ProtaStructure® Suite

Structural BIM Design Technology for a Connected World

- Fast multi-material building modelling using physical structural members

- State-of-the-art structural analysis methods

- Economical and reliable design

- Fully automated engineering drawings and fabrication detailing

- Complete quantities take-off for costing and comparison

- Leading BIM Integration for project coordination

ProtaStructure *is an innovative BIM solution for structural engineers to model, analyze and design buildings* quickly and accurately.

From one central model, easily compare different schemes and automate your steel and concrete design, significantly reducing project delivery time.

Produce high quality drawings and all design documentation from **Prota**Structure automatically using included **Prota**Details and **Prota**Steel. Seamlessly coordinate projects with intelligent BIM integration.

ProtaStructure saves time and increases business profitability.

PROTA
Innovation to Design

www.protasoftware.com

At First Glance
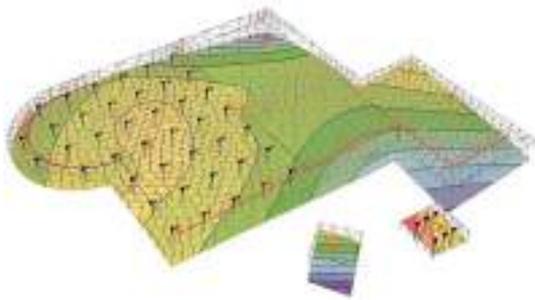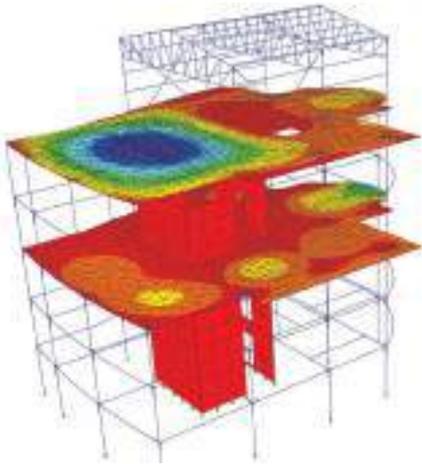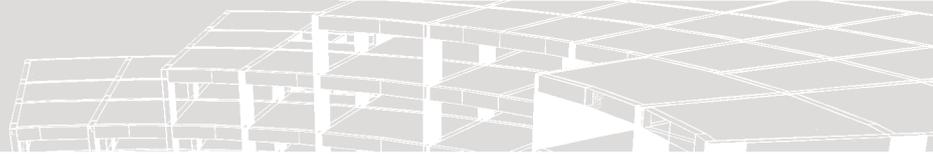
- Fast project delivery with fully integrated Concrete and Steel design from one central structural BIM design model.

- **Easy, quick** and **intuitive** physical modelling with **Multiple Window Views** and **Dynamic Input.**

- 64-bit Architecture and Enhanced Technology Platform.

- **3D finite element analysis** with **state-of-the-art analytical model** with extensive analysis options and shell element support for floors and shearwalls.

- **Advanced analysis** techniques including Linear Elastic Analysis, Equivalent Static Earthquake Load, Response Spectrum Analysis, Time-History, Pushover, Concurrent cracked and uncracked analysis, Staged Construction, P-Delta, Temperature Difference, and Seismic Basement and Isolator considerations.

- Design to a range of leading **international codes** including **specialist seismic requirements.**

- Seismic assessment methodologies for Performance Based Design or Retrofit of buildings using **Linear Elastic, Nonlinear Push over** or **Time-History analyses.**

- Fully automated **RC detailing** into your drawing sheets. **Manual drafting** using smart rebars. Change management and dynamic quantity tables together with Fast engineering macros including **retaining wall, stair, pool, pile analysis, design** and detailing.
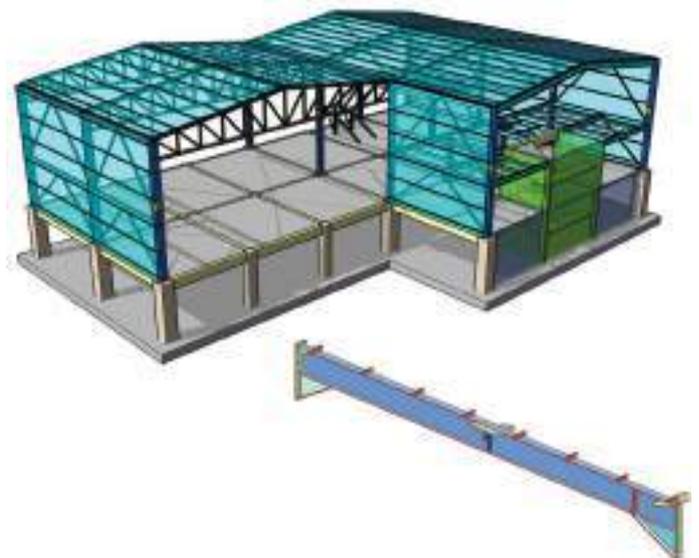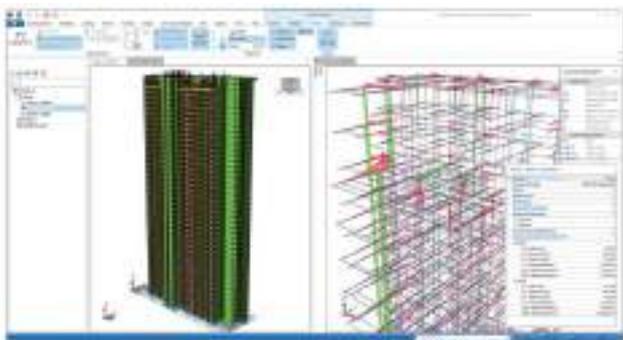
- Automated **steel connection design** using **IntelliConnect,** full steelwork engineering drawings together with comprehensive **part numbering** and **shop detailing for fabrication.**

- **Industry leading BIM integration** for starting, coordinating and sharing models

- **Interactive user experience** with extensive in-product learning, contextual help, live updates and dedicated technical support from Professional Engineers.

Why Prota?

Prota draws from over 35 years of excellence delivering structural software development globally and technical expertise as award winning international professional engineering and architectural consulting practice.

Designed by Engineers for Engineers

Prota has a passion for engineering excellence and making the world a better place. Prota Group actively engages in technical research, present papers to numerous conferences and publications around the world and contribute to drafting codes of practice to share our extensive knowledge, especially in earthquake design. Prota Engineering, our professional consulting business, has completed projects in more than 30 countries around the world with a focus on large commercial and infrastructure projects including airports and metro-lines. We actively use BIM technology to deliver both conventional and design build projects where optimizing design and practical construction methodologies are critical to success. **Prota**Structure is born out of a desire to share our knowledge and is shaped by our own inhouse experience together with our thousands of users around the world.

