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BLOCK II_COMPUTER TOOLS

BIMVET3 Tutorial No 1

Title: CAD (COMPUTER AIDED DESIGN) SOFTWARE SOLUTIONS

1 - Aims

The objectives of this tutorial are as follows:

- Get acquainted with and be able to adapt different types of software used in the construction sector, at different stages of the BIM life cycle.
- Get acquainted with software for designing virtual and/or real objects.
- Be able to choose CAD software solutions properly.

2 - Learning methodology

- The teacher will provide an explanation of the material with practical examples.
- Students will read this tutorial and analyze examples of the video.
- To evaluate the achievements of practical teaching, each student will write short descriptions and answer questions provided.

3 -Tutorial duration

The practice described in this tutorial will be carried out in a computer classroom.

It will last 2/3 teaching hours.

Note: duration of the tutorial depends on teacher professionalism.

4 - Necessary teaching resources

Hardware requirements: computer room with computers equipped with access to multimedia and internet.

Required software: Autodesk AutoCAD, Bentley MicroStation; SolidWorks; SketchUp, Onshape, ArchiCAD, Autodesk Revit, Autodesk Inventor,

„Autodesk® Robot™ Structural Analysis Professional“, AutoCAD Electrical, Autodesk® Fabrication, Autodesk 360.

5 - Tutorial Contents

CAD (COMPUTER AIDED DESIGN) SOFTWARE SOLUTIONS.

5.1 Introduction

BIM Software is a set of programs, procedures and rules for data processing and management. In the construction sector, different types and stages of software are in use. Typical software solutions are presented at a generalized level. The list of software solutions is based on the BIM Handbook, the ISO 19650: 1 standard and expert insights. Software solutions are categorized in accordance with the purpose for which the software is used: software for designing virtual or real objects. Using CAD, graphic objects are created - sketches, technical solutions and drawings, which provide graphic and other information (descriptions of materials and processes, dimensions and etc., depending on the use of the program).

5.2 2D CAD software solutions

Software for designing two - dimensional space (plane) graphical objects that consist of geometric elements such as lines, curves or other geometric shapes.

The main computer aided design tool:

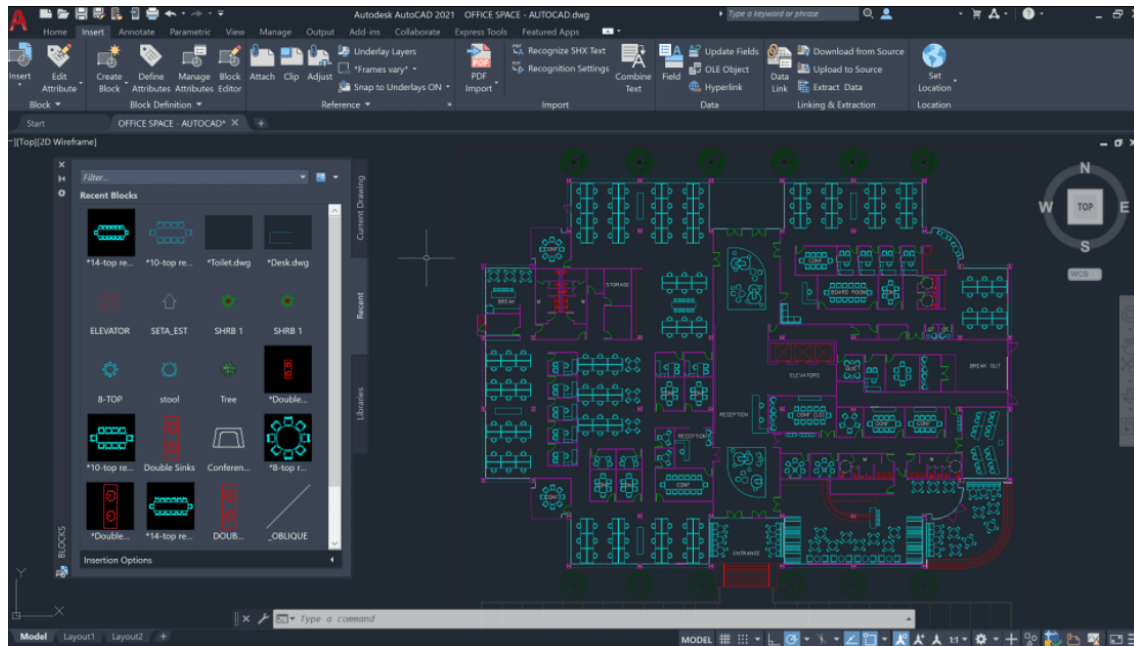


Autodesk AutoCAD is the most popular, versatile automated two-dimensional and three-dimensional design system with a set of features and commands for drawing, visualization, documentation, and data sharing. The AutoCAD work environment is easy to understand and modify according to user needs, and the toolbars are adapted for high-quality and fast design. This program is a basic framework on which a whole range of applications is built. AutoCAD has flexible two-dimensional design and drawing tools, as well as convenient three-dimensional object modelling tools.

AutoCAD software's main advantages:

- Creates professional looking 2D and 3D projects;
- Offers specialized AutoCAD® program tools for professionals in architecture, manufacturing, electrical engineering, internal engineering networks and other fields;

- Speeds up the design workflow;
- Imports and merges models from various other applications into 1 project;
- Offers web.autocad.com platform for online access or the AutoCAD mobile app for mobile access;
- Professional visualizations help to attract investors.



