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# **CSAY OBSTACLE HEIGHT CALCULATION**

(Version 2023.1)  
(A free and open-source software)

Based  
On  
ICAO ANNEX-14, VOL-I  
Obstacle Limitation Surface

Er. AJAY YADAV

2023

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## **CHAPTER 1      DEFINITION**

### **1.1 Definitions as per ICAO Annex 14**

#### **1.1.1 Aerodrome**

A defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft.

#### **1.1.2 Balked Landing**

A landing manoeuvre that is unexpectedly discontinued at any point below the obstacle clearance altitude/height (OCA/H).

#### **1.1.3 Aerodrome Reference point**

The designated geographical location of an aerodrome

#### **1.1.4 Clearway**

A defined rectangular area on the ground or water under the control of the appropriate authority, selected or prepared as a suitable area over which an aeroplane may make a portion of its initial climb to a specified height.

#### **1.1.5 Displaced Threshold**

A threshold not located at the extremity of a runway

#### **1.1.6 Obstacle**

All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that:

- a) are located on an area intended for the surface movement of aircraft; or
- b) extend above a defined surface intended to protect aircraft in flight; or
- c) stand outside those defined surfaces and that have been assessed as being a hazard to air navigation.

### 1.1.7 Obstacle Free Zone (OFZ)

The airspace above the inner approach surface, inner transitional surfaces, and balked landing surface and that portion of the strip bounded by these surfaces, which is not penetrated by any fixed obstacle other than a low-mass and frangibly mounted one required for air navigation purposes.

### 1.1.8 Obstacle Limitation Surface (OLS)

It defines the limit to which objects may project into the airspace

### 1.1.9 Runway

A defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft.

### 1.1.10 Runway strips

A defined area including the runway and stopway, if provided, intended:

- to reduce the risk of damage to aircraft running off a runway; and
- to protect aircraft flying over it during take-off or landing operations.

### 1.1.11 Threshold

The beginning of that portion of the runway usable for landing.

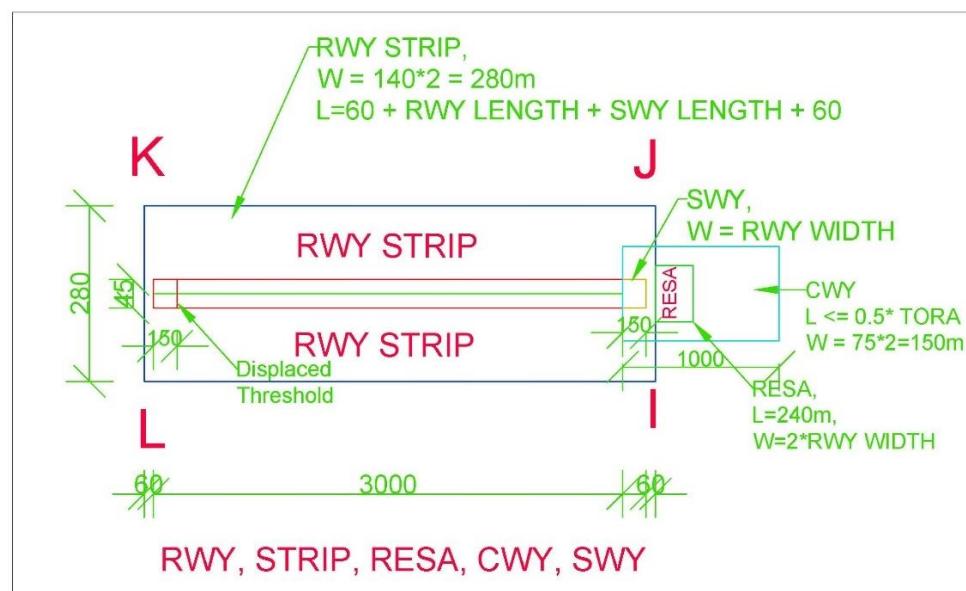


Figure 1. Rwy, Strip and other detail

## CHAPTER 2      OBSTACLE LIMITATION SURFACE

### 2.1 Types of Obstacle Limitation Surfaces

1. CONICAL SURFACE
2. INNER HORIZONTAL SURFACE
3. INNER APPROACH SURFACE
4. APPROACH SURFACE
5. TRANSITIONAL SURFACE
6. INNER TRANSITIONAL SURFACE
7. BALKED LANDING SURFACE
8. TAKEOFF CLIMB SURFACE
9. OUTER HORIZONTAL SURFACE

### 2.2 OLS requirement

| Runway Category       | Runway Sub-Category                          | Obstacle Limitation surface   |
|-----------------------|--|---|
| Non-Instrument Runway |  | <ol style="list-style-type: none"><li>1. Conical surface</li><li>2. Inner Horizontal</li><li>3. Approach surface</li><li>4. Transitional surface</li></ol>  |
| Instrument Runway     | Non-Precision Approach Runway                | <ol style="list-style-type: none"><li>1. Conical surface</li><li>2. Inner Horizontal</li><li>3. Approach surface</li><li>4. Transitional surface</li></ol>  |
|                       | Precision Approach Runway Category I         | <p>Mandatory Surfaces (Shall be)</p> <ol style="list-style-type: none"><li>1. Conical surface</li><li>2. Inner Horizontal</li><li>3. Approach surface</li><li>4. Transitional surface</li></ol> <p>Optional Surfaces (Should be)</p> <ol style="list-style-type: none"><li>1. <i>Inner Approach surface</i></li><li>2. <i>Inner Transitional surface</i></li><li>3. <i>Balked landing surface</i></li></ol> |
|                       | Precision Approach Runway Category II or III | <ol style="list-style-type: none"><li>1. Conical surface</li><li>2. Inner Horizontal</li><li>3. Approach surface</li><li>4. Transitional surface</li><li>5. Inner Approach surface</li><li>6. Inner Transitional surface</li><li>7. Balked landing surface</li></ol>  |

- Note – 1: Take off climb surface shall be established for all runways meant of Take off climb.

### 2.3 Details of each OLS

In this document, calculations and drawings shall be based on “**PRECISION APPROACH RUNWAY CAT II OR III**” based on Table 4-1 Dimensions and slopes of obstacle limitation surfaces — Approach runways of ICAO ANNEX – 14, Vol – I, 9<sup>th</sup> Edition.

#### 2.3.1 Conical Surface

| Surfaces | Dimension |
|----------|-----------|
| CONICAL  |           |
| Slope_%  | 5         |
| Height_m | 100       |

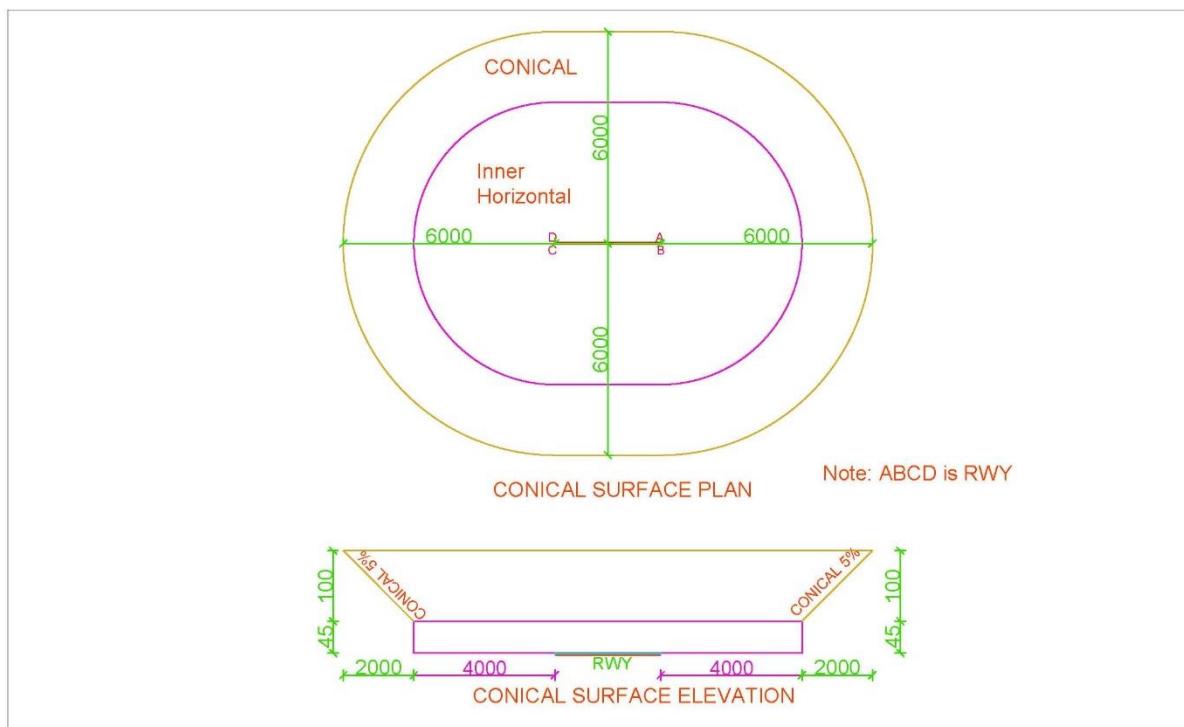


Figure 2. Conical Surface

### 2.3.2 Inner Horizontal Surface

| Surfaces         | Dimension |
|------------------|-----------|
| INNER_HORIZONTAL |           |
| Height_m         | 45        |
| Radius_m         | 4000      |

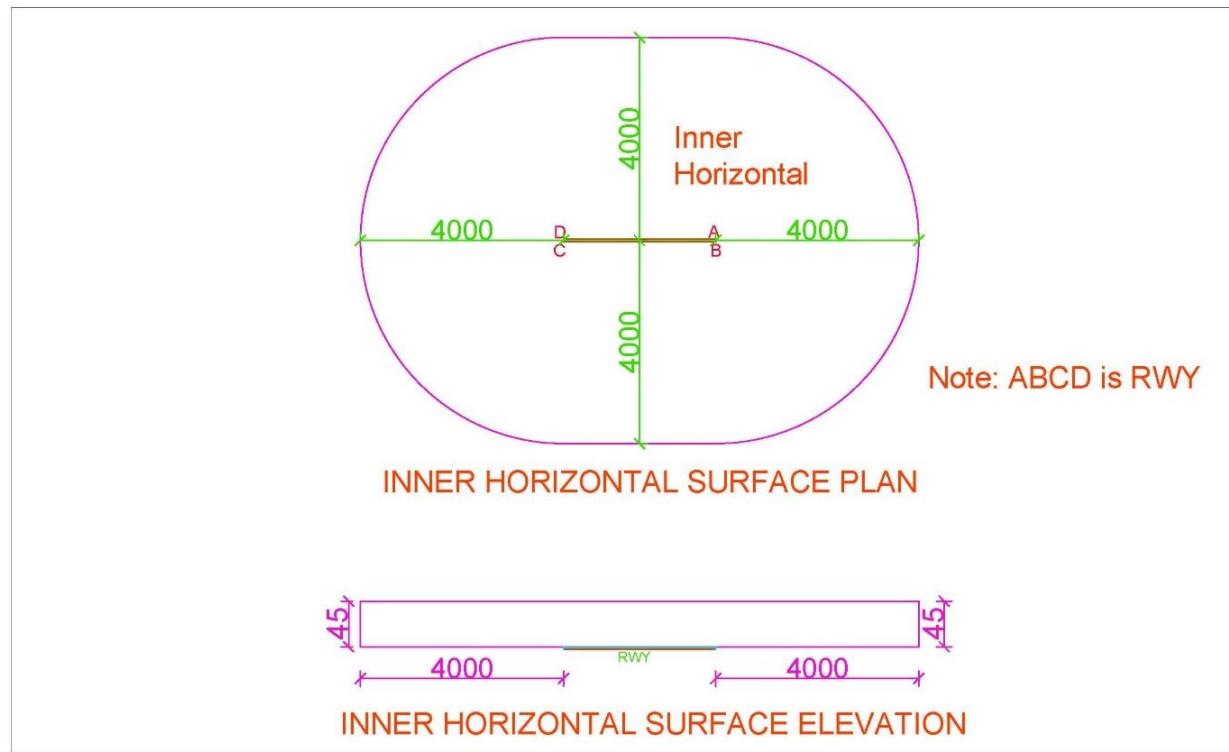


Figure 3. Inner Horizontal Surface

### 2.3.3 Inner Approach Surface

| Surfaces                  |  | Dimension |
|---------------------------|--|-----------|
| INNER_APPROACH            |  |           |
| Width_m                   |  | 120       |
| Distance_from_threshold_m |  | 60        |
| Length_m                  |  | 900       |
| Slope_%                   |  | 2         |

