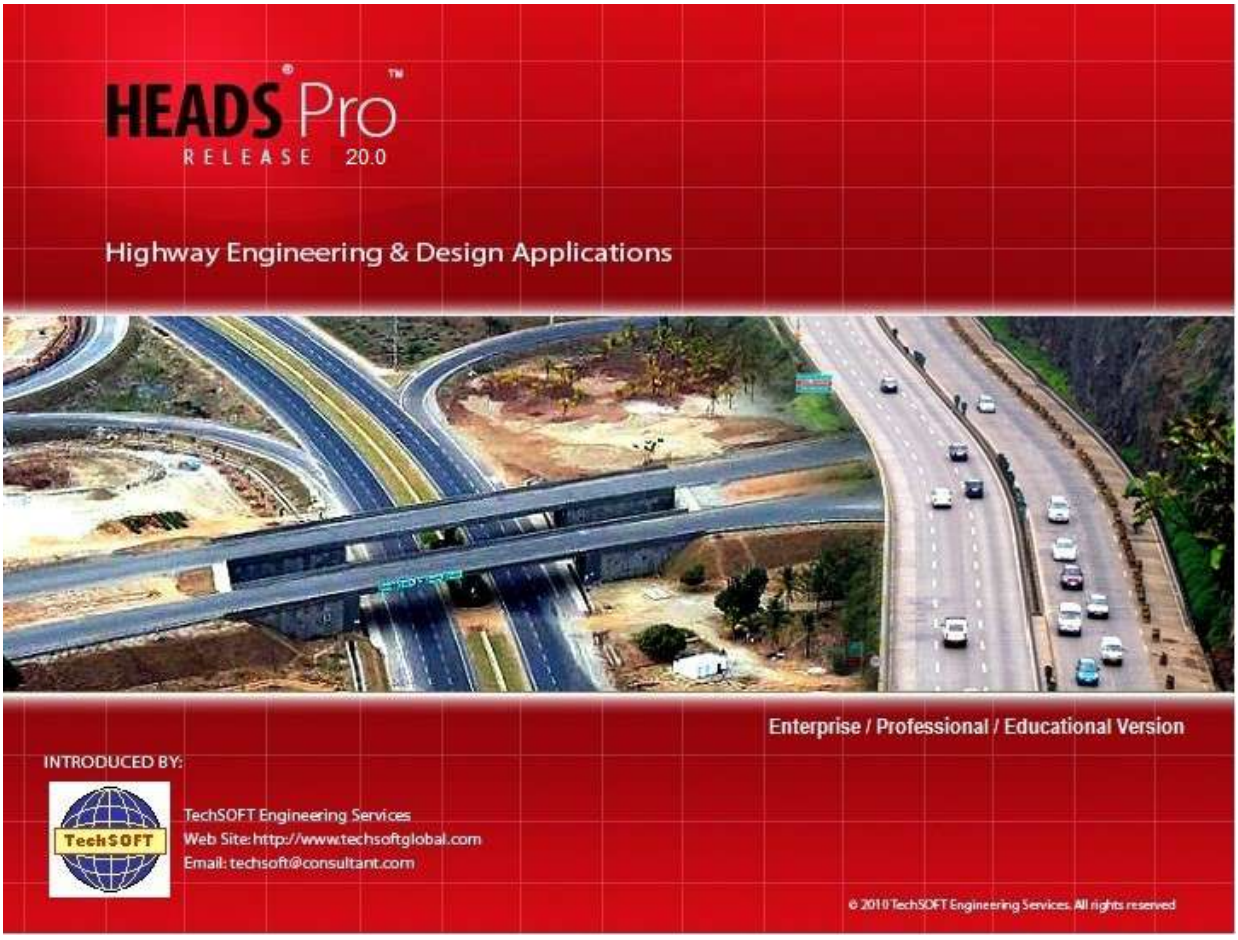
HEADS Pro®

The most powerful and largest software System for Highway Engineering and Design with special features for Uniform & Multi Section Highway Widening & Strengthening, Hill Roads, Low Cost Rural Roads with best quality AI-Generated PLAN-PROFILE-CROSS SECTION drawings in user's drawing sheets, Tunnels Geometric Design, Flexible Pavement Design by AASHTO and IRC 37- 2018/2019 by IIT-Pave and Rigid Concrete Pavement Design by AASHTO (CRCP JRCP) and IRC 58 with Cumulative Fatigue Damage Analysis, Grade Separated Interchanges, At-Grade Intersections with Type Selection & Design, Swept Path Analysis, Car Racing Track Design, Bituminous / Asphalt Mix Design, Highway and Hill Road Drainage Design, Highway Lighting Design, CAD Construction Drawings, Enabling construction by GPS driven Dozer-Grader-Paver for accurate elevations without survey checks, Land Record and Land Drawing Management by MS-ACCESS database Management, Bill of Quantities etc.

[Operating Systems: Microsoft Windows 10/Win11 with 32 / 64 Bit, Minimum 4 GB RAM, 100 GB HDD space]



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HEADS Pro - Ultimate software for Highway Engineering applications

HEADS Pro is a CAD based String modeling software and features for the followings:

Applications for Projects:

- Design of Uniform cross section highways, low-cost rural roads, hill roads
- Design of Multiple cross section urban streets, highways, expressways, freeways
- Design for Highway widening, by changing widening pattern over specified lengths
- Design of Hill roads with extra widening, varying cut slopes on depth of cut, provisions for gabion wall, retaining walls
- Design of Vehicular Tunnels and structural design of RCC Tunnel Lining with portals and steel ribs
- Design of At Grade Intersections, Roundabouts, Insertion of Intersection Type Design and Swept path Analysis
- Design of Multi Level Grade Separated Interchanges,
- Design of High-Speed Car Racing Track with alignment by Closed Traverse and Parabolic Concave Cross Section

Applications for Engineering Design:

- Alignment design for Highways, Low-cost rural roads, Tunnels, Railways, MRT, LRT etc.
- Processing Geometric design with detail reports containing complete set of site setting-out information
- Producing best formatted construction drawings for PLAN, PROFILE, Cross Sections
- Flexible pavement design for Highways and Rural Roads by following AASHTO, IRC SP 20, SP 72, etc.,
- Rigid Concrete Pavement design by following AASHTO standard
- Pavement Overlay design by using Benkelman Bean rebound deflection data
- Layered System Analysis for Pavement improvement using Fiber Glass Geogrids to repair Cracked Pavement.
- Bituminous Mix Design for various bituminous layers
- Computation of Equivalent Standard Axle in Millions (MSA) by using Axle Load Survey data
- Hydrological design of Highway and Hill Road Drainage, Highway Lighting,
- Design of Loop alignments for Multi-level Grade separated Interchanges and Intersections etc.
- Design of Tunnels with RCC Lining by using Rock Quality Designation (RQD) and Rock Mass Rating (RMR)
- Detailed and well formatted Design Reports and Drawings.
- Produces **LANDXML** output for 3D Visualization Drive Through by using software UC-win/Road.
- Produces Estimation of Quantities and Analysis of Item Unit Rates,
- Processing Cross Sections Survey by Auto Level,
- Bill of Quantities for Running Account Billing with Analysis for Unit Item Rates,
- Generating Site Setting out details with desired modifications as and when required,
- Preparation of As-built Drawings
- Alignment, Profile, Cross Section for Tunnel Design including excavation quantities for Pay-cut, As0buit-cut, Design-cut,
- String Tables with Elevations at Normal Cross fall & Super elevated sections for construction by advanced motor grader and Paver.

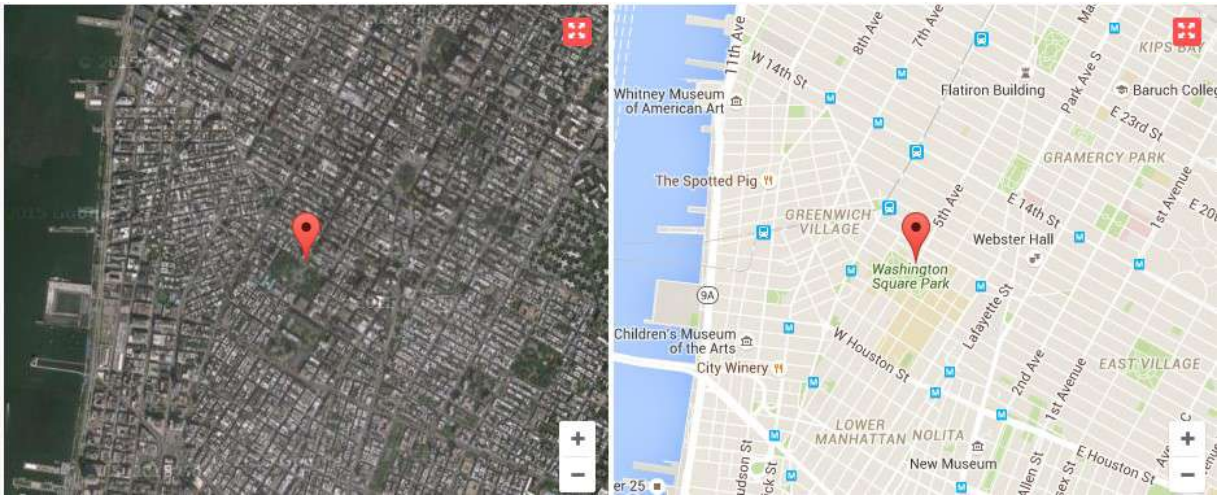
Special Points on Technical Specifications:

- Co-ordinate Conversion to exchange data between GPS & Total Station.
- Traverse Survey with String Modeling and closing error distribution.
- Contouring with user defined intervals and display of Elevations.
- DTM is accurate & can take up to 300,000 points.
- Model Strings may take up to 20,000 Strings.
- Conceptualization of Route Alignment on Aerial Photograph / Satellite Imagery.
- Co-ordinate transformation from Long-Lat to East-North and the reverse
- Low-Cost Rural Road design using IRC SP 19, SP 20 & SP 72.
- Optimized road profile design for Exact Quantity of Pavement, Profile correction & Overlay.
- Design of Hill Roads with Sharp bends and variety of design conditions.
- Expressway design with Speed higher than 100 KPH following AASHTO.
- Hydrological design of Highway Drainage.
- Pavement design & Cost Estimation with Analysis for Unit Item Rates.
- Asphalt Concrete Mix Design & Quality Control.
- Auto level survey for Cross Sections and Bill of Quantities.
- Extended ground in Cross Section drawing to show full Survey Corridor.
- Built-in CAD engine for viewing and editing drawings compatible to AutoCAD.
- DXF Plan, Profile & Cross Section Drawings compatible to all CAD software.
- Long Section Drawing with Alignment & Super Elevation details, even in Pieces.
- Plan drawings in sheet wise pieces by Sheet Layout.
- Interactive design for a length of 100 Km in one go (in True Sense).
- Control on Shifting of Alignment for Tunnel Centre Line.
- 3D perspective view from various angles
- Exporting LANDXML data for “Drive Through” Simulation by UC win/Road.
- Straight forward interactive design for Main Alignment & Interchange Loops.
- Irregular occurrence of Service Roads on either side and change of cross section.

Topographical Survey or Satellite Data Processing

Computer applications are very effectively helpful in every stage of Highway development projects starting from Conceptual phase to Preliminary design, to Detail engineering to Construction. The collecting and processing of ground survey data is the first step in computer aided highway design. The process includes creating of ground model, Digital mapping to create the survey base plan, triangulation to create the Digital Terrain Model or DTM and thus the ground Contours and finally the ground long and cross sections.

The collecting of ground data uses either obtaining the field survey data most commonly by using the Total Station instrument or obtaining the ground elevation data with the latest available satellite based technology which also helps in identifying the best possible route of the road, its realignment and the widening scheme.



Ground Modeling

The Survey data whether by Total Station survey or by Satellite data, but the data must be made available in the desired format of five columns for: Serial Number, Easting (metres), Northing (metres), Elevation (metres) and Feature Code and saved as a text file (for example SURVEY.TXT) which can be opened in 'Notepad'. In its has five columns of data, when a data record with Serial No. '0' is met then it discontinues the last feature and reads a new feature in the Ground Model. After creating the ground model it is drawn to create the survey base map and is described in the relevant section of this book.

Triangulation and Contours

The model Name, String Label and increments for primary, secondary and Text are set with default names & values. If the ground is of flat nature then user has to reduce the primary contour increment as 0.5 or 0.1 to get contours for the relatively flat ground. The secondary contour increment is always five times of increment of the primary contours. Texts for contour elevations are displayed on the secondary contours.

Tutorial Videos

The various Tutorial Videos are available to understand and master the above processes by watching the Tutorial Videos and next by operating software HEADS Pro by following the steps as described in the HEADS Pro Design Manual.

Processing of Topographic Survey Data by Total Station instrument

Trimble GPS Receiver R8 with Communications

Trimble GPS Receiver R10 with Advanced

Trimble R8 Model 4 trimble gps receiver

The project corridor may be identified by site reconnaissance survey and by using Topographic maps along with satellite imageries by using Google Earth, as well.

The ground elevation data may be either obtained by Total Station Survey or by downloading from SRTM (Shuttle Radar Topography Mission) by using internet. User may procure the computer program Global Mapper to download ground topography data from internet. Most widely the softwares use Total Station Survey Data for processing Topographical details most effectively and economically in various highway construction projects.

The next job is to prepare the Survey Base Plan or Ground Model from the ground survey data with Total Station. By selecting drawing feature symbols from CAD Block library, the various texts obtained from the surveyors are also placed correctly in the Base Plan drawing. The drawing is made in CAD layered system and is compatible to AutoCAD and other popular CAD softwares.

Finally the Digital Terrain Model (DTM) is created by using the Total Station survey data by Triangulation and subsequently processed for contouring.

Processing of Cross Section Survey Data by Auto / Digital Level instrument

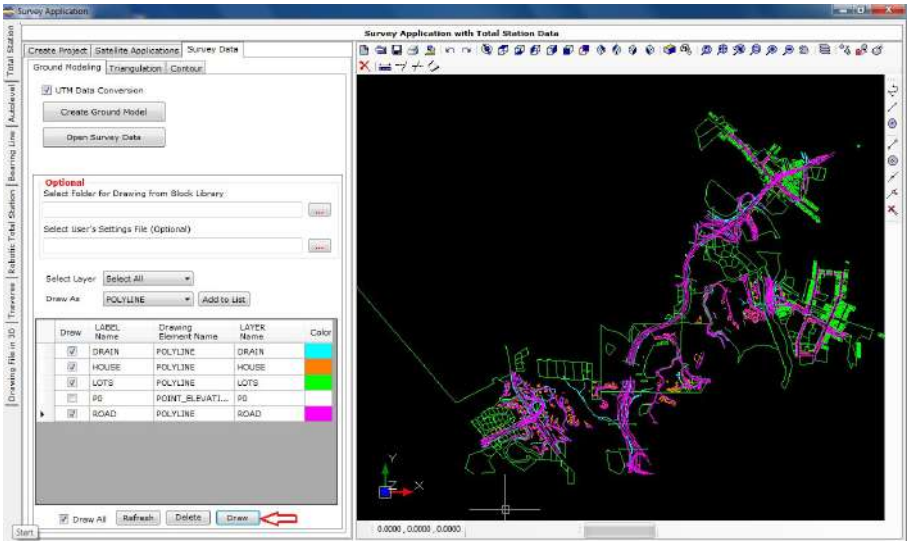
The Autolevel data contains Chainages at a regular / constant interval, the distances on the cross section on either side of the centre point 0.0, left side in '-ve' & right side is '+ve' and the elevations (Z) at all distances on either side of the centre point. The data do not have Easting (X) and Northing (Y) at these points where (Z) is available. So, to get Easting (X) and Northing (Y) at these points an alignment is to be defined, which passes through the centre point at '0.0' of the cross sections at every chainage. The alignment must have the chainages at intervals same as that in the Autolevel Cross section survey. Referring to this alignment the program will obtain the X & Y Coordinates of each point on the cross section, this helps in making Triangulation, Digital Terrain Model and finally the Contours of the ground. Only the survey base plan drawing by digital mapping will not be created from ground model, which needs Total Station data for reading various features like Houses, Drains, Electric Poles, Boundary walls etc. on the ground.

Processing of Bearing Line Survey Data

The Bearing Line method of survey is very widely used in the design of hill roads. Every hill road commonly has hill on one side and valley on the other side. In Bearing Line Survey the traverse passes through the foothill side, which changes its side with respect to the road to stick to the hill.

Ground Modeling

The data in the Total Station survey data file must be made available in the following format and saved as a text file (for example SURVEY.TXT) which can be opened in 'Notepad'. It has five columns of data, when a data record with Serial No. '0' is met (as after Serial No. 5) then it discontinues the last feature and reads a new feature (from Serial No. 1) in the Ground Model.

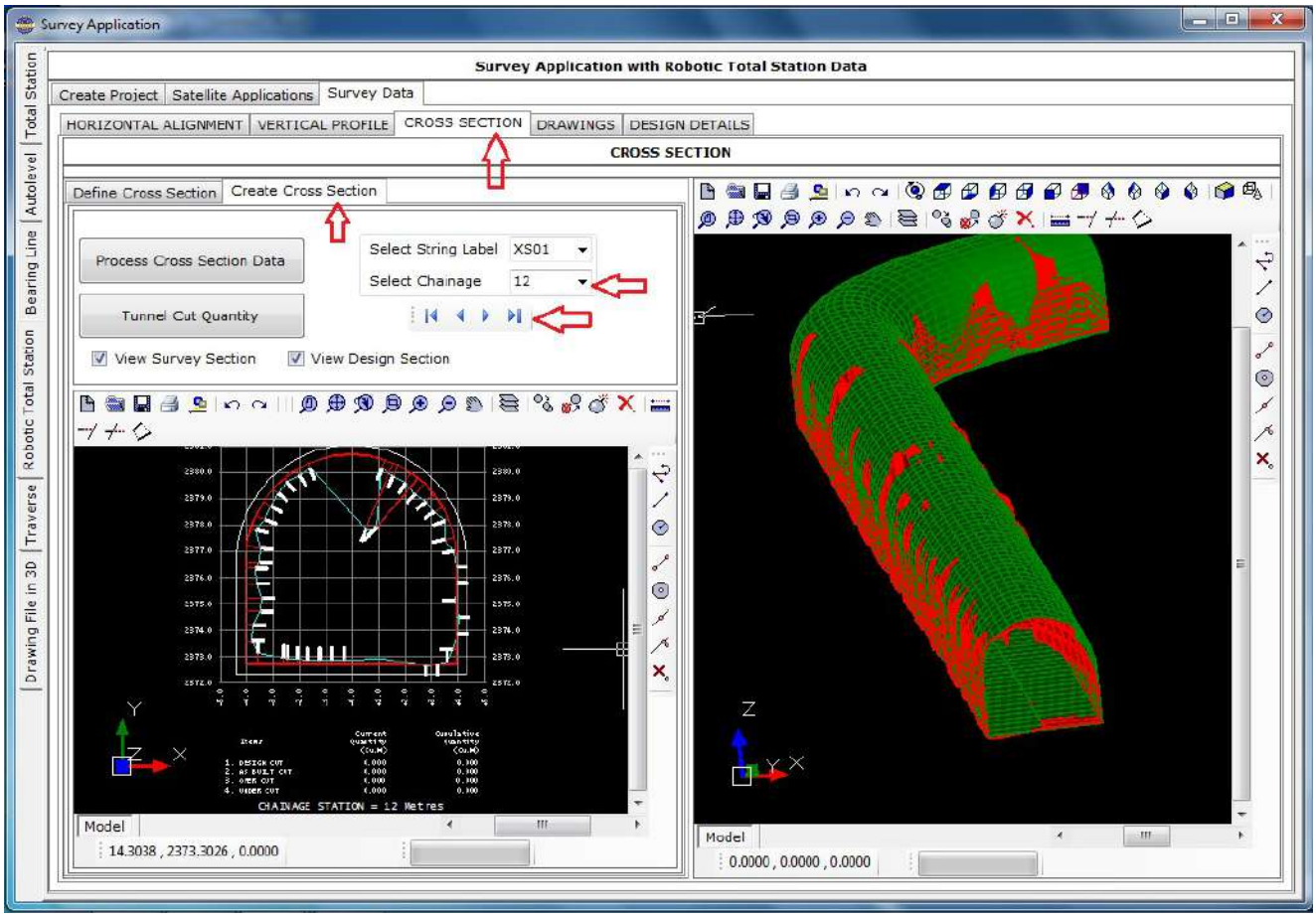


HEADS Pro may be used for **Safety Studies** for High Speed Expressways. For the design of railways at design speed 120 KPH or more by following relevant International Standard, HEADS Pro Rail is the most appropriate road design software HEADS Pro creates 3 dimensional perspective view of the terrain and the designed railway. It can convert the design output in LandXML format and supports Visualization and Drive Through by UC-win/Road.