<https://www.autodesk.com/products/autocad-web-app/overview>

<https://www.youtube.com/watch?v=hO865EIE0p0>

https://www.youtube.com/watch?v=-ndFLv_hEn4

[https://www.youtube.com/watch?v=pvKVy-](https://www.youtube.com/watch?v=pvKVy-eMDYc&list=RDCMUC17rnDjAIowh68LIGcaeL9A&index=1)

[eMDYc&list=RDCMUC17rnDjAIowh68LIGcaeL9A&index=1](https://www.youtube.com/watch?v=pvKVy-eMDYc&list=RDCMUC17rnDjAIowh68LIGcaeL9A&index=1)

5.3 3D CAD software solutions

Software for designing three-dimensional graphical objects that consist of sets of points connected by lines, curves, planes, and so on. 3D objects can be represented as: objects created in real space; three-dimensional optical spatial images; three-dimensional images simulated by three-dimensional object computers.

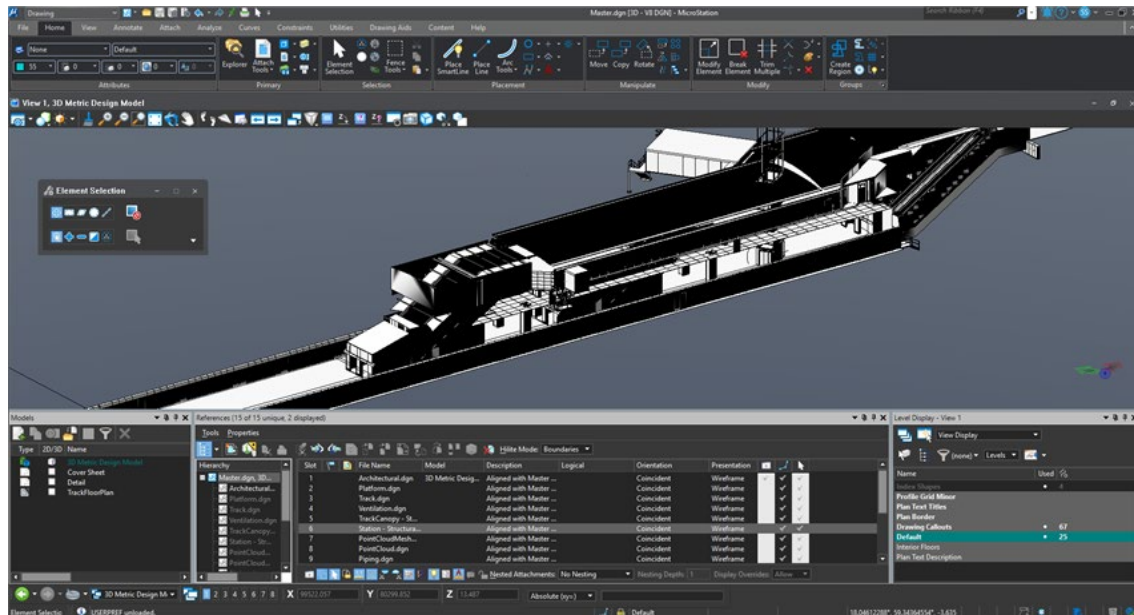
3D CAD software solutions:



Bentley MicroStation is software for computer-aided graphics and 2D / 3D modelling. It is one of the world's leading automated design systems.

The design process takes place in an interactive and visual environment, and the drawing and modelling functions are controlled and used with the help of windows.

This program is easy to adapt to specific tasks as the Bentley MicroStation supports JMDL®, MDL®, MicroStation Basic and Microsoft® Visual Basic® for Applications (VBA) programming languages.



https://www.youtube.com/watch?v=BczYA7a8_VA

<https://www.bentley.com/en/about-us>

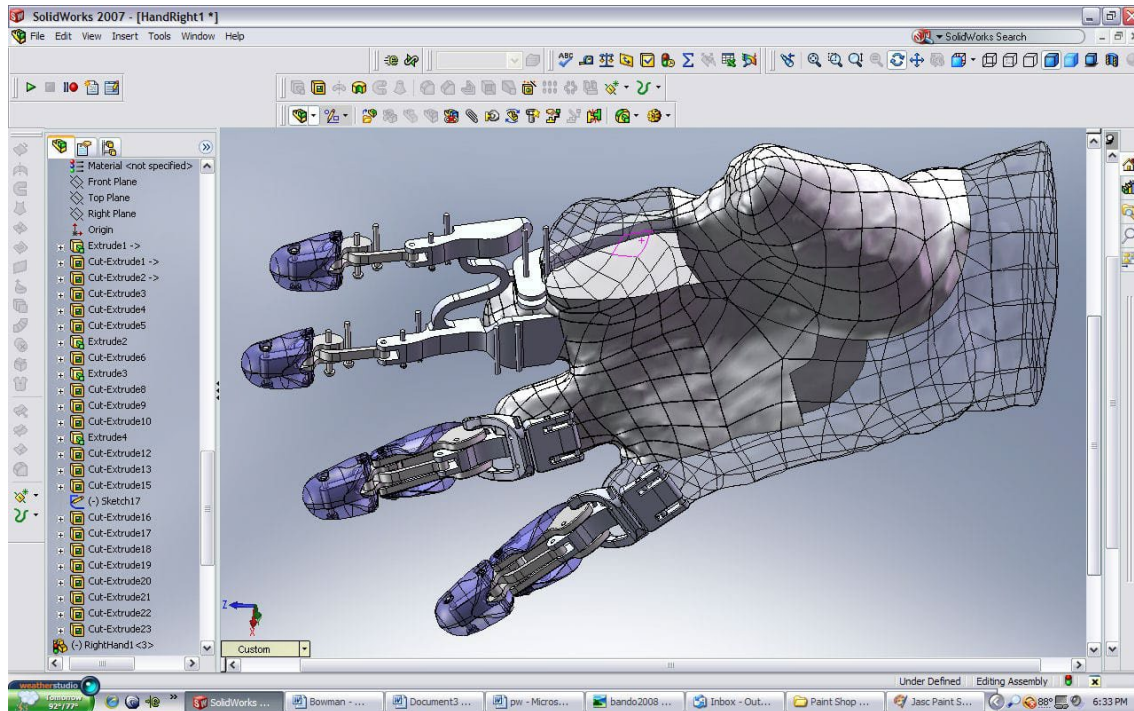
<https://www.youtube.com/channel/UC1G4bUAnMFhDvkKu3kqHKUg>



SolidWorks is a three - dimensional design solution that enables to perform all stages of design:

- creation of a three-dimensional model, its presentation;
- kinematic and dynamic calculation of product mechanisms;
- strength calculations of individual parts and assemblies of the product, including various joints and supports (e.g., bolted and welded joints, resilient base, etc.);

- development of work documentation (drawings and specifications);
- laying of pipelines and electrical installation;
- project data storage and sharing by adapting Workgroup PDM technical documentation management systems.



