



**R.C.Patel College Of Engineering &
Polytechnic, Shirpur**
Department of Civil Engineering



Course Title- Emerging Trends in civil Engineering **course Code -**315315

Programme Name - Civil Engineering **Semester-**Third

Unit	Title	COs	Learning hours	R Level	U Level	A Level	Total Marks
I	Softwares in Civil Engineering	CO1	6	6	6	2	14

CO-1- Suggest the relevant softwares for given construction projects.

Syllabus:

- 1.1 Merits and Demerits of soft computing technique.
- 1.2 Applications of Civil Engineering softwares : Build-Master, HEC-RAS, STRAP, WaterGEMS, ArcGIS, STAAD-Pro, RISA-Connection, MIDAS, Building Information Modeling (BIM), Procore, Primavera Pro, Virtual Reality Software-VR, MX Road Software, Building Planning & Management System (BPMS), Plaxis 3D, Autodesk Construction Cloud, Powerplay, Geo5

Subject Teacher
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What is computing:-

computing means to execute any work with the help of computer or other computing device.

SOFT COMPUTING vs HARD COMPUTINGMERITS AND DEMERITS OF SOFT COMPUTING TECHNIQUEMERITS:-

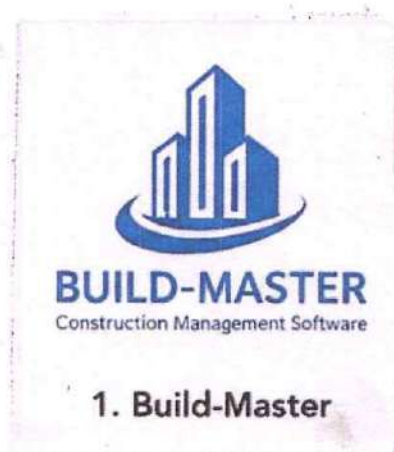
1. Adaptive and Learning ability
2. Robust and tolerant
3. Able to solve complex problem.
4. It is Flexible or Adapts to change.
5. To Reduced computational cost
6. Ability to handle uncertainty
7. Wide Application within upgradation

DEMERTS:-

1. Does not provide always exact and optimal soln.
2. Accuracy may be lower than traditional computing
3. It requires training
4. Difficult to select parameter
5. performance depends upon given data.
6. difficult to verify and validate the obtained solution.

SOFTWARES IN CIVIL ENGINEERING1. BUILD-MASTER:-

- It is construction project management software designed to plan, execute, monitor and control construction projects digitally.
- It introduced project planning, material management, documentation and planning of team into a single platform.
- specially for R.C.C. Building Analysis, Design, drawing and estimation.
- It is used for low rise buildings

FEATURES:-

1. Tools and process - It used existing tools to providing consistent process across builds.
2. Resource management - It allocate, manpower, machinery and equipment effectively.

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③ self host on windows or linux:- We can operate or run Build master in our private cloud.

APPLICATIONS:-

- i) scheduling of beams and slabs from single line plan layout.
- ii) Generate 3D space frame model from data plan.
- iii) It generate R.C.C. Working plan with centre line plan.
- iv) 3D-elevation
- v) calculation of rebar length.

HEC-RAS:- [HYDROLOGIC ENGINEERING CENTER'S RIVER ANALYSIS SYSTEM]

- developed by U.S.A. Army corps of Engineers.
- It is used for hydraulic calculations

objectives:- To calculate water surface profiles and simulates how water flows through rivers, streams and other open channels.

- also predict the various levels of water.
- velocity of water, sediment movement and also quality of water at different conditions

FEATURES :-

1. Steady flow analysis - water surface profiles
2. 2D hydraulic modeling - simulates water movement across flood plains, urban areas, and complex terrain.
3. Bridge and culvert analysis - Analyze flows through bridges, culverts and other hydraulic structures.
4. Hydraulic structure modeling - supports levees, weirs, gates and lateral structures.
5. GIS compatibility :- To import and exports spatial data by using GIS.

Applications :-

- i) River and stream hydraulic modeling
- ii) Flood plain mapping and management.
- iii) DAM Analysis.
- iv) Urban drainage and storm water management.
- v) Environmental impact studies.

