Project Level Planning Using Pontis Results

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ABSTRACT

The Minnesota Department of Transportation (Mn/DOT) has used network level results from the Pontis Bridge Management System for several years to suggest appropriate levels of bridge funding. In 1998 Mn/DOT began using project level reports from Pontis to aid in development of bridge improvement programs and 20-year bridge plans. Bridge improvement and replacement guidelines have been written to include element level inspection results in selection criteria, summaries have been prepared to list potential bridge projects, and Pontis Benefit/Cost ratios have been provided to assist bridge engineers in development of annual bridge programs. This paper highlights the procedures and reports that Mn/DOT has used to include bridge management concepts in the project selection process.

OVERVIEW

Pontis is a bridge management system (BMS) that has been developed by FHWA and AASHTO to help federal and state Departments of Transportation manage the vast inventory of bridges in the United States. Bridge management requires that sufficient funding is allocated to support a comprehensive bridge improvement, replacement, and expansion program; and bridge projects need to be selected which are cost effective, timely, and which meet department goals and standards. While much of the early efforts in Pontis development centered around inspection data collection and network level planning, the project level portion is an extremely important area where state DOT's need to have assistance in planning bridge programs. This paper explains how the Minnesota Department of Transportation (Mn/DOT) has used Pontis BMS reports to aid in bridge project selection.

HISTORY OF PONTIS USE IN MINNESOTA

Mn/DOT began implementation of Pontis bridge management concepts in 1993 using element level data collection. Mn/DOT has been recording element level inspection data since 1993 on all state owned bridges and since 1995 on all local road system bridges. Data collection systems external to Pontis were developed to aid in field data collection and reporting of summary information at the District and local levels. The Pontis database has been used to report statewide inspection results and produce network level reports since 1995. Network level reports have been instrumental since 1995 to justify higher levels of funding for Mn/DOT owned bridges.

The first project level reports were simple condition based reports which listed bridge element conditions for joints, substructures, railings, and bearings. Reports such as these have been valuable tools for Mn/DOT bridge maintenance crews in systematically identifying bridge projects. Benefit/Cost analyses were not presented on these reports, but the data from element level inspections pointed out the problem areas which bridge maintenance personnel know need repair. A sample report generated by InfoMaker on the Pontis database for strip seal expansion joints is given in Figure 1.

Pontis Benefit/Cost ratios (B/C) were first used in Mn/DOT in 1998 as an additional tool for project level planning during development of Bridge Improvement Programs and 20-year plans. Bridge Improvement Programs include projects such as deck replacements, deck overlays, joint replacements and railing repairs. District 20-Year Plans include lists of potential bridge replacement projects that are anticipated within the next 20 years. Pontis B/C results were used to supplement other standard methods including National Bridge Inventory (NBI) condition and inventory summaries, sufficiency ratings, and deficiency status, which have been used for many years to identify candidate bridge projects. In recent years Mn/DOT has decentralized funding of bridge projects to the districts, and accurate, detailed data is important to ensure adequate funding of the bridge program, which must compete against other needed work.

NEED FOR PROJECT LEVEL BMS PLANNING

Since project funding has been decentralized to the District offices, it is more important than ever that good lists of candidate bridge projects be available for review and consideration. Network level reports available from Pontis are excellent tools for displaying needs when requesting appropriate levels of funding from the state legislature,

Leaking Strip Seal Expansion Joints **3/3/99**
(Condition State 3 is the Worst Condition)

Structure Number	Route #	Over the Bridge	Total Qty of Joints	State 1	State 2	State 3
5983	0035	OV MINN R & BLACKDOG RD	199	197	0	2
9340	0035	OV RR & MISS R & 2ND ST	289	277	0	12
27879	0035	OVER WASHINGTON AVE	92	87	5	0
27880A	0035	WB ON RP FROM 35W COLL R	18	17	0	1
27895	0035	OVER STINSON BLVD	91	88	3	0
27899	0035	OVER MC RY	200	198	2	0
5983	0035	OV MINN R & BLACKDOG RD	199	197	0	2
9044	0035	NB OVER 106TH ST	54	53	0	1
9340	0035	OV RR & MISS R & 2ND ST	289	277	0	12
27893	0035	OVER TH 88 & BNSF RR	87	48	39	0
27895	0035	OVER STINSON BLVD	91	88	3	0
27899	0035	OVER MC RY	133	132	0	1
6515	0035	OVER BNSF-SL & CAYUGA ST	366	0	0	366

Figure 1: Sample Pontis element inspection results for bridge maintenance.

but they are of less value in selection of individual projects. Districts need to prioritize bridges for improvement, rehabilitation, replacement, and expansion. Bridge projects must also be prioritized with roadway, safety, and other projects for inclusion in the overall district transportation plan. Management system integration has been discussed in Mn/DOT for several years, but no formal process is in place at this time to assist Districts in integrating their needs across the many facets of transportation. As a result, Districts need accurate, up-to-date information to assist in determining the appropriate levels of funding for each functional group under their jurisdiction.