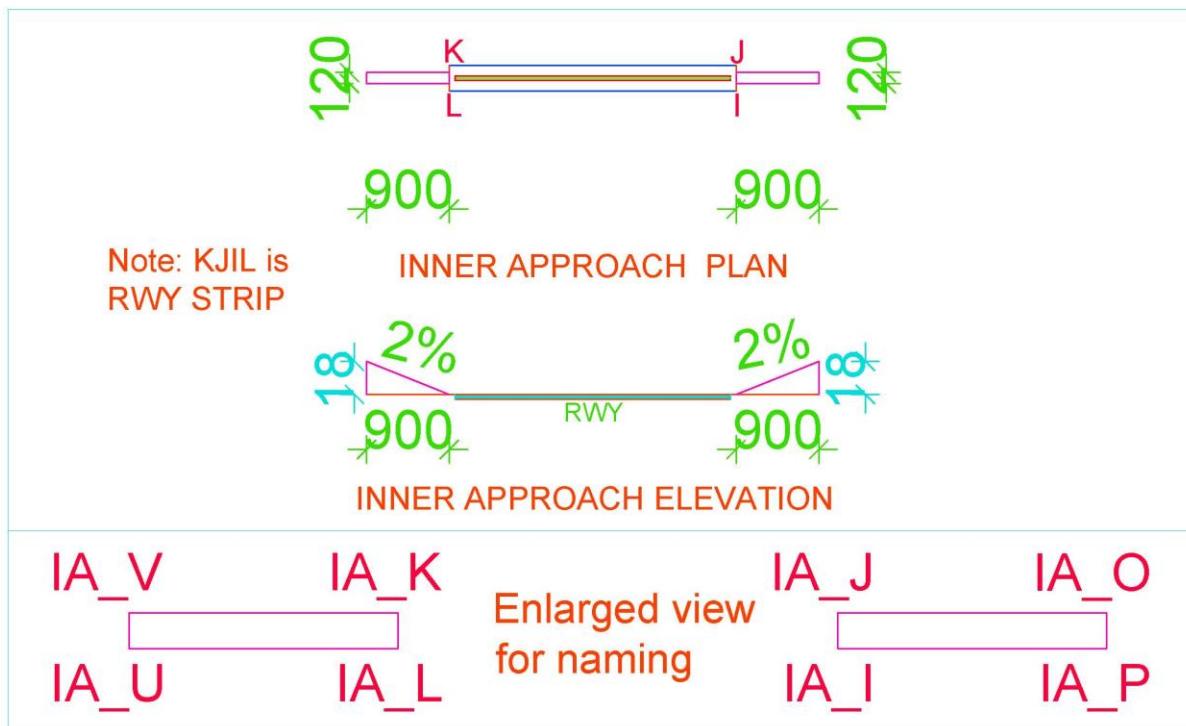


Figure 4. Inner Approach Surface

### 2.3.4 Approach Surface

| Surfaces                  | Dimension | Surfaces           | Dimension |
|---------------------------|-----------|--------------------|-----------|
| Length_of_inner_edge_m    | 280       | Second_Section     |           |
| Distance_from_threshold_m | 60        | Length_m           | 3600      |
| Divergence_%              | 15        | Slope_%            | 2.5       |
| First_Section             |           | Horizontal_Section |           |
| Length_m                  | 3000      | Length_m           | 8400      |
| Slope_%                   | 2         |                    |           |

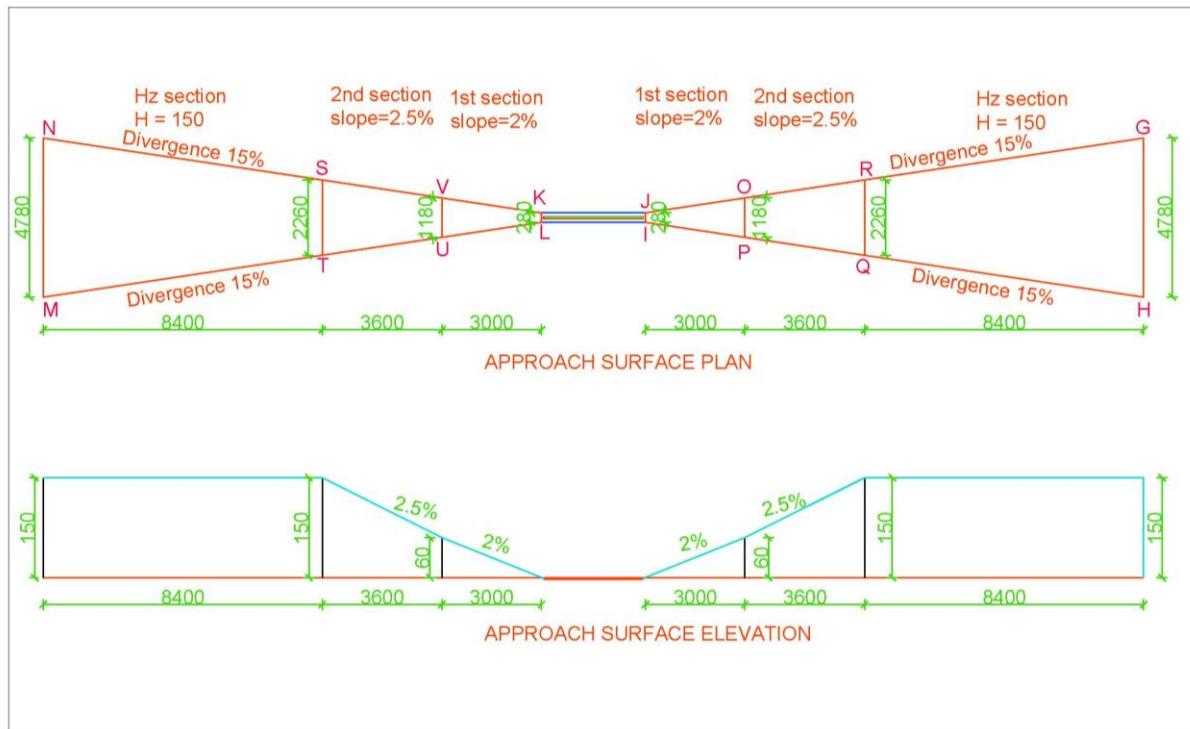


Figure 5. Approach Surface

### 2.3.5 Transitional Surface

| Surfaces           | Dimension |
|--------------------|-----------|
| INNER_TRANSITIONAL |           |
| Slope_%            | 14.3      |

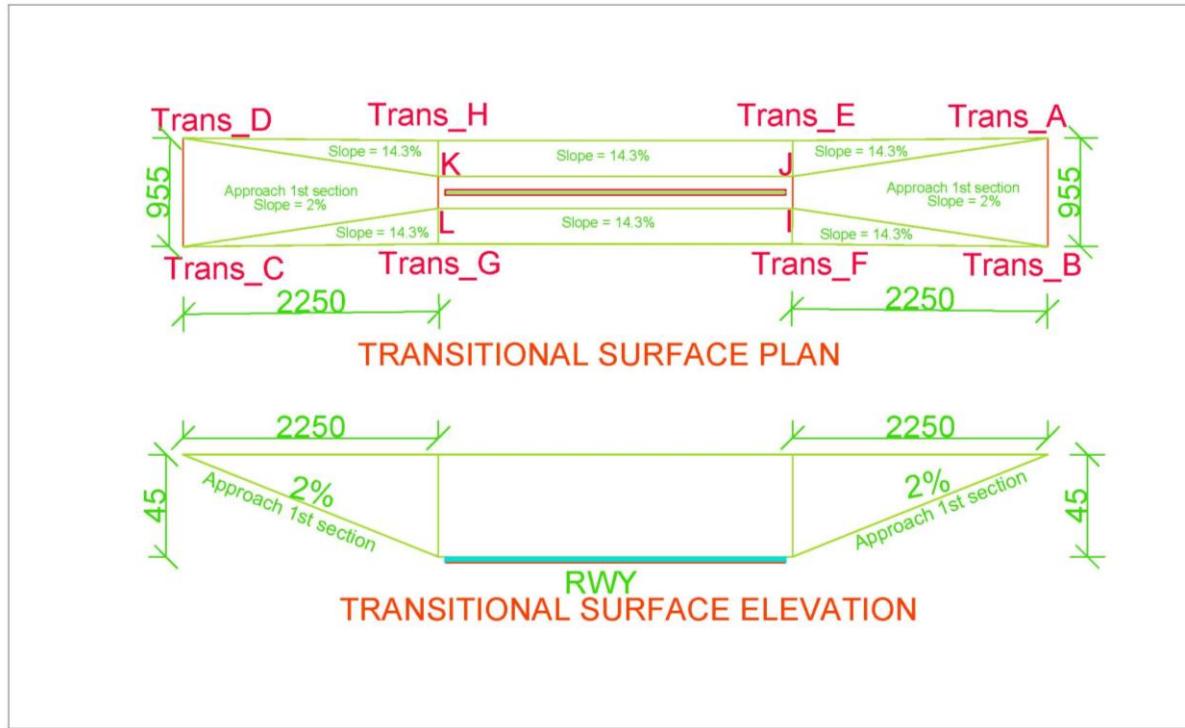


Figure 6. Transitional Surface

### 2.3.6 Inner Transitional Surface

| Surfaces     | Dimension |
|--------------|-----------|
| TRANSITIONAL |           |
| Slope_%      | 33.3      |

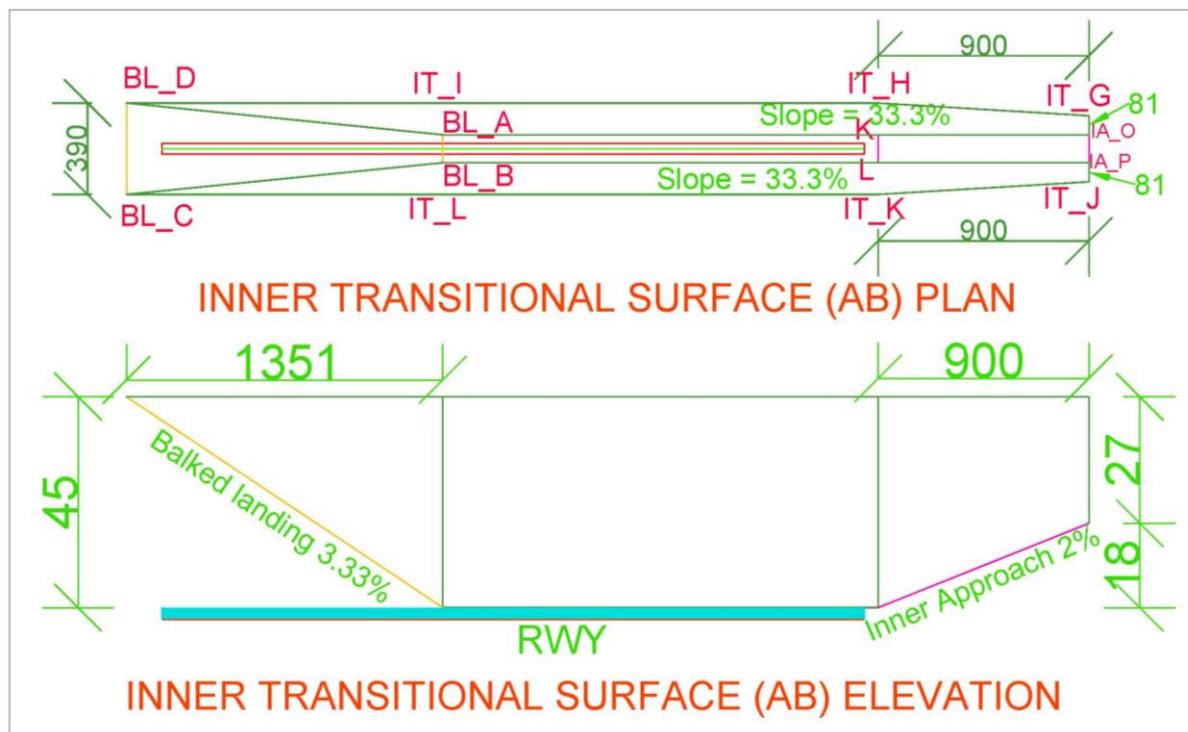


Figure 7. Inner Transitional Surface (AB Side)

