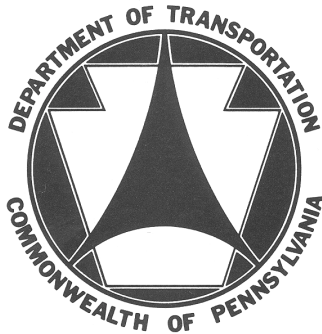


RESEARCH PAYS OFF



COMPUTER-AIDED BRIDGE DESIGN

PennDOT Uses BRADD-2 To Design Single-Span Bridges

Because designing bridges is time consuming, most bridge owners have attempted to standardize common bridge types and pertinent details to decrease the time and effort involved. The Pennsylvania Department of Transportation is no exception. Design of standard bridge types and repetitive design processes lends themselves to automation. Since the early 1980s, when new computer technology, especially computer graphics, was first applied to bridge design, PennDOT has used advances in computer technology to improve productivity.

Problem

Of the more than 22,900 bridges in Pennsylvania, approximately 16,000 are under the jurisdiction of PennDOT. It has been estimated that 50 percent of the bridges in Pennsylvania will have outlived their 50-year design life within the next decade, which will greatly increase the number of deficient bridges. To address this problem, the Pennsylvania legislature instituted a "Billion-Dollar Bridge Program" in late 1982. Since then, PennDOT has been charged with the rehabilitation or replacement of more than 5,800 state and local bridges through additional legislation. This

has required improved productivity in all areas of engineering, especially in bridge design.

Solution

In 1985 PennDOT contracted with Michael Baker, Jr., Inc., of Beaver, Pennsylvania, to design and develop a computer-aided design and drafting system for simple one-span bridges that employed PennDOT specifications. The second version of the Bridge Automated Design and Drafting (BRADD-2) system was the result. An early version of the system allowed only changes in the stated magnitude of dimensions on standard contract plan drawings. BRADD-2 handles proportional changes of the drawings themselves. General use of BRADD-2 began in March 1988; as of June 1990, PennDOT has designed more than 160 bridges using this system.

The BRADD-2 system can

- Perform complete superstructure and substructure design and draft simple one-span bridges, 18 to 200 feet in length;
- Accept interactive input from a menu-driven system using an alphanumeric terminal;

- Handle such superstructure types as precast concrete channel beams, prestressed concrete box beams and I-beams, steel-rolled beams, and steel-plate girders;

- Handle such substructure types as stub, cantilever, and wall abutments on spread or pile footings (abutment wing-walls can be flared from 15 to 75 degrees or U shaped);

- Handle a wide variety of cross sections, including normal, superelevation transitions, or fully superelevated sections with or without sidewalks;

- Handle tangent or curved horizontal alignments and vertical curves anywhere along the bridge;

- Generate automatic quantity and cost estimate calculations (thus comparison and value engineering studies can be performed before final design drawings are generated and more accurate quantity and cost estimates can be specified for budgeting);

- Generate design drawings showing all detail to the appropriate scale with the steel reinforcement labeled; and

- Design and draft abutments separately from the superstructure. BRADD-2 can therefore be used for abutments of bridges that are not simple one-span designs.

Application

BRADD-2 has changed the way by which PennDOT develops bridge contract plans. Eleven engineering districts of PennDOT use BRADD-2 for in-house design projects such as partial plan preparation for multiple-span bridges. For designs contracted out, consultants provide design data to PennDOT for input to BRADD-2 and the incorporation of modifications to final plan documents, if necessary. Although the system was developed to produce cost-effective bridge designs, plans generated by BRADD-2 occasionally need modification or updating because of the dynamics of bridge design and construction specification.