Components of HEC-RAS:-

Components	Purpose
Steady Flow Data Editor	Inputs steady flow conditions such as discharge, boundary conditions, and flow profiles.
Sediment Transport Module	Simulates erosion, deposition, and sediment movement in rivers.
Water Quality Module	Models water temperature and water quality parameters (available in supported versions).
Hydraulic Tables	Provides detailed hydraulic results for each river section.

STRAP! - [STRUCTURAL ANALYSIS PROGRAM]

- strap is versatile tools for the design of wide range of concrete and steel structures including residential/ commercial buildings, bridges, retaining tanks etc.

- It allows to perform structural analysis using finite element methods

- It also used GUI interface

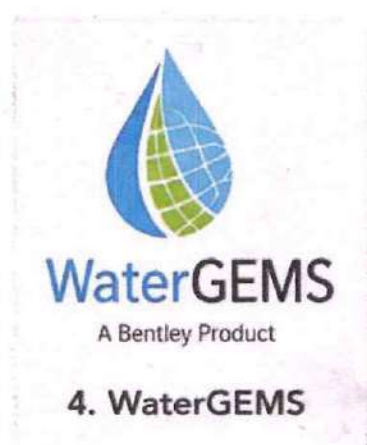
Applications :-

- i) structural modeling of bridges and flyovers.
- ii) seismic analysis of multistoried building.
- iii) Industrial steel structures.
- iv) foundation and footing design
- v) design of retaining wall

Main Features of STRAP

Feature	Description
2D & 3D Structural Modeling	Creates and analyzes both two-dimensional and three-dimensional structural models.
Finite Element Analysis (FEA)	Uses the Finite Element Method for accurate structural analysis.
Static & Dynamic Analysis	Performs static, seismic, wind, and dynamic load analysis.
Steel Structure Design	Designs steel members according to various international design codes.
RCC Structure Design	Designs reinforced concrete beams, columns, slabs, and foundations.
Automatic Load Combinations	Automatically generates load combinations as per design standards.
Buckling & Stability Analysis	Evaluates the stability and buckling behavior of compression members.
Graphical Results	Displays bending moment, shear force, axial force, stress, and deflection diagrams.
Code-Based Design	Supports multiple national and international structural design codes.
Report Generation	Generates detailed structural analysis and design reports for documentation.

WATER GEMS:-



- It is hydraulic modeling and water distribution network analysis software.
- Developed by Bentley Systems.
- It is used to designing, analyzing, operating and optimizing water supply system.

Significance of WaterGEMS:-

Feature	Description
Hydraulic Network Modeling	Models water distribution systems including pipes, pumps, valves, tanks, and reservoirs.
Steady-State Analysis	Calculates pressure, flow, and velocity under normal operating conditions.
Extended Period Simulation (EPS)	Simulates network performance over time by considering varying demand and operating conditions.
Water Quality Analysis	Simulates chlorine concentration, water age, and contaminant movement within the network.
Pump and Valve Modeling	Analyzes the performance of pumps, pressure-reducing valves, and control valves.
Fire Flow Analysis	Determines whether the network can supply adequate flow and pressure during firefighting conditions.
Demand Management	Estimates and manages water demand patterns for different consumer zones.
Scenario Management	Compares multiple design and operational scenarios without altering the base model.
GIS and CAD Integration	Integrates with GIS platforms and CAD software for efficient data exchange.

ARC GIS:- software developed by Esri

- It is used to create, manage, analyze, and visualize geographic data and spatial data.
- It is released in 1999 and developed at USA.

Applications:-

- Land surveying and mapping.
- Urban and regional planning.
- Transportation route planning.
- Water supply and sewerage planning.
- Watershed management.
- Environmental impact assessment.

- Agriculture and Land management.
- Education and Research.



Significance of Arc GIS:-

Feature	Description
Digital Mapping	Creates professional digital maps from spatial data.
Spatial Analysis	Performs buffering, overlay, network, and terrain analysis.
GIS Database Management	Stores, edits, and manages geographic datasets.
2D & 3D Visualization	Displays geographic information in both 2D and 3D.
Remote Sensing Integration	Works with satellite imagery, aerial photographs, and drone data.
Geo referencing	Aligns scanned maps and images with real-world coordinates.
Network Analysis	Finds the shortest routes and optimizes transportation networks.
Terrain & Surface Analysis	Generates contour maps, slope maps, aspect maps, and digital elevation models (DEMs).
Web GIS	Publishes interactive maps and dashboards online.

