X-88017/1/2016 NHP/ 1579-1634
Government of India
Ministry of Jal Shakti
Department of Water Resources, RD & GR
National Hydrology Project

2nd Floor, Rear Wing,
Mahanagar Doorsanchar Sadan
9, CGO Complex, Lodi Road,
New Delhi-110003.
Dated the 20th July, 2021

Dear Sirs,

As you are aware under National Hydrology Project (NHP), Survey of India (SoI) has developed two important tools for ascertaining positional accuracy in a precise manner with substantial reduction in time of observation and other related efforts. These tools are:-

1. Continuous Operating Reference Station (CORS) ie, active network of reference stations.
2. Geoid model

Whereas CORS system will provide the latitude and longitude of a station/point with accuracy in centimetres and height of station with respect to the ellipsoid datum, Geoid model will be used to convert the ellipsoidal heights into ortho-metric height (i.e. altitude above mean sea level.

CORS system has been established by the Survey of India in the States of Uttar Pradesh and Uttarakhand (under NHP) whereas the same has been established for Maharashtra, Karnataka and Haryana under non NHP. The system is nearing completion in Punjab, Rajasthan, and Madhya Pradesh.

Geoid model has completed by the Survey of India for Uttar Pradesh, West Bengal, Bihar, Jharkhand, Haryana and Uttarakhand (in the districts of Dehradun, Haridwar, Udham Singh Nagar, Pauri Garhwal and Tehri

Garhwal). Geoid model for Punjab, Goa, Kerala and Himachal Pradesh would be completed shortly. Considering the utility of these systems for survey works associated with Water Resources as well as other engineering applications. SoP has been prepared by the Survey of India and the same is attached herewith along with the relevant annexures.

Since CORS network is not completed throughout the country, the SoP also includes procedure for using SOI Ground Control Points (GCPs) as reference stations i.e. passive network of stations.

Annexures have been prepared assuming that the user is acquainted with the GPS data processing knowledge and having basic survey skills using DGPS. However, it is felt that most of the users may not be having clear knowledge as above physical training needs to require acquiring requisite skill. As such, you are requested to identify suitable officers who can be imparted training by SOI for utilising these tools. The training period is expected to be of at least 3 working days and training would be carried out in SOI Complex at Dehradun. Convenient dates for training may also be communicated to SOI for the proposed training program so that Survey of India can arrange such trainings on mutually convenient dates.

Yours sincerely,

Encl: As above

20/2/2024

(Rakesh Kashyap)
Senior Joint Commissioner (NHP)
Tel:- 011- 24367081

To:

Nodal Officers of All Implementing Agencies under NHP.

Copy for information:

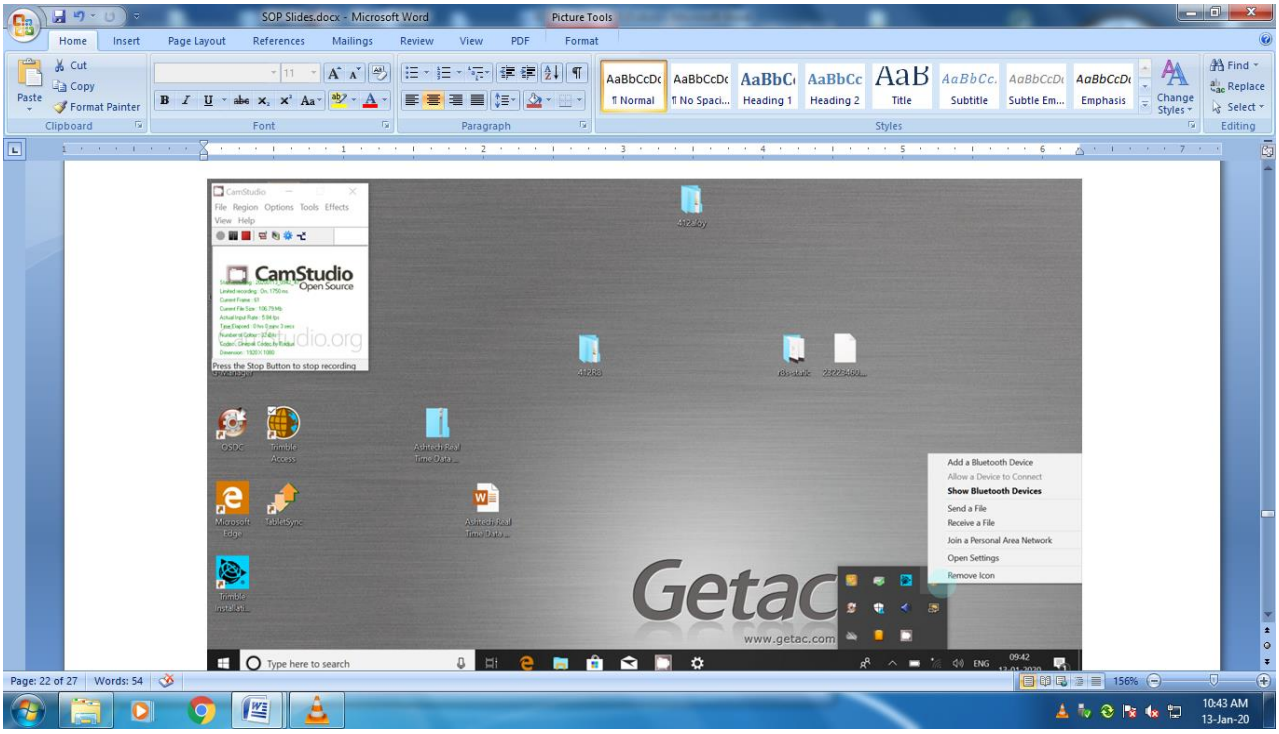
1. PPS to JS (A, IC & GW), D/o WR, RD & GR, New Delhi
2. Project Director, Survey of India.
3. SJC I/SJC-II/ SJC-III/ DS , NHP, New Delhi
4. DC/ DD (NHP) New Delhi
5. DTL, TAMC, New Delhi

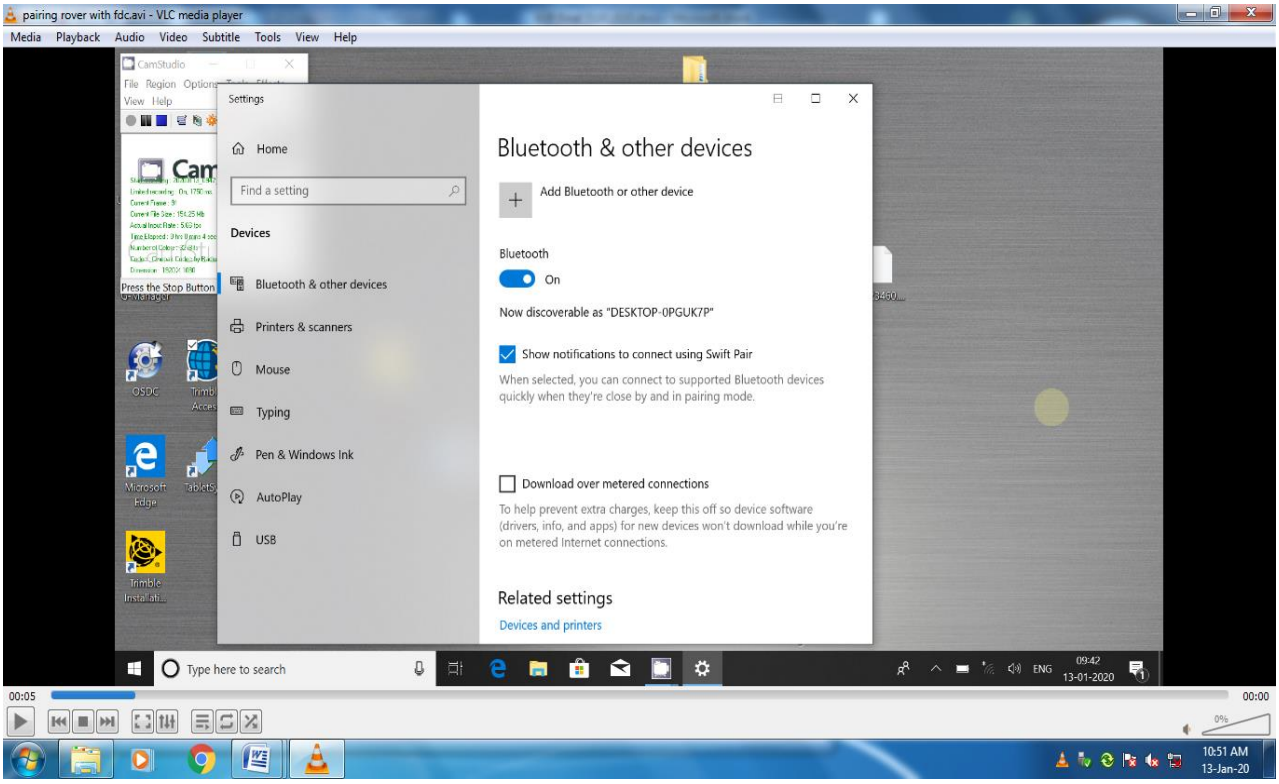
Annexure 'A'

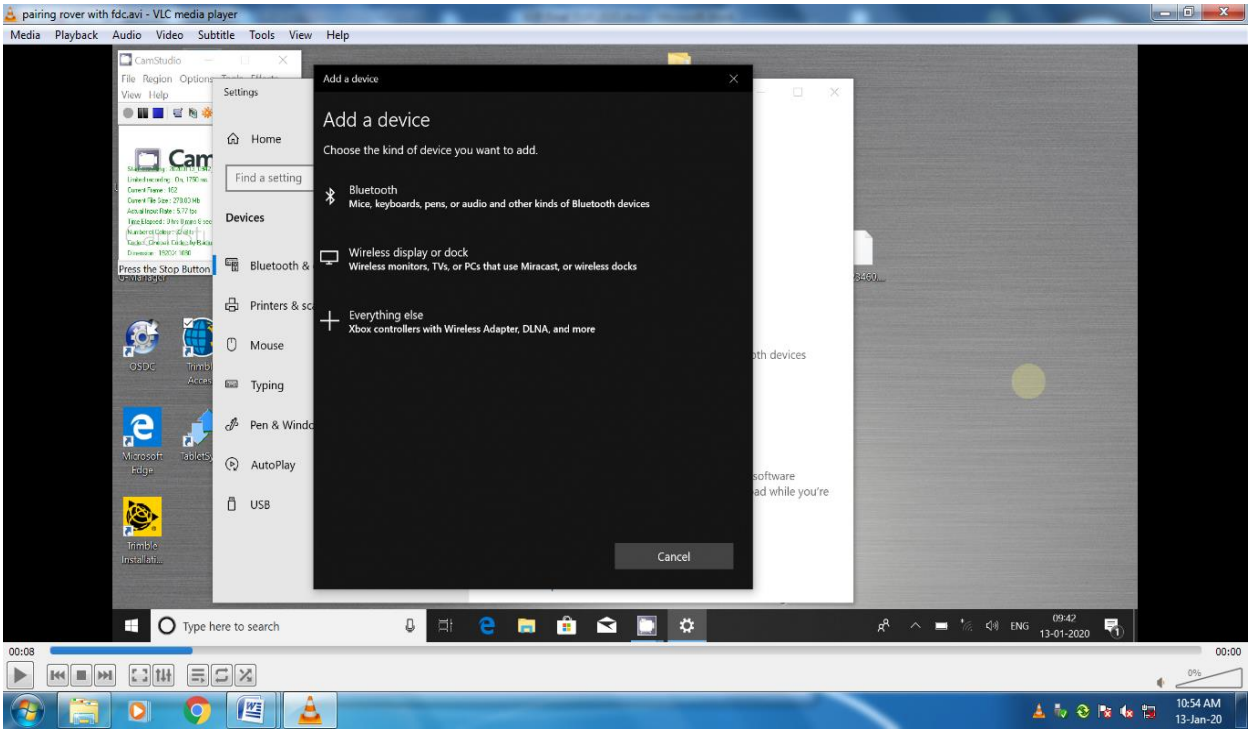
SETUP OF ROVER (R8s)

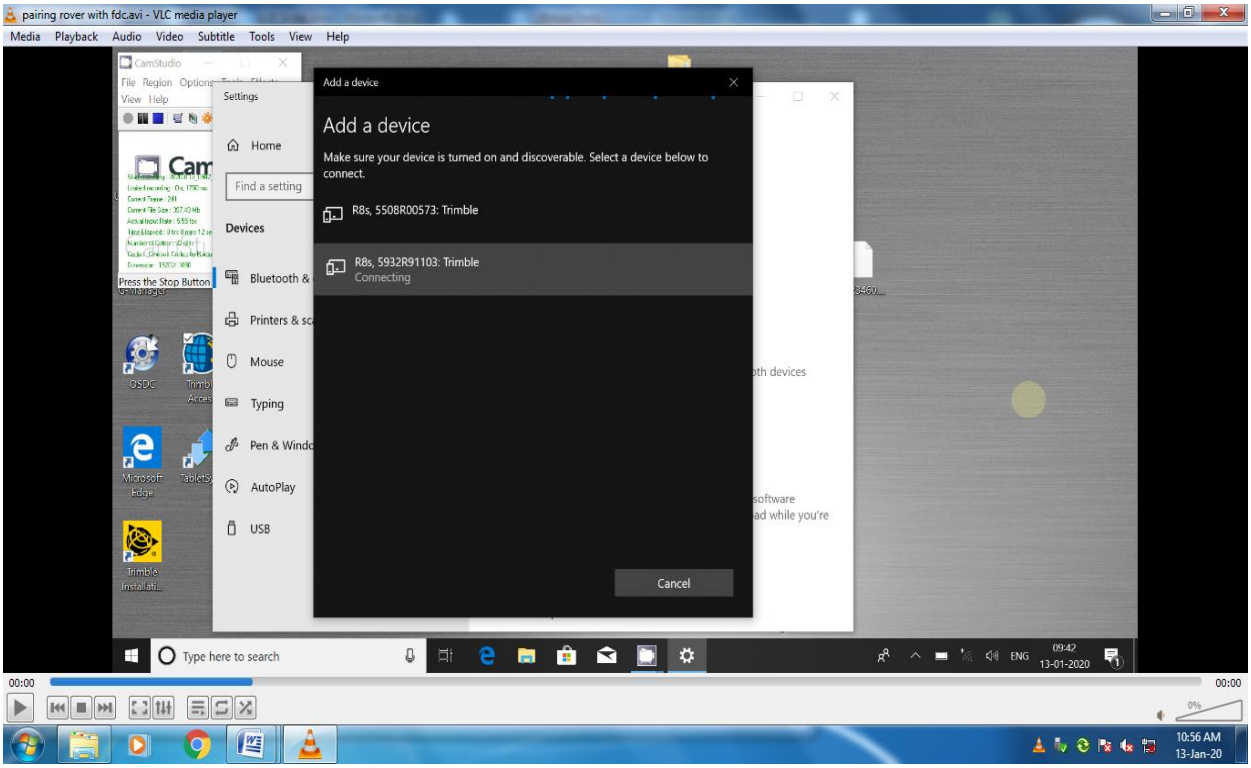
Step 1: Turn on the Receiver R8s Rover and notice the light blinking.

Step 2: Mount the Receiver R8s Rover on the rod provided and place it vertical exactly over the Rover station mark with the help of bipod.
Step 3: Check the verticality of the rod viewing the bubble. Adjust the bipod legs if necessary.
Step 4: Connect Field Data Collector (Getac tab) to Wi Fi internet connection.
Step 5: Pair Field Data Collector (Getac tab) to the receiver R8s Rover with Bluetooth connectivity.Forthis go to Bluetooth icon in Field Data Collector (Getac tab), Add and pair Bluetooth device i.e. Rover, by steps shown in the following slides serially.

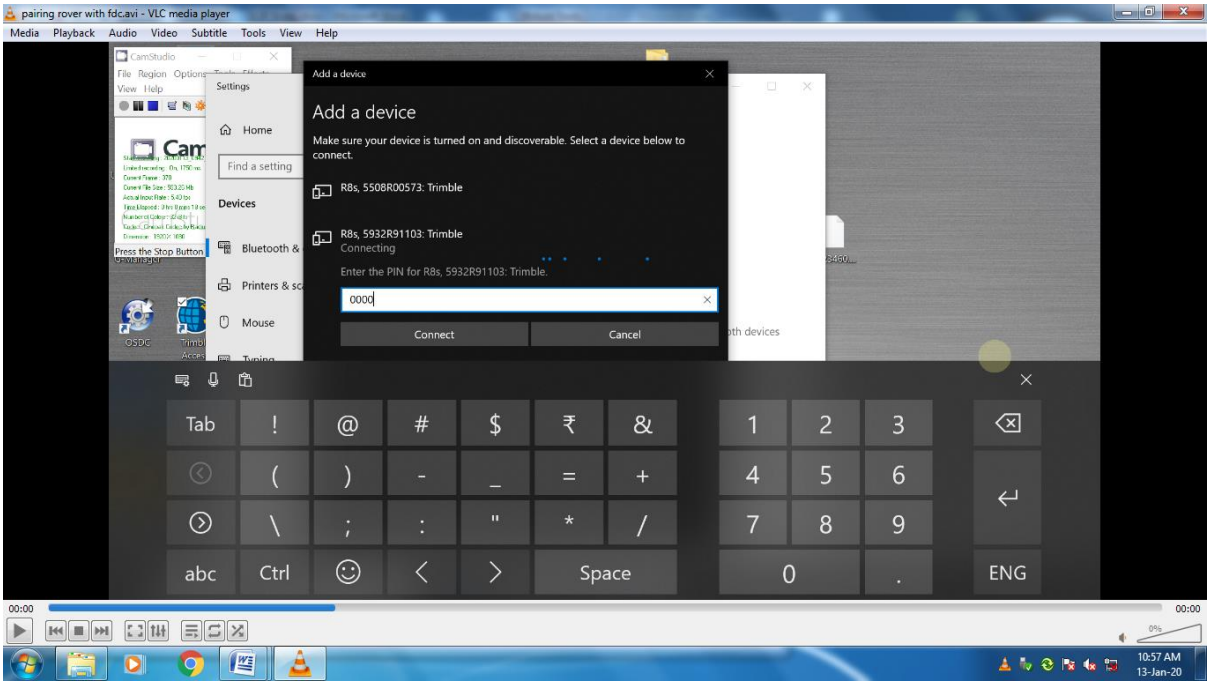

SOP Slides.docx - Microsoft Word
Picture Tools
Home
Insert
Page Layout
References
Mailings
Review
View
PDF
Format
Paste
Cut
Copy
Format Painter
Clipboard
Font
Paragraph
Styles
Find
Replace
Select
Editing
CamStudio
Open Source
Press the Stop Button to stop recording
Getac
www.getac.com
Add a Bluetooth Device
Allow a Device to Connect
Show Bluetooth Devices
Send a File
Receive a File
Join a Personal Area Network
Open Settings
Remove Icon
Type here to search
Page: 22 of 27
Words: 54
156%
10:43 AM
13-Jan-20

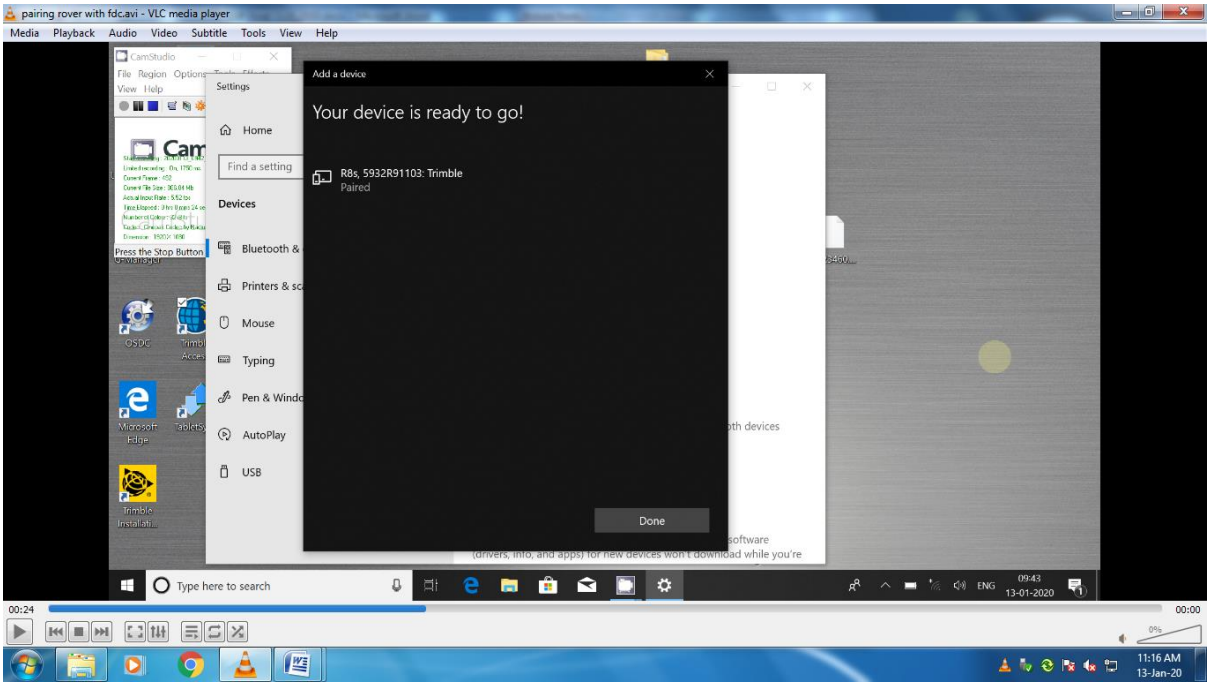

pairing rover with fdc.avi - VLC media player
Media
Playback
Audio
Video
Subtitle
Tools
View
Help
Settings
Home
Find a setting
Devices
Bluetooth & other devices
Printers & scanners
Mouse
Typing
Pen & Windows Ink
AutoPlay
USB
Bluetooth & other devices
Add Bluetooth or other device
Bluetooth
On
Now discoverable as "DESKTOP-0PGUK7P"
Show notifications to connect using Swift Pair
When selected, you can connect to supported Bluetooth devices quickly when they're close by and in pairing mode.
Download over metered connections
To help prevent extra charges, keep this off so device software (drivers, info, and apps) for new devices won't download while you're on metered Internet connections.
Related settings
Devices and printers
Type here to search
ENG
09:42
13-01-2020
00:05
00:00
10:51 AM
13-Jan-20

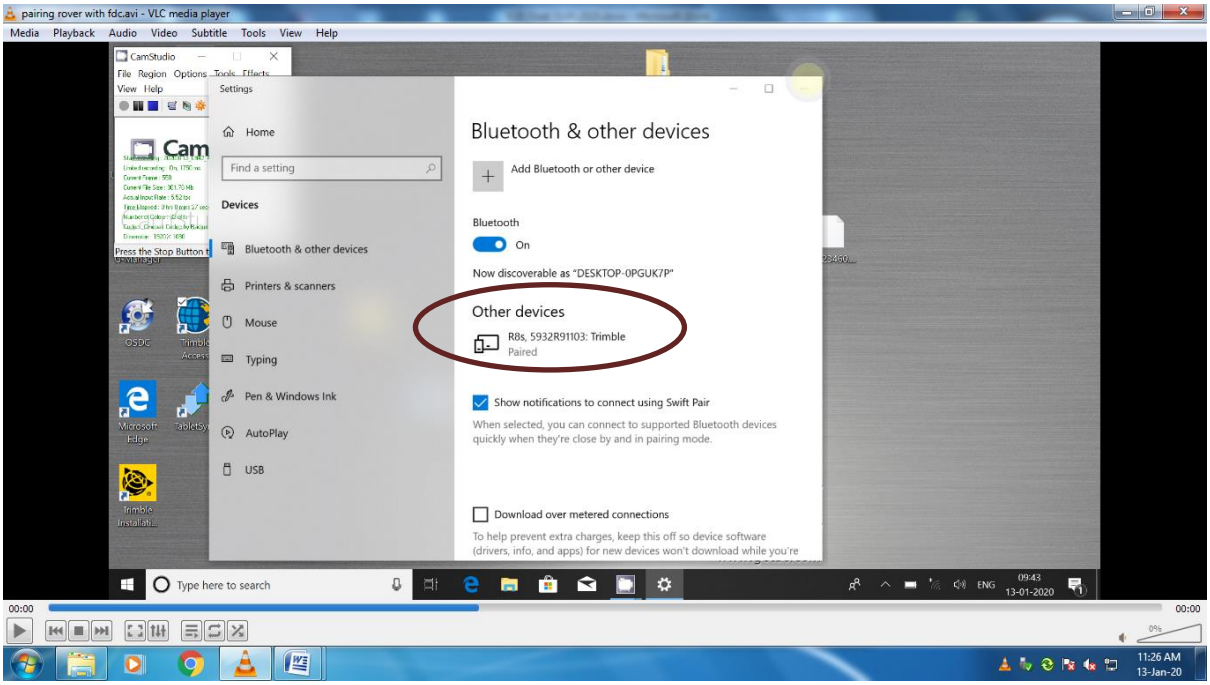




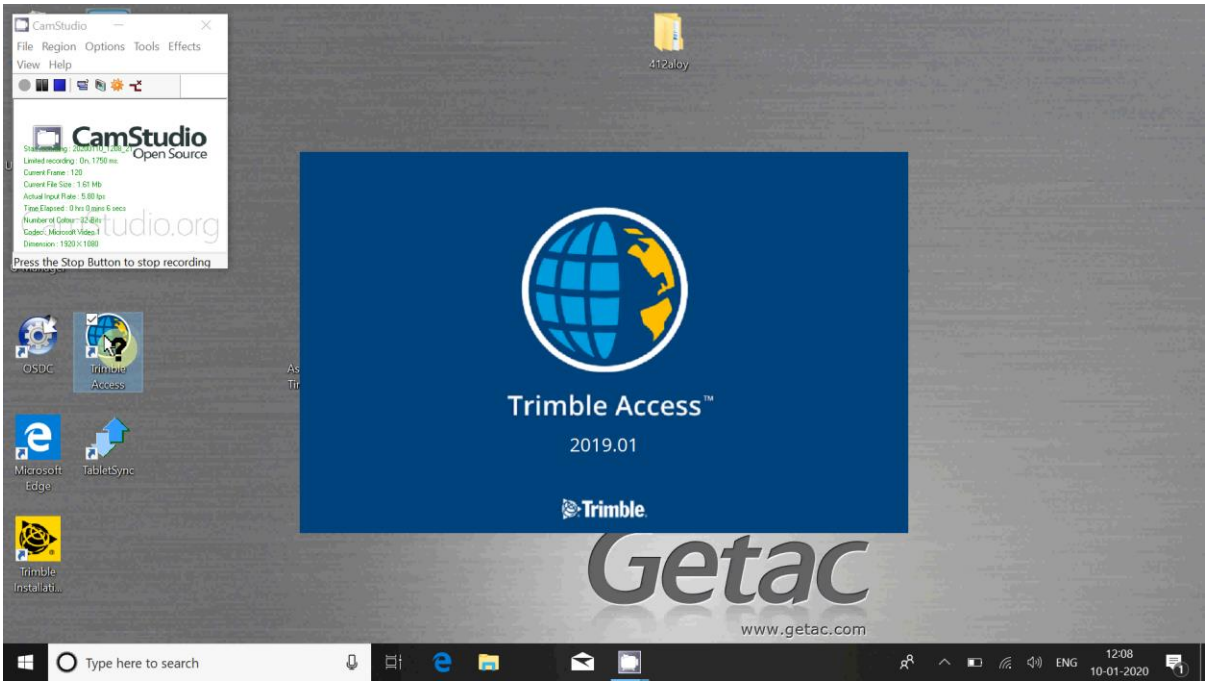
Step 6: Enter default PIN 0000 and click Connect tab. Your device is ready to go! message will be displayed for paired device R8s receiver and will reflect in the Settings window.


pairing rover with fdc.avi - VLC media player
Media Playback Audio Video Subtitle Tools View Help
Add a device
Add a device
Make sure your device is turned on and discoverable. Select a device below to connect.
R8s, 5508R00573: Trimble
R8s, 5932R91103: Trimble
Connecting
Enter the PIN for R8s, 5932R91103: Trimble.
0000
Connect
Cancel
Settings
Home
Find a setting
Devices
Bluetooth &
Printers & sc
Mouse
Tab
Space
ENG
10:57 AM
13-Jan-20

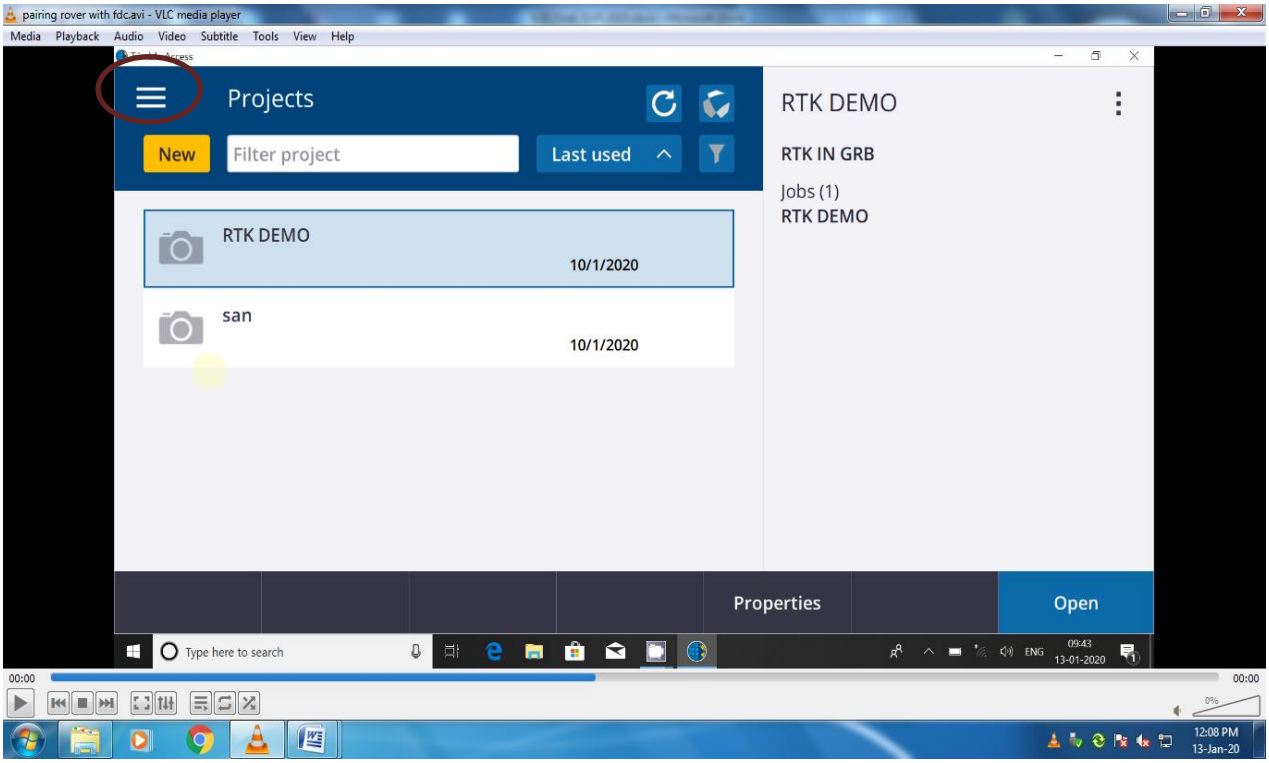

pairing rover with fdc.avi - VLC media player
Media Playback Audio Video Subtitle Tools View Help
Add a device
Your device is ready to go!
R8s, 5932R91103: Trimble
Paired
Done
Settings
Home
Find a setting
Devices
Bluetooth &
Printers & sc
Mouse
Typing
Pen & Windc
AutoPlay
USB
Type here to search
ENG
09:43
13-01-2020
11:16 AM
13-Jan-20



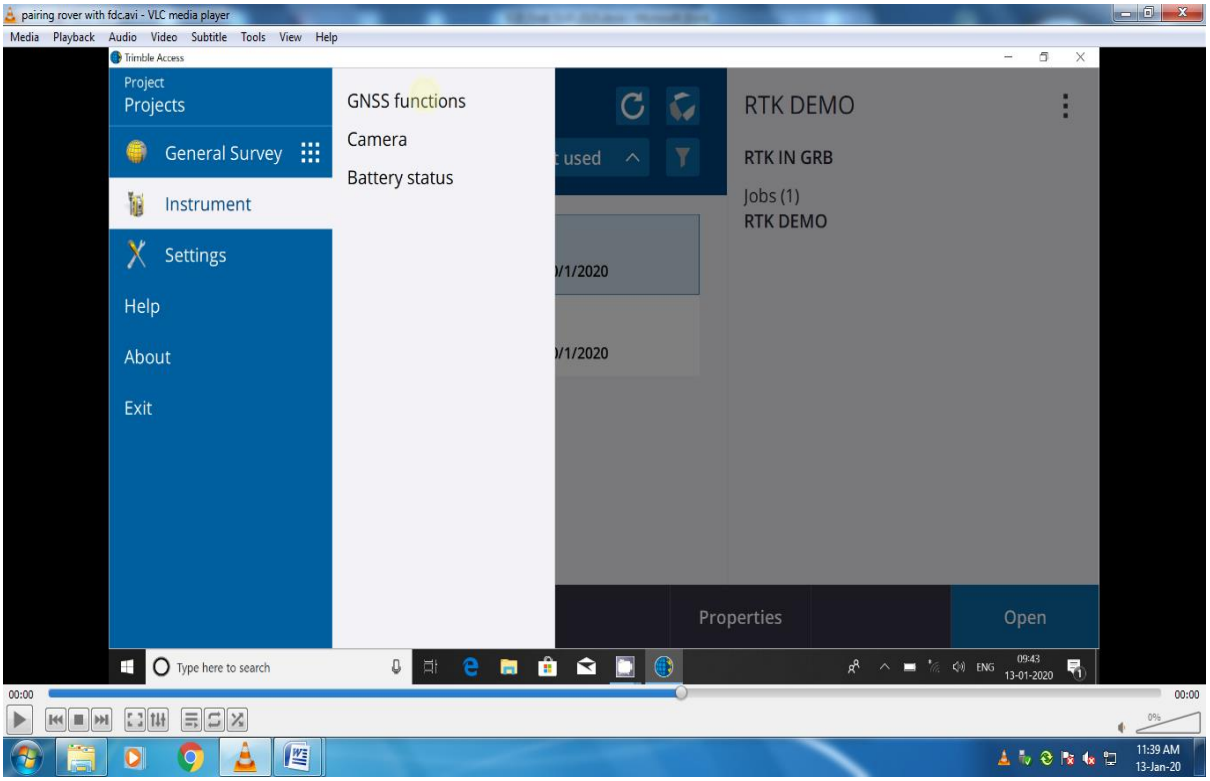
Step 7: Open Trimble Access application on the tab.



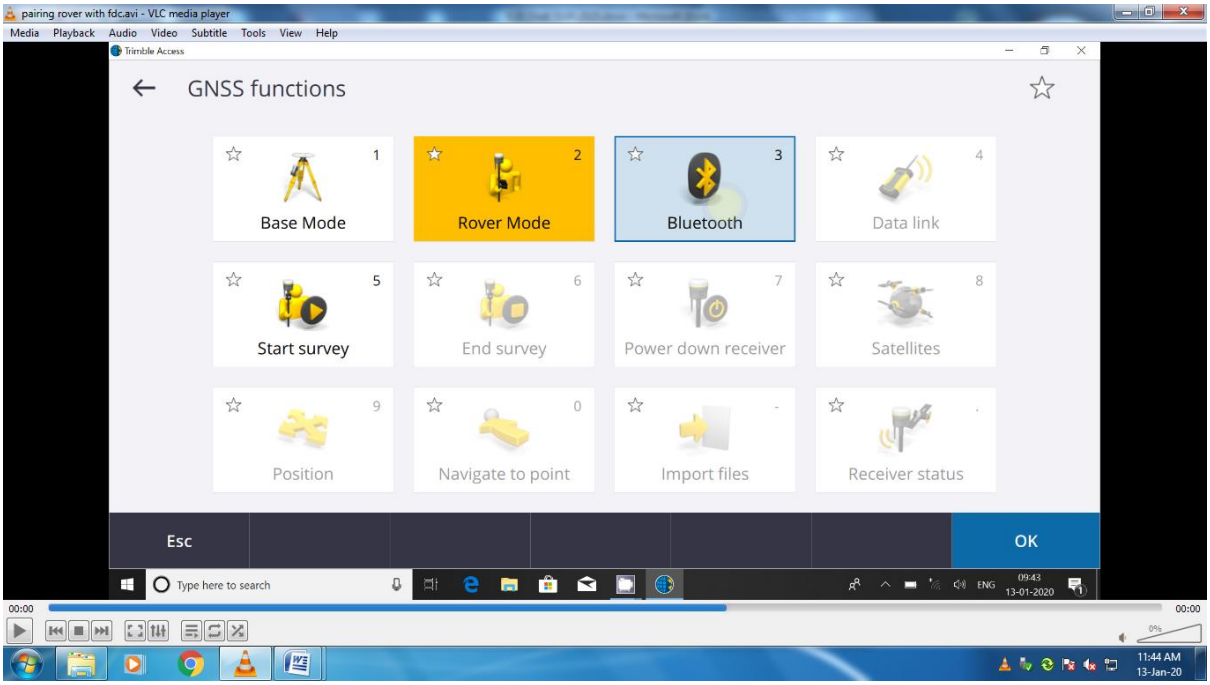
Step 8: Main window will open up. Click on NW corner tab as shown in the following slide.



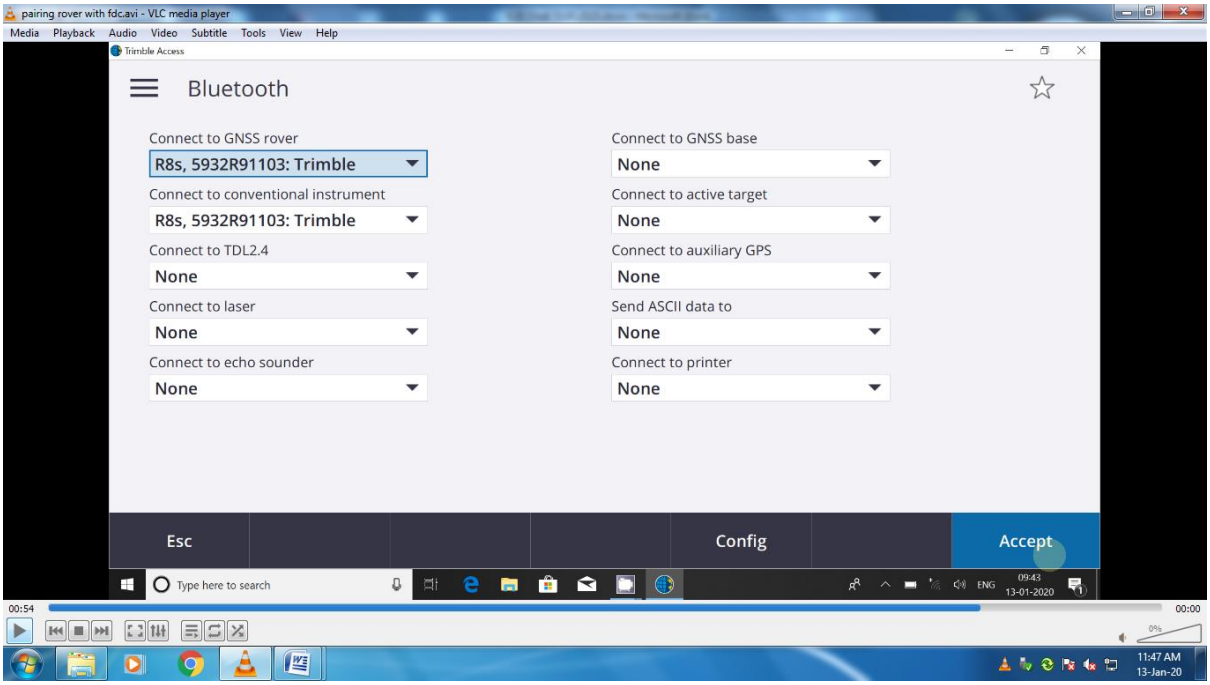
Step 9: Click Instrument and GNSS functions.