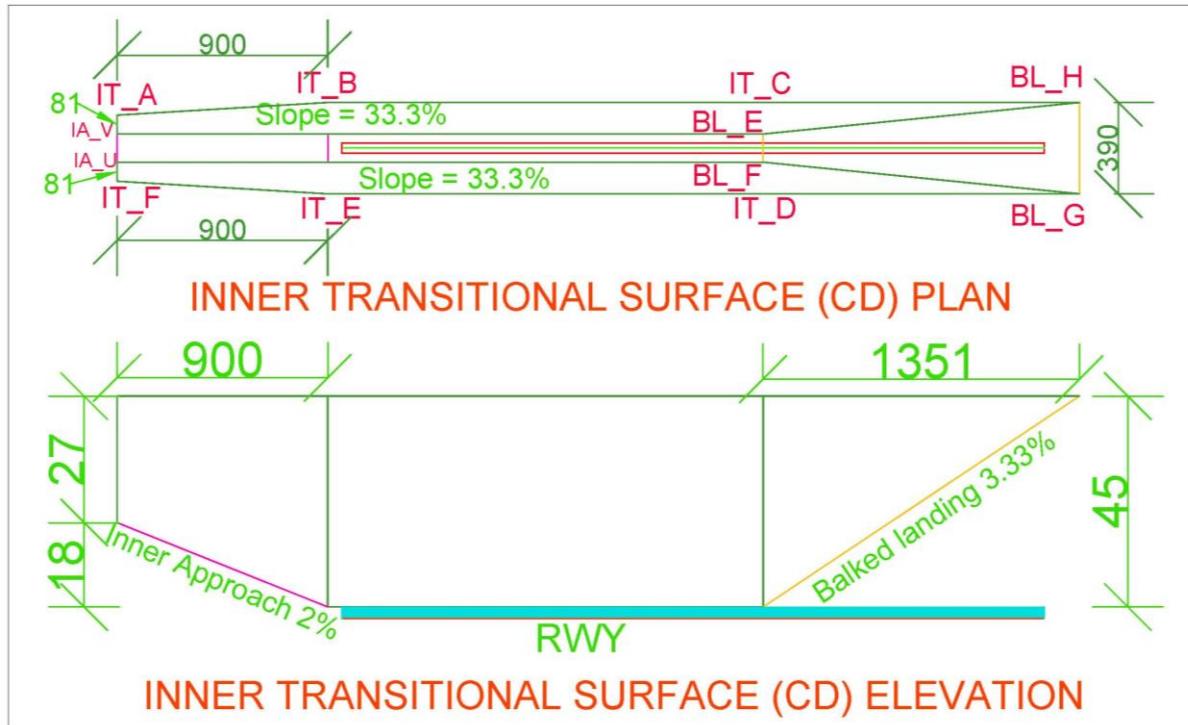


Figure 8. Inner Transitional Surface (CD Side)

### 2.3.7 Balked Landing Surface

| Surfaces                  | Dimension |
|---------------------------|-----------|
| BALKED_LANDING            |           |
| Length_of_inner_edge_m    | 120       |
| Distance_from_threshold_m | 1800      |
| Divergence_%              | 10        |
| Slope_%                   | 3.33      |

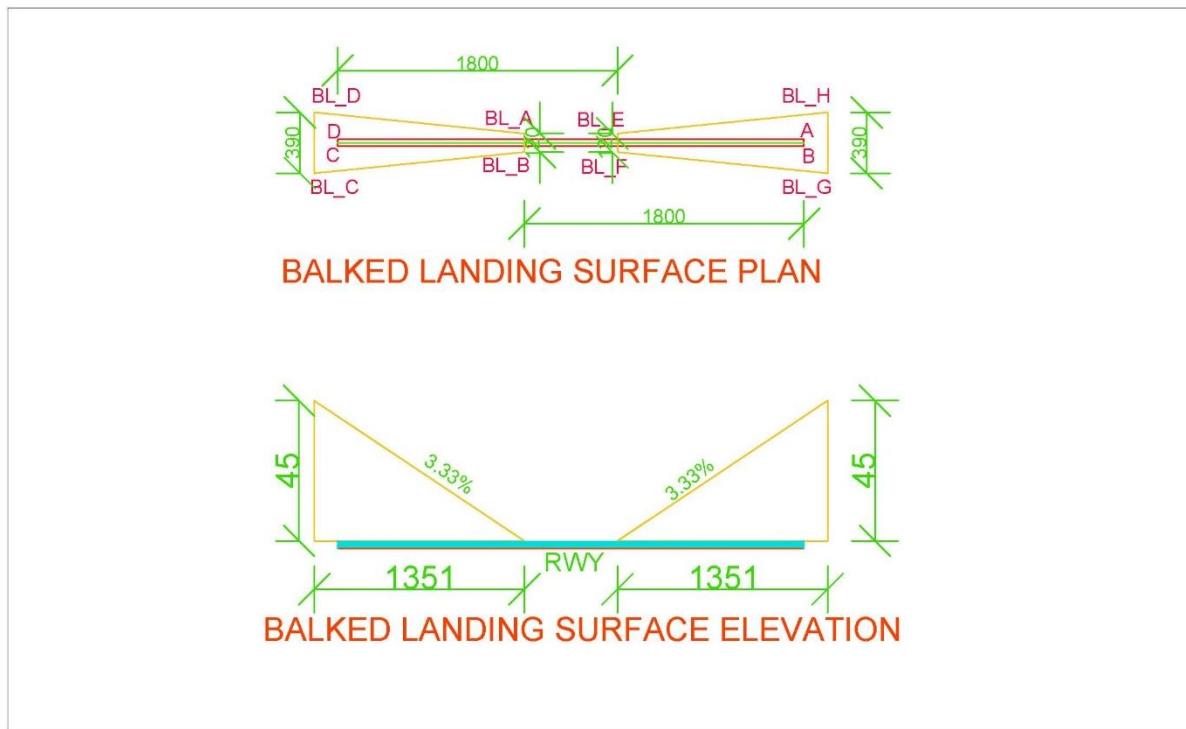


Figure 9. Balked Landing Surface

➤ Note:

- If threshold is displaced by distance 'd', Balked landing surface will also be displaced by distance 'd' in the direction of displaced threshold.
- In Figure 16 "VNBW.txt", AB\_Threshold\_Displaced\_By and CD\_Threshold\_Displaced\_By shall be given value d1 and d2 respectively if Threshold AB is displaced by d1 and CD is displaced by d2.
- If thresholds aren't displaced, value will be zero

### 2.3.8 Take Off Climb Surface

| Surfaces                | Dimension |
|-------------------------|-----------|
| TAKE_OF_CLIMB_SURFACE   |           |
| Length_of_inner_edge_m  | 180       |
| Distance_from_RWY_End_m | 60        |
| Divergence_%            | 12.5      |
| Final_Width_m           | 1800      |
| Length_m                | 15000     |
| Slope_%                 | 2         |

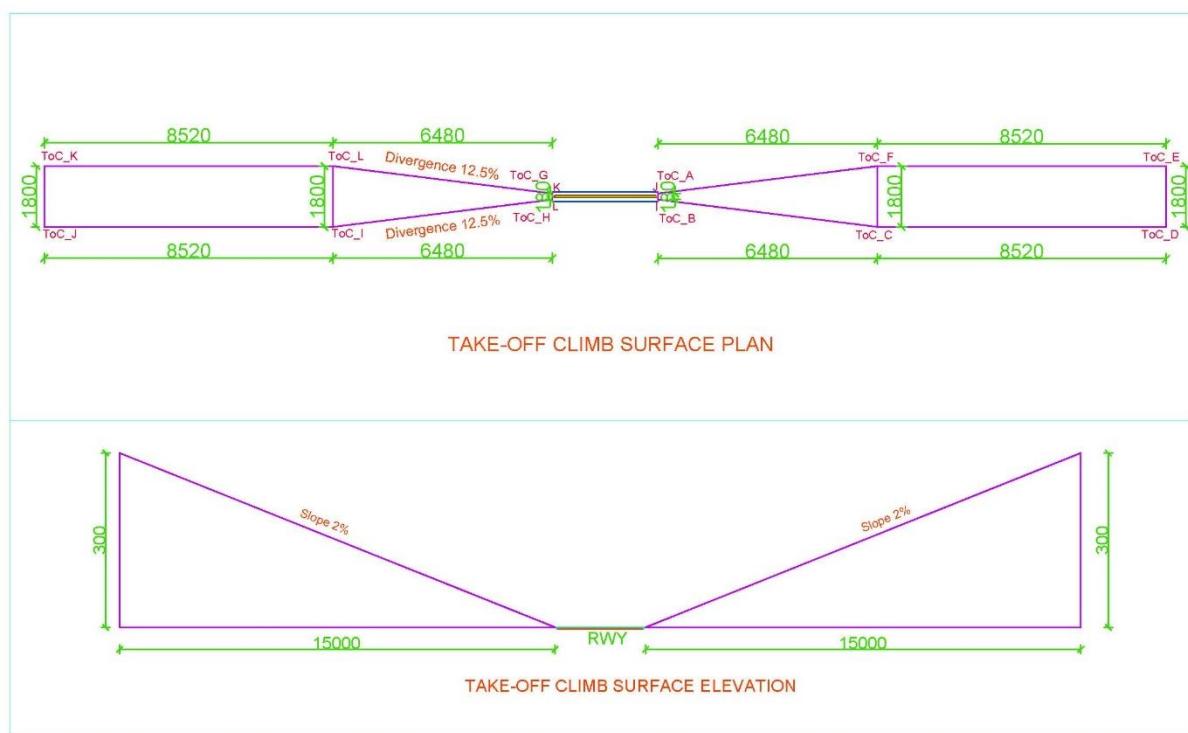


Figure 10. Take off Climb Surface

➤ Note:

- Take-Off Climb Surface starts from 60m end of runway (i.e. RWY strip) or end of clearway, whichever is greater.
- For example, as in Figure 1,
  - Distance of strip from RWY end ( $d_1$ ) = SWY + strip end =  $150+60=210m$
  - Distance of CWY from RWY end ( $d_2$ ) = 1000 m
  - Distance beyond strip end of CWY =  $1000-210=790 m = d$
  - This value i.e., 'd' is to be placed for respective end of runway in AB\_CLWY\_beyond\_strip and CD\_CLWY\_beyond\_strip as in Figure 16.

