ALGOR software includes design, analysis and simulation tools that enable engineers to test and predict real-world behavior of new and existing products. Simulation capabilities include static stress and Mechanical Event Simulation (MES) with linear and non-linear material models, linear dynamics, steady-state and transient heat transfer, steady and unsteady fluid flow, electrostatics, full multi-physics and piping. MES combines large-scale motion and stress analysis with consideration of full inertial effects to enable engineers to see motion and its results, such as impact, buckling and permanent deformation. These analysis capabilities are all available within a complete and easy-to-use interface, FEMPRO, that supports a wide range of CAD solid models and includes finite element meshing and model-building tools.

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ERITower analyzes and designs 3-sided guyed and self-supporting towers and round and tapered monopoles. The program designs or checks members using EIA/TIA standards from Rev A to G. Linear and non-linear analyses can determine displacements and forces within the structure. Wind pressures, forces, and ice loads are calculated automatically. Extensive graphics plots include material take-off, plot plan, shear-moment, leg-compression, displacement, twist, feed-line, guy-anchor and stress plots. Reports are generated in Microsoft Word RTF format. Libraries of feedlines, dishes, appurtenances and tower sections can be referenced from within the program. Both imperial and metric units are supported. A complete user's manual and HTML help is included.

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Real3D-Analysis is a comprehensive 32-bit Windows structural analysis program. Elements include beam/truss, thick and thin plate/steel and solid brick. Easy input and output through point-and-click, spreadsheet, automatic model generation, intuitive moment-shear diagram, and stress contour. Features include 128-bit floating-point solver (linear or p-delta), realistic graphics based on OpenGL™, HTML report and multiple-document interface.

RcSections is a 32-bit Windows analysis and design program for reinforced concrete sections according to ACI-99 and ACI-02. Sections can be rectangular, circular, Tee, I, or inverted L, and generic sections with openings. Features include automatic section generations, accurate and fast solver, result data in a spreadsheet, 2D P-M and M-M, interaction diagrams and 3D P-M-M capacity surface.

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STRAP Version 11.0 is a 3D, static and dynamic, frame and finite-element analysis and design program. STRAP’s pre- and post-analysis options speed and simplify data input and results interpretation. Post-processors are available for rolled and lightweight steel and concrete, including an option to produce a general arrangement drawing for models; integration to the BEAMD system that details reinforced concrete beams and produces a beam schedule; and addition of the ASCE standard (ASCE7-98) for earthquake design. STRAP for Bridges designs bridge structures for moving loads. The program creates 3D influence lines for any point and calculates the critical effect of vehicle loads.

C-Concepts, Inc.
Structural Engineering Software
product case study

Greenside Place Link Bridge

Greenside Place Link Bridge is an S-shaped, helical steel-lattice structure that spans 50 m across Leith Street in Edinburgh, Scotland. Buro Happold Consulting Engineers used LUSAS Bridge to carry out a static analysis, a nonlinear buckling analysis, and a natural frequency check of the structure for client Coal Pension Properties (c/o LaSalle Investment Management).

The bridge is a free-standing structure of curved, 139.7 mm × 10 mm round HSS spiraling around six longitudinal 193.7 mm × 16 mm round HSS located in the top and bottom of the bridge cross-section. The 5 m-wide × 4 m-high helix is supported by spayed legs of 457 mm × 25 mm round HSS springing from concrete plinths. Aluminum planking is used for the decking. Glass panels frame the sides of the walkway and provide a roof for pedestrian protection.

The geometry for the bridge was imported from an existing CAD model using a DXF file. In Lusas, named groups assisted with the assignment of attributes such as geometric and material properties. This function allows common parts of a model to be viewed or selected in isolation, and provides greater control over results processing. Thick beam elements were assigned to the line features representing the main steel members. Joint elements modeled the pinned connections between the supports and the helical HSS. Fully fixed supports were used at connection with the concrete base. Engineers assessed long-term loads like differential settlement and short-term loads from pedestrians, wind, and temperature. They also considered accidental loads from vehicle impact with the concrete piers.

A static analysis of the proposed structure showed that the bottom members of the helix immediately above the inclined supports were overstressed and modification or stiffening would be required for the final structure. “The helical structure, which provides shear transfer between the top and bottom chords, globally was very stiff,” said Iva Triljkovich, structural engineer at Buro Happold. “The only problem we had was locally around the supports. We considered different strengthening strategies, including a steel plated stiffening option, but this didn’t solve the problem.” Finally, 193.7 mm × 20 mm round HSS diaphragm rings were used at each support location. Subsequent analysis showed that the insertion of these rings lowered the stresses in the helix local to the supports to an acceptable level.