Leading BIM Expertise

Open BIM collaboration and sharing knowledge is a core principal at Prota. It helped us deliver some of the world's most challenging infrastructure and transportation projects. **Prota**BIM reinforces Prota's standing as a leading provider of advanced BIM technology with new bi-directional links with the latest versions of Revit, IFC, DXF and other recognized BIM and Analysis formats. Models can be synchronized and design changes tracked greatly enhancing your project coordination and workflow.

Advanced Analysis Features

Prota develops its own focused analytic approaches important for building design, from basic static, dynamic and finite-elements analysis to advanced considerations including nonlinear static pushover, time-history, construction stage and P-Delta analyses, Prota has you covered.

Code-Based Design Expertise

Prota's experience with delivering projects around the world coupled with close collaboration with users and industry experts means we understand structural design. At its core, **Prota**Structure provides a sophisticated and flexible structural design engine allowing you to optimize your entire building from the roof to the foundations. All the detailed code-based checks are performed and documented to your chosen code of practice. A growing range of international and seismic codes of practice are supported including US, European and British Standards.

Friendly Professional Support That Engages

We strive to provide our users with great experiences using **Prota**Structure. From our extensive online Prota Help Center to our in-product learning we aim to enrich your knowledge and provide practical, user friendly support. Our professional support engineers love engaging with our clients, whether its answering technical queries or providing hands-on training, we are here to help.

Leading Structural BIM Collaboration


› Structural BIM at Its Core

ProtaStructure is natively designed with structural BIM in mind. We use intelligent physical objects to drive modeling, design, coordination and documentation.

Support for BIM Industry Standards

› **Prota**Structure supports both import and export of IFC and 3D DXF files enabling professionals to share the models between **Prota**Structure and other leading BIM platforms including Autodesk Revit, ArchiCAD, and AllPlan.

› Bi-directional Integration with Autodesk Revit

Prota has developed bespoke integration with Autodesk Revit to facilitate direct, seamless model coordination, providing tools to roundtrip and synchronize changes as they occur. Explore revisions with color-coded visualization and interactive change logs. Take advantage of new family mapping functionality providing you with a tailored experience to suit your BIM work processes and standards.
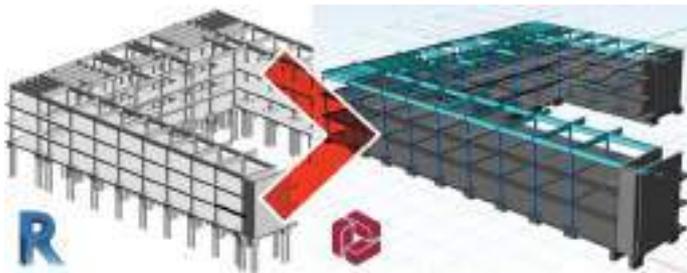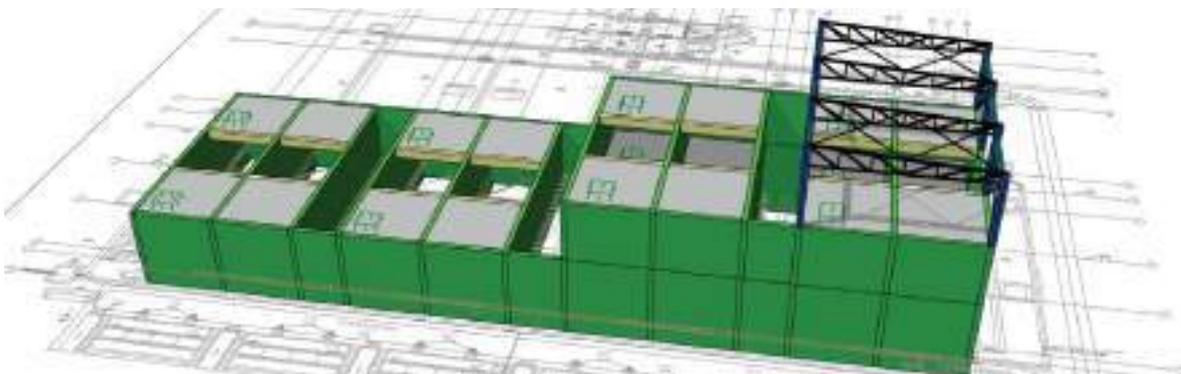

› Analysis Model Collaboration

We understand that engineering offices use a range of different analysis and design tools to get the job done. Many firms and checking authorities also require structural engineers to cross-check and validate analysis results against other accepted platforms. **Prota**Structure allows you to easily achieve this with open intelligent model links to OpenSees, ETABS™, SAP2000™, LUSAS™, and more.

› Create Models from 2D and 3D Information

Modelling processes can even start with our DXF import where we can convert and extrude drawings into Physical **Prota**Structure models. Line and face elements like column, beam, walls and slabs in 2D key plans and 3D DXF files can be quickly converted to 3D **Prota**Structure models. Architectural drawings can be overlaid against structural floors to aid coordination.

› Output Reports and Drawings to Industry Standard Formats

- Create and share customizable and highly visual calculation reports featuring Microsoft Office and PDF export abilities.

- Detail drawings are fully compatible with industry standard DXF and DWG formats. All drawings in **Prota**Structure follows best drafting practices and provide full layer, style and scaling flexibility.

- Bespoke templates customized to suit your company drafting preferences can also be easily established and re-used for any project. Additional formats including 3D DXF, STL and image files are also available.

Seismic Analysis and Design Capabilities

ProtaStructure provides engineers with comprehensive tools to design and detail buildings quickly and economically to meet rigorous earthquake standards including US and EC codes of practice.

Wide Coverage of Seismic Codes

ProtaStructure supports a wide range of seismic codes including IBC, UBC, EC8, NSCP, SNI, Thai, Indian and Turkish standards.

Seismic Parameters and Response Spectra

Elastic and design response spectra are calculated automatically using code-specified parameters. Site-specific spectra can also be introduced. Mass sources are automatically calculated including consideration of varied live load participation.

Equivalent Static Earthquake Loads

Static earthquake loads are automatically calculated and applied at story levels. Multiple diaphragms and accidental eccentricities are taken into consideration.