STADD-PRO :- [structural Analysis And Design]



- It is developed by Bentley system
- Widely used by structural Engineers for the analysis of and designing of buildings, bridges, towers, industrial structures and other infrastructure projects.
- It is developed in 1997 in USA.

Key Features of STADD pro:-

Feature	Description
3D Structural Modeling	Creates and analyzes complex 3D structural models.
Structural Analysis	Performs linear, nonlinear, static, and dynamic analysis.
RCC & Steel Design	Designs reinforced concrete and steel structures according to international codes.
Load Analysis	Supports dead, live, wind, seismic, snow, and moving loads.
Automatic Load Combinations	Generates load combinations based on selected design standards.
Finite Element Analysis (FEA)	Uses finite element methods for accurate structural analysis.
Code-Based Design	Supports numerous national and international design codes.
Foundation Modeling	Assists in analyzing and designing foundations and support systems.
Graphical Results	Displays bending moment, shear force, axial force, stress, and deflection diagrams.

RISA CONNECTION! - It is specially design for steel structure analysis.

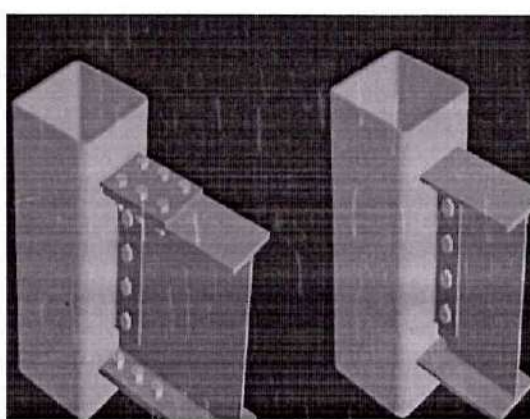


- To analyze and design steel connection for buildings, bridges, industrial plants and other steel structures. According to international design codes.

7. RISA-Connection

Key Features of RISA Connection:-

Feature	Description
Steel Connection Design	Designs bolted and welded steel connections.
Code-Based Design	Supports major international steel design standards such as AISC.
Connection Analysis	Evaluates the strength, stability, and safety of steel joints.
3D Connection Visualization	Displays detailed three-dimensional models of connections.
Automatic Design Checks	Performs code compliance checks automatically.
Bolt and Weld Design	Calculates bolt sizes, weld lengths, and connection capacities.
Base Plate Design	Designs steel column base plates and anchor bolts.
Report Generation	Produces detailed calculation reports and design summaries.
Integration with Structural Software	Exchanges data with other structural analysis software, including RISA structural analysis programs.



MIDAS! - Developed by MIDAS IT (1989) in south korea.



Widely used in analysis, design and maintenance of bridges, buildings and geotechnical structures.

8. MIDAS

Key Features of MIDAS IT:-

Feature	Description
3D Structural Modeling	Creates and analyzes complex 3D structural models.
Finite Element Analysis (FEA)	Performs accurate finite element analysis of structures.
Static & Dynamic Analysis	Supports static, seismic, wind, moving load, and dynamic analysis.
Bridge Design	Designs RCC, PSC, steel, cable-stayed, and suspension bridges.
Load Combination	Automatically generates and checks load combinations.
Code-Based Design	Supports various international structural design standards.
Construction Stage Analysis	Simulates different stages of construction and evaluates structural behavior.
Prestressed Concrete Analysis	Designs and analyzes prestressed concrete structures.
Graphical Results	Displays bending moment, shear force, stress, displacement, and deformation diagrams.

Applications of MIDAS:-

Feature	Description
Bridge Engineering	Analysis and design of highway, railway, and pedestrian bridges.
Building Design	Structural analysis and design of residential and commercial buildings.
Industrial Structures	Design of factories, warehouses, and industrial plants.
High-Rise Buildings	Analysis of tall buildings under wind and earthquake loads.
Transportation Infrastructure	Design of flyovers, viaducts, and elevated corridors.
Geotechnical Engineering	Analysis of retaining walls, tunnels, and soil-structure interaction.
Water Resource Structures	Design of dams, spillways, and hydraulic structures.
Power Plants	Structural analysis of thermal, hydro, and nuclear power plant facilities.
Seismic Engineering	Earthquake-resistant design and seismic performance evaluation.