<https://www.solidworks.com/media/first-look-solidworks-cad>

<https://www.youtube.com/watch?v=DgyrGsAdUPE>

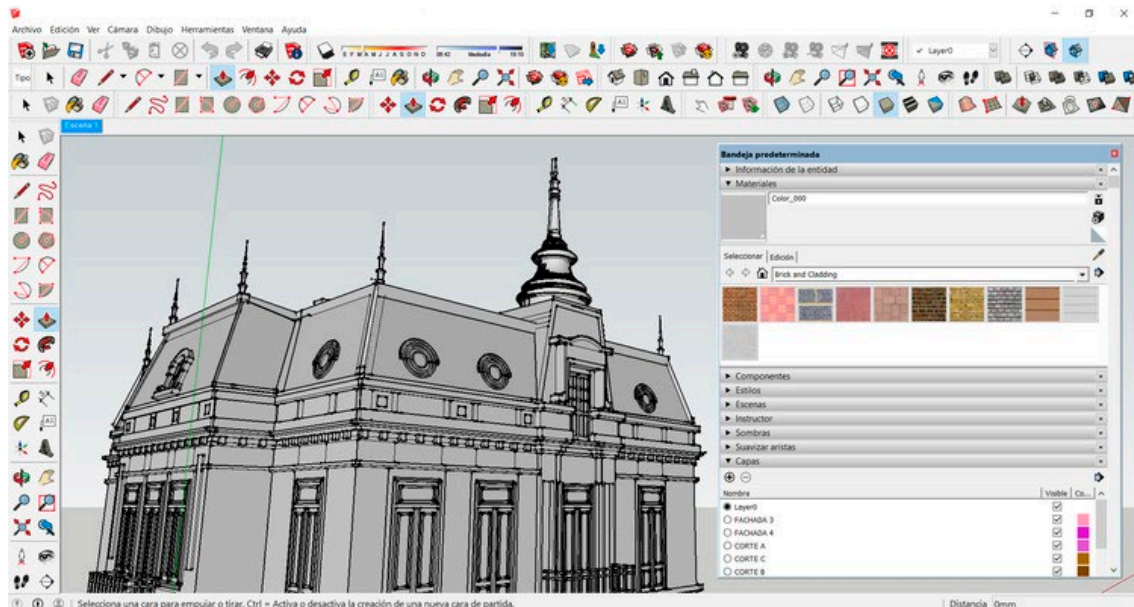
<https://www.youtube.com/watch?v=8UKg928M4C0>



SketchUp is a 3D modelling program designed for both professionals and beginners. SketchUp stands out from other 3D modelling applications as a simple and quick-to-understand environment.

SketchUp CAD system for creating three-dimensional models in 2000 was developed by a US startup @Last Software. The company's goal was to create a tool for creating 3D content that enables design professionals to work by expressing feelings and freedom as if drawn with a pencil on a piece of paper.

The simple environment makes the tool fun and easy to use. There are no complicated buttons common to complex traditional programs.