Diaphragm Modeling and Story Meshing

ProtaStructure has smart features for automatically detecting and defining intelligent rigid diaphragms. Multiple towers with discrete independent floors, discontinuous, stepping, sloping slabs and openings are all considered. Any floor can be selectively meshed and assigned as a flexible diaphragm.
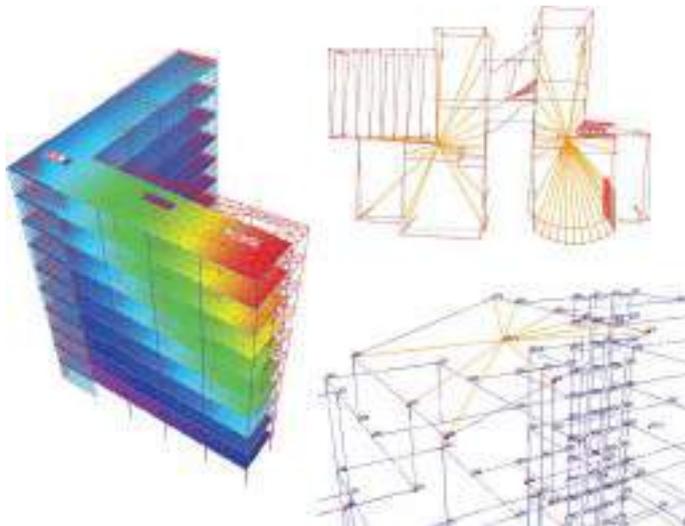

Strong Column-Weak Beam Checks

Tedious Strong Column-Weak Beam checks are automated at every joint. Joint checks are summated bi-directionally at every floor to ensure building collapse mechanisms perform in meeting accepted code provisions.

Joint Shear Checks

Overlooking joint shear can potentially cause catastrophic failure of buildings during earthquake events. **Prota**Structure automatically detects Confined or Unconfined joints and checks against brittle failure.
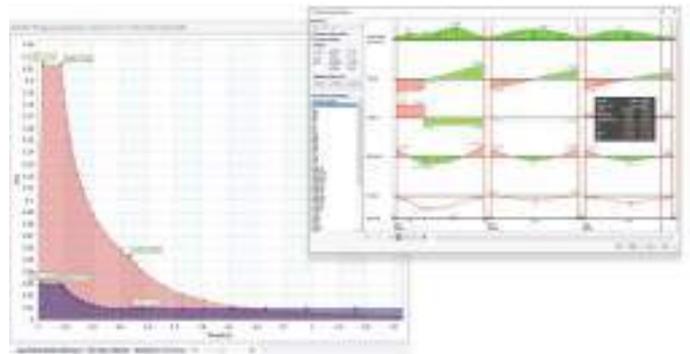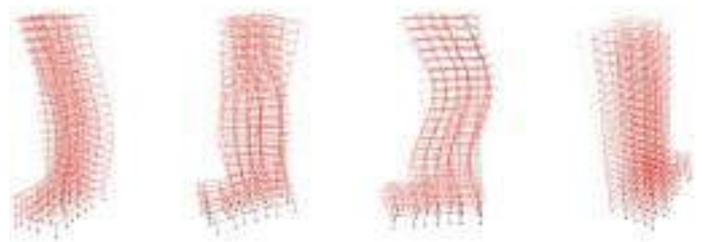
Response Spectrum Analysis

Mode superposition analysis can be used where static approach is not applicable. Modal results are combined with CQC. RSA base shear is automatically scaled to Equivalent Static results. Cumulative mass participation of modes is automatically calculated.

Two Stage Analysis for Upper and Lower Structure

An automated two stage analysis is performed in one-go for buildings with rigid basements. Different mass sources for upper and lower structure are automatically considered.

Consider Cracked and Uncracked Sections in One Analysis Run

Cracked and uncracked section properties can be simultaneously used in the same analysis for different load cases. Code modification defaults can be automatically applied to section properties.

Vertical and Horizontal Irregularities

ProtaStructure has powerful features to assess building irregularities in accordance with earthquake code requirements. Floor Torsion, Diaphragm Discontinuity, Mass, Stiffness, Weak Storey and Non-parallel system irregularities are all checked, and any required penalties are applied.

Seismic Analysis and Design Capabilities

Seismic Isolators

Seismic isolators can be inserted anywhere on the structure for different seismic isolation scenarios. Both upper and lower structure design can be performed in **Prota**Structure using target earthquake spectra. Drift of the structure and isolator displacements are also reported as a part of the design.
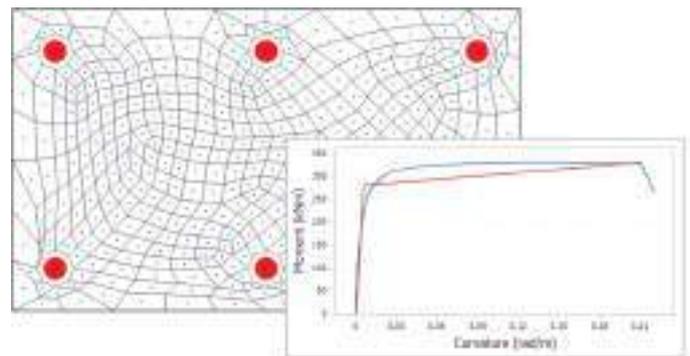
Nonlinear Fiber Analysis of Sections

• Column, beam, and Wall sections can be modeled with fiber elements using distributed plasticity and analyzed with state-of-the-art numerical techniques to derive the Moment-Curvature relationships.

• Force-deformation relationships for integration points are obtained from detailed fiber section analysis.

Nonlinear Static Pushover

• Single Mode Static Pushover analysis is performed using **Prota**Structure - **OpenSees integration.** Parameters such as the number of steps and target displacements can be controlled by the user.

• After the analysis, the Capacity Curve is obtained. Users can specify the monitored node for which the curve will be generated. Results can be examined at any desired step. A detailed performance assessment report is generated afterwards.

Ductile Member Design and Detailing

Columns, walls, and beams are designed to special ductility requirements. Automated confinement of beam and column critical sections, wall end zones (boundary elements), wall design envelope, capacity shear design and much more are automatically considered.

Diaphragm Integrity and Load Transfer Checks

Transfer of inertia loads between slabs and lateral load resisting members including shearwalls and collectors beams is automatically verified. For flexible diaphragms, in-plane shear, tension and compression stresses are checked to prevent diaphragm failure.

Wall Coupling Beams

Special attention is provided for coupling beams. Different cracked section properties can be defined. The wall-beams assembly is checked for coupled wall effectiveness.

ProtaStructure for Performance-Based Design and Building Assessment

Prota provides unique tools for engineers to carry out performance-based building assessment.
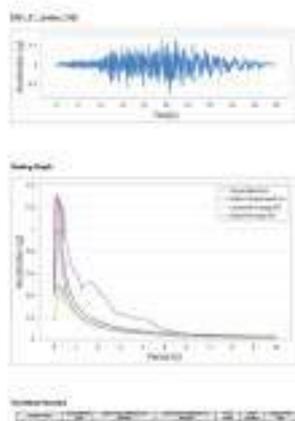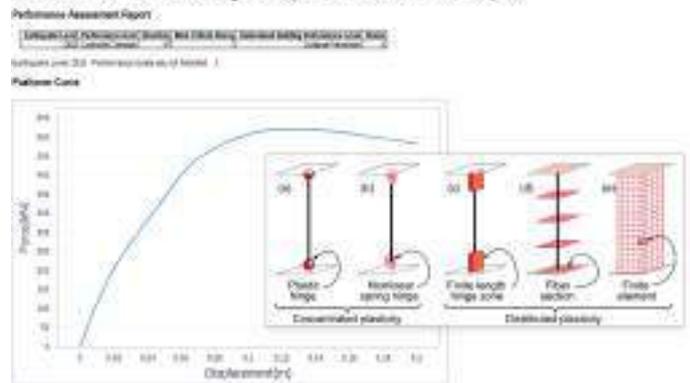
Nonlinear Time-History Analysis

• Nonlinear Time-History analysis can be performed using **Prota**Structure - **OpenSees integration.**

• User selected multiple ground motions can be applied simultaneously in X and Y directions. Ground motion application direction is rotated by 90 degrees, and analyses are repeated.