BIM:- [Building Information Modeling]

BUILDING INFORMATION MODELING

9. Building Information Modeling (BIM)

- It is a digital process for creating and managing information on construction project across its entire lifecycle.

- It provides a shared knowledge resource for information about facility, forming a reliable basis for decisions during its life cycle from inception onward.

Feature	Description
Intelligent 3D Modeling	Creates and manages 3D models containing geometric and engineering information.
Integrated Project Data	Stores architectural, structural, and MEP information in a single model.
Clash Detection	Detects conflicts between structural, architectural, and MEP components before construction.
Quantity Takeoff	Automatically generates quantities and material estimates from the model.
Collaboration	Enables architects, engineers, contractors, and owners to work on a shared model.
Construction Scheduling (4D BIM)	Links the 3D model with the project schedule to visualize construction progress.
Cost Estimation (5D BIM)	Integrates project costs with the model for budgeting and cost control.
Document Generation	Produces plans, elevations, sections, schedules, and reports automatically.
Lifecycle Management	Supports operation, maintenance, and facility management after construction.

Applications of BIM:-

Feature	Description
Building Design	Architectural, structural, and MEP modeling.
Construction Planning	Project planning, scheduling, and coordination.
Quantity Estimation	Automatic quantity takeoff and BOQ preparation.
Cost Management	Budget estimation and cost control.
Clash Detection	Identifies design conflicts before construction begins.
Infrastructure Projects	Used in roads, bridges, tunnels, airports, and railways.
Facility Management	Supports maintenance and operation of completed buildings.
Renovation Projects	Assists in remodeling and rehabilitation of existing structures.
Smart City Development	Integrates digital models into urban planning projects.

PROCORE:-

- It is cloud based construction project management software developed by procore tech.

- It serves as a robust platform for civil engineering professionals, offering a suite of tools that enhance project management.

10. Procore

Feature	Description
Project Management	Plans, monitors, and controls construction projects from start to finish.
Document Management	Stores and shares drawings, contracts, RFIs, submittals, and reports securely.
Project Scheduling	Tracks project timelines, milestones, and work progress.
Budget & Cost Management	Monitors project budgets, expenses, and financial performance.
Quality & Safety Management	Records inspections, safety observations, incidents, and corrective actions.
Field Collaboration	Enables real-time communication between office staff and site engineers using mobile devices.
Daily Progress Reports	Creates and manages daily site reports, manpower records, and work logs.
Resource Management	Tracks labor, equipment, subcontractors, and material usage.
Cloud-Based Access	Provides secure access to project information from anywhere via the cloud.
Reporting & Dashboards	Generates project reports, dashboards, and performance analytics for decision-making.

Applications of PROCORE:-

Feature	Description
Building Construction	Manages residential, commercial, and institutional building projects.
Infrastructure Projects	Supports roads, bridges, railways, airports, and utility construction.
Cost Control	Tracks budgets, expenses, invoices, and project costs.
Project Documentation	Maintains drawings, contracts, RFIs, submittals, and correspondence.
Site Management	Monitors daily construction activities and workforce productivity.
Quality Assurance	Records inspections, defects, and quality control activities.
Safety Management	Tracks safety inspections, incidents, and compliance records.
Contractor Coordination	Improves communication among owners, consultants, contractors, and subcontractors.
Progress Monitoring	Tracks project milestones and completion status in real time.

PRIMAVERA:-

11. Primavera Pro

- primavera p6 professional is a project management software developed by oracle.
- it is widely used in large scale construction, infrastructure, oil & gas, manufacturing and engineering project planning, scheduling, resource allocation.

Significance of PRIMAVERA:-

Feature	Description
Project Planning	Creates detailed project plans and work breakdown structures (WBS).
Project Scheduling	Develops and manages schedules using Gantt charts and network diagrams.
Resource Management	Allocates and monitors labor, equipment, and materials efficiently.
Cost Management	Tracks project budgets, costs, and expenditures.
Critical Path Method (CPM)	Identifies the critical path and activities affecting project completion.
Progress Tracking	Monitors project progress by comparing planned and actual performance.
Risk Analysis	Assists in identifying and managing project risks.
Baseline Management	Creates and compares project baselines to measure performance.
Multi-Project Management	Manages multiple projects simultaneously from a single platform.
Reports & Dashboards	Generates customizable reports, charts, and project performance dashboards.