HEADS Pro in project cost estimation by **Analysis of Item Rates.** With In built formulas on components of Materials, Equipment and Laborer the Unit Item Rates are computed for the Earthwork for Embankment, Pavement, Culvert, Bridge and other work in worksheet format.

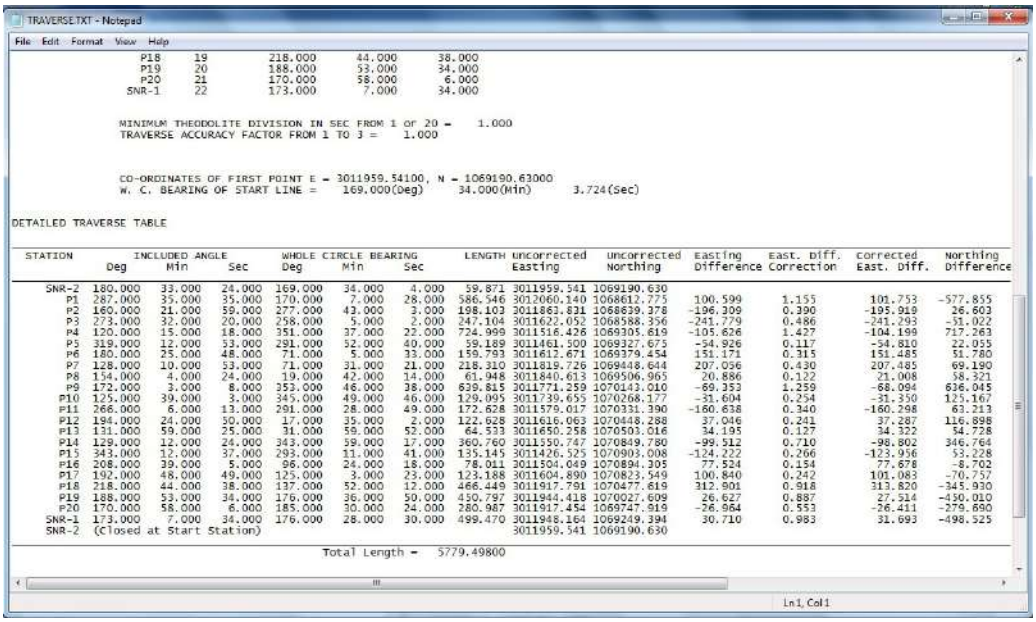
Processing of TRIMBLE Robot Total Station Scan Laser Survey Data

The TRIMBLE Robot Total Station survey data is very widely used in the construction of Bored Tunnels. This is to be noted that the survey is carried out after the boring is done for the tunnel, by following the design horizontal alignment, vertical profile and proposed cross section for the tunnel. The survey data is used to estimate the actual boring against the design cross section of the tunnel. At every chainage the **As-Biult and Design Cross Sections** are plotted. From the cross sections the **'Under Cut'** and **'Over Cut'** quantities are computed by comparing the as-built against the design cross section. Some times in case of excessive overcut the cut quantity is considered up to certain extent outside the design cross section, which is marked as the **'Pay Line'**. Proper measures are to be taken to restore all the over cuts and to remove unwanted soil/rock at the under cuts to match the bored cross sections with the design cross section. All these actions can be done by using the Robotic Total Station survey data and thus processing by HEADS Pro to generate cross sections and quantities for Design Cut, As-built Cut (Under Cut & Over Cut) and the Pay Line, also by creating CAD drawings and detail report.



Processing of Traverse Survey Data

HEADS Pro generates Traverse Report describing corrected Traverse and its coordinates with closing error corrections by Bowditch, Transit and Closed link, with EDM applications.



TRAVERSE.TXT - Notepad

File Edit Format View Help

P18	19	218.000	44.000	38.000
P19	20	188.000	53.000	34.000
P20	21	170.000	58.000	6.000
SNR-1	22	173.000	7.000	34.000

MINIMUM THEODOLITE DIVISION IN SEC FROM 1 OF 20 = 1.000
TRAVERSE ACCURACY FACTOR FROM 1 TO 3 = 1.000

CO-ORDINATES OF FIRST POINT E = 3011959.54100, N = 1069190.63000
W. C. BEARING OF START LINE = 169.000(Deg) 34.000(Min) 3.724(Sec)

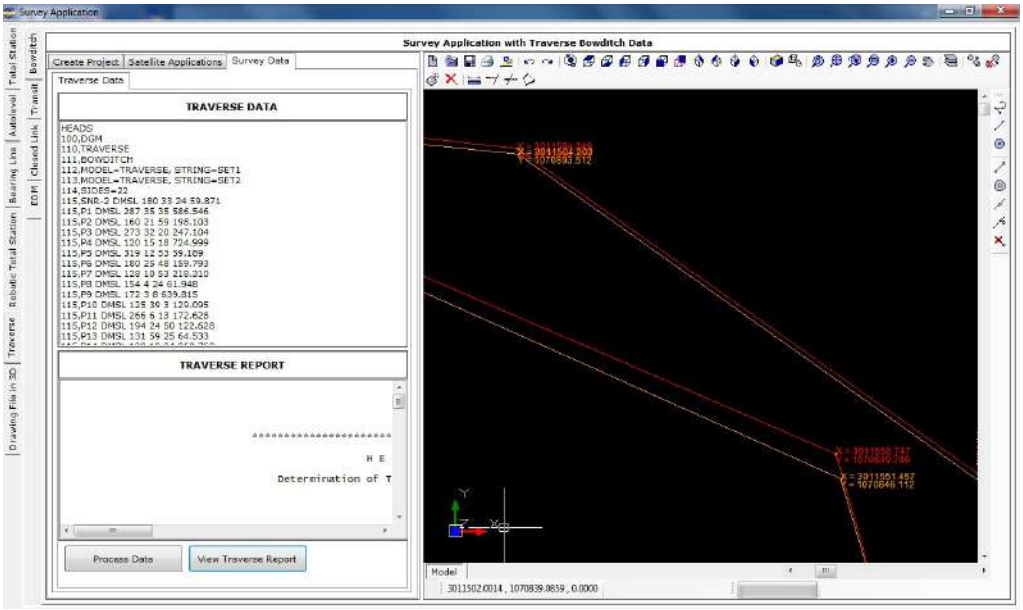
DETAILED TRAVERSE TABLE

STATION	INCLUDED ANGLE Deg	Min	Sec	WHOLE CIRCLE BEARING Deg	Min	Sec	LENGTH	Uncorrected Easting	Uncorrected Northing	Easting Difference	East. Diff. Correction	Corrected East. Diff.	Northing Difference
SNR-2	180.000	33.000	24.000	169.000	34.000	4.000	59.871	3011959.541	1069190.630				
P1	287.000	35.000	35.000	170.000	7.000	28.000	586.546	3012060.140	1068612.775	100.599	1.155	101.753	-577.855
P2	160.000	21.000	59.000	277.000	43.000	3.000	198.103	3011863.831	1068639.278	-196.309	0.390	-195.919	26.503
P3	273.000	32.000	20.000	258.000	5.000	2.000	247.104	3011622.052	1068588.356	-241.779	0.486	-241.293	-51.022
P4	120.000	15.000	18.000	351.000	37.000	22.000	724.999	3011516.426	1069305.619	-105.626	1.427	-104.199	717.263
P5	319.000	12.000	53.000	291.000	52.000	40.000	59.189	3011461.500	1069327.675	-54.926	0.117	-54.810	22.055
P6	180.000	25.000	48.000	71.000	5.000	33.000	159.793	3011612.671	1069379.454	151.171	0.313	151.485	51.780
P7	128.000	10.000	53.000	71.000	31.000	21.000	218.310	3011819.726	1069448.644	207.056	0.430	207.485	69.190
P8	154.000	4.000	24.000	19.000	42.000	14.000	61.948	3011840.613	1069506.965	20.886	0.122	21.008	58.321
P9	172.000	3.000	8.000	353.000	46.000	38.000	639.815	3011771.259	1070143.010	-69.353	1.259	-68.094	636.045
P10	125.000	39.000	3.000	345.000	49.000	46.000	129.095	3011739.655	1070268.177	-31.604	0.254	-31.350	125.167
P11	266.000	6.000	13.000	291.000	28.000	49.000	172.628	3011579.017	1070331.390	-160.638	0.340	-160.298	63.213
P12	194.000	24.000	50.000	17.000	35.000	2.000	122.628	3011616.063	1070448.288	37.046	0.241	37.287	116.898
P13	131.000	59.000	25.000	31.000	59.000	52.000	64.533	3011650.258	1070503.016	34.195	0.127	34.322	54.728
P14	129.000	12.000	24.000	343.000	59.000	17.000	360.760	3011550.747	1070849.780	-99.512	0.710	-98.802	346.764
P15	343.000	12.000	37.000	293.000	11.000	41.000	135.145	3011426.525	1070903.008	-124.222	0.266	-123.956	53.228
P16	208.000	39.000	5.000	96.000	24.000	18.000	78.011	3011504.049	1070894.305	77.524	0.154	77.678	-8.702
P17	192.000	48.000	49.000	125.000	3.000	23.000	123.188	3011604.890	1070823.549	100.840	0.242	101.083	-70.757
P18	218.000	44.000	38.000	137.000	52.000	12.000	466.449	3011917.791	1070477.619	312.901	0.918	313.820	-345.930
P19	188.000	53.000	34.000	176.000	36.000	50.000	450.797	3011944.418	1070027.609	26.627	0.887	27.514	-450.010
P20	170.000	58.000	6.000	185.000	30.000	24.000	280.987	3011917.454	1069747.519	-26.964	0.553	-26.411	-279.890
SNR-1	173.000	7.000	34.000	176.000	28.000	30.000	499.470	3011948.164	1069249.394	30.710	0.983	31.693	-498.525
SNR-2	(Closed at Start Station)							3011959.541	1069190.630				

Total Length = 5779.49800

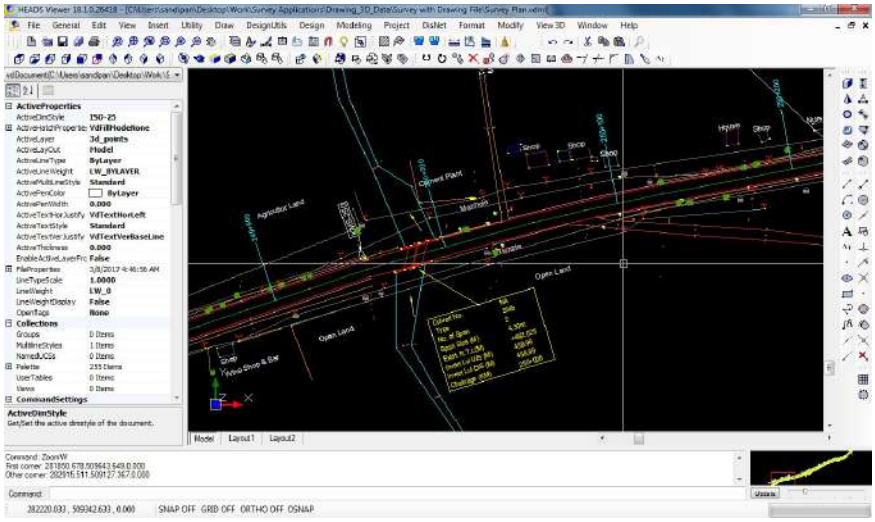
Ln 1, Col 1

The HEADS Pro CAD view of drawing with uncorrected and corrected Traverse and its coordinates.



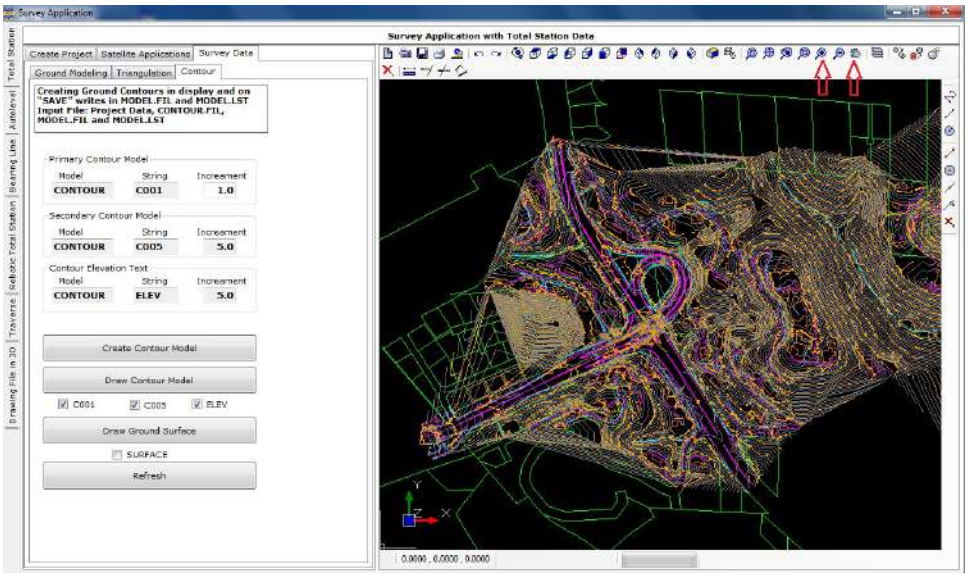
Processing of Drawing File in 3D to extract ground data

The survey plan drawing is made in 3 Dimension and the processing is done to extract the Layer wise x,y,z data of various features of the drawing. The data is saved as Text data in Total Station format and created model with string labels taking from the layer names by saving in the model files.



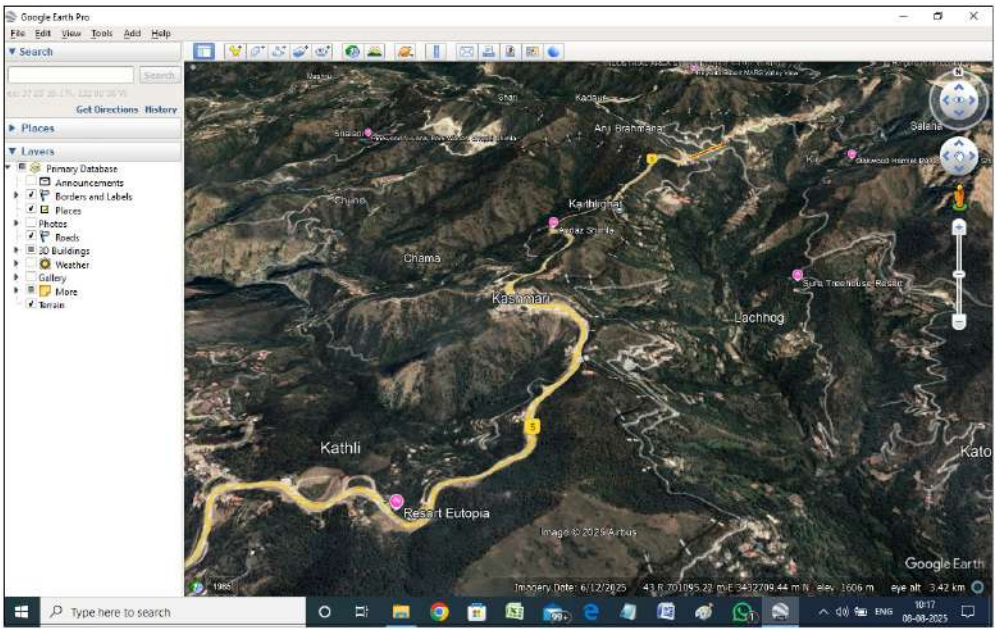
Triangulation and Contours

The model Name, String Label and increments for primary, secondary and Text are set with default names & values. If the ground is of flat-nature then user has to reduce the primary contour increment as 0.5 or 0.1 to get contours for the relatively flat ground. The secondary contour increment is always five times of increment of the primary contours. Texts for contour elevations are displayed on the secondary contours.



Alignment Design on Satellite Imagery

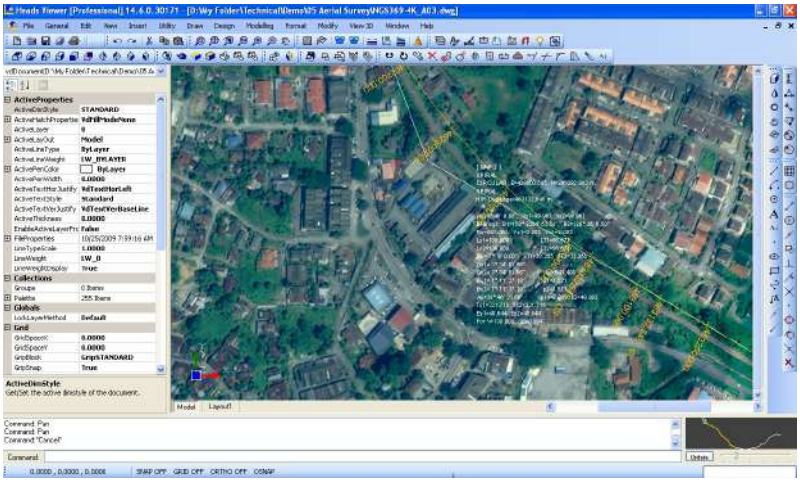
HEADS Pro minimizes the exercise to transform the Surveyors coordinates into Global UTM / GPS Coordinates using in-built CAD engine, next the transformed drawing may be opened for conversion to KML/KMZ file to open in Google Earth to define the road alignment for Site Layout, Green Field alignments, Bypasses and Realignments as larger area with existing Land use are visible. The area as identified by site reconnaissance survey, by using Topographic maps and satellite imageries.



Processing Downloaded Ground Elevation Data

The ground elevation data may be downloaded from SRTM (Shuttle Radar Topography Mission) by using software Global Maper and Digital Terrain Model along with contours may be generated for the entire area under the study. This enables the engineers to Develop the Ground Model, Digital Terrain Model (DTM) by Delauny Triangulation, Ground Contours, Ground Sections at user given primary and secondary intervals, 3D Surface with rendering, Ground Long and Cross Sections, Digital Mapping.

HEADS Pro features for Traverse coordinates with closing error correction by Bowditch, Transit & Close Link methods, EDM Survey, Coordinate Transformation from WGS84 to Lambert Conformal Conic Projection (Long Lat to East North) and the reverse with Spheroid Everest 1956. This enables to install Survey reference pillars along the proposed highway route for their reference during the construction. Satellite images and **Aerial Photos** may be used for producing the best possible design.