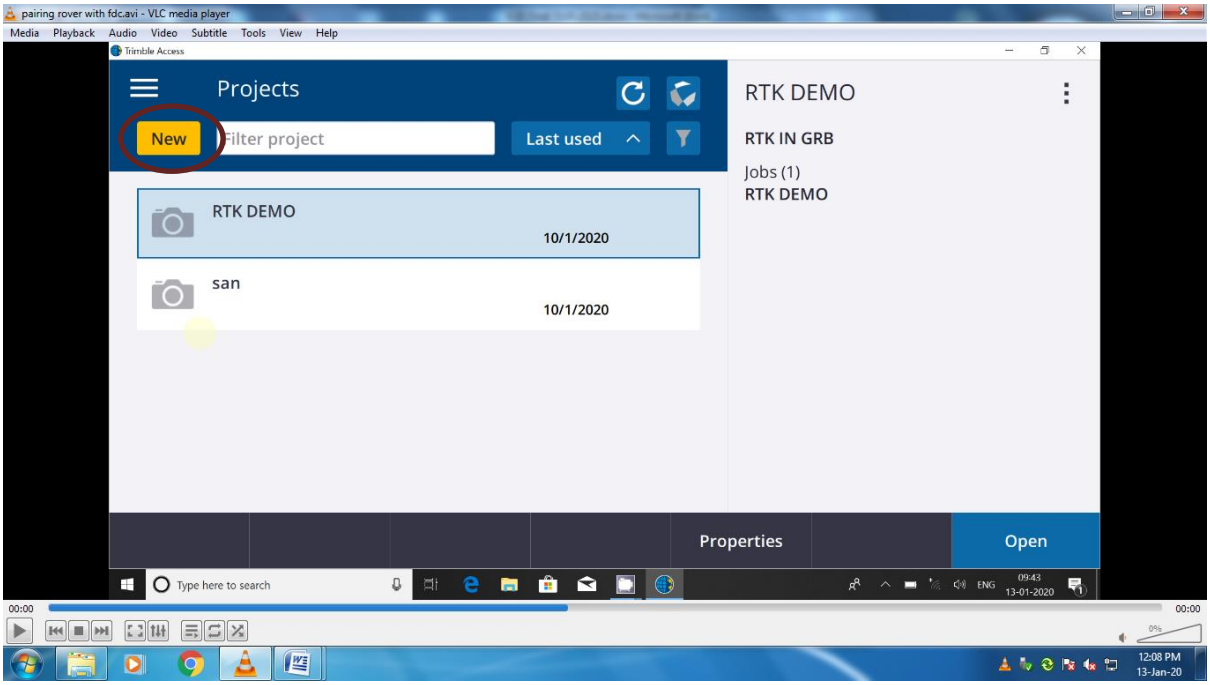
Step 10: Choose Bluetooth icon and clickOK tab as shown below. Bluetooth window will open up.

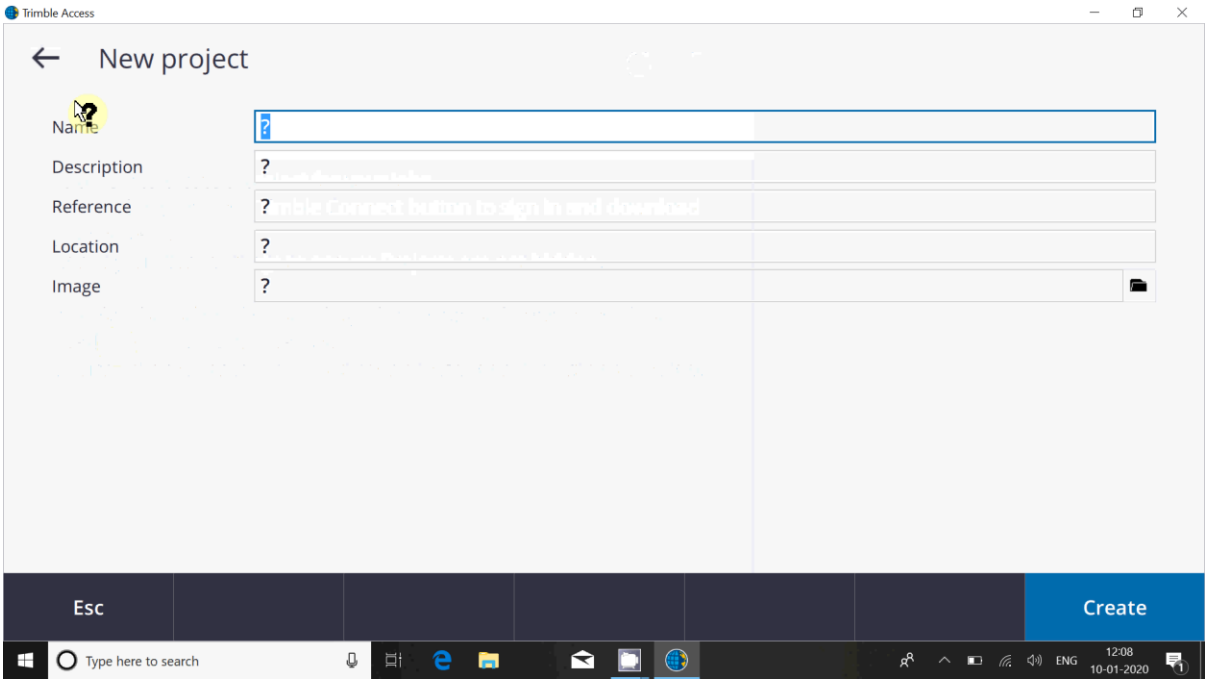


Step 11: Select paired Trimble R8s Rover receiver, which is just paired, for first two drop down menus as shown below and click Accept tab. Press Esc tab to return to main menu.

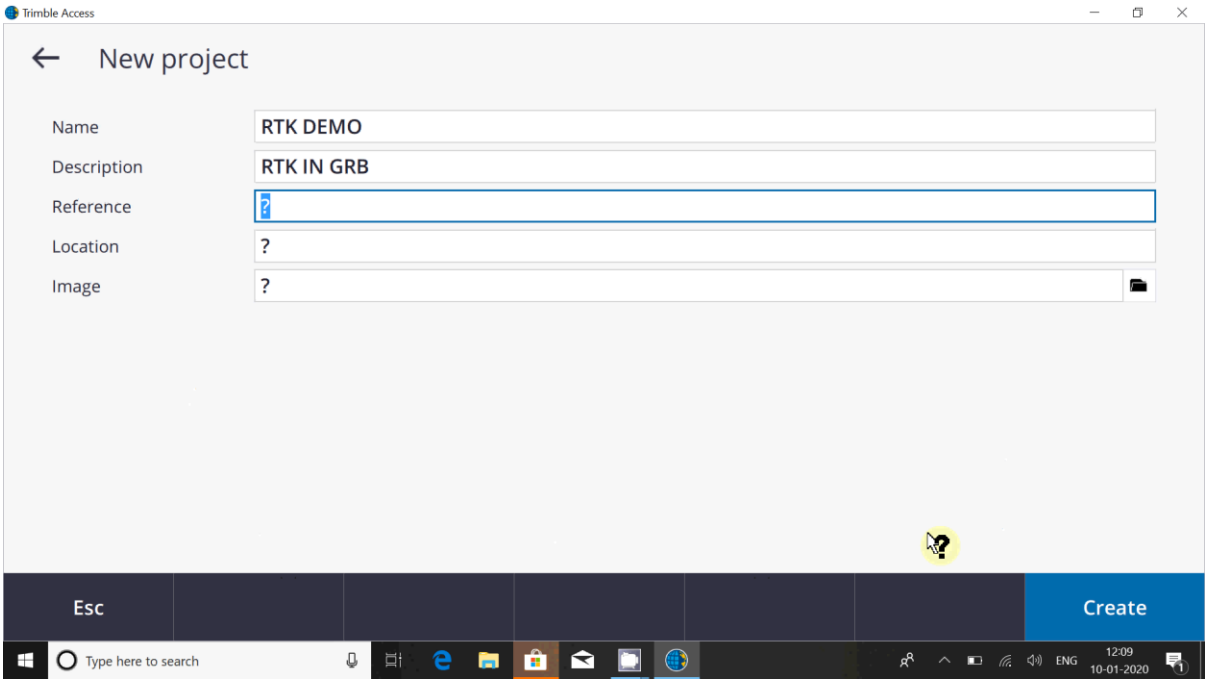


Now Getac tab and Rover receiver both have been paired, connected, configured and ready to use.
Step 12: Click New tab to create a new project. New project window will open up.

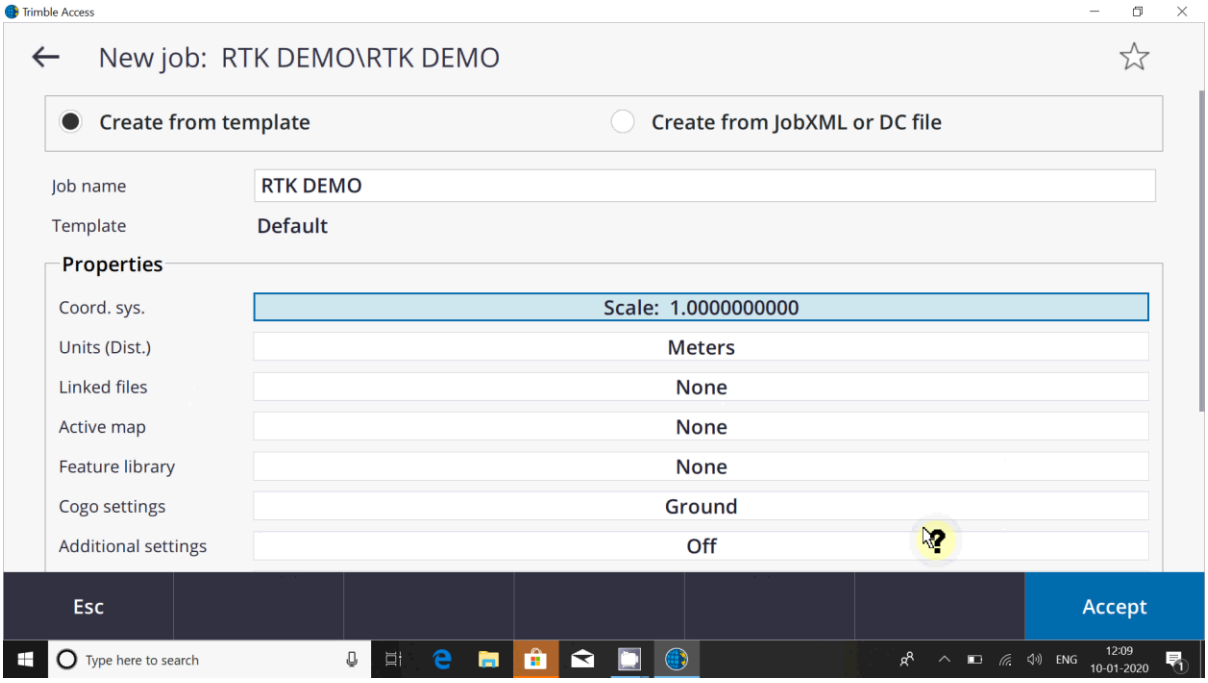




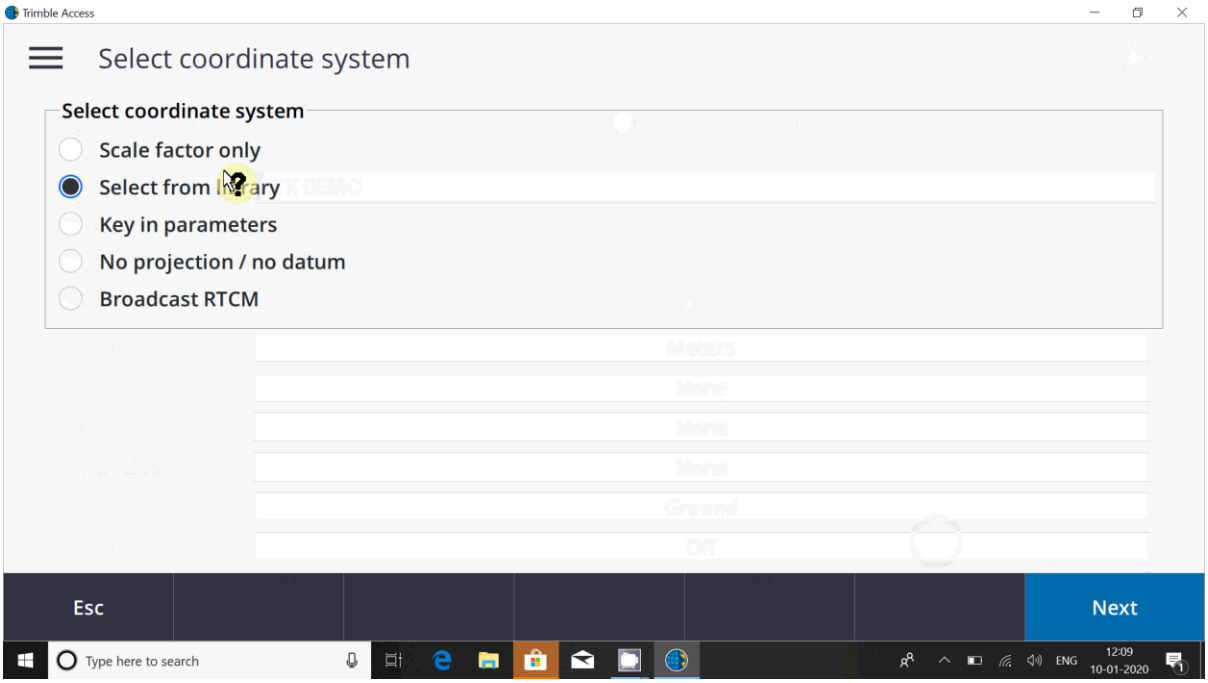
Step 13: Provide a Name and Description (optional) to the project.



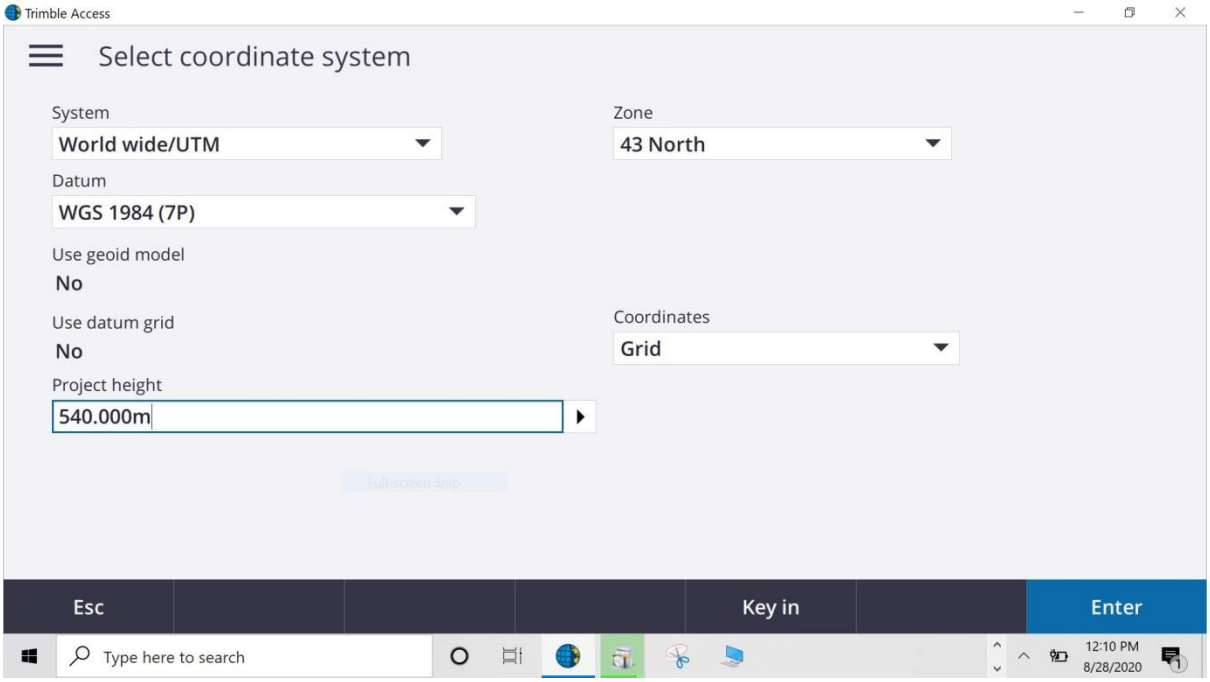
Step 14: Click Create tab at SE corner. New job window will open up.
Step 15: Provide a job name and click on Coord. Sys. Select coordinate system window will open up.



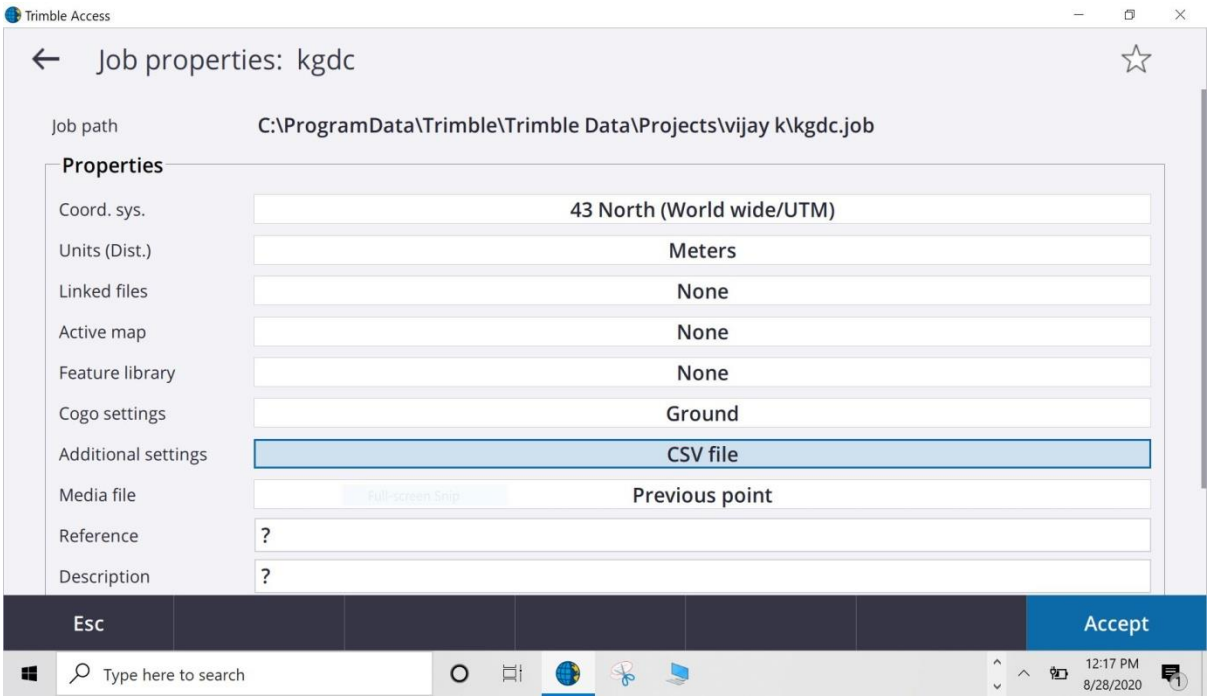
Step 16: Click radio button of Select from library as shown below and click Next tab.



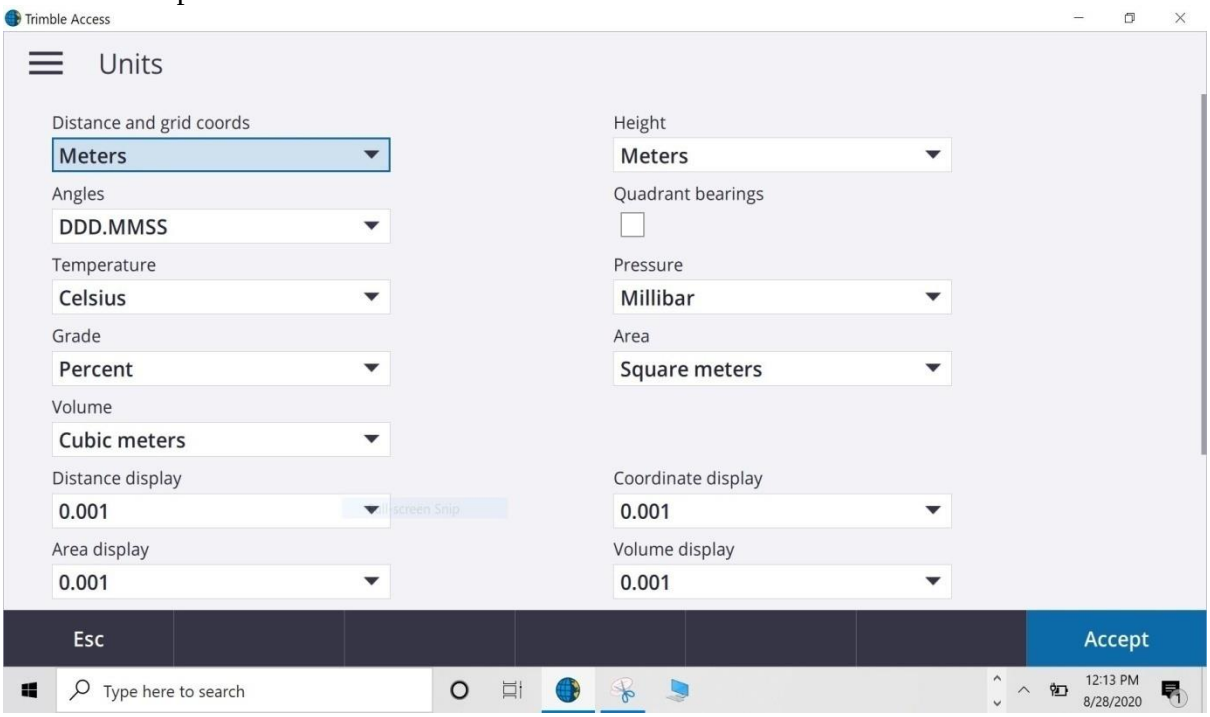
Step 17: Select System, Zone, Datum and fill the approx. height of the terrain and click store tab.

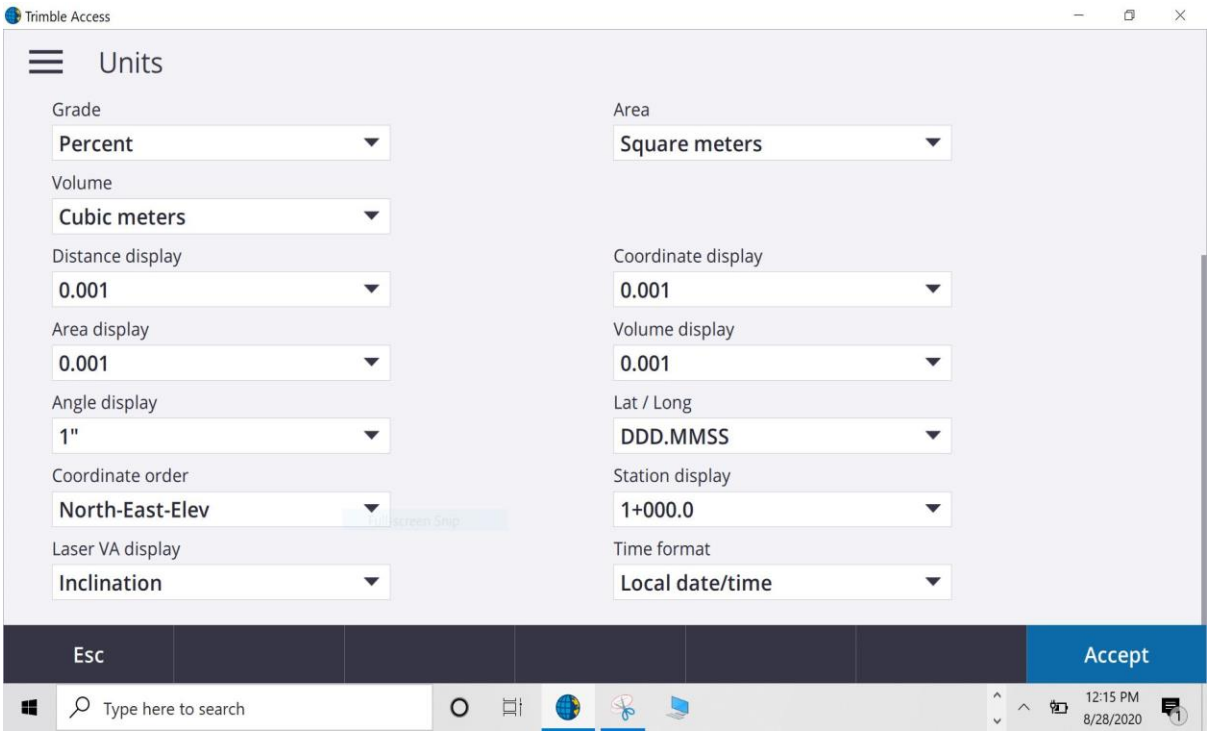


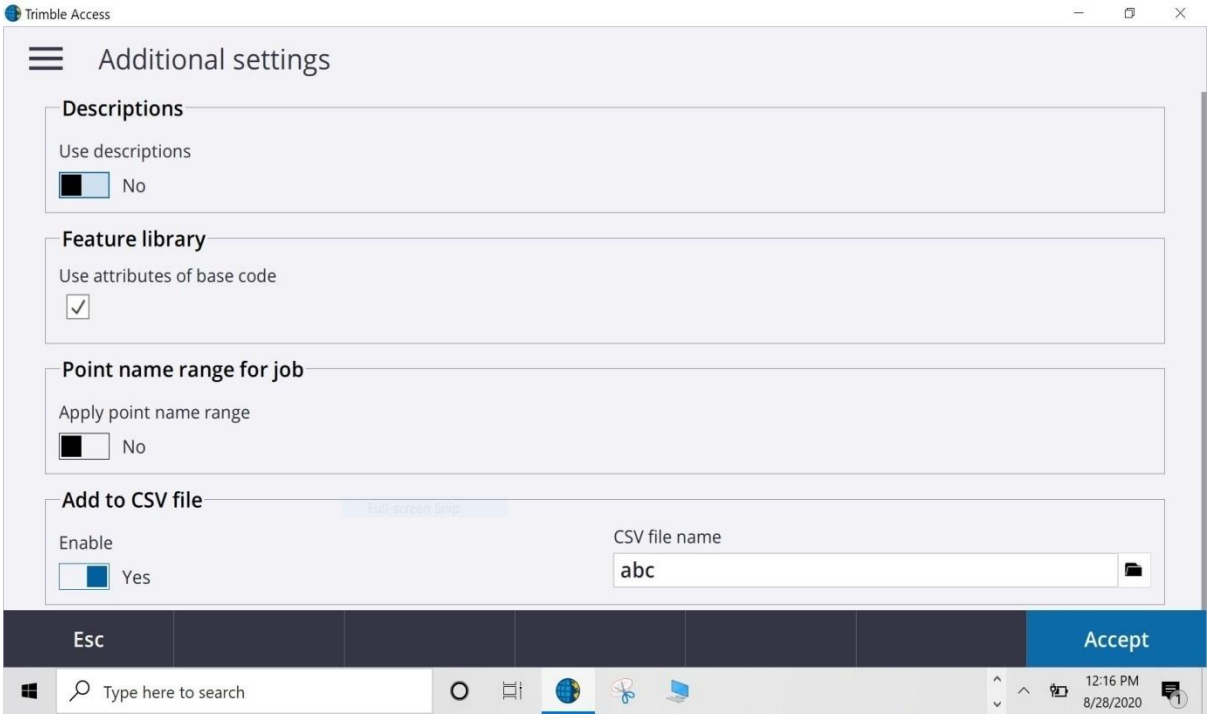
Step 18: Click Enter tab at SE corner.
Click on units and check the details as follows
Click on Additional settings and check the details as follows



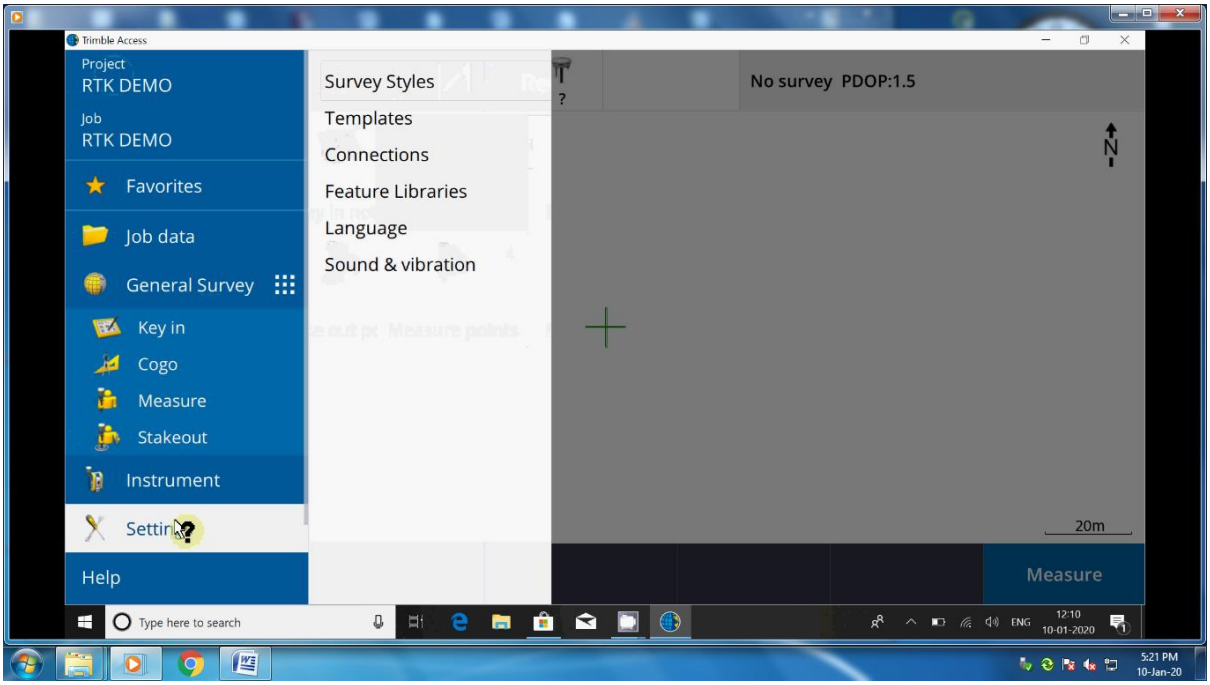
Click on accept



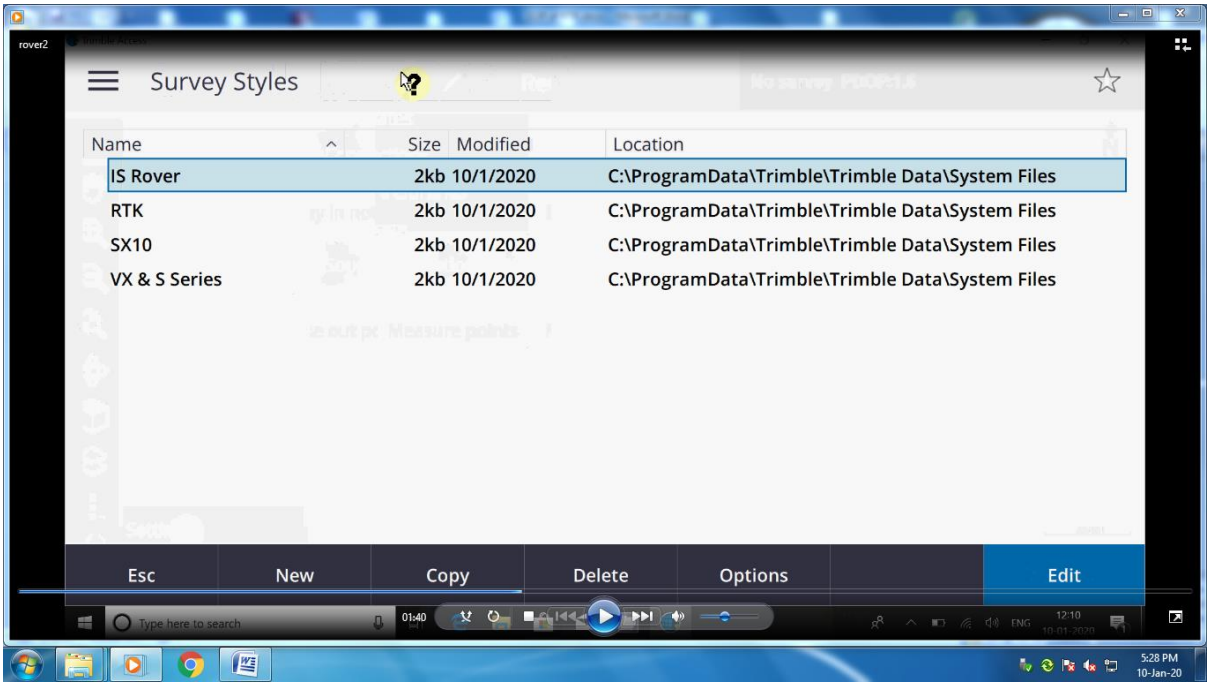




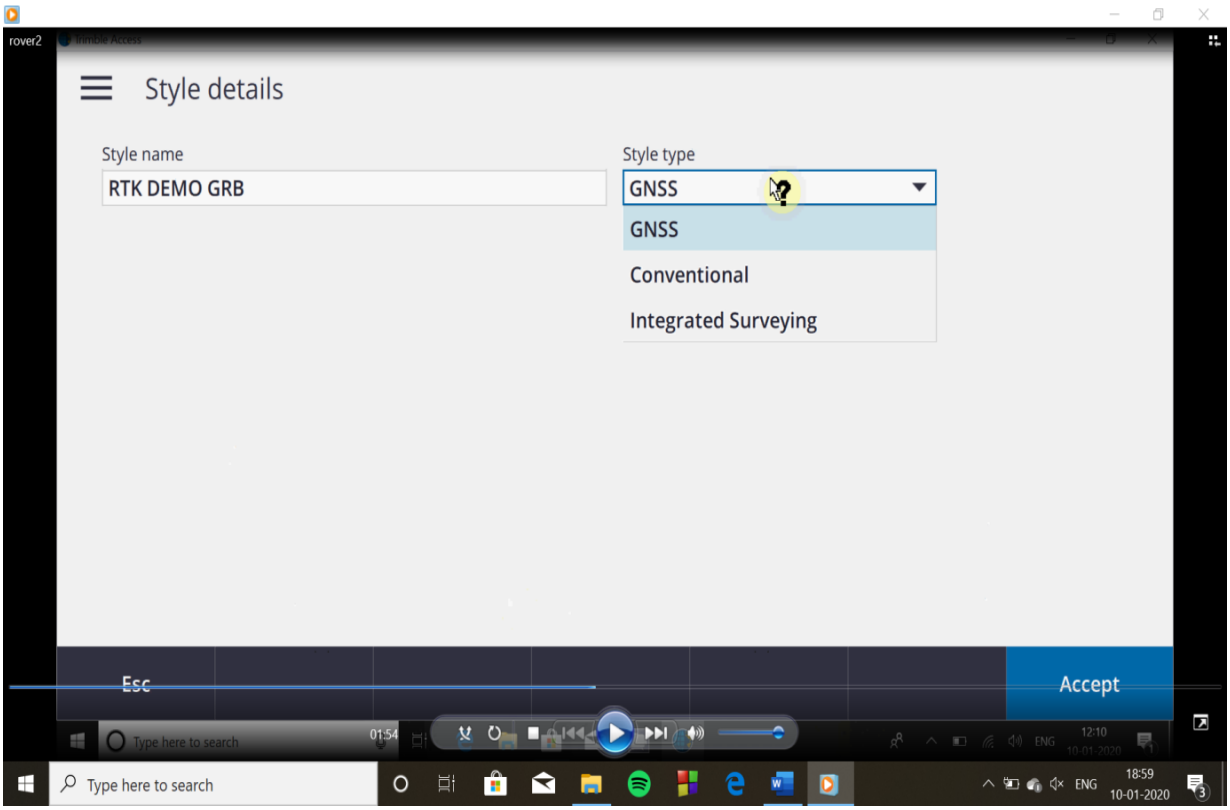
Step 19: Click on the NW corner tab on the main screen to select Settings and then Survey Styles. Survey Styles window will open up.



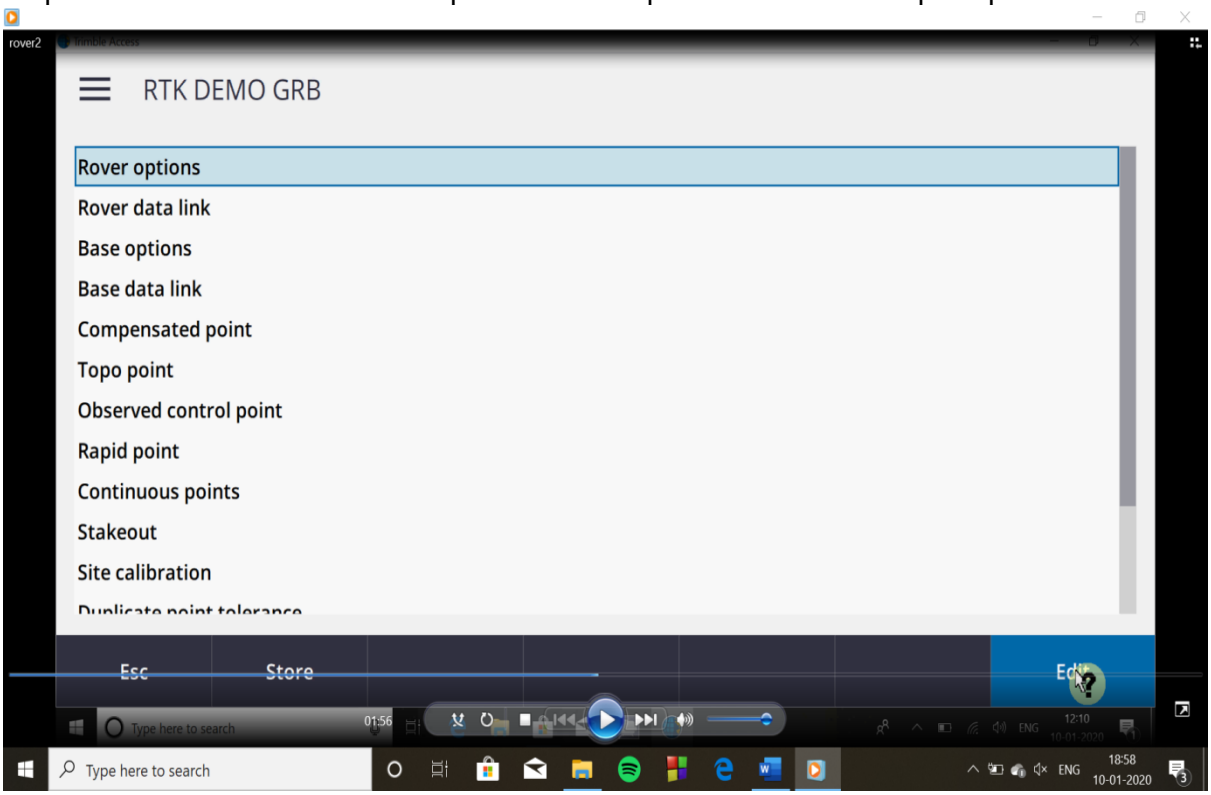
Step 20: Click New tab. Style details window will open up.



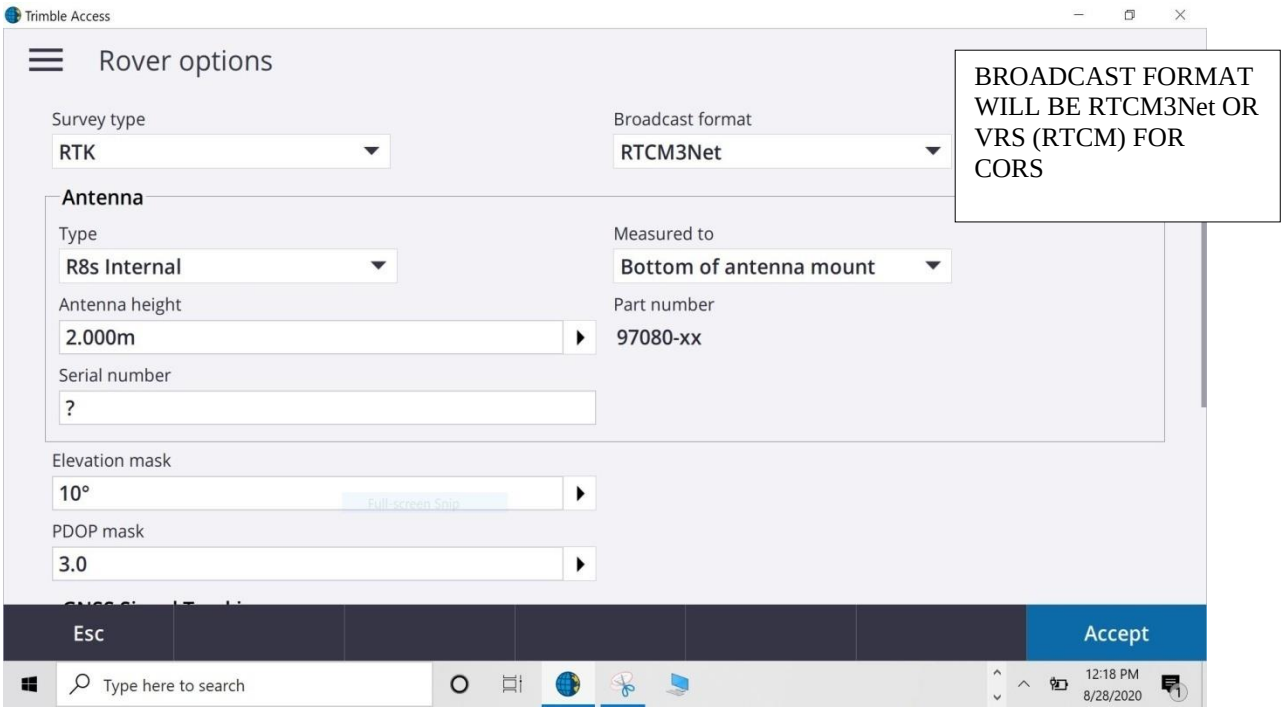
Step 21: Provide the Style name and Survey type. Click Accept tab. New window will open up.