<https://help.sketchup.com/en/sketchup/viewing-model>

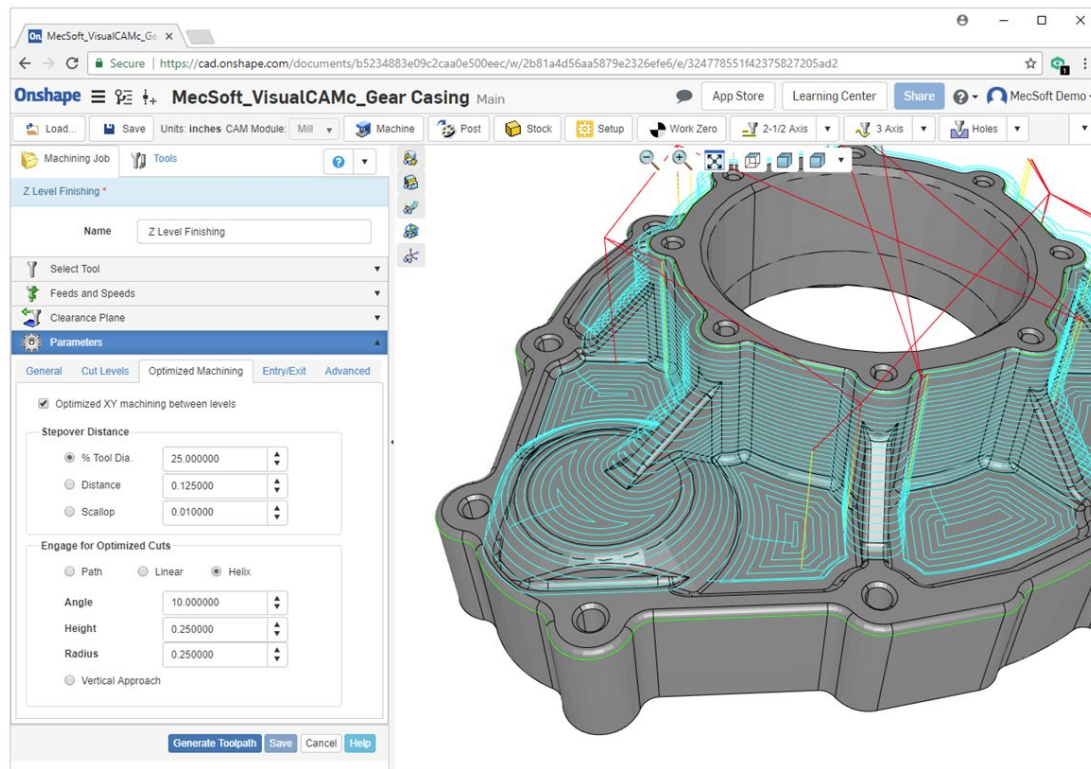
<https://www.sketchup.com/>

<https://www.youtube.com/user/SketchUpVideo>



Onshape is a fully mechanical CAD platform designed for professional users and advanced teams. You can create, edit, collaborate, and comment in real time with others from any computer or mobile device with an Internet connection. With Onshape secure cloud workspace teams, you can work from anywhere, on any device, without the hassle of file management, IT overhead, and license key allocation, helping engineers focus more on their best work.

Onshape is a computer-aided design (CAD) software system delivered online using the Software as a Service (SAAS) model. It makes extensive use of cloud computing, a lot of processing and rendering on web servers, and allows users to interact with the system through a web browser or iOS and Android apps.



<https://www.onshape.com/en/>

<https://www.youtube.com/channel/UCTvd5lUSLftH8Qcd7Pl1nQg>

<https://www.youtube.com/watch?v=8KWrpTxna0>

5.4 Architectural CAD software solutions

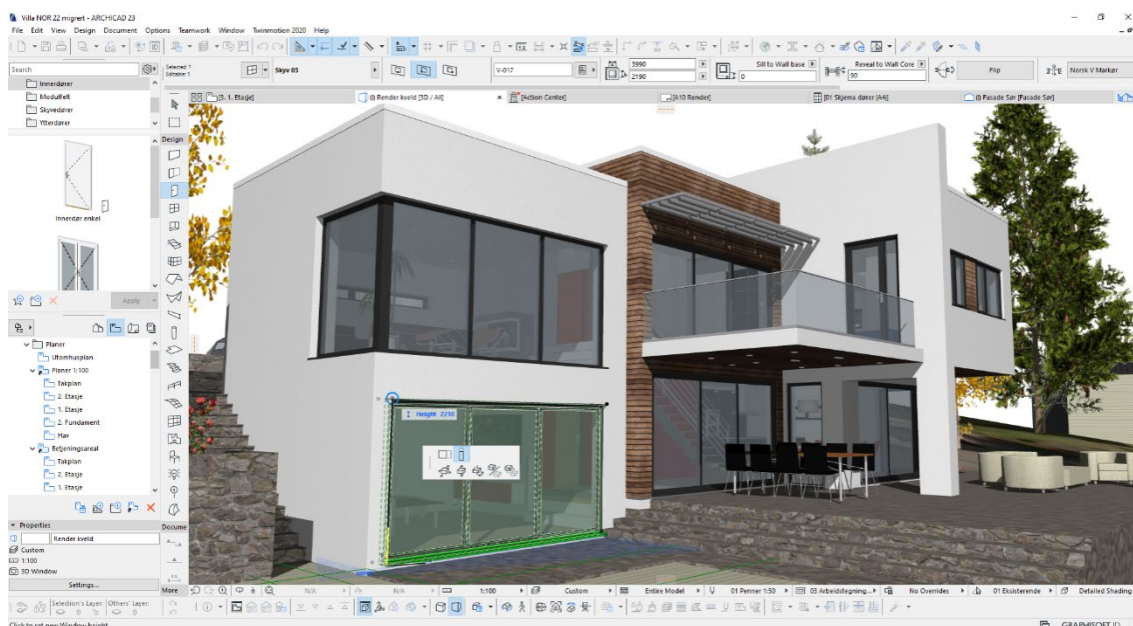
Software for designing architectural solutions. During the design, drawings or plans of 2D or 3D buildings are created.



GRAPHISOFT
ArchiCAD®

ArchiCAD is a CAD software package developed by Graphisoft (Hungary). The program is designed for architects and interior designers and is also widely used among designers and engineers. It runs on both Windows and MacOS operating systems. This program, unlike other traditional CAD programs, creates a virtual object from which project plans, facades, sections, nodes and spatial images are generated. Also, this program supports most CAD system formats (dwg, dxf, IFC, 3Ds, etc.) and most raster graphics formats. ArchiCAD has its

own visualization function that allows you to create extremely realistic images. ArchiCAD is one of the leading programs in the field of building design.