Long range planning is also regularly performed in Mn/DOT. District 20-Year Plans are developed to identify future bridge improvement and replacement needs and funding requirements for various highway preservation and improvement categories. District bridge personnel who put together 20-year plans need to know with some certainty the types of projects and even which specific bridges will need to be funded within the next 20 years. Long range project modeling in Pontis is certainly a tool which provides information to better plan for the future.

Mn/DOT's EFFORTS TO USE PONTIS AS A BRIDGE MANAGEMENT TOOL

Inclusion of Element Level Inspection Criteria in Bridge Improvement and Replacement Guidelines

Mn/DOT's Office of Bridges and Structures regularly publishes guidelines that define standards which must be met upon completion of bridge improvement projects as well as criteria to select bridge rehabilitation and replacement projects. The FY 1998–1999 Bridge Improvement and Replacement Guidelines (*1*) were revised to include criteria related to element level inspection conditions. Table G-1 of the Guidelines is shown in Figure 2 and provides minimum standards which must be met upon completion of bridge improvement projects. The condition portion states that all "main structural elements must have no portion in the worst condition and less than 10% in the second worst condition state and deck is in condition state 3 or better." Further definitions state that main superstructure elements include girders, floor beams, stringers, and slab spans; main substructure elements include pier caps, pier walls, pier columns, abutments, and piling in pile bents; and decks include concrete decks or slabs on box and "T" girders, decks on "I" girders and decks on slab spans.

Since the table indicates conditions desired upon completion of bridge improvement projects, all bridges which do not meet the criteria can be identified as possible bridge improvement projects. If completed work will not meet the criteria upon completion of the project, a design exception must be authorized. A sample report based on condition criteria using Pontis and the InfoMaker report writer is shown in Figure 3. These reports have been valuable information for personnel setting up bridge improvement programs in their districts.

The "1998–1999 Bridge Improvement and Replacement Guidelines" also outline appropriate condition levels for bridge rehabilitation and replacement projects. The criteria are similar to improvement projects, except more deterioration of structural elements is required to trigger the selection criteria. The guidelines state that "major

Inventory Feature	Type Hwy.	ADT	Minimum Value
Inventory Rating	All	All	HS 18 (MS 16.2)
Vertical Underclearance (Right and Left)	Interstate Urban	All	15'-0" (4.57m)
	Interstate Rural	All	16'-0" (4.9m)
	Principal & Minor Arterial	All	14'-6" (4.4m)
	Major & Minor Collectors and Local Roads	All	14'-6" (4.4m)
	Railroad Under	All	22'-0" (6.71m)
Lateral Underclearance (Right and Left)	Interstate (1 way)	All	4' (1.2m) Left, 10' (3.0m) Right
	Interstate (Ramp)	All	2' (0.61m) Left, 4' (1.2m) Right
	Principal and Minor Arterials	All	6' (1.8m)
	Major and Minor Collectors	All	4' (1.2m)
	Railroad Under	All	8' -6" (2.6m)
Scour Criticality	All	All	All scour prevention methods are in place.
Deck Width	Trunk Highway 2 lanes	0 - 100	24' (7.3m)
		101 - 400	28' (8.5m)
		401 - 2000	30' (9.1m)
		2001 - 4000	34' (10.4m)
		5001 +	38' (11.6m)
	Interstate (2 lanes)	All	36' (11.0m)
	Interstate (3 lanes)	All	(12N + 14) (3.7N + 4.3)
Type of Railing	All	All	Meets Mn/DOT Railing Policy
Bridge Feature	**Highway Class or Type Hwy.**	**ADT**	**Minimum Condition Criteria**
Superstructure Condition	All	All	No portion of main structural element in worst condition and portion in 2nd worst condition less than 10%
Substructure Condition	All	All	No portion of main structural element in worst condition and portion in 2nd worst condition less than 10%
Culvert Condition	All	All	No portion of culvert in worst condition and portion in 2nd worst condition less than 10%
Deck Condition	All	All	Deck is in condition state 3 or better

Figure 2: Mn/DOT bridge improvement guidelines.

Metro Division 6/24/98 — Bridges which exceed condition criteria for improvement on page 12 of the Fy 1998-1999 Bridge Improvement and Replacement Guidelines. Greater than 10% of super, sub, or culvert conditions in worst 2 conditions or deck condition 4 or 5.