A nonlinear buckling analysis was carried out to determine when the structure would start to behave nonlinearly. An initial imperfection was applied to the deformed buckling shape and the structure was loaded incrementally. It was shown that the structure remains linear within the range of the design loading.

While dynamic response to pedestrian loading can be a problem for some footbridges, a straightforward natural frequency analysis showed that the first horizontal mode shape of 2.55 Hz and the first vertical mode shape of 6.32 Hz were both above the critical frequency range for pedestrian comfort according to the UK DO37/01 design code. Gain frequencies also were outside of the critical walking range. “We compared gain frequencies against pacing and jumping frequencies for both vertical and horizontal movement of the bridge and got satisfactory results, showing that pedestrians will not feel any discomfort when crossing the bridge,” Triljkovich said. “Because of the complex nature of the structure and its S-shaped form, it would not have been possible for us to be sure of the exact stresses and forces in the helical members without the use of LUSAS.”
Digital Canal Engineering Software

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Digital Canal’s Structural Expert Series (SES) provides software for analysis, design and detailing. The frame analysis and design product VersaFrame runs stand-alone or integrated in AutoCAD. This program uses CAD to model, analyze, and design structures. Additional products include: steel design, concrete design, footing design, timber design, wind analysis, and retaining and masonry wall design. VIP clients receive free upgrades on their products. Free Downloads are available on the web site or by request.

Dlubal Engineering Software
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Dlubal offers a 3D finite element program for structural engineers. RFEM’s graphic user interface allows visual modeling of complex structures. Includes beams, plates and shells and libraries of materials and international sections. Stress, buckling and dynamic analysis are available in additional modules. RSTAB is made for frameworks. Design modules are available for steel, timber and concrete. New are steel connection modules. Designed connections can be displayed in rendered views. RFEM and RSTAB also can be controlled externally by a programmable COM interface like Visual Basic. RSTAB links to ProSteel3D, XSTEEL and other CAD software. Analysis results are presented in a customizable report with images. More information and demo are available for download from the web site.

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Engineering Advice’s web-enabled LRFD Steel Design program was developed by engineers based on the 3rd Edition of the AISC Specification and Manual of Steel Construction. The software is a learning aid to students and engineers. It covers analysis and design of tension and compression members, flexural members, floor and roof systems, members subject to compression and flexure, and bolted and welded connections. Connections include simple shear, eccentric shear and tension, welded seated beam connections, welded bracket plate connections, bolted bracket plate connections, column base plate, flexible and rigid moment connections.

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GTSTRUDL is database-driven structural analysis and design software with features for linear, non-linear, static and dynamic frame and finite-element analysis, steel and concrete frame design, and offshore jacket analysis and design. Graphic creation of frame and finite element models; Model Wizard; predefined and user-defined tables of steel shapes; data sheets to view, edit and sort information; graphic results display; steel design for US and international design codes; Steel Design Wizard; concrete design for US/British Codes; linear dynamic analysis; elastic buckling analysis; nonlinear static and dynamic analysis; and push-over analysis. GT STRUDL® is a registered service mark of the Georgia Tech Research Corporation, Atlanta.

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The VisualAnalysis 5.1 Package solves simple beam problems and completes time-history analysis of multi-story buildings. Sketch models using CAD-like features or generate them with wizards, spreadsheets, copy and paste, and more. Import STAAD or DXF files. Design in any material, code-check for steel, wood, concrete, and cold-formed steel. 5.1 is updated to the latest AISC specifications, supplements, and errata, including HSS and Single Angles. St. Venant torsion is checked. Switch between ASD and LRFD. Create custom reports. A single license is $995-$1995. Download free demo from the web site.

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ROBOT Millennium is finite-element structural engineering software for analysis and design of buildings, bridges, industrial facilities, and other structures. The software performs static/dynamic analysis of 2D/3D projects with beams, plates, shells and solids elements. It features flexible modeling, integrated steel and concrete design, automatic meshing of plates and shells, ability to use volumetric finite elements, advanced analysis and comprehensive output reports. Analysis includes harmonic, seismic and pushover, linear/non-linear time-history, non-linear with true cables, P-Delta and large displacements, beam-material non-linearity and plastic hinges. ROBOT can compare alternate designs in steel and reinforced concrete following updated American and International codes. ROBOT is also interfaced with CAD/CAE software using DWG and other formats.

