The trowel, level, and mixer are essential tools for masonry. Increasingly, so are the personal computer and the growing selection of software to aid in masonry design.

Now in most architectural and engineering offices, computers make it easier to design with and specify masonry, an important consideration for busy design professionals. In fact, the availability of electronic design aids has become a factor some designers consider when selecting building materials. Beyond boosting productivity, the new software is changing the way masonry is used and making it more competitive in the marketplace.

For example, new structural engineering software speeds up design calculations so that several design alternatives can be compared and the most efficient system used. With manual calculation techniques, designs tended to be conservative and relied heavily on rules of thumb and simplified structural tables. Today, dynamic modelling, finite element analysis, and other techniques not practical without computers enable engineers to study specific design loads and conditions and use masonry in ways not previously possible.

Computer-aided design (CAD) allows designers to experiment with decorative brick patterns and other special treatments. Since a wide variety of brick sizes and bond patterns can be called up from a library of standard CAD drawing elements, an architect can readily see how a building looks with Flemish bond, staggered Roman bricks, or even a customized block design.

Once the designer is satisfied with the appearance of the plans and elevations, the building can be visualized in computer-generated, three-dimensional perspective drawings. By rendering the drawings with computer-generated shadows, colors, and surface textures, a designer can show a client what a building will look like with astonishing realism. The drawings can then be animated, even on a desktop.
computer, enabling the viewer to see the building as though walking through the completed facility.

The potential impact of CAD on architectural aesthetics is demonstrated by the Beckman Institute at the University of Illinois at Urbana. This large laboratory is clad in intricate patterns of colored bricks, produced in special sizes and shapes. According to Smith, Hinchman and Grylls, the building's architectural firm, the project could not have been executed without the ability to lay out the brickwork in the computer. The architects furnished the masonry contractor with detailed installation drawings showing the layout of each bond pattern and special condition.

Going a step further, CAD has also simplified designing and manufacturing custom brick shapes and preparing installation drawings. In the future, the use of computers for design, manufacturing, and construction management—combined with robotics and automated material control—may evolve into a sort of CAD/CAM, the computerized integration of design and manufacturing.

For example, data in a designer's CAD drawing could be used to direct numerically controlled tools to carve graphics or sculpture into green bricks before they are fired.

Where masonry construction methods were once relatively standardized, today's variety of masonry systems has increased the importance of clear construction documents. Reinforced masonry, insulated walls, veneer systems, and high-performance fire-rated or acoustically rated systems each require careful attention to detailing and specifying. Software can lead designers step-by-step through the detailing process.

The Brick Institute of America, for example, is developing a program to lay out masonry fireplaces that have the proper proportions to create a strong draft. And the Wisconsin Concrete Masonry Association provides designers with "Pre-Engineered Masonry Building" designs on CAD to use as a starting point for building design.

Initially, individual software programs were written to accomplish a single task. In contrast, current efforts in software development are aimed at integrating design functions. For example, improved links between CAD and cost-estimating databases will make it possible for a designer to quickly determine how much various masonry systems would cost. Other programs, such as the Construction Criteria Base, combine in a single location a veritable encyclopedia of masonry specifications, reference standards, and design manuals used in the U.S. Government's building activities.

The International Masonry Institute's "Masonry Compute" program offers an interactive curriculum for teaching masonry to designers, with modules on masonry fundamentals, designs, and costs, and a laser disc of material on manufacturing, placement, patterns, and case studies. Other software not only calculates masonry reinforcement but also shows suggested details and specifications.

As the following directory of software indicates, designers have a variety of software from which to choose. While most of the software is reasonably priced, considering how much it can boost the productivity of professional staff, much of it is discounted even further by masonry manufacturers or trade associations eager to promote their products.

Most programs run on MS-DOS (IBM-compatible) personal computers and come with user manuals or other hard copy documentation. However, you should verify additional hardware requirements and software compatibility before purchasing. And although design software can appear to act as "expert systems," don't overlook the need for professional design review.

**Structural engineering**

**CAVWALL - Design of Nonbearing, Non-Reinforced Cavity Walls:** Architectural and engineering design of nonbearing, non-reinforced cavity walls, partitions, and parapets of clay brick and concrete masonry units. The menu-driven program provides information on lateral loads, water permeance, crack control, cost, fire protection, heat transfer, vapor and air retarders, durability, and aesthetics.

