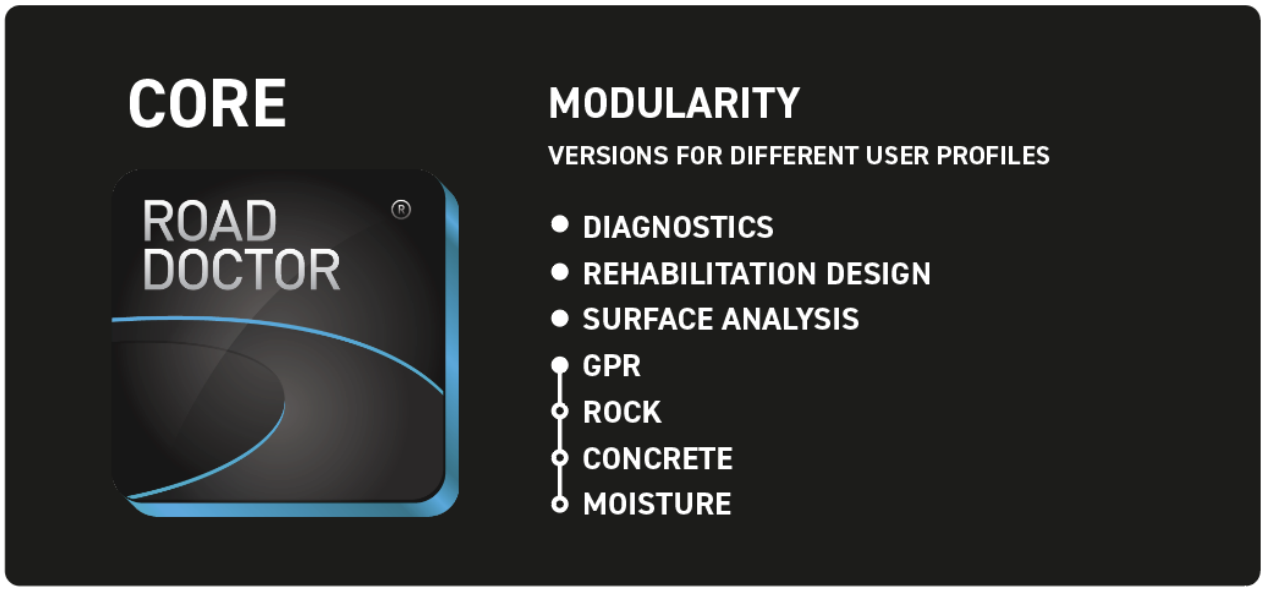
Road Doctor® 3.7 and Modules

The software is designed and built around Road Doctor® CORE which can be accompanied with 7 modules according to customer's needs.



Road Doctor® 3 "CORE"

- Project Management
  - Projects structured to lines, datatypes, and user defined data sub types or classes
  - Multiple projects form a project group – easy to handle several network level projects
  - Project Templates for standardizing project folder structures and settings
  - New project group and project creation with or without using a project template
  - Merging and splitting existing project lines to new projects
  - Line creation and coordinates handling
  - Supports almost all coordinate systems in the world + others as user defined format
  - Linking Ground Penetrating Radar, Falling weight, Profilometer, Map, Image, Point Cloud, Thermal Camera, Ground truth, Document files, and Video data
  - Linking to file Databases and Database servers
  - Analysis database creation
  - Project transfer (Zipping, folder copy)
  - Multiple data removing and restoring
  - Users and operations control
  - Converting videos to smaller size by reducing the video image size and using fixed distance videos
- Viewing all linked data including data created in special Modules
  - All data in the same view synchronized by the distance (Video, GPR,FWD, Data base, Profilometer, images, maps, point cloud, etc)
  - Multiple GPR data in the same view with or without interpretations
  - Viewing predefined 3D data views with slice and cross-sections views
  - Showing Distances as m, km and km+m, hm and hm+m, or in imperial units (miles, feets, miles+ft, mi + mi/1000) also shown in reverse direction if necessary
  - Chainages from a special Road Network file
  - Data specific user modifiable legends