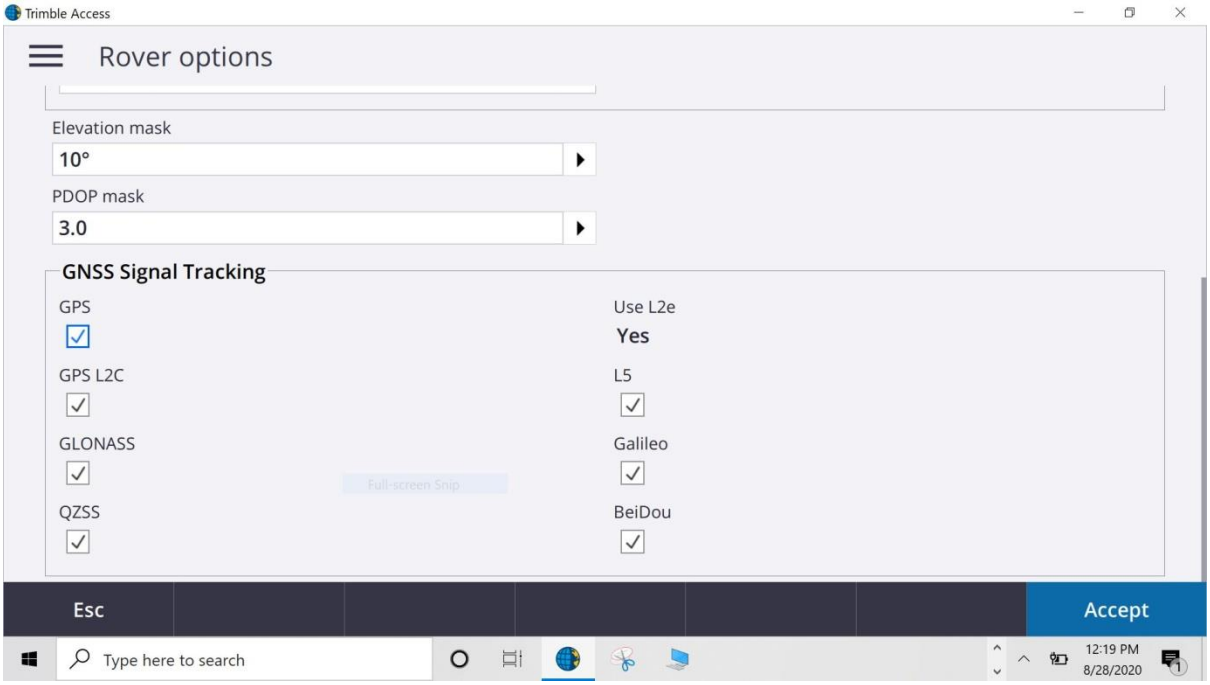
Step 22: Click Edit tab for Rover options. Rover options window will open up.



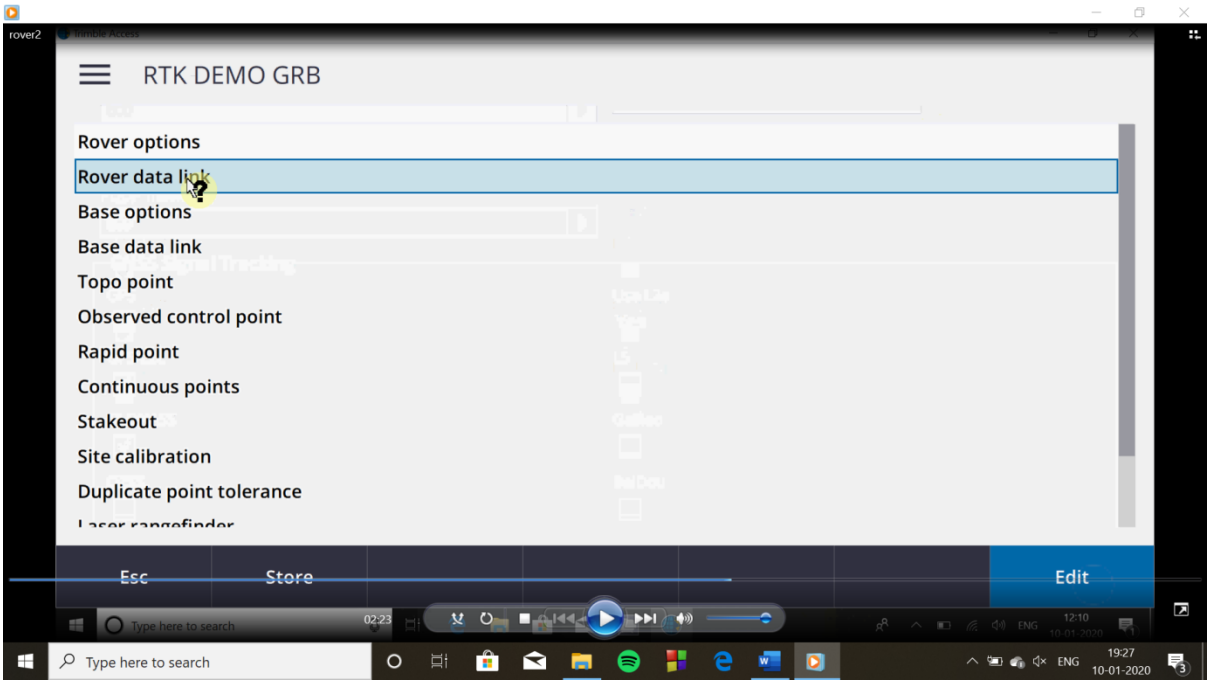
Step 23: Provide the information as shown in the slide below.



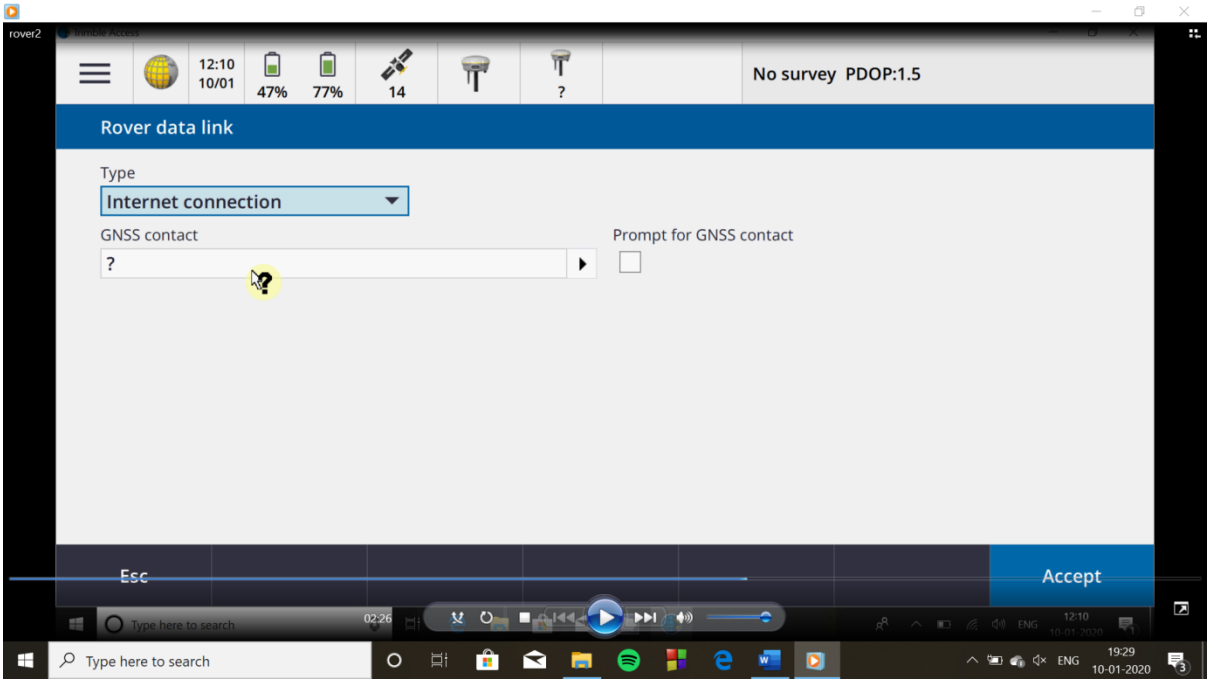
Step 24: Provide Serial number of R8s receiver (Optional).



Step 25: Elevation mask and PDOP mask default values can be altered if required.
Step 26: GNSS Signal Tracking can be checked for desired constellations. Click Accept tab. Again, we will come back to new window.
Step 27: Click Edit tab for Rover data link. Rover data link window will open up.

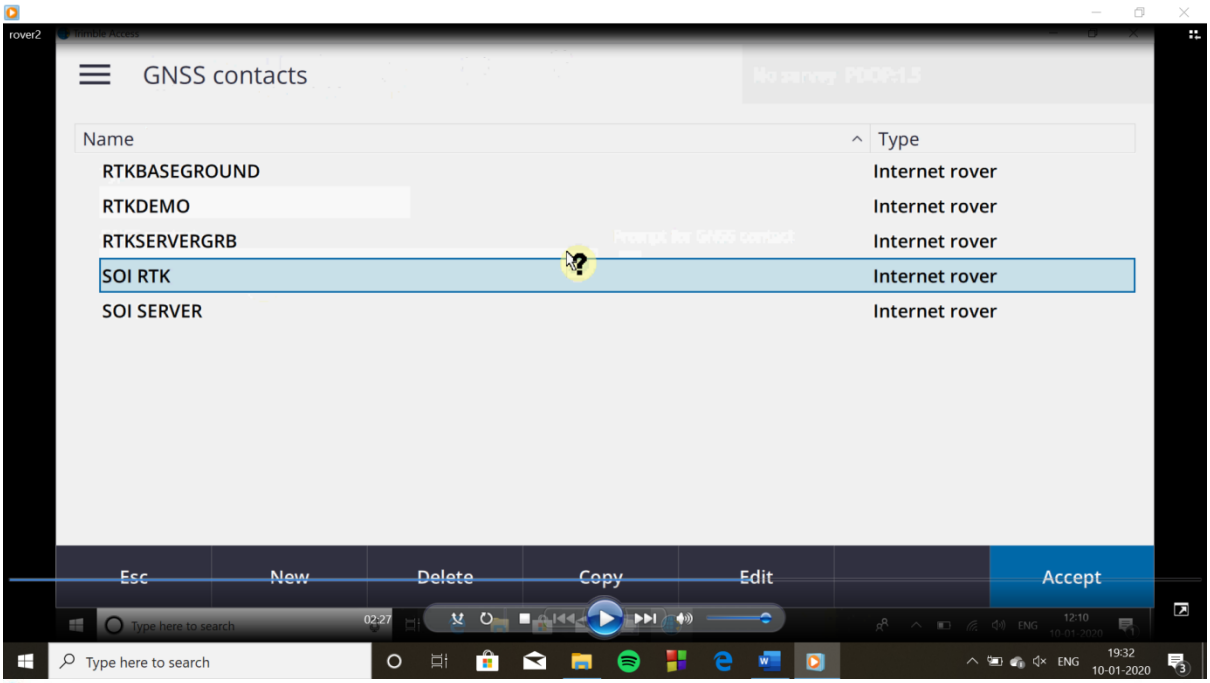


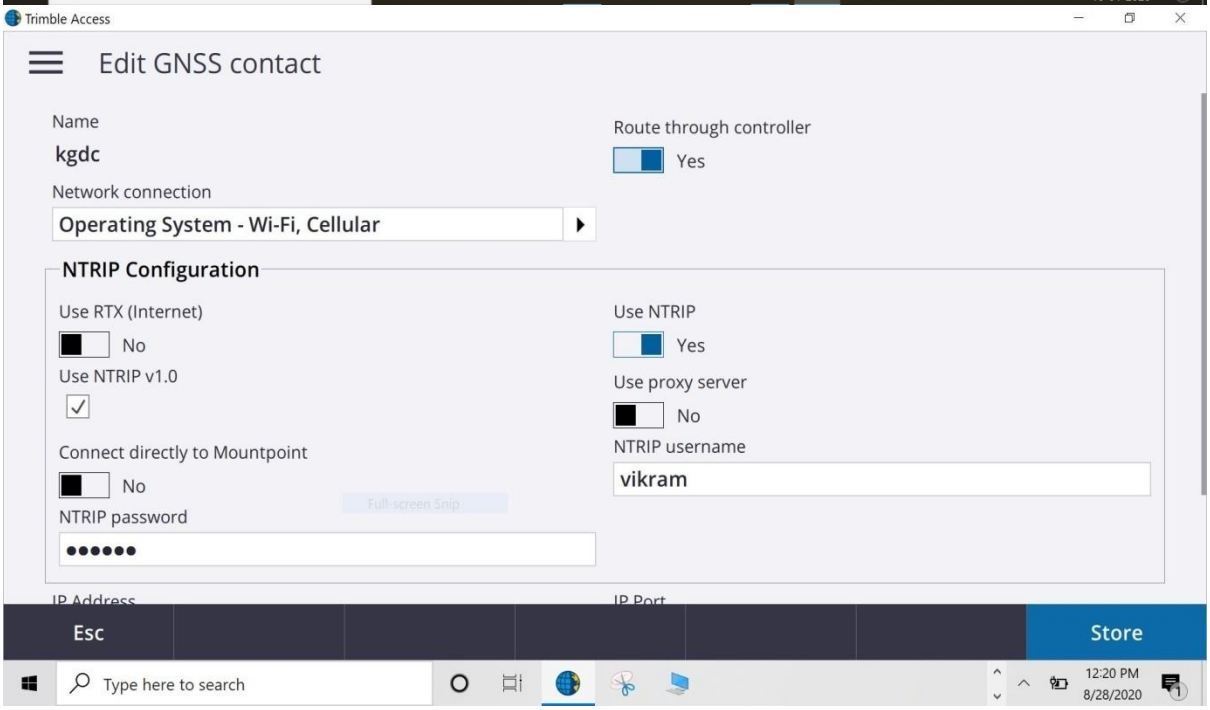
Step 28: Select Type as Internet connection. Click on GNSS contact. A GNSS contact list will come up.



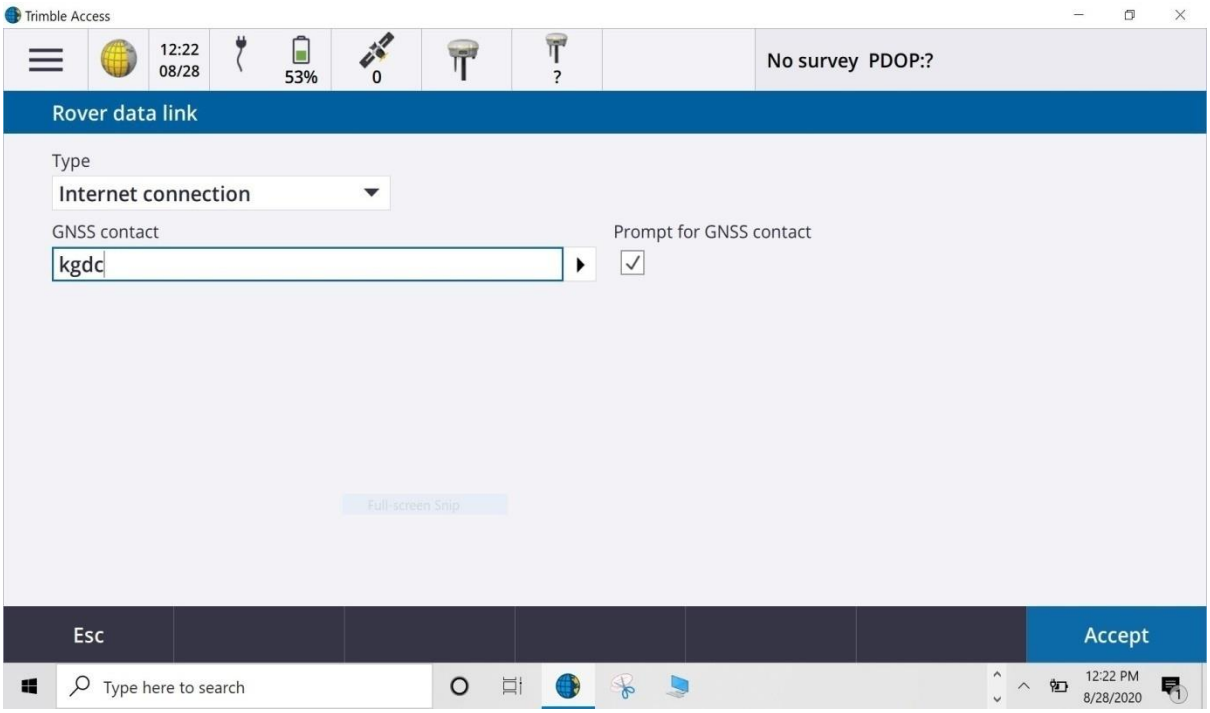
Step 29: Select desired GNSS contact, edit existing or create a new GNSS contact. Accordingly, a new window will open up.

Step 30: Here we will provide the IP address of Remote Server and IP Port of communicating Rover. IP Port will be unique for communicating Rover. There may be other Rovers communicating to the same server but IP Port will be different for different Rovers.
Below a new GNSS contact SOI SERVER SGW has been created. Click the Store tab.

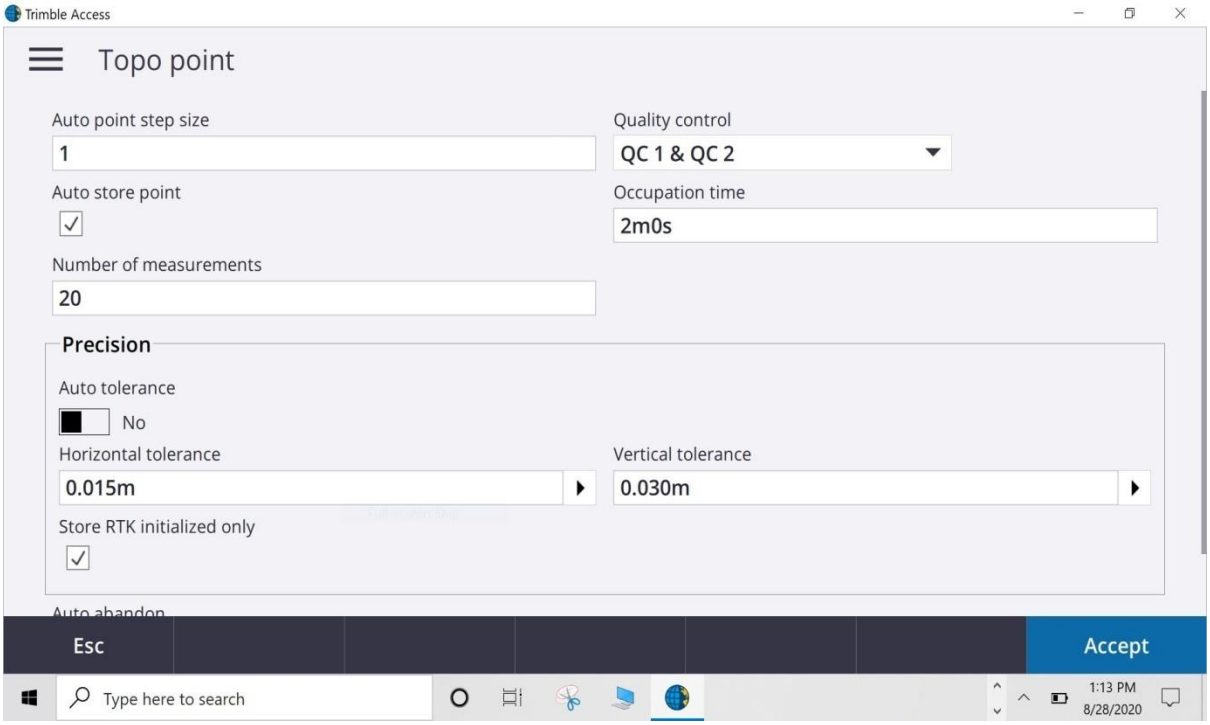




NTRIP user name dgrb1 or dgrb2 or dgrb3	NTRIP password dgrb1 or dgrb2 or dgrb3	Ip Address 103.205.244.106 Port 2101

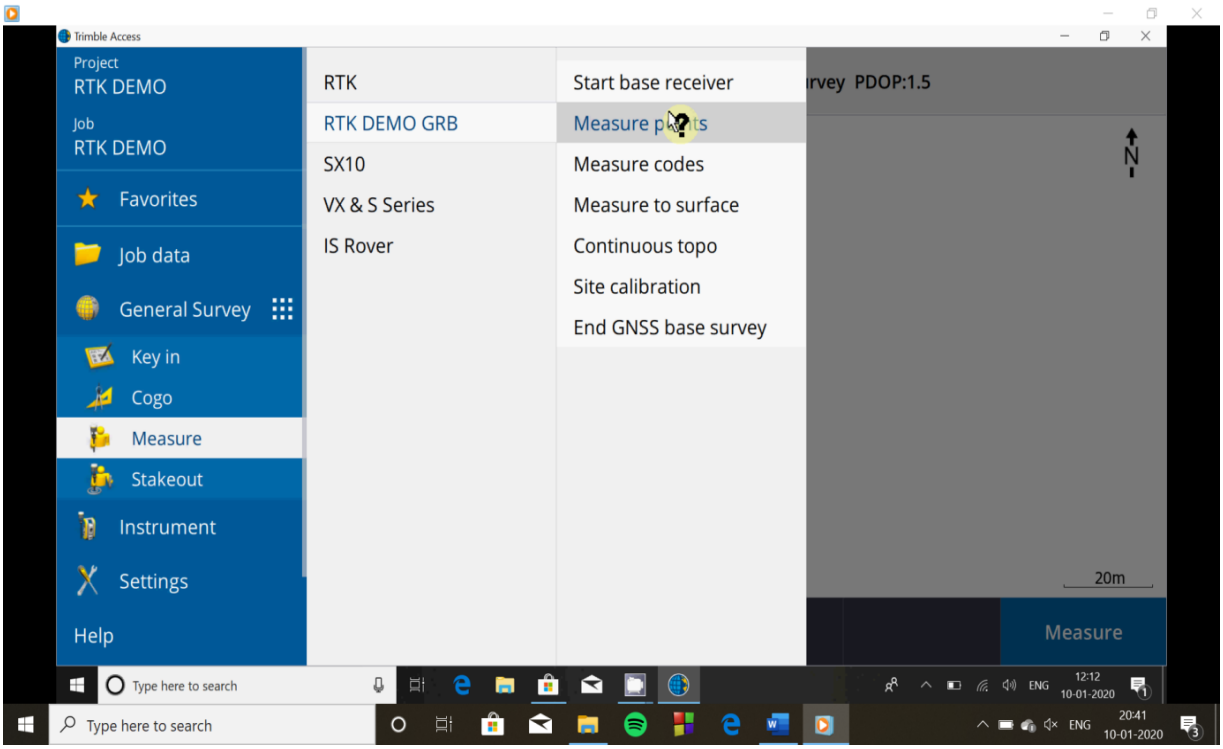


Click accept and go to Topo point

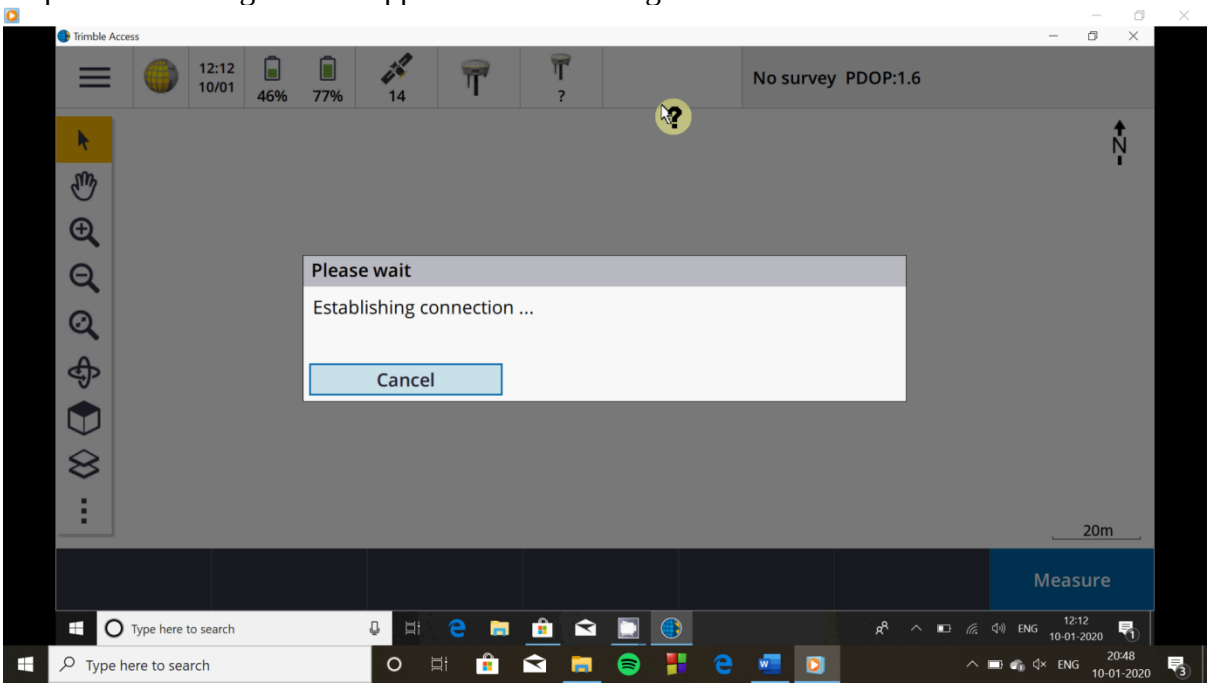


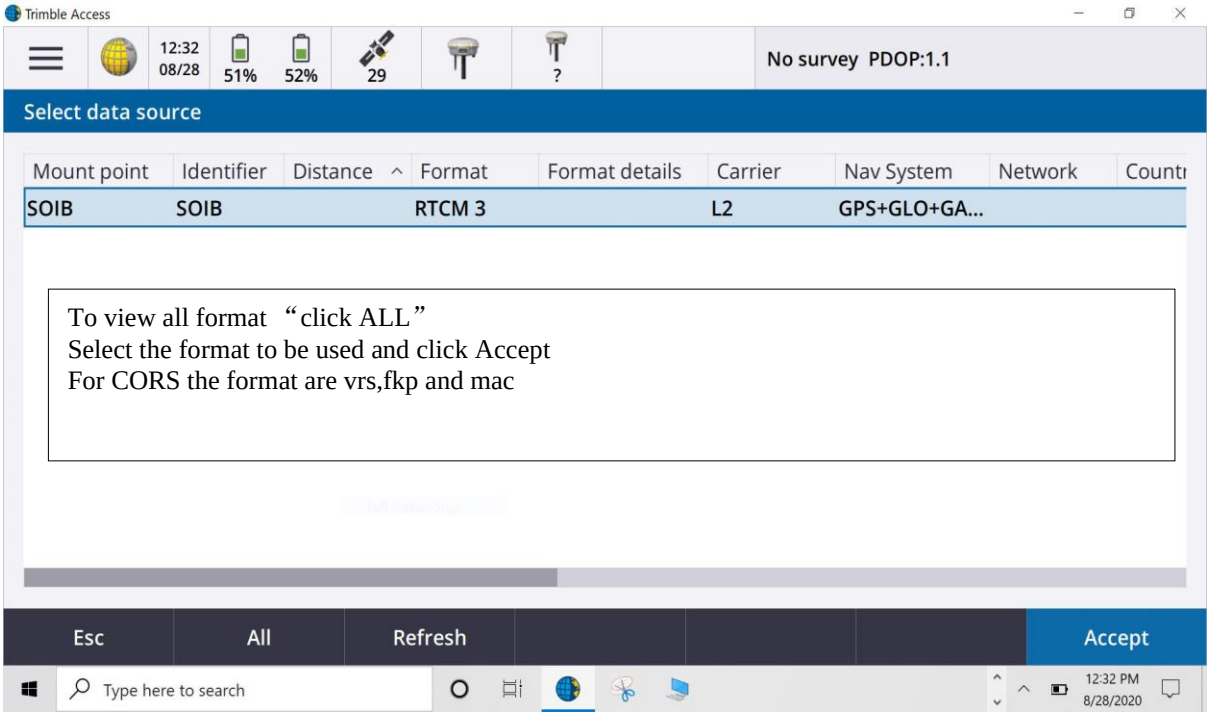
Step 31: Click Accept tab. We will return to main menu.

Step 32: Click Measure, select your Survey style and select Measure points as shown below

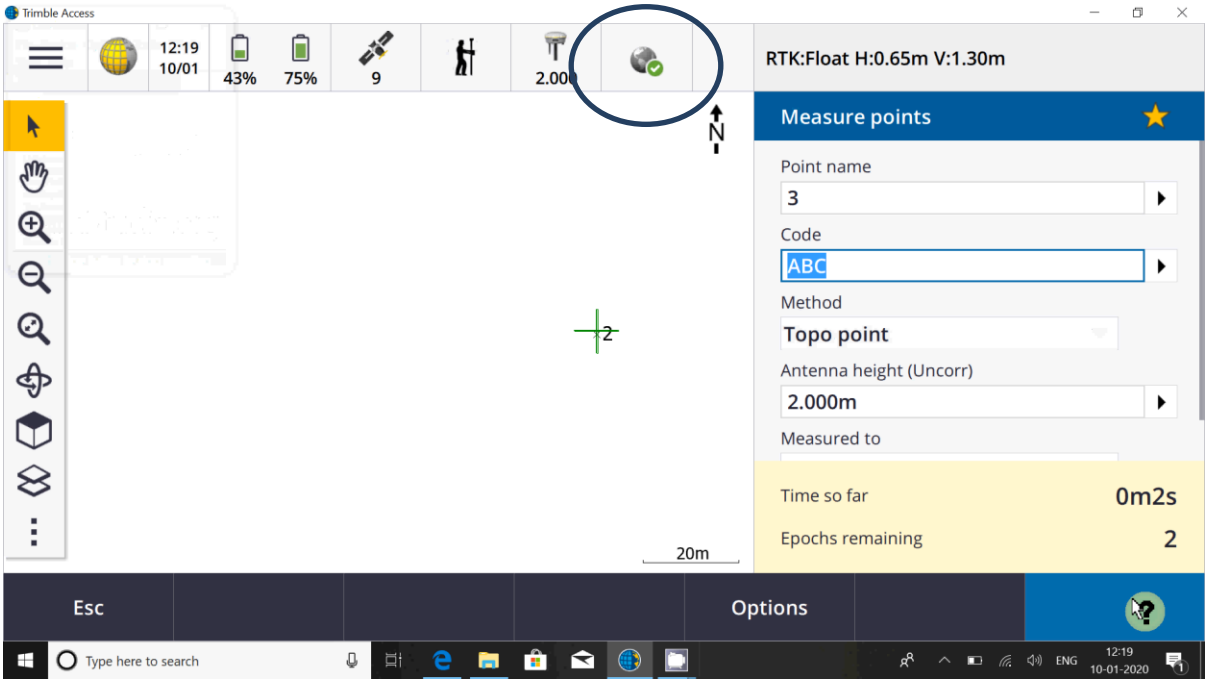


Step 33: Processing bar will appear for establishing connection to the Server.



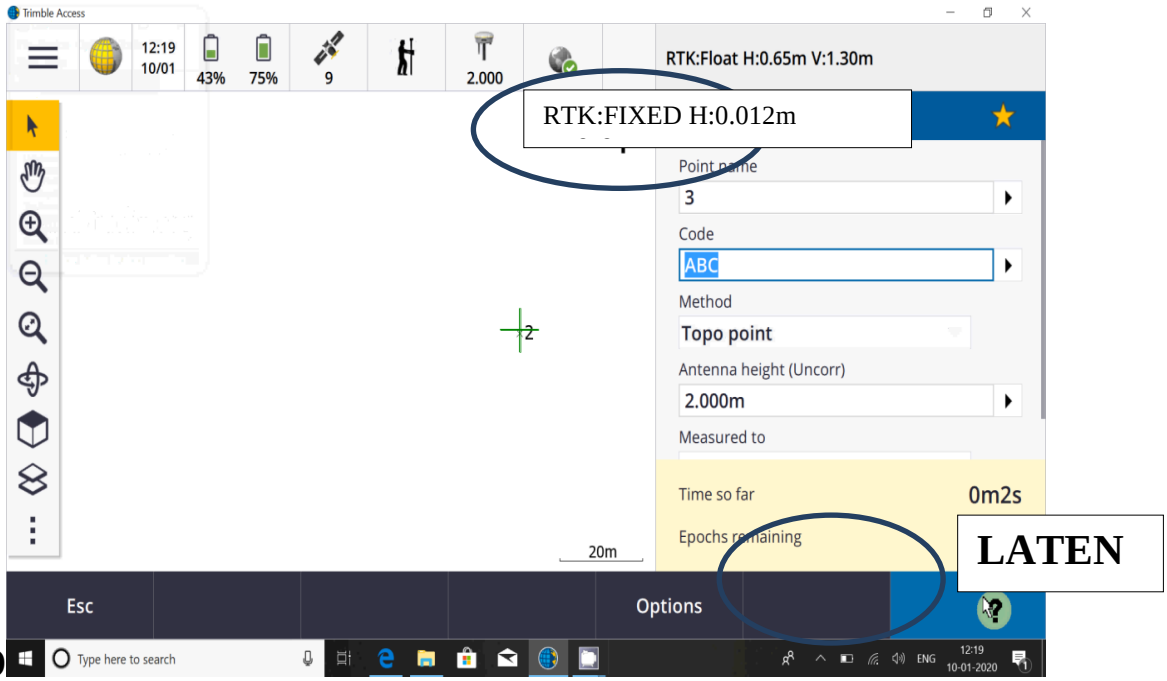


Step 34: A tick will be displayed after successful connection as shown below in circle.



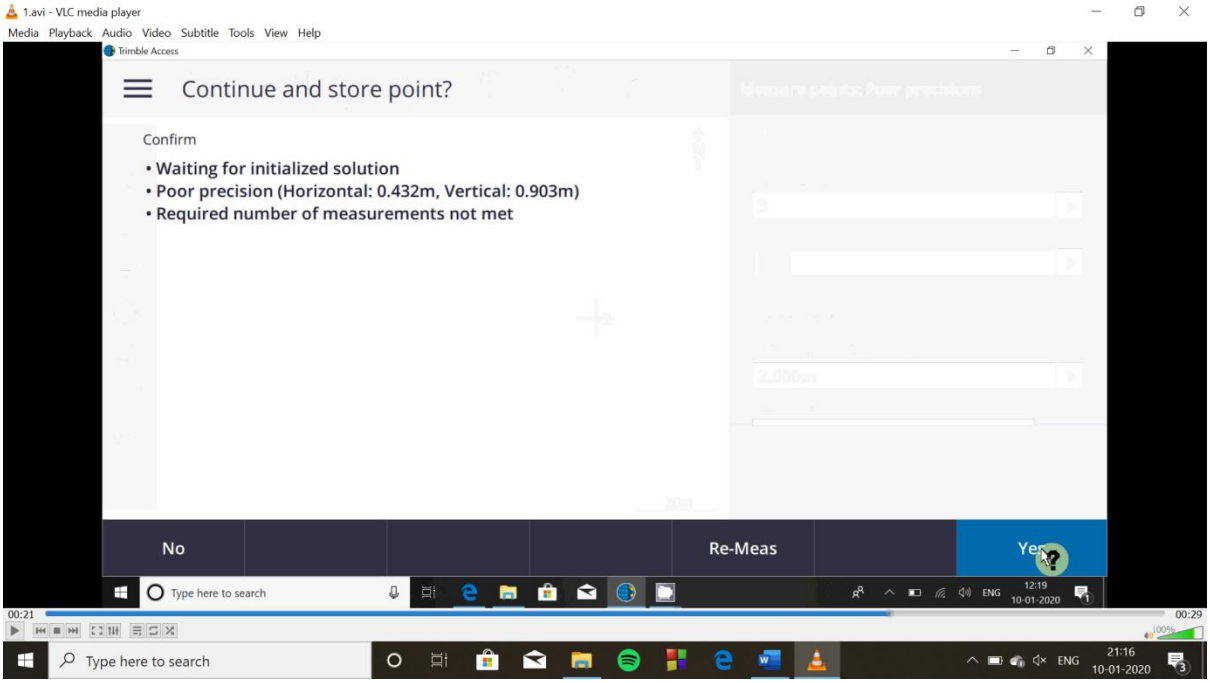
Step 35: click in option and select QC1&QC2

Step 36: RTK solution will be Float or Fix as shown in the circle below. Point name, Code and Antenna height can be provided if accepted. To accept click on SE corner tab as shown below. More points can be measured if we continue to store points.



FIXED

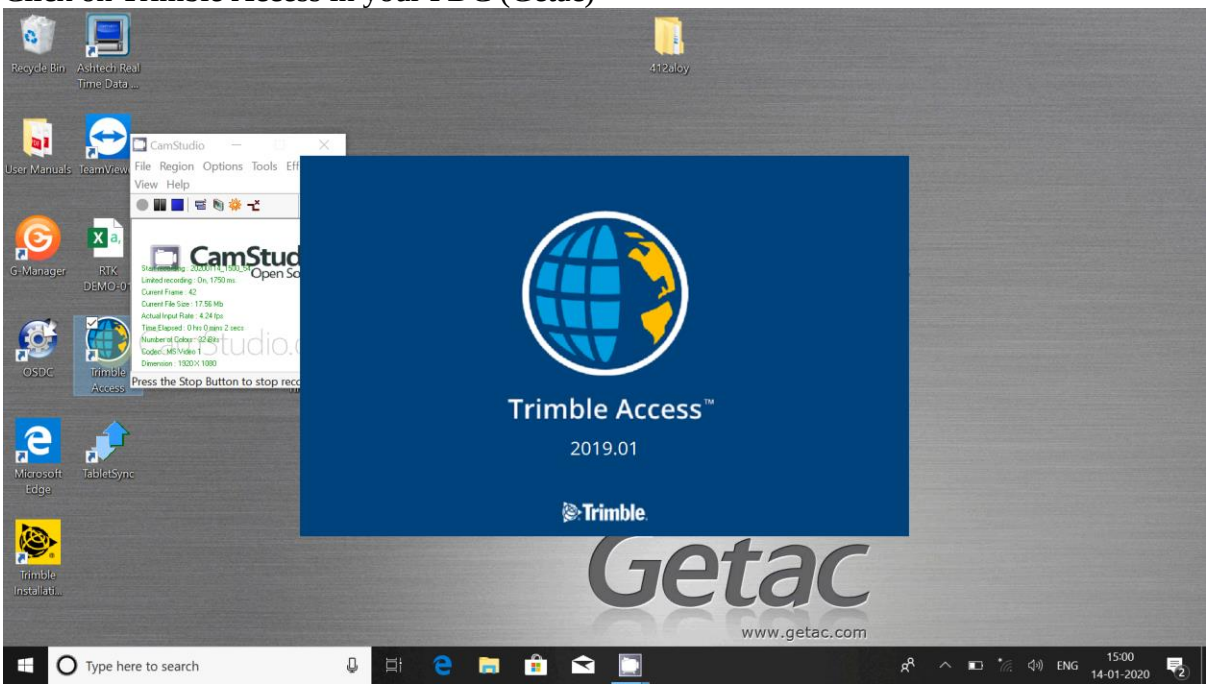
LATEN



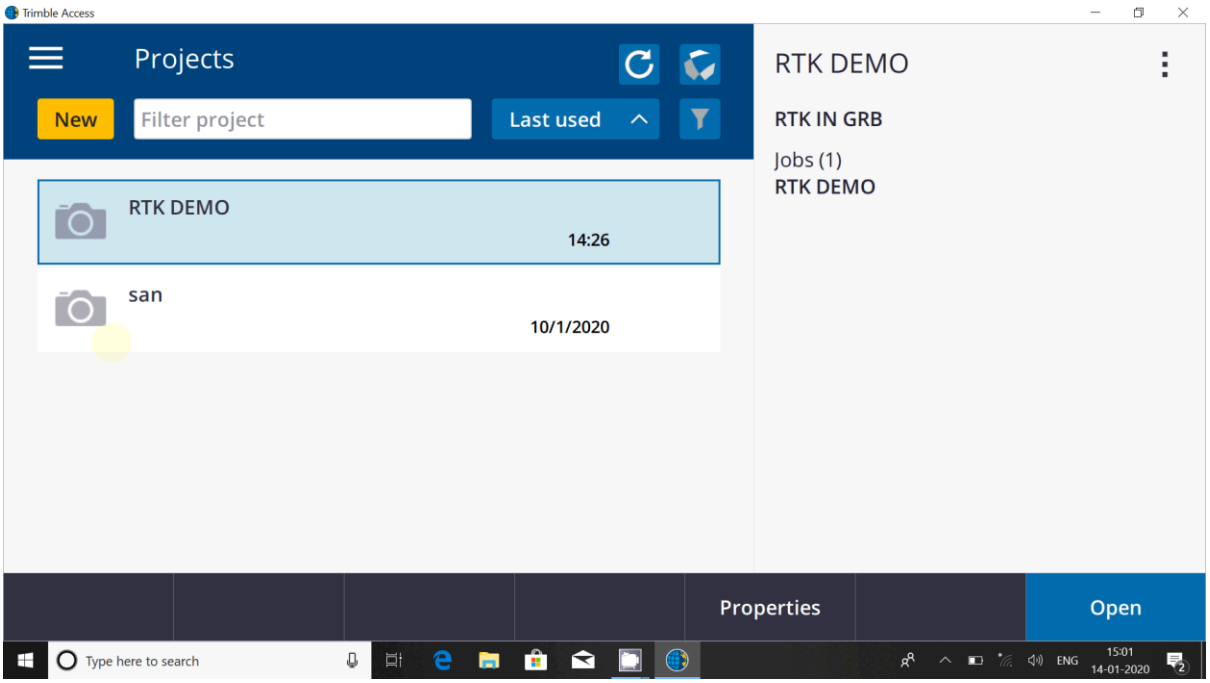
The Rover point collected will instantly give corrected coordinates with respect to Base.