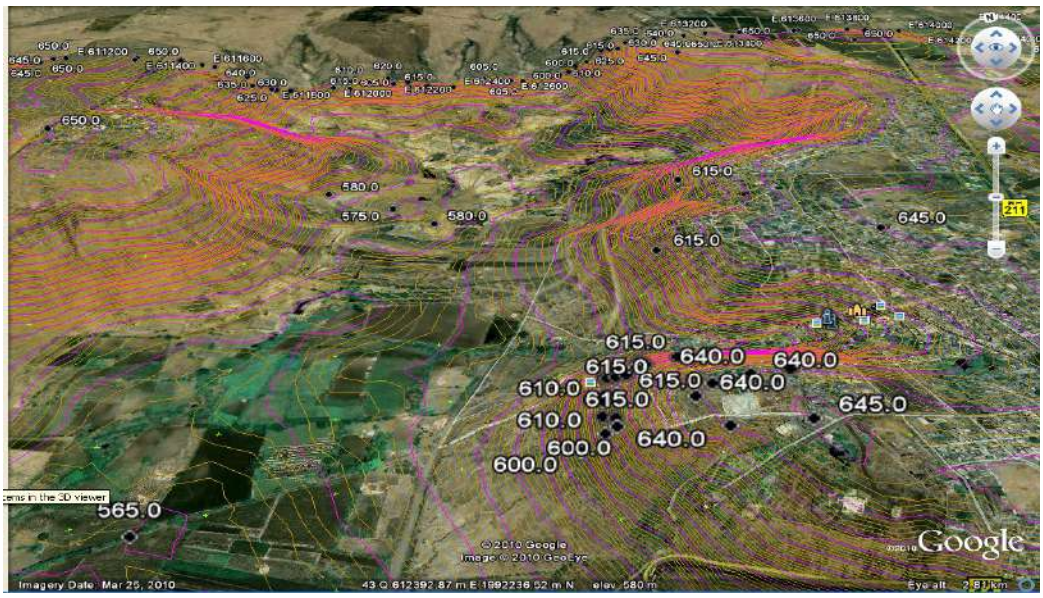
The Aerial photographs may be used for drawing the alignment by considering the Land use

Processing of downloaded Ground Elevation Data from Satellite by internet

By defining tentative alignment by drawing straights by “My Path” in Google Earth to define the project corridor and subsequently downloading ground elevation data by using Global Mapper minimizes the exercise to transform the Surveyors coordinates in TM (Transverse Mercator) into Global Coordinates in UTM (Universal Transverse Mercator) / GPS. The alignment file may be saved as KML/KMZ file. This file may be opened in future in Google Earth to mark various features along the corridor, for example, the road alignment with existing ‘Land-use’ etc. The area may also be identified or verified by site reconnaissance survey or by using Topographic maps or by procuring satellite imageries from the survey department.

Next, the KML/KMZ file may be opened with Global Mapper and saved as DXF file. Also, the ground elevation data may be downloaded with Global Mapper from SRTM (Shuttle Radar Topography Mission). The DXF file of the alignment is opened in HEADS Viewer and the alignment geometrics are design as Horizontal Alignment of the project highway.

The downloaded ground elevation data is to be opened with software MS-Excel for saving in the desired format. Next the ground data is opened with software HEADS Pro to create the ground model, and next the Digital Terrain Model along with contours are to be generated for the entire area under the study. This enables the engineers to Develop the Survey Base Plan, Digital Terrain Model (DTM) by Delauny Triangulation, Ground Contours at user given primary & secondary intervals, 3D Surface with rendering, Ground Long and Cross Sections. The Digital mapping facility by drawing ground model enables the users to prepare Survey base Plan drawings over Google Pictures using the CAD engine of software HEADS Pro.



The contours are superimposed on the satellite imagery

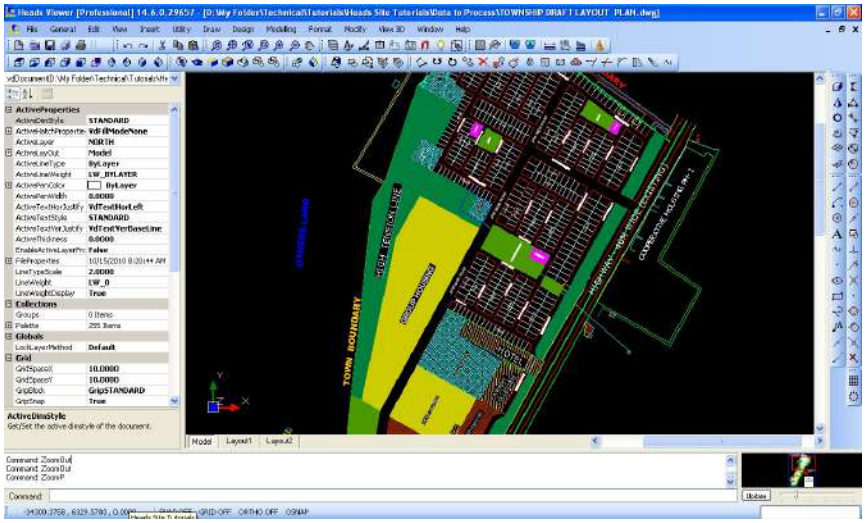
The ground survey work also includes obtaining of Traverse coordinates with closing error correction by Bowditch, Transit & Close Link methods, EDM Survey, Coordinate Transformation from WGS84 to Lambert Conformal Conic Projection (Long Lat to East North) and the reverse with Spheroid Everest 1956. This enables to install Survey reference pillars along the proposed highway route for their reference during the construction.

Software HEADS Pro will be applied for the design of highway widening with reference to an existing road with multiple cross sections and multiple alignments, where the road cross sections may change with different configuration and with the change in widening pattern from Left to right to concentric along the route from origin to destination. The design has special treatment in hill stretches. Provision for tunnels is also possible with very special design techniques.

Land Record and Land Map Drawing Management System

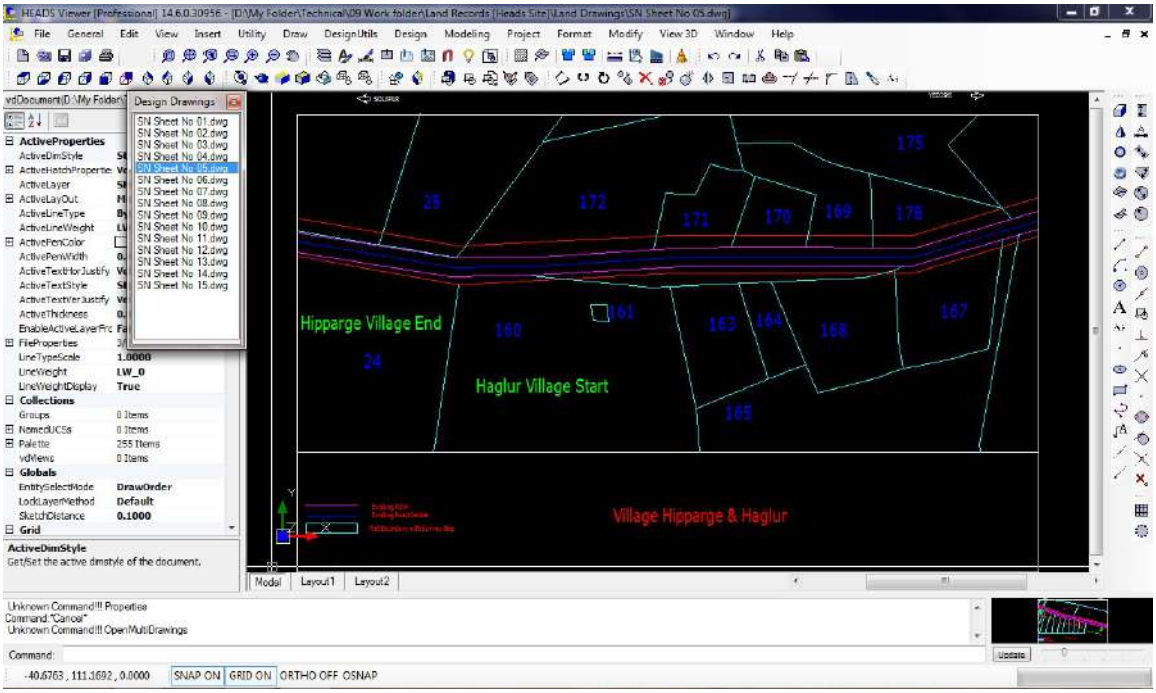
Relational Data Base Management System (RDBMS) by Microsoft-ACCESS is used in association with Microsoft-Excel and HEADS Pro CAD Viewer

For any site development project for Township, Industrial Plants, Roads, Airports, Housing projects the Acquisition of Land for the site is the next job for preparing for construction. The list of names of the land owners, Land category, Land Plot ID, Plot Number, reference District and State in the country. The owners of the acquired land plots are paid by the project authorities. A proper storage of the details along with land maps are therefore essential for the project. The record details are maintained in Relational Data Base Management Systems (RDBMS) and all the land maps as CAD Drawings. The built-in CAD engine is highly powerful with complete drafting and editing facilities. The drawings are compatible to AutoCAD and all other popular CAD softwares.

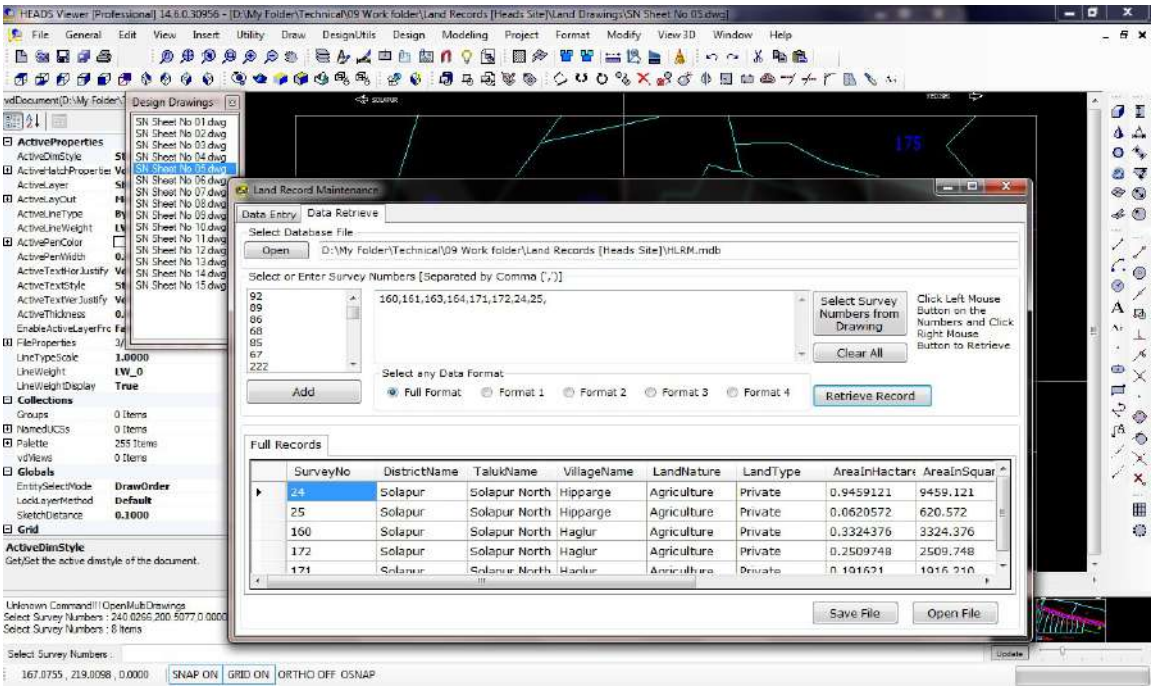


Land records may be Entered and stored in MS Access Database format and CAD Drawings

For any Site preparation the land records and land maps in the existing ground are most essential and properly coordinated by HEADS Pro. The establishment of correlation between the database records and the related drawings are extremely useful facilities for maintaining the land records by the users.

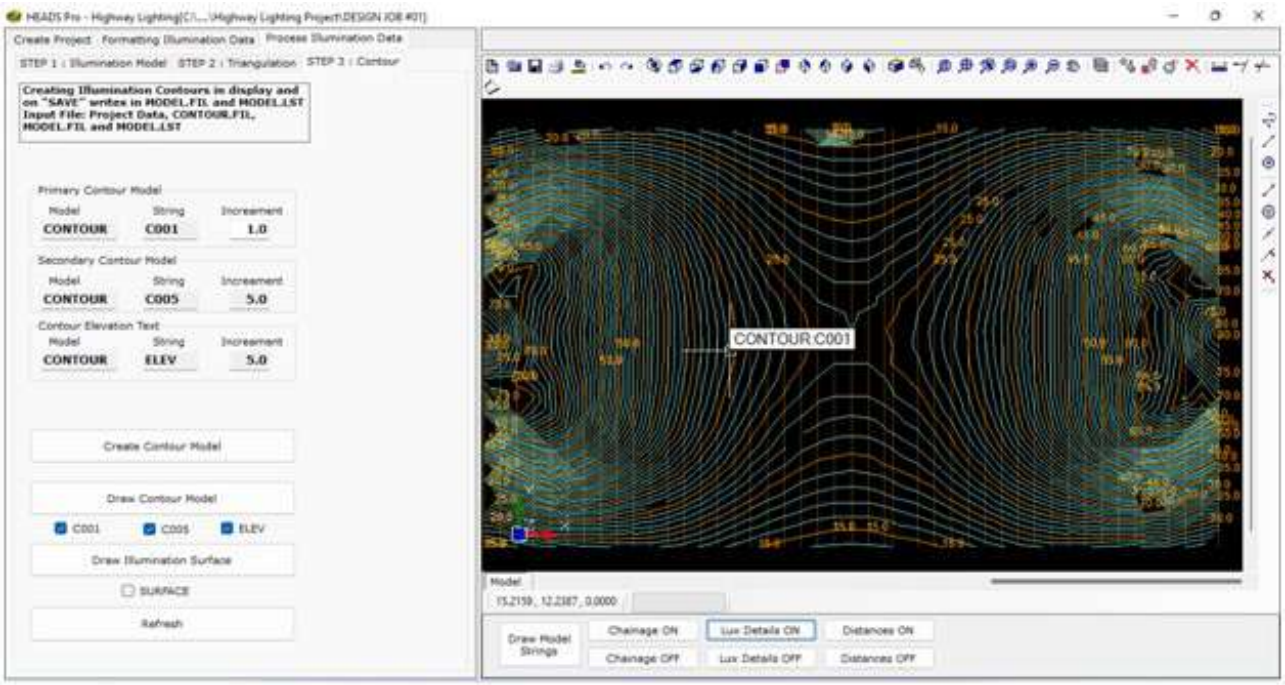


Land records may be retrieved in various specified formats from database or drawings. The relationship between the land map drawings and related records in database management system is highly useful for land record maintenance.



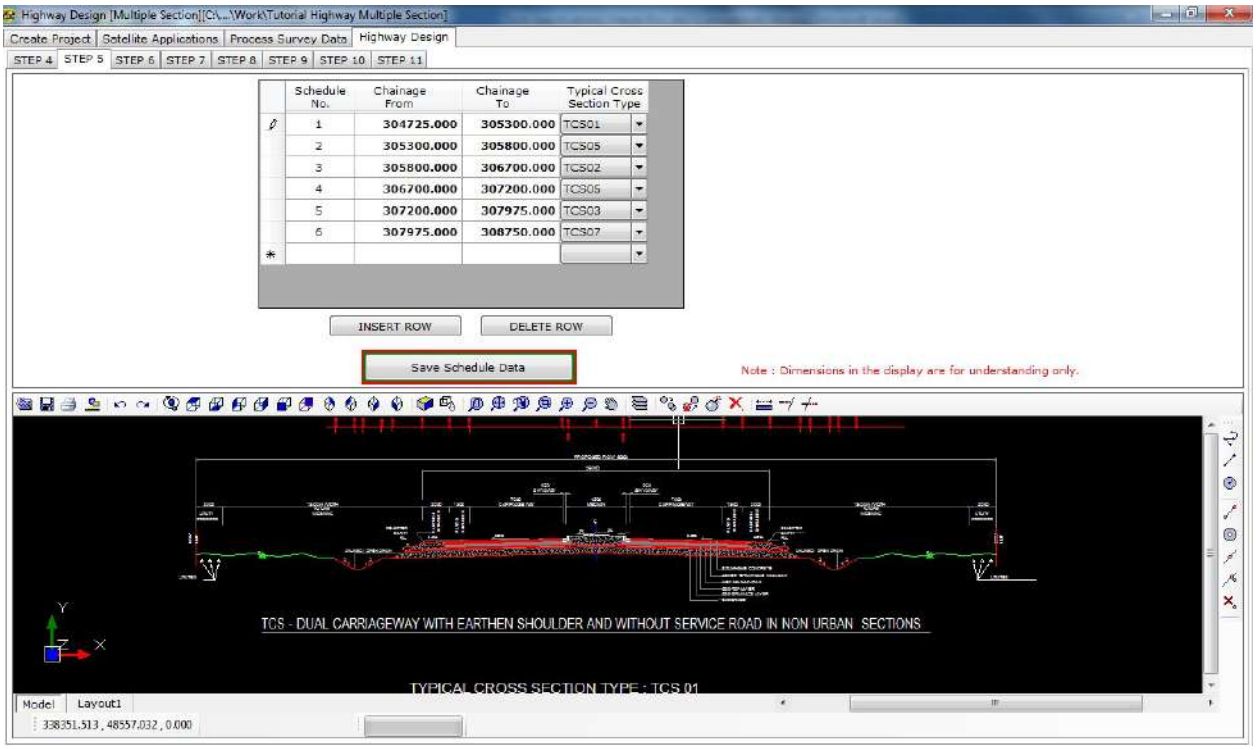
Road Safety on Night Time Visibility - Street Lighting Illumination Design

A section of the roadway may be selected for measurement of illumination and to study the illumination pattern. An area of 44.5 metres x 25.5 metres on the roadway may be selected. Here the distance between two consecutive light posts is 44.5 metres and it is measured as the length along the travel direction of the road. The width of the roadway illuminated by the street lights is 25.5 metres. The height of light posts may be 12 metres. The illumination by reflected light from the surface of the road at every grid point at an interval of 0.5 metre may be measured by illumination meter and recorded in a raw data file along the length and width of the area under the study. The data in the raw data file are to be processed by triangulation and illumination contours. The Type of Lamp (Murcury/Sodium/Halogen/LED), power of Lamp, Height of Lamp and Spacing of Lamp Posts may be adjusted to get the required illumination pattern.

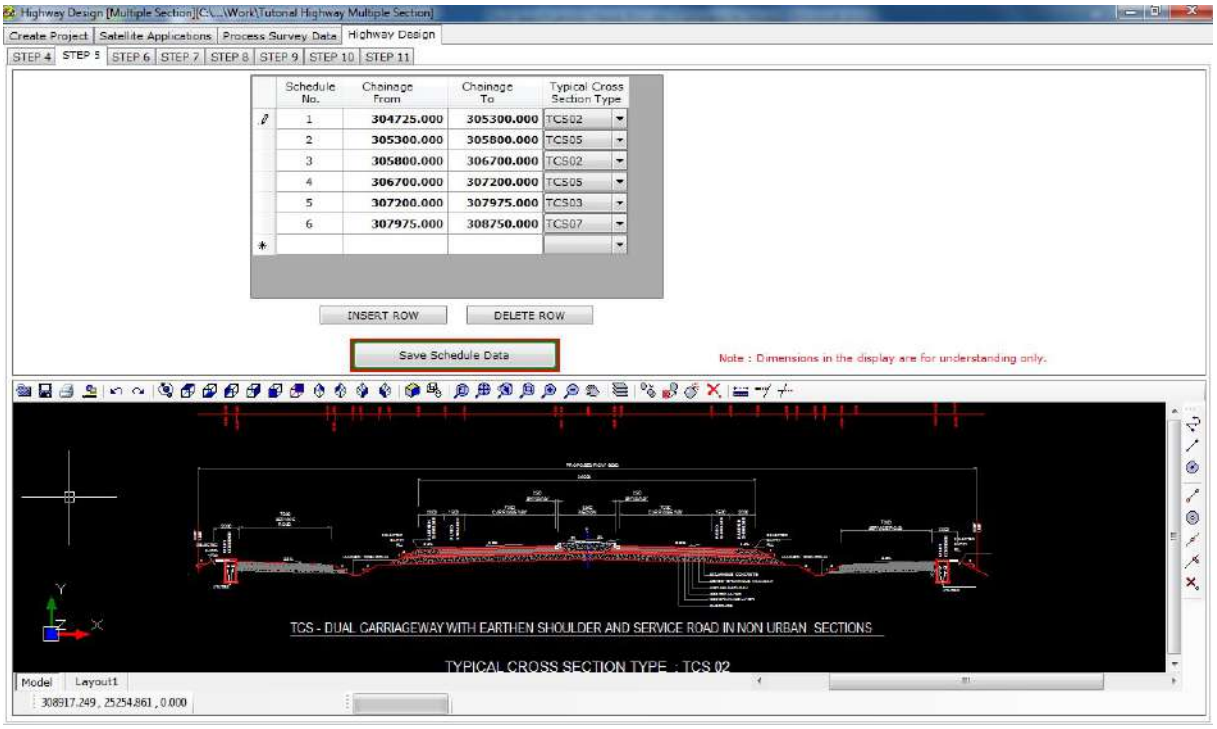


Design of **Highways & Expressways** is aided by applying different configuration for Typical Cross Section (TCS) from various chainage to chainage to chainage along its alignment starting from origin to destination.