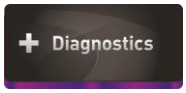
  - Database data shown as Line graphs, Bar graphs, Area graphs, Surface plot (2D grid) and From-To plots, cross-section plots, Line graphs with point symbols and user defined line width and colour
  - Falling weight data shown as deflection bowls, deflection basin parameters SCI/BCI, Surface moduli and Apparent moduli values calculated at different depths. Basic temperature correction available.
  - Saving the views with external videos for later use or use in free Road Doctor Viewer version.
  - Multiple views, videos, or image-lists synchronized, 360-videos and images.
  - Saving views as templates enables reusing views with different data sets.
- GPR data handling features
  - Linking GSSI (.dzt), Malå GS, Impulse Radar, IDS (.dt), Sensors & Software, Utsi Electronics, and Kontur data format (.3dr,.3dra), and user defined formats
  - GPS coordinates linking, limited rescaling, joining, channel splitting and data reversing
  - Fast on-screen GPR-data processing: background removal, dc-level removal, vertical and horizontal filtering, migration, Hilbert transform, Savitzky-Golay filtering, signal amplification
  - Viewing GPR with topography, both in profile and cross-section direction
  - Single scan view for frequency content analysis
  - Support for GSSI's RADAN™ interpretations import
- Data analysis
  - Marking and classification of interesting sections manually
  - Making annotation and notes into data sections
  - Digitizing interfaces and other features of interest in surface and GPR data
- Table tools
  - Arithmetic operations between fields
  - Data filtering by Boxcar, Savitzky-Golay, Butterworth, FFT filtering,
  - Linear and cubic-spline interpolation
  - Data averaging, Deviation, min-max picking
  - Slope and trend analysis with statistics based on values in multiple columns
  - User programmed external operations for data in a table
  - Sorting rows based on row values or columns based on column names.
  - Coordinate transformation in a table
  - Data transfer and synching between tables
  - Quick separate graph drawing, bar, pie and line graphs
  - Data classification and statistics
  - Exporting any data with coordinates from a table to Google KML or ESRI shapefiles
- Printing out all data
  - Printing to images and all supported Windows printers
  - Automatically splits long printouts
- Exporting GPR interpretation and Analysis Data
  - Exporting to predefined and user definable text outputs and DXF-output
  - Coordinates included with the output
  - Analysis data output to Google KML and ESRI shapefiles
- Thematic maps
  - Analysis, database and point cloud data shown on mapview
  - Point data with coordinates from data table
  - Data shown as classified to different colours
  - Maps linked from TIFF, JPG, etc. images
  - Support for WMS map-servers and Google maps
  - Thematic maps saved with views for later use or updating
- Viewing point cloud data
  - Importing point-cloud data from LAS-files or from Road Doctor's own .rdpc-data format
  - Viewing point-cloud data in a built in Point Cloud view

    - Viewing interpretations with cross-section data and as separate layers in point-cloud data
- Result outputs
    - Printing result profiles to images and all supported Windows and pdf printers
    - Automatically splits long printouts
    - Output/capture screen videos from results profiles together with videos/images, map and profile data.
    - Exporting to predefined and user definable text outputs
    - Coordinates included with the output (GPR and analysis data)
    - Database and Analysis data output to Google KML and Esri shape files
    - Saving results as ready made views for viewing in free **Road Doctor Viewer** software.

GPR Module

- Advanced GPR data handling
    - Fast batch linking operation automating line creation, data linking and basic processing operations
    - Fingerprint data calculation in Batch linking operation for data frequency analysis
    - Horn antenna data processing including bouncing removal and template removal
    - Data reversing, joining, channel splitting, cutting and scale correction operations
    - Dielectric value calculation/void content from horn antenna data based on surface reflection
    - Asphalt layer thickness calculation and average Er-estimation based on CDP method using special two 2GHz aligned horn antenna configuration. Works for 8-30cm asphalt layers. (Coreless)
    - Data Frequency content map from selected distance and time window
    - Projection of GPR data to the Point cloud view
    - GPR data distance matching and adjusting operation for multi-year measurements.
    - GPR Module required before acquiring Road Doctor Concrete, Rock, Moisture and Coreless modules
- GPR data interpretation
    - Specific database for interpretation points
    - Manual picking of layers and objects
    - Semiautomatic picking of layers
    - Rectangular objects
    - Marking notes
    - Combination of GPR interpretation from several measurements
    - Calculating Dielectric value / Velocity using known layer depths.
    - Calculating Dielectric values using hyperbola fitting
- 3D GPR data handling
    - Fast read access optimized data buffer files for 3D data handling
    - Time-slices from selected time-interval (average, minimum, maximum, from level amplitude)
    - cross-section view with cross-section topography
    - True offsets for channels in time-slice and cross-section views
    - 3D-interpretation in profile, cross-section, and slice data views.
    - Interpretation of vectors (pipes etc.) and areas (damage areas etc.) in time slice view
    - Time slices in data map view
- Elmod™ (6.5) back-calculation link
    - Helps verifying the interpreted layer thicknesses
    - See Design Module