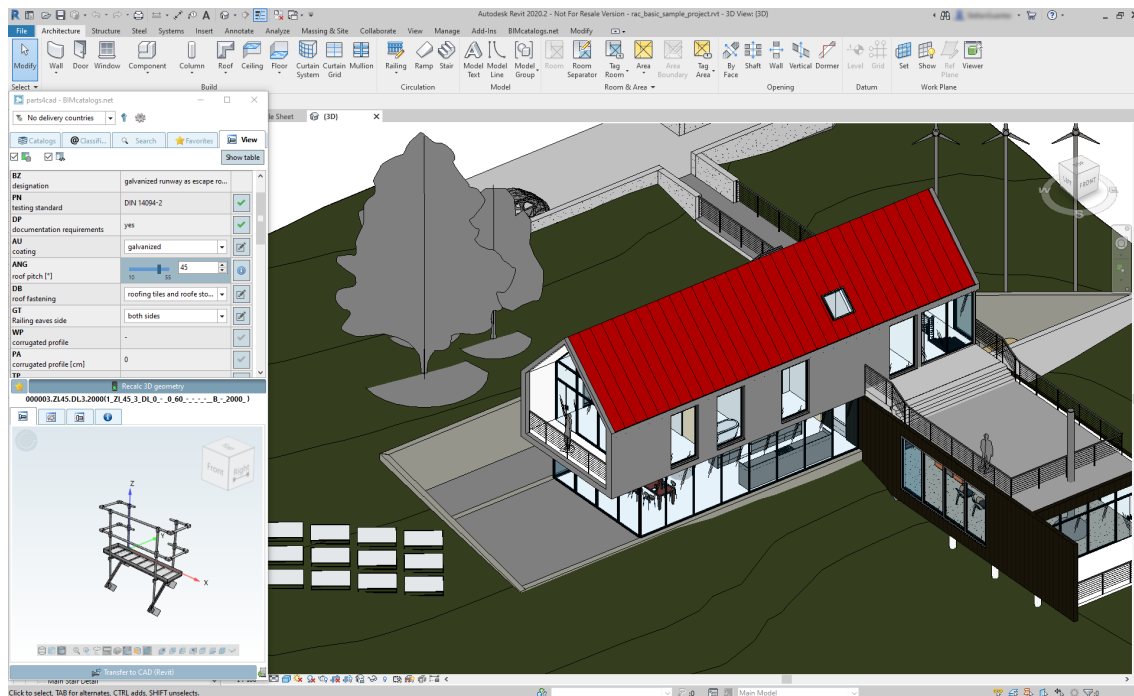
<https://graphisoft.com/solutions/archicad>

<https://www.youtube.com/user/Archicad>

<https://www.youtube.com/watch?v=hW46PKLcKdc>



Autodesk Revit is building design software based on information modelling technology (BIM) that ensures the unity of the entire project, providing complete creative freedom and maximum efficiency. Each building project includes a complete description of the building and all the information needed to create both 2D and 3D images, specifications, and spreadsheets. This information is stored in a single database. For all building model views (plans, sections, and tables) Revit uses a single database. Changes from any image are transferred to the database and from the database to all other images. This working method is known as BIM (building information modelling). So, Revit works with a single model, and all images (plans, facades, sections, 3D images, tables, etc.) are generated by Revit Architecture itself. In a model created on this principle, changing something in one image changes in others. This technology allows those working with Revit Architecture to make fewer mistakes and save time.



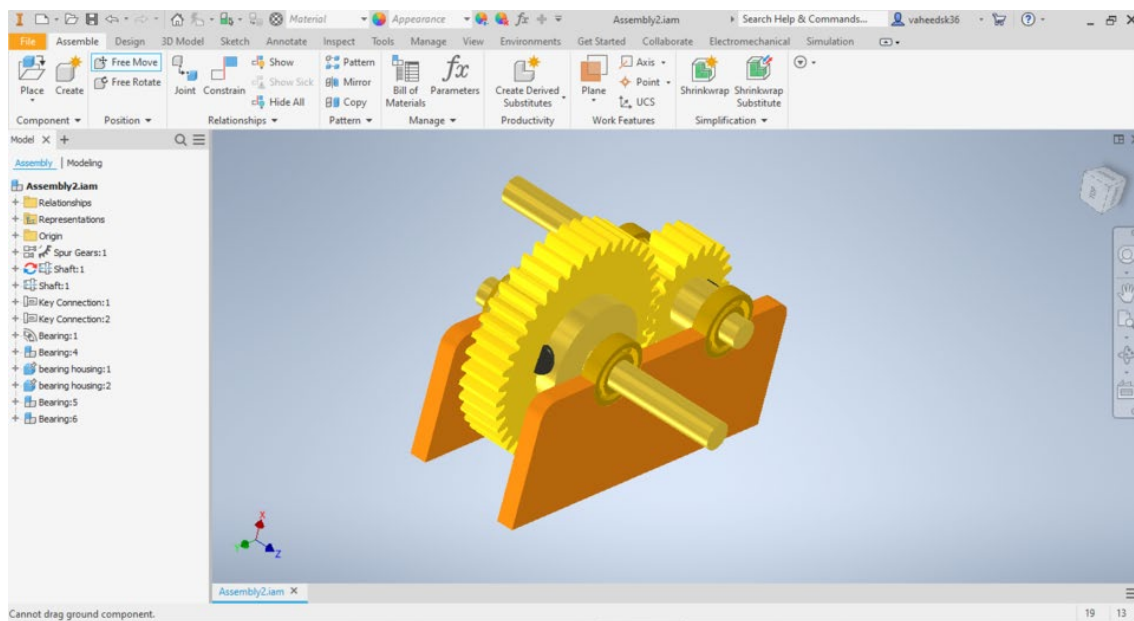
<https://www.youtube.com/watch?v=1MUOz3l2N-k>

<https://www.youtube.com/watch?v=Nd6U2KgHI6k>

<https://www.autodesk.com/solutions/revit-vs-autocad>



Autodesk Inventor is a program for designing various products, making their drawings, and creating product visualizations. Create a 3D prototype of your product and test it before production. With this software, designing details in a 3D environment is much easier and faster than in a 2D environment, errors are avoided because drawings stay in touch with the model, making changes to the product especially easy. The concept of a digital prototype allows you to test a product before it starts production, which allows you to save money by testing a digital prototype on a computer instead of a real product in a laboratory.