Applications of PRIMAVERA:-

Feature	Description
Building Construction	Plans and schedules residential, commercial, and industrial buildings.
Highway & Bridge Projects	Manages construction schedules for roads, bridges, and flyovers.
Infrastructure Development	Controls large infrastructure projects such as airports, railways, and metro systems.
Power Plants	Schedules thermal, hydro, nuclear, and renewable energy projects.
Oil & Gas Projects	Manages refinery, pipeline, and offshore construction projects.

BPMS [Building planning & management system]

BUILDING PLANNING & MANAGEMENT SYSTEM

14. Building Planning & Management System (BPMS)

- A software platform used to plan, design, monitor, manage and control building projects throughout their lifecycle.
- It helps to engineers, contractors and project managers to improve efficiency, reduce cost and complete projects on time.

Aspect	Significance	Applications
Project Planning	Helps in preparing detailed project plans and defining project scope.	Residential, commercial, and industrial building projects.
Scheduling	Enables preparation and monitoring of construction schedules to avoid delays.	Construction activity planning using Gantt charts and timelines.
Resource Management	Optimizes the use of labor, materials, and equipment.	Allocation of manpower, machinery, and construction materials.
Cost Management	Assists in budgeting, cost estimation, and expense tracking.	Project budgeting, cost control, and financial management.
Document Management	Stores and organizes drawings, contracts, reports, and approvals electronically.	Digital management of blueprints, permits, contracts, and project records.
Quality Management	Ensures work complies with quality standards and specifications.	Site inspections, quality audits, and compliance monitoring.
Safety Management	Improves workplace safety through monitoring and reporting.	Safety inspections, hazard identification, and accident reporting.
Progress Monitoring	Tracks project progress in real time and identifies delays.	Daily work progress reports and milestone tracking.
Communication & Collaboration	Facilitates coordination among project stakeholders.	Communication between architects, engineers, contractors, and clients.
Reporting & Analytics	Generates reports and dashboards for informed decision-making.	Project performance analysis and management reporting.
Facility Management	Supports maintenance and operation after project completion.	Building maintenance scheduling and asset management.

PLAXIS - 3D:-**PLAXIS 3D**

15. Plaxis 3D

- It is Geotechnical Engineering software.
- It is developed by sequent
- It is based on FEM [Finite Element Method]
- It is used for analysing soil and rock behaviour, foundation, tunnels, excavation etc.

Major feature and applications of AUTODESK CONSTRUCTION CLOUD

Feature	Application in Civil Engineering
3D Finite Element Analysis	Performs accurate analysis of complex soil and rock behavior in three dimensions.
Soil-Structure Interaction	Studies interaction between soil and structures such as foundations, retaining walls, and tunnels.
Advanced Soil Models	Simulates realistic behavior of different soil types under various loading conditions.
Foundation Analysis	Designs and analyzes shallow foundations, raft foundations, and pile foundations.
Tunnel Analysis	Evaluates stability, deformation, and stresses during tunnel excavation.
Slope Stability Analysis	Assesses slope safety and predicts possible failures in embankments and hillsides.
Excavation Simulation	Models deep excavations with retaining systems and construction stages.
Groundwater Flow Analysis	Simulates seepage, pore water pressure, and dewatering effects.
Dynamic Analysis	Evaluates earthquake loading, machine vibrations, and dynamic soil response.

AUTODESK CONSTRUCTION CLOUD:-**AUTODESK
CONSTRUCTION CLOUD**16. Autodesk
Construction Cloud

- It is based on cloud based management and collaboration platform
- It is developed by Autodesk

Major feature and applications of AUTODESK CONSTRUCTION CLOUD

Feature	Application in Civil Engineering
Cloud-Based Collaboration	Enables architects, engineers, contractors, and owners to collaborate in real time from any location.
Centralized Document Management	Stores drawings, specifications, contracts, RFIs, and submittals in one secure location with version control.
BIM Model Coordination	Coordinates 3D BIM models and detects clashes before construction, reducing design errors and rework.
Real-Time Project Updates	Provides instant updates on project progress, ensuring all stakeholders work with the latest information.
Issue Tracking	Records, assigns, and monitors design and construction issues until they are resolved.
Quality Management	Conducts inspections, manages punch lists, and ensures construction quality standards are met.
Safety Management	Tracks safety observations, incidents, and inspections to improve workplace safety.
Cost Management	Manages budgets, contracts, change orders, and project expenses to control construction costs.
Schedule Integration	Integrates project schedules to monitor milestones, delays, and overall project progress.
Mobile Accessibility	Allows engineers and site supervisors to access project information using smartphones and tablets.