### 2.3.9 Outer Horizontal Surface

| Surfaces  | Dimension |
|-----------|-----------|
| Center at | ARP       |
| Radius_m  | 15000     |

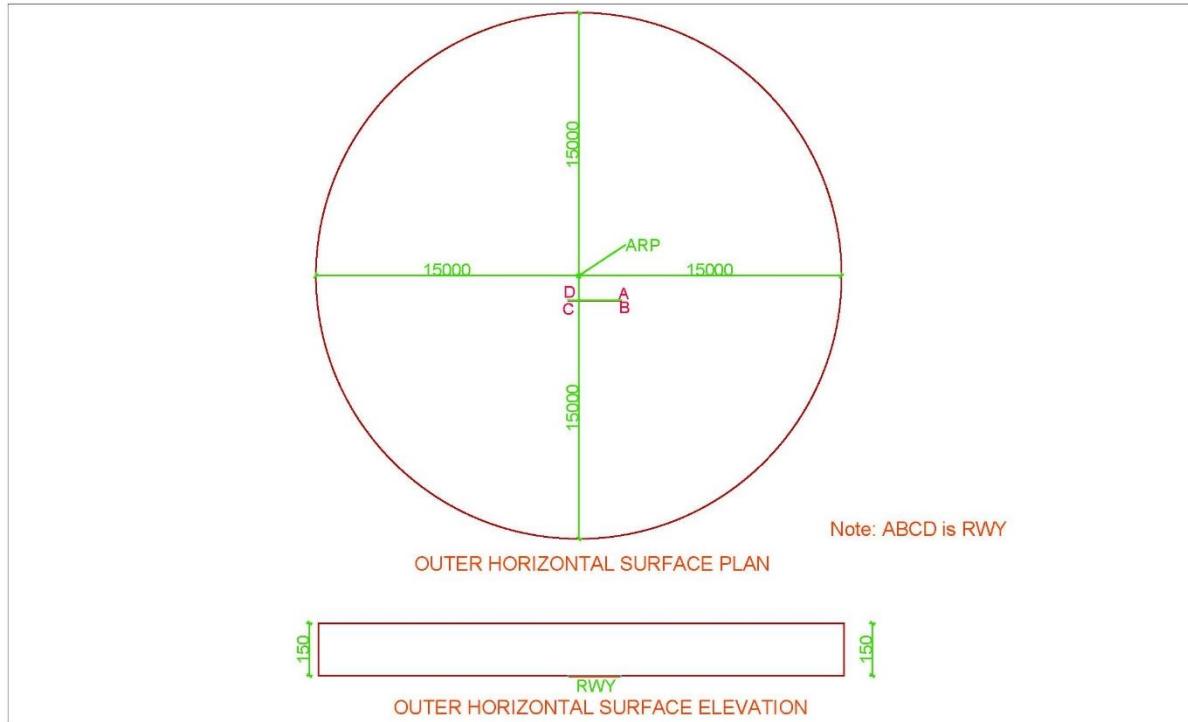


Figure 11. Outer Horizontal Surface

## CHAPTER 3 INTRODUCTION TO SOFTWARE

### 3.1 Overview of Software

|  |   |
|--|---|
| Name of the Software                               | <b>CSAY Obstacle Height Calculation</b>   |
| Version  | 2023.1  |
| Type   | Free and Open source  |
| Operating System                                   | Windows 10 (preferable) or higher   |
| Display resolution of Monitor screen (Recommended) | 1366 x 768  |
| Setup  | No installation required  |
| Link to download                                   | <a href="https://github.com/ajayyadavay/CSAYObstacleHeightCalculation">https://github.com/ajayyadavay/CSAYObstacleHeightCalculation</a> |
| Created/Developed/Programmed by                    | Er. Ajay Yadav  |
| E-mail:  | <a href="mailto:Civil.ajayyadav@gmail.com">Civil.ajayyadav@gmail.com</a>  |

### 3.2 Functions of Software

- 1) Finds the height of the obstacle
- 2) Generates OLS for any airport with single runway with correct input of respective Ellipsoid parameters
- 3) Creates pdf of the report
- 4) Draws map of Obstacle Limitation surface and plotted point showing distance between runway and obstacle location
- 5) Creates tippanni in Nepali and Letter in Nepali as well as English
- 6) Exports the route between runway and obstacle and their points to KML file
- 7) Allows user to Perform database operations: ADD, MODIFY, DELETE, DISPLAY, FILTER
- 8) Exports the saved/added data to excel
- 9) Allows user to Auto process which will generate report, tippanni, letter, KML and Map will be saved in a folder
- 10) Allows user to enter decimal degrees (DD) of location of obstacle and also assists in converting from Degree, Minute and Second (DMS) format to DD.
- 11) Allows user to draw all the obstacle limitation surfaces or only selected surfaces and the selected OLSs will only be used during calculation
- 12) Allows user to extract coordinate (latitude and longitude) from map on mouse click
- 13) Allows user to input multiple obstacle coordinates in ".txt" format, calculates intrusion into OLS and export result to Excel used generally during OLS Survey.

### 3.3 Limitation of Software

- 1) This software can be used for airport having only one Runway and not for airport having the parallel or intersecting runways or more than one Runways.

### 3.4 Layout of Software

- 1) There are Ten Tabs
- 2) All the Text boxes labelled with black foreground is input and others are either calculated textboxes or loaded from the '\*.txt' files
- 3) For Auto process, input all required value and click on menu Processing>Auto Process
- 4) Textboxes with orange colored label in "General" tab are mandatory input fields
- 5) All the Combo Boxes have their values loaded from "\*.txt" files
- 6) OLS Map is drawn in "OLS Map" tab

7) At top, there is Menu (File, Database and Processing)

### 3.5 Input Text files ("\*.txt") and folder

All the text files contain data as per the name of the text files and data are tab delimited.

Note1: The user is allowed only to edit the content of text files strictly adhering to the format and user cannot rename or delete the text files or change their location.

Note2: After entering data in specified format in any ".txt" files, don't press enter to start new lines at the end of file as in Figure 13 i.e., the file should be ended with text as in Figure 12.

The screenshot shows a Notepad window titled "Toc\_CD\_RL - Notepad". The menu bar includes File, Edit, Format, View, and Help. The text area contains the following data:

```
Note:RL of extended RWY CL from CD to :  
Distance_From_CD      RL_m      Remark  
0          105      CD_Threshold_Midpoint  
30         105  
60         105      KL_Midpoint
```

A green callout box points to the word "KL\_Midpoint". It contains the text: "The cursor should end here and also no. of lines shown in status bar (Ln 5) is equal to no. of lines in text i.e., 5. Hence, OK." A green arrow also points to the status bar, which displays "Ln 5, Col 19".

Figure 12. Dos for preparing any input ".txt" files

The screenshot shows a Notepad window titled "\*Toc\_CD\_RL - Notepad". The menu bar includes File, Edit, Format, View, and Help. The text area contains the same data as Figure 12, but with an extra line break at the end:

```
Note:RL of extended RWY CL from CD to :  
Distance_From_CD      RL_m      Remark  
0          105      CD_Threshold_Midpoint  
30         105  
60         105      KL_Midpoint
```

A red callout box points to the word "KL\_Midpoint". It contains the text: "The cursor shouldn't end here and also no. of lines shown in status bar (Ln 6) isn't equal to no. of lines in text i.e., 5. Hence, NOT OK." A red arrow points to the status bar, which displays "Ln 6, Col 1".

Figure 13. Don'ts for preparing any ".txt" files

Figure 14 shows folders and its content. The user can edit content as per their requirement.

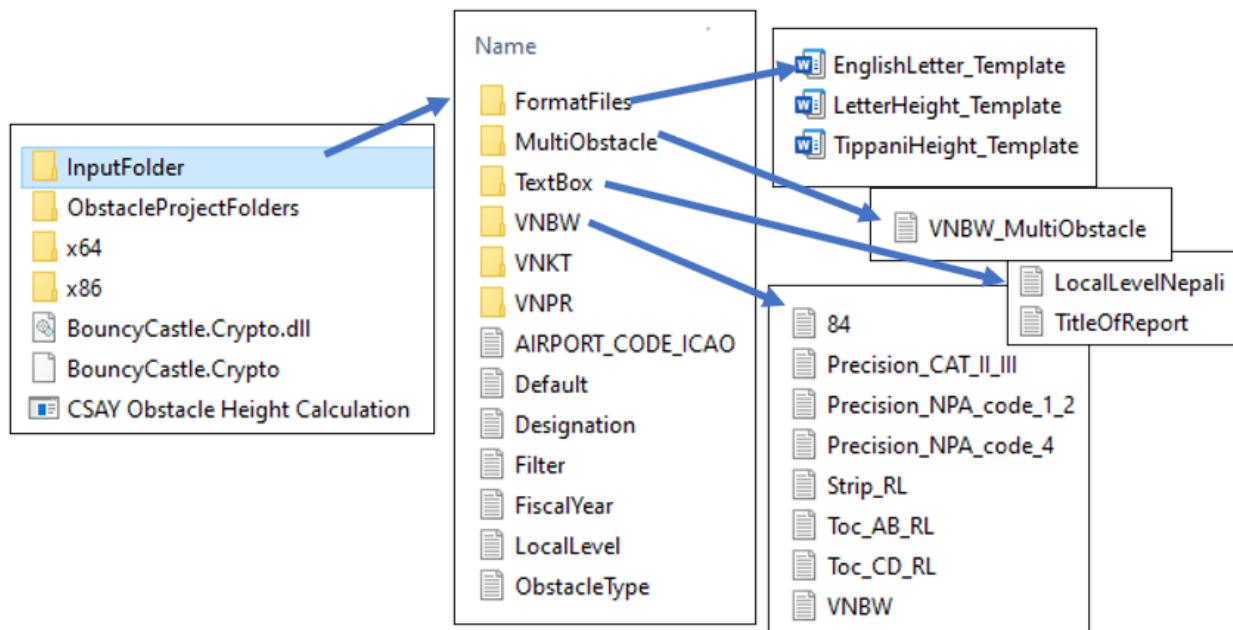


Figure 14. Input folder and its content

### 3.5.1 Content of TextBox Folder

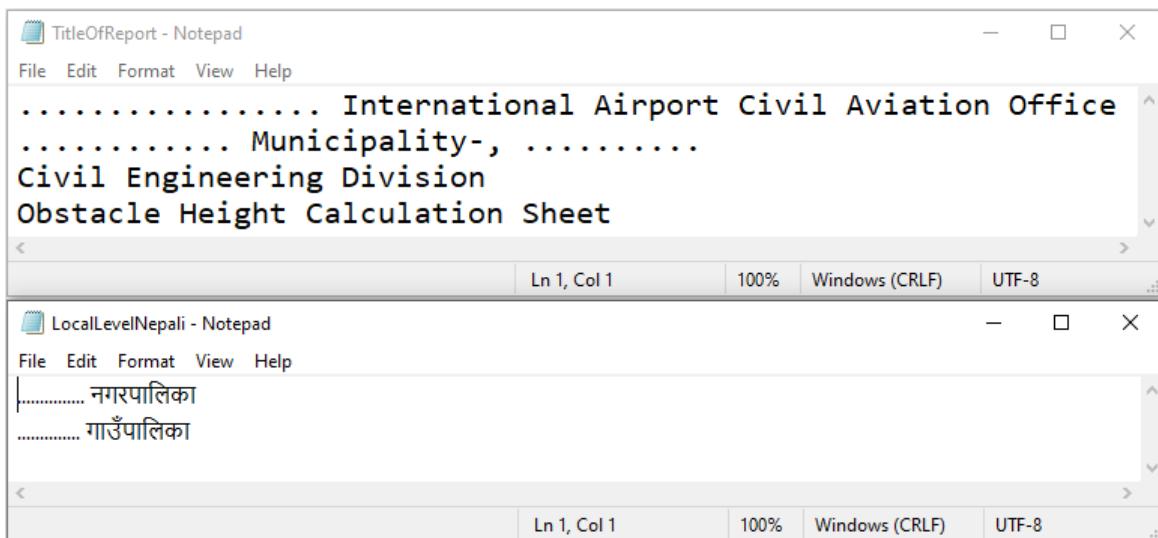


Figure 15. TextBox Folder Content

- 1) LocalLevelNepali.txt → contains local level name in Nepali/Devanagari and it should be in the same order as that of English local level name as shown in Figure 18.
- 2) TitleOfReport.txt → contains title of the report generated

### 3.5.2 Airport code folder content

The screenshot shows four Notepad windows side-by-side:

- Toc\_AB\_RL - Notepad**: Contains data for Runway AB Threshold Displacement.
- Precision\_CAT\_II\_III - Notepad**: Contains data for Runway Classification and OLS table columns.
- Everest\_Nagarkot - Notepad**: Contains data for Runway CD Threshold Displacement.
- Strip\_RL - Notepad**: Contains data for Runway Strip RL.