SOP for Export RTK data file

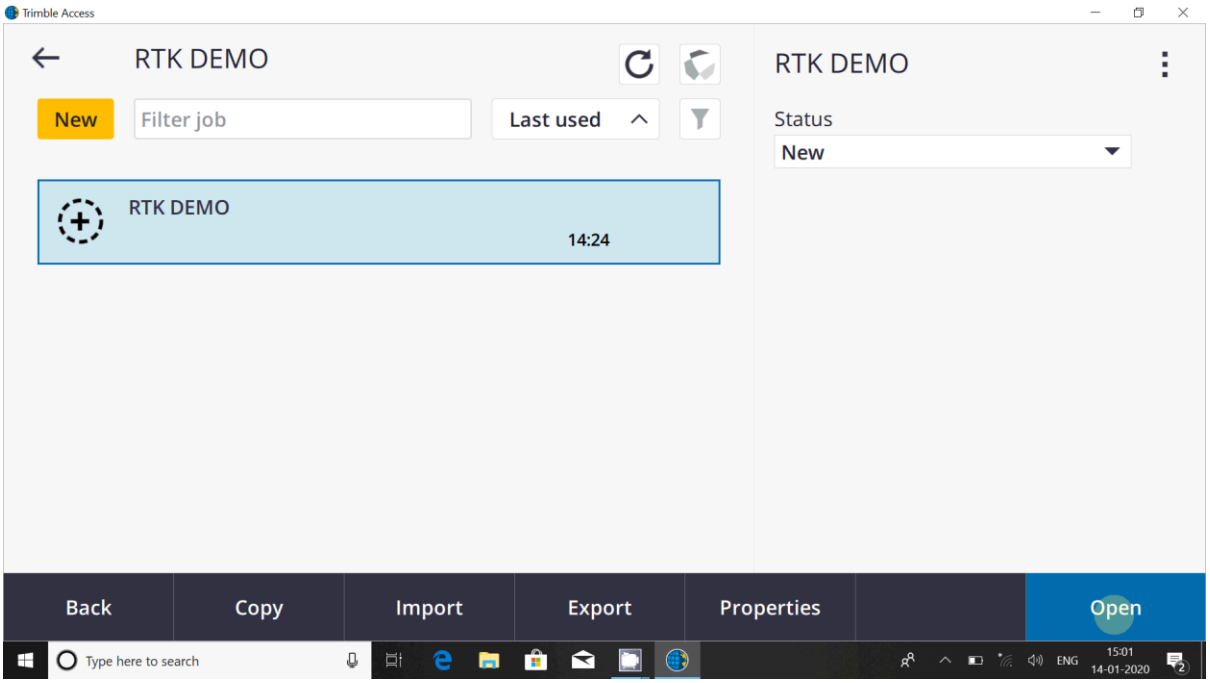
Click on Trimble Access in your FDC (Getac)



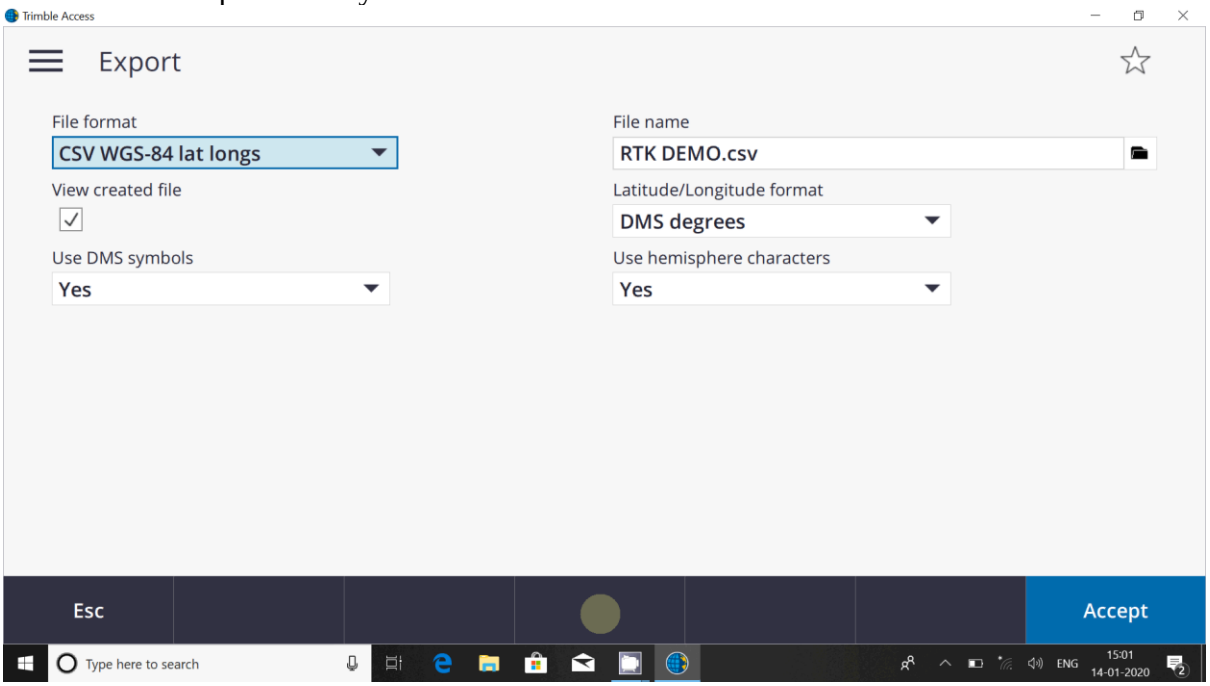
Open your RTK project



Open your RTK Job (eg. RTK DEMO)

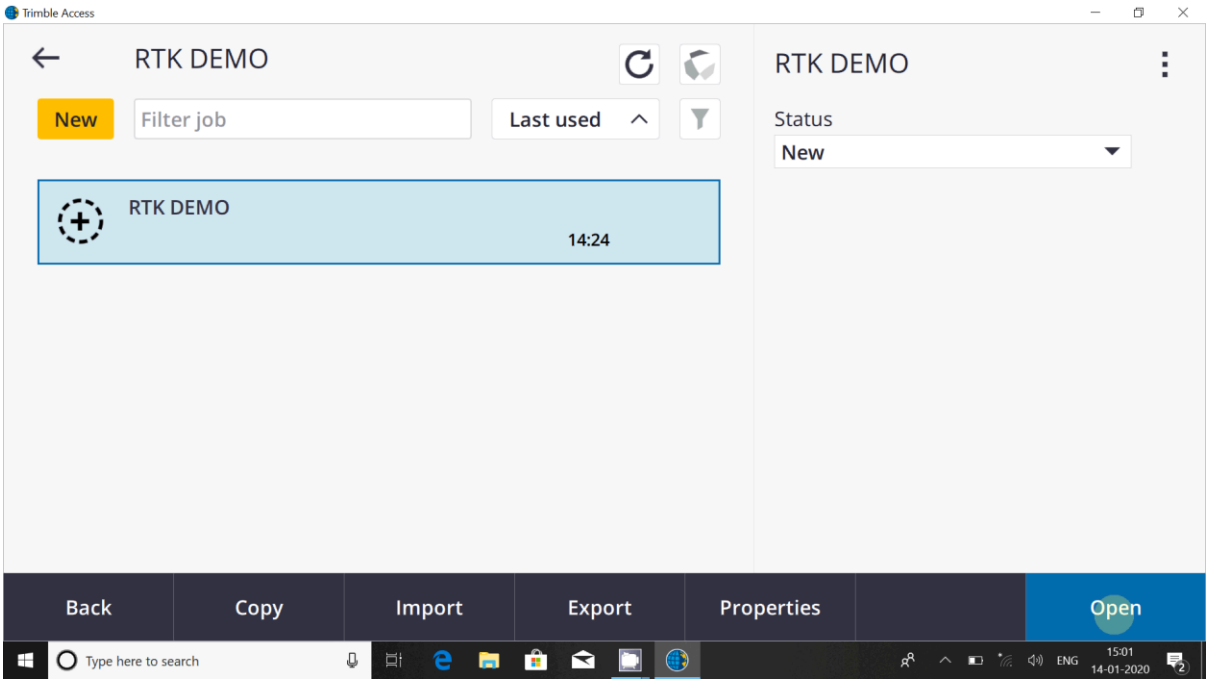


Now click on Export tab in your FDC

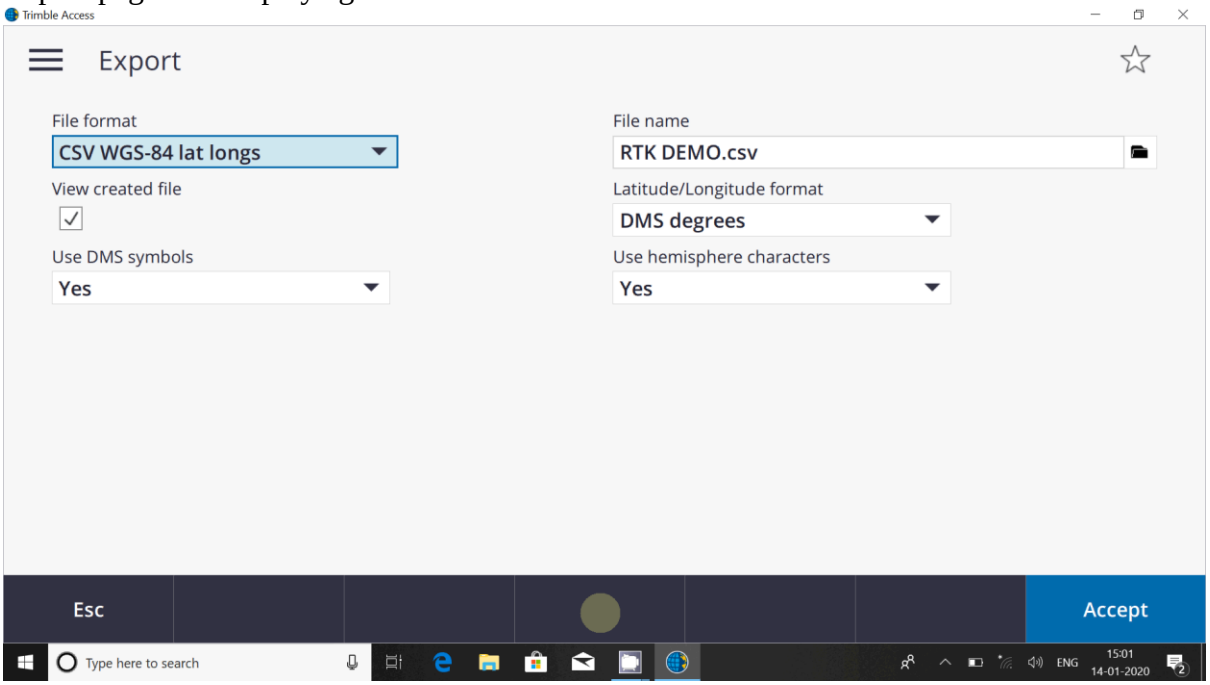


Export page will open.
Different File formats are given. Here select file format as “CSV WGS-84 lat longs”
In “File name” select your desired path
Select “Accept”
Now file has been exported in Lat Long format as path given and file will be opened in MS excel.

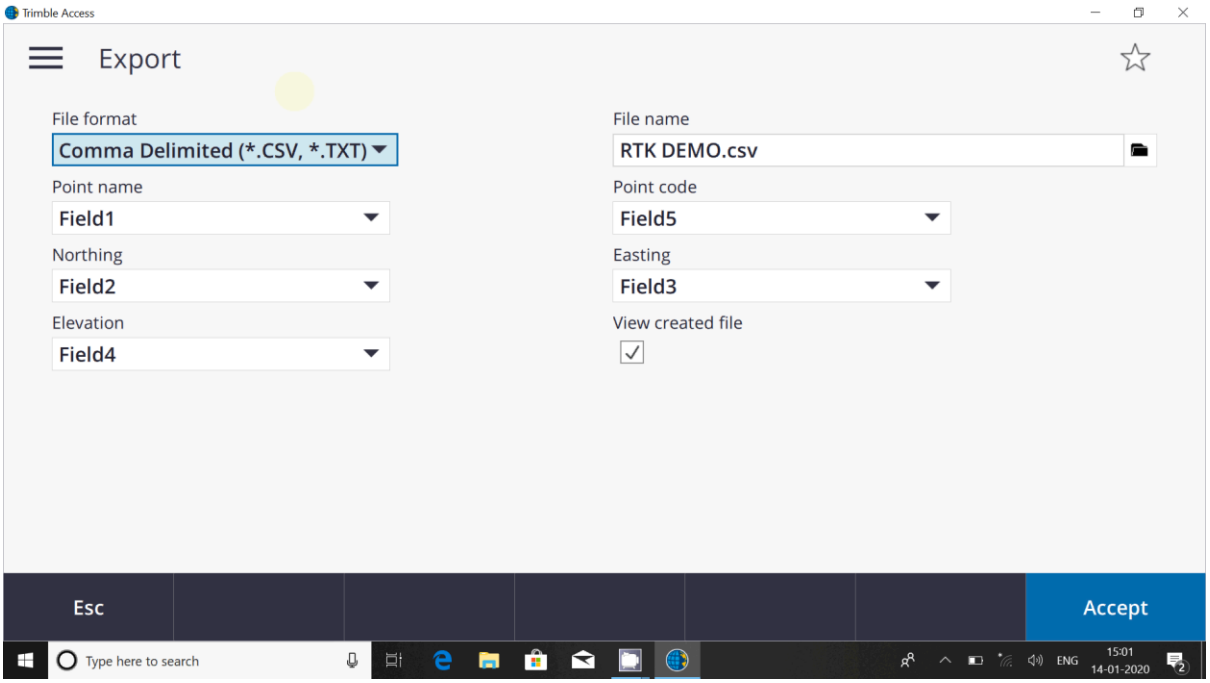
Again you will be back in your Job page



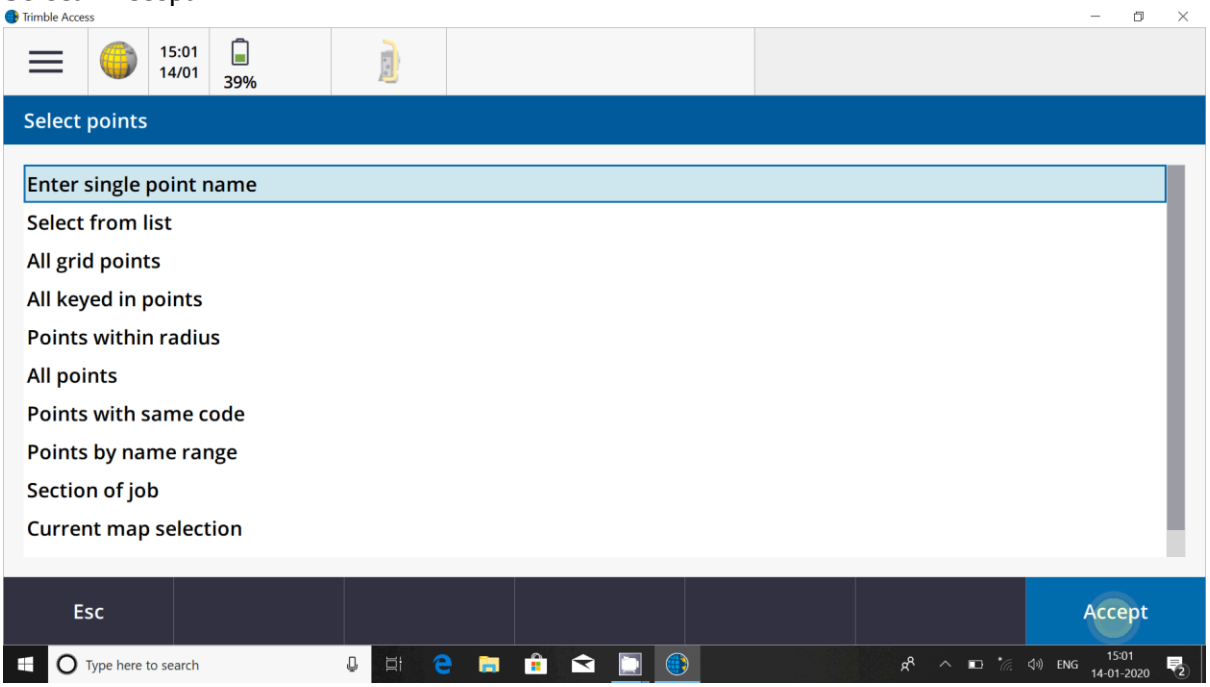
Export page will display again



Now we have to take coordinate in Easting & Northing format. So select “Comma delimited (*.CSV,*.TXT)” in File Format.



In “File name” select your desired path
Select “Accept”



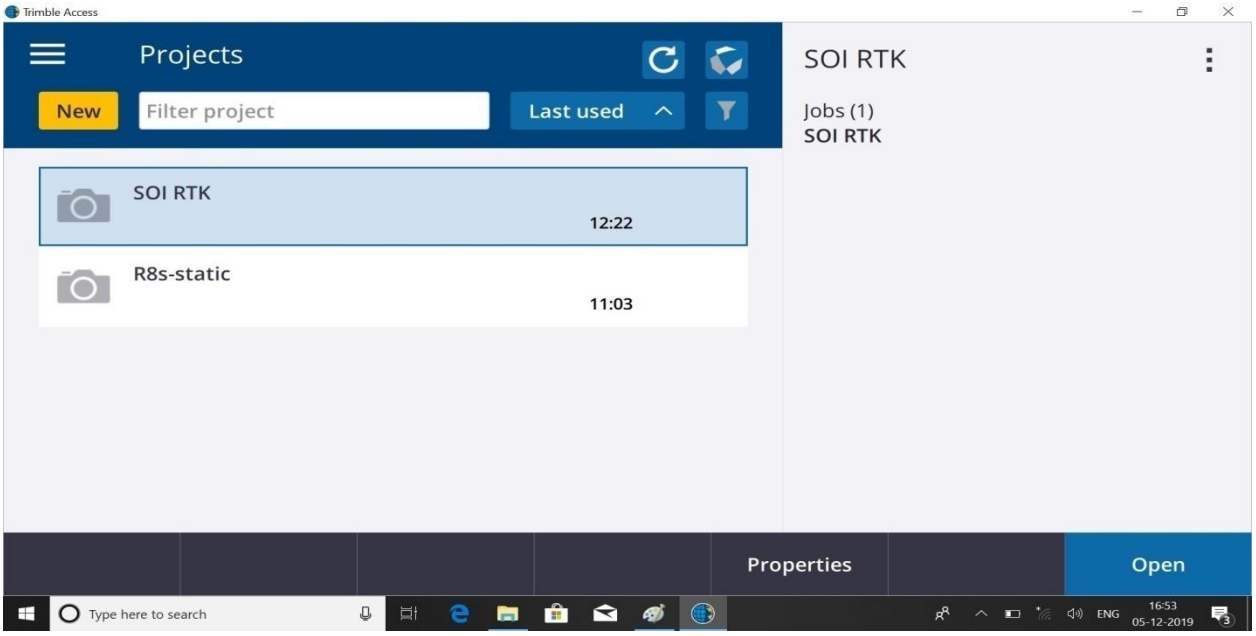
Select “All points” from options and click on Accept.
Now file has been exported in Easting & Northing format as path given and file will be opened in MS excel.

Annexure 'B'

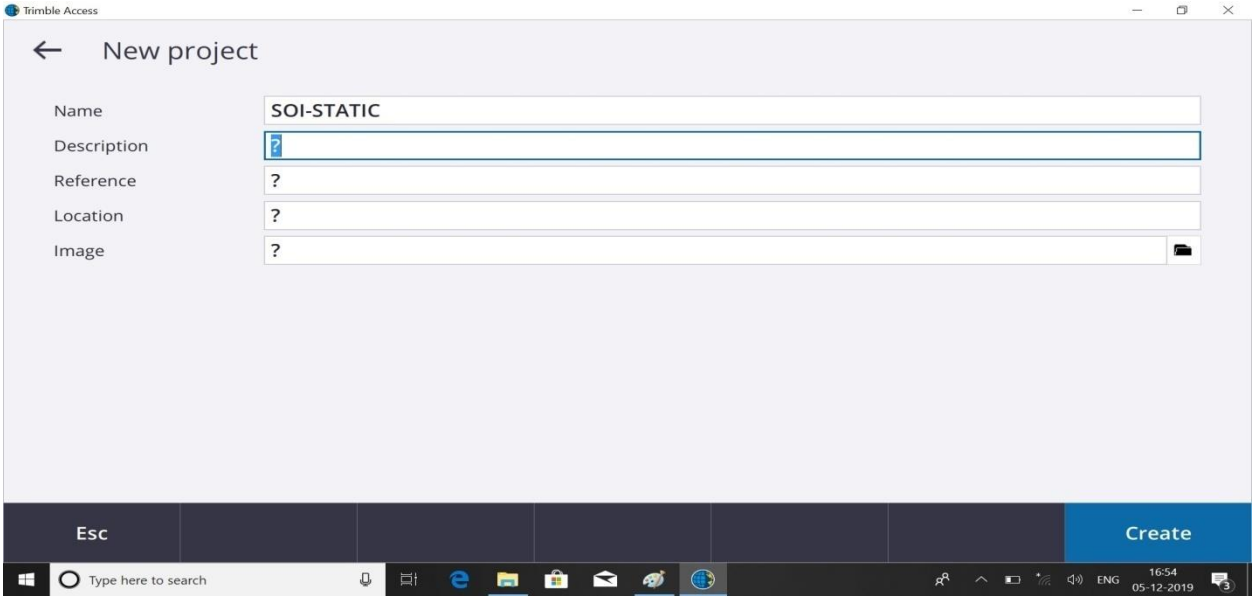
R8S INTERNAL STATIC

For static observation we have to first create the job & survey style using Trimble access in your field controlling device.

Open Trimble Access a default window will open

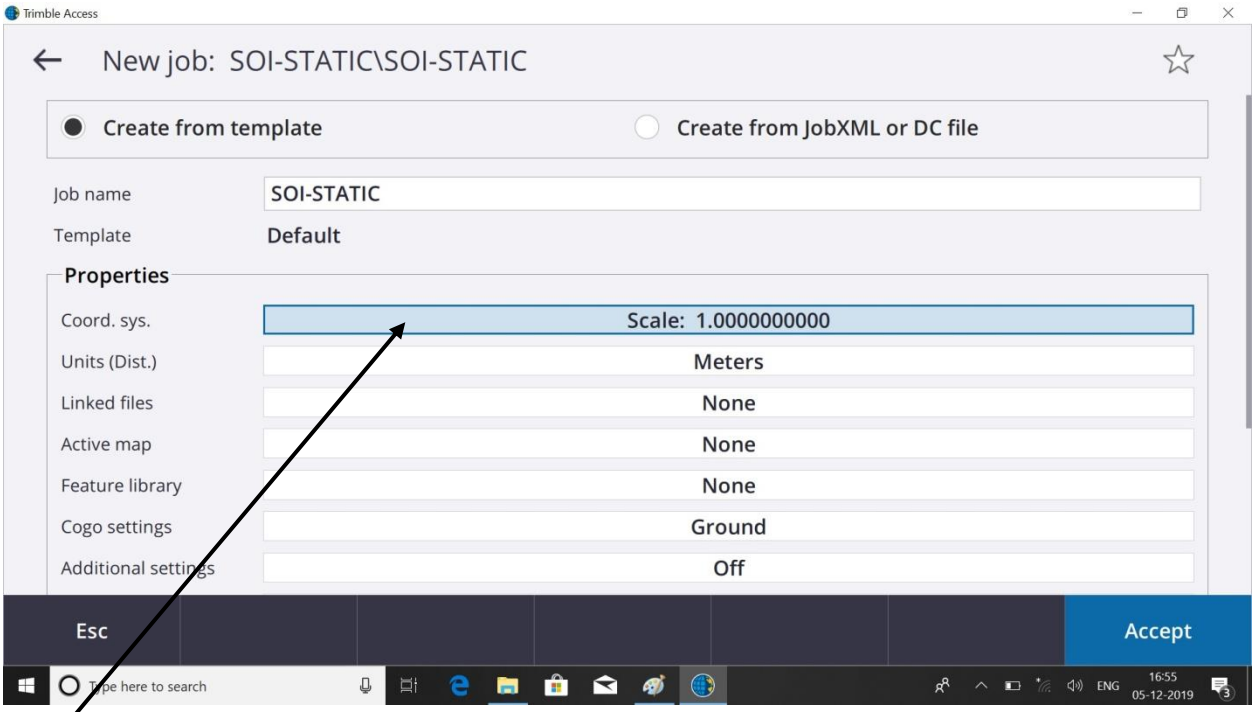


To create a new project, click on new.

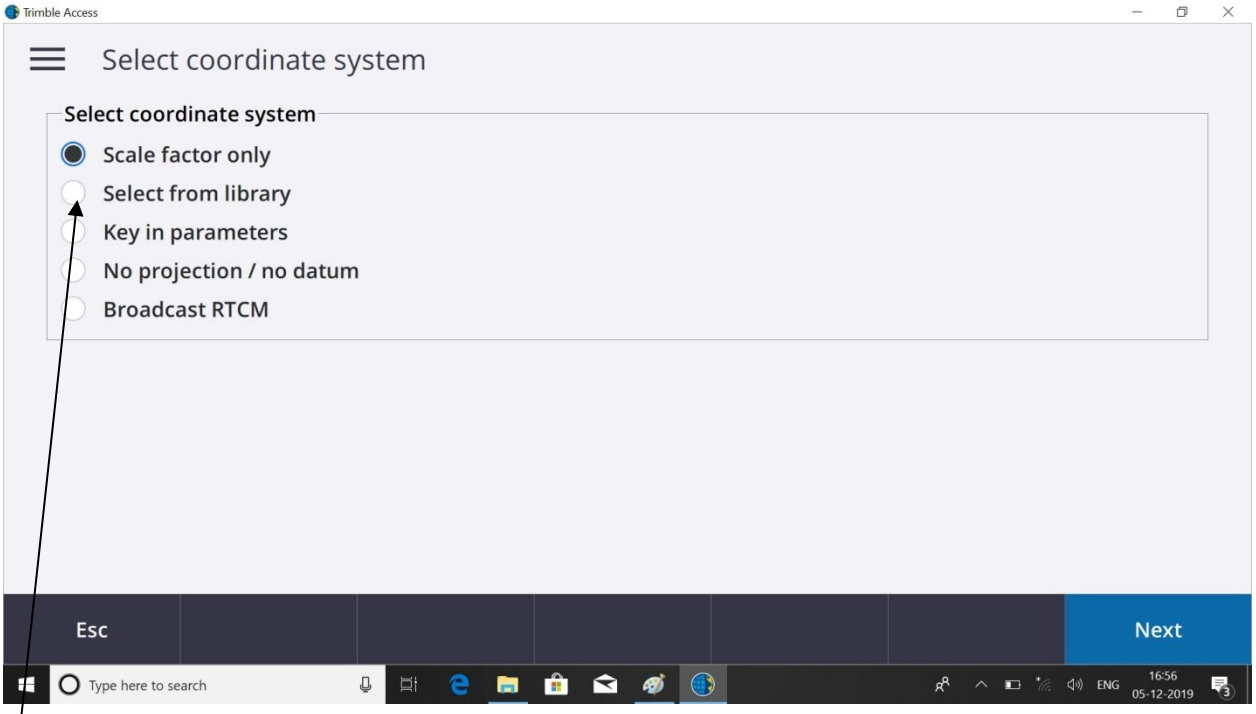


Give the name of your project, n click on create.

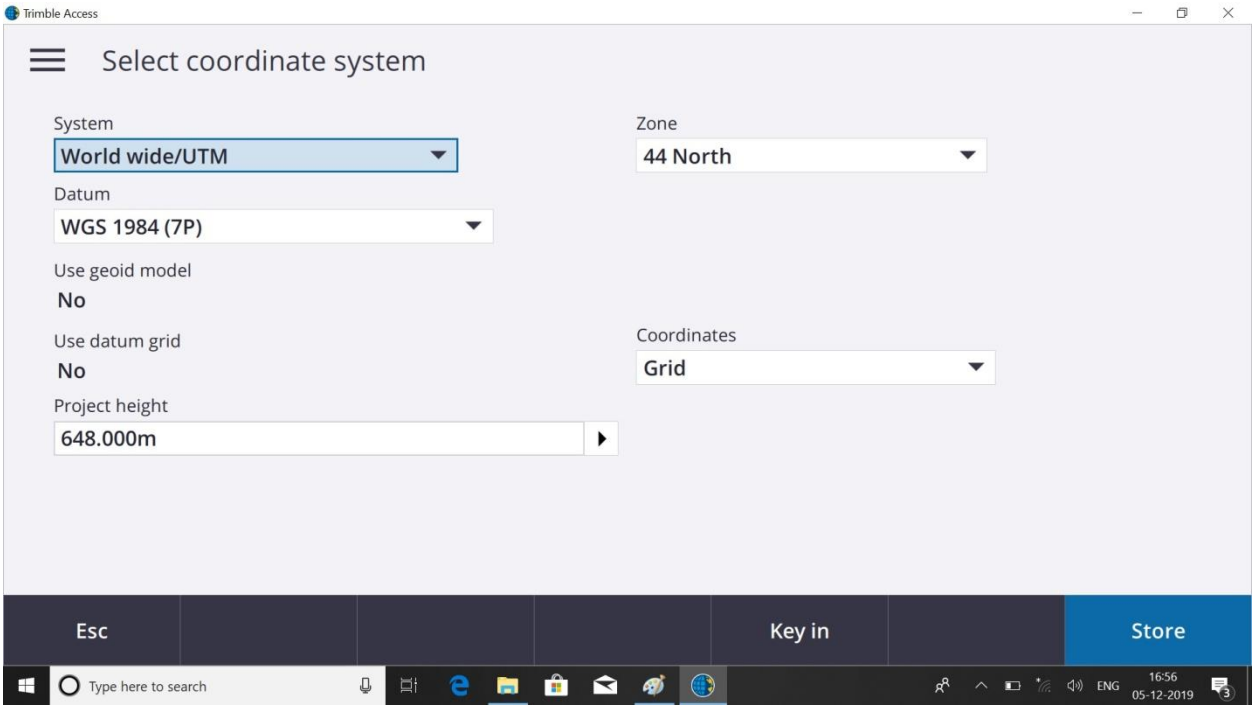
A new job window will open. Give the job name



Click here to set the coordinate system.

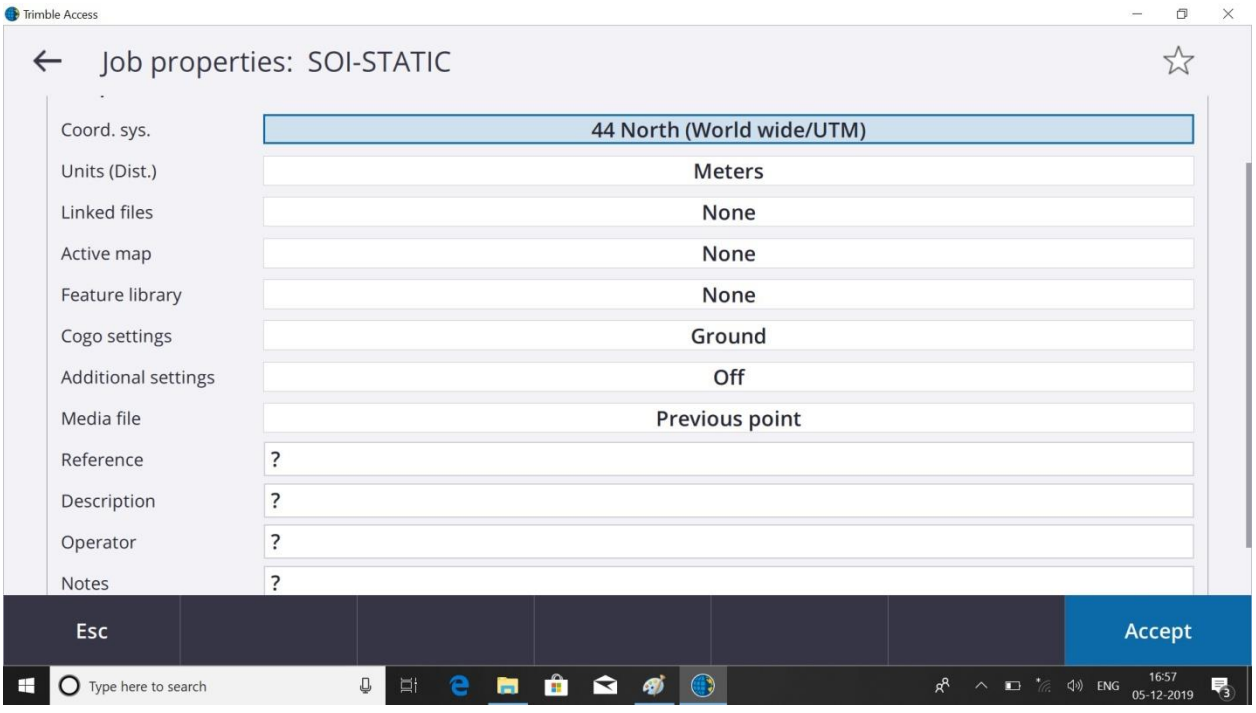


Click the option –“Select from Library”



Select the coordinate system, Zone, Datum& approximate project height, and click on store.

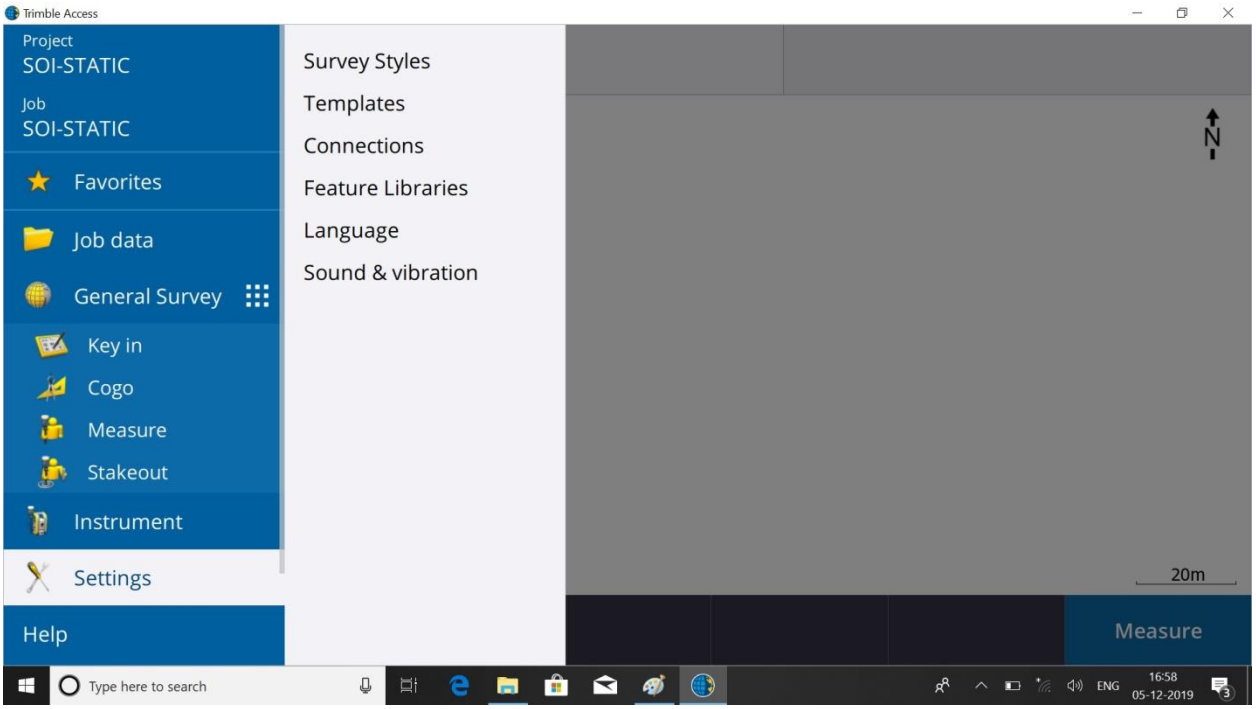
You will be redirected to the job property page. Rest all the settings are by default.



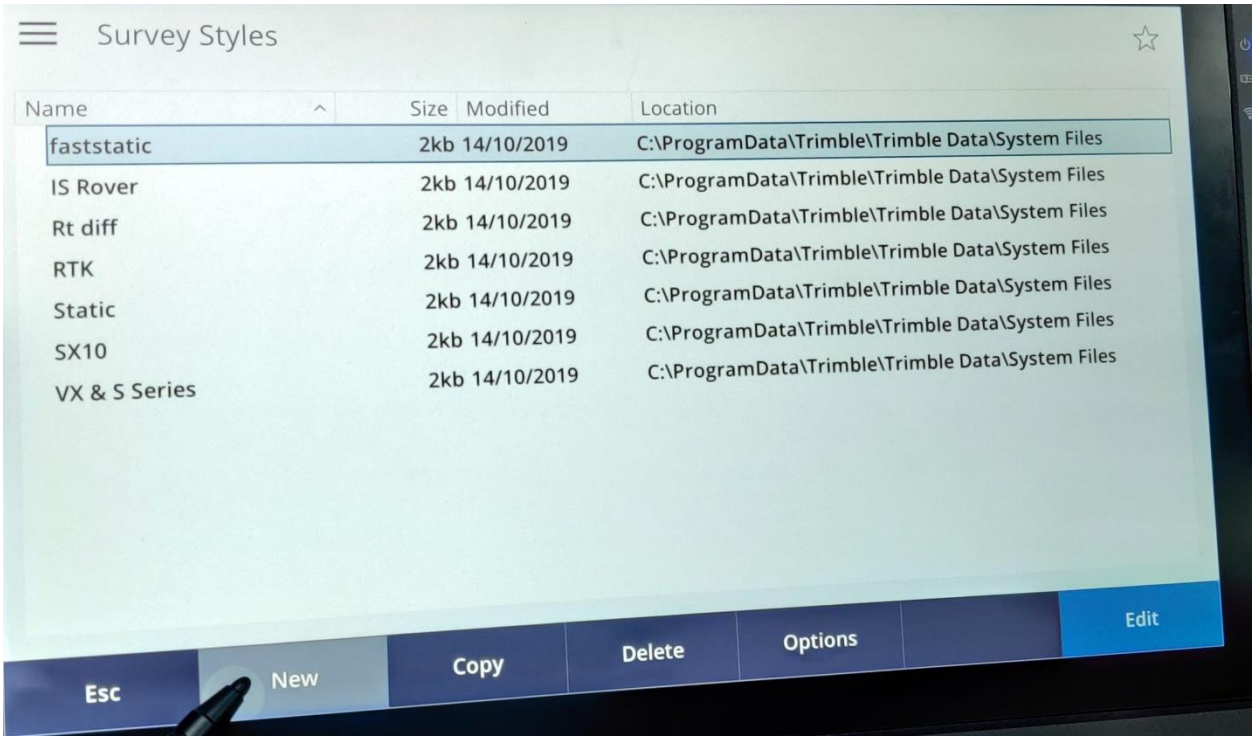
Now we will create a survey style for static observation.

Click on the main menu icon o the left most corner of your field data controller.