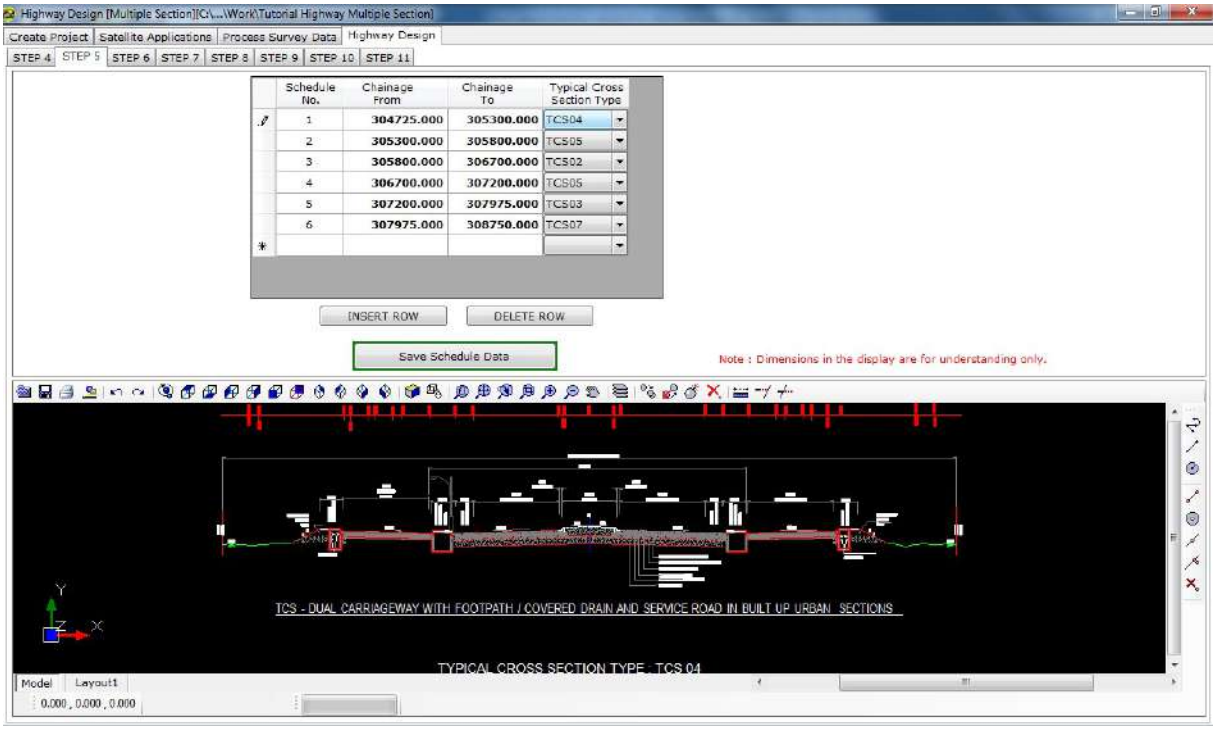
The cross section of Dual carriageway configuration for 4/6/8 Lane highway or expressway in Non-urban locations may be selected with necessary modifications from various applicable cross sections



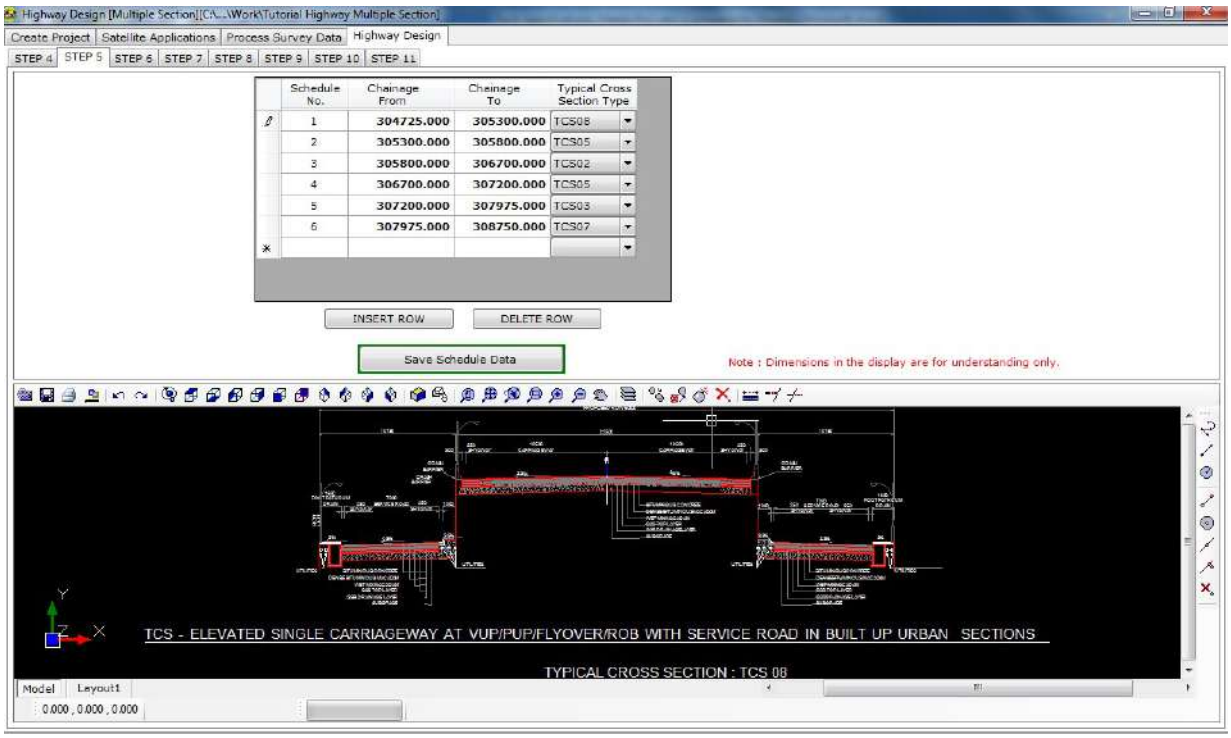
The cross section of Dual carriageway configuration for 4/6/8 Lane highway or expressway with service roads on either side in <u>non-urban</u> locations may be selected with necessary modifications



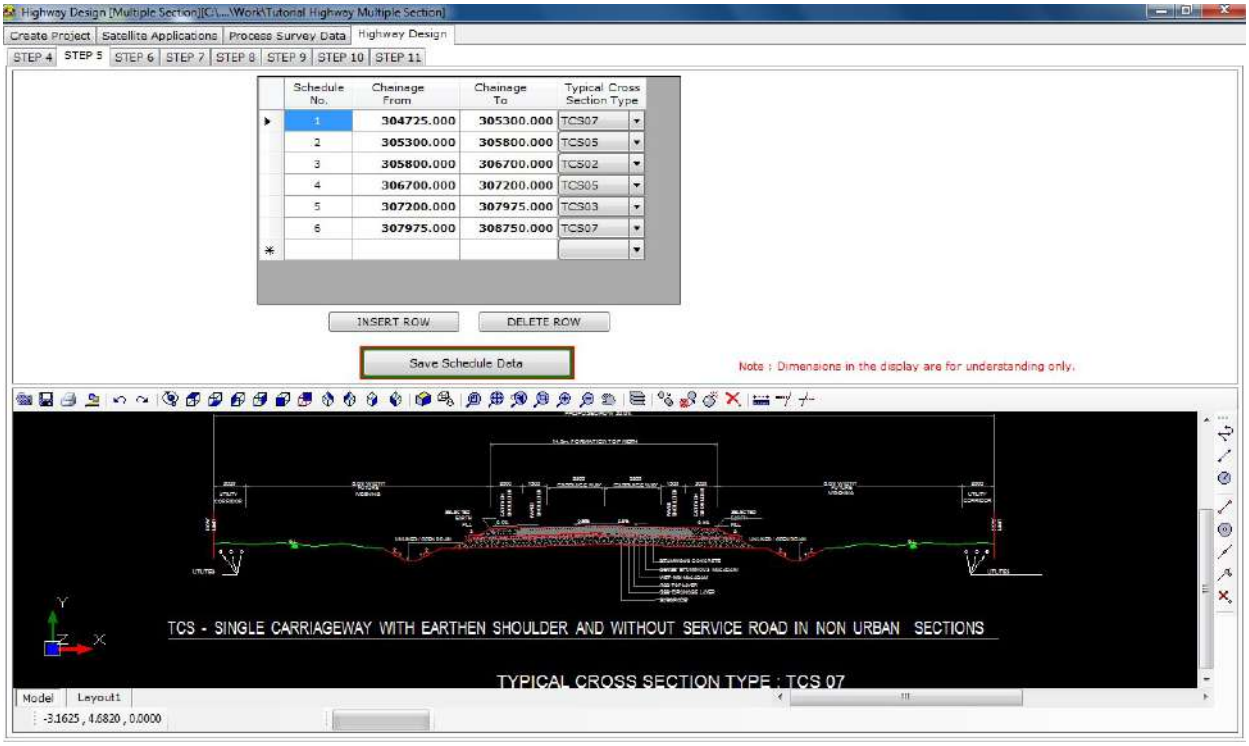
The cross section of Dual carriageway configuration for 4/6/8 Lane highway or expressway with service roads on either side in <u>Urban</u> locations may be selected with necessary modifications



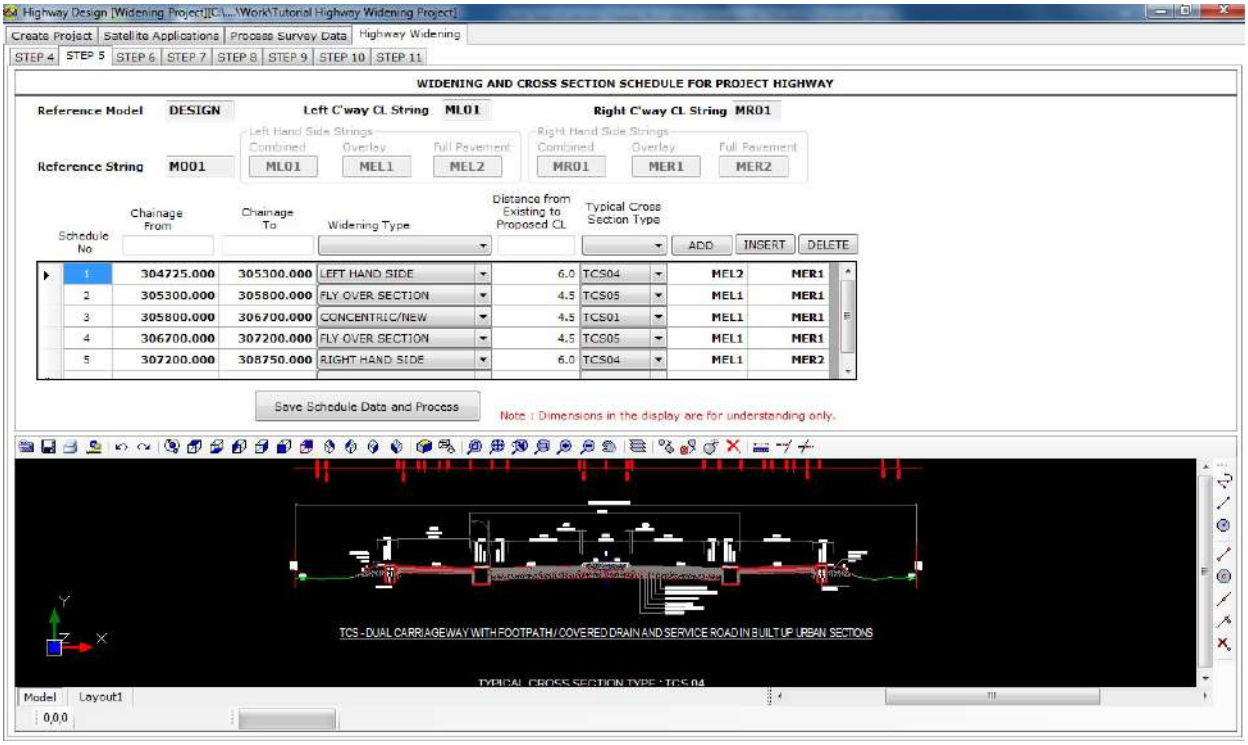
The cross section for flyovers / underpasses with dual carriageway configuration for 2/4/6/8 Lane highway or expressway with service roads on either side in either urban or non-urban locations may be selected with necessary modifications



The cross section with single carriageway configuration for highway or expressway in non-urban locations may be selected with necessary modifications

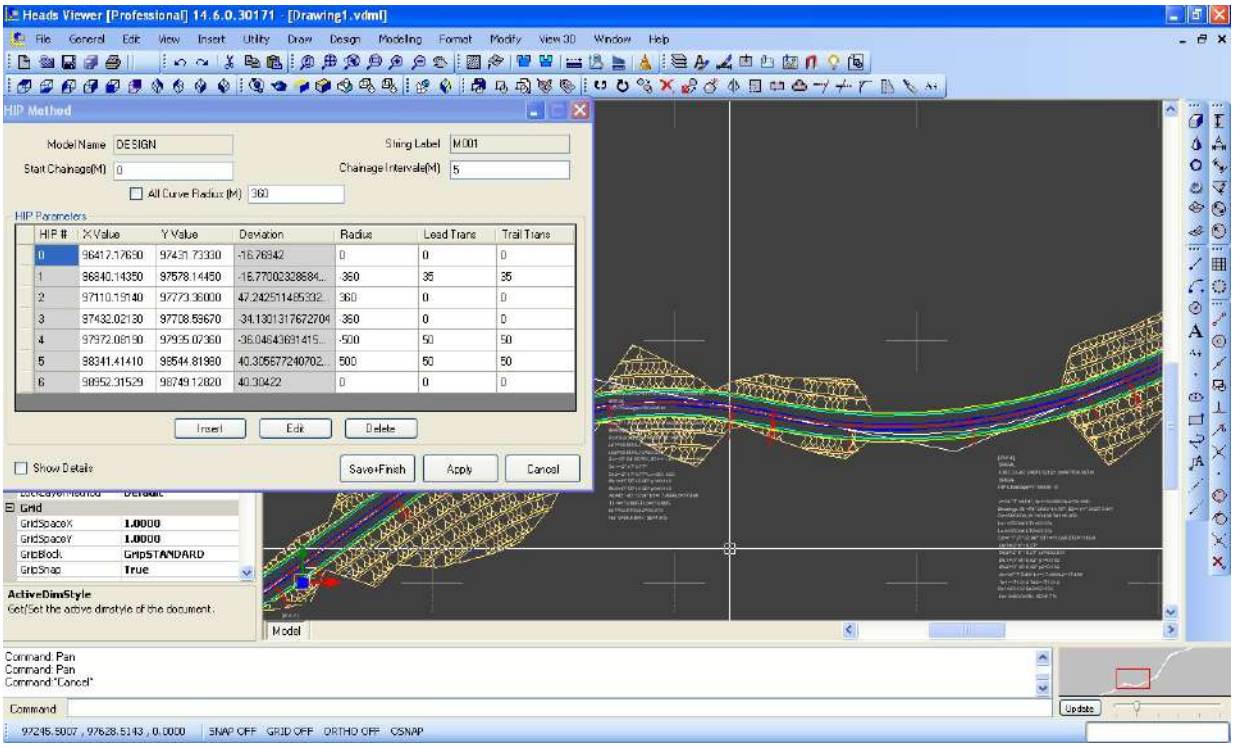


The widening pattern may be defined as Left / Concentric / Right / Flyover from chainage to chainage with necessary modifications

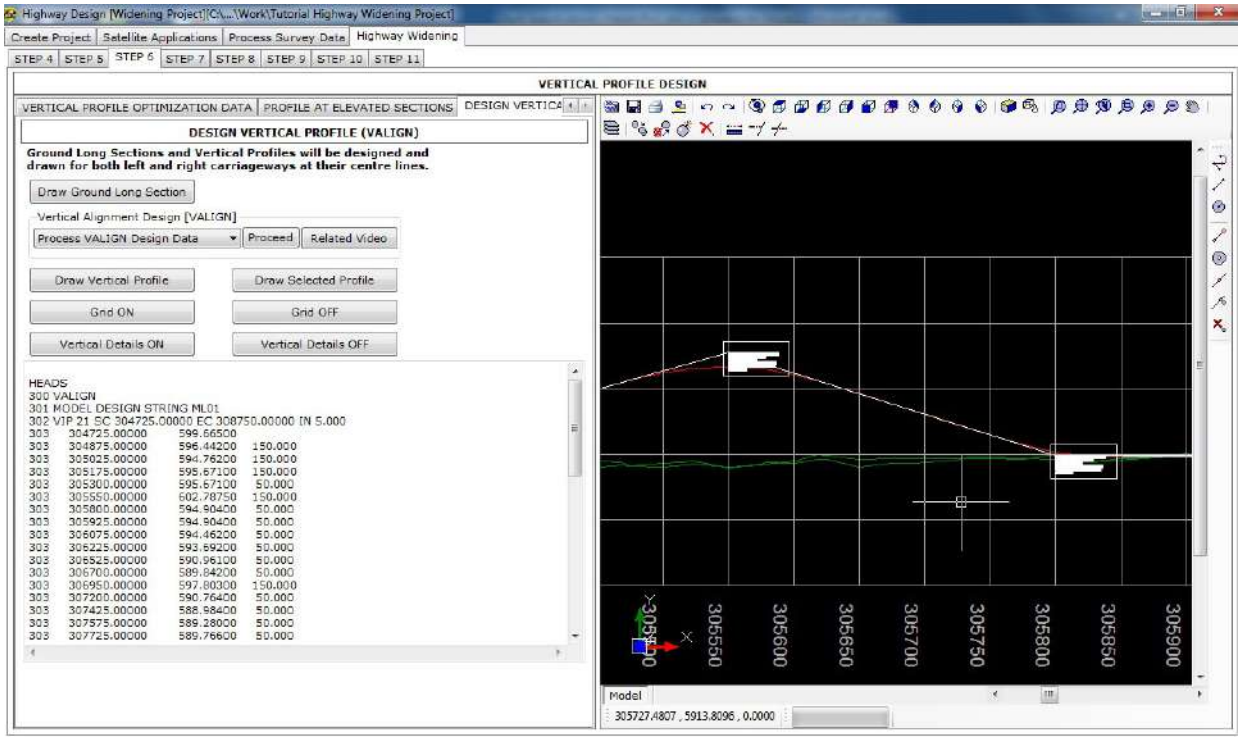


Built-in CAD Engine For Interactive Design and Drawings

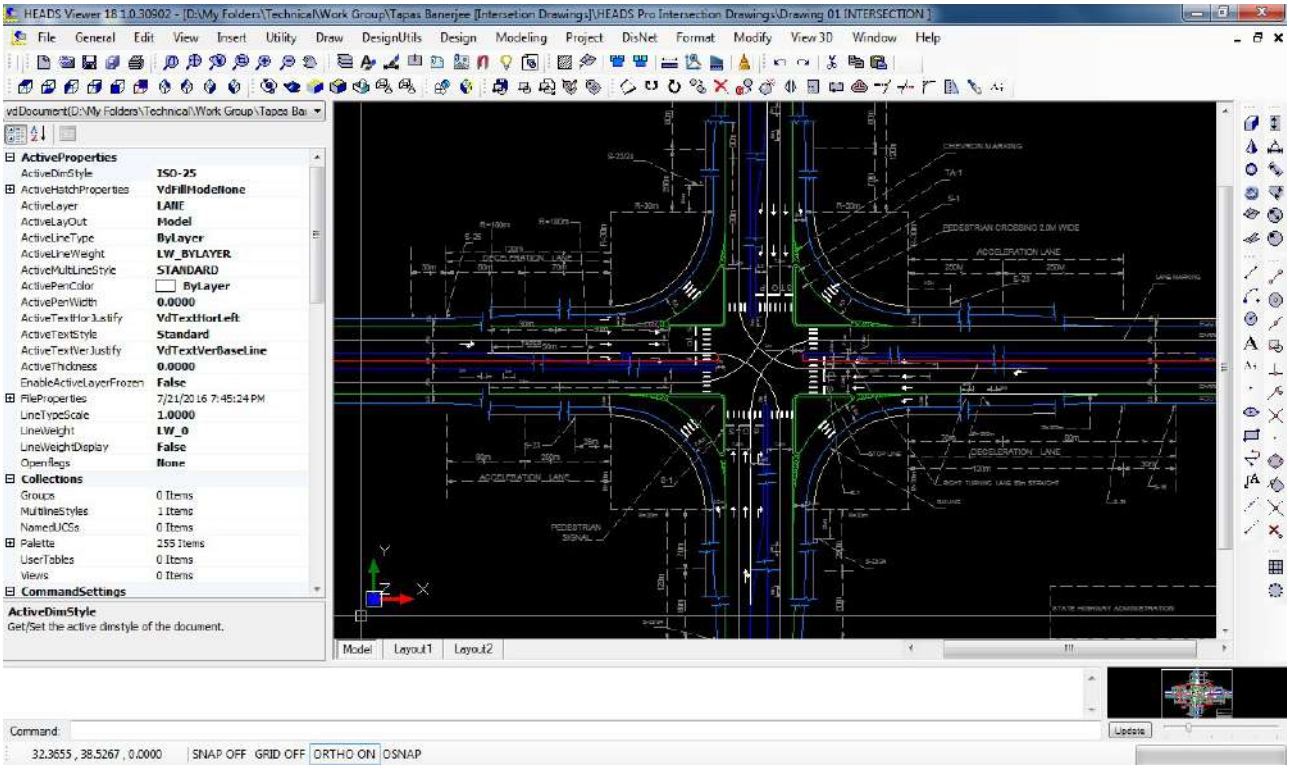
HEADS Pro features for its various options available for the geometric design of road alignment either by Interactive design over the survey plan drawing or by Automatic wizard or by Processing alignment data or on Satellite imagery.