Red arrows point from the first three windows to the second one, indicating its importance.

Figure 16. Airport Code (e.g., VNBW) Folder Content

- 1) "84.txt"
  - a. contains parameter of ellipsoid used in 2D projection i.e., to convert latitude and longitude to Easting and Northing and vice-versa.
  - b. Instead of "84.txt", you can rename or create a new file with different longitude, e.g., "87.txt" but "87" should be specified in "VNBW.txt" as value of Central\_Meridian.
- 2) "Precision\_CAT\_II\_III.txt"
  - a. contains data of any one column of OLS table of ICAO ANNEX-14, VOL I, chapter 4, which specified dimension of OLS.
  - b. Also "Precision\_CAT\_II\_III" should be specified in "VNBW.txt" as value of "RWY\_Classify".
  - c. Different filename can be used but should be specified in "VNBW.txt"
- 3) ToC\_CD\_RL.txt
  - a. This text file contains data of chainage-wise Reduced Level (RL) of extended centerline of Runway starting from the CD side Threshold and continuing along the centerline of clearway or end of Runway strip whichever is greater.
  - b. *This filename cannot be changed.*
  - c. The maximum RL contained in this file is used as ground RL for Take-Off Climb Surface at CD Threshold.
- 4) ToC\_AB\_RL.txt
  - a. This text file contains data of chainage-wise Reduced Level (RL) of extended centerline of Runway starting from the AB side Threshold and continuing along the centerline of clearway or end of Runway strip whichever is greater.
  - b. *This filename cannot be changed.*
  - c. The maximum RL contained in this file is used as ground RL for Take-Off Climb Surface at AB Threshold.
- 5) Strip\_RL.txt

- a. Contains data of chainage-wise RL of centerline of strip i.e., centerline of Runway and its extension on both ends beyond thresholds and up to strip end.
  - b. *This filename cannot be changed.*
  - c. This data is used as ground RL for Transitional surface, Inner transitional surface, Approach and Inner Approach Surface.
  - d. Transitional and Inner transitional surfaces use the nearest RL data and these surfaces will be drawn in the chainage specified in this file
  - e. For Approach and Inner Approach, the midpoint RL of respective threshold is used and these RLs are identified by keyword *CD\_Threshold\_Midpoint* and *AB\_Threshold\_Midpoint* contained in this file.
  - f. The chainage can be any regular interval (e.g., 0, 10, 20, 30, etc.) or irregular interval (e.g., 0, 10, 15, 23, 28, 30, etc.) but starting chainage i.e., zero should always begin at midpoint of “KL” near “CD threshold”.
  - g. For nomenclature, refer Figure 5 and Figure 34.
- 6) Airportcode.txt e.g., VNBW.txt
- a. This file can have any ICAO airport code name like “VNBW.txt”, “VNKT.txt”, “VNPR.txt”, etc. Here “VNBW.txt” is used throughout the document as example.
  - b. In text file VNBW.txt, Central meridian should be a number e.g., 84 and a filename “84.txt” should be in the same folder containing parameters of ellipsoid in format as shown in Figure 16.
  - c. “Reference\_dataum\_for\_IHS\_m” contains RL for Inner Horizontal Surface
  - d. RWY Classify should contain the filename e.g. “Precision\_CAT\_II\_III.txt” of the file which contains information of OLS dimensions as shown in Figure 16.
  - e. AB\_Threshold\_Displaced\_by and CD\_Threshold\_Displaced\_by contains length by which these thresholds have been displaced
  - f. AB\_CLWY\_beyond\_Strip contains length of clearway which extends beyond the strip at AB threshold as in Figure 1, this value will be  $(1000 - 150 - 60) = 790$ .
  - g. CD\_CLWY\_beyond\_Strip contains length of clearway which extends beyond the strip at CD threshold as in Figure 1, this value will be 0 as there is no clearway. Also, these values will be zero when clearway doesn't extend beyond the Runway strip.
  - h. AB\_CLWY\_beyond\_Strip and CD\_CLWY\_beyond\_Strip specifies how far will the Take Off climb surface begins beyond the strip
  - i. ARP\_Lat\_N and ARP\_Long\_E contains latitude and longitude of ARP published in Aerodrome manual
  - j. RWY\_AB\_DESIGNATION specifies the designation of Runway on AB side and the software itself calculates the designation of CD side.
  - k. A,B,C,D are points of the runway corners and contains their respective latitude and longitude. Refer Figure 34, for nomenclature.

### 3.5.3 MultiObstacle input format

| VNBW Multi OLS survey data |              |             |             |        |        |
|----------------------------|--------------|-------------|-------------|--------|--------|
| ObstacleID                 | ObstacleType | Latitude    | Longitude   |        |        |
| 101                        | Tree         | 27.50111524 | 83.43858719 | 108    | 35     |
| 102                        | Building     | 27.49746084 | 83.46330643 | 107    |        |
| 103                        | Tower        | 27.49548133 | 83.48922729 | 102.65 | 46.95  |
| 104                        | Hospita      | 27.50613984 | 83.42399597 | 106.32 | 43.62  |
| 105                        | Tree         | 27.50339918 | 83.39653015 | 118.32 | 24.87  |
| 106                        | Tree         | 27.46228108 | 83.3731842  | 107.98 | 32.987 |
| 107                        | Tower        | 27.50796691 | 83.38880539 | 106.35 | 45.65  |
| 108                        | Building     | 27.53232492 | 83.29559326 | 109.32 |        |

Figure 17. MultiObstacle folder content

- 1) "AirportCode\_MultiObstacle.txt" (e.g., here "VNBW\_MultiObstacle.txt") in the folder MultiObstacle as shown in Figure 14 contains contains data related to different obstacle obtained after OLS survey and it loaded in the first table of Figure 29.

### 3.5.4 Others Texfile input format

|                            |                     |                         |
|----------------------------|---------------------|-------------------------|
| FiscalYear ...             | AirportCode         | AIRPORT_CODE_ICAO ...   |
| 7980                       | VNBW                | VNPR                    |
| Windows (CRLF)             | 100% Windows (CRLF) | 100% Windows (CRLF)     |
| Designation - ...          | ID                  | ..... Municipality      |
| File Edit Format View Help | FiscalYear          | ..... Ruralmunicipality |
| Mr.                        | ObstacleType        | ObstacleType - Notepad  |
| Mrs.                       | FirstName           | Building                |
| Miss                       | LocalLevel          | Tower                   |
| M/s                        | SurfaceName         |                         |
| Windows (CRLF)             | 10 Unix (LF)        | 100% Unix (LF)          |
| UTF-8                      | UTF-8               | UTF-8                   |

Figure 18. Other texfile content format

- 1) FiscalYear.txt
  - a. Contains fiscal year data in column-wise list format
- 2) Default.txt
  - a. Contains only one airport code among the codes specified in "AIRPORT\_CODE\_ICAO.txt", which will be automatically loaded when the software opens by default. This can be changed to VNPR or VNKT or any other name among the list contained in "AIRPORT\_CODE\_ICAO.txt"

- 3) "AIRPORT\_CODE\_ICAO.txt"
  - a. contains column-wise list of ICAO airport codes.
  - b. However, IATA codes can also be used but all the files and folders should be renamed accordingly
- 4) Designation.txt
  - a. Contains designation that will be put before name of the person/building/tower, etc. whose data is entered
- 5) Filter.txt
  - a. Contains the column name of table shown in Figure 19, which can be used to filter the record in the table
- 6) LocalLevel.txt
  - a. Contains local level name in English and must match the order contained in LocalLevelNepali.txt
  - b. These texts are loaded in the combo box as shown in Figure 23 (for English) and Figure 24 (For Nepali/Devanagari)
  - c. Selecting any name from "LocalLevel.txt" will automatically load corresponding name from "LocalLevelNepali.txt".
- 7) ObstacleType.txt
  - a. Contains the type of obstacle in column-wise list format

### 3.6 Content of Tab

#### 3.6.1 Load All Record

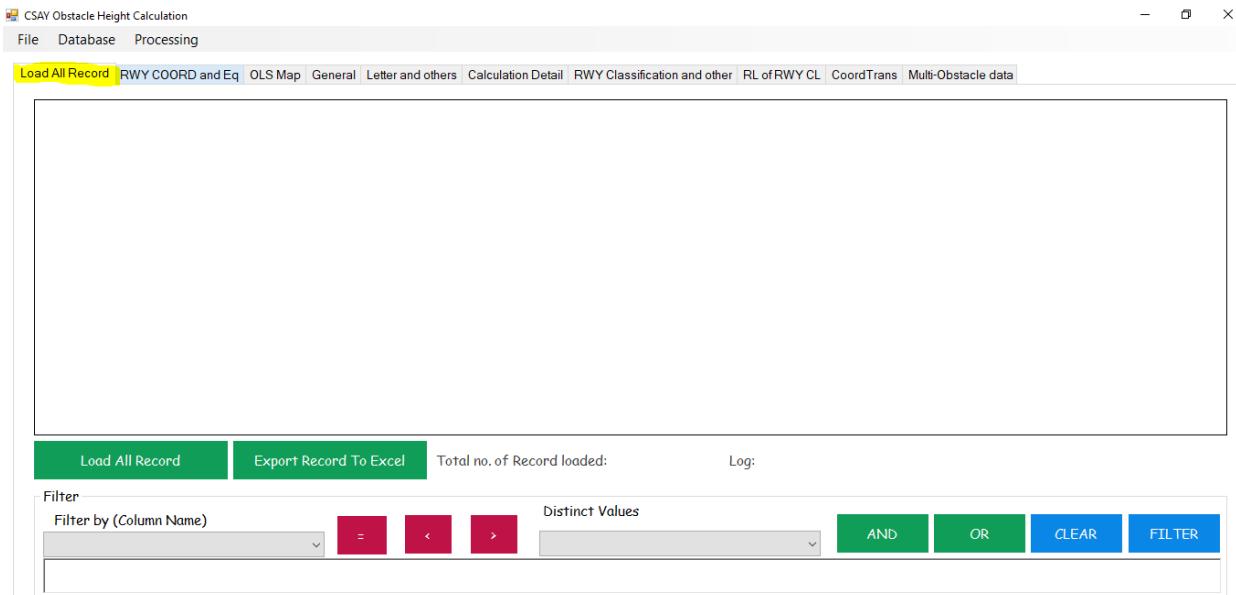


Figure 19. Load all Records Tab

### 3.6.2 RWY COORD and Eq

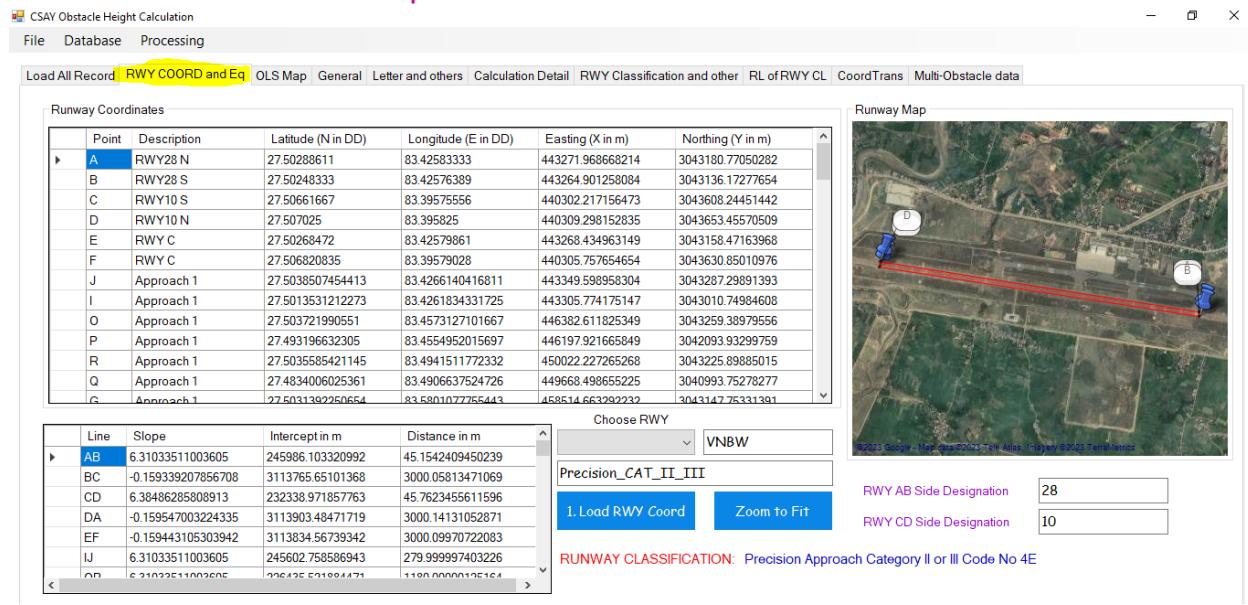


Figure 20. RWY COORD and Eq Tab

- 1) As in Figure 20, First enter the required data in specified format in text files as in Figure 14
- 2) Choose RWY
- 3) A Folder of the same name (Here, it is VNBW) should be present in “InputFolder” and a file named “VNBW.txt” will be in the folder VNBW as shown in Figure 14 and Figure 16
- 4) Click button “1. Load RWY Coord” to load and “Zoom to Fit” to fit.
- 5) As in Figure 14, the “default.txt” contains name of the Airport code which will be automatically loaded, if file exists, when the software opens.
- 6) Runway Classification name will be loaded from “Precision\_CAT\_II\_III.txt” as shown in Figure 14 and Figure 16.
- 7) RWY AB side Designation is taken from “VNBW.txt” as in Figure 16 while RWY CD side Designation is calculated by software.