UNIT-I

Softwares in Civil Engineering

8. **WaterGEMS** helps in:
- Pipe network analysis
 - Soil investigation
 - RCC design
 - EQ analysis
9. **GIS** helps in:
- Spatial data analysis
 - Brick testing
 - Concrete testing
 - Painting
10. **STAAD-Pro** can design:
- RCC
 - Steel
 - Bridges
 - All
11. **RISA-Connection** designs:
- Beam-column joints
 - Roads
 - Dams
 - Pavements
12. **MIDAS** is suitable for:
- Bridge engineering
 - Brick testing
 - Curing
 - Painting
13. **BIM** stands for:
- Building Information Modeling
 - Building Internet Management
 - Basic Infrastructure Method
 - None
14. **Primavera Pro** is used for:
- Project scheduling
 - Soil testing
 - GIS
 - RCC
15. **VR** helps engineers:
- Visualize before construction
 - Test cement
 - Test steel
 - Rainfall
16. **BPMIS** stands for:
- Building Planning & Management System
 - Building Project Mgmt Software
 - Basic Planning
 - None
17. **BPMIS** is used for:
- Building approvals
 - Soil testing
 - GIS
 - Structure
18. **Plaxis 3D** is used for:
- Geotechnical engineering
 - Survey
 - Plumbing
 - Estimation
19. **Plaxis 3D** analyzes:
- Soil
 - Foundations
 - Excavations
 - All
20. **Autodesk Construction Cloud** provides:
- Document management
 - Field management
 - Collaboration
 - All
21. **Geos** can design:
- Foundations
 - Retaining walls
 - Slopes
 - All
22. Best software for flood modelling?
- HEC-RAS
 - STAAD
 - Build-Master
 - Procure
23. Software for water network analysis?
- WaterGEMS
 - MX Road
 - STAAD
 - Build-Master
24. Software for soil/foundation analysis?
- Plaxis 3D
 - ArGIS
 - Primavera
 - Build-Master
25. Which software is used for road geometric design?
- MX Road
 - Geos
 - HEC-RAS
 - Procure
26. Which software supports digital construction workflows?
- BIM
 - WaterGEMS
 - STRAP
 - HEC-RAS
27. Which software allows pressure and flow simulation in pipes?
- BIM
 - WaterGEMS
 - STRAP
 - HEC-RAS
28. Match the Pair
- | Column A | Column B |
|-----------|-------------------|
| HEC-RAS | Flood analysis |
| STAAD-Pro | Structural design |
| ArGIS | Mapping |
| Geos | Foundation design |
1. **Soft computing** is mainly used for:
- Exact calculations only
 - Handling uncertainty and approximation
 - Writing programs
 - Database management
2. **Main advantage of soft computing** is:
- Requires exact input
 - Handles imprecise data
 - Cannot learn
 - High cost
3. **A demerit of soft computing** is:
- Flexible
 - Adaptive
 - Less accurate for exact problems
 - Learns from data
4. **Soft computing** is widely used in:
- Painting
 - Carpentry
 - Typing
 - Quantity estimation
5. **Build-Master** is mainly used for:
- Video editing
 - GIS
 - Survey
 - Structural design
6. **HEC-RAS** is used for:
- River hydraulics
 - Road design
 - BIM
 - Frames
7. **STRAP** can analyze:
- Trusses
 - Buildings
 - Frames
 - All

29. Match the Pair

Column A	Column B
Virtual Reality (VR)	Geotechnical analysis
MX Road	Road alignment and highway design
BPMS	Building approval and management
Plaxis 3D	3D project visualization

30. Match the Pair

Column A	Column B
MIDAS	Project scheduling and planning
BIM	Construction project collaboration
Procore	Structural analysis and bridge engineering
Primavera Pro	Building Information Modeling