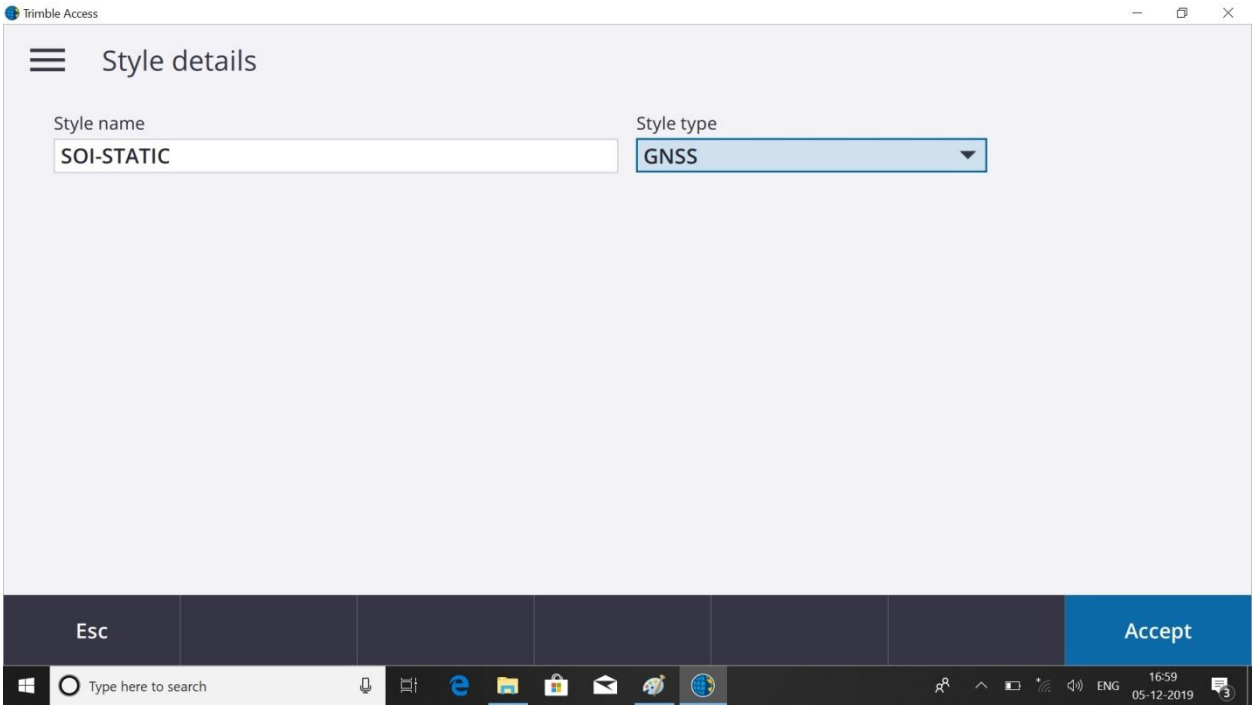
Go to –“Settings>Survey style”



Click on new to create a new survey style

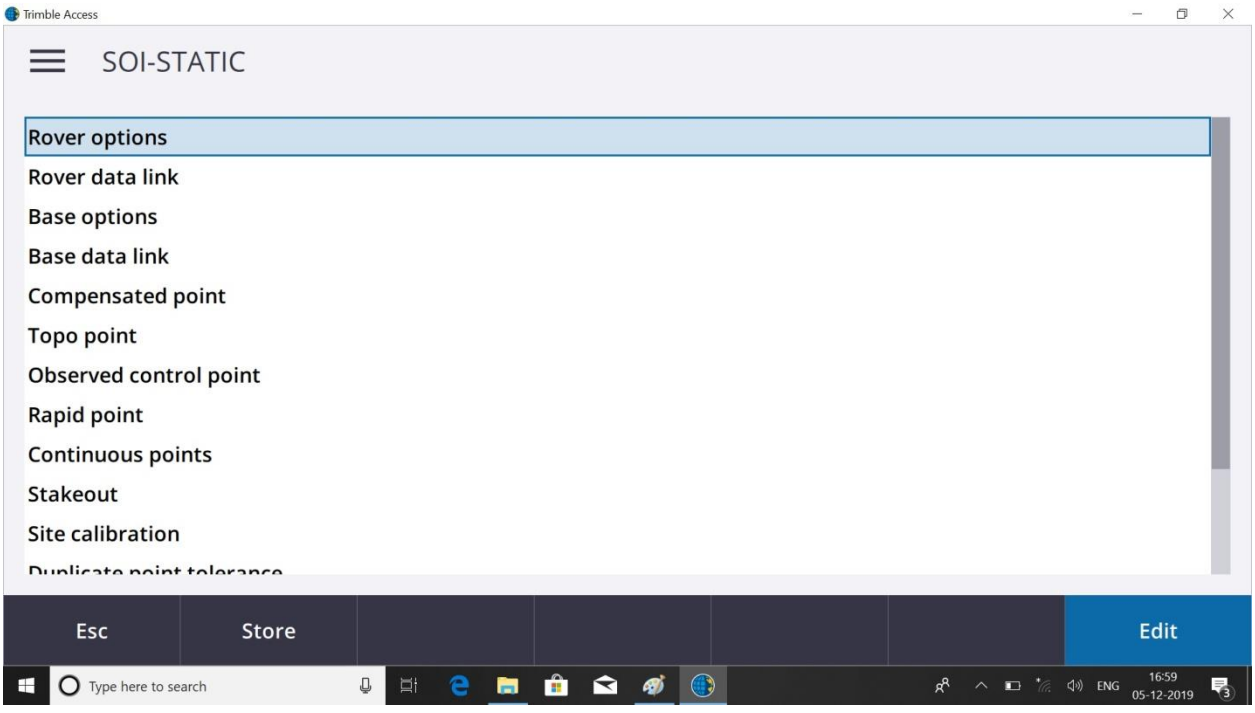


Give the name of your" survey style, style type"

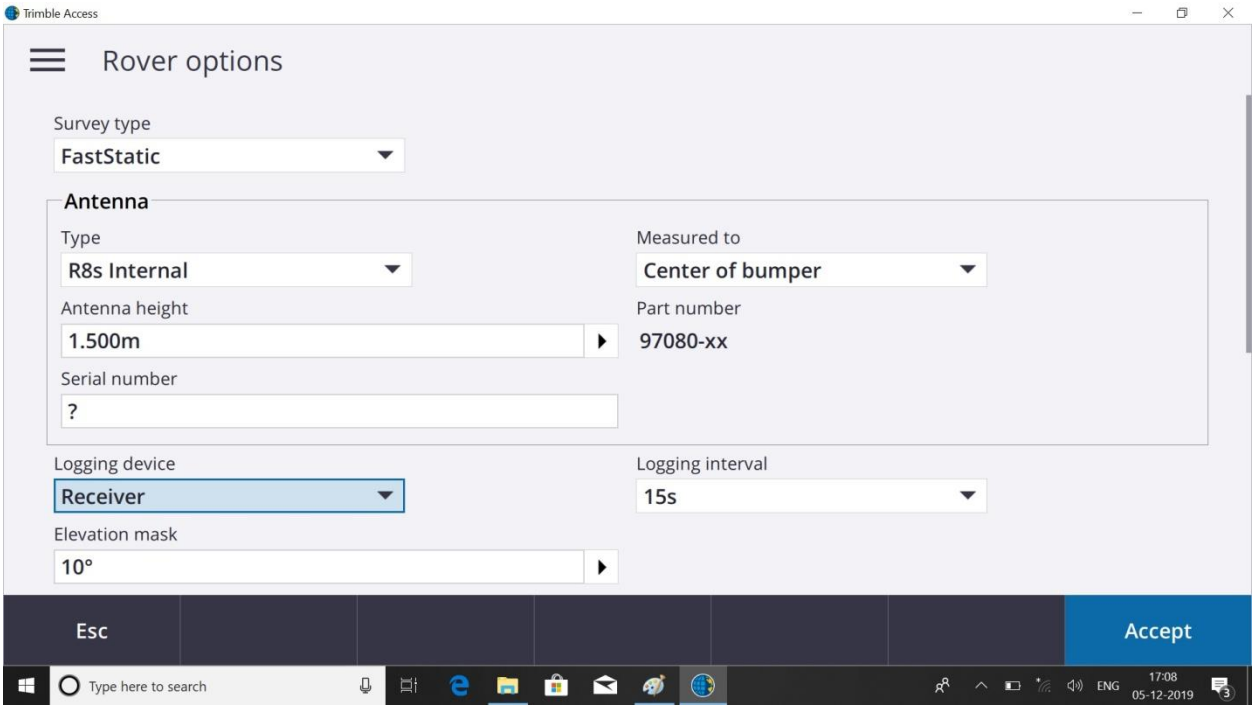


Click on Accept.

A new window will open.



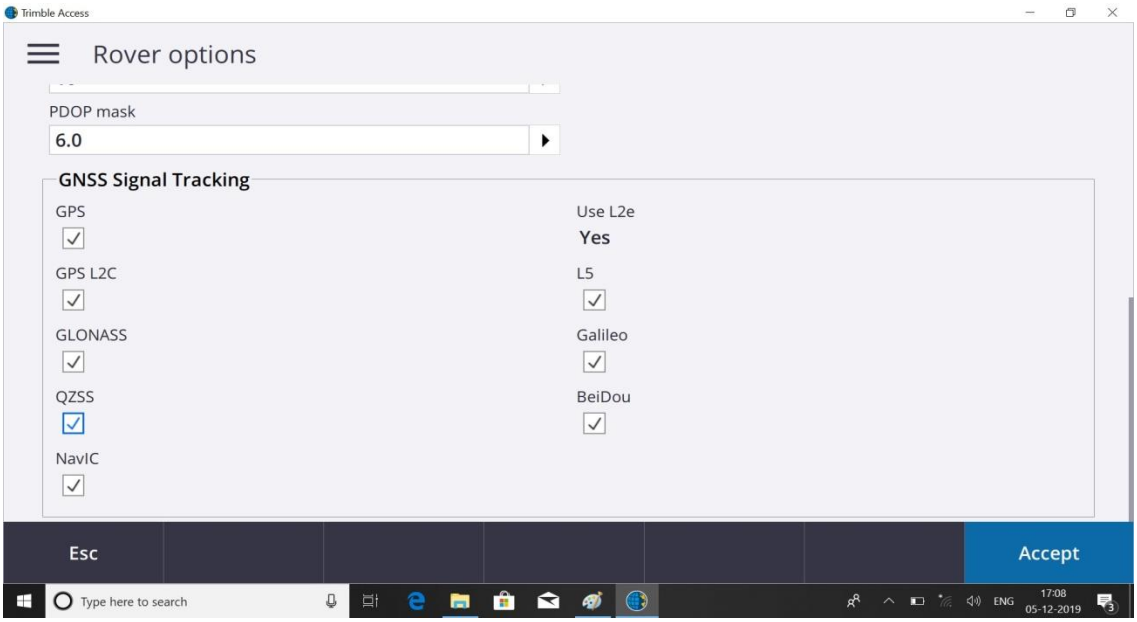
Select –“Rover options”



Input your –survey style, antenna type, antenna height, logging device& logging interval.

Use Antenna measurement method-“CENTER OF BUMPER” in case of tripod

“Check in all the GNSS signal tracking” as shown below.



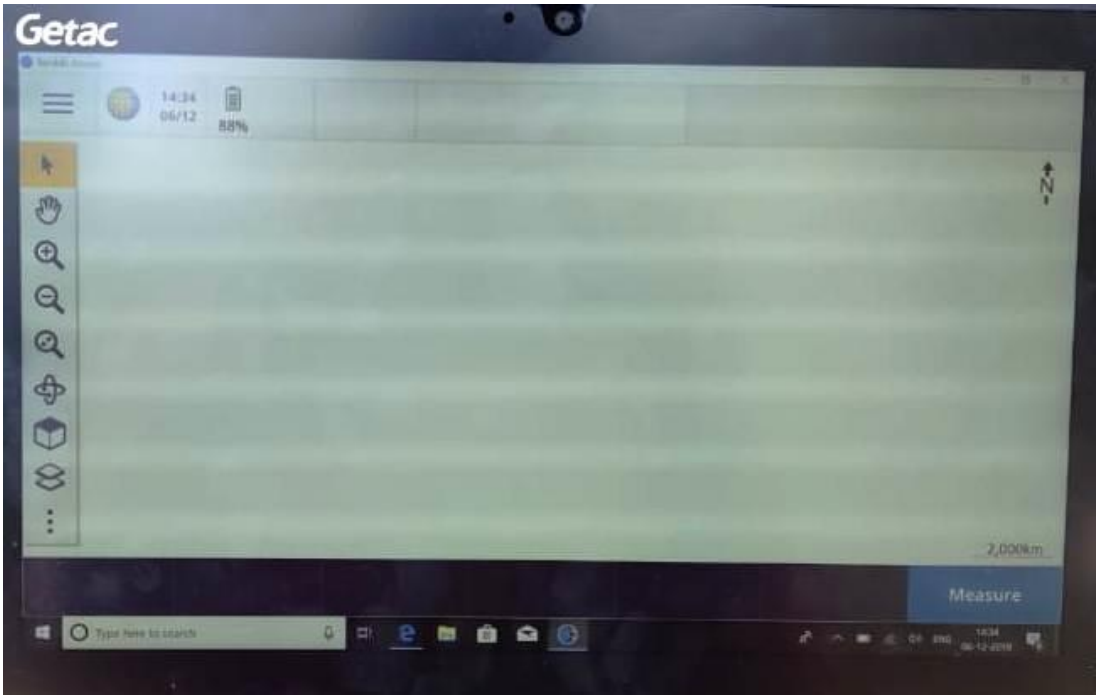
Click on Accept

Now you can start your static survey by centering & leveling your GNSS receiver in the ground.

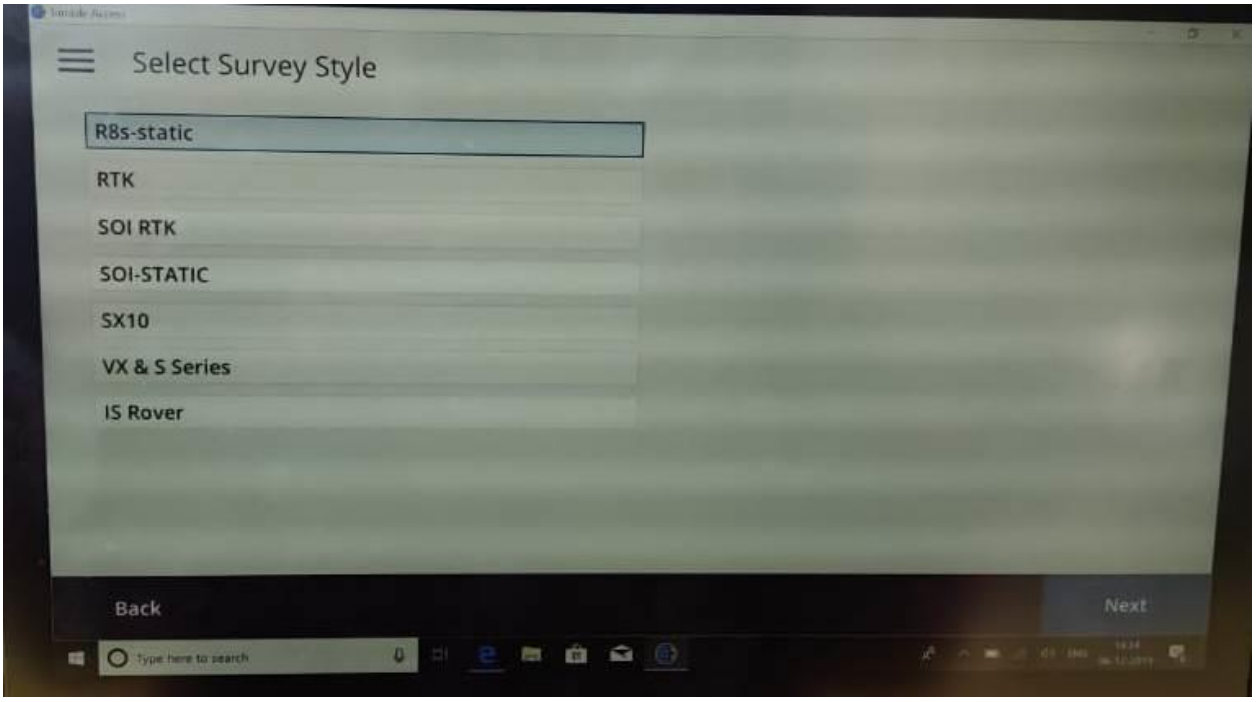
Switch on the power button of your GNSS R8s receiver.

Now in your field data collector unit

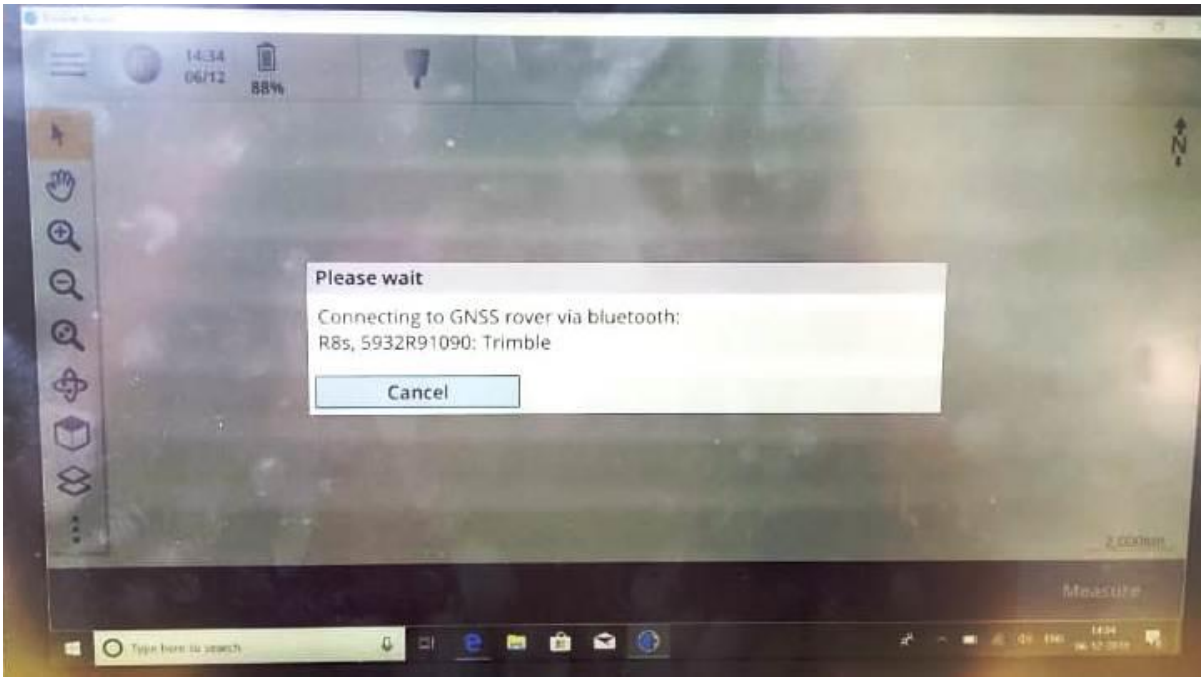
Open your job



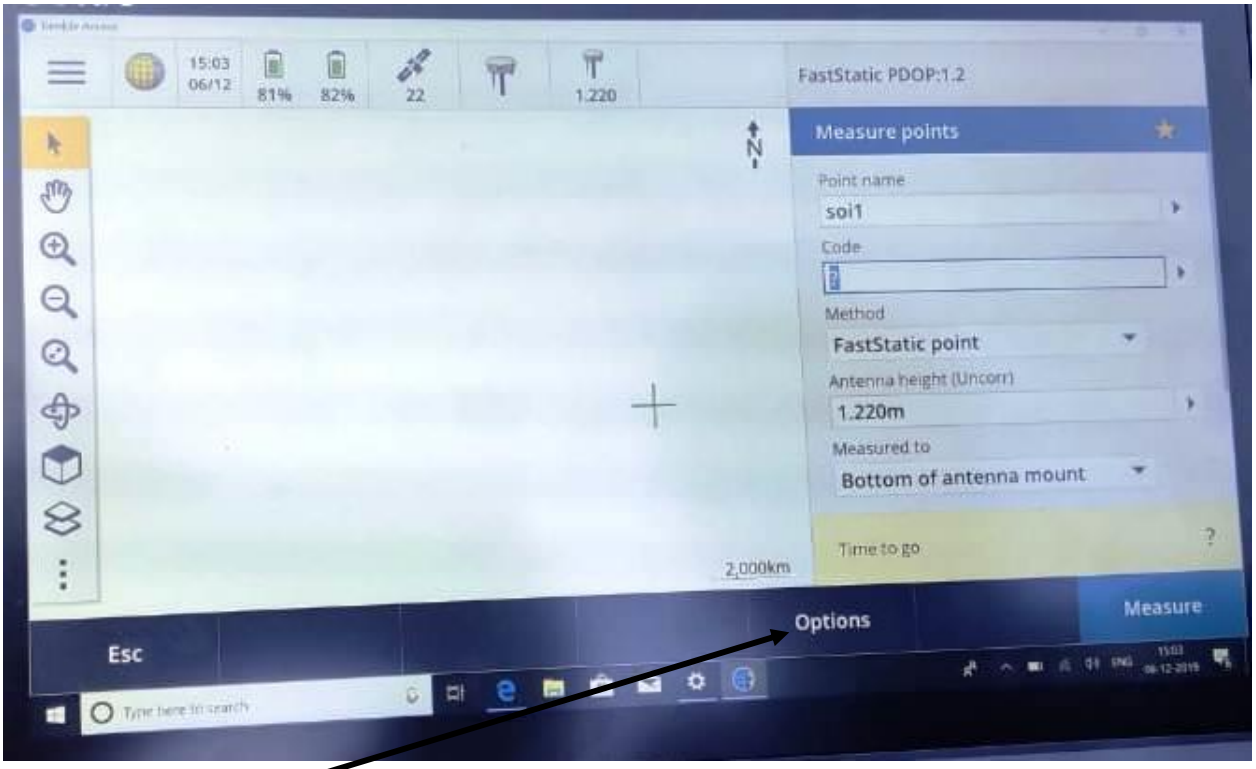
Click on measure it will ask you to select your survey style, select your survey style



It will now establish Bluetooth connection of your FDC to R8s Antenna

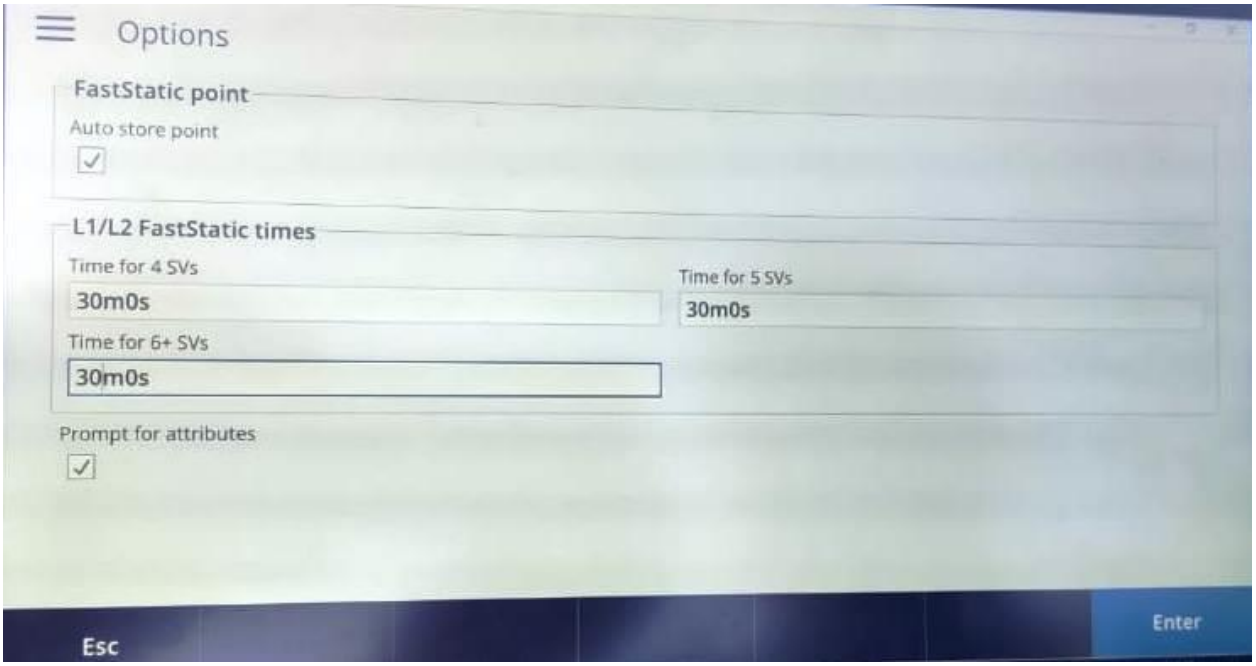


After establishing Bluetooth connection it will ask for the point name



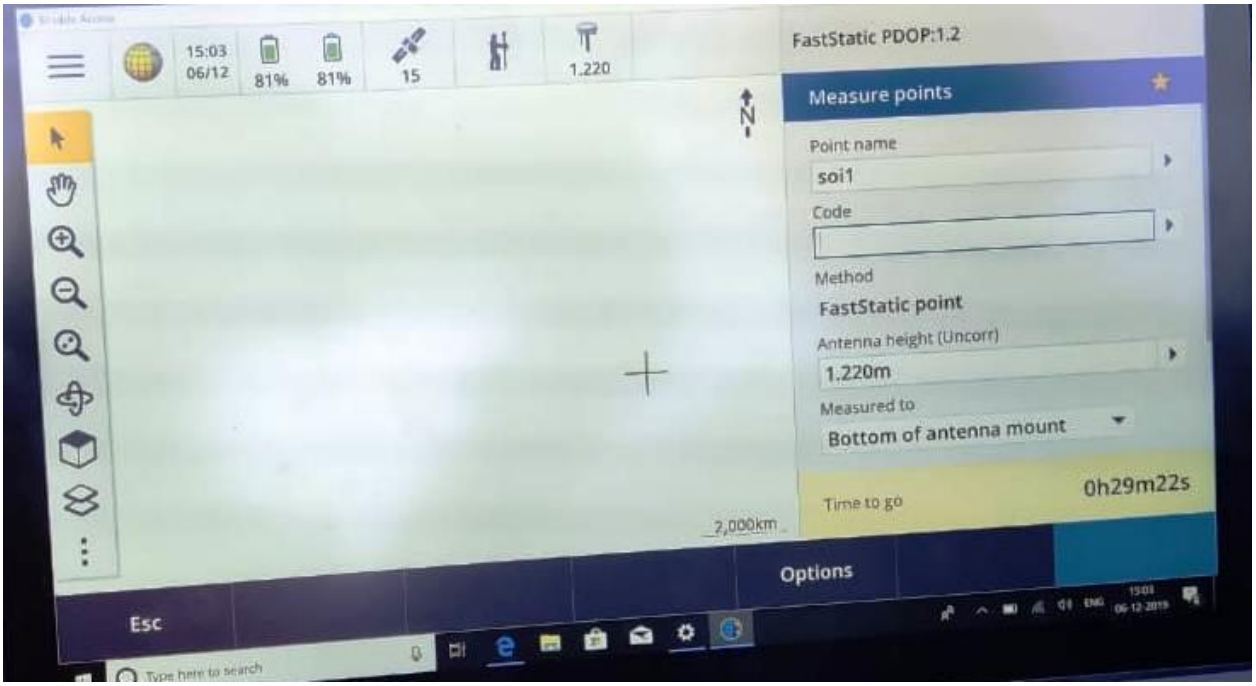
Enter the point name, choose the method fast static, and enter the instrument height.

Click on the option to enter the time interval for your static observation, a new window will open up



Click on auto store point, select the time interval for your static observation and click on enter.

You will be redirected to the previous window. And at the bottom it will show you the time remaining to complete your observation.



Static observation file is available in in the project file in the following path:

C\Program Data\Trimble\Trimble Data\"User Account"\Project*.t02.

This data is then processed in TBC software to get the final coordinates.

Contents

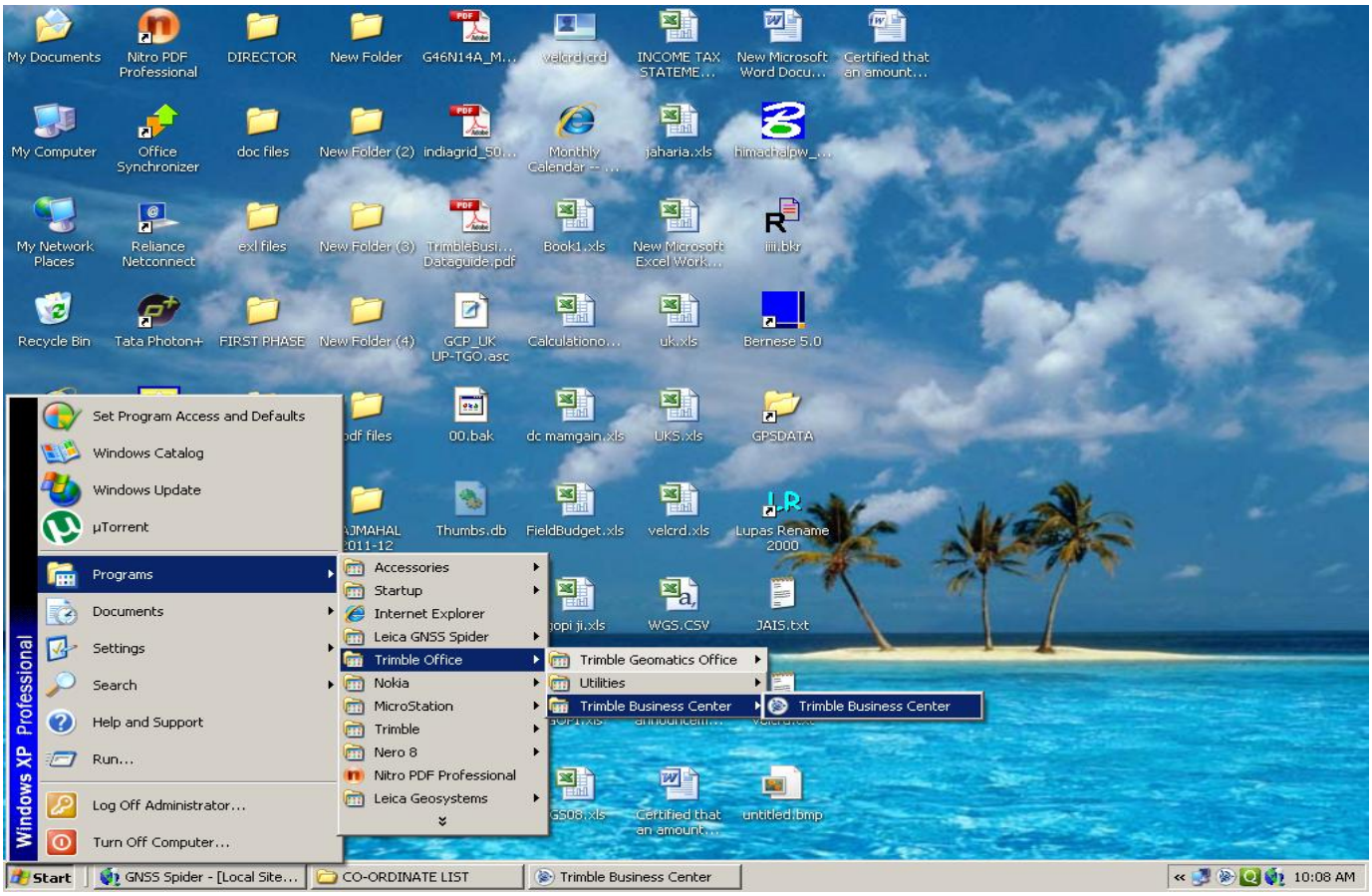
CREATING A NEW PROJECT 2
PROJECT SETTING 6
DATA IMPORT 9
PROCESSING OF BASELINE 11
Loop Closure 17
NETWORK ADJUSTMENT 19
Point to be checked in Network Adjustment Report 21
Disclaimer 23

STEP -1

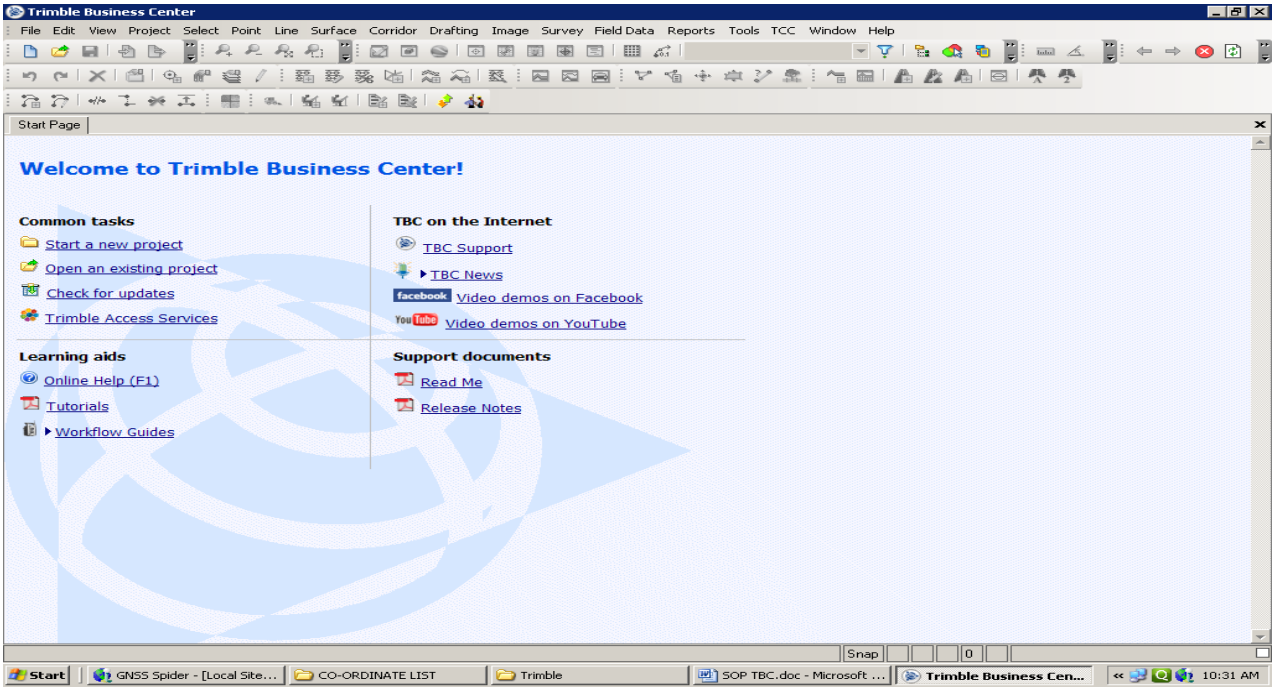
CREATING A NEW PROJECT

Open the "TRIMBLE BUSSINESS CENTRE" software.

1. Start>program files>Trimble Office> Trimble Business Centre> Trimble Business Centre

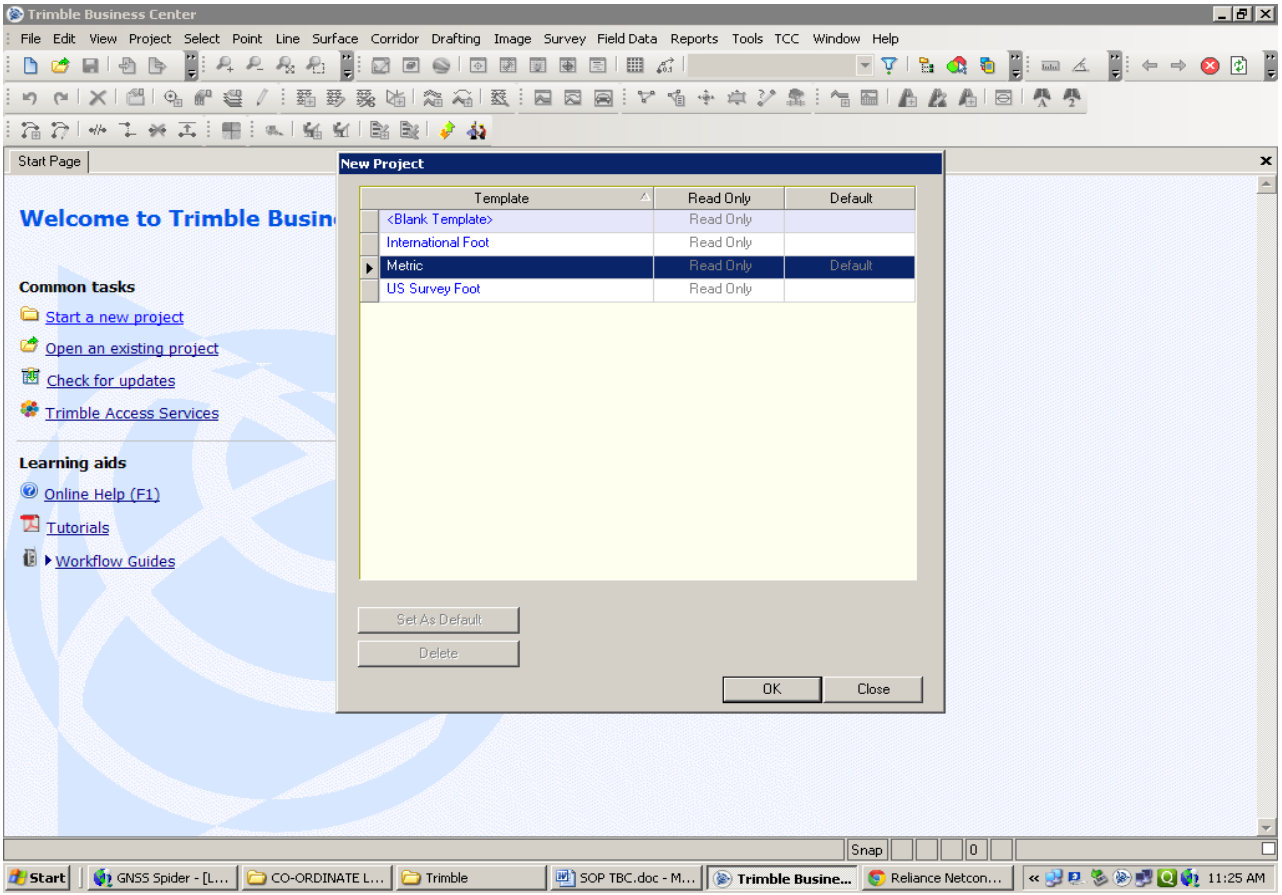


The following page will display.



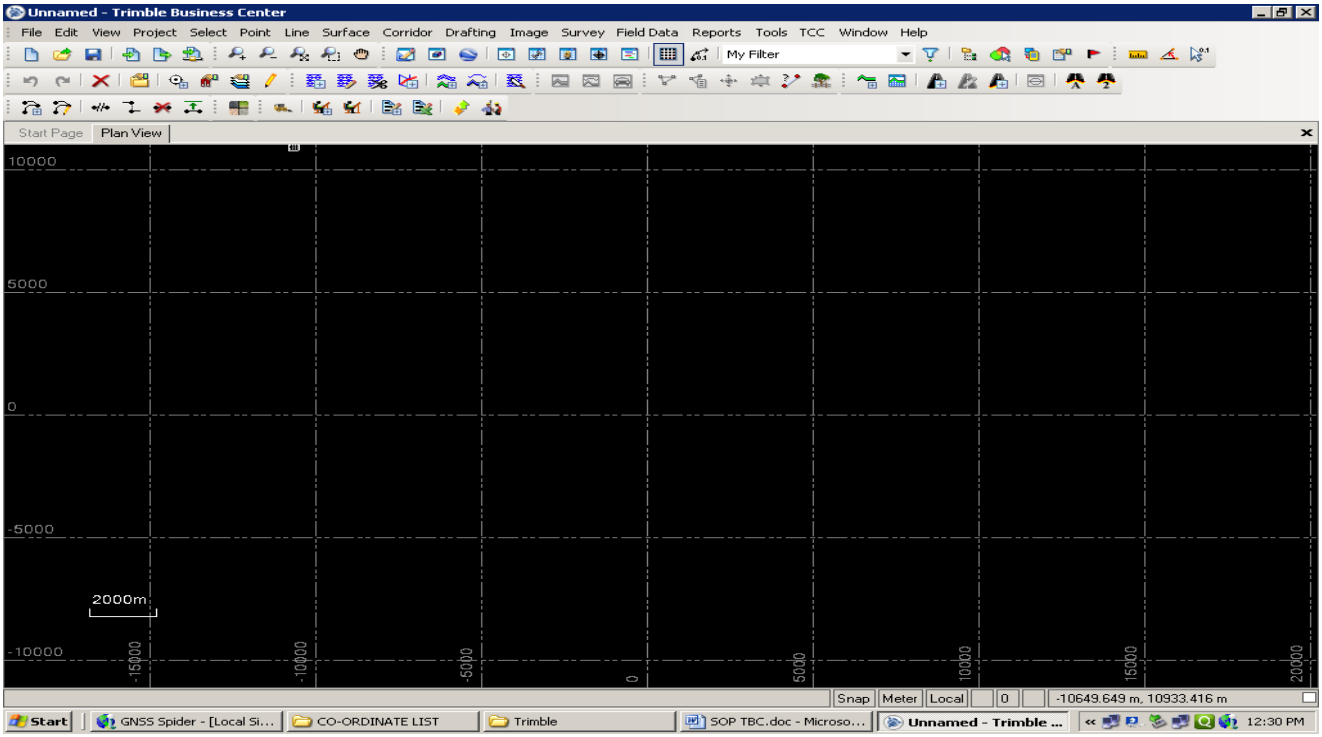
1. Click Start New Project

The following page will display.



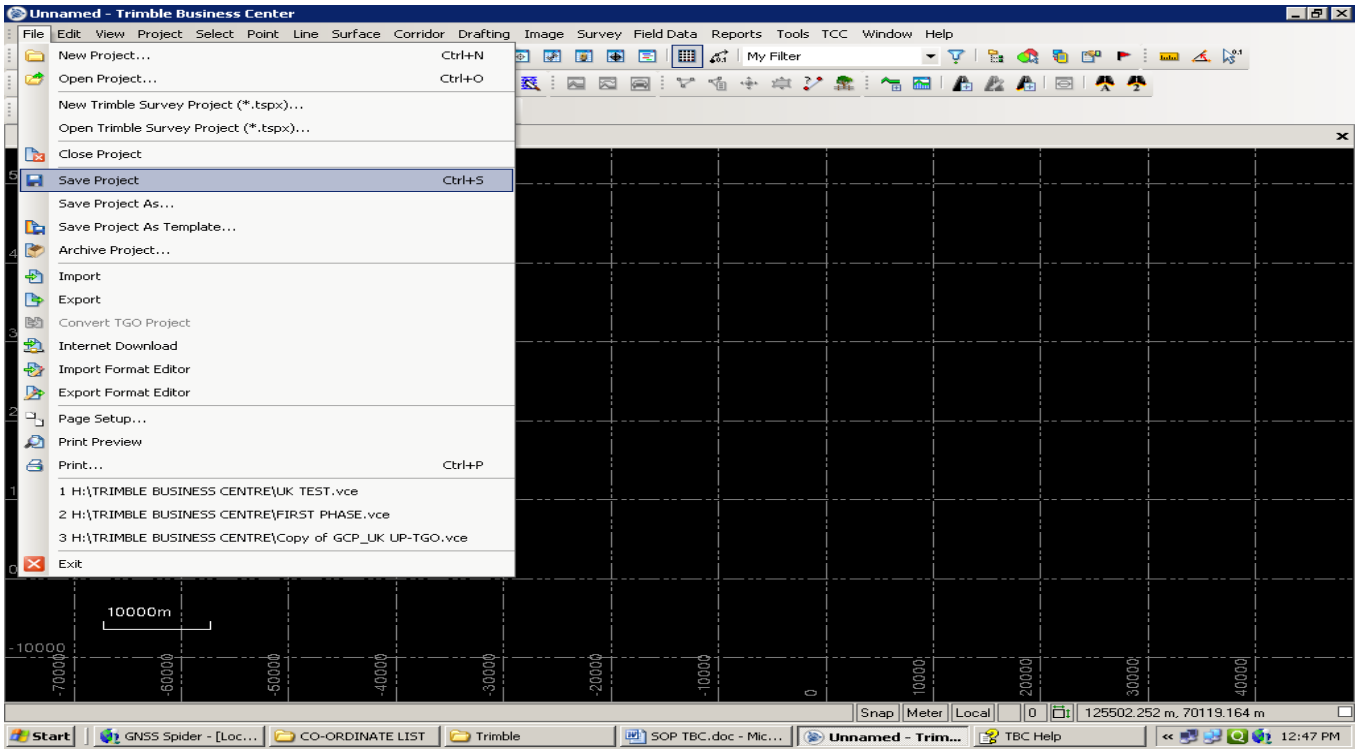
Click ok.