Benefit

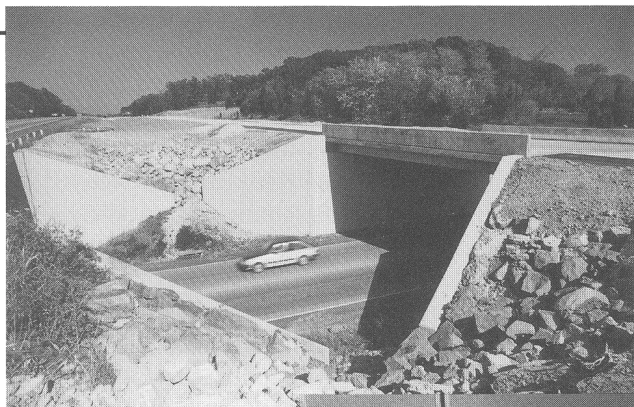
Productivity gains vary from 5:1 to 10:1 depending on the complexity of the geometrics and the need to modify details to specific site conditions. After one year of using BRADD-2, PennDOT estimated that it takes between 80 and 100 person-hours to design and develop contract plans including bid quantities, design and drawing checks, and modifications to suit site conditions. This compares favorably with the 500 to 1,000 person-hours needed to develop similar contract plans without BRADD-2. A significant portion of the initial investment made to develop BRADD-2 has already been recovered.

In April 1989 the American Association of State Highway and Transportation Officials acquired the trademark copyright and the right to sublicense the BRADD-2 soft-

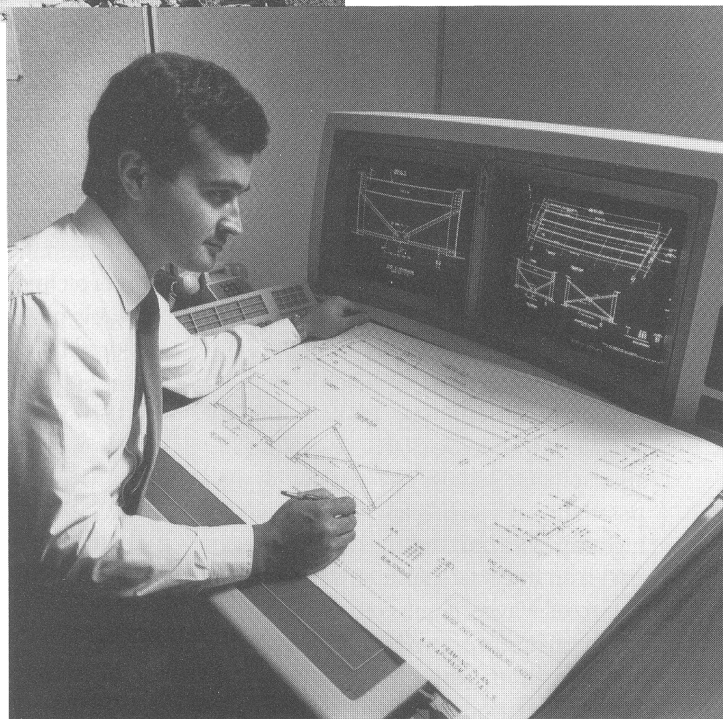
ware. As part of this acquisition, an AASHTO BRADD-2 task force will provide guidance and act as a clearinghouse for maintaining and enhancing the software system. New York will be the first state to offer a modification to BRADD-2. The AASHTO task force is now evaluating the feasibility of a combined PennDOT-New York DOT version of BRADD-2.

For more information contact F.W. Bowser or M.G. Patel, Pennsylvania Department of Transportation, Room 1118, Transportation and Safety Building, Harrisburg, Pennsylvania 17120 (telephone 717-787-3310 or 717-787-2881).

For more information on AASHTO BRADD-2, contact Jan Machis, American Association of State Highway and Transportation Officials, 444 North Capitol Street, N.W., Suite 225, Washington, D.C. 20001 (telephone 202-624-8599).



Simple one-span bridge near Gettysburg, Pennsylvania, was designed on BRADD-2.



Work station for computer-aided design and drafting system.