### 3.6.3 OLS Map

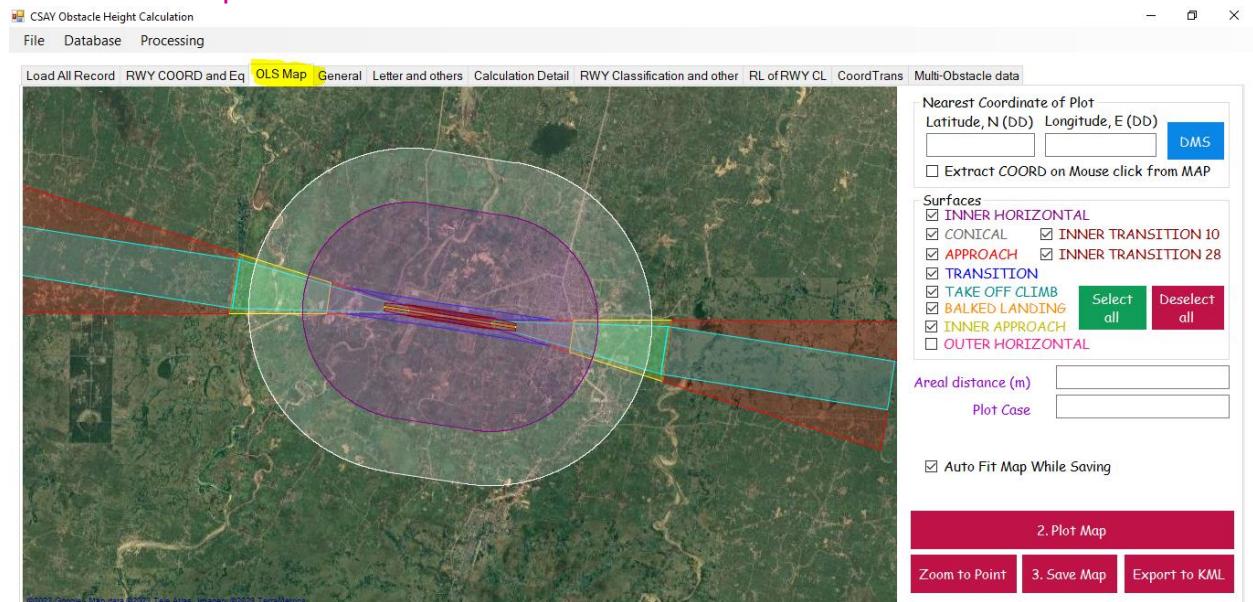


Figure 21. OLS Map Tab

|   | Description | Degree | Minute | Second |  |
|---|-------------|--------|--------|--------|--|
| ► | Latitude    |        |        |        |  |
|   | Longitude   |        |        |        |  |
| * |             |        |        |        |  |

Latitude (DD)

Longitude (DD)

Send DMS to Main Form

**New**    **Calculate**    **Exit**

Figure 22. DMS to DD Converter

- 1) Input latitude and longitude in DD format.
- 2) Click DMS and enter latitude and longitude in DMS format as in Figure 22.
- 3) If “Extract COORD on mouse click from Map” is checked on, latitude and longitude text boxes will be filled with the latitude and longitude of the map and if checked off, user has to input the coordinate themselves.
- 4) Under surfaces, select the required surfaces to **display and use in calculation**

- 5) As shown in Figure 21, Outer horizontal surface is not checked (i.e., not selected) so, it is not displayed and also will not be used to calculate intrusion into OLS.
- 6) Click button “2. Plot Map” to plot the obstacle and runway point and calculate areal distance according to the plot case (refer Figure 35 for plot case)
- 7) If “Auto Fit Map While Saving” is checked on, the map will be autofit to the points plotted and that map will be saved but if it is checked off, the user can adjust the map to desired zoom level by scrolling mouse wheel and then click “3. Save Map”. However, if you click Processing>Auto process, map will be autofit.
- 8) Click “Export to KML” to export the points of runway, obstacle and line joining them to KML file
- 9) “Zoom to Point” zooms map to the plotted point

### 3.6.4 General

The screenshot shows the 'General' tab of the 'CSAY Obstacle Height Calculation' application. The window title is 'CSAY Obstacle Height Calculation'. The menu bar includes 'File', 'Database', 'Processing', and tabs for 'Load All Record', 'RWY COORD and Eq', 'OLS Map', 'General' (which is highlighted in yellow), 'Letter and others', 'Calculation Detail', 'RWY Classification and other', 'RL of RWY CL', 'CoordTrans', and 'Multi-Obstacle data'. The 'General' tab contains several input fields:

- General:** Fields include 'ID' (dropdown), 'Fiscal Year (\*)' (dropdown), 'Plot no. (\*)' (text box), 'Obstacle Type' (dropdown).
- Name:** Fields include 'Designation' (dropdown), 'First Name (\*)' (text box), 'Middle Name' (text box), 'Last Name' (text box).
- Address:** Fields include 'Local Level (\*)' (dropdown), 'Ward no.' (text box), 'Tole' (text box).
- Elevation of Proposed Obstacle:** Fields include 'RL of Plinth (AMSL)' (text box), 'Height above plinth' (text box), 'Elevation of obstacle (AMSL)' (text box), and 'Permitted elevation of obstacle (AMSL)' (text box).
- Coordinate of RWY:** Fields include 'Latitude, N (DD)' (text box) and 'Longitude, E (DD)' (text box).

Figure 23. General Tab

- 1) All **orange label** marked with (\*) are mandatory fields/textboxes
- 2) All black labelled fields are to be entered by user
- 3) Other are calculated or loaded from text files
- 4) **Elevation of obstacle (AMSL) = RL of Plinth (AMSL) + Height of Plinth**
- 5) if Elevation of obstacle > Allowable elevation (i.e., RL of OLS) then **permitted elevation of obstacle (AMSL)** will be **red**, otherwise **green**.

### 3.6.5 Letters and others

Date:-

Date of previous letter

Ref. no. of previous letter

**Title of Report**

..... International Airport Civil Aviation Office  
Municipality-  
Civil Engineering Division  
Obstacle Height Calculation Sheet

**Documents required**

1. Letter from concerned local level requesting for building height clearance stating name, address and plot number of owner's land
2. Building site location, plan section showing elevation data signed by Consultant Engineer and Owner
3. Coordinate (latitude and longitude) of proposed building corners and Reduced Level (AMSL) of Ground/Plinth level of building
4. Map issued from Survey department showing owner's plot number

**Fill Following text in Devanagiri script**

निवेदनको मिति:-   
प्राप्त निवेदनको मिति:-   
प्राप्त निवेदनको च.न.-   
क्रिता नं.-   
उचाई:-   
वडा नं.-   
स्थानीय तह:-

**Create English Letter** **Create Nepali Letter** **Create Nepali Tippani**

Figure 24. Letters and Others Tab

- 1) All black labeled are input
- 2) Blue colored fields are loaded form text files as shown in Figure 14.
- 3) No need to write in Devanagari i.e., Nepali because when you input in English, these Devanagari fields will be automatically filled
- 4) “Create English Letter”, “Create Nepali Letter” and “Create Nepali Tippani” button will create letter and Tippani in the format contained in “FormatFiles” folder as shown in Figure 14.

### 3.6.6 Calculation Detail

**Calculation detail of all the surfaces under which the obstacle lies**

| SN | Surface Name | Surface Height | Datum RL | RL of Surface | Calculation |
|----|--------------|----------------|----------|---------------|-------------|
| *  |              |                |          |               |             |

**Final Surface Calculation detail**

**Allowable Elevation**

|                  |                      |                          |                      |                            |                      |
|------------------|----------------------|--------------------------|----------------------|----------------------------|----------------------|
| RL of RWY (AMSL) | <input type="text"/> | Surface height above RWY | <input type="text"/> | Elevation allowable (AMSL) | <input type="text"/> |
| Surface          | <input type="text"/> |                          |                      | Central Reference Meridian | 84                   |

Figure 25. Calculation Detail

- 1) All the OLS below which the obstacle lies, will be listed with detailed calculation in the table as shown in Figure 25.
- 2) The minimum elevation data and corresponding surfaces will be shown in the text boxes and that shall be added to the table as shown in Figure 25.
- 3) If there are more than one minimum, all will be transferred from table to text box.

### 3.6.7 RWY Classification and other

Figure 26. RWY Classification and other Tab

### 3.6.8 RL of RWY CL

Figure 27. RL of RWY CL tab

- After the user prepare input files as shown from 3.5 to 3.5.4, the tables and textboxes shown in Figure 27 will be automatically loaded.

### 3.6.9 Coord Trans

Figure 28. Coord Trans tab

- 1) The tables in this tab are automatically calculated after the user prepare input files as shown from 3.5 to 3.5.3

### 3.6.10 Multi-Obstacle data Tab

Figure 29. Multi-Obstacle data tab

- 1) The first table is input table which takes input on clicking button “Load data” from filename “AirportCode\_MultiObstacle.txt” i.e., for VNBW, it will be “VNBW\_MultiObstacle.txt” as shown in Figure 17.
- 2) Button “Generate Output table”, calculated the RL of obstacle and OLS and intrusion, if any
- 3) “Export Output to Excel” exports to excel

- 4) "Auto process Multi Obstacle" automatically performs action from (1) to (3), given that the input files are in format
- 5) It can be used in OLS Survey
- 6) These data are not added to the database of the software and user has to save excel files themselves
- 7) While calculating data, violet colored progress bar appears

### 3.6.11 Menu

When any menu is clicked or any process occurs, message is displayed in the white box and when file is saved, location of last saved file is displayed in the **orange region** as shown in Figure 32.