Requires: Macintosh II From: National Concrete Masonry Association (NCMA) Cost: $195

**CMD-91.04 Concrete Masonry Design:** This program is based on 1991 Uniform Building Code requirements and verifies out-of-plane forces, in-plane forces, axial loads, and flexural capacities.

Requires: MS-DOS and Lotus 1-2-3 or compatible spreadsheet From: Concrete Masonry Association of California & Nevada Cost: $195

**IMFLEX:** Program calculates the moment-curvature relationship for hollow unit masonry shear walls.

Requires: MS-DOS From: Concrete Masonry Association of California & Nevada Cost: $55

**MASDESIG - Load-Bearing Masonry Wall Design:** Calculates flexural and shear stresses of hollow concrete masonry walls and amount of vertical reinforcement required.

Requires: MS-DOS From: NCMA Cost: $175

**MASRET - Masonry Retaining Walls:** Considers earth pressure coefficients, bending moments, bearing stability, overturning, sliding, and reinforcement for concrete masonry cantilever retaining walls.

Requires: MS-DOS From: NCMA Cost: $230

**RFWALL:** Designs retaining and foundation walls in accordance with UBC working stress or ultimate strength design requirements.

Requires: MS-DOS From: Arizona Masonry Guild Cost: $90

**SHWALL - Shear Wall Structural Engineering Analysis Program:** This Lotus 1-2-3 spreadsheet analyzes concrete masonry shear walls in accordance with strength design procedures.

Requires: MS-DOS and Lotus 1-2-3 From: NCMA Cost: $60

**SLWALL - Slender Wall Structural Enginee-**
**Brick Construction Details:** This software contains brick details and specifications based on the Brick Institute of America’s Technical Notes. Produced by ASG, this Vertex CADatalog allows the proper details and specs to be selected via an interactive menu system.

**Cost:** $49.95

**Brick Hatch Patterns:** This new program contains nearly 100 hatch patterns for masonry bonding and sections of common brick sizes and shapes for use with AutoCad and other drawing programs.

**Cost:** $99

**Concrete Masonry Details for Building Construction:** This software aids in the design of both reinforced and unreinforced concrete masonry.

**Cost:** $125

**Masonry Accessories:** Ties, anchors, flashings, and other masonry accessories shown in isometric DXF-format CAD files.

**Cost:** $95

**ImageCELS:** The full library contains over 1100 surface texture images for use with rendering or paint programs. Among the masonry images are granites, marble, split-faced CMU, and other brick and block styles.

**Cost:** $495 for full library; $99 for smaller library on diskettes

**Pre-Engineered Masonry Building:** To compete with the pre-engineered metal building industry, which offers a sort of one-stop shopping, the Wisconsin Concrete Masonry Association prepared engineering calculations and drawings for generic CMU commercial and light industrial buildings. The drawings include information on common roof systems, floor slabs, and other building elements and have been approved under the Wisconsin Building Code. The drawings provide a head start when preparing a project’s actual construction documents.

**Cost:** Free to qualified users

**PC GlassBlock:** This program has details and specifications for glass masonry products. Produced by ASG, this Vertex CADatalog allows the proper details and specs to be selected via an interactive menu system.

**Cost:** Free to qualified designers

**Tallwall:** Helps design tall, slender, and multistory walls according to the strength design procedures of the 1991 Uniform Building Code.

**Cost:** $90

**U.S. Coordinated Program for Masonry Building Research:** Several advanced masonry engineering programs are being developed under a grant from the National Science Foundation. For additional information, contact: James L. Noland, Atkinson-Noland & Associates, Inc., 2619 Spruce, Boulder, CO 80302 (303-444-3620; fax 303.444.3239).

**Visualization:** Programs such as AutoDesk’s 3-D Studio and ASG’s Model Vision can project a CAD drawing into perspective, “paint” surfaces, and cast shadows to create a near-photo realistic drawing of a building. Visualization software packages typically contain routines for simulating masonry colors, textures, and bond patterns. They can also be used to create animated movies of the buildings. The cost of the software has fallen to just a few thousand dollars and can be run on the more powerful desktop personal computers.