• Ground motion records are automatically scaled by **Prota**Structure to your design requirements using the **simple scaling method** between 0.2T and 1.5T.

• Analysis results from multiple ground motion sets are automatically post-processed. The average values of absolute maximum responses are extracted and used to prepare detailed performance assessment reports.

Design Codes

Structural engineers around the world like to employ their own local approaches to both design and detailing. At Prota we understand this which is why we offer both a broad range of leading international codes as well as provide specific customization to suit your local requirements.

Reinforced Concrete Design Codes

ACI318-08	ACI318-11	ACI318-14	BS8110-97
CP65	HK2004	TS500-2000	

Eurocode 2 Base Code and National Annexes

United Kingdom	Ireland	Poland	Singapore
Malaysia			

Steel Design Codes

AISC360-10 (LRFD, ASD)	TSC 2016 (LRFD, ASD)	BS5950

Eurocode 3 Base Code and National Annexes

United Kingdom	Poland	Singapore	Malaysia

Seismic Codes

IBC 2018	UBC97	SNI1726-19	NSCP 2015
DPT 1301/1302-61	TDY 2007	TBDY 2018	

Eurocode 8 Base Code and National Annexes

Singapore	Malaysia

Loading and Wind Codes

BS 6399	TS 498	ASCE 07-10	MS 1533
DPT 1311-50	NSCP 2015		

Eurocode 1 Base Code and National Annexes

United Kingdom	Ireland	Poland	Singapore
Malaysia	Philippines	Indonesia	Thailand

Project References

İstanbul New Airport

Prefabricated Slabs
Total Area: 1.500.000 sq. meters

Bartın Public Hospital

Seismically Isolated Building
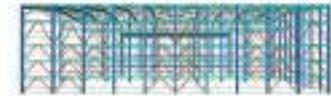Total Area: 52.000 sq. meters

AllSancak Residences

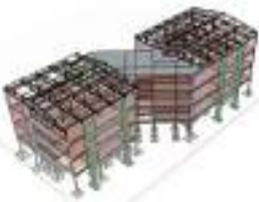*High-Rise Concrete Building*
Total Area: 110.000 sq. meters

Thu Thiem 2HA Residences

Cast-In-Place Concrete Load-Bearing System
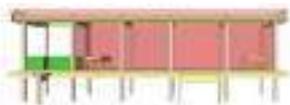Total Area: 20.000 sq. meters

Marmara Basibuyuk Research Hospital

Seismically Isolated Building
Total Area: 112.400 sq. meters

Yacht Maintenance Facilities

Steel Moment Resisting Frames
Total Area: 22.000 sq. meters

General Medical Laboratory

Braced Frames
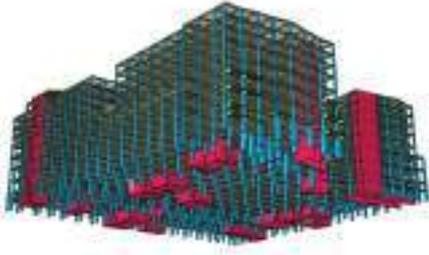Total Area: 780 sq. meters

Chemical Building

Concrete Frame Structure
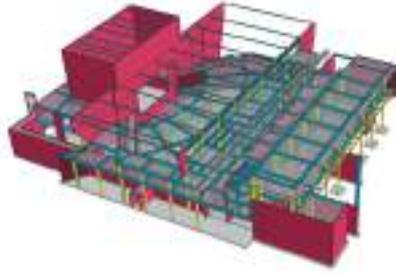Total Area: 33.000 sq. meters

Women and Children Development Initiative Foundation Center

Steel Construction Roof System
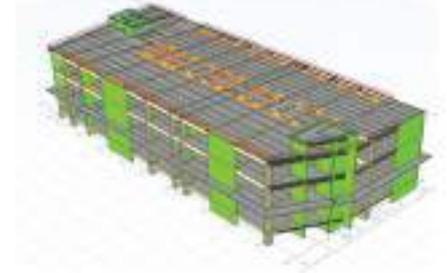Total Area: 20.000 sq. meters

Project References

Capa & Cerrahpasa Healthcare Campus

Cast-In-Place Concrete Frame Structure
Total Area: 1.000.000 sq. meters

TED College School Building

Cast-In-Place Concrete Frame Structure
Total Area: 141.000 sq. meters

Turkcell Data Center

Cast-In-Place Concrete Load-Bearing System
Total Area: 15.000 sq. meters

Serdang Cardiology Hospital

Cast-In-Place Concrete Frame Structure
Total Area: 30.000 sq. meters

Kemasepakat

High-Rise Concrete Building
Total Area: 65.000 sq. meters

Malatya State Hopsital

Seismically Isolated Building
Total Area: 52.300 sq. meters

THY Maintenance Repair Overhaul Facilities

Steel Construction Hangars
Total Area: 431.143 sq. meters

Bersatu

*Steel Construction Roof System*
Total Area: 17.000 sq. meters

Manisa Merkez Efendi State Hospital

Seismically Isolated Building
Total Area: 115.000 sq. meters

Modelling

With its focus on structural BIM modelling, **Prota**Structure allows **physical RC, Steel** and **Composite** structural members to be **easily, quickly** and **intuitively** defined in one model.


- Instantly **create models using smart DXF import** to extrude gridlines, beams, columns, slabs and shearwalls directly from structural or architectural drawings or make use of physical **BIM links** with **IFC's, Revit** or **3D DXFs** to establish complete models with a click.

- Use dynamic input to rapidly create Concrete **beam, columns, slabs, foundations** and **shearwalls** and custom shaped **corewalls** and **columns.** Define **openings, drops** and **physical set out** to exactly define your project.

