Major traverse Station.**
5. Station pegs should be marked as **14M11** for **Major Traverse** and **14ms** for **Minor Traverse**. Prefix number **14** is camp group number; letter **M or m** denotes the **major or minor** traverse and the suffix number **11 or 5** denote the traverse station number. Use the same notation in plotting except for common station (Use **CP_1** and **CP_2** for common station). Never drive the peg at frequent public walkways.
6. Measure two way traverse leg distance (i.e. in the forward and backward directions) by means of tape calibrated against the standard length provided in the field or by total station. Note that the precision of measurements should be:

   For major traverse tape measurement ≥ 1:2000
   For major traverse EDM measurement ≥ 1:5000
   For minor traverse tape measurement ≥ 1:1000
   For minor traverse EDM measurement ≥ 1:3000

7. Measure ***two sets*** of horizontal circle reading of **major traverse stations** either by Theodolite or by Total Station. The difference between face left and face right readings should be within ***± (180°±20")***. Note that the difference between the mean angles of two sets reading should be within ***a minute***.
8. Measure only ***one set*** of angles for **minor traverse**. The difference between face left and face right reading is not allowed more than **± (180°±20")**.
9. Balance the traverse by proper way adjusting angular and linear closing errors. The theoretical sum of **interior/exterior** angles in a closed traverse should be equal to **(2N±4)* 90°**. The permissible angular error for the sum of traverse angles should be less than:

   For major traverse = $\pm 30'' \sqrt{n}$
   For minor traverse = $\pm 1' \sqrt{n}$

Relative precision ratio or total error of closure should be higher than:

1:5000 for major traverse

1:3000 for minor traverse

10. **For Vertical Control**, perform two peg tests before the start of fly levelling. Perform fly levelling to transfer R.L. from the given **PBM** to the allocated **minor traverse**. Take three wire staff readings and establish other TBMs as per field requirement. Note that **collimation precision** should be better than **1:10000**. To eliminate collimation error, levelling instrument must be set up in such a position so that fore sight and back sight distances are nearly equal to ±1m. **BM and their RL** will be provided in the field. The permissible error of closure for fly leveling is $\pm 24\sqrt{k}$ **mm**.
11. Plot the major traverse and minor traverse at site by coordinate method in scale **1:1000** and **1:500** respectively. Plotting of minor traverse should depict in the major traverse. Orientation check will be performed at site if possible.
12. Carry out the detail survey of the given sub area (minor) either by tacheometric system using theodolite or by total station with reference to the major and minor traverse stations. Make the detailed free hand sketch of the minor area including natural details ridge lines, valley lines every change of slopes and planes as well as manmade features such as buildings, roads, transmission lines, fencing, invert of drain, underground structures etc according to station wise.
13. All the details are to be plotted with respect to vertical and horizontal control from the respective station. Use conventional symbols for plotting the map.
14. **Topographic nature** of the given minor area should depict through the contour lines at suitable interval (contour interval = 1m). Interpolate the **Index Contour** lines precisely by arithmetic calculation method with the help of guide points and then interpolate remaining contour lines either by graphical method or by estimation method. Do not erase those scatter guide points from the original sheet even after plotting of the contours. While taking tacheometric details special consideration must be taken along ridge lines, valley lines and abrupt level change points.

B. Bridge Site Survey

Road alignment and Bridge site survey are considered as a single package work for two groups. Two groups are merged into one group to perform Road Alignment Survey and Bridge Site survey. But reports and drawings must be submitted separately by individual group.

1. Carry out reconnaissance survey of the bridge site area. Establish necessary triangulation stations to determine **Bridge Axis** Length, as well as horizontal and vertical control of the area. Well condition triangles should be formed while selecting the triangulation stations.
2. Maintain free board distance at least 4 m in between invert of proposed bridge and high flood level mark.
3. In triangulation, distance of **Base Line** must be measured in an accuracy of **1: 2000**.

4. Observed **two sets of horizontal circle reading** by the theodolite to measure the angle of base triangles and **one set angles** for others extended triangles. Note that the difference between the mean angles of two sets should be within **a minute**. Angular misclosure for base triangle should be **±30"√N** and other triangle **±1'√N**.
5. Compute the length of proposed bridge axis by triangulation survey from two adjacent base triangles by using sine law and determine the length of bridge axis by taking average length. Computed mean length of bridge axis from two base triangles should be **≥ 1:2000**.
6. Conduct fly leveling to transfer the R.L. from given BM to the nearest triangulation station of the bridge axis and make circuit close for checking error of closure.
7. Carry out **reciprocal leveling** to transfer level from one bank to other bank of the river / stream within a precision of **±24√K mm**. Determine the RL of the other triangulation stations by fly levelling from the end point of bridge axis.
8. **Plot a topographic map** indicating contour lines at suitable interval (Contour Interval = 1m). Interpolate the **Index Contour** lines precisely by arithmetic calculation method with the help of the guide points and then interpolate remaining contour lines either by graphical method or by estimation method. **Do not erase RL of guide points in the original sheet even after plotting of contours.**
   Note: Value of Index Contour = Multiple of (5 * Contour Interval)
9. Draw longitudinal section along the river bed up to **150m** up-stream and **50m** down-stream assuming **0.00m** chain age at centre of bridge axis. Draw cross section at **25m** interval from topographic map and one at the bridge axis.