The following page will display.

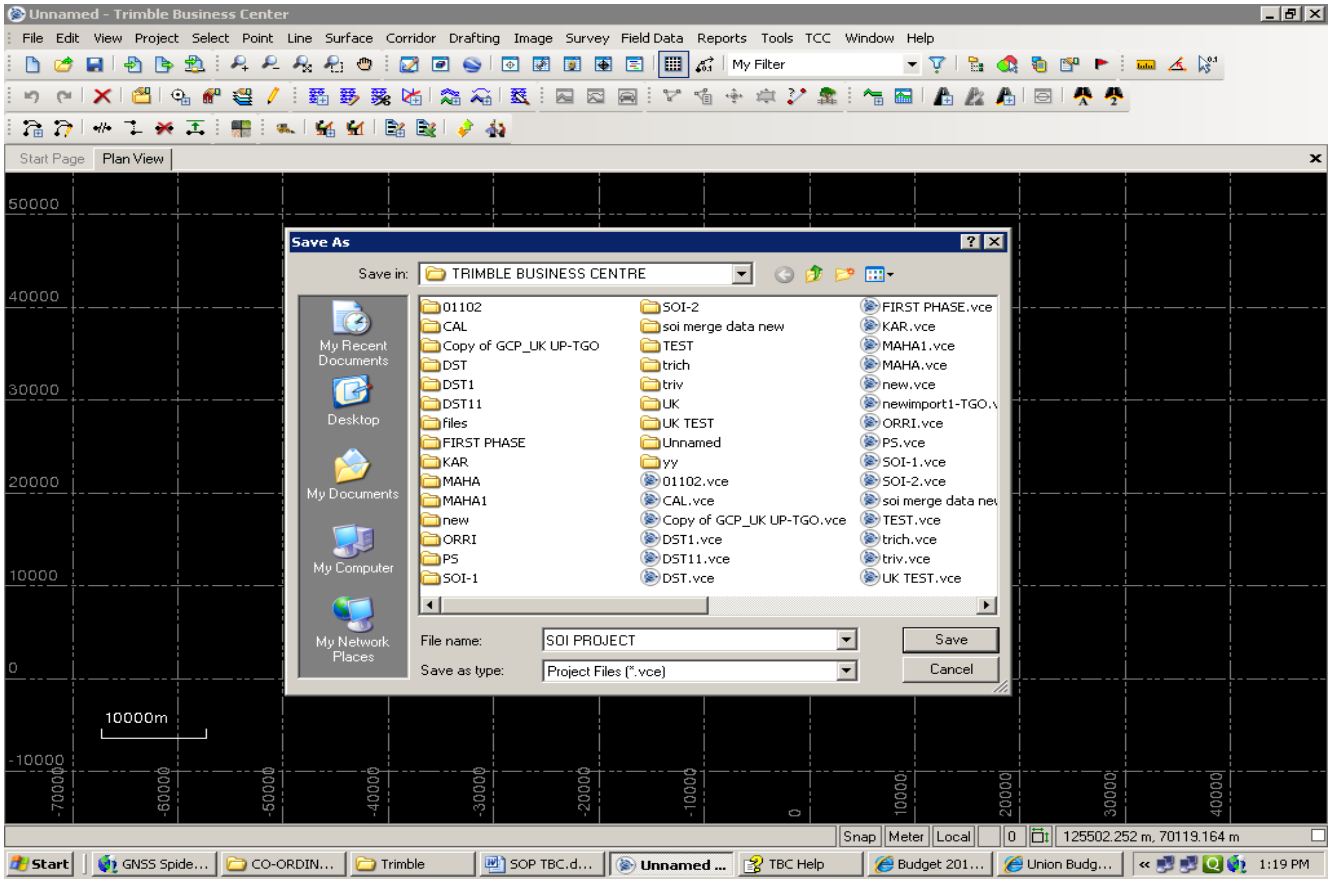


1. Select the Following Command

   Menu>File> Save Project



The following page will display.



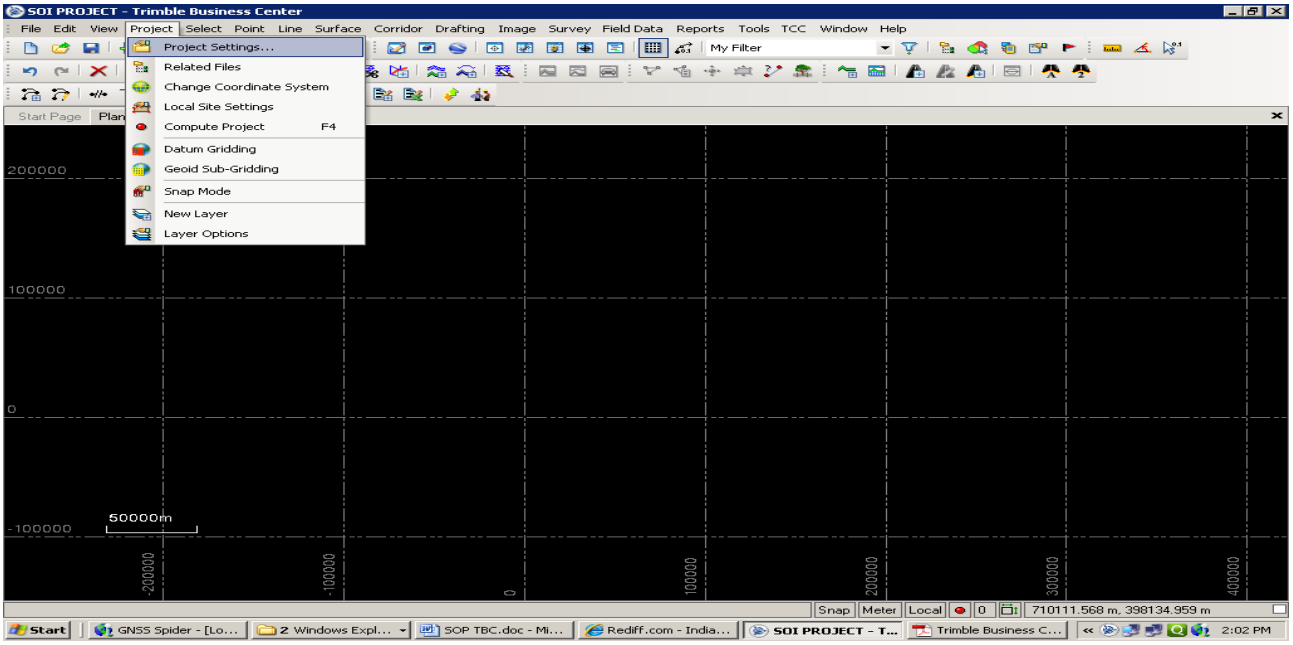
NOTE: It will save in default path: “C/Documents/Trimble Business Centre”.
User can save it to any specified required path.

THEN CLICK SAVE.

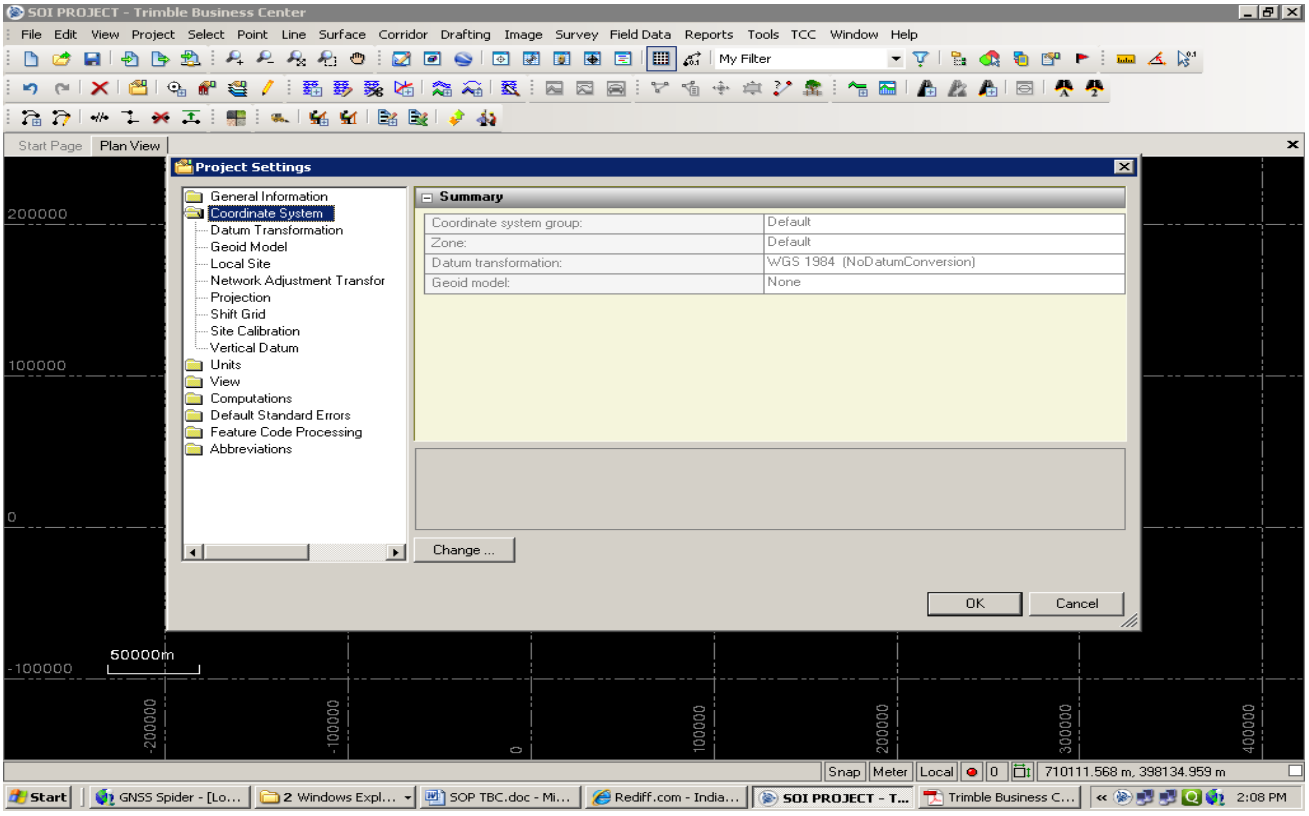
STEP 2

PROJECT SETTING

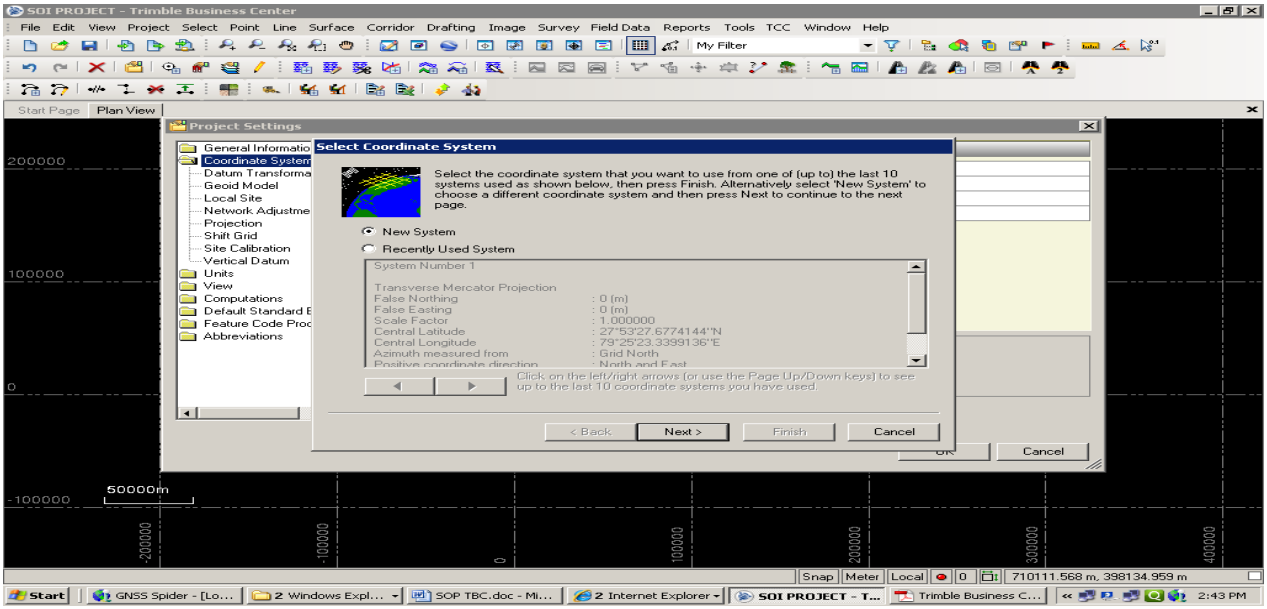
1. Menu>Project > Project Setting



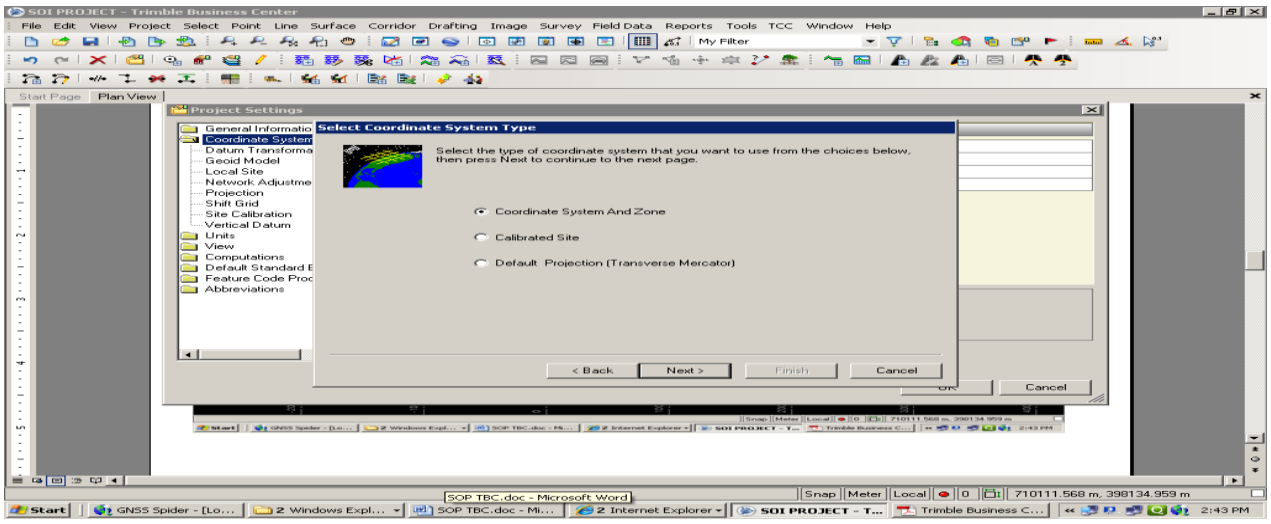
The following page will display.



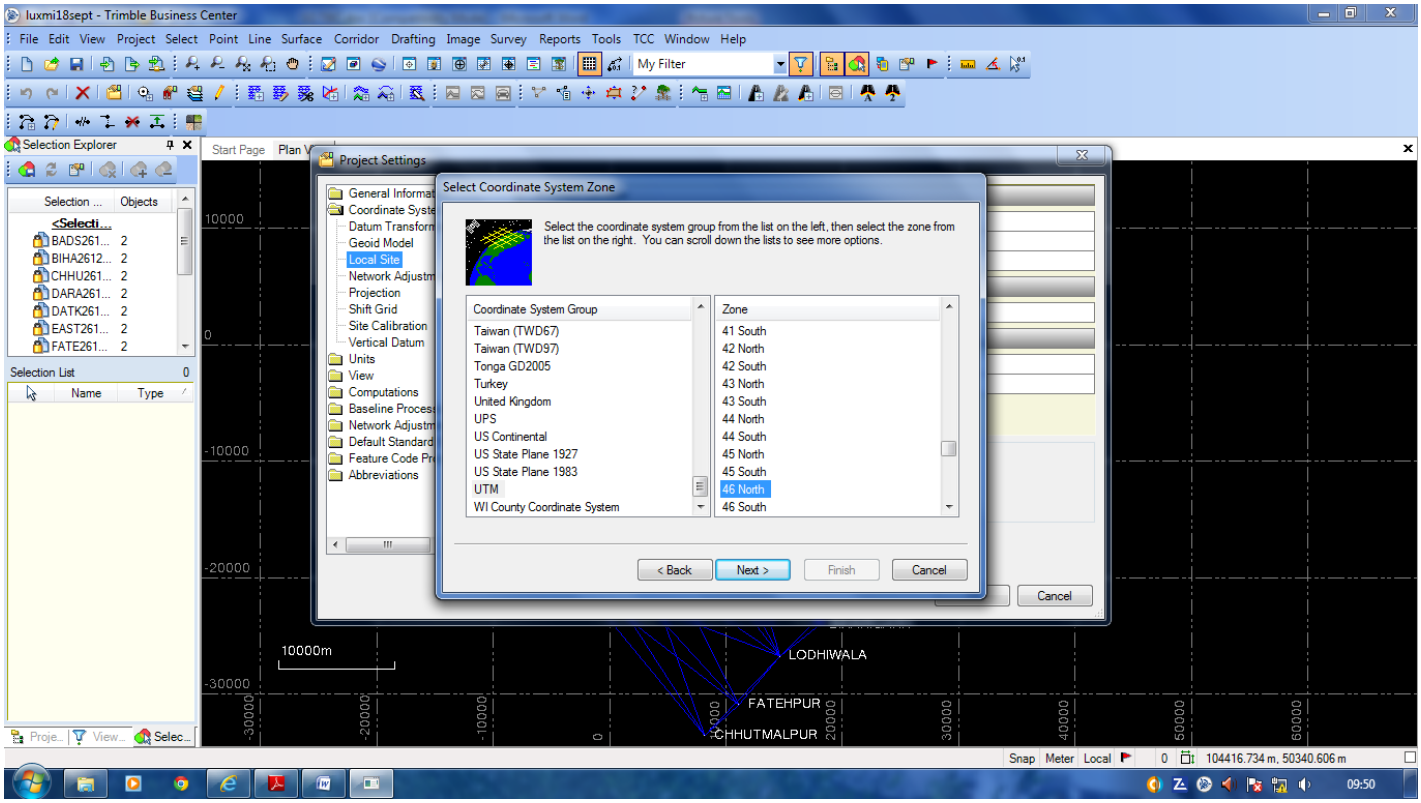
Click Change



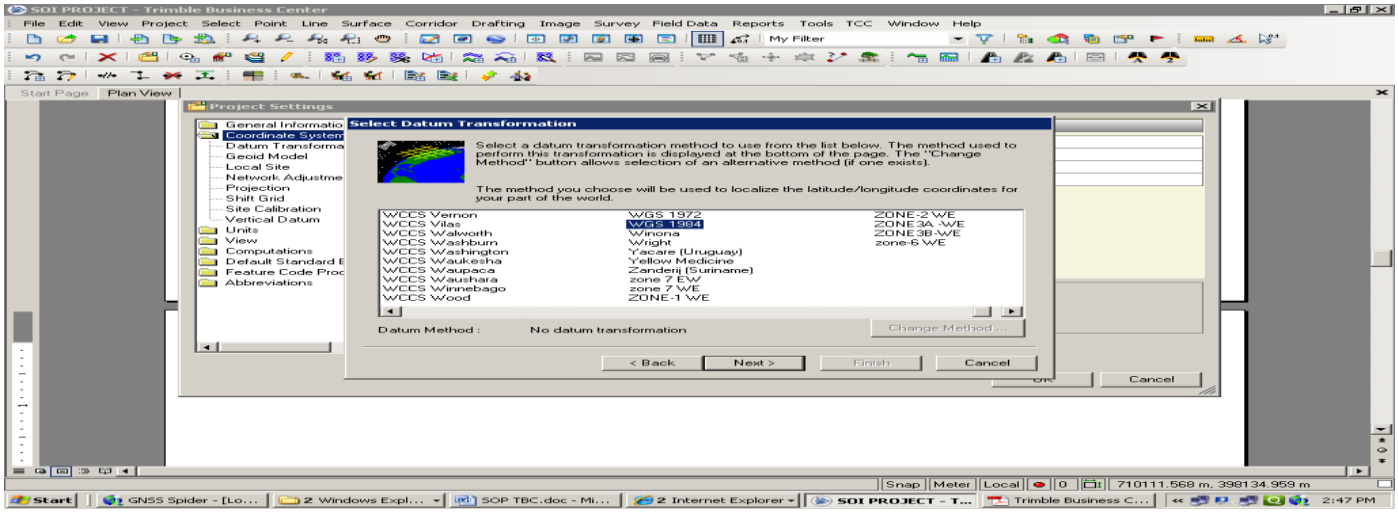
Click Next



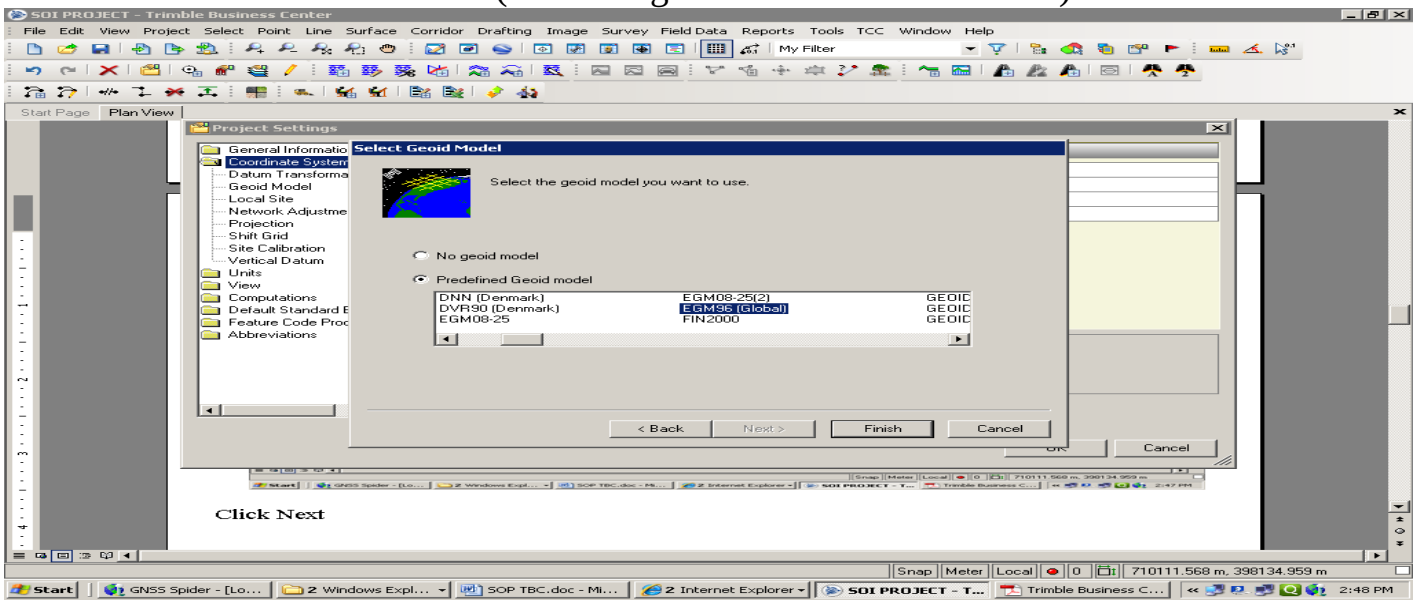
Click Next and select coordinates system as per requirement.



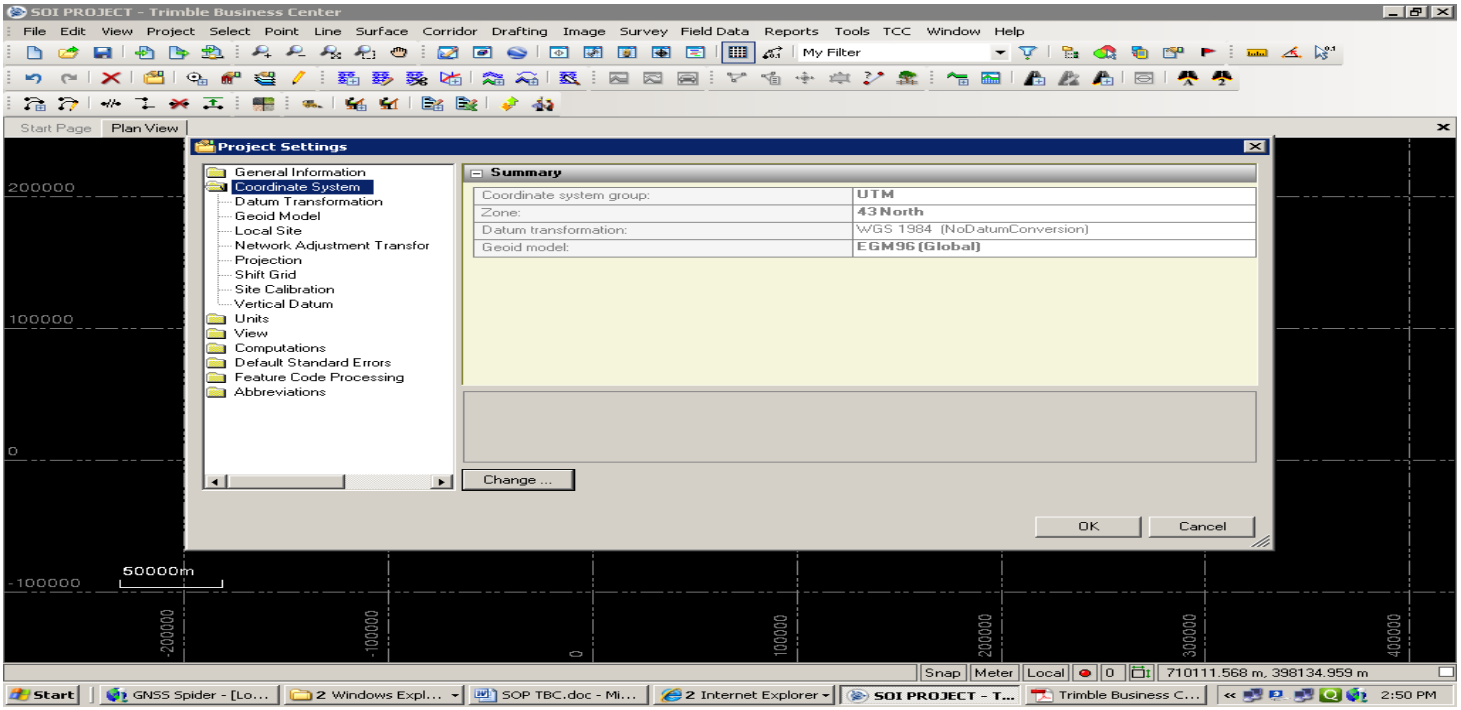
Click Next



Click Next and select Geoid model (the latest geoid model is EGM -2008)



Click Finish.



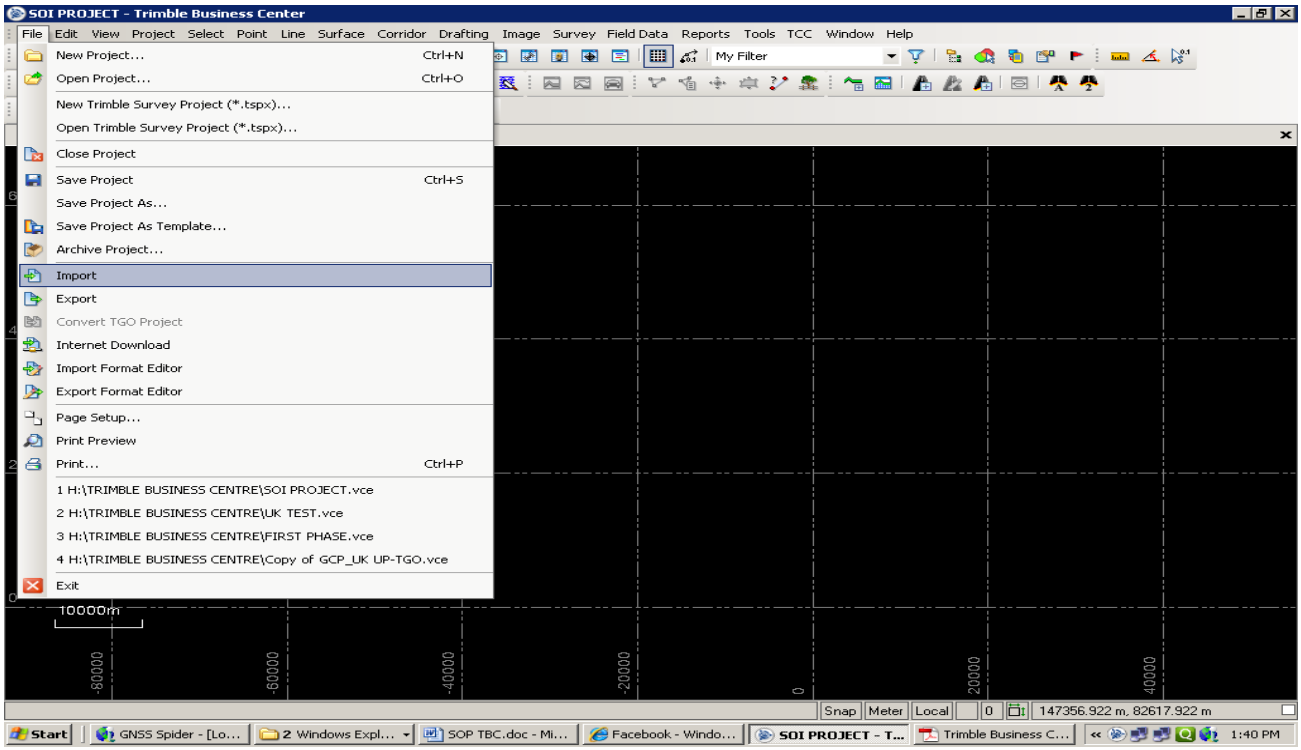
Click OK.

STEP-3

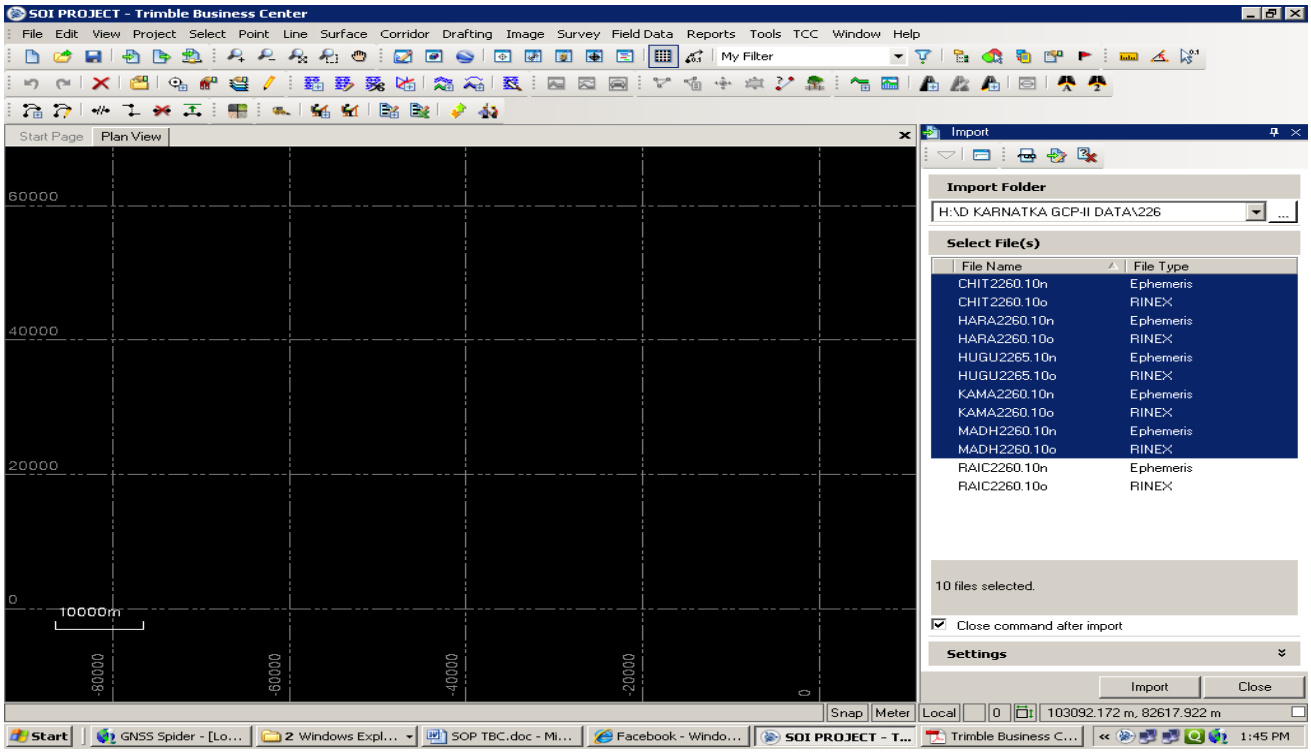
DATA IMPORT

*"TBC can import data in its raw (*dat,*.T01,*.T02) as well as in RINEX format"*

1. Menu>File>Import

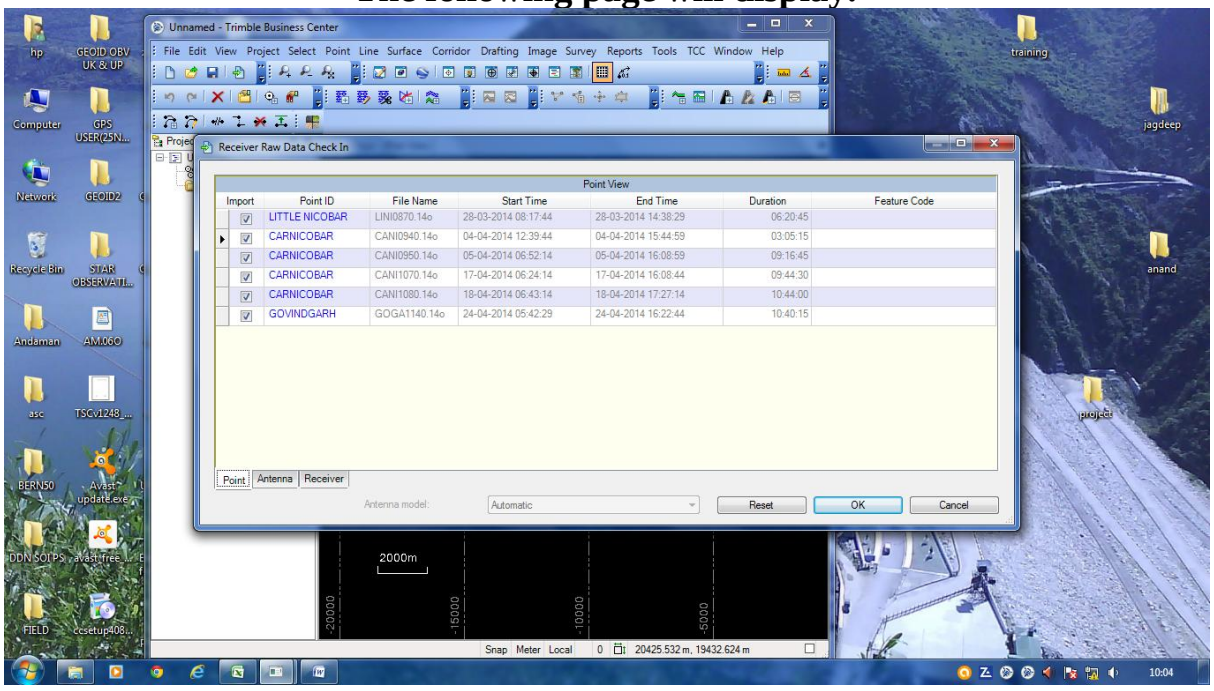


The following page will display.

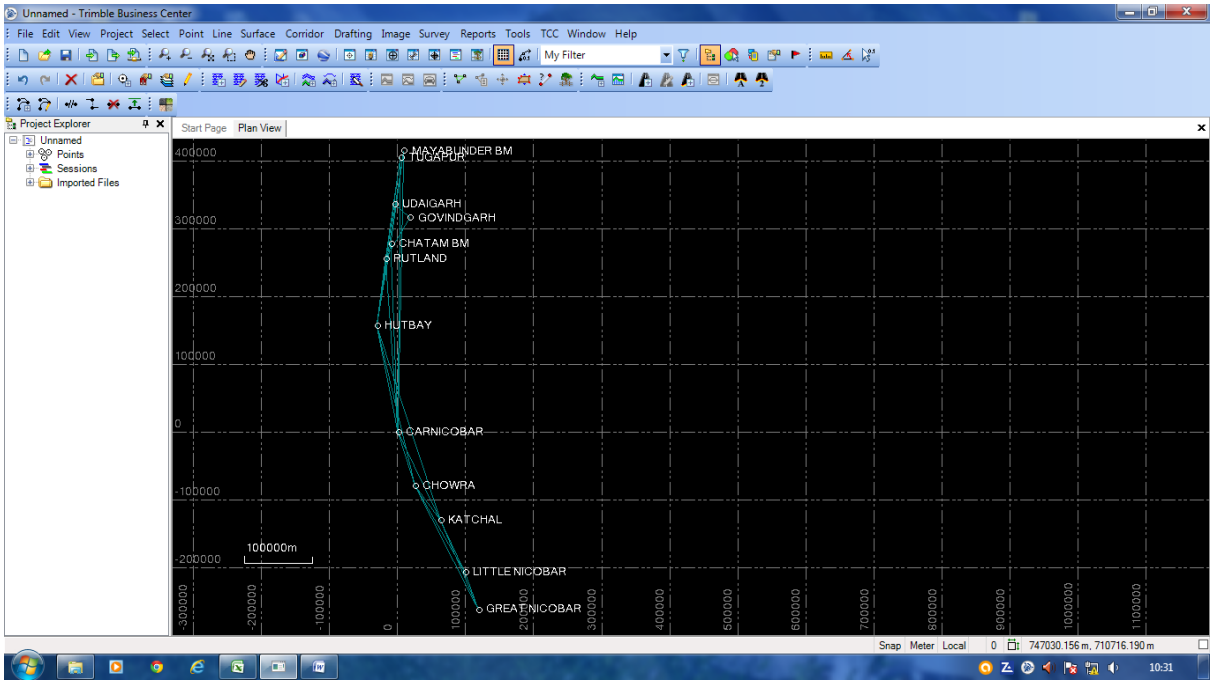


Select Your Data and Then Click Import

The following page will display.



"Here we can edit the point id & instrument height if required and details regarding the field observation can be checked."
THEN CLICK OK.