- Use real structural steel elements including **truss, purlin, brace, girt, sag rods** with flexible parametric macros. Specify your **splice locations** on steel columns, beams and trusses.
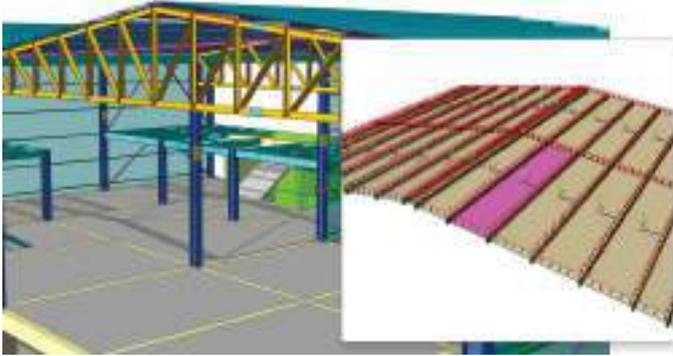
- Make use of the new general purpose **frame member** to model irregular arrangements with ease.

- **Merge different model parts together** allowing concurrent modelling for rapid project creation.

- Fast generation of multiple storeys with **similar storey** feature.

- Simultaneously work on different floor plans and 3D model with **multiple window system.** Easy access to parts of model with element **Filters.**

- Define different materials and reinforcement steel grades **on floor** and **element basis throughout the project.**
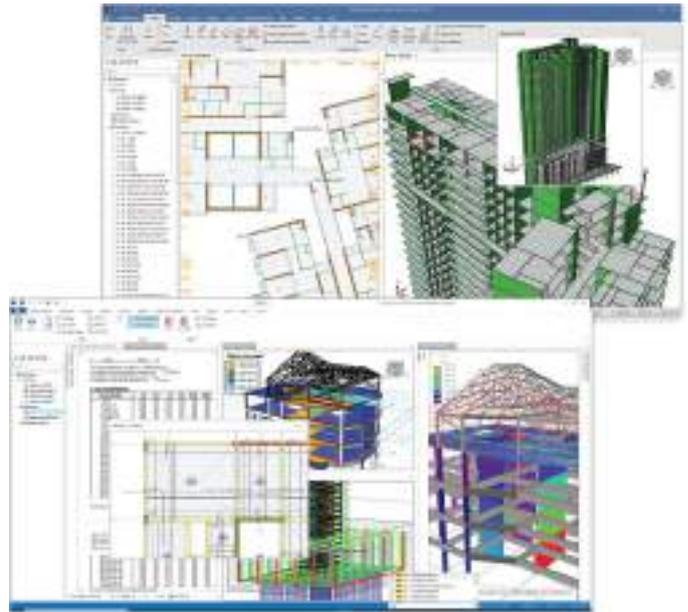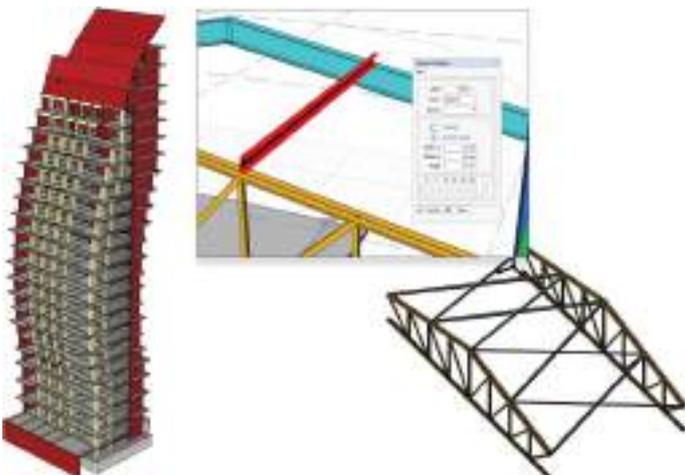
- Define conventional, waffle, precast and flat slabs with **curved** and **irregular** edges and **drop head** panels.

- Create **Raft, Piled-Raft, Pad Base, Pile Cap** and **Combined foundations** together with **Strip Footings** and **Foundation Beams** for complete foundation design. Set foundations up at **any level.**

- Build **custom trusses** using the truss editor and save them in the library for later use. Define multiple horizontal and vertical **braces** and use flexible purlin layout generators.
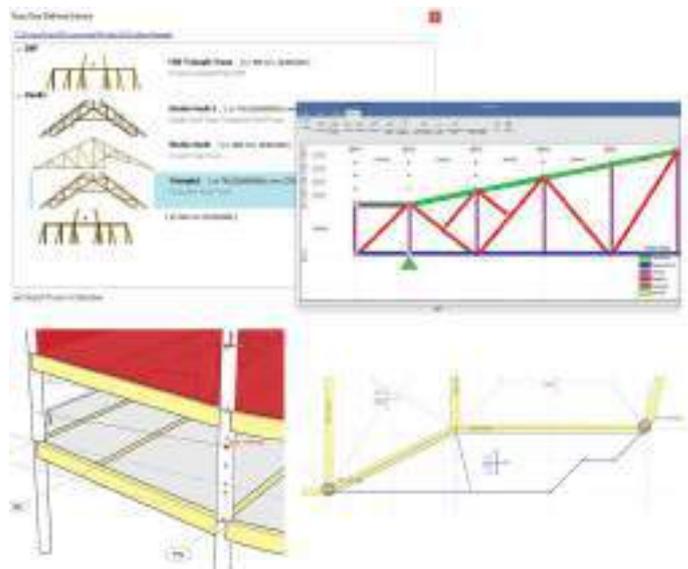

- Create **Arc** and **multi-segment** axes/beams, **sloping members** and structures with non-orthogonal plans.

- **Anchor** fixed column and beam positions to corners and edges. When section sizes change, anchored positions are retained.

- Model **sloping slabs, beams, columns** and sloping and tapered **shearwalls** easily using planes or multi gridlines.

- Assign flexible user-defined supports including springs under columns and shearwalls.

Loading

Prota's unique loading processes are highly automated and accurate, saving you time and driving efficient design.

- Automatically decompose loads from plate, ribbed and waffle slabs, using **Yield Lines** and/or **Finite Elements Methods.** Apply point, line and patch loads to slabs.

- Apply user-defined **Point Loads, Moments** and **Span Loads** to columns and shearwalls.

- Check model loads, finishes, elements sizes and properties using color coded **visual interrogation.**

- Automatic calculation of code-based seismic loads using **Equivalent Static** and **Response Spectrum Analysis** methods.