Diagnostics Module



- Bearing capacity analysis using Swedish/Norwegian formulas
    - Calculates the Swedish bearing capacity index (BI, bärighets index) based on pavement thickness and falling weight deflections
    - Estimates the residual pavement lifetime calculated from given Traffic information and BI.
    - Calculates the strain at the pavement bottom and subgrade moduli.
    - Calculates Norwegian Bearing Capacity (NBC)
- IRI and rutting analysis
    - Takes measurements from several years and calculates the rutting and IRI increase
    - Estimates the residual lifetime based on Rutting/IRI increase and given threshold value
- Pavement distress inventory
    - Tool for picking the pavement distress or furniture or almost any other user definable parameter from video data
- Automatic analysis
    - Uses the profile data from databases, GPR, FWD, and other Analysis shown on the screen
    - Classifies data automatically based on set threshold and data combination rules
    - Writes the results to an analysis database
- I MSI Analysis
    - Modified Swiss Index for pavement damage inventory
    - Manual classification of road condition at fixed intervals
- Odemark dimensioning analysis for Initial structure
    - Calculation of bearing capacity of current structure, based on layer thickness (GPR or DB) and FWD
    - See Design Module
- Forward calculation of layer moduli
    - See Design Module
- Road feature measurement tool
    - Measure the size of objects in a video or image
    - Measure the road width
- Thermal diagnostics tools
    - Importing Thermal camera (FLIR .seq) data into Road Doctor
    - Viewing the Thermal camera data and picking features of interest
    - Minimum, maximum, and average temperatures from selected points

Rehabilitation Design Module

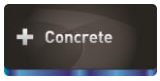
- Creation of design database
- Rehabilitation design tools
    - Select and draw quickly new structures
    - Operations: Remove, Mix, Add new layer, Add to layer, Strengthen, Off road left/right
    - Define wedge structures
    - Overlay with the existing structures
- Fill & Mill tools
    - Optimize the pavement milling and filling using precise Point Cloud data
- Odemark dimensioning analysis for initial structure and new structure
    - Bearing capacity (BC) for existing structure using Odemark formulas and measured or estimated layer thicknesses and forward or back calculated layer moduli
    - BC for new structures using Odemark formulas for the given rehabilitation measures and layers
    - Compare to Target BC and correct if needed right away
- Forward calculation of layer moduli

    - Forward calculation of layer moduli using FHWA formulas (Hoggs).
- Elmod™ back-calculation link
    - Transfers the falling weight deflections and layer thicknesses to Elmod™ for back-calculation
    - Returns, saves and shows the results on the screen for further use
    - Compatible with Dynatest's Elmod™ 6.5.

Surface Analysis Module

- Batch linking of Road Doctor Survey Van (RDSV)-.rdls-data files and videos along with GPR-files.
- Automatic project and line creation based on measured RDSV - data.
- Point Cloud
    - Projecting different measurements on point-cloud data
    - 3D view synchronized with Road Doctor data view
    - Zoom, rotate and pan point cloud view
    - Filtering of imported point cloud data
    - Combining multiple point cloud data
- 3D surface data extraction from laser-scanner data
    - Extract from RDSV .rdls-data (SICK laser) or from LAS data
    - User definable output grids
    - Picks minimum, maximum, or average value from the given cell size
    - Possible to output all the points to LAS or XYZI Point Cloud formats
- Rutting calculation from laser-scanner data
    - Calculate rutting using several methods: straight lines, water, string, cutting edge
    - Fully automatic calculation or visually controlled manual or semiautomatic calculation of rutting
    - Define the location for the rutting calculation based on manually or automatically detected road edge or centerline
    - Filters out error points from surface data
- IRI calculation from Accelerometer data
    - IRI based on the profile derived from accelerometer or Pitch parameter
- Semiautomatic road shape calculation from laser scanner data
    - Extracts ditch depth, road's inner and outer slope, road width, road centerline, surrounding ground level
    - Manually and visually controlled
    - Parameters can be changed at any time
- Accelerometer data analysis
    - Calculates running or fixed distance deviation of data
    - Hilbert transform for data envelope detection
    - Wavelength analysis using Fourier transform
- Database tools
    - data filtering in profile direction using convolution, Fast Fourier Transform or Butterworth filtering
    - Database distance adjusting using marked point, data in single or multiple files
    - Semi-automatic data base data distance adjustment

Concrete Module

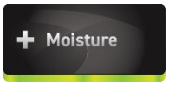


- Special tool for concrete bridge decks and other concrete structures less than 0,5m thick
- Calculates frequency and amplitude response of structures from GPR Data
    - low, medium and high frequency window
    - calculation from fixed time window or from interpreted layer level
    - response presented as surface maps and tables
    - attenuation compensation
- **GPR module is required**
- Used with 3D GPR data

ROCK Module

- Calculates the Excavation Damage Zone based on the given threshold criteria
    - manual tracking the surface
    - automatic tracking the EDZ surface
    - attenuation compensation
- The calculation uses Frequency analysis of the data.
- **GPR Module is required**
- Can be used with 1D or 3D GPR data
- Can be used also as a general GPR data frequency and amplitude analysis tool

Moisture Module



- Provides an apparent moisture map at set frequency window from set time range
- Alternatively calculates apparent moisture index at three time windows
- The calculation uses Frequency and amplitude analysis of the data.
- **GPR Module is required**
- Takes use of 1D or 3D GPR data
- Can be used also as a general GPR data frequency and amplitude analysis tool
- Uses FFT or DFT and selectable window function.
- Possible to use interpreted layers for reference level.
- Supports both single data view and slice view from number of GPR profiles.
- Includes all the features of the **concrete module.**