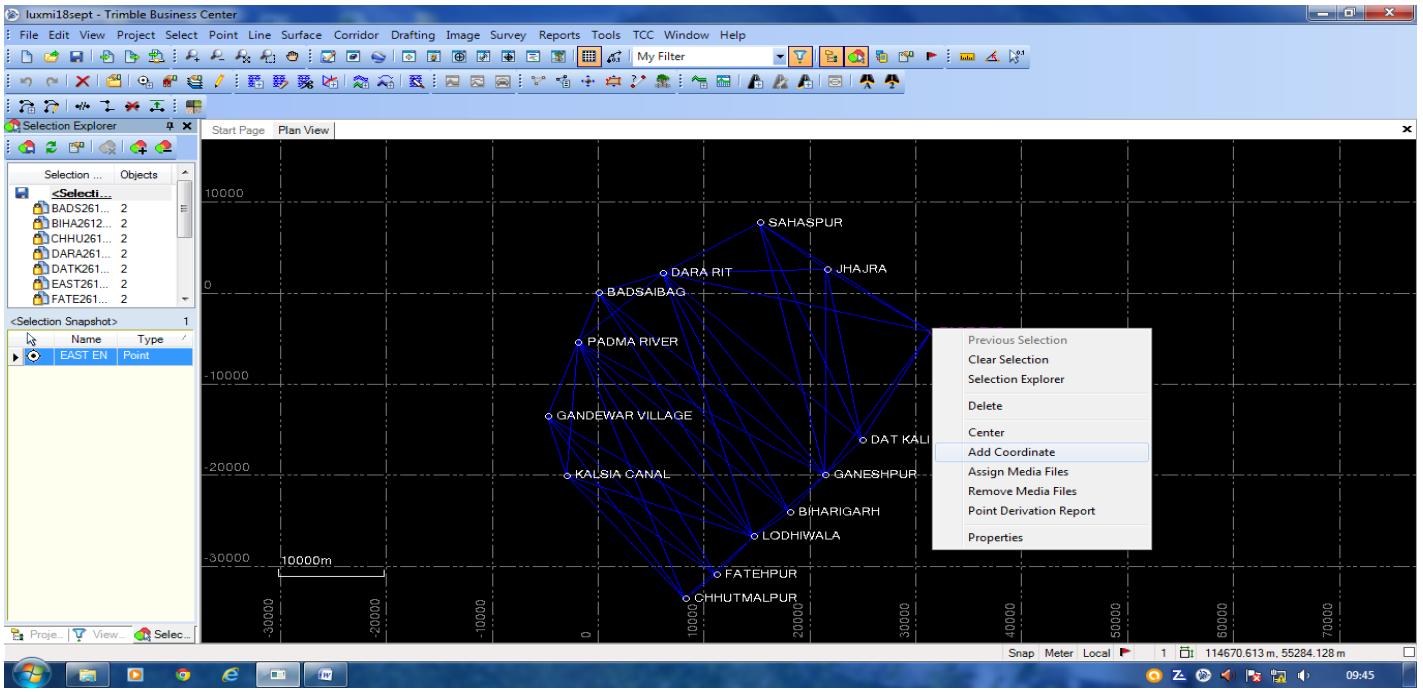
(After the raw data files are imported, the plan view shows all potential baselines (unprocessed base lines) in green color in the survey network. Because the data is raw static data, the baselines must still be processed.)

STEP-4

PROCESSING OF BASELINE

1. **Click Add co-ordinate button**

Note: "It can be done also by selecting the point and then "right click>Add-coordinate" command"



Add the known coordinates

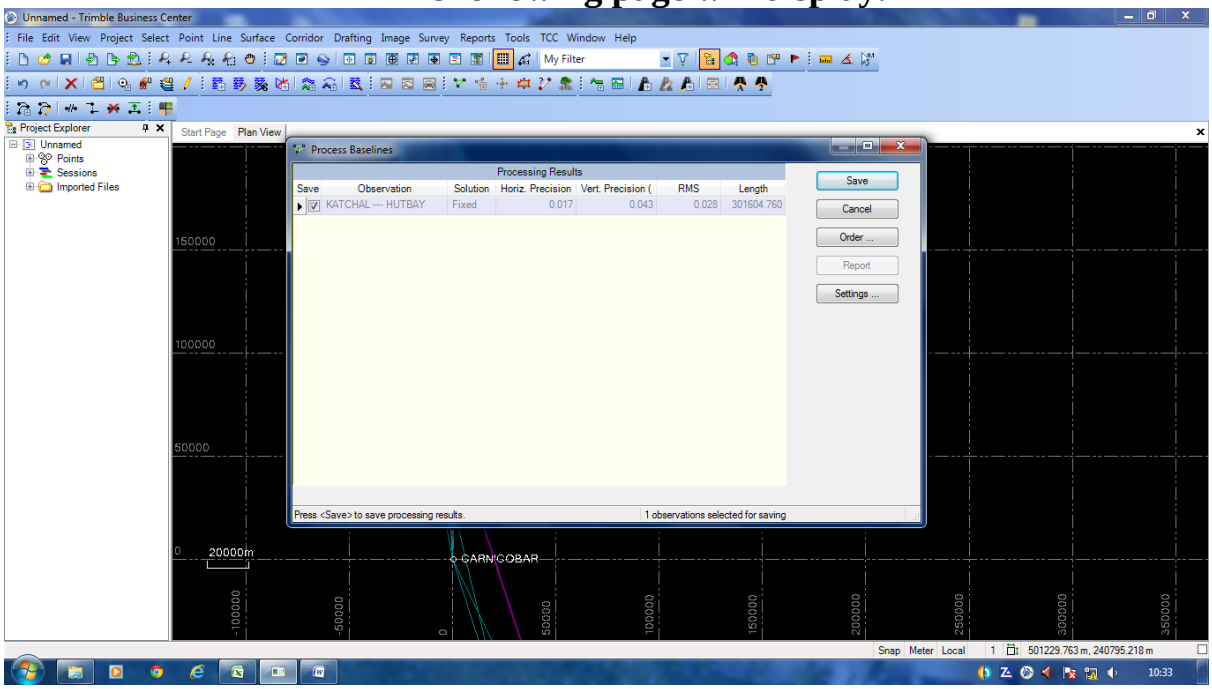
Select Co-ordinate Type ➔ Global

Key in your "Latitude, Longitude & Height" and assign it as Control Quality.

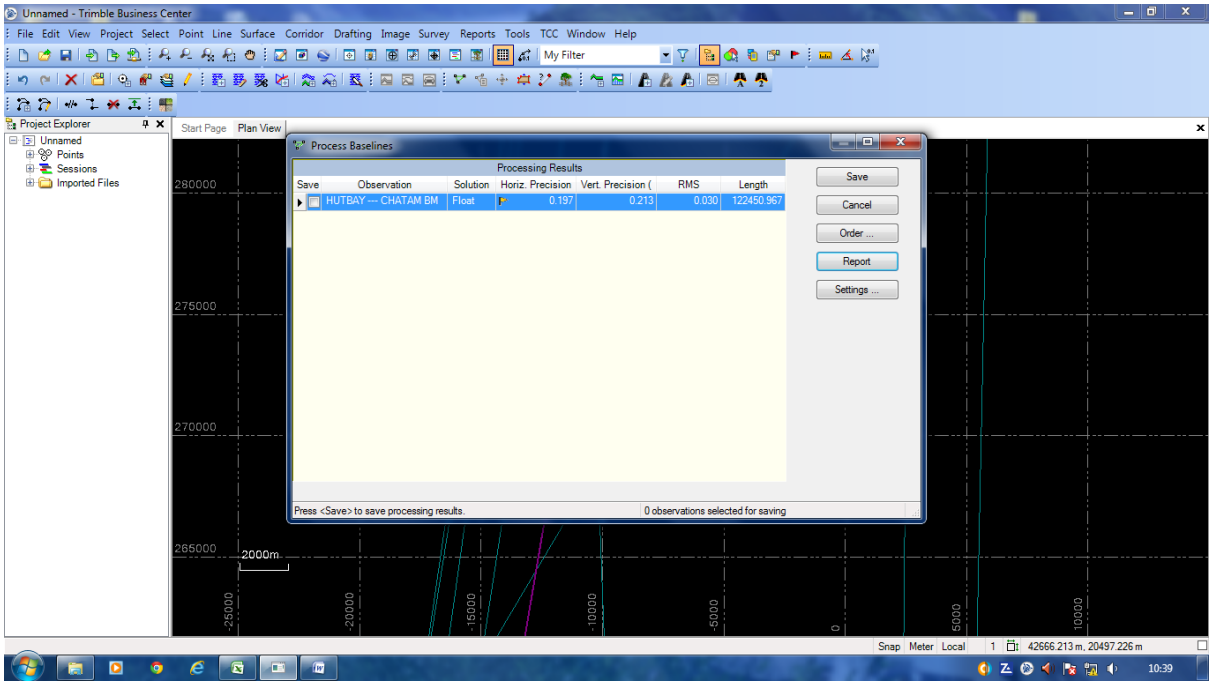
Click ➔ Ok

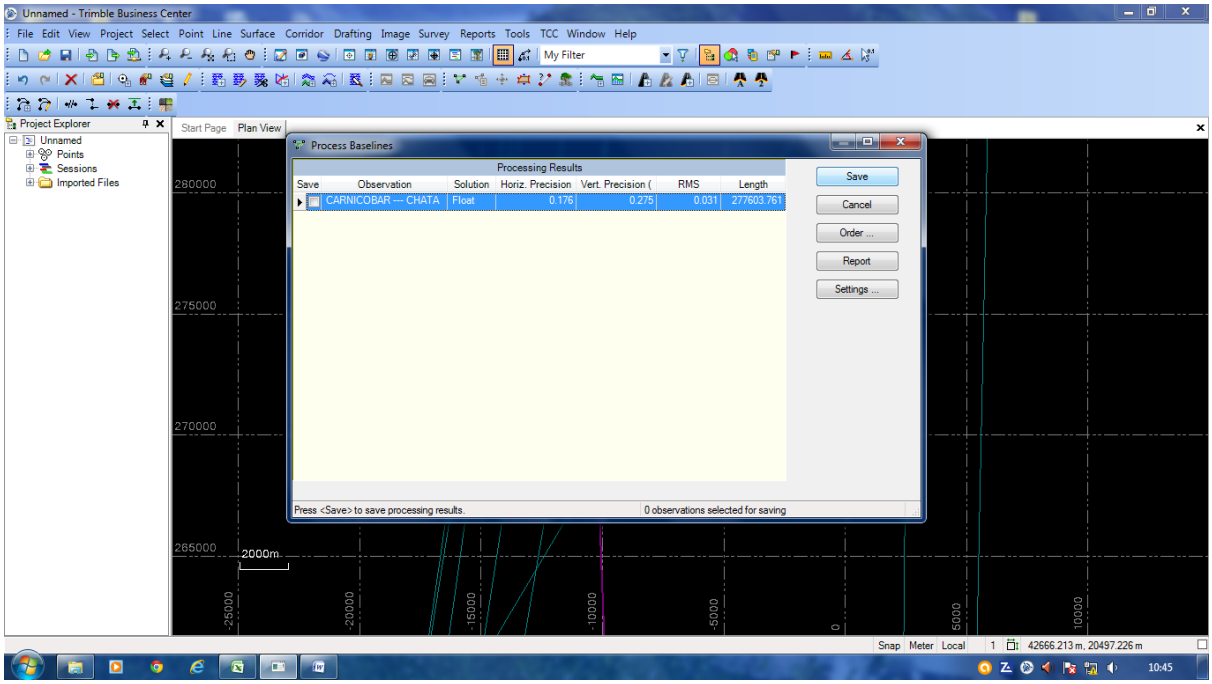
2. Menu>Survey>Processing Baselines

The following page will display.



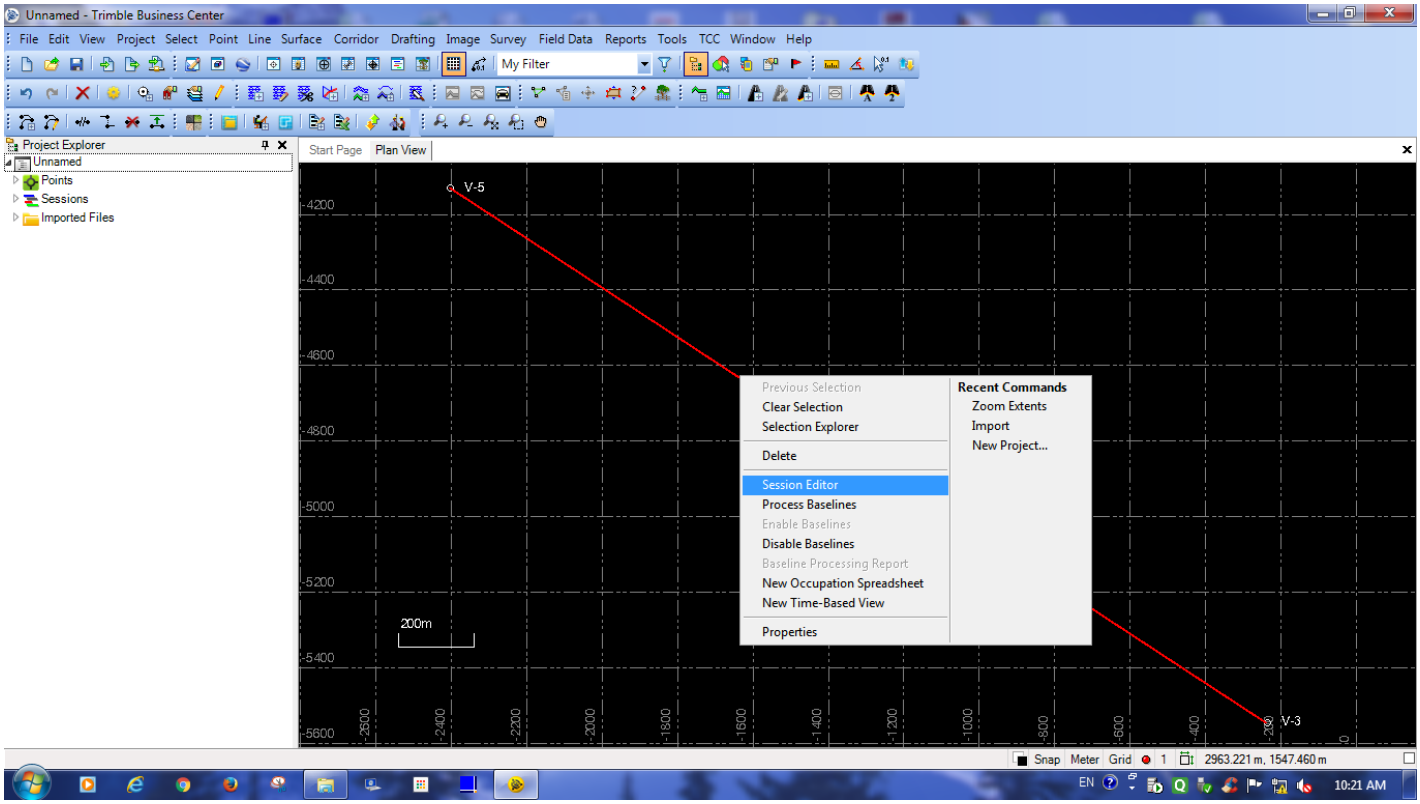
Click Save.
Go to next line





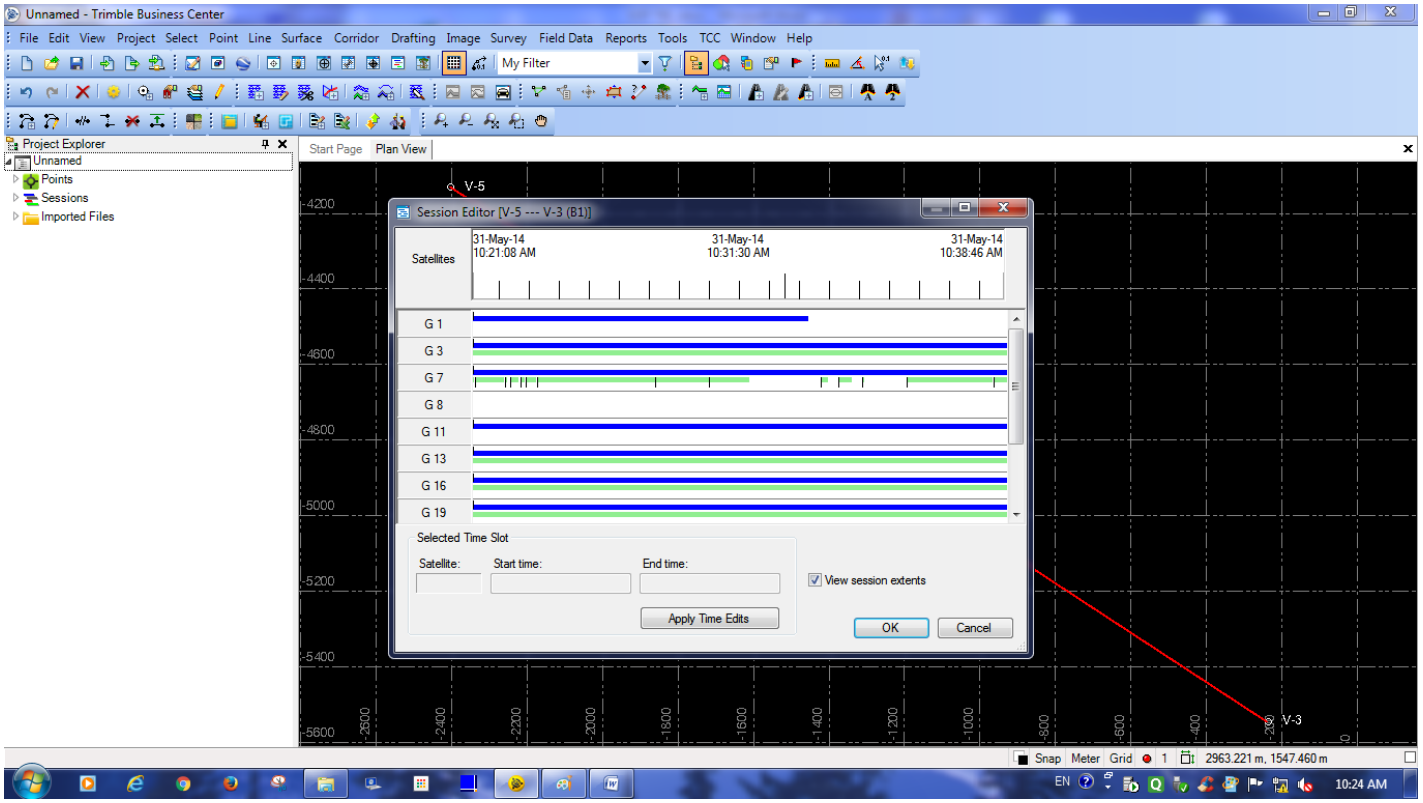
If the solution is fixed and there is not any flag symbol on the baseline save the line , otherwise rectify it with the help of elevation mask and session editor.
NOTE: The blue potential vector showed that the unprocessed base line is processed now.

To open session editor >select baseline>right click the selected baseline>click on session editor



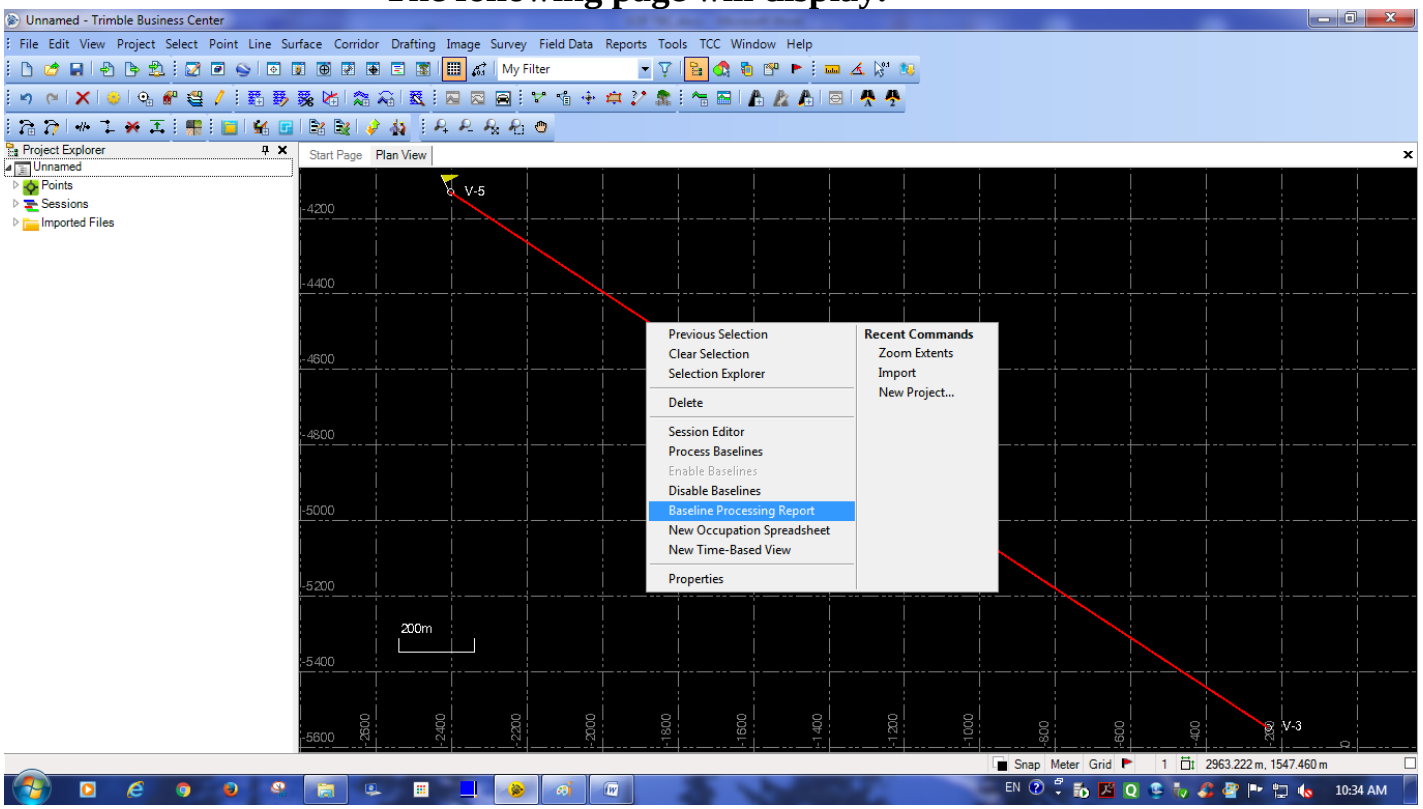
The following page will display.

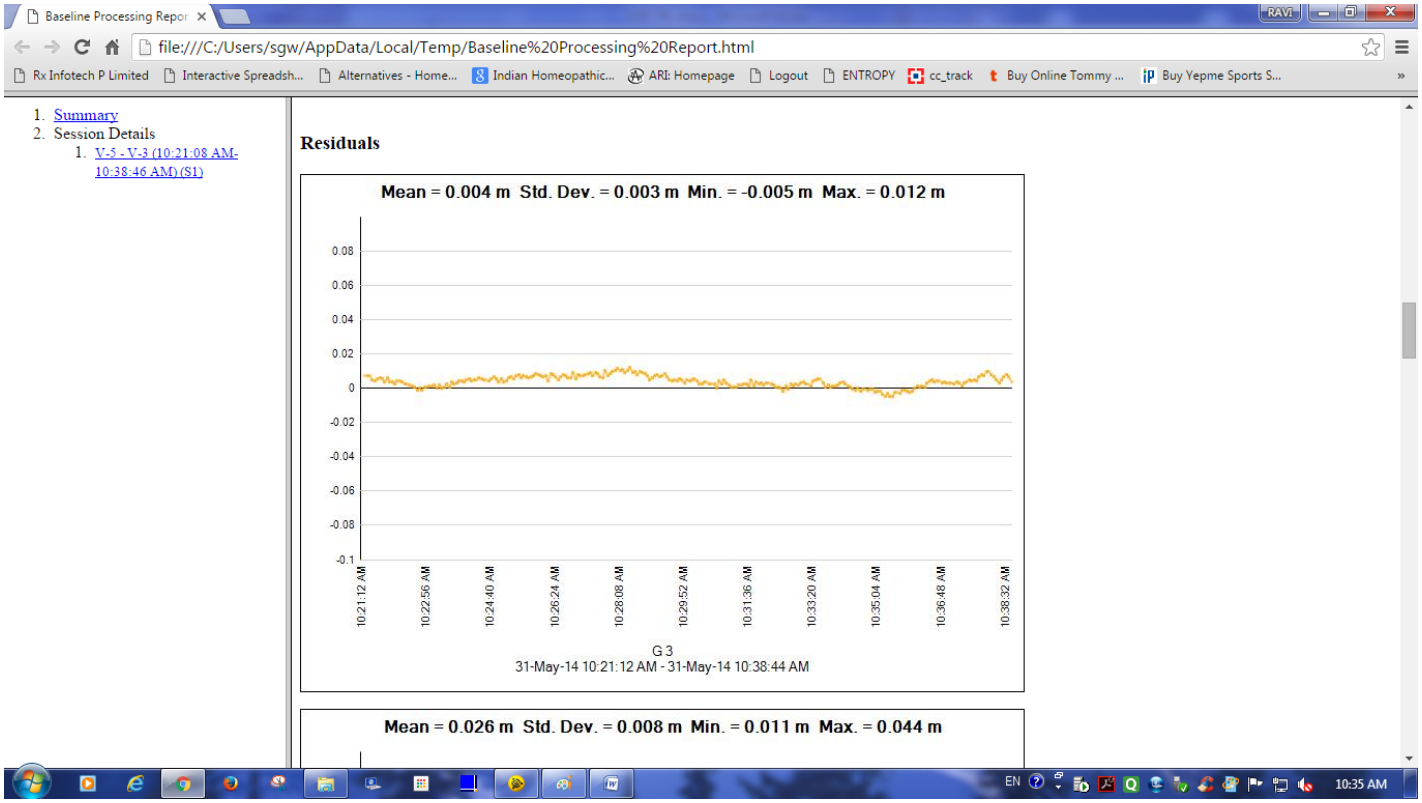
Here ,satellite for complete duration of observation or part of it can be disabled



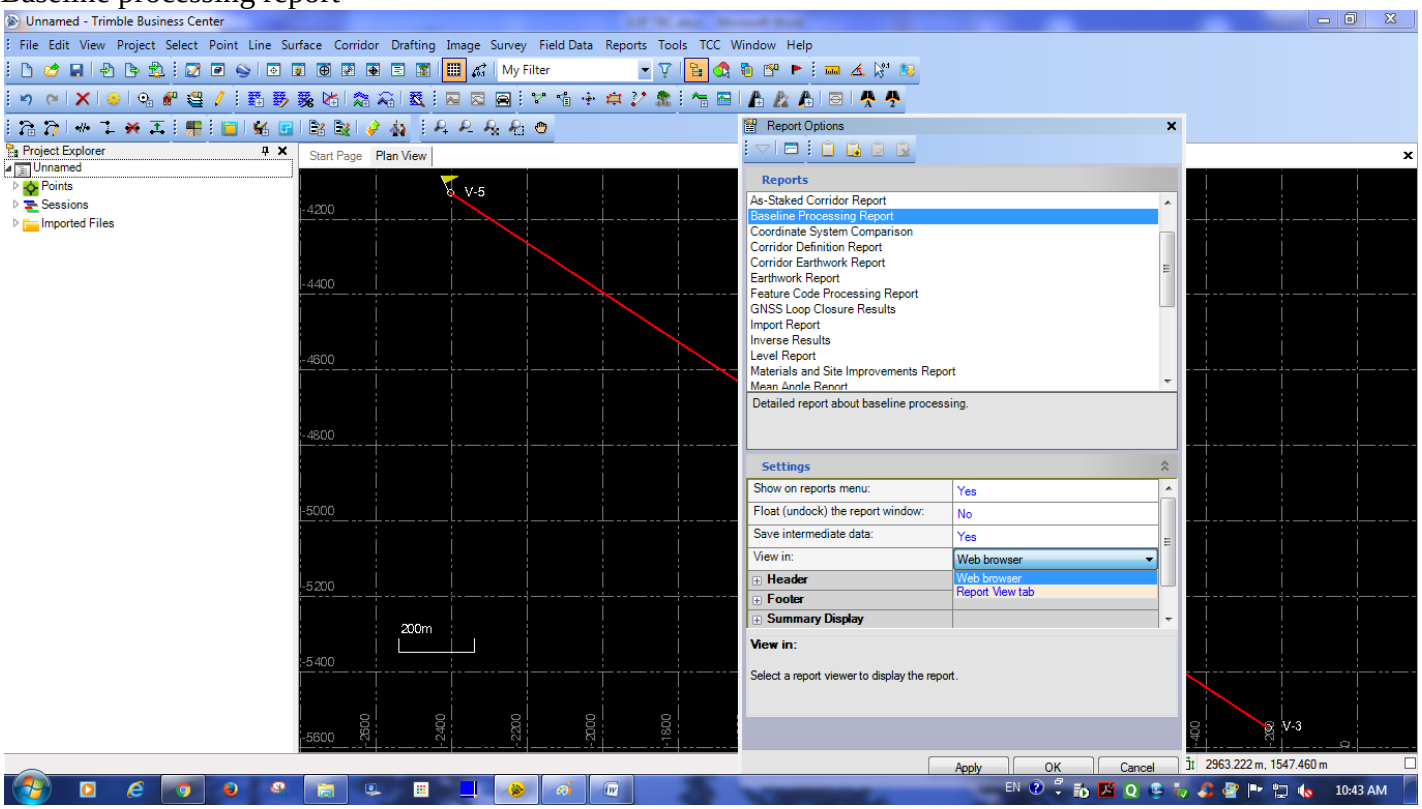
To chose which satellite or part of it to be disabled> select baseline>right click the selected baseline> click on baseline processing report

The following page will display.



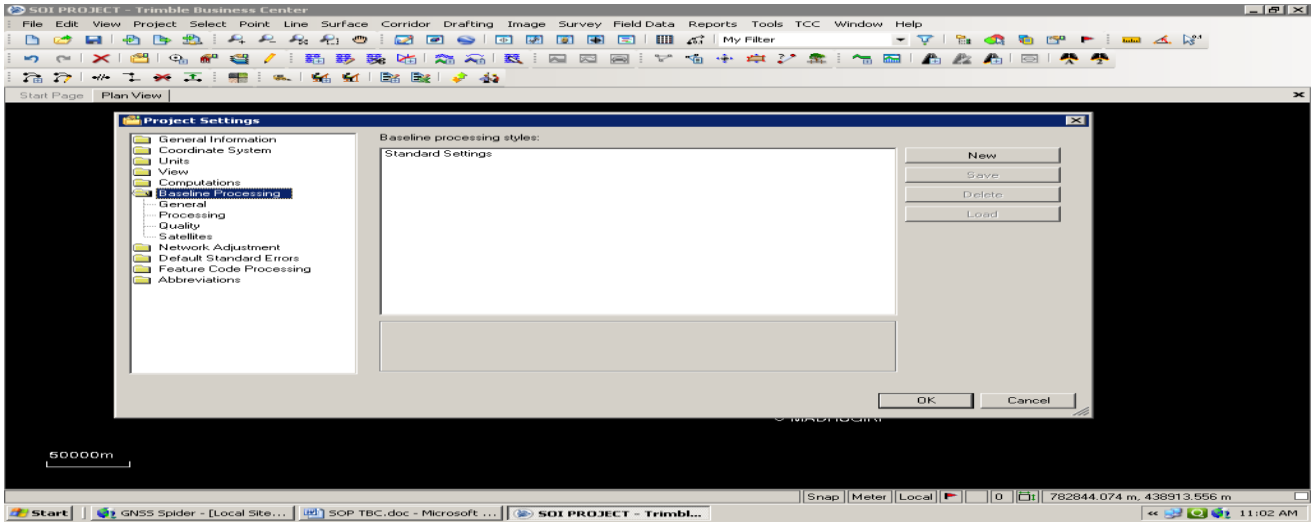


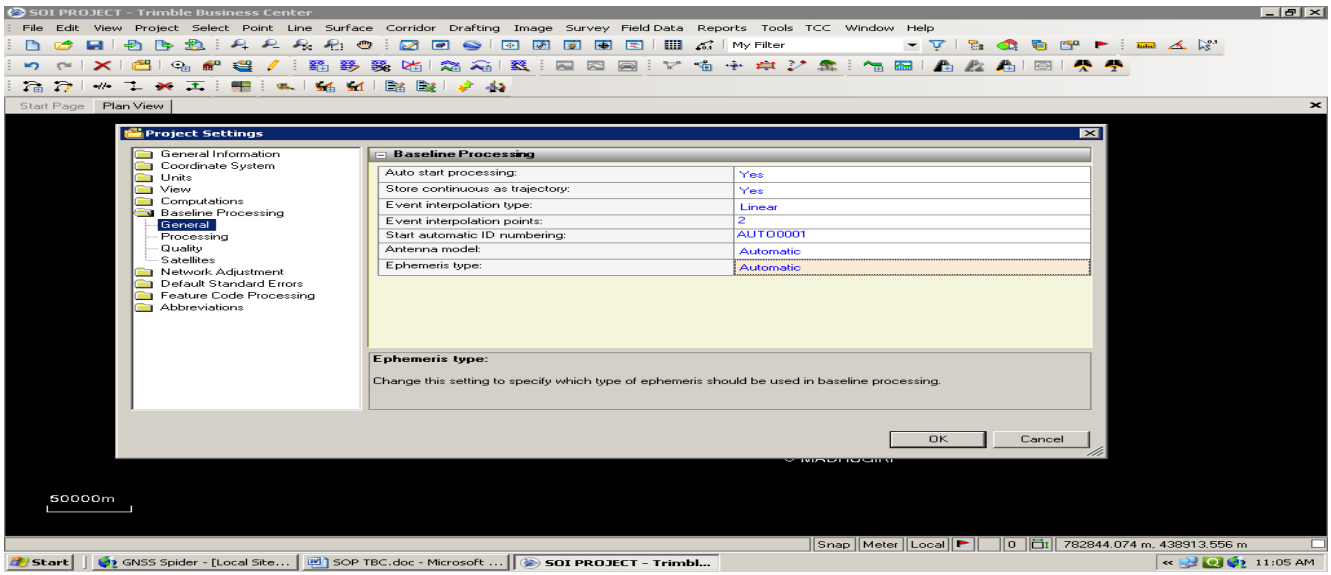
Here, the time for which residuals are not near the zero line has to be disabled in session editor.
The baseline processing report can be opened in web view or tab view >Reports(in main menu)>Report options>Baseline processing report



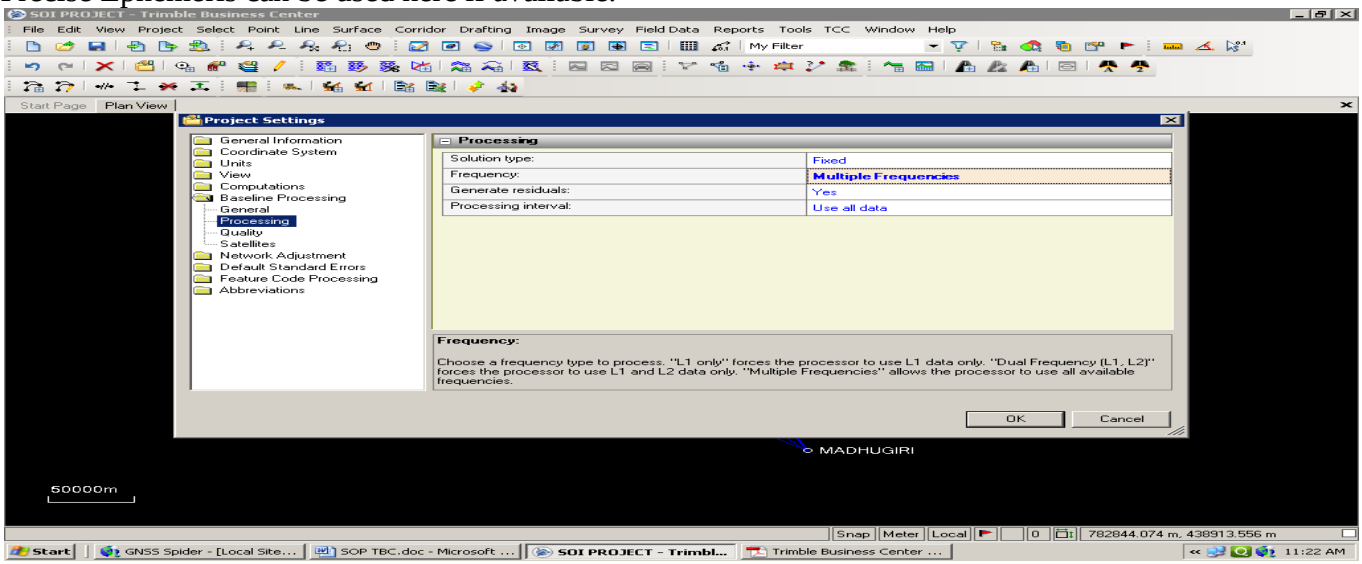
NOTE: The blue potential vector showed that the unprocessed base line is processed now.

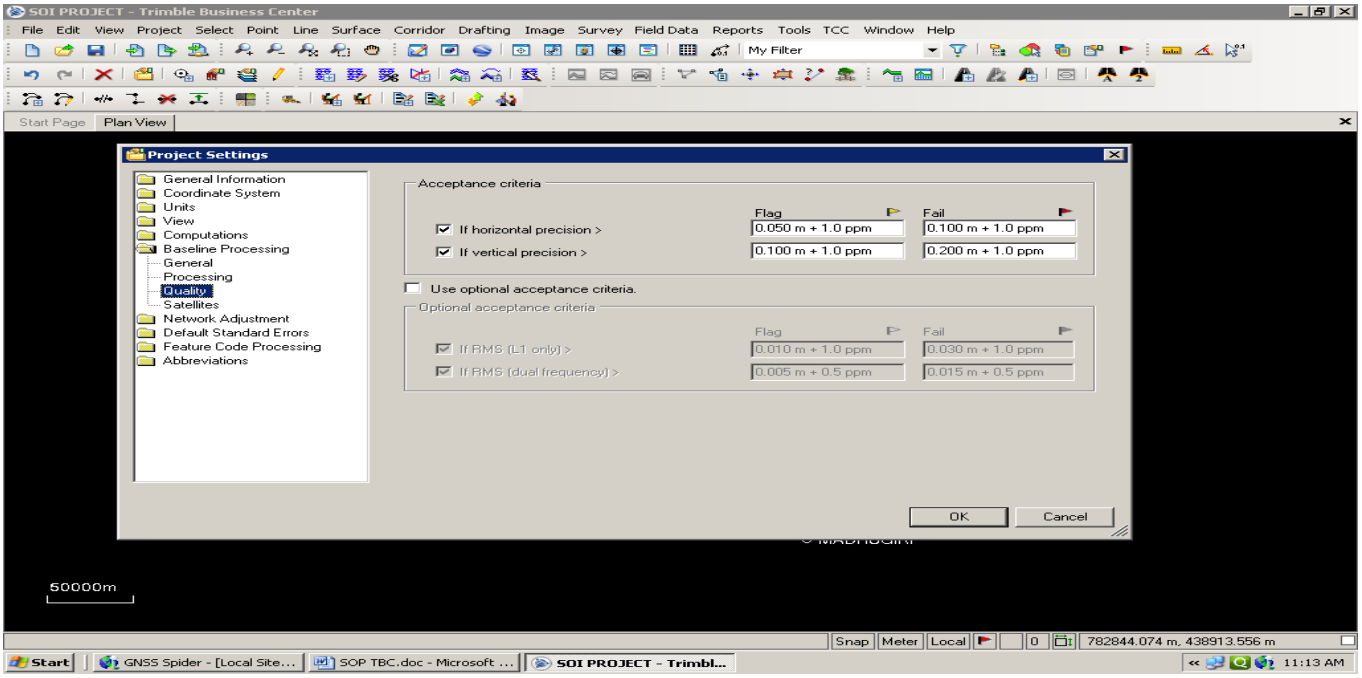
*Select types of ephemeries through which you want to process ,e.g. broadcast and precise.

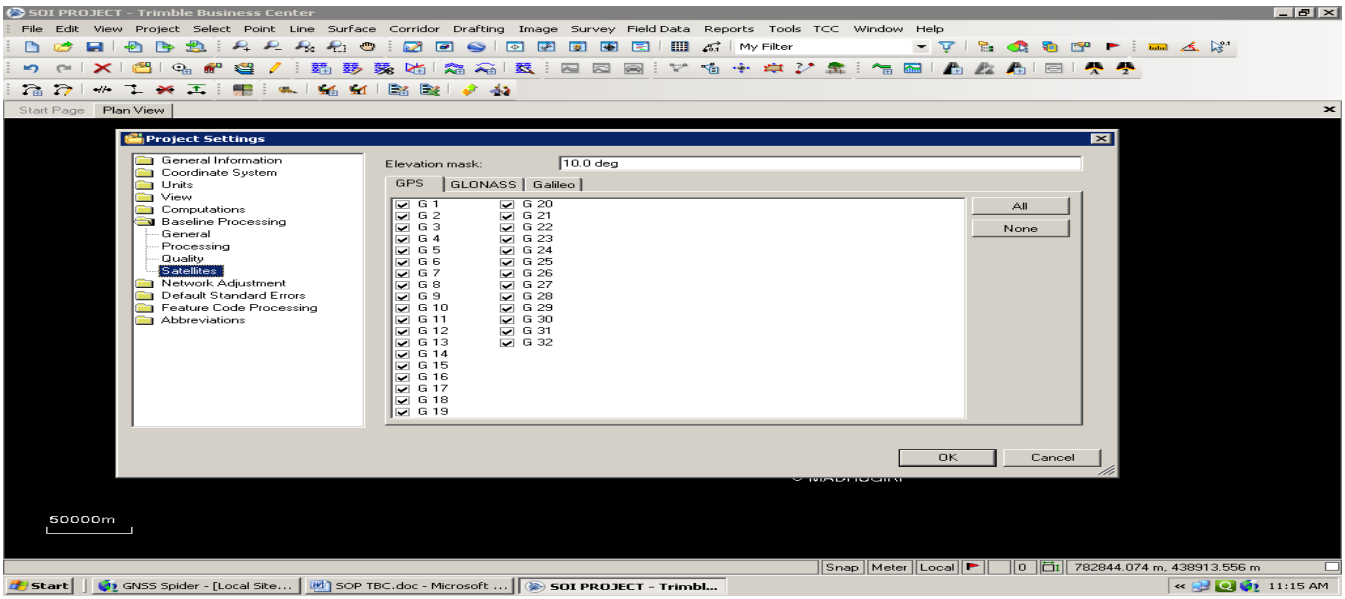




Precise Ephemeris can be used here if available.