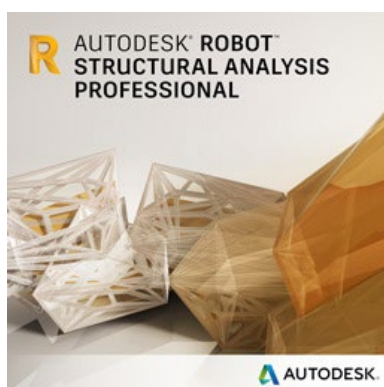
<https://www.youtube.com/watch?v=SsLkAokkeR8>

<https://www.youtube.com/watch?v=87iFjsYPEk4>

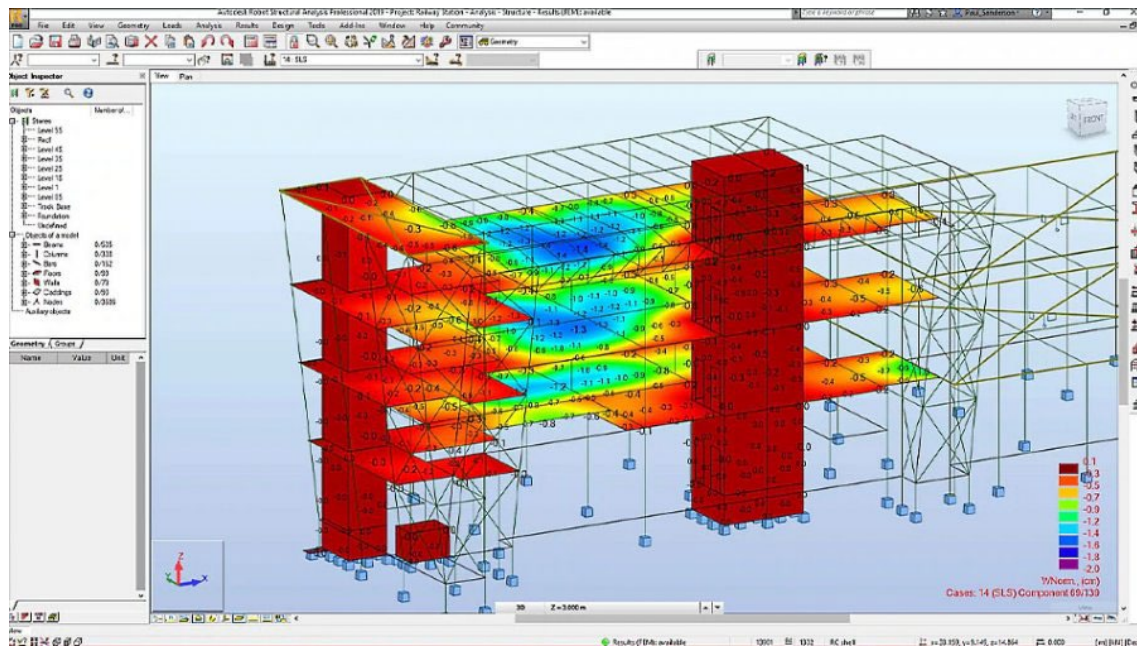
https://www.youtube.com/watch?v=_aL8FGZU0FM

5.5 Construction CAD software solutions

Software for design solutions. During the construction, information models are developed where the material parameters of building structures are stored.



„Autodesk® Robot™ Structural Analysis Professional“ - the most advanced software for design and analysis of reinforced concrete, steel, wooden structures and foundations, preparation of documentation and drawings. With this program, both elementary linear analysis and complex dynamic calculations can be performed.



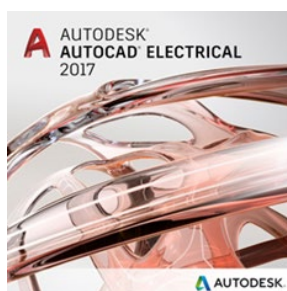
<https://www.youtube.com/watch?v=Kw1luWtYSBg>

<https://www.youtube.com/watch?v=n3O0iJLcuS0>

<https://www.youtube.com/watch?v=JroqEumdNX0>

5.6 MEP (Mechanical, electrical, and plumbing) CAD software solutions

Software for the design of engineering solutions for construction services. It creates informational models containing plans for layout of heating, ventilation, water supply and sewage, electrical engineering network systems in the building plan.



AutoCAD Electrical - specialized software for the design of electrical and automation systems. The program has all the features of AutoCAD® plus a full set of functions for preparing electrical diagrams. Extensive character libraries and automated electrical network design work help you work faster, so electrical engineers can spend more time innovating. Special tool

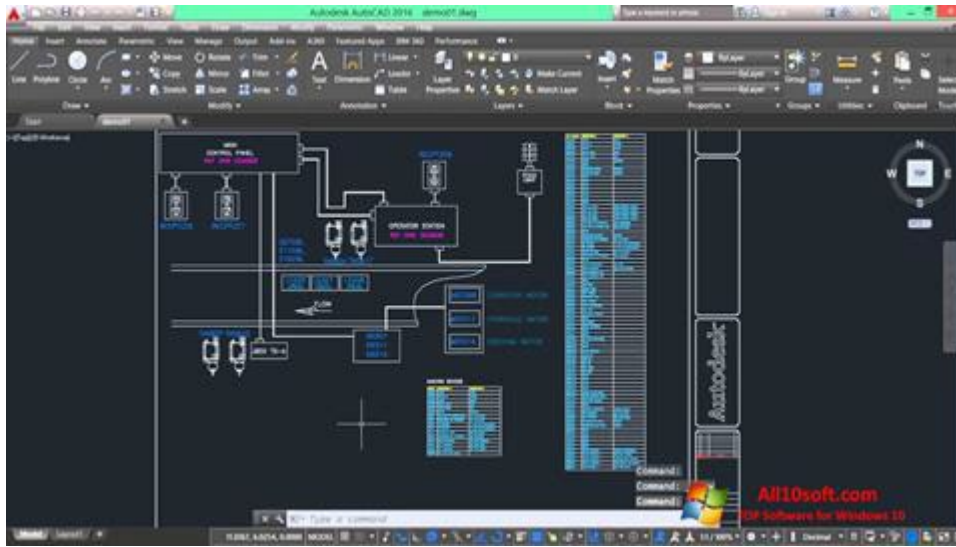
sets for working with projects, circuit elements, wires and electrical and control panels facilitate and speed up design work.