- **Automatic Wind Load Calculation** to EN1991-4(2005) BS6399-2(1997), ASCE7(2010) & MS1533(2002) and Thailand codes
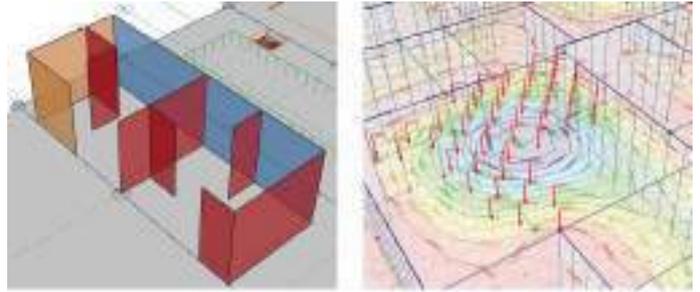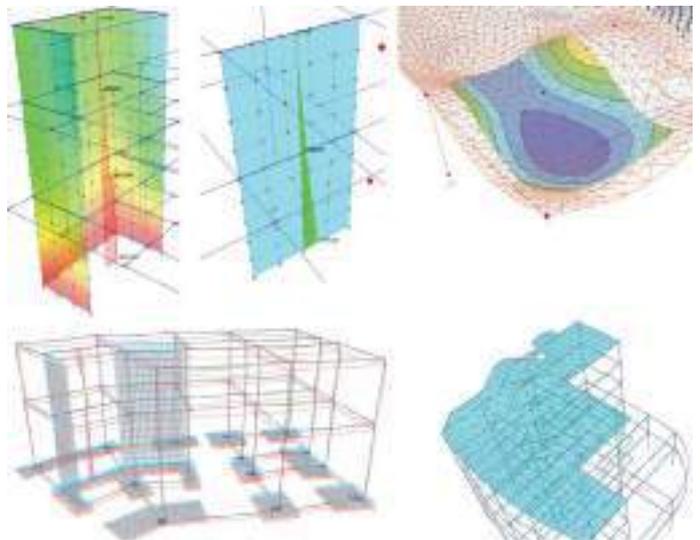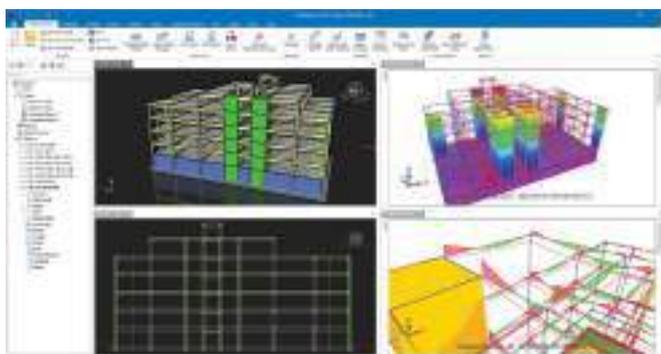

Analysis

Structural analysis is performed by specifically developed 64-bit 3D finite element solver and state-of-the-art analytical model.

- Rapid analysis using multi-cores and pre-processing technology.

- Analysis of slab systems independently or **integrated with the structure** by using finite elements.

- Automatic **rigid links, rigid zones** and **asymmetrical end-releases** on frame members.

- Analysis of shearwalls and custom shaped corewalls with or without openings using **shell elements, mid-pier** and **single-pier** models.


- **Staged Construction Analysis** with detailed options, **P-Delta** analysis and definition of equal/gradient **temperature differences.** Special **Seismic** Analysis considerations.

- **Soil-Structure Interaction Analysis** for all types of foundations.

- S**ophisticated Post Analysis checks** for reviewing code compliance including deflections

- Real-time visualization of stress contours, deformations, force and moment **diagrams** using the full-featured **Analysis Post-Processor.**
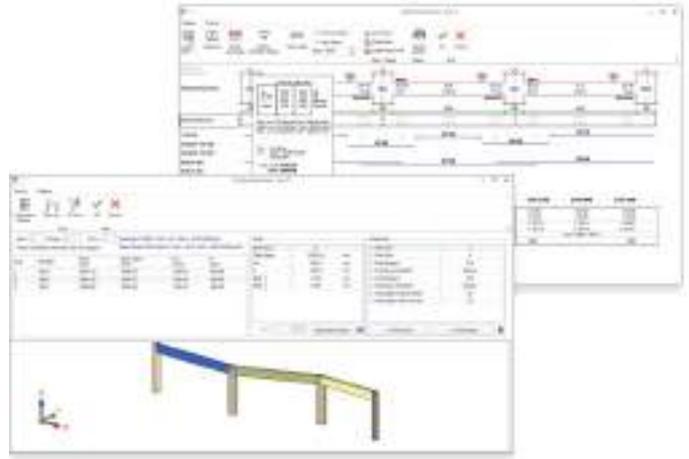
Design

Design is the very essence of what we do as Structural Engineers. Providing elegant, practical solutions to design is at the heart of **Prota**Structure


- **Interactive** and **batch concrete beam** and **column design including reinforcement optimizations** and **design grouping.**

- **Biaxial design** and reinforcement optimization of columns and shearwalls with any section. Generation of interaction diagrams and capacity reports for easy design tracking.

- Design of shearwalls and slabs using conventional or **mesh** reinforcement.
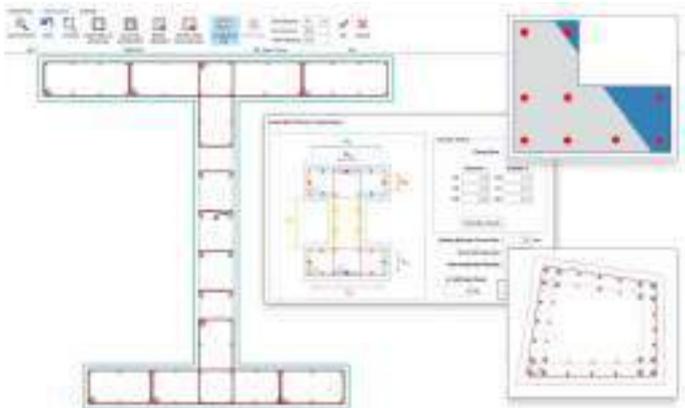
- Selection of the most efficient **steel profile** based on active codes.

- Automatic design of **steel connections** using **IntelliConnect** and ability to reuse at all similar joints.

- **Integrated meshing** and analysis of slab and foundation systems with the building model.

- **Advanced documentation tools** including ordered report sets, integration of external reports, table of contents, smart notification system (summary of warning, error and information messages).

- Automatically create reinforcement layouts for columns and **corewalls** with **"I, H, L, T, U, E, +"** sections.

- Code-based **automatic containment tools** to specify link and tie-bar layouts compatible with column sections of any shape and size.

- Design economically and accurately by including **column sections** in FE mesh and considering openings, drops and loads on slabs in FE analysis.