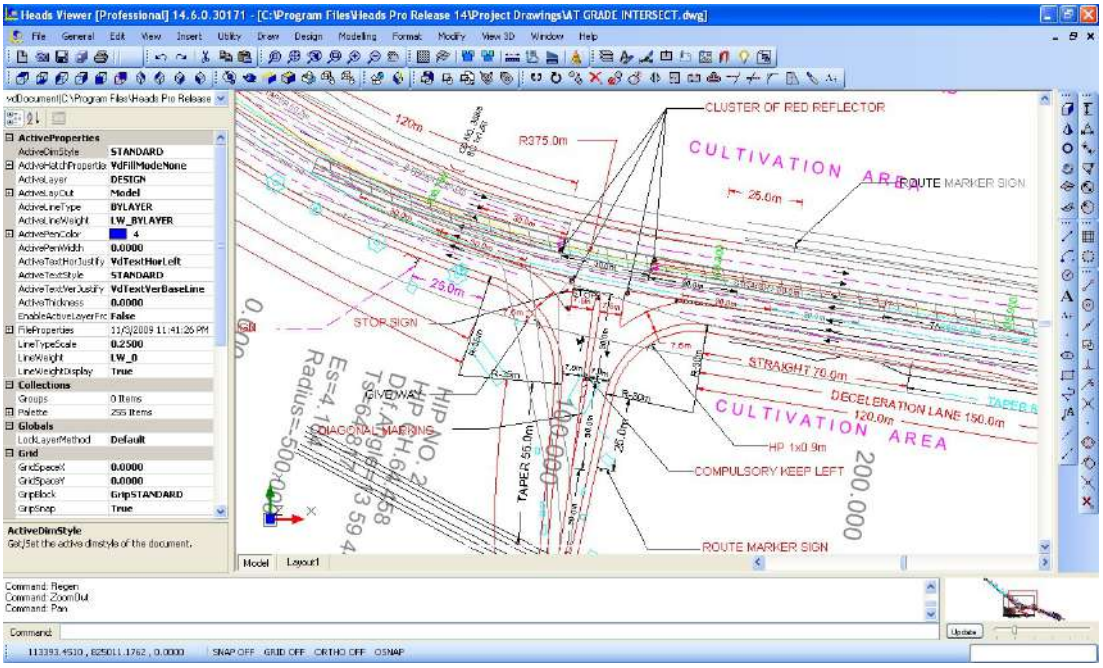
HEADS Pro features for its various options available for the geometric design of road profile either by Interactive design over the ground long section or by Automatic wizard with optimization or by Processing vertical profile data.



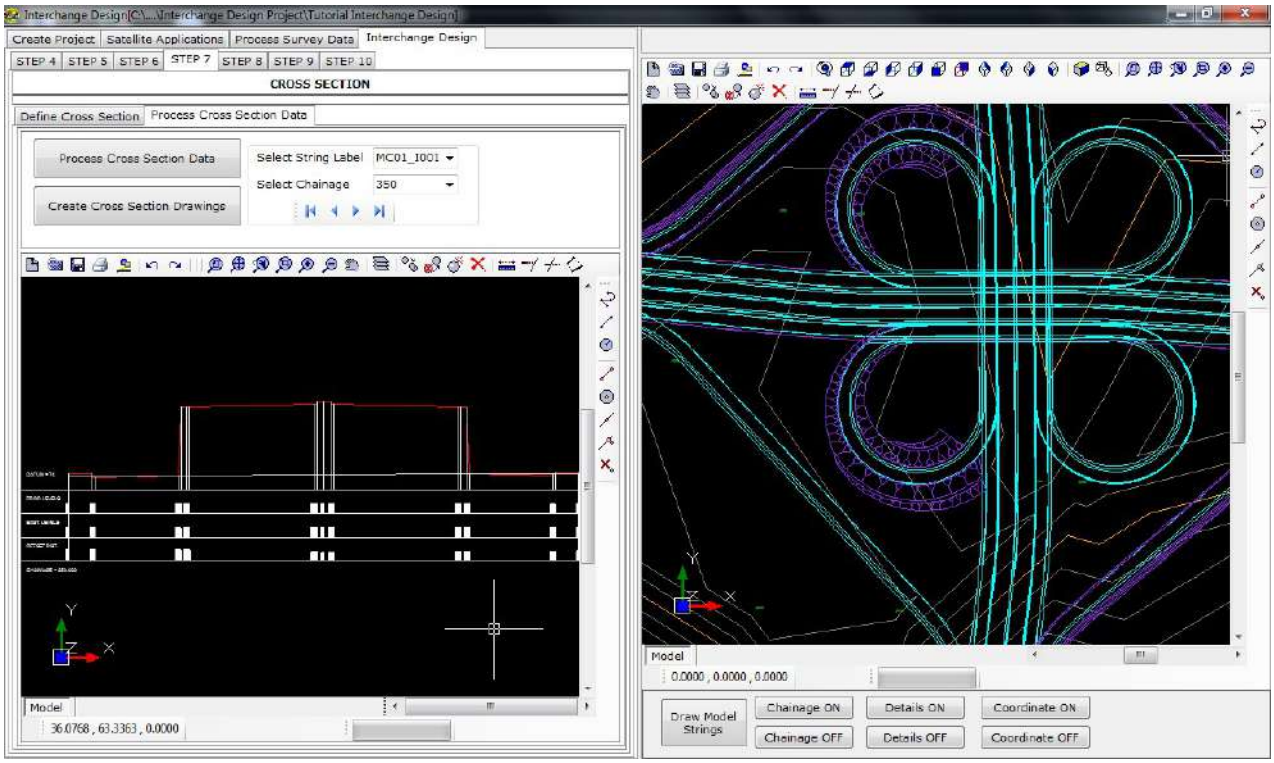
Design of At-grade intersections and Roundabouts with built-in CAD enable the users to handle any complex site situation for in best possible way.



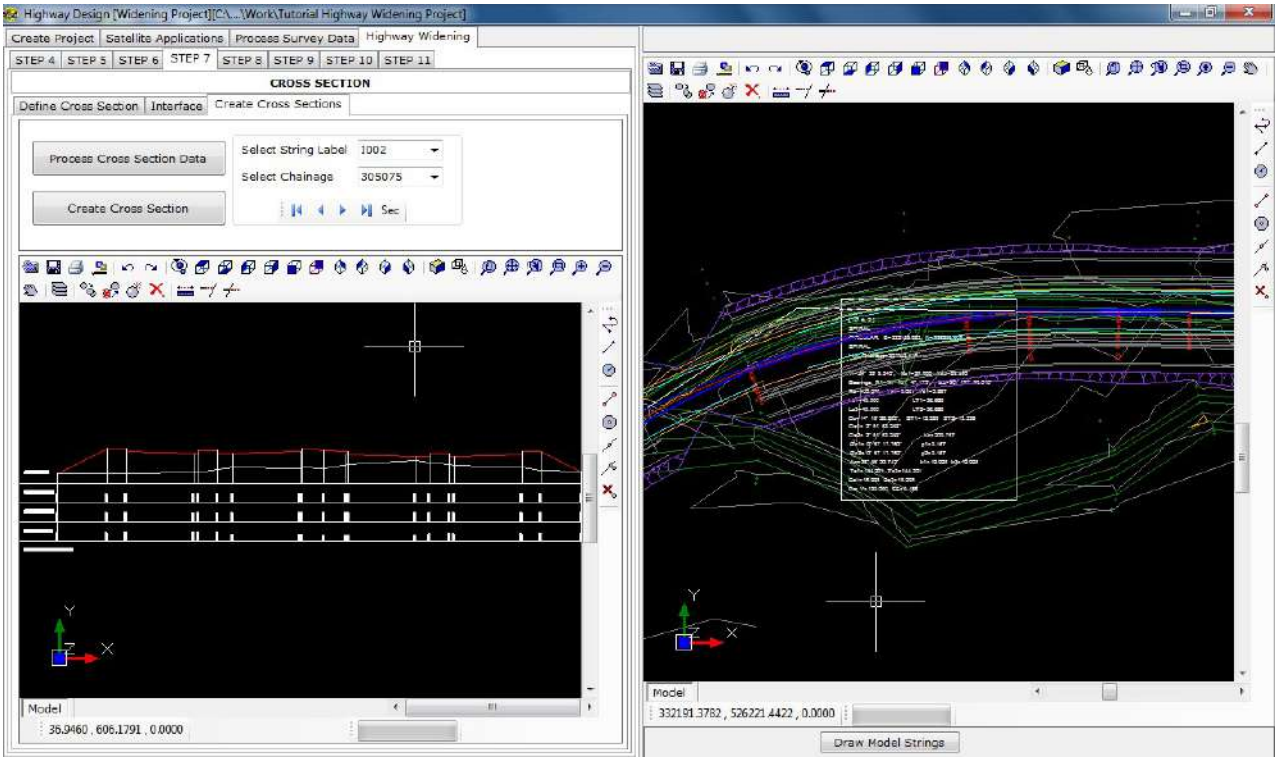
HEADS Pro has built-in CAD enable the users to handle any complex site situation for design of at grade intersections acceleration lane, deceleration lane, merging lane, diverging lane in best possible way.



Design of multi level Grade Separated Interchanges with design of alignment, vertical profile and cross sections for main lines, each loop, slip roads, merging lanes and diverging lanes.

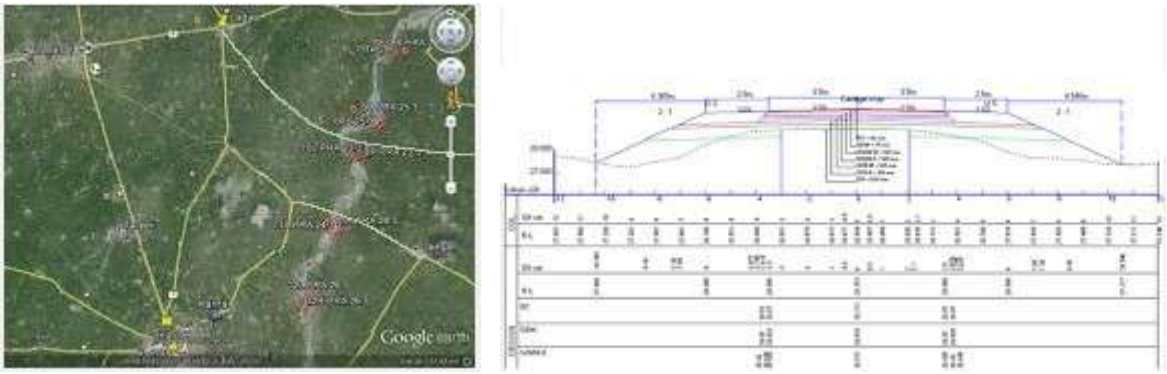


HEADS Pro features for CAD based design where the verification of the work done can be done instantaneously before going to the next step, by providing special facilities user can design Road with Uniform Cross Section, Multiple Cross Sections, Highway Widening and Changing of widening pattern either as concentric or on Left or Right side By applying different Typical Cross Sections from Chainage to Chainage.

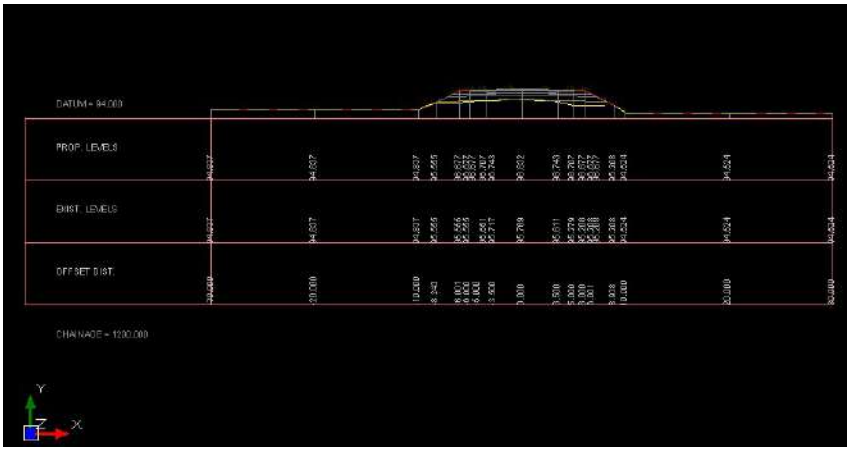


Design of Low-Cost Rural Roads is available by selecting from Core Network of Village Roads, identifying the origin to destination of each road by using GPS, developing alignment geometrics, pavement design, BoQ and Cost estimation and finally producing the construction drawings helps in preparing the Bid documents and further for construction at site.

HEADS Pro reduces the time for project preparation significantly by using various latest technologies like GPS, Satellite imagery to complete the Detail Project Report (DPR) in the shortest time. In the design of pavements the use of Optimization Technology keeps the earthwork to the desired level only with respect to the HFL and avoiding the undesired quantity of earthwork to minimum possible extent.



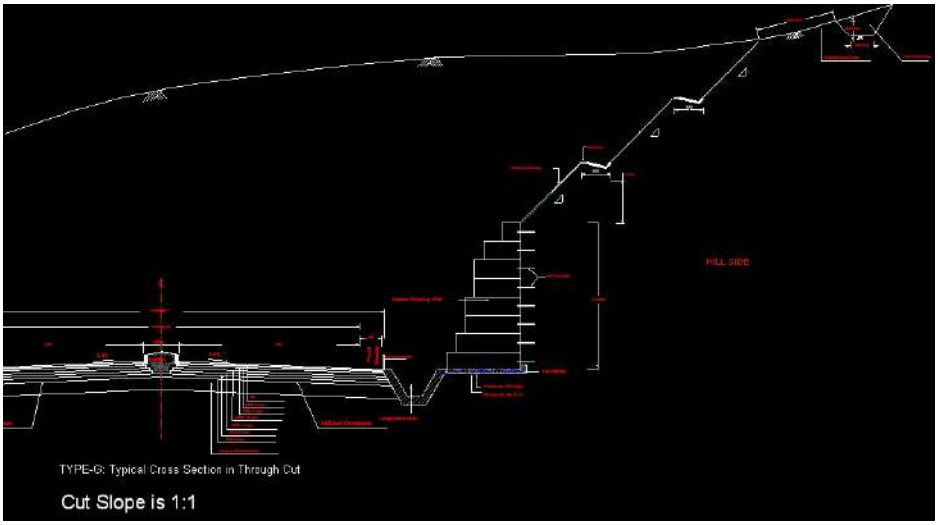
Construction of Low Cost Rural Roads may be either for new roads or for resurfacing of the existing roads with various pavement layers which designed for various rural commodity transport vehicles, Agricultural Tractors and must be strong enough to last long.



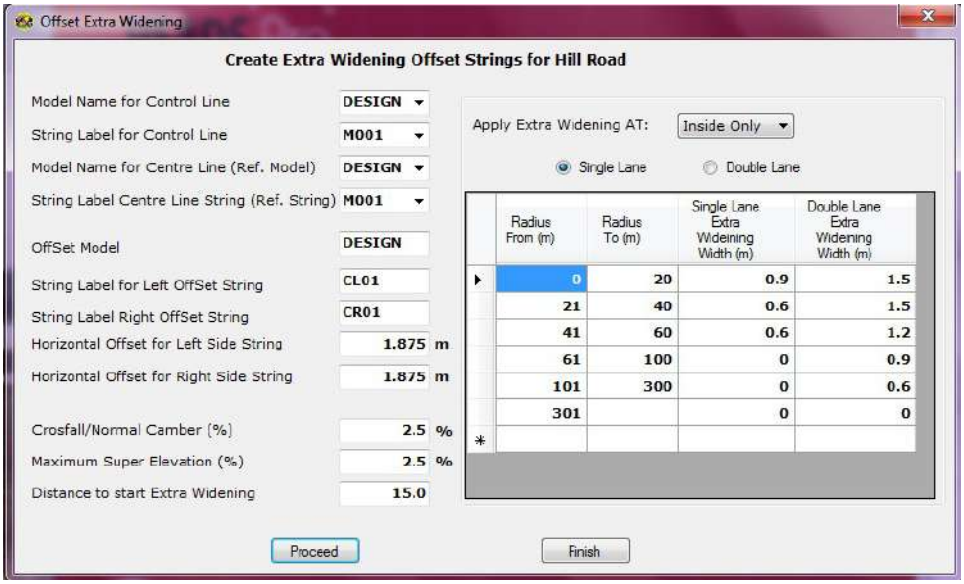
Cross section Drawing for new single carriageway construction

Design of Hill Roads is available with special treatments for (i) Carriageway Widening at curves (ii) Provision for slopes on cut side varying with the depth, (iii) Provision for Gabion Walls on cut side and (iv) provision for Retaining Walls on the fill / valley side.