Year Prog	Bridge #	Hwy TH	Element		Quantity		# Conds	% CS 1	% CS 2	% CS 3	% CS 4	% CS 5
'00	27938	0035	122	P Conc Deck/Rigid Ov	686	sq.m	5	0	0	0	100	0
	27941	0035	122	P Conc Deck/Rigid Ov	577	sq.m	5	0	0	0	100	0
'99	9096	0035	58	R/Conc Column	11	ea.	4	82	0	18	0	0
			62	R/Conc Abutment	22	m.	4	70	0	0	30	0
	9097	0035	58	R/Conc Column	6	ea.	4	67	0	33	0	0
	9607	0035	62	R/Conc Abutment	30	m.	4	92	0	0	8	0
	6652	0035	58	R/Conc Column	6	ea.	4	66	17	17	0	0
'99	9088	0035	8	Pnt Stl 'I' Gird 'B'	1639	m.	5	0	0	25	75	0
			62	R/Conc Abutment	55	m.	4	80	0	0	20	0
			114	P Conc Deck/AC Ovly	1288	sq.m	5	0	0	0	0	100
'00	27934	0035	122	P Conc Deck/Rigid Ov	1496	sq.m	5	0	0	0	0	100
	27936	0035	58	R/Conc Deck Column	6	ea.	4	34	33	33	0	0
			122	P Conc Deck/Rigid Ov	717	sq.m	5	0	0	0	100	0
'00	27935	0035	58	R/Conc Deck Column	6	ea.	4	0	50	50	0	0
			122	P Conc Deck/Rigid Ov	748	sq.m	5	0	0	0	0	100

Figure 3: Potential bridge improvement projects.

superstructure elements have 20% or more in the worst two condition states; the deck condition is 4 or 5; or the under deck smart flag rating is 3, 4, or 5" to be selected for rehabilitation and "main structural elements have 20% or more in the worst two condition states" to be selected for replacement projects. These guidelines have helped establish bridge management concepts in development of bridge repair, improvement, or replacement programs.

Use of Pontis in Development of 2002 Bridge Improvement Program in Metro Division

Mn/DOT's Metro Division is responsible for 1,300 state owned bridges in the region surrounding metropolitan Minneapolis/St. Paul. This area is subject to much higher traffic volumes and more severe environmental impacts due to application of roadway deicers than any other area of the state. The severe environment results in a different rate of deterioration than for many other Mn/DOT owned bridges. The high traffic volumes may limit the amount of preventive maintenance which can be performed on the bridges, and contract bridge repair becomes valuable in maintaining these bridges in a safe condition. The Metro Division has allocated approximately $13 million annually for bridge improvement projects, which comprises between 30% and 40% of the overall Metro bridge program. With limited funding and a large number of bridges to be considered, it is very important that accurate data is available to select appropriate projects.

Typical selection criteria in the past have included personal knowledge of bridge conditions by bridge engineers in the Metro Division and the Bridge Office, summary reports on National Bridge Inspection (NBI) conditions, and rankings based on the

FHWA sufficiency ratings and deficient status. Inventory information on the type of deck protection systems and type of expansion joint devices was used to identify deficiencies which could be corrected with deck overlay and joint replacement programs. With the advent of element level inspections, additional data are now available to compare the condition of paint systems, railings, and joints as well as entire bridge conditions.

In 1998 during the development of the 2002 Bridge Improvement Program, Pontis Benefit/Cost ratios (B/C) were considered for the first time. Reports were generated showing overall B/C ratios for bridges and B/C ratios for various element types. These data supplemented other known data on subject bridges such as NBI condition codes and bridge inventory characteristics. Among the benefits gained by these Pontis reports were identification of maintenance painting projects and identification of railing rehabilitation projects. While some maintenance painting has been programmed in the past, the Pontis B/C ratios gave even more defensible supporting information regarding the benefit of such programs. The B/C ratios for painting elements that are in condition states 3 and 4 (out of a total of 5 possible conditions) are among the highest ratios for any action on any element in any condition state.

B/C ratios for railing rehabilitation also showed up on Pontis reports as being cost effective. Since railings are an important safety element on bridges, the Metro Division decided to program several railing retrofit projects in 2002. This was an area that was not considered in previous Improvement Programs. A typical Pontis report showing B/C ratios is shown in Figure 4.

Figure 4 shows the B/C ratios for all elements on a given bridge for Maintenance Repair and Rehabilitation (MR&R) only. Geometric improvements are not considered in determining this ratio. By definition, any B/C ratio greater than zero (0.0) is a cost effective action, as the benefit is defined as the cost savings of taking an action today instead of waiting one year when portions of the element will have deteriorated to the

PONTIS THIRD YEAR PROJECT LIST **6/23/98**
(Preservation projects suggested by Pontis B/C ratio as being worthwhile)
Sorted by road system, by road number and by Ref. Pt.