- Design of flat, ribbed, waffle slab systems using analytical and finite elements methods and automatic punching checks.
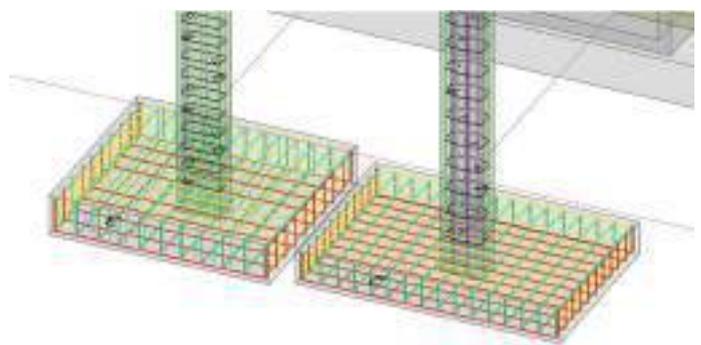

- Design **pad bases, pile caps, strip foundations, rafts, piled rafts** and **combined foundations** using analytical and finite element methods.

- **Combine different models** to cater for shared foundation systems.

- Use different **subgrade coefficients** and **varied thicknesses** for within raft foundations.

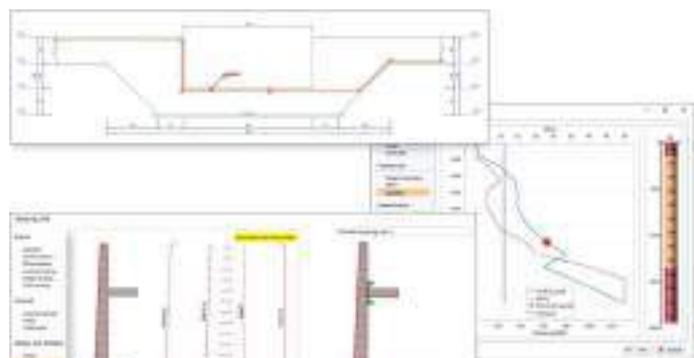# **Prota**Details® RC Detailing and Component Design

Engineers have longed for the ability to automatically create all RC detailing from the design, intuitively laid out into drawing sheets, and complemented with full drafting and editing capability.

- Automatically **produce details** from your **Prota**Structure design models into your drawing sheets, only with one click.

- Carry out **all your drafting** using standard CAD drawing commands without the need for other CAD software. Features include extensive **command-line** support and customization, **DWG/DXF support,** dimensions, layers, style, **intelligent undo/redo** and much more…

- Generate **dynamic quantity tables** with **full bar bending schedules,** which are updated instantly when changes occur.

- Customize drawings with your **own title blocks** with auto referencing including all project and sheet information.
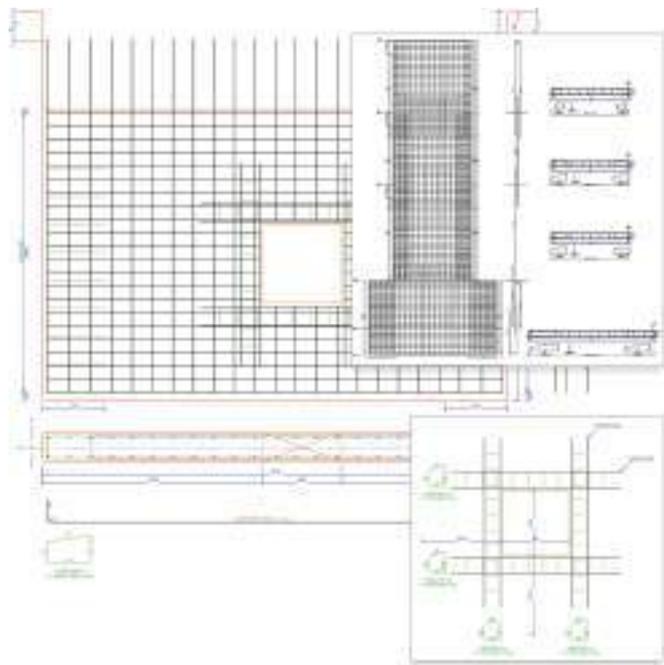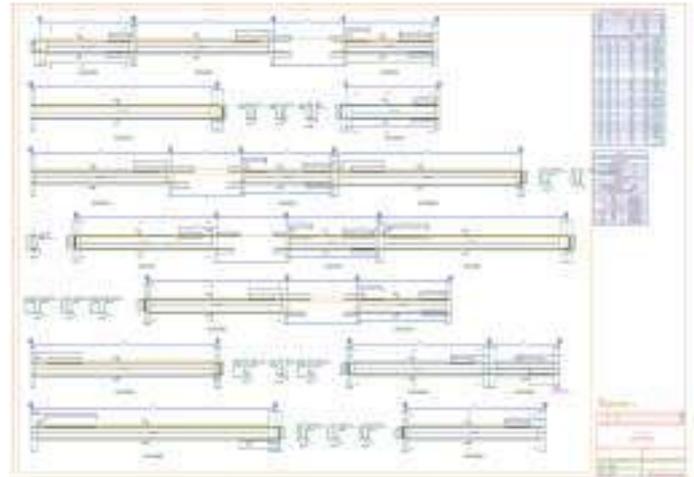
- Make use of **smart rebar library, intelligent detailing items** and **tools** to perform **semi-automatic structural drafting** for the cases where a full automation is not possible.

- **Automatically** or manually **truncate beam elevations** to fit any sheet layout.

- Convert your old reinforcement drawings to smart rebars and instantly provide steel quantity take off.

- Insert details with different drawing scales side-by-side on the same sheet. **Smart scaling system** automatically manages all relevant texts, object sizes and dimensions.

- **Automatically update design detail changes** from **Prota**Structure as they occur.

Use ProtaDetails' growing library of intelligent macros to design and detail other components in your projects including;

- Automated analysis, design and detailing of **cantilever retaining walls.**

- Design of **RC Stairs, Pile Caps, Corbels, Steel Scaffold Systems, Swimming Pools** and more including all details, quantities and calculation reports.

- Design your **piles** using detailed soil profiles for **pile working load assessment,** iterative non-linear **lateral pile analysis** and **pile section design.**

- Produce **engineering details** for other components including Culverts, Retrofit Walls, Foundation Pits, Pad Bases, Walls, Continuous RC Beams and more.
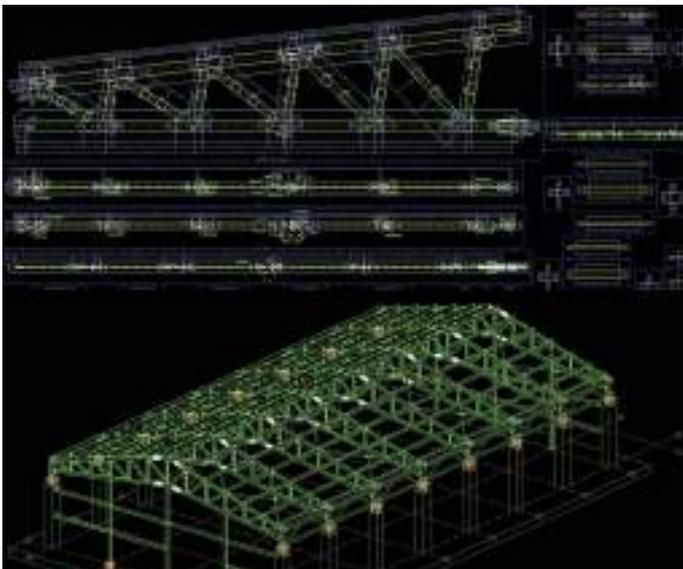
ProtaSteel®

powered by **comosys**

Steel Connections and Detailing

Nowadays clients want practical, complete steel details and automated connection design to drive on-time project delivery and cost control.