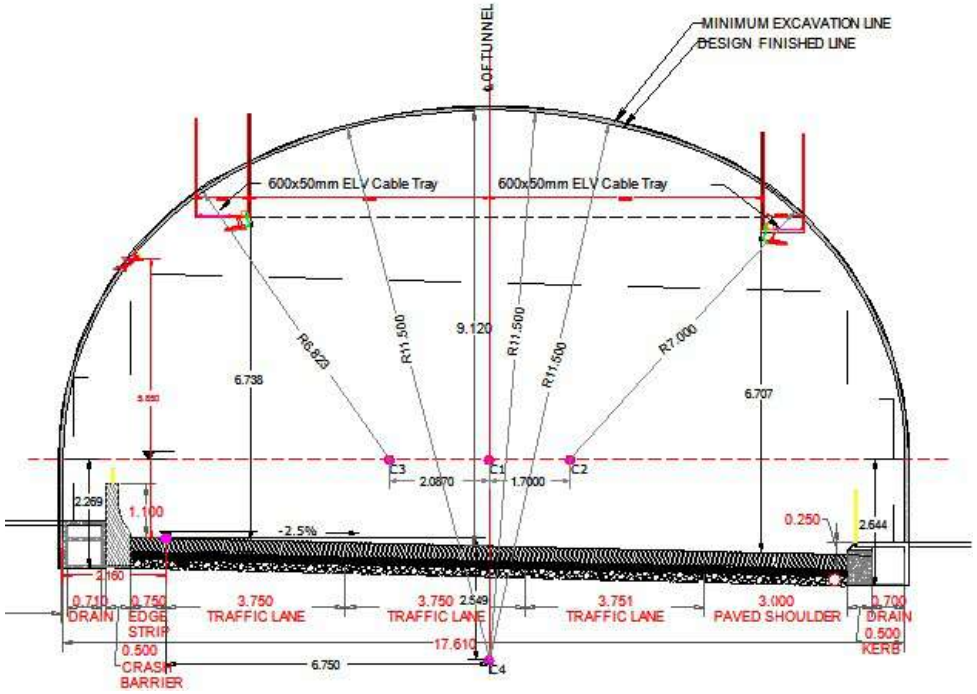
Widening of Hill Roads using Varying Slopes on Cut side depending on Depth and using Gabion Wall on Cut side and Retaining wall on Fill / Valley side is best designed.



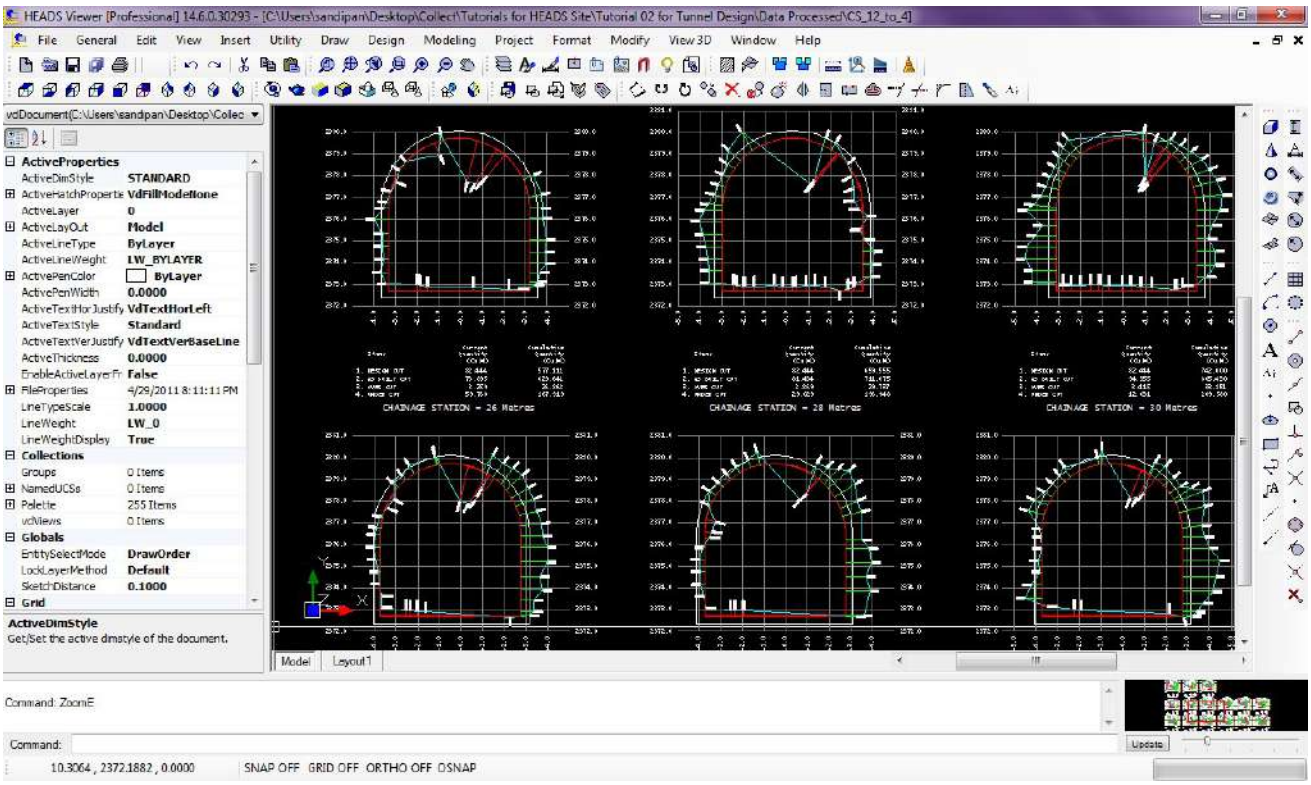
Provisions for **Extra Widening** following the country's design standard is important in the design of Hill Roads which is not available in the market available softwares, so the designer must be careful in selecting the right software product to keep provisions of inside / outside / both sides widening at the curves.



Tunnel Geometrics **HEADS Pro** features for the Design of alignment, profile and cross sections with Quantities separately for Design-cut, Over-cut, Under-cut and As-Built cut for Highway Tunnels. HEADS Pro features for CAD based checking of Coach Profile inside the Tunnel. All the design work produce construction drawings in CAD,



The Boring Cut Quantities are estimated for Design Cut, As Built Cut, Over Cut and Under Cut. The “Pay Line” outside the design section is also defined to include the desired amount of overcut in the measurements. Ready to Plot and Editable CAD Drawings are created as the output.



Planning for a road tunnel

Planning for a road tunnel requires multi-disciplinary involvement and assessments, and should generally adopt the same standards as for surface roads and bridge options, with some exceptions. Certain considerations, such as lighting, ventilation, life safety, operation and maintenance, etc. should be addressed specifically for tunnels. In addition to the capital construction cost, a life cycle cost analysis should be performed taking into account the life expectancy of a tunnel. It should be noted that the life expectancies of tunnels are significantly longer than those of other facilities such as roads and bridges. Traditionally, tunnels are designed for a life of 100 to 125 years. However, existing old tunnels (over 100 years old) still operate successfully throughout the world. Recent trends have been to design tunnels for 150 years life.

The size and type of vehicles to be considered depend upon the class of road. Generally, the tunnel geometrical configuration should accommodate all potential vehicles that use the roads leading to the tunnel including over-height vehicles such as military vehicles if needed. Road tunnels should have at least the same traffic capacity as that of surface roads. However, traffic will slow down if the lane width is less than standards (too narrow) and will shy away from tunnel walls if insufficient lateral clearance is provided inside the tunnel.

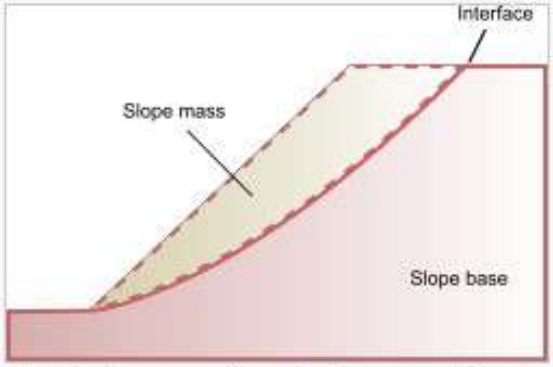
The commonly used tunneling are (i) Cut-and-cover tunnels, (ii) Bored or mined tunnels, (iii) Rock tunnels, (iv) Soft ground tunnels, (v) Immersed tunnels, (vi) Jacked box tunnels.

The structural design of tunnels is available in our software ASTRA Pro, mainly by Drill & Blast / New Austrian Tunneling Method (NATM). Design of Tunnel Support System is done with Rock bolts, Lattice girder steel ribs, Wire mesh or Fiber Reinforced Shotcrete, based on geological mapping with RMR. Design of RCC Tunnel Portal and Tunnel lining are done by Finite Element Model Analysis.

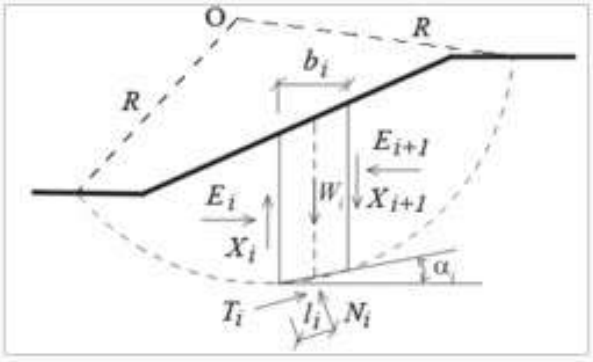
Analysis for Stability of Slopes

Slope stability analysis is performed to assess the safe design of a human-made or natural slopes (e.g. embankments of dam, dyke, road, cuts, open-pit mining, excavations, landfills etc.) and the equilibrium conditions. Slope stability is the resistance of inclined surface to failure by sliding or collapsing. The main objectives of slope stability analysis are finding endangered areas, investigation of potential failure mechanisms, determination of the slope sensitivity to different triggering mechanisms, designing of optimal slopes with regard to safety, reliability and economics, designing possible remedial measures, e.g. barriers and stabilization.

Successful design of the slope requires geological information and site characteristics, e.g. properties of soil/rock mass, slope geometry, groundwater conditions, alternation of materials by faulting, joint or discontinuity systems, movements and tension in joints, earthquake activity etc. The presence of water has a detrimental effect on slope stability. Water pressure acting in the pore spaces, fractures or other discontinuities in the materials that make up the pit slope will reduce the strength of those materials. Choice of correct analysis technique depends on both site conditions and the potential mode of failure, with careful consideration being given to the varying strengths, weaknesses and limitations inherent in each methodology.



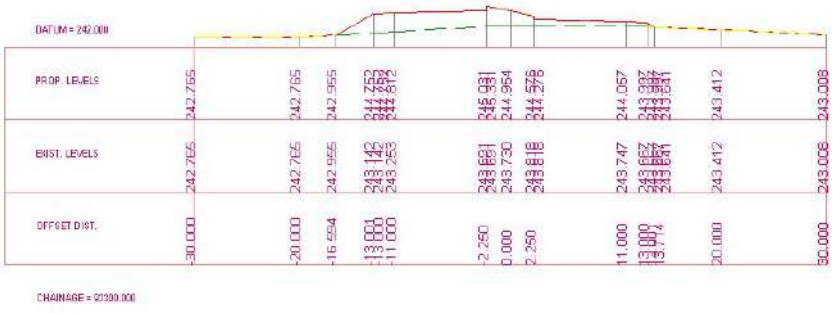
A typical cross-section of a slope used in two-dimensional analyses.



Schematic of the method of slices showing rotation center.

Highway Strengthening and Widening

In developing countries most of the projects are widening of the existing road carriageway. This needs strengthening of the existing carriageway with Profile correction followed by laying of Bituminous overlay at the top and on the other side there is construction of a new carriageway with full Pavement structure. This needs two separate designs for two carriageways in respect of Horizontal and Vertical alignment. In case the height of existing embankment is low then the surfaces of two carriageways will be at different levels. This is best done in HEADS Pro using the versatile String technique.



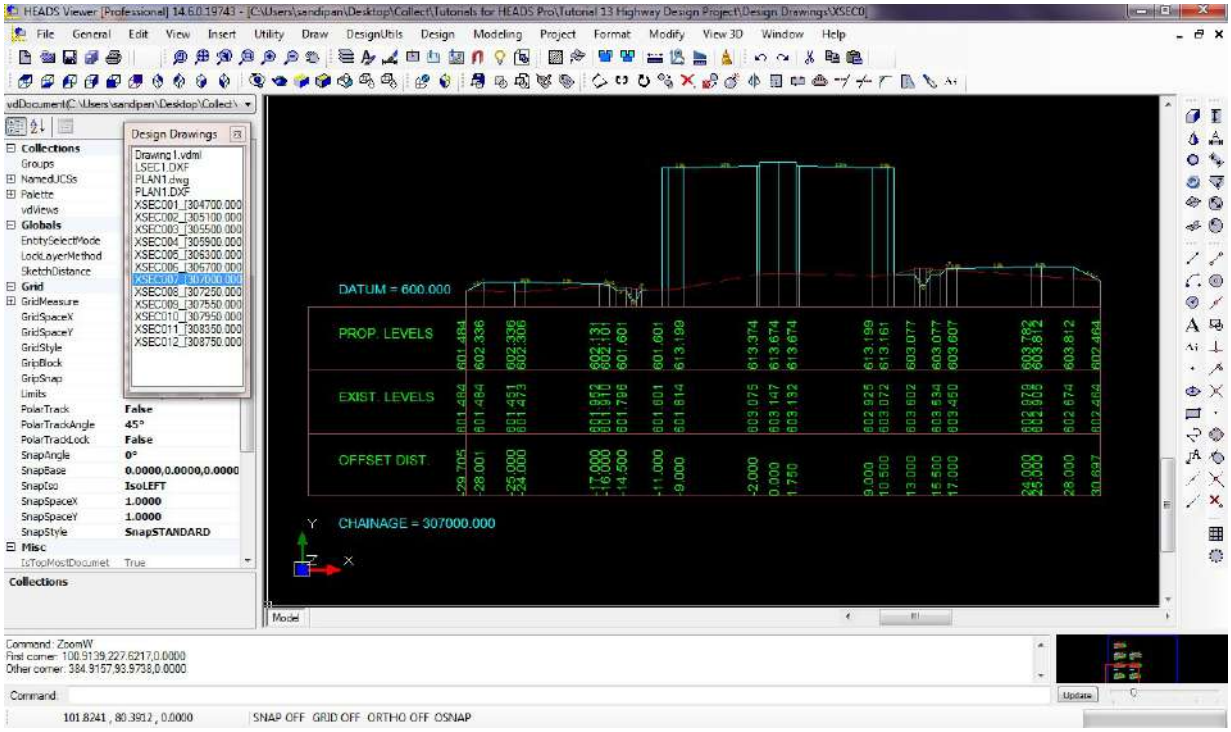
Split Carriageway Design for Road Widening

Split Carriageway section after Road Widening

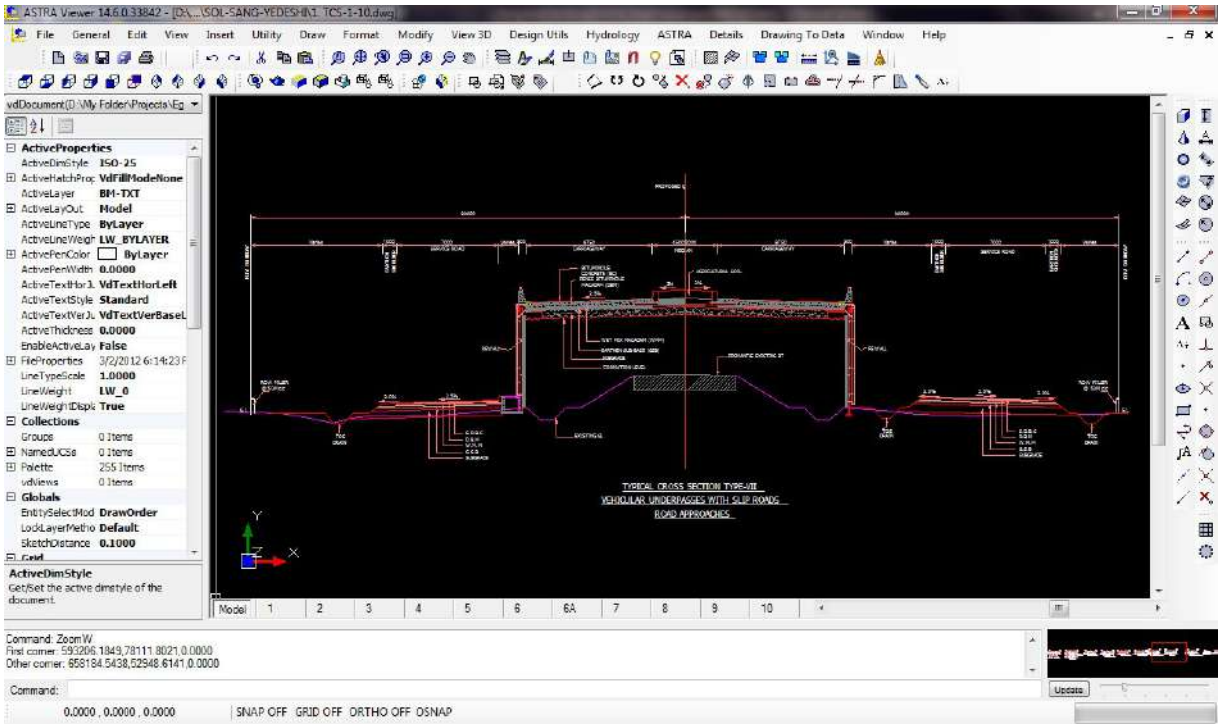
Pavement construction for Road Widening

Construction Drawings for Rehabilitation of Old Roads

Some times the existing single carriageway 2 lane road is proposed for rehabilitation after carrying out Benkelman Beam Deflection test and within the limited budgetary provisions. Here the central portion may be treated with Profile correction and a course of pavement overlay commonly by Bituminous Macadam or Dense Bituminous Macadam. In case the edges on both the sides are broken or damaged then full pavement structure for limited width may be proposed at the edges in such sections. HEADS Pro computes the quantities for Profile Correction Course (PCC), Overlay and for side layers with best possible accuracy and produces the drawings with various levels at specified distances. These drawings are most essentials for such construction.