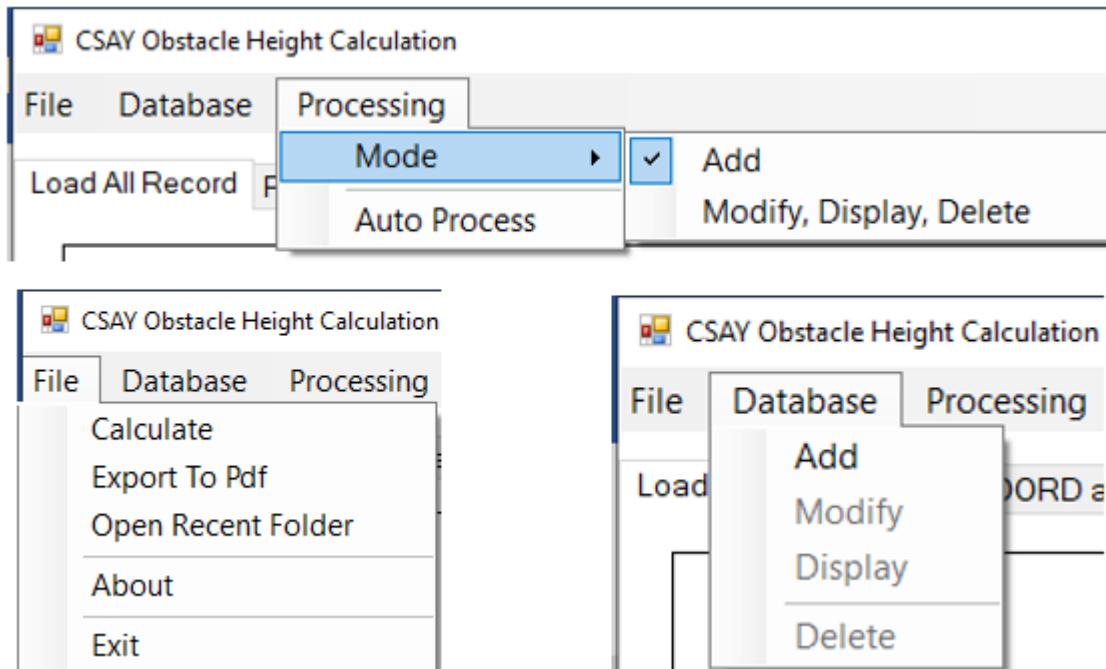


Figure 30. Menu

- 1) File menu
  - a. Calculate
    - i. After the user prepare input files as shown from 3.5 to 3.5.4, the user should click on "2. Plot map" of Figure 21
    - ii. Then user need to input "RL of plinth (AMSL)" and "Height above plinth" as in Figure 23
    - iii. Then user can click on File>Calculate and view calculation details as shown in Figure 25.
  - b. After calculation and input of all black labelled fields, use can export report to pdf by clicking File>Export to Pdf
  - c. "Open Recent Folder" opens recently calculated and saved files i.e., address displayed in the **orange region** of Figure 32
  - d. "About" open about form as in Figure 31.
  - e. "Exit" closes the software
- 2) Database menu

- a. “Add” to add data to database and ID auto-increases and all the generated files of projects are saved in Folder “ObstacleProjectFolders” as shown in Figure 14.
  - b. “Modify” to modify the existing data
  - c. “Display” to display the data after input of ID in General tab as in Figure 23
  - d. “Delete” to delete the existing data. Once you delete data, you cannot retrieve it.
- 3) Processing
- a. Mode>Add
    - i. When this mode is checked on, Database>Add will be enabled, Project ID text field will be disabled in General tab as shown in Figure 23 and user will be allowed to add data
  - b. Mode>Modify, Display, Delete
    - i. When “Modify, Display, “Delete” is checked on, “Delete”, “Modify” and “Display” of Database menu will be enabled and File>Add will be disabled and Project ID of General tab (Figure 23) will also be enabled for user to input ID to display, delete or modify record.
    - ii. The ID can be known by clicking on button “Load All Record” of Figure 16
  - c. Auto Process
    - i. Firstly, prepare input files from 3.5 to 3.5.4
    - ii. Choose required airport code and click on “1. Load RWY COORD” as shown in Figure 20.
    - iii. Input coordinates in latitude and longitude format in respective fields as shown in Figure 21. OLS Map Tab.
    - iv. Input all other required fields of General tab (Figure 23) and letter and others tab (Figure 24)
    - v. Click on Processing>Auto Process and wait until 100% processing is completed to generate reports, letters, Tippini, calculate obstacle elevation, export KML and save map.

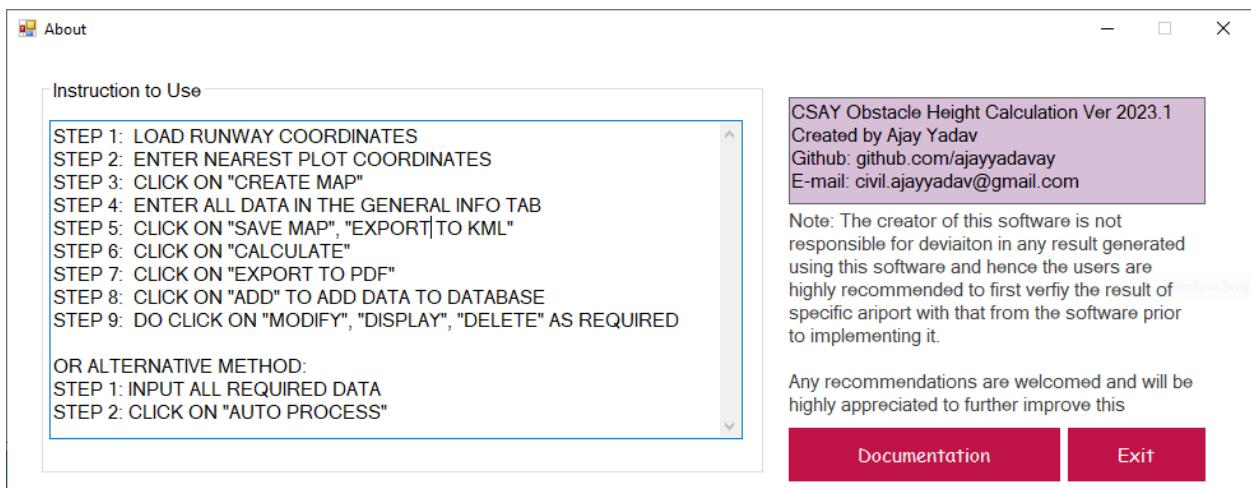


Figure 31. About



Figure 32. Message and recently saved location (Orange region)

### 3.6.12 Filter

Figure 33. Filter

- 1) Format of Filter is –
  - a. '**FirstName**'='Alpha' **OR** '**ObstacleType**'='Building'
  - b. Those records will be shown in the table of Figure 19 having First name as 'Alpha' or Obstacle type as 'Building'
  - c. The user can use different such combination of filter
  - d. Button "Clear" will clear the filter text field
  - e. Button "=", "<", ">", "AND", "OR" will input these texts in filter field
  - f. When the user selects the "Filter by (Column Name)" loaded from "Filter.txt" (Figure 18), combo box "Distinct Values" will be automatically loaded.
  - g. Distinct values of any column are the distinct values saved in the database under the same column of table Figure 19.

### 3.7 Nomenclature of Runway corners

- 1) The naming of corners of Runway shall be according to Figure 34.
- 2) Reference runway is RWY 10-28
- 3) Non-reference runway is any runway other than the reference runway i.e., RWY 10-28
- 4) To name any non-reference runway (i.e., runway other than RWY 10-28),
  - a. Draw the centerline runway edge strip rectangular line of reference and the non-reference runway
  - b. Rotate the reference runway i.e., RWY 10-28 about mid-point of centerline of RWY in such a that all the following conditions are satisfied-
    - i. AB should always be below the EW line
    - ii. CD should always be above the EW line
    - iii. ABCD should be in anti-clockwise direction
    - iv. AB and CD should be shorter sides i.e., along width of RWY
    - v. AD and BC should be longer sides i.e., along the length of RWY
  - c. Then get the latitude and longitude of corners A, B, C and D from google earth, GPS, etc. and those coordinates in Airport code text file (e.g., VNBW.txt, VNKT.txt, VNPK.txt, etc.) in the format specified as in Figure 16.

Note:

1. *If the naming order is wrong or not as per specified, OLS cannot be drawn correctly.*
2. *Since the software code was written with respect to RWY 10-28 and parameters were then set for other runways so, RWY 10-28 is regarded as reference runway.*
3. *For RWY 09-27, AB will on 27 side and CD on 09 side*

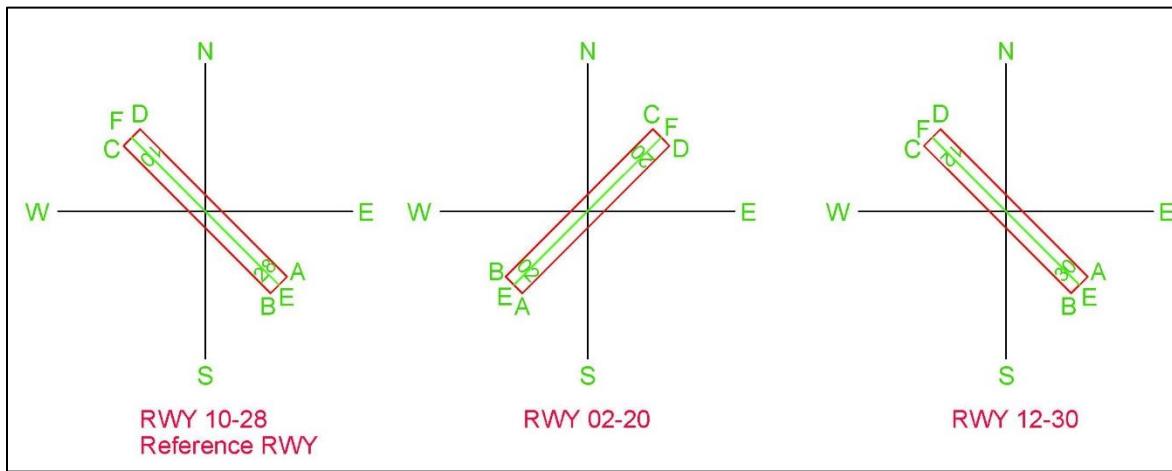


Figure 34. Runway corner nomenclature

### 3.8 Plot case of Obstacle

| Plotcase No | Shortest distance of obstacle from runway                       |
|-------------|---|
| 1, 3, 5, 7  | distance between obstacle and RWY point D, A, B, C respectively |
| 2, 4, 6, 8  | Perpendicula distance on sides AD, AB, BC, CD respectively      |

| OLS   | Plotcase No.          |
|---|-----------------------|
| Conical, Inner Horizontal, Outer Horizontal | 1 to 8                |
| Transition, Inner Transition                | 1, 2, 3, 5, 6, 7      |
| Inner Approach, Approach, Take Off Climb    | 1, 8, 7, 3, 4, 5      |
| Balked Landing                              | 1 to 8 and within RWY |

**Plot case from 1 to 8**

Figure 35. Plot case of obstacle

- 1) As shown in Figure 35, there are 8 plot cases i.e., 8 possible locations of obstacle with respect to the runway
- 2) The first table shows how to find the shortest distance of the obstacle from the runway i.e., to find distance, the second point is the obstacle itself and the first point is as described in the table varying according to plot case
- 3) The second table shows how the particular OLS has spread over multiple plot cases e.g., Conical exists in all plot cases, Transition surface lies in plot case 1,2,3,5,6 and 7 and also shows that transitional surface cannot lie in plot case position 4 and 8, etc.