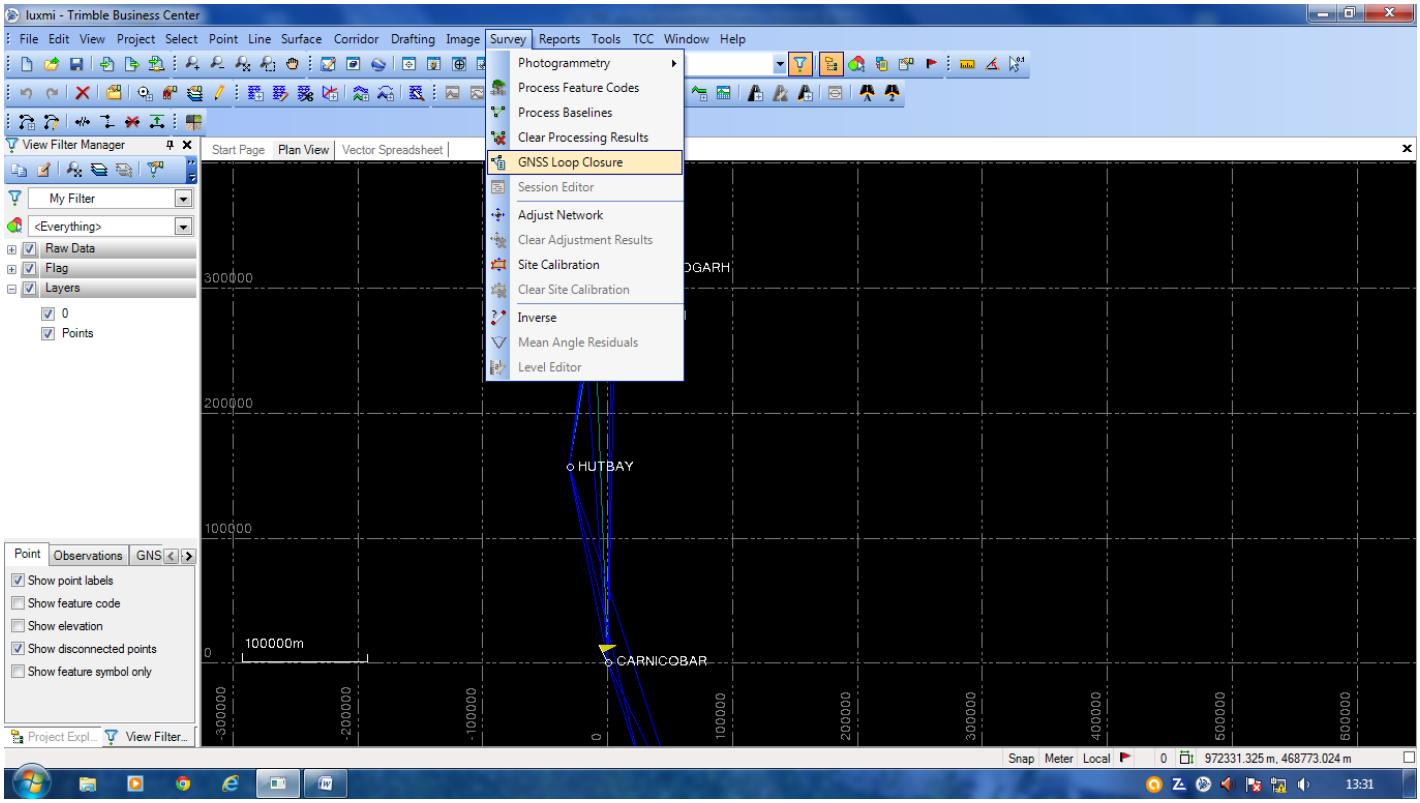
Elevation mask can be changed here, if required.

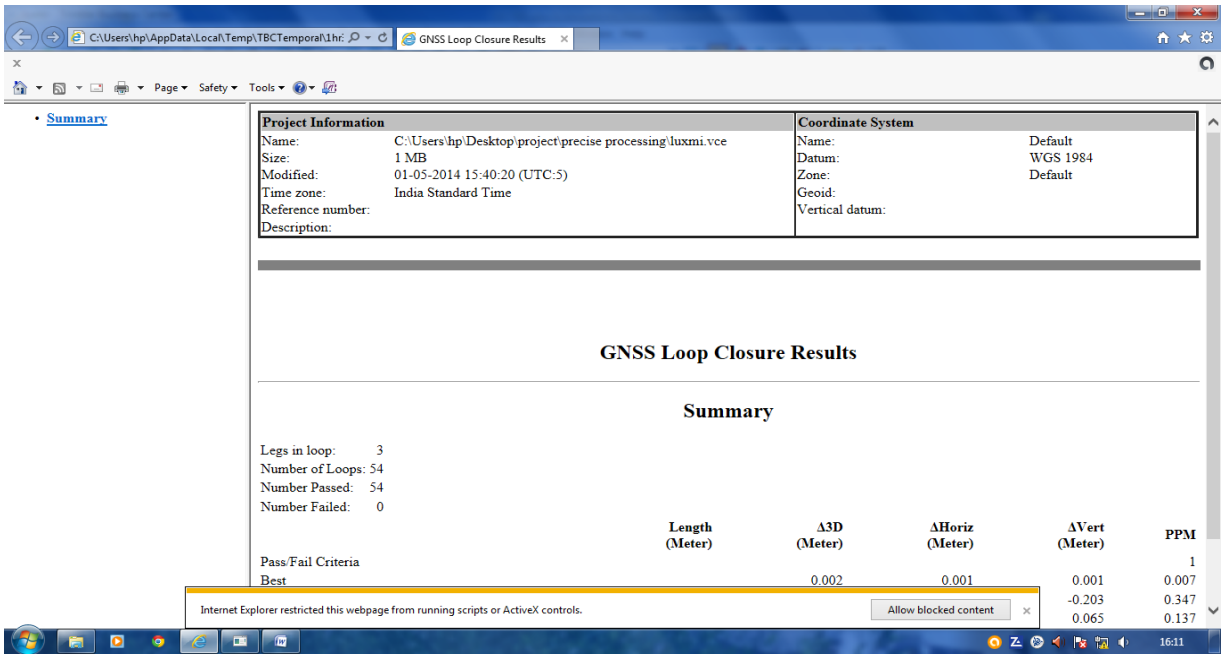
Loop Closure

Now before going for the adjustment the loop closure must be checked. The Loop Closure Results report is a useful way to find large blunders in the data set, Such as errors with antenna heights, one point with different name or different point with same name.**However,loop closure can only be checked in case of close figure For this select the command**

Menu> Survey> GNSS loop closure

The following page will display.





STEP-5

NETWORK ADJUSTMENT

"Once all baselines in the control network have been processed and reviewed, you can adjust your survey network"

SURVEY> ADJUST NETWORK

Note:
If the elevation (MSL height) of a station (Bench Mark) is available, then the adjusted vertical control can be obtained from the network up to sub metre level accuracy.

Click Add co-ordinate button

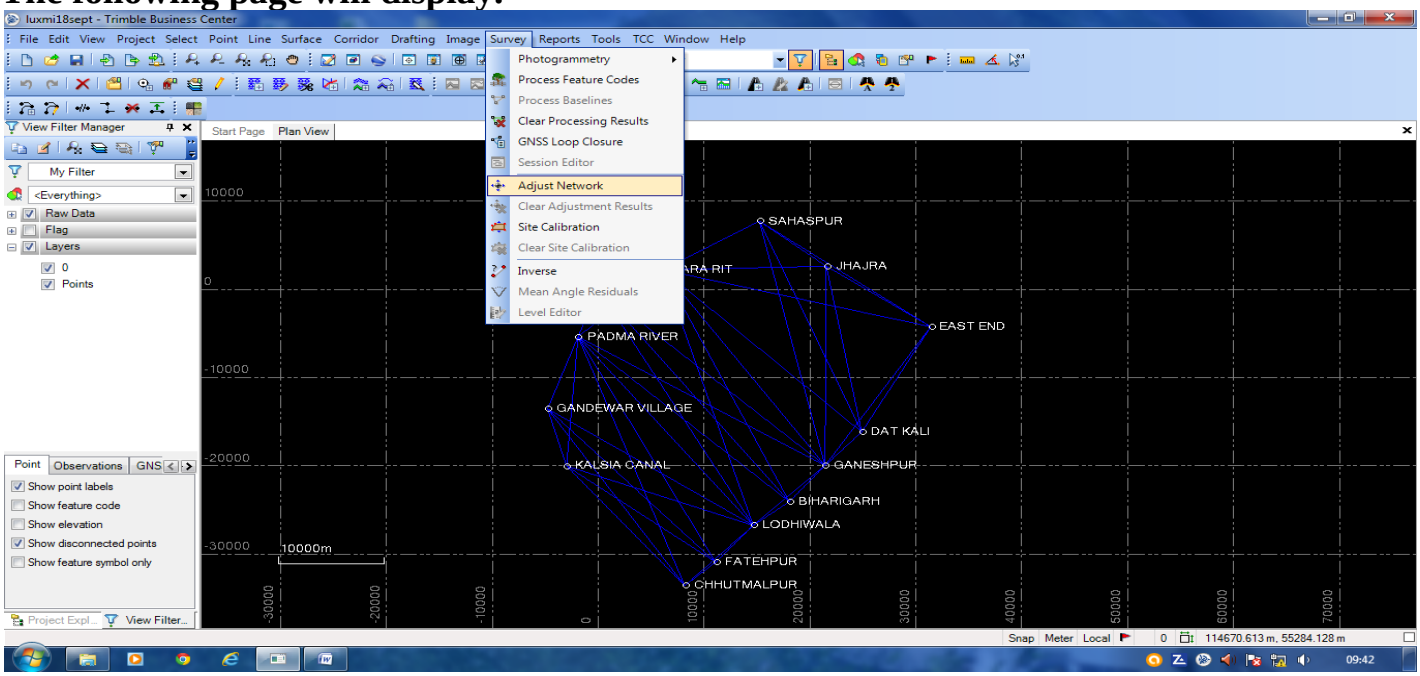
Note: "It can be done by selecting the point and then "right click>Add-coordinate" command"

Select Co-ordinate Type ➔ Gird

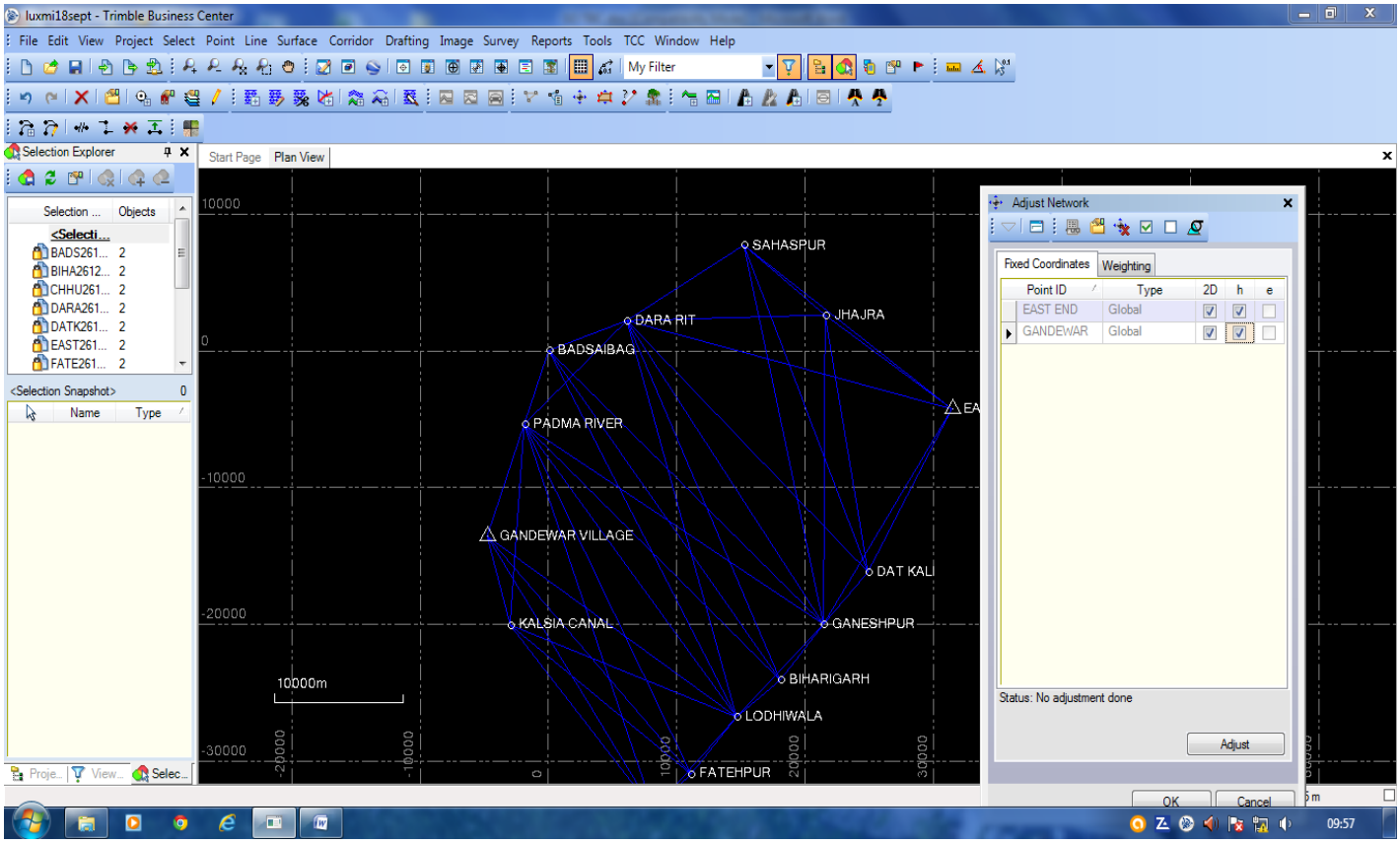
Key in your "MSL Height" and assign it as Control Quality.

Click ➔ Ok

Select the following command
Menu>Survey>Adjust Network
The following page will display.

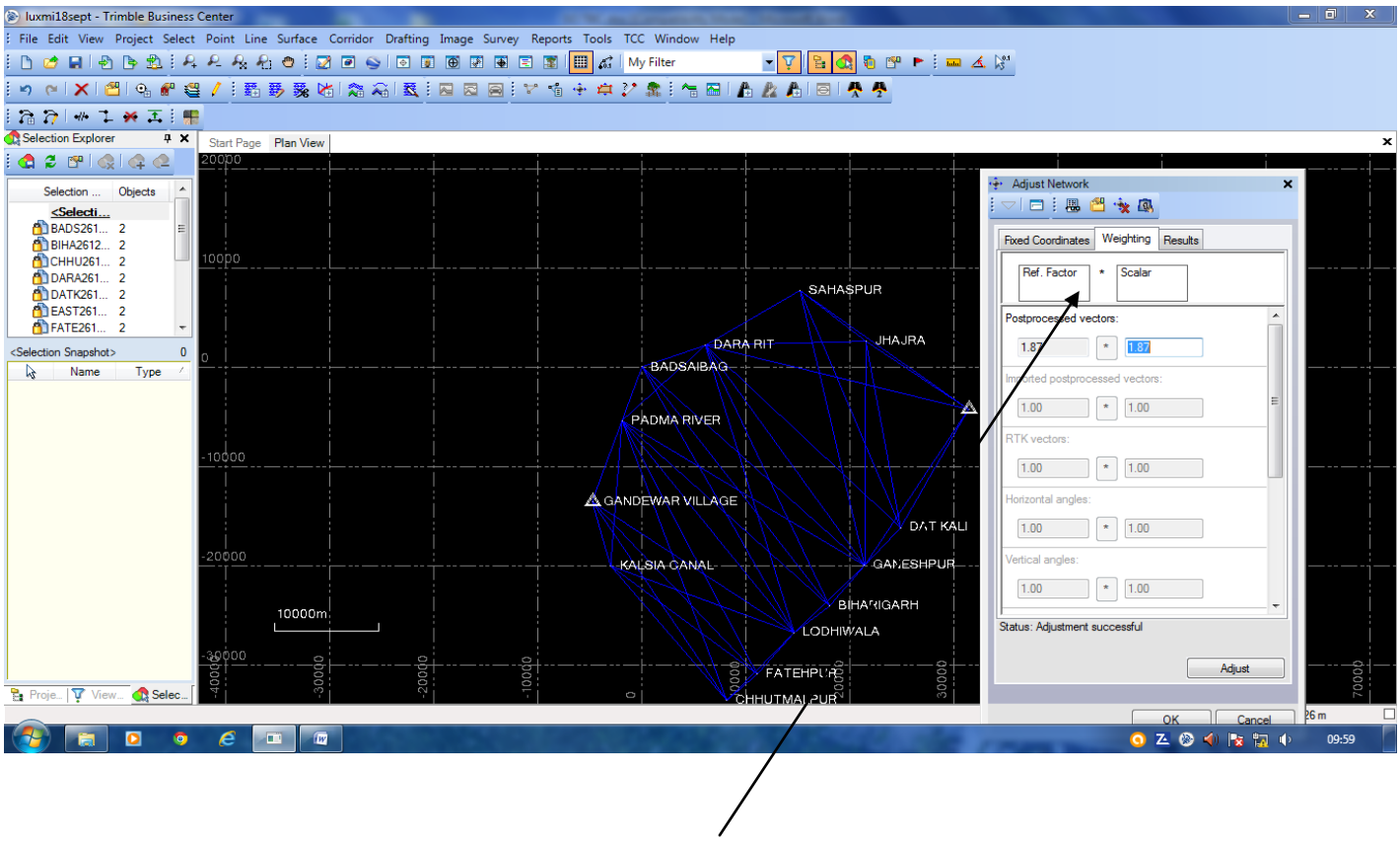


The following page will display.



Check on ➔ "2D & h" box if MSL Height to be fixed then check on "2D & e" box
Click ➔ Adjust

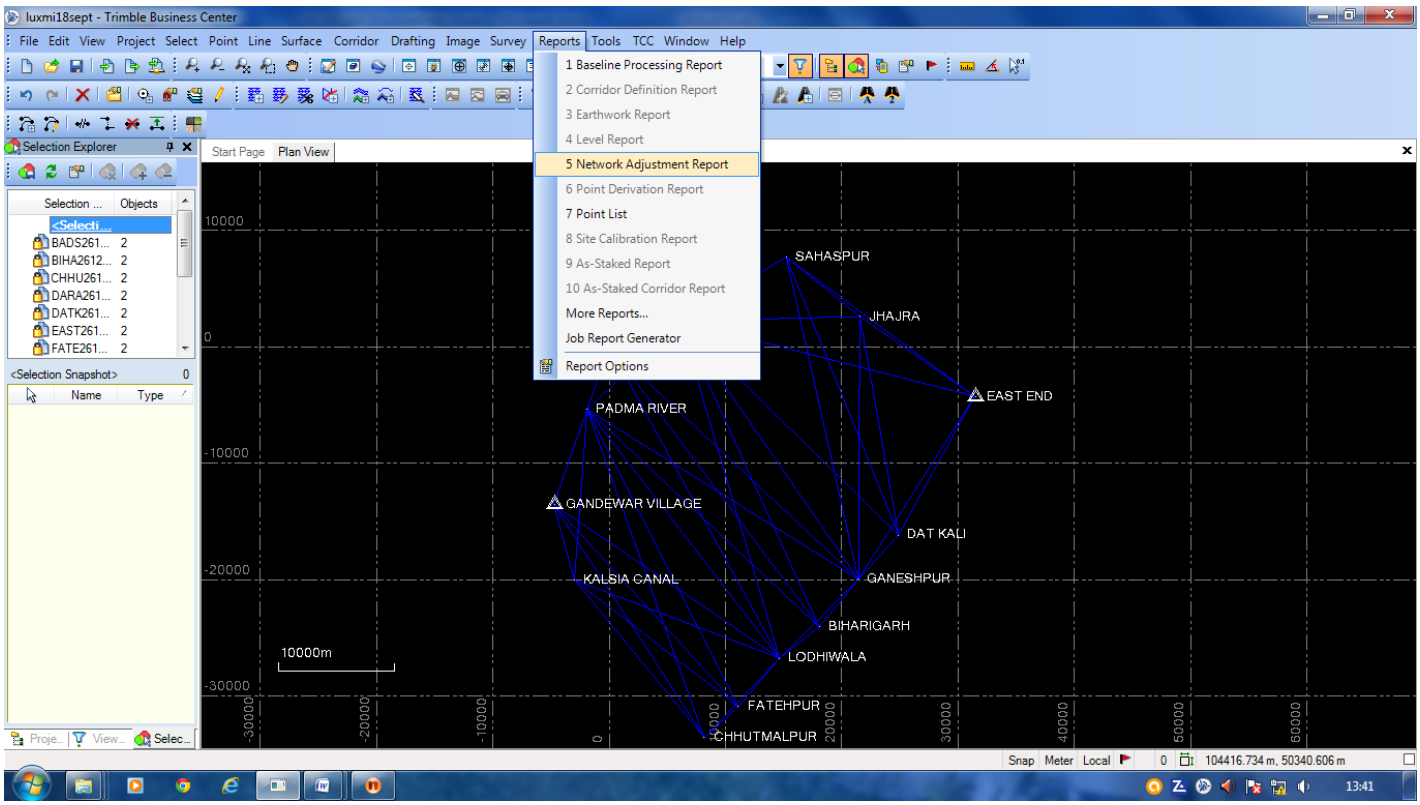
NOW Click ➔ Weighting This step is required if the value shown below the Postprocessed vector (1.87 in this case) is not coming near about 1



Make a click on * in Post processed vectors tab:

Now again “Adjust” the data

Note: For Adjustment Report



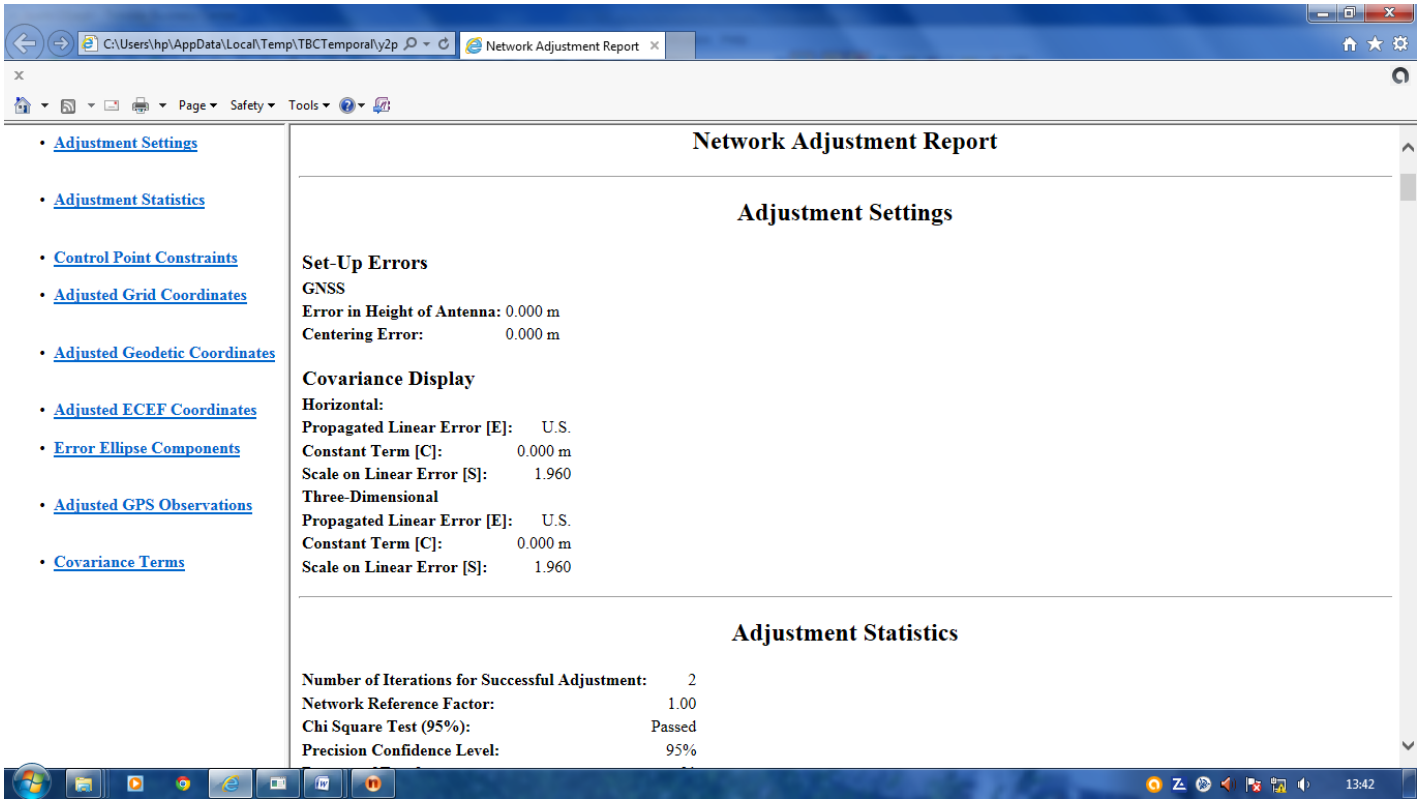
Point to be checked in Network Adjustment Report

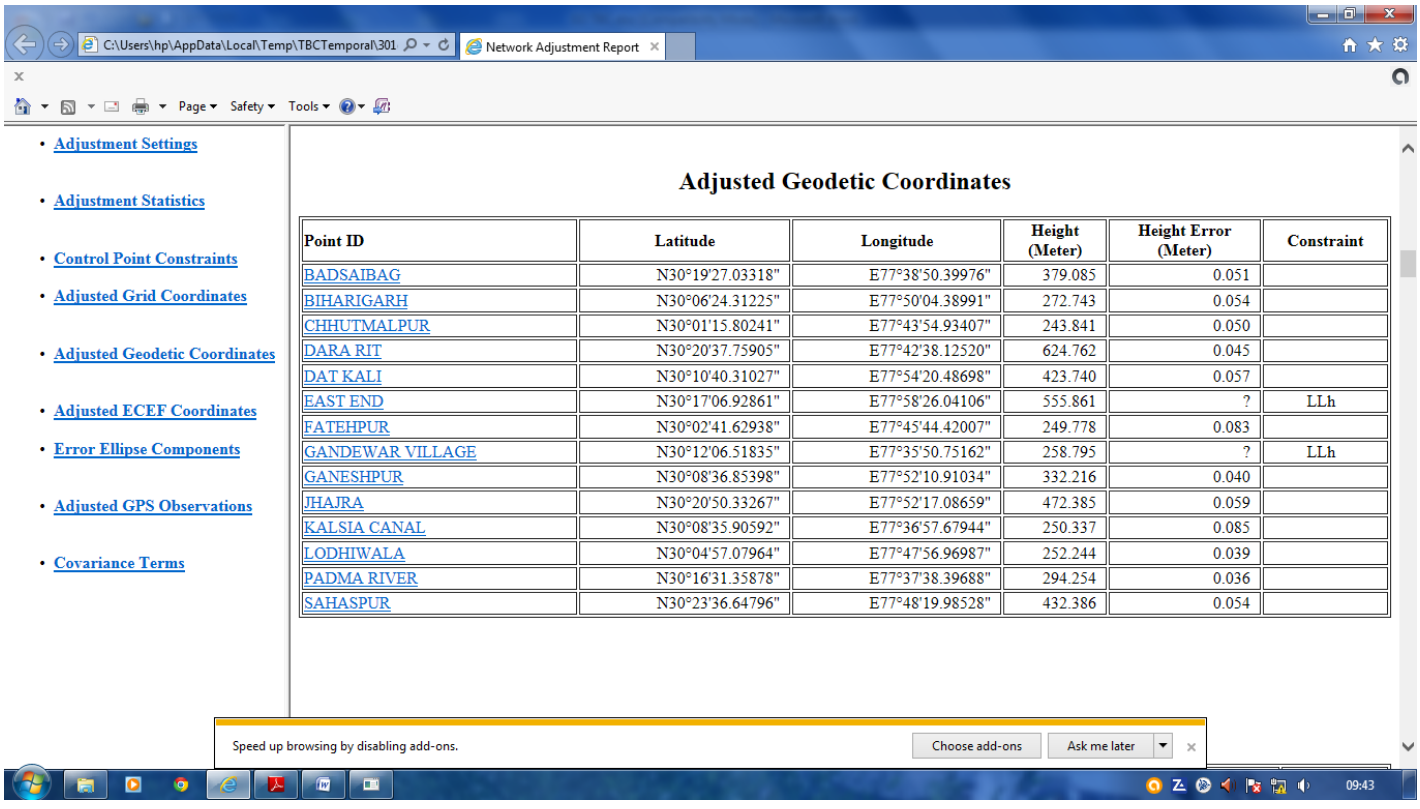
Network Reference Factor must be one or near to one

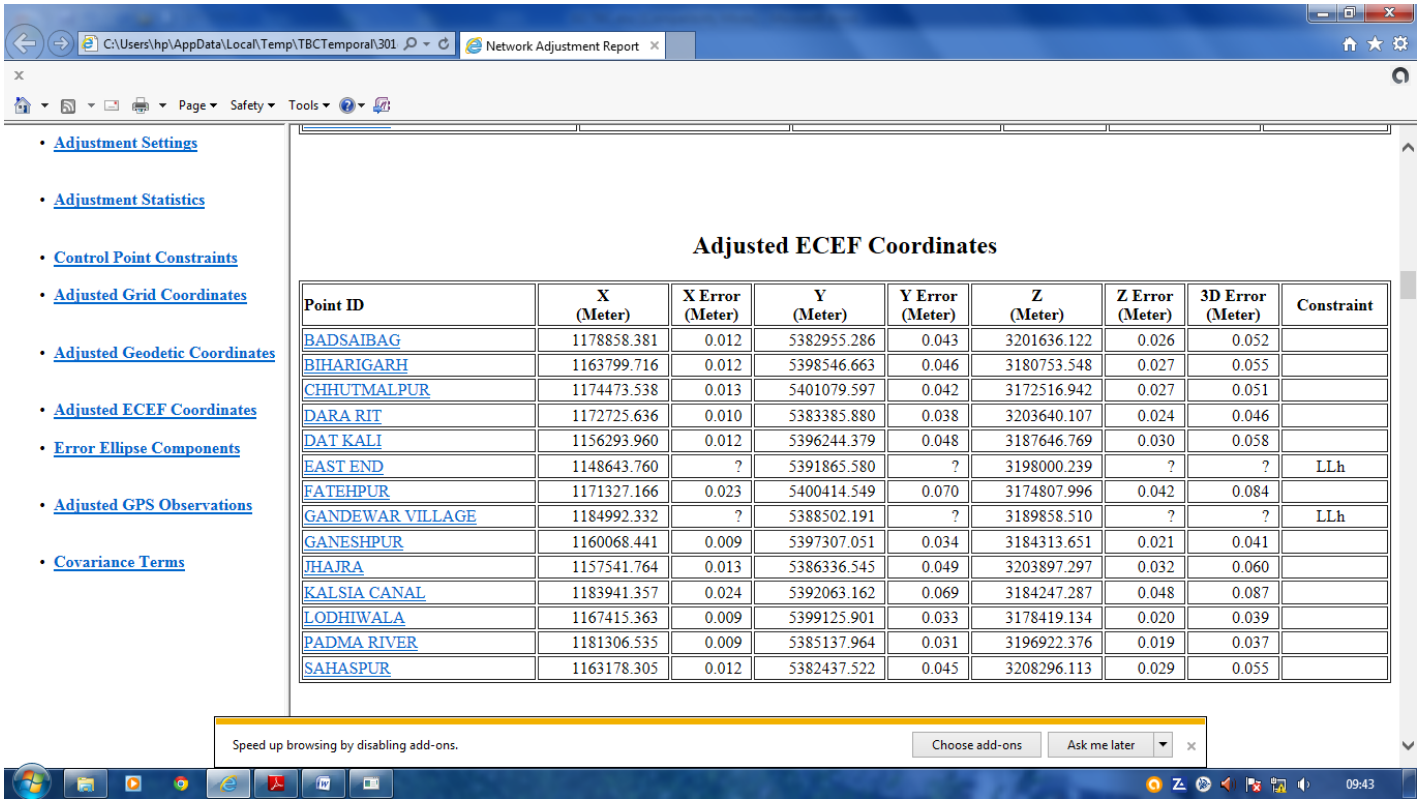
Chi Square Test must be passed

Horizontal and vertical error must be in reasonable limit

All vector must be in black colour under Adjusted GNSS Observations


C:\Users\hp\AppData\Local\Temp\TBCTemporal\y2p
Network Adjustment Report
Page
Safety
Tools
Adjustment Settings
Adjustment Statistics
Control Point Constraints
Adjusted Grid Coordinates
Adjusted Geodetic Coordinates
Adjusted ECEF Coordinates
Error Ellipse Components
Adjusted GPS Observations
Covariance Terms
Network Adjustment Report
Adjustment Settings
Set-Up Errors
GNSS
Error in Height of Antenna: 0.000 m
Centering Error: 0.000 m
Covariance Display
Horizontal:
Propagated Linear Error [E]: U.S.
Constant Term [C]: 0.000 m
Scale on Linear Error [S]: 1.960
Three-Dimensional
Propagated Linear Error [E]: U.S.
Constant Term [C]: 0.000 m
Scale on Linear Error [S]: 1.960
Adjustment Statistics
Number of Iterations for Successful Adjustment: 2
Network Reference Factor: 1.00
Chi Square Test (95%): Passed
Precision Confidence Level: 95%
13:42


C:\Users\hp\AppData\Local\Temp\TBCTemporal\301
Network Adjustment Report
Page
Safety
Tools
Adjustment Settings
Adjustment Statistics
Control Point Constraints
Adjusted Grid Coordinates
Adjusted Geodetic Coordinates
Adjusted ECEF Coordinates
Error Ellipse Components
Adjusted GPS Observations
Covariance Terms
Adjusted Geodetic Coordinates
Point ID | Latitude | Longitude | Height (Meter) | Height Error (Meter) | Constraint
BADSAIBAG | N30°19'27.03318" | E77°38'50.39976" | 379.085 | 0.051
BIHARIGARH | N30°06'24.31225" | E77°50'04.38991" | 272.743 | 0.054
CHHUTMALPUR | N30°01'15.80241" | E77°43'54.93407" | 243.841 | 0.050
DARA RIT | N30°20'37.75905" | E77°42'38.12520" | 624.762 | 0.045
DAT KALI | N30°10'40.31027" | E77°54'20.48698" | 423.740 | 0.057
EAST END | N30°17'06.92861" | E77°58'26.04106" | 555.861 | ? | LLh
FATEHPUR | N30°02'41.62938" | E77°45'44.42007" | 249.778 | 0.083
GANDEWAR VILLAGE | N30°12'06.51835" | E77°35'50.75162" | 258.795 | ? | LLh
GANESHPUR | N30°08'36.85398" | E77°52'10.91034" | 332.216 | 0.040
JHAJRA | N30°20'50.33267" | E77°52'17.08659" | 472.385 | 0.059
KALSIA CANAL | N30°08'35.90592" | E77°36'57.67944" | 250.337 | 0.085
LODHIWALA | N30°04'57.07964" | E77°47'56.96987" | 252.244 | 0.039
PADMA RIVER | N30°16'31.35878" | E77°37'38.39688" | 294.254 | 0.036
SAHASPUR | N30°23'36.64796" | E77°48'19.98528" | 432.386 | 0.054
Speed up browsing by disabling add-ons.
Choose add-ons
Ask me later
09:43



Disclaimer

This SOP is made assuming that user has some previous knowledge of GPS data processing ,However for user with no previous knowledge of GPS data processing ,hands on training is recommended.

SOP for GNSS Observation in Order to Determine Latitude, Longitude & Ellipsoidal Height and subsequently use of Geoid Model for National Hydrology Project.

The coordinates obtained from GPS/GNSS observations are burdened with many errors like Satellite Clock and orbit error, Ionospheric delay and Topospheric delay, Receiver Noise, Multipath and Receiver Clock error. Due the above errors the coordinates obtained are inaccurate and needs to be corrected before use.

To minimize the effect of these errors the GPS/GNSS data of observation points needs to be processed with reference to some known reference stations whose coordinates are accurately known to us.

The reference stations are of two types

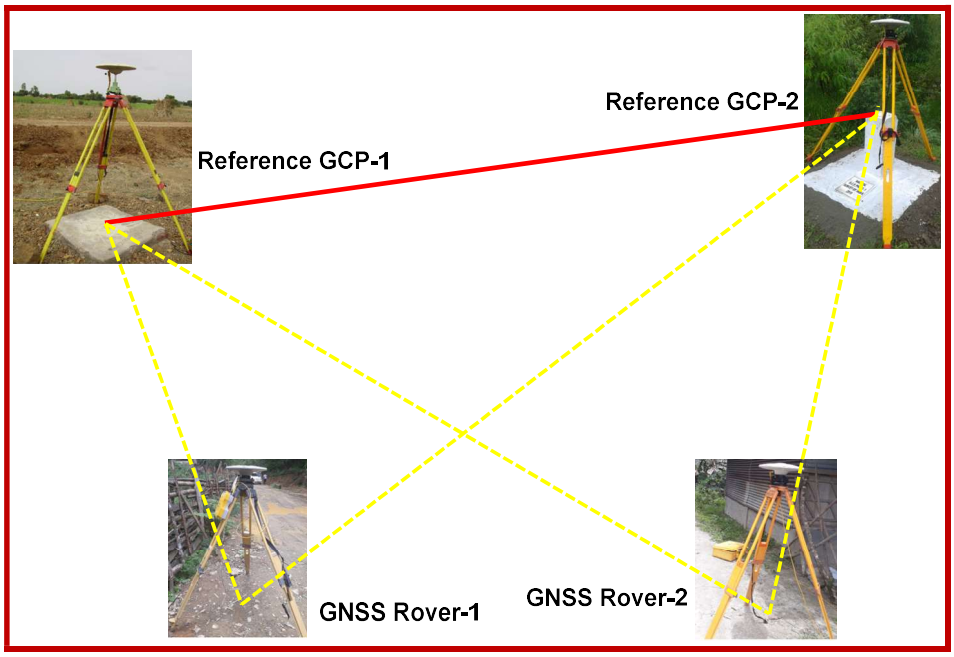
1. **CORS Network established by SOI: Active Network of Reference Stations**
2. **SOI GCPs: Passive Network of Reference Stations**

1. CORS Network established by SOI: Active Network of Reference Stations

- Continuously Operating Reference Stations CORS are geodetic quality GNSS receivers and antennas that are permanently installed at a Reference Station (RS) having very accurately pre-determined coordinates.
- These Reference Stations collect GNSS data continuously, and transmit data via Internet to a central server (Control & Processing Centre).
- **The incoming data is processed at the server to generate corrections which are made available to users over the Internet in real-time in order to get the accurate coordinates.**
- **To get accurate coordinates using the CORS network is known as Network Real Time Kinematic (NRTK) survey technique.**
- **To avail the facility of NRTK survey users needs to have a RTK enabled GNSS receiver with internet connectivity.**
- Different brand receivers are available in the market. The Standard Operating Procedure (SOP) to carry out NRTK survey is different for different brand receivers.
- At present SOI is using **Trimble R8s** GNSS receiver for NRTK survey. The SOP to carry out NRTK survey using **Trimble R8s GNSS receiver given in Annexure 'A'**.

2. SOI GCPs: Passive Network of Reference Stations

- The states where CORS network is not available, the SOI GCPs can be used as reference stations to get the accurate latitude longitude and ellipsoidal height of the survey points.
- The SOI has established Ground Control Point (GCP) Library of about 2500 Ground Control Points in the entire country and derived their coordinates (Latitude, Longitude and Ellipsoidal Height) with high accuracy. These GCPs define the Horizontal datum of the country and can be used for various surveying, mapping and developmental activities. These GCPs has cement concrete structure/Monumentation and can be located on the ground by their description which is available with SOI. **These GCPs are passive reference stations.**
- To get the accurate coordinates of survey points for any surveying and mapping activity the GPS/GNSS observation of survey points needs to be carried out for 1 to 2 hours with reference to SOI GCPs in static and relative/differential mode. The GPS/GNSS data thus collected needs to be processed with reference to SOI GCPs in order to derive the accurate coordinates (Latitude, Longitude and Ellipsoidal Height) of new survey points.
- The coordinates of reference GCPs which is required during the post processing can be obtained from SOI as per departmental policy.
- In this process at least two Observers with two GNSS receivers needs to occupy the Reference GCPs falling in the area of work and one or more observers needs to occupy the new survey points with 1 to 2 hours common observation duration.



- This technique is known as static survey technique and require the at least three GNSS receivers. More receivers will increase the progress of the work.
- The static survey requires:
    - 1 to 2 hours GNSS Data collection using GNSS receiver

    - GNSS data downloading from the receiver to a computer having GNSS data processing software and finally
    - GNSS data Processing using software
- The SOP for GNSS data collection in static mode using a **Trimble R8s GNSS** receiver and downloading to a computer is given in **Annexure 'B'**.
- The SOP for GNSS data processing using Trimble Business Center (TBC) software is given in **Annexure 'C'**.
- The output of NRTK as well as static survey is accurate Latitude, Longitude and ellipsoidal heights.
- **In order to get Orthometric Height of survey points, the Latitude, Longitude and Ellipsoidal heights of survey points can be supplied to SOI. The SOI use the Geoid model and convert the ellipsoidal heights into Orthometric Heights.**
- **The SOPs as mentioned above are given in Annexure 'A', 'B' and 'C'.**