The program automatically:

- updates the information notes of the project drawings, numbers the wires and diagram elements,

- connects the wires to the loadable terminals,
- prepares various reports and specifications,
- finds errors made during design,
- indicates changes made to the drawings.

In addition, designers have the ability to create new elements and databases.



<https://www.autodesk.com/autodesk-university/class/Migrating-AutoCAD-AutoCAD-Electrical-2016>

<https://www.youtube.com/watch?v=dKDgfdPcHTI>

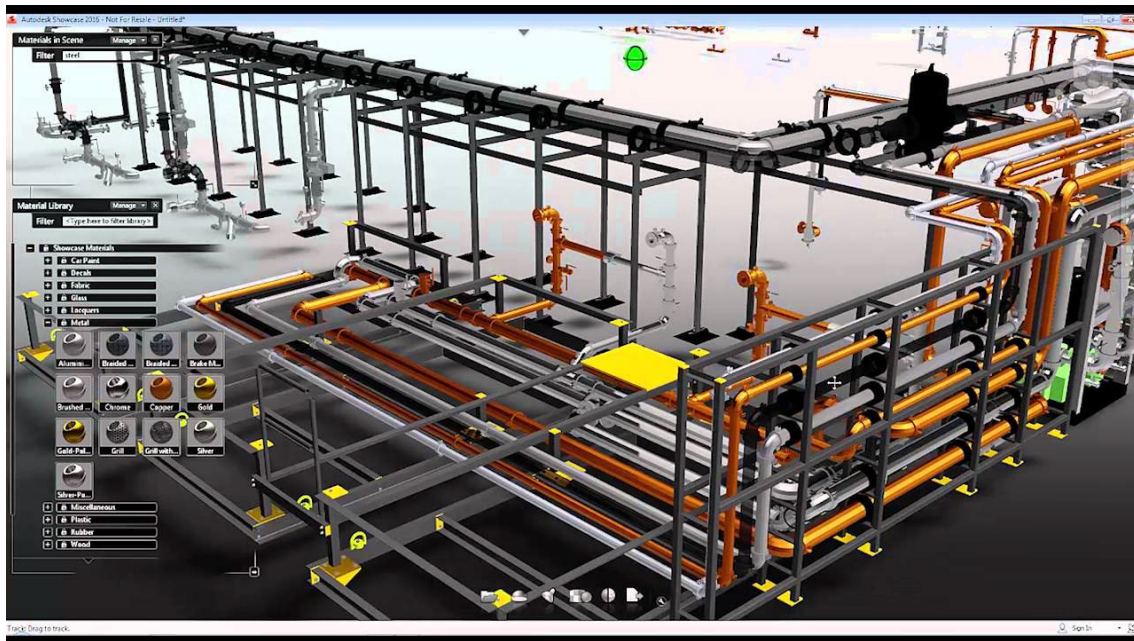
<https://www.youtube.com/watch?v=Fa5gYiapD1E>



Autodesk® Fabrication is a comprehensive engineering component detailing and manufacturing solution that combines BIM (Building Information Modelling) and CAD tools.

The package is intended for designers and manufacturers of engineering system components working on the principles of BIM work.

The suite offers tools that streamline the detailing and production workflow - this suite includes the latest versions of Autodesk Revit, AutoCAD, Navisworks Simulate, CADmep, ESTmep, CAMduct, and Point Layout.



<https://www.youtube.com/watch?v=I1vBHgED4tk>

<https://www.autodesk.com/autodesk-university/class/Creating-Great-Fabrication-Services-2016>

<https://www.youtube.com/watch?v=TTKFW9D3RAc>

<https://www.youtube.com/watch?v=OhRNlkSPfwo>

5.7 Automated CAD module generation (Model Generation) software solutions

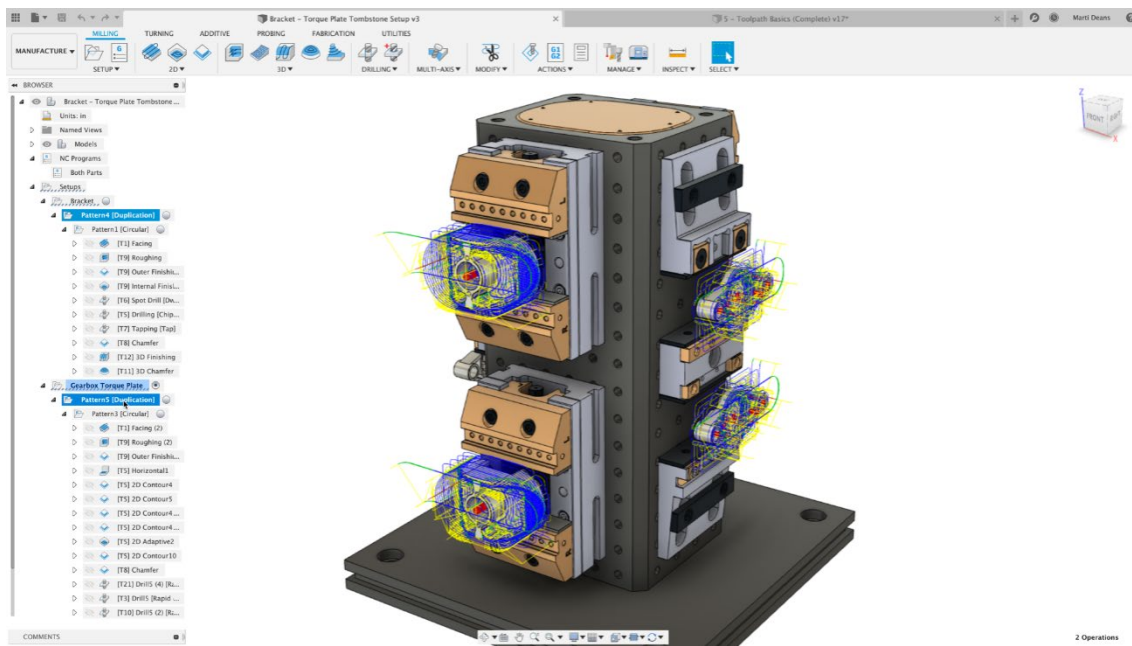
Designed to automate module generation work. The design describes the algorithms used to create, modify, analyze, or optimize the models.