### 3.9 Output

#### 3.9.1 Report

..... International Airport Civil Aviation Office  
..... Municipality-, .....  
Civil Engineering Division  
Obstacle Height Calculation Sheet

| A. General Information   |   |   |
|--|---|---|
| 1  | Obstacle Calculation ID                     | 1   |
| 2  | Fiscal Year                                 | 7980  |
| 3  | Obstacle Type                               | Tower   |
| 4  | Owner's Name                                | Alpha Yankee  |
| 5  | Address                                     | Tango Municipality - 11, Bravo                            |
| 6  | Plot number                                 | 123   |
| 7  | Nearest Plot Coordinate                     | 27.5018765576825, 83.4597015380859                        |
| 8  | Runway Coordinate                           | 27.50288611, 83.42583333                                  |
| 9  | Distance from RWY to Obstacle               | 3347.17 m   |
| B. Elevation of Proposed obstacle  |   |   |
| 10   | RL of Plinth (AMSL)                         | 135 m   |
| 11   | Height of obstacle above Plinth             | 25 m  |
| 12   | Maximum Elevation of Obstacle (AMSL)        | 160.000 m   |
| C. Allowable Elevation of Obstacle   |   |   |
| 13   | RL of RWY (AMSL)                            | 105.000 m   |
| 14   | Obstacle lying in surface                   | INNER HORIZONTAL  |
| 15   | Surface height above RWY                    | 45.000 m  |
| 16   | Allowable Maximum Obstacle Elevation        | $105 + 45.000 = 150.000$                                  |
| 17   | Hence, Maximum Permitted height of obstacle | 150.000 m   |
| D. Reference   |   |   |
| 18   | Runway Classification                       | Precision Approach Category II or III Code No 4E          |
| 19   | Airport                                     | VNBW  |
| 20   | Docs refered                                | OLS Chart of ICAO Annex-14 Volume I, Chapter 4 and CAR-14 |
| E. Google Earth Image showing RWY to Obstacle position                               |   |   |
|  |   |   |

### 3.9.2 Letter in Nepali

|  |                  |
|--|------------------|
| श्री   | मिति: २०..-००-०० |
| विषय: भवन निर्माणका लागि सहमति सम्बन्धमा ।   |                  |
| <p>उपरोक्त विषयमा त्यस कार्यालायको च.नं. ०००, मिति २०../००-०० को पत्रबाट माग भएको सिफारिस सम्बन्धमा, न.पा. वडा नं. ० ख, किता नं. ०,००,००० मा घर निर्माण गर्न भनी प्राप्त भएका भवन निर्माण सम्बन्धी नक्सा, अन्य संलग्न कागजात तथा सो स्थानको गुगल अर्थबाट लिइएको elevation समेतलाई अध्ययन गर्दा उक्त भवनको अधिक्तम उचाई ०००.०० मिटर (AMSL) रहेको पाइएको । यस प्राधिकरणको पूर्व स्वीकृती विना उक्त उचाईमा वृद्धि गर्ने कुनै पनि स्थायी संरचना निर्माण, पोल, टावर, एण्टेना तथा अन्य कुनै पनि उपकरण जडान समेत नगर्ने सर्तमा Country's adoption of ICAO ANNEX-14, अन्तर्गत Obstacle Limitation Surface (OLS) मा व्यवस्था भएको मापदण्ड वमोजिम निर्माण सहमति प्रदान गरिएको व्यहोरा निर्णयानुसार जानकारी गराइन्छ ।</p> |                  |
| वोधार्थ:   | १.               |

- 1) Note: In InputFolder>FormatFiles>LetterHeight\_Template.dotx as shown above, the **orange colored** text is not be deleted or edited as they are bookmarked and software replaces these orange colored text with the calculated and user-input data.
- 2) However, the black texts can be edited as required and saved with same file name.
- 3) Bookmarks: Date\_BM\_Letter, Elevation\_Letter, OwnerLocation\_BM\_Letter , PlotNo\_BM\_Letter, PrevDate\_BM\_Letter, RefNo\_BM\_Letter

### 3.9.3 Tippani in Nepali

कार्यालय

विषय: भवनको उचाई सम्बन्धमा ।

मिति: २०००/००/००

ज्यू

प्रस्तुत विषयमा नगरपालिका कार्यालयको च. नं. ०००, मिति २०००/००/०० को पत्र र सो साथ प्राप्त जग्गाको नम्बर, साईट प्लान, भवन निर्माण नम्बर तथा अन्य कागजपत्र पेश गरी भवन निर्माणको लागि सहमति माग गरेको व्यहोरा अनुरोध छ । Contrary's adoption of ICAO ANNEX-14 अन्तर्गत Obstacle Limitation Surface (OLS) मा भएका मापदण्ड वमोजिम निर्माण सहमति दिन प्राप्त कागजपत्र तथा गुगल अर्थबाट site को elevation तथा रनवे देखि सो स्थान सम्मको दुरि लिई निर्माण हुने संरचनाको अधिकतम उचाई निकालिएको Calculation Sheet यसै साथ संलग्न छ । सो अनुसार भवनको अधिकतम उचाई ०००.०० मिटर (AMSL) भएको पाइएको हुँदा न. पा. वडा नं. ००, कित्ता नं. ०, ००, ००० मा उक्त उचाईको भवन निर्माणले OLS मा बाधा नपर्ने हुँदा निर्माण सहमति दिन सकिने व्यहोरा निर्णयार्थ पेश गर्दछु ।

चेक जाँच गरी राय ।

श्री

उक्त पेश भई आएका Calculation Sheet, नम्बर तथा अन्य कागजपत्रहरू चेक जाँच गर्दा Contrary's adoption of ICAO ANNEX-14 अनुसार OLS penetrate नगरेकोले सहमति दिन सकिने व्यहोरा पेश गर्दछु ।

श्री

ज्यू  
माथि पेश भए वमोजिमको व्यहोरा स्वीकृतार्थ पेश गर्दछु ।

- 1) Note: In InputFolder>FormatFiles>LetterHeight\_Template as shown above, the orange colored text is not be deleted or edited as they are bookmarked and software replaces these orange colored text with the calculated and user-input data.
  - 2) However, the black texts can be edited as required and saved with same file name.

- 3) Bookmarks: Date\_BM\_Tippani, Elevation\_BM\_Tippani, LocalLevel\_BM\_Tippani, OwnerLocation\_BM\_Tippani, PlotNo\_BM\_Tippani, PrevDate\_BM\_Tippani, RefNo\_BM\_Tippani

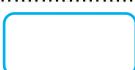
### 3.9.4 Letter in English

Date: - 2080-02-18

To  


Subject: Regarding consent for building construction

In response to the letter received from that office dated 2080-01-05 with ref. no. 235 requesting consent for Building construction, this is to certify that maximum permitted elevation of the proposed Building located at Foxtrot Municipality-7, Tango having plot no. 123, 254 of Mr. Alpha Yankee determined after studying the received drawings, Google Earth Map other related papers is 128.030 m (AMSL). Furthermore, it is to notify that this permit has been granted in accordance with the standards stipulated in Obstacle Limitation Surface (OLS) under Civil Aviation Requirement-14 (CAR-14) on the condition that there shall be no further increment of Building height by permanent construction of structure or by installment of pole, tower, antenna or any other equipment without prior approval of this Authority.

.....  


CC:  


- 1) Note: In InputFolder>FormatFiles>LetterHeight\_Template.dotx as shown above, the orange colored text is not be deleted or edited as they are bookmarked and software replaces these orange colored text with the calculated and user-input data.
- 2) However, the black texts can be edited as required and saved with same file name.
- 3) Bookmarks: Date\_El, Prev\_Date\_El, Ref\_no\_El, Address\_El, Plot\_No\_El, Name\_El and RL\_El.

### 3.10 Steps to calculate Obstacle Height with Auto-Process

The following steps shall be followed to calculate Obstacle height

- 1) Prepare input in all the text files as in Figure 14
- 2) Open the application

| CSAY_OHC > CSAY Obstacle Height Calculation > CSAY Obstacle Height Calculation > bin > Debug |                          |                      |                                  |  |  |
|--|--------------------------|----------------------|----------------------------------|--|--|
| Name   | Date modified            | Type                 |                                  |  |  |
| InputFolder  | 5/31/2023 1:55 PM        | File folder          | Software location address        |  |  |
| ObstacleProjectFolders   | 5/28/2023 10:20 PM       | File folder          | Prepare input files here         |  |  |
| x64  | 3/28/2023 10:08 PM       | File folder          | Output files/folders appear here |  |  |
| x86  | 3/28/2023 10:08 PM       | File folder          |                                  |  |  |
| BouncyCastle.Crypto.dll  | 12/18/2020 3:17 AM       | Application exten... | 2,851 KB                         |  |  |
| BouncyCastle.Crypto  | 12/18/2020 2:58 AM       | XML Document         | 1,476 KB                         |  |  |
| <b>CSAY Obstacle Height Calculation</b>  | <b>5/31/2023 2:27 PM</b> | <b>Application</b>   | <b>235 KB</b>                    |  |  |
| CSAY Obstacle Height Calculation.exe.co...   | 4/5/2023 4:30 PM         | XML Configuratio...  | 2 KB                             |  |  |
| CSAY Obstacle Height Calculation.pdb   | 5/31/2023 2:27 PM        | Program Debug D...   | 268 KB                           |  |  |

Figure 36. Software Executable file Location

- 3) The screen as in Figure 19 appears
- 4) Load RWY location data as in Figure 20
- 5) Navigate through different tabs and input all the fields labelled black in color as in Figure 21 to Figure 24.
- 6) Click “Auto process” from menu Processing>Auto Process Figure 30
- 7) The output will be saved in “ObstacleProjectFolders” as shown in Figure 36.
- 8) All records are stored in “ObstacleHeightRecord.sqlite3” located in the same folder as the application itself.

### 3.11 OLS output of some of the single runway airport

- 1) The data for these outputs have been obtained from Google Earth.
- 2) The RL of RWY and strip centerline and its extension has been entered randomly only for illustration
- 3) To obtain accurate OLS Map, the user should enter the existing field/site data of the particular airport including RL, displaced threshold, clearway length and RL, etc.

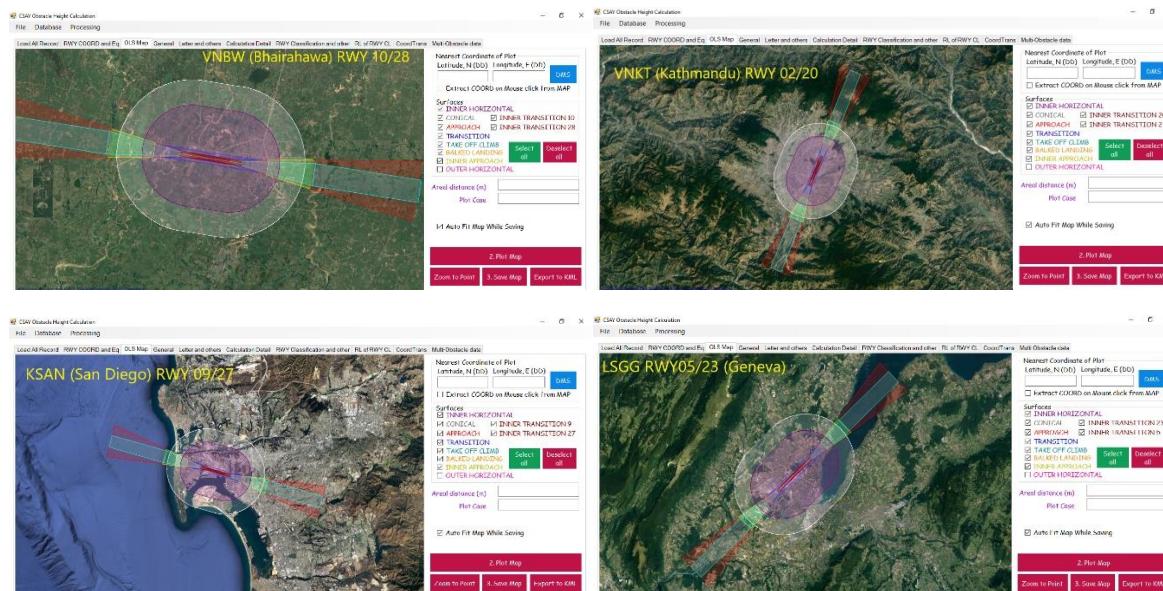


Figure 37. Illustrative OLS map of some single runway airport

# **CSAY OBSTACLE HEIGHT CALCULATION**

## **(A Free and Open-Source Software)**

**Version 2023.1**

### **Functions/Features of the Software**

- ❖ Finds the height of the obstacle, plots OLS, generates report, letters and Tippanni, export plotted points to KML
- ❖ Generates OLS for any airport with single runway
- ❖ Perform database operations: ADD, MODIFY, DELETE, DISPLAY, FILTER
- ❖ Draws and calculates the selected OLS
- ❖ Allows user to extract coordinate (latitude and longitude) from map on mouse click
- ❖ Allows user to input multiple obstacle coordinates in “.txt” format, calculates intrusion into OLS and export result to Excel used generally during OLS Survey.

**Er. AJAY YADAV**