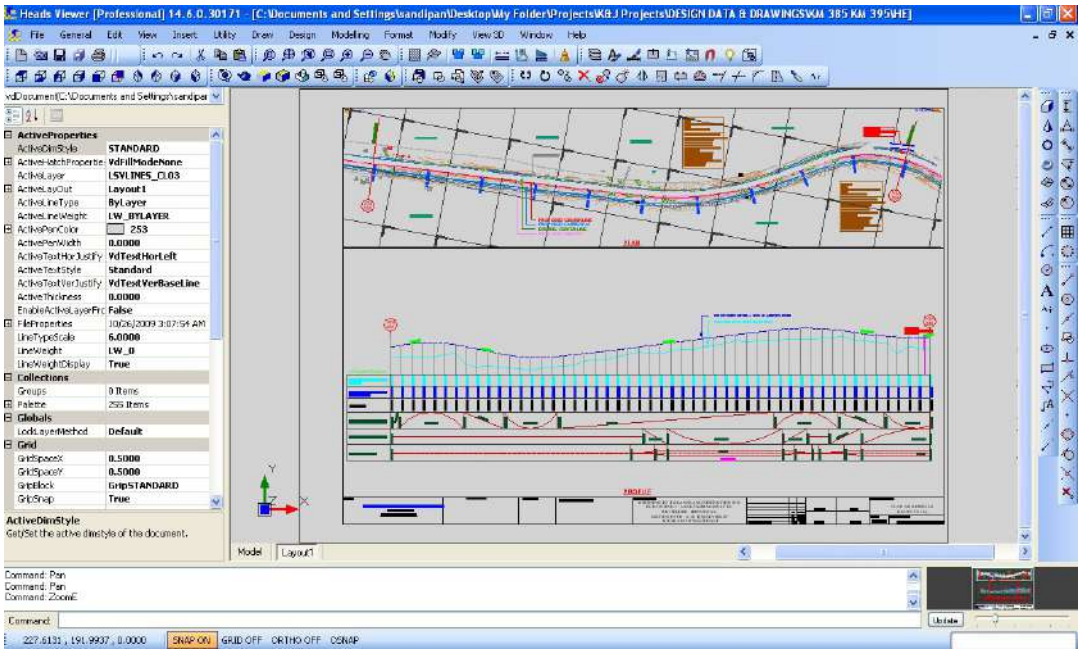


Cross Section Drawing with Fly over and Service Roads for Highway Rehabilitation projects



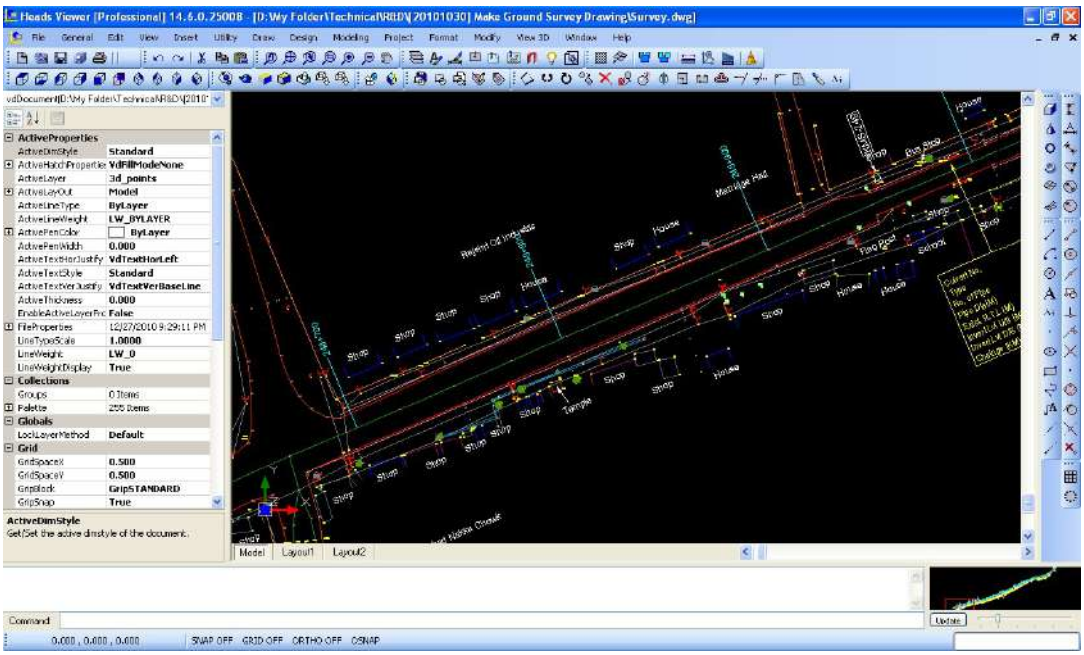
Construction and As-built Drawings are produced by HEADS Pro

HEADS Pro produces Plan-Profile and Cross section drawings for the projects in international standard, which means that the information mentioned in the drawing fulfills all construction requirements following the standards and specifications of most of the countries in the world.



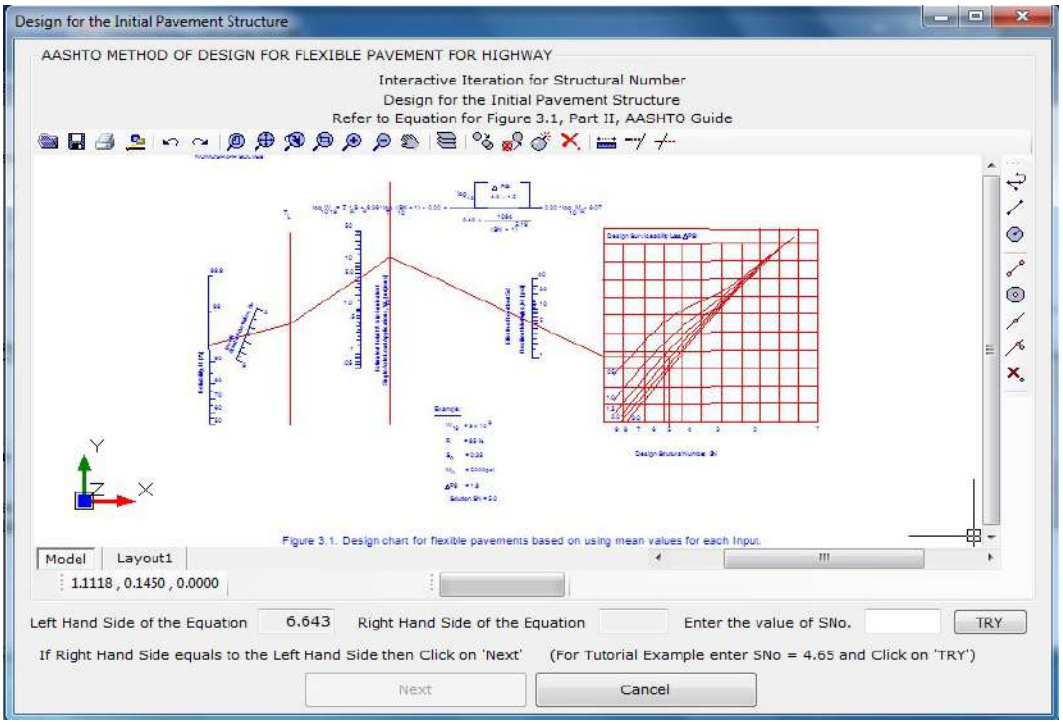
Plan & Profile Drawing

HEADS Pro produces Survey Base Plan by Digital Mapping from the Ground Survey Text data and by selecting drawing feature symbols from CAD Block library, the various texts obtained from the surveyors are also placed correctly in the Base Plan drawing. The drawing is made in CAD layered system and is compatible to AutoCAD and other popular CAD softwares for any further editing/drafting. Contours and DTM, with Ground sections are also produced as Reports and CAD drawings for Plan & Profile, Cross sections. This saves the time significantly in preparation for the Detail Engineering Projects.

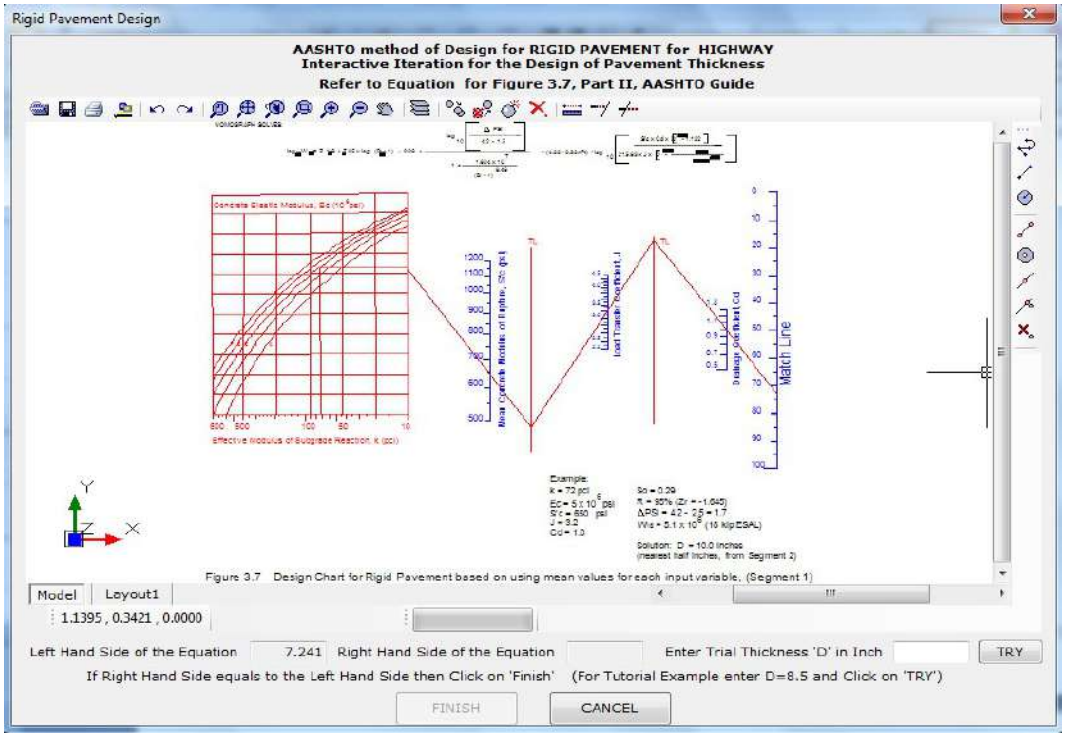


Survey Base Plan

HEADS Pro features for Pavement Design in AASHTO and IRC methods for Flexible Pavement with stage construction facilities, Rigid Pavement by CRCP & JRCP, with Cumulative Fatigue Damage analysis, Pavement Overlay by Benkelman Beam Deflection test data, Design of Bituminous based on Marshall Test data for Bulk Density, Stability and Flow and Blended Grading of aggregates with diagram. Flexible Bituminous Pavement Design by IRC 37 2018/2019 includes design by IIT-Pave, Low Volume Rural Road Pavement design features for IRC SP 72 and Rigid Concrete Pavement Design by IRC 58 includes Cumulative Fatigue Damage Analysis.



Design of Flexible Pavement in AASHTO method



Design of Rigid Pavement in AASHTO method

Pavement Strengthening for Cracked / Distressed Pavements by Layered System Analysis

Reinforcing asphalt / bituminous layers by using Geogrids and reinforcing Subgrade by using Geotextiles. Layered Pavement System Analysis is available to determine the increase in the strength of pavement using Geotextiles or Fiber Glass Geogrids / Geosynthetics.

The cost of Pavement structure is important for every road project and compromising with the structure will not allow the pavement to last long. So the cost reduction is to be done without lowering its strength. Now products are available to incorporate the pavement to increase the strength and longevity at a lesser cost. This is commonly done by laying Geosynthetics layer in between the layers of Asphalt concrete and Dense Bituminous Macadam and also by laying Jute Geotextiles at the top of the Subgrade layer.

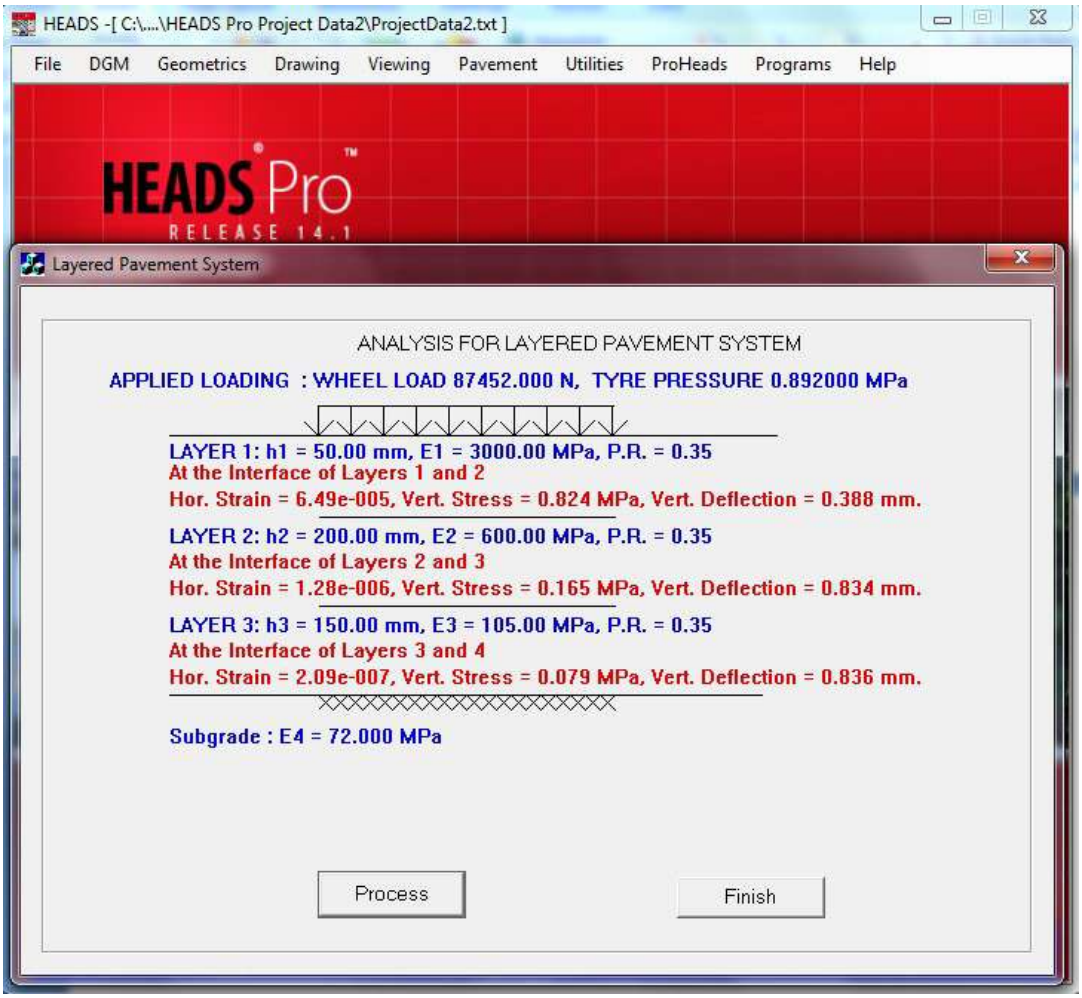
Geosynthetics are not decomposable but Jute Geotextiles are decomposable and both increase the life of pavement significantly. Jute Geotextiles are very useful when the road is to be constructed in unstable ground. It is available in plenty in India and Bangladesh and is an inexpensive material. If the ground is stable but traffic load is high then the pavement structure becomes expensive. To reduce the cost either less expensive layers or lesser thickness are to be thought of. In such case if the strength is to be maintained same as the original structure then incorporating of Geosynthetics is an effective solution.

This requires correct analysis to determine the strength of the pavement structure by using various layers of different strength and thicknesses. Every pavement option may also be studied with and without incorporating the Geosynthetics.

The strength of pavement is required by obtaining the Elastic modulus and Poisson's ratio. The various companies are producing Falling weight Deflectometer, one of them is Dynatest (www.dynatest.com) and for analysis software HEADS Pro may be used for various options. In HEADS Pro software option is available for Analysis for Layered pavement System. It may be used for 2 or 3 or 4 layer Pavement system, where the Layers may be combined to define as a Bound (Asphalt/Bituminous) Layer, Unbound layer (Granular Base), Sub Base and Sub Grade. The input is required for Thickness of each Layer (excluding Subgrade), Modulus of Elasticity of each Layer and Poisson's ration of each Layer (excluding Subgrade).

Input Data <u>without applying</u> Geosynthetics	**Input Data <u>for applying</u> Fiber Glass Geosynthetics**
Let us consider 3 Layers as: **Thicknesses:** Asphalt Concrete: Thickness = 50 mm, Wet Mix Macadam : Thickness = 200 mm, Sub Grade : No Thickness, **Elastic Modulii:** Asphalt Concrete: Elastic Modulus = 3000 N/ Sq. mm., Wet Mix Macadam : Elastic Modulus = 600 N/ Sq. mm., Sub Grade: Elastic Modulus = 72 N/ Sq. mm., **Poisson's Ratios:** Asphalt Concrete: Poisson's Ratio = 0.35, Wet Mix Macadam : Poisson's Ratio = 0.35, Sub Grade: Poisson's Ratio = 0.35, **Wheel Load** = 87452 kN. **Tire Pessure** = 0.892 N / Sq. mm. **HEADS Input Data:** HEADS 2400,LAYERS 2401,TOL=3 2402,TH=50,200 2403,EM=3000,600,72 2404,PR=0.35,0.35,0.35 2405,WL=87452 2406,TP=0.892 FINISH	Thickness of Fiber Glass Geosynthetics = 3 mm. Tensile Strength of Fiber Glass Geosynthetics = 200 kN/m. = (200 x 1000) / (1000 x 3) = 67 N/ Sq. mm. Elastic Modulus = 67 N/ Sq. mm. Poisson's Ratio = 0.45 Let us consider 3 Layers as: **Thicknesses:** Asphalt Concrete: Thickness = 50 mm, Fiber Glass Geo Synthetics: Thickness = 3 mm, Wet Mix Macadam : Thickness = 200 mm, **Elastic Moduli:** Asphalt Concrete: Elastic Modulus = 3000 N/ Sq. mm., Fiber Glass Geo Synthetics: Elastic Modulus = 67 N/ Sq. mm., Wet Mix Macadam : Elastic Modulus = 200 N/ Sq. mm., **Poisson's Ratios**: Asphalt Concrete: Poisson's Ratio = 0.35, Fiber Glass Geo Synthetics: Poisson's Ratio = 0.45, Wet Mix Macadam : Poisson's Ratio = 0.35, **Wheel Load** = 87452 kN. **Tire Pressure** = 0.892 N / Sq. mm. **HEADS Input Data:** HEADS 2400,LAYERS 2401,TOL=4 2402,TH=50,3,200 2403,EM=3000,67,600,72 2404,PR=0.35,0.45,0.35 2405,WL=87452 2406,TP=0.892 FINISH

The final result is produced as : **Horizontal Strain, Vertical Stress and Vertical Deflection at the interface of each two Layers.** The above results are improved by incorporating Geosynthetics or any other type of Reinforcement is used. The Analysis Report is generated with details of all Formulae and Calculation Steps and is highly useful for the users.



Analysis for Layered Pavement System

Output	Pavement without Geosynthetics	Pavement with Geosynthetics
Horizontal Strain	6.488e-005 mm./mm.	3.604e-005 mm./mm.
Vertical Stress	0.824 N/sq.mm.(MPa)	0.773 N/sq.mm.(MPa)
Vertical Deflection	0.388 mm.	0.349 mm.