Integration with Autodesk 360.



Process can be made easier with the Autodesk 360 cloud service. When working with AutoCAD, the user can automatically save drawings online and download them from any workstation. Ability to view or edit the work online using a web browser or smartphone.

The Autodesk 360 cloud service allows the user to share drawings, track changes, and allow others to comment on them. The new AutoCAD Settings Sync feature enables downloading of all user-created settings and drawings to any computer.



<https://www.youtube.com/watch?v=BufA3vwwO9Q>

<https://www.youtube.com/watch?v=h9wpIYhYvh4>

<https://www.autodesk.com/bim-360/>

The development of the industry is always complex, so inevitably, a particular software is applied to a particular industry.

The breakdown of the software by industry is presented in the following tables.

For architects

Software	Description
ABVENT Artlantis	Photorealistic visualization
Allplan Architecture	Preparation of an architectural project
Autodesk 3ds Max	Three-dimensional modelling, animation, representation
Autodesk AutoCAD	Automated design
Autodesk BIM 360	Construction project management

Autodesk Insight 360	Building's structural analysis
Autodesk Navisworks	Project review
Autodesk Revit	Parametric design
Bentley MicroStation	Information modelling system
Bentley Systems AECOsim Building Designer	Interdisciplinary BIM technology system
BricsCAD	Drawing and modelling
EliteCAD	3D design
GRAPHISOFT ArchiCAD	Architectural design
IES VE	Performance evaluation
Lumion	Visualization
MAXON Cinema 4D	Freeform modelling
Trimble SketchUp Pro	3D modelling
Twinmotion	Real-time video visualization

For engineers

Software	Description
Allplan Engineering	Structural design
Autodesk AutoCAD	Automated design
Autodesk Infrastructure Map Server	Map distribution
Autodesk Insight 360	Building's analysis
Autodesk MEP Fabrication Suite	Detailing and production of engineering elements
Autodesk Navisworks	Project review
Autodesk Revit	Parametric design

AX3000	Design of building engineering systems
Bentley Geo Web Publisher	Publication of geodata on the Internet
Bentley Map	Cartography
Bentley MicroStation	Information Modelling System
Bentley OpenPlant	Industrial engineering design
Bentley PowerProStructures	Development of 3D models of reinforced concrete and metal structures
Bentley Systems AECOSim Building Designer	Interdisciplinary BIM Technology System
BricsCAD	Drawing and modelling
ContextCapture	Automated photogrammetry
DDS-CAD	Electrical system design, HVAC, water supply, sewage design
eCognition	Photogrammetry
IES VE	Performance evaluation
LumenRT	Real-time photorealistic visualization
MagiCAD	Engineering design
Scia	Development of structures, elements, compilation of a calculation scheme, inspection
SOLIDWORKS	3D design
Trimble	Photogrammetry, geodesy, 3D scanning, GIS
UASMaster	Photogrammetry
WaterCAD	Design of water supply networks

For Builders / Project Managers

Software	Description
Autodesk BIM 360	Construction project management
BIMcollab	Cooperation of project participants
Bricsys 24/7	Project management
Dalux	Construction management
LOD Planner	Planning and enforcement
simplebim	IFC information management and filtering
Solibri Model Checker	Visualization of design solutions
SOLIDWORKS	3D design
Trimble Connect	Cooperation of project participants
VICO Office	Use of 4D and 5D
Viewpoint	Document control and cooperation

For constructors

Software	Description
Allplan Engineering	Structural design
ATHENA	Design of aluminum-glass facades, winter gardens, metal structures
Autodesk AutoCAD	Automated design
Autodesk Insight 360	Structural analysis
Autodesk Inventor	Modelling of digital prototypes of products

Autodesk Navisworks	Project review
Autodesk Revit	Parametric design
Autodesk Robot Structural Analysis Professional	Design, analysis, documentation and drawings of reinforced concrete, steel, wooden structures, foundations
Bentley MicroStation	Information modelling system
Bentley PowerProStructures	Development of 3D models of reinforced concrete and metal structures
Bentley Systems AECOsim Building Designer	Interdisciplinary BIM technology system
Dlubal RFEM	Structural analysis
GEO5	Solving geotechnical problems
IDEA StatiCa	Information loading, design of structures and elements
LIRA	Calculation and design of structures
MONOMAKH	Automated design of multi-storey frame reinforced concrete buildings
Scia	Development of structures, elements, compilation of a calculation scheme, inspection
SEMA	Design of wooden frame, panel and log houses, roofs, stairs
SOLIDWORKS	3D design
Tekla Model Sharing	Cooperation of project participants
Tekla Structural Designer	Analysis and design
Tekla Structures	Structural modelling

TeklaTedds	Structural calculations
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Other software

Software	Description
ANSYS	Modelling of engineering tasks
ArcGIS	Map creation
Autodesk Infraworks	Infrastructure design
Autodesk Maya	3D modelling, animation, effects creation, visualization
Autodesk Vault	Product data management
CGS Autosign	Automated road marking and traffic marking
DraftSight	Creating and reviewing drawings
eDrawings	Viewing and printing of files
Esri ArcPad	GIS data field collection and storage
Granlund Manager	Building maintenance management system
KitchenDraw	Furniture and interior design
Survey Mobile Android	Geodesy: field measurement

6. Deliverables

The student will have to answer the submitted test questionnaires.

7. What we have learned

The student has become acquainted with and is able to adapt different types of software used in the construction sector at different stages of the BIM lifecycle.