   Scale for plotting

   Topographic map: 1:500
   - *L-section: Horizontal Scale = 1:500 and Vertical scale = 1:50*
   - *Cross section: Horizontal scale = 1:200 and Vertical scale = 1:200*

10. Carry out hydrological survey of river/stream. Collect hydraulic data such as velocity of flow, high flood level, normal water level and low water level. All these should be shown in map and cross section of river.

C. Road Alignment Survey

1. Carry out reconnaissance survey and alignment selection of a road corridor about **700m** or more.
2. Starting and end point of road, location of bridge site will be provided at the site.
3. Road alignment selection i.e. IP selection shall be carried out considering the obligatory points, permissible gradient, bridge site, balancing cut and fill, shape of the ridge, valley and cross drainage, lateral slopes, geometry of horizontal and vertical curves etc.
4. Alignment must be selected not exceeding **12%** gradient of the existing ground surface.
5. Radius of the horizontal curve should not less than **15 m**. While assuming the radius of the horizontal curve, select the radius in the multiple of 5 or 10.
6. Point of commencement (T_1) and point of tangency (T_2) must not be located within the bridge axis. Start and finish of curves must be totally outside the bridge axis end points.

7. Avoid subsequent reverse as well as compound curves in road alignment.
8. Deflection angle should not be greater than **90°**.
9. Two successive curves must not be overlapped.
10. Measure Bearing of the starting leg. To compute bearing of next leg, record deflection angle with respect to preceding leg.
11. Setting out of horizontal curve is not necessary for less than **3° (degree)** deflection angles but compute the chainage as usual manner.
12. Theodolite team shall carry out the detailed survey of the road alignment. Theodolite team will mark pegging at **15m** interval **(multiple of 15m)** along the centre line of road and at curve points BC, MC and EC for longitudinal section as well as X-section. Set horizontal curve by fixing BC, MC and EC. Theodolite team should fill up **three field book (FB)** separately such as tacheometry FB, horizontal curve FB including detail sketch and chainage calculation sheet.
13. Carry out levelling survey for longitudinal section along the centre line at 15 m interval, at abrupt change point and at the curve point BC, MC and EC. Establish **TBM** at approximately **500m** interval and near cross drainage. Close the level circuit by doing fly levelling and check the RL at job site immediately. Permissible error of closure for levelling must not be greater than $\pm 24\sqrt{K}$ **mm**
14. **While making turning point, read the corresponding BS and FS readings within 0.6 to 3.0m.**
15. Perform cross sectioning survey either by levelling instrument or by levelling staff and tape along the road alignment at **15m** interval and at abrupt change of slope and BC, MC and EC those established by the theodolite team. During the field survey, draw neat and clean free hand dimensional sketches of the cross section. Coverage width of the cross section must not be less than **10m** on either side (left and right) from proposed centre line of the road and at **5m** regular interval as well as other salient points from centre line.
16. Prepare a road corridor plan in **1:500** scale showing **5m** formation width, **20m** right of way (corridor width 10m left and 10m right) from proposed centre line, location of intersection point (IP), geometry of horizontal curve with chainages of BC, MC, EC chainages of drainages, chainages of centre line details and other details such as vegetation, forest, cultivation, barren land etc.
17. Draw longitudinal section of road centre line [horizontal scale **1:1000**, Vertical axis **1:100**]. Draw the working profile i.e. formation level assuming balancing of cut and fill in between economical haul distances. Draw cross section [Horizontal Scale = Vertical Scale **1:100**] of existing ground surface and show the formation level and width (5m) assuming side slope 2:1 in filling and 1.5:1 in cutting. (H:V)

Care, Handling and safe-guarding of instrument

Surveying instruments are delicate, so handle them with utmost care. Improper handling of instrument, carelessness during the field works etc can cause instrument to out of adjustment and even may cause serious damage. If instrument is damaged, it is not possible to repair or adjust immediately at the camp site.

1. It is important to keep in mind that delicate surveying instrument need to be handled carefully. **Each and every student is liable to compensate the cost of repairing / maintenance / lost and not returned instrument / accessories.**
2. Some accessories such as **plumb bob, measuring tapes, first aid kit** etc will be issued to each group for **10 days**. Such accessories should be returned only on the closing day. Other instruments as accessories will be issued as per the schedule and these instruments should be returned daily at the camp site store. Be responsible to verify the instruments and accessories during issuing and returning.

Booking Formats

All necessary instruction sheets, guidelines for works and data table would be provided in compiled form for each camp group. All field data and notes must be recorded on those formats.

Always keep in mind the following point.

- Documentation must be neat and clean
- Do not record the data in loose sheets except referencing sketches, overall sketches etc.