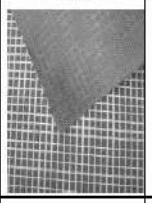
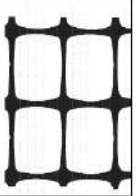
Analysis for Layered Pavement System...Result
Most effective for the repairing of Cracked Pavements

Comparative study of results obtained from HEADS PRO

Laying of Geogrids are in progress

Geogrids Laid over cracked surface before laying the wearing course to strengthen the weakened asphalt course

Summary of Issues to consider when selecting Reinforcement Products

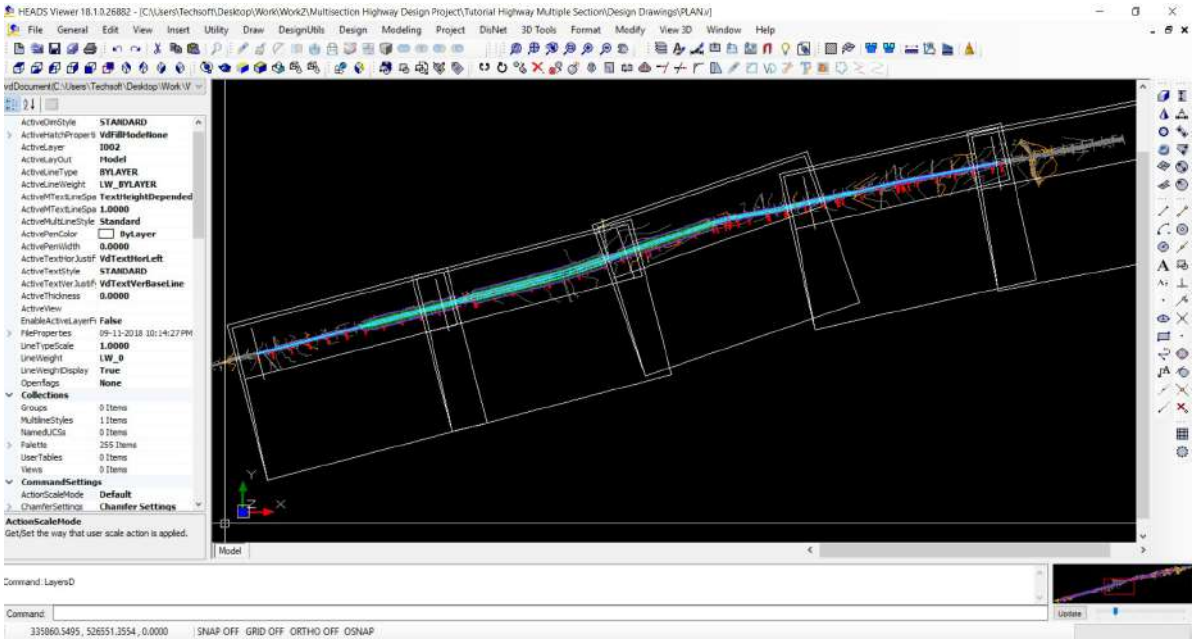
Issues to Consider	Paving Fabric	Paving Grids			Composite Paving Grids	
	a) Polyester or polypropylene [1]	a) Glass fibre grids [2]	b) Polyester grids [3]	c) Steel mesh [4]	a) Stitched or Warp knitted [5]	b) Bonded [6]
Photos of Typical Products						
Overlay Stress Absorption	i. Act as stress absorbing interlays ii. Prevent ingress of water into pavement layers iii. Bridge shrinkage cracks iv. Provides increased overlay performance by 20 to 40%	i. Modulus ratio of up to 20:1 over asphalt ii. High stiffness redirects crack energy iii. High stiffness resists deformation	i. Increases tensile strength of asphalt layer ii. Reduces tensile peak stress iii. Assists with asphalt fatigue iv. Reduces formation of ruts	i. Reduces peak tensile stress ii. Improves asphalt fatigue iii. Absorbs crack discontinuities iv. Good rut resistance	i. High stiffness redirects crack energy ii. Reduces peak tensile stress iii. Improves asphalt fatigue	i. Increase fatigue life of pavement with weak foundations ii. Used in above application, reduces rutting and controls reflective cracking iii. Susceptible to creep
Overlay Thickness	i. Generally 35mm but can be as little as 25mm	i. Minimum overlay thickness of 40mm ii. 25mm overlay thickness achieved under controlled conditions	i. 50mm with paver ii. 40mm manual installation	i. 50mm minimum ii. 60mm unsupervised	i. 40mm Minimum ii. 25mm used successfully in light trafficked areas with low loadings	i. Stiff bi-axial grids used in 70mm overlays ii. Thinner composite polyester grids used in 50mm overlays

Selection of Geogrids

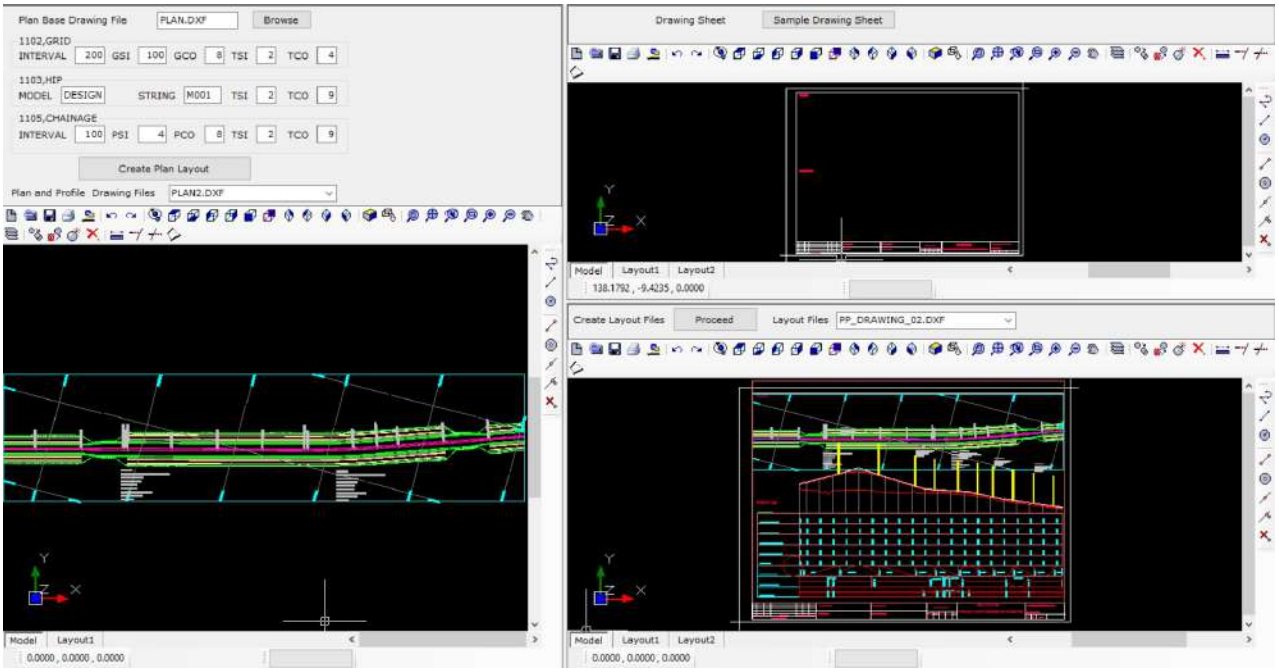
A number of field tests are available to test the strength of the pavement at site after construction but it is very rare to find a facility to estimate the results before construction. So the procedure described above is expected to be highly useful to project authorities and consultants to decide on the pavement structure and the type of reinforcement to be used. This will ensure increased design life of pavement at a lesser cost.

AI-based drawing sheet layout of for automatic PLAN-PROFILE Drawings

For highway of length 100 or 200 km it is indeed tedious to layout sheets for every 1 km length, on full length PLAN drawing, to cut the full-length drawing into 1 km pieces, as required to produce the PLAN-PROFILE drawings. The same is now automatic for user selected sheet size, scale, start and end chainage, length in each sheet, etc. This is now saving significant time to create a large number of PLAN drawings containing desired length of the road.



Upon finalizing the project drawing sheet by editing the sample drawing sheet, the cutting of PLAN drawing of full length into pieces of desired length and finally the insertion of PLAN and PROFILE parts of every kilometer of road is now just a mouse click only. The intelligence in HEADS Pro is the best in the industry for its power and accuracy.



DESIGN OF HIGHWAY and Hill Road DRAINAGE

HEADS Pro has highly effective module for design of highway drainage, based on storm water duration and hydrological data and by using manning's coefficients the adequacy of the proposed drain section is checked.

The section of drain is considered based upon vertical profile of the highway and the location of discharge points. The design is difficult in plain terrain as the natural slope is not available so planning is to be done carefully.

Provision for adequate drainage is of paramount importance in road design and cannot be overemphasized. The presence of excess water or moisture within the roadway will adversely affect the engineering properties of the materials with which it was constructed. Cut or fill failures, road surface erosion, and weakened sub grades followed by a mass failure are all products of inadequate or poorly designed drainage. As has been stated previously, many drainage problems can be avoided in the location and design of the road: Drainage design is most appropriately included in alignment and gradient planning.

HEADS Pro enables the GPS based Moto Graders and Dozers by providing the formation details of cross sections at various levels of pavement construction layers, at successive chainages, along straight sections with normal camber / crossfall and on curved sections with super-elevations.

The new road elevations and the existing ground elevations at each distance are also given chainage wise, in each table. The GPS reads the distance wise Easting, Northing and new road elevation values from the table at every chainage and sets the angle and height of the motor grader blade. The motor grader proceeds to make the formation of the road at any layer wise level. It interpolates the elevations in between the two successive chainages. This interpolation may be linear, so accurate in straight grades, but may not be accurate in vertical curves. Therefore closer interval of chainage (say, 5.0 m.) may result in higher accuracy and smoothness in curved profiles.

Modern motor grader machines come equipped with advanced technology, such as GPS and laser systems, which further enhance their precision and efficiency. These technologies allow operators to execute complex grading tasks with ease, reducing the likelihood of errors and the need for rework. Most people think that GPS is only used for driving directions in their cars and location services on their smart-phones. However, that same GPS technology is widely used in road construction as well. For the past several years, contractors have been utilizing GPS technology to help guide heavy equipment operators and others involved in the construction of our roadways.

Use of GPS technology to guide and control earth-moving equipment such as dozers, motor graders, and excavators has quickly become commonplace in highway construction because it speeds project delivery and cuts costs. It has been estimated that productivity of this type of equipment is double that of conventional equipment. When considering the use of GPS, one of the requirements needed in machine guidance is a three-dimensional (3D) terrain model known as a digital terrain model (DTM).


Source Website: https://heavyindustry.trimble.com/en/products/civil-construction/machine-control

Table - 1

Chainages Points ID-Label

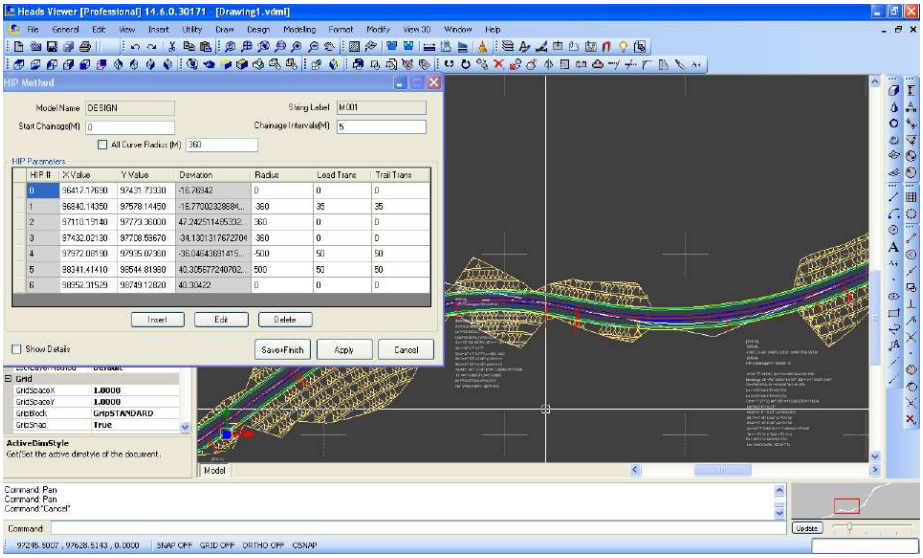
0.0 15 XS01

Distances from Center Line (m.)	Easting (m.)	Northing (m.)	New Elevations	Existing Elevations	CUT/FILL
-12.000	796690.78185	348633.70787	53.10300	60.14251	1
-12.000	796690.78185	348633.70787	53.10300	60.14251	1
-11.000	796691.23832	348632.81813	53.13300	60.13619	1
-9.500	796691.92303	348631.48353	53.17100	60.13005	1
-2.500	796695.11835	348625.25537	53.34600	60.14879	1
-2.250	796695.23247	348625.03294	53.34600	60.14362	1
-2.250	796695.23247	348625.03294	53.64600	60.14362	1
0.000	796696.25954	348623.03103	53.64600	60.08715	1
2.250	796697.28661	348621.02912	53.64600	59.99217	1
2.250	796697.28661	348621.02912	53.34600	59.99217	1
2.500	796697.40073	348620.80669	53.34600	59.99383	1
9.500	796700.59605	348614.57853	53.17100	60.01090	1
11.000	796701.28076	348613.24393	53.13300	60.02230	1
12.000	796701.73723	348612.35419	53.10300	60.25468	1
12.000	796701.73723	348612.35419	53.10300	60.25468	1
5.00000	15 XS01				
-12.000	796713.02529	348645.11972	52.71184	58.69368	1
-12.000	796713.02529	348645.11972	52.71184	58.69368	1
-11.000	796713.48176	348644.22998	52.74184	58.68105	1
-9.500	796714.16647	348642.89538	52.77984	58.65229	1
-2.500	796717.36178	348636.66721	52.95484	58.48065	1
-2.250	796717.47590	348636.44478	52.95484	58.47356	1
-2.250	796717.47590	348636.44478	53.25484	58.47356	1
0.000	796718.50296	348634.44287	53.25484	58.39752	1
2.250	796719.53002	348632.44096	53.25484	58.07726	1
2.250	796719.53002	348632.44096	52.95484	58.07726	1
2.500	796719.64414	348632.21853	52.95484	58.01913	1
9.500	796722.83945	348625.99036	52.77984	57.70925	1
11.000	796723.52416	348624.65576	52.74184	57.64849	1
12.000	796723.98063	348623.76602	52.71184	57.68198	1
12.000	796723.98063	348623.76602	52.71184	57.68198	1
10.00000	15 XS01				
-12.000	796735.26869	348656.53156	52.32068	57.14367	1
-12.000	796735.26869	348656.53156	52.32068	57.14367	1
-11.000	796735.72516	348655.64182	52.35068	57.13743	1
-9.500	796736.40987	348654.30722	52.38868	57.10971	1
-2.500	796739.60519	348648.07906	52.56368	56.73238	1
-2.250	796739.71931	348647.85663	52.56368	56.72118	1
-2.250	796739.71931	348647.85663	52.86368	56.72118	1
0.000	796740.74638	348645.85472	52.86368	56.64972	1
2.250	796741.77345	348643.85281	52.86368	56.63094	1
2.250	796741.77345	348643.85281	52.56368	56.63094	1
2.500	796741.88757	348643.63038	52.56368	56.63210	1
9.500	796745.08289	348637.40222	52.38868	57.30949	1
11.000	796745.76760	348636.06762	52.35068	57.62392	1
12.000	796746.22407	348635.17788	52.32068	57.83551	1
12.000	796746.22407	348635.17788	52.32068	57.83551	1

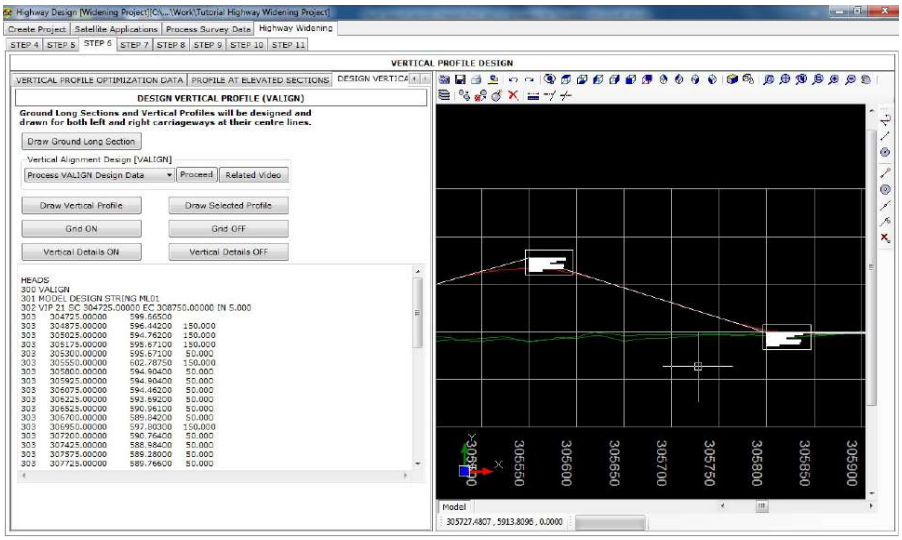
Table -1 gives cross section of the road to be built as a dual carriageway highway, Each cross section is at a user defined chainage interval that is set during the design of horizontal alignment and vertical profile of the road to be built.

Referring to Table – 1 (For example), the start chainage is 0.0m. and at this chainage there are 15 cross section points where --12.0m. is the left most and 12.0m. is the right most points, as measured from 0.0 which is at the position of the centre line,

From distance -2.25 m. to 2.25 m. is the raised median of height 0.3m,
From distance -2.25 m. to -2.5 m. is the Shy zone on left side,
From distance 2.25 m. to 2.5 m. is the Shy zone on right side,
From distance -2.5 m. to -9.5 m. is the left carriageway,
From distance 2.5 m. to 9.5 m. is the Right Carriageway,
From distance -9.5 m. to -11.0 m. Left Paved shoulder,
From distance 9.5 m. to 11.0 m. is the Right Paved shoulder,
From distance -11.0 m. to -12.0 m. is the Left Earthen shoulder,
From distance 11.0 m. to 12.0 m. is the Right Earthen shoulder.

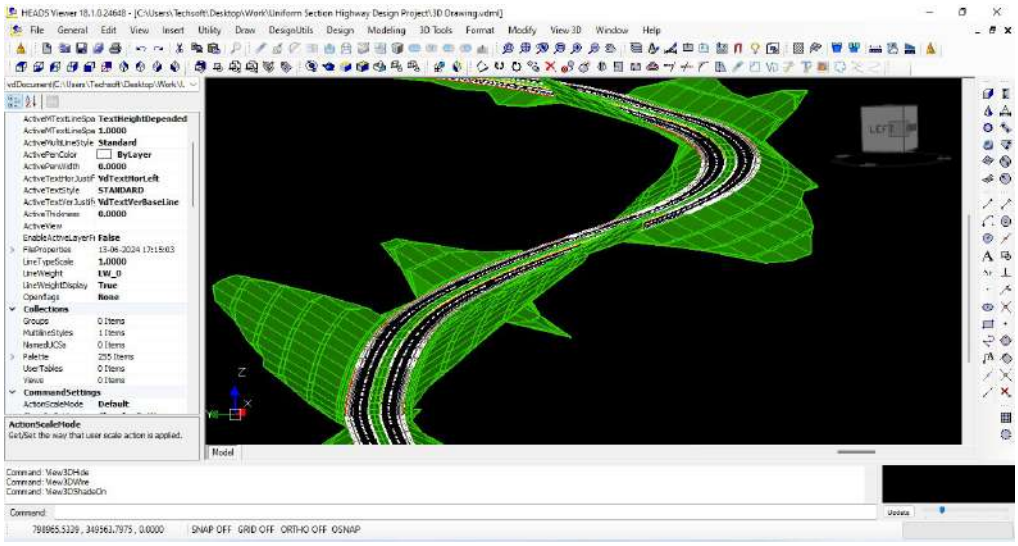


Interactive CAD based design of Horizontal Alignment of the Road to be built



Interactive CAD based design of Vertical Profile of the Road to be built

The design is created as 3-Dimensional model and is powerful for design of highways with multiple cross sections and multiple alignments, where the road cross sections may change with different configuration and with the change in widening pattern from Left to right to concentric along the route from origin to destination. The design has special treatment in hill stretches. for presentation purposes.



3-D Representations in Cut or Fill Sections on Digital Terrain Model (DTM) of the Road to be built

Current design practice dictates that highways and other infrastructure facilities are designed in two-dimensions using traditional computerized design programs. GPS machine guidance technology requires that these designs then be converted to 3D representations before they can be used. The conversion is usually completed by the construction contractor, which adds time and cost. However, completing DTMs during the design phase is the next logical progression and starts to make the process more efficient.

The conventional way of building a road (without using GPS) requires a survey team to work hand-in-hand with the earth movers. This survey team must stake out the project and check the grades as the work progresses. Although the GPS receivers on earth-moving equipment can interact directly to the satellites, it is determined that setting up a base station for each project cuts down on transmission errors. The base station is the direct link to the satellites and it gives clear signals to the operators on the jobsite. Locations for the base stations should be chosen near the jobsites that can be mounted high for less interference, and that will easily transmit the information to all the GPS units on the job.

It's only a matter of time before all transportation agencies will need to produce 3D models. HEADS pro has the ability to produce quality 3D plans for many applications.

1. HEADS Pro Installation Setup, may be downloaded from web site www.techsoftglobal.com

2. Tutorials Guides with real project data and Tutorial Videos, are provided under 'File' menu and User's Manual is provided under 'Help' menu on main screen of HEADS Pro. Visit web site www.roadbridgedesign.com for Users' Guide under menu 'Book Tutorials' then 'Computer Aided Highway Engineering'.

3. HEADS Pro Tutorial Videos are also provided in channel "Techsoft Forum" in YOUTUBE, go to 'Play List' to watch the videos ….

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