**Cost:** $95

**Specifications:** In addition to the other specification software listed in this directory, the following commercially available guide specifications have computer-based information on masonry:

Masonry pavements

**PAVECHECK:** Analyzes base and street pavement designs for interlocking concrete pavements in accordance with 1986 AASHTO Guide for the Design of Pavement Structures. **Requires:** MS-DOS **From:** NCMA **Cost:** $50 plus $25 User Manual

**Interlocking Concrete & Grid Pavements:** Presents architectural specifications, installation details, and product information in an electronic form. Produced by ASG, this Vertex CADalog allows the proper details and specs to be selected via an interactive menu system. **Requires:** MS-DOS. Drawings can be used in .DXF-compatible CAD programs. Specifications can be printed directly or imported into most word processors. **From:** NCMA **Cost:** $60

**LOCKPAVE:** Aids in design of commercial and industrial pavements by calculating loading capabilities, costs and road traffic models. French, English, Metric and Imperial versions available. **Requires:** MS-DOS **From:** National Precast Concrete Association **Cost:** $875 ($420 for members)

Miscellaneous

**Concrete Masonry R-Value Program:** This Lotus 1-2-3 spreadsheet calculates the R-value (thermal resistance) of concrete masonry units in accordance with ASHRAE methods. **Requires:** MS-DOS and Lotus 1-2-3 **From:** NCMA **Cost:** $125

**Construction Criteria Base:** This database is a veritable encyclopedia of standards, specifications, and design manuals used in construction by Government agencies. For example, it contains the Corps of Engineers Technical Manual TM 5-809-3-Masonry Structural Design for Buildings, plus documents from Brick Institute of America, Indiana Limestone Institute, National Building Granite Quarries Association, etc. **Requires:** MS-DOS and CD-ROM drive **From:** National Institute of Building Sciences **Cost:** $970 for four quarterly releases

**Electronic Sweet's:** An electronic version of the familiar Sweet's catalog files, scheduled for release early this year. **Requires:** MS-DOS, Windows, CD-ROM reader **From:** Sweet's Electronic Publishing

**Masonry Compute:** Program offers an interactive curriculum for teaching masonry to designers, with modules on masonry fundamentals, design and costs, and a laser disc of material on manufacturing, placement, patterns, and case studies. A lesson on stone is being developed as is a CD-ROM-based version. **Requires:** MS-DOS, AutoCAD, laser disc player **From:** International Masonry Institute **Cost:** $250

### Sources

- Arizona Masonry Guild, 522 N. Central, Suite 115, Phoenix, AZ 85012 (602-265-5999)
- ASG, 4000 Bridgeway, Suite 309, Sausalito, CA 94965 (415-332-2123; fax 415.289.4935)
- AutoDesk, 2320 Marinship Way, Sausalito, CA 94965 (415-491-8754)
- Brick Institute of America, 11490 Commerce Park Dr., Reston, VA 22091 (703-620-0010; fax 703.620.3928)
- Concrete Masonry Association of California & Nevada, 6060 Sunrise Vista Dr., Suite 1875, Citrus Heights, CA 95610 (916-722-1700; fax 916.722.1819)
- Heckmann Building Products, 4015 W. Carroll Ave., Chicago, IL 60624 (312-826-8586 or 800-621-4140)
- IMAGETECHS, 720 Bollinger Rd., Suite 802, San Jose, CA 95129 (408-252-5487)
- International Masonry Institute, 823 15th St. NW, Washington, D.C. 20005 (202-783-3908)
- National Precast Concrete Association, 230 Horse Pen Rd., Herndon, VA 22071 (703-713-1900; fax 703.713.1910)
- National Precast Concrete Association, 10333 N. Meridian, Indianapolis, IN 46290 (317-571-9500)
- Softdesk Inc., 7 Liberty Hill Rd., Henniker, NH 03242 (603-428-3199; fax 603.428.7901)
- Pittsburgh Corning Corp., 800 Presque Isle Dr., Pittsburgh, PA 15239 (800-992-5769)
- Sweet's Electronic Publishing, 99 Monroe Ave. NW, Suite 400, Grand Rapids, MI 49503 (616-454-0000; fax 616.454.4140)
- Wisconsin Concrete Masonry Association, 9501 S. Shore Dr., Valders, WI 54245 (414-773-2888; fax 414.773.2823)

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