Precaution in receiving and handling instruments

1. Note down the Instrument name, Code No., Type and all the accessories which are issued to your group.
2. Carefully inspect the condition of instrument and accessories included in the box before you carry it to the site.
3. First of all try to be familiar first with the handling, functioning or operating of any instrument that you have not handled before. Assure yourself to handle/operate them perfectly.
4. Always close the instrument box after taking the instrument and accessories from the box.
5. Do not touch the Total station by wet hand.
6. Do not shift the instrument mounted on the tripod, which is strictly prohibited.
7. Protect the instrument from rain and be careful not to expose the instrument to direct sunlight and rain.
8. Never leave the instruments alone.

Belongings and Accessories

Students shall manage and carry the accessories in the survey camp as follows:

1. T- Square Set square with French curve, ruler and accessories.
2. Instrument box with necessary tools (divider, compass, protractor etc.)
3. Stationeries – Good quality hard (H) and soft (HB) pencil, lead, eraser, line and blank loose papers, drawing sheets, A2, A3 and A4 paper sheets, Graph sheets, cello tape, stitch machine, punching etc.
4. Water proof files, clipboards.
5. Booking formats, Field notebooks, Surveying Books for Reference etc.

6. Programmable/Scientific calculator, Lab top computer
7. Caps, Water bottle, Umbrella Torch light.
8. Permanent marker - Red and Black. Do not misuse permanent markers elsewhere.

Personal Health and Safety

- ***Wear hat and appropriate field shoe for your safety. Do not wear slipper during field work.***
- Keep disinfected water for drinking.
- Keep some dry foods

Always keep in mind **if health is lost everything is lost** so be careful about your health.

General Instruction

- Use ball pen strictly for recording numerical field data.
- If the recorded data needs to be corrected, just cancel data by drawing single line and write new data on the vacant space above or below the previous one.
- Never try to memorize measured field data. During the time of measurement record the measured data immediately in the field book or diary etc.
- Data must be initialed by the respective teacher each day
- Draw sketches and write remarks whenever are required.
- Draw detailed sketch of each individual station.

Survey Camp Drawing/Report Guidelines

- **Margin for Reports**: 1.5 inch left, 1 inch right, 1 inch top and bottom of the page
- **Letter Font size**: New times Roman, 12 point for ordinary letters, 16 point and 14 point for heading and sub heading and title with bold
- **Line spacing**: Single
- **Margin of border line in drawing sheet**: 1.5 cm in left, 1 cm in top, bottom and left
- **Title of Drawing**: Show title in top of the drawing sheet and scale just below the title
- **Grid Lines**: Faint grid lines must be drawn in the topo sheet
- **Control Station**: Appropriate symbol of stations and corresponding RL must be shown on the topo sheets
- **Darker and Heavier Contour**: Index contour must be drawn primarily representing more darker and heavier than intermediate contour
- **Dotted Contour**: Contour must be drawn in dotted form where direct guide point cannot be picked up
- **Spot Height**: Sufficient spot heights are essential in topo sheet. Show ground points with RL in such a way that decimal point and ground point be the same
- **Traverse Line**: Show traverse line in broken form and distinct than other lines
- **Bold Lines**: Finishing lines of hard detail must be in bold
- **Hatching Lines**: These lines must be drawn in the 45^0 inclination with the longest line and little bit faint and at 5 mm spacing
- **Presentation of drawing** : Drawing sheet must be attractive and pleasant and all cartographic requirements should be fulfilled
- **Final Report**: Final report should be in the standard format and compilation of literature portion, Field data and drawings must be in sequential order as per jobs wise

Report Format/Content for Survey Camp

Main Report **Page No.**

Acknowledgement
Introduction
Salient features
List of figures
List of tables
List of drawings
Objectives

1. **Project Area**
   - Location and accessibility
   - Topography and geology
   - Rainfall, climate and vegetation
   - Others

2. **Topographical Survey**
   - Objectives
   - Brief description of the area
   - Norms (Technical specifications)
   - Equipment
   - Methodology
   - Reconnaissance
   - Major traverse
   - Minor traverse
   - Detailing
   - Levelling
   - Computation and plotting
   - Comments and conclusion

3. **Bridge Site Survey**
   - Objectives
   - Brief description of the area
   - Hydrology, geology and soil
   - Norms (Technical specifications)
   - Equipment
   - Methodology
   - Site selection
   - Topographic survey
   - Longitudinal section
   - Cross section
   - Levelling
   - Detailing
   - Computation and plotting
   - Comments and conclusion

4. **Road Alignment and Geometric Design**
   - Objectives

Brief description of the area
Hydrology, geology and soil
Norms (Technical specifications)
Equipment
Methodology
Horizontal alignment
Vertical alignment
Longitudinal section
Cross section
Levelling
Detailing
Topographic survey of road corridor
Structures
Comments and conclusion

5. List of tables

Drawings

Index map
Location map
Topographic map, drawings of major and minor traverse
Drawings of road and bridge sites (Topographic map, longitudinal profile and cross section of road and bridge)
Drawing of typical structures

Note: Copy of all drawings in A3 size should enclose in the main report.