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FrameWorks Plus 7.2 ($4200) produces intelligent models and fabrication and detailing data packages. Use 3D model data for physical members, material takeoffs, and project reviews. Supports 3D modeling and drawing, fabrication and detailing of steel beams, columns, braces, cutouts, sleeves, concrete slabs and walls, and offshore marine structures. The software is SDNF and CIMsteel compliant, runs on Microsoft Windows NT, and provides certified interfaces to GT-STRUDL, LARSA, STAAD-Pro, SAP2000, RAM Steel, Xsteel, SDS/2, StruCAD, CDS. Features AISC and BCSA tables and standard section data from 15 countries.
SPACE GASS is a structural analysis and design program for 2D and 3D frames, trusses, grillages and beams. It comes with features that make it suitable for any job from small beams, trusses and portal frames to large high-rise buildings, towers, cranes and bridges. Items such as graphical input, polar co-ordinates, elastic supports, pin-ended members, tension-only members, rigid member offsets, and non-linear analysis are all standard features.

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Curved and straight steel bridge design and rating software for compliance with AASHTO, ASD, LFD, and LRFD.

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**Steel Products**

**Structural Engineering Software**
evations, typical sections and foundation plans. A structural shapes' database includes a structural design calculator. This software ($1200.00/license) requires basic AutoCAD experience. Structural drawings are produced in Auto regime (minutes per drawing). The program is flexible for design changes.
Research Engineers introduces STAAD.Pro 2003, structural engineering software for 3D model generation, analysis and multi-material design. It has GUI, visualization tools, analysis and design facilities, and integration to other modeling and design software products. Compatible with Windows 2000, Windows ME and optimized for Windows XP.

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SAFI is an integrated design program for steel, composite, concrete and aluminum structures. SAFI 3D engine performs static analysis, P-Delta, non-linear, modal, buckling and finite elements. Seismic analysis is available, including spectral seismic, time-history seismic and time-history dynamic analysis. The IBC and NBC seismic loads are automated. SAFI Steel designs according to American, Canadian and European standards. The Steel Calculator allows you to verify, design and optimize simple or continuous steel beams and columns. SAFI also offers SAFI Concrete, SAFI Pretension, SAFI Tower, SAFI Tubular, SAFI Bridge, SAFI Steel and Wood bridges, SAFI Highway Signs structures and Concrete and Footing calculators. Demos, videos and project files are available on the web site.

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Structural Desktop provides AutoCAD-based methods to create geometric models compatible with analytical design programs. It converts analytical software databases into intelligent structural objects for the creation of contract documents. Structural Desktop has an extensive library of structural members from the AISC, SJI, LGS, AISI and PCI. Prismatic sections and plate elements also are supported. The program can create design files using AutoCAD; read supported analytical/design files; create a model from any DXF or DWG; automatic drawing in 2D or 3D; detailed material take-off; interface with AutoCAD-based detailing packages; and create interface files for Architectural Desktop.

SAFI is an integrated design program for steel, composite, concrete and aluminum structures. SAFI 3D engine performs static analysis, P-Delta, non-linear, modal, buckling and finite elements. Seismic analysis is available, including spectral seismic, time-history seismic and time-history dynamic analysis. The IBC and NBC seismic loads are automated. SAFI Steel designs according to American, Canadian and European standards. The Steel Calculator allows you to verify, design and optimize simple or continuous steel beams and columns. SAFI also offers SAFI Concrete, SAFI Pretension, SAFI Tower, SAFI Tubular, SAFI Bridge, SAFI Steel and Wood bridges, SAFI Highway Signs structures and Concrete and Footing calculators. Demos, videos and project files are available on the web site.

HSS_connex is a program dedicated for HSS truss connection design that complements the AISC HSS Connections Manual. The scope extends to welded T, Y, K (gap and overlap) and KT truss connec-
Structural Engineering Software

Intelligent Design & Generating Alternative Optimized Members of Steel Structure, Built-up from Plates: (Non-Compact Sections, AISC-1989/ASD and AISC-1999/LRFD): Computer program assumes structural analysis output and user-defined data as input file, starts design with user-defined minimum section dimensions ($B_{\text{min}}, TB_{\text{min}}/D_{\text{min}}, TD_{\text{min}}$). If section fails, automatically increases flange or web dimensions ($B$, $TB$ or $D$ or $TD$) using algorithm to design and generate alternative optimized member's sections, satisfying specification requirements and user-defined flange/web dimensions limits: ($B_{\text{min}} \leq B \leq B_{\text{max}}, TB_{\text{min}} \leq TB_{\text{opt}}, D_{\text{min}} \leq D_{\text{opt}}, TD_{\text{min}} \leq TD_{\text{opt}}$).

Program provides alternative optimized I- or BOX-sections (column or beam or girder) and does not use any built-in or user-defined sectional file. This engine program can be linked to any analysis software.

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