ProtaSteel is the all-in-one steel detailing solution for engineers, fabricators and drafting professionals.
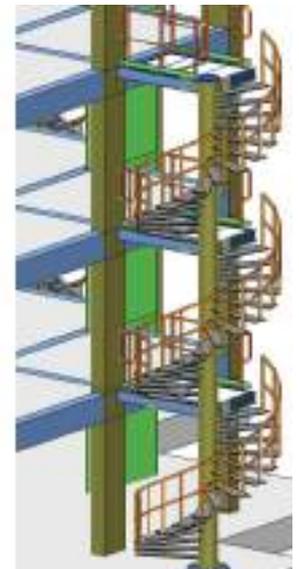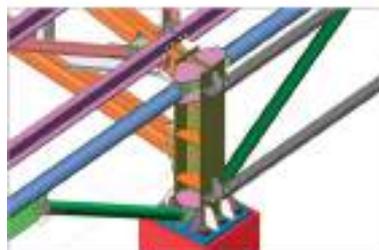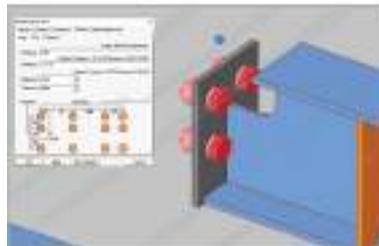
- Communicate **Prota**Structure models seemlessly to **Prota**Steel including all physical elements and analytical results

- Use our unique **IntelliConnect** to rapidly automate connection design with a focus on constructability.

- Easily model and detail any steel connection using **Fully-featured Parametric Connection Libraries.**

- See the step-by-step **connection design calculations** with detailed **code clause referencing.**

- Insert **ancillary steel** including sag rods, purlins, girts, braces, stairs, chequer plate, railings, secondary beams and eaves beam to complete your model.

- Automatically **detect all clashes** between parts.
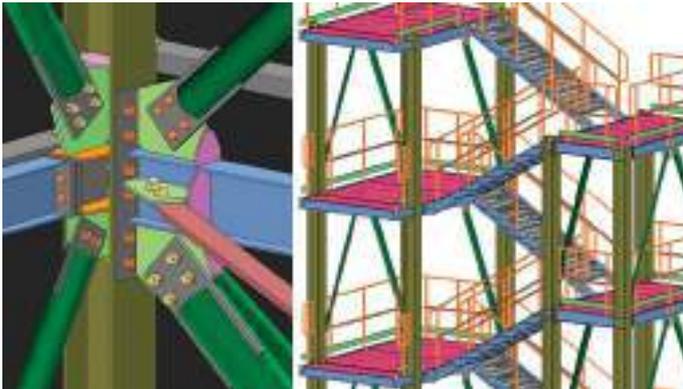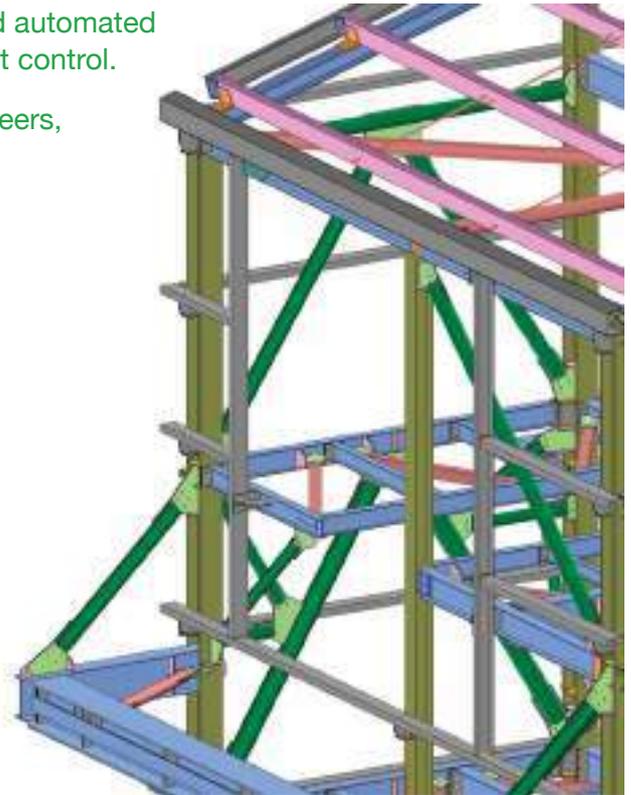
- Increased productivity with **unique connection macros** including truss apex, truss-column, **steel beam to concrete,** and embedded steel connections.

- Automatically compile **comprehensive design reports** and track connection design status with model color coding.

- Create macro presets for any connection or modeling macro using your **favorite settings** and **company standards.** Seamlessly update any changes in **Prota**Structure models to **Prota**Steel

- Fully-flexible **Automatic Part** and **Assembly Numbering** that intelligently manages part-marks on subsequent revisions of the model.

- Automatically prepare all **General Arrangement Drawings, Truss Details, Connection Details,** and **Shop Drawings.**

- Full **cutting list**s provide insight into efficient procurement and cost control. **Intelligent data** communication with **IFC's, NC's,** and Tekla Structures.

- Easily create your own user-defined connections using general purpose tools like **plate, bolt, weld, section, cut, chamfer** and **fillet** and use these connections at similar joints.

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Prota HQ.
ODTÜ-Teknokent, Galyum Binası
1. Kat No: 20 ODTÜ 06531
Ankara, Turkey
Tel: +90 312 210 1788

Prota İstanbul
Barbaros Mah. Sütçüyolu Cad.
No: 72/1 Ataşehir 34746
Istanbul, Turkey
Tel: +90 216 428 9434

Prota Poland
ul. Wspólna 35 lok.12
Śródmiéscie 00-519
Warsaw, Poland
Tel: +48 22 114 17 15

Prota Asia Sdn Bhd
Unit 20-13A, Q Sentral, Jalen Stesen
Sentral 2, KL Sentral, 50470
Kuala Lumpur, Malaysia
Tel: +603 2276 3355

Prota Asia Pte Ltd
Level 39, 10 Marina Boulevard,
Marina Bay Financial Centre,
Tower 2, 018983 Singapore
Tel: +65 6818 5766