Year Prog	Bridge #	County	Location	Hwy #	Year Built	Year Recon	Year Prog	Cost	Benefit	B/C
'00	~~27938~~	27	AT THE E JCT CSAH 62	0035	1964		2000	51275	37761	.7364
'01	~~27880A~~	27	AT THE JCT TH 35W	0035	1970		2000	90956	8116	.0892
	19851	19	0.5 MIN OF JCT TH 110	0035	1966	1984	2000	71017	4972	.0700
	27726	27	0.3 MIN S OF JCT TH 55	0094	1979		2000	53937	10282	.1906
	27728	27	0.3 MIN N OF JCT TH 12	0094	1978		2000	52341	6742	.1288
	27906	27	AT JCT TH 494	0094	1969		2000	72346	6613	.0914
'01	~~27969~~	27	1.9 MIN NW OF JCT TH 494	0094	1969		2000	55767	7327	.1314
'00	~~27970~~	27	1.9 MIN NW OF JCT TH 494	0094	1969		2000	50646	6552	.1294
	27799	27	1.9 MI. S OF JCT TH 394	0094	1968	1986	2000	50599	7958	.1573
	27586	27	1.0 MI. S OF JCT TH 7	169	1978		2000	87865	20175	.2296

Figure 4: Pontis report showing benefit/cost ratio.

next worst condition state and will cost more to repair. Since the B/C ratio is an overall ratio for the bridge, the numbers are fairly low, but they do illustrate which bridges should be worked on and help with prioritizing projects. Since Mn/DOT had not entered projects already programmed into the Pontis database, we saw an additional benefit in that many projects which were programmed in 1999–2001 showed up on the project listing. This gives us confidence that the Pontis summaries are in-line with current engineering judgment and also that current engineering judgment reflects the B/C analysis.

To better define project details, a Pontis project level detail report as shown in Figure 5 shows which individual actions are recommended. These reports better define project costs and the extent of work needed.

We have found that while the costs are not always accurately portrayed in these reports, they do provide good information to aid in project selection. We anticipate that

First Year Programmed Project Detail 1998

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Project ID:	Bridge ID:	Project's Primary Action Type:	Total Cost	Benefit	Status:
MR&R In 1998	19807	Repair Repair	87,974	9,776	PG/PP/

Preservation Actions

State and Action	Quantity	Direct Cost	Benefit
Span: 0 Element: Strip Seal Exp Joint Envt: Sev.			
3 Replace gland and pa	1	165	192
Span: 0 Element: Pnt Stl "I" Gird "B" Envt: Sev.			
4 Spot blast, clean &	298	87,809	9,584
Project Total		87,974	9,776

Project ID:	Bridge ID:	Project's Primary Action Type:	Total Cost	Benefit	Status:
MR&R In 1998	19808	Repair Repair	88,454	9,810	PG/PP/

Preservation Actions

State and Action	Quantity	Direct Cost	Benefit
Span: 0 Element: R/Conc Cap Envt: Sev.			
2 Seal cracks minor pa	1	186	2
Span: 0 Element: Strip Seal Exp Joint Envt: Sev.			
3 Replace gland and pa	1	165	192
Span: 0 Element: Pnt St. "I" Gird "B" Envt: Sev.			
4 Spot blast, clean &	299	88,103	9,616
Project Total		88,454	9,810

Project ID:	Bridge ID:	Project's Primary Action Type:	Total Cost	Benefit	Status:
MR&R In 1998	19825	Repair Repair	318,240	20,145	PG/PP/

Preservation Actions

State and Action	Quantity	Direct Cost	Benefit
Span: 0 Element: P Conc Deck/Thin Ovl Envt: Sev.			
3 Repair spalls/delams	5583	315,495	6,923
Span: 0 Element: Pourable Joint Seal Envt: Sev.			
3 Clean joint; patch s	183	2,745	13,222
Project Total		318,240	20,145

Figure 5: Pontis project detail reports.

once better cost and deterioration information is provided in the system, these numbers will be more reliable. Expected enhancements to Pontis will greatly aid in this effort.

To help finalize some decisions on which projects to select for inclusion in the 2002 Metro Bridge Improvement Program (BIP), we combined results from the Pontis B/C reports (Figure 4), the Improvement Guideline reports (Figure 3), and the Pontis Project detail reports (Figure 5). A typical comparison is shown below in Table 1.

This information was considered along with reports on element level condition information for decks, railings, joints, substructures, superstructures, NBI condition information, personal knowledge of bridge conditions, and sufficiency ratings. A final bridge improvement program was then presented to Metro Division management staff for approval.

Development of Long Range (20-year) Bridge Plan in District 1

The Mn/DOT District 1 is located in the northeastern part of Minnesota and is responsible for 600 trunk highway bridges. District 20-year plans have regularly been produced to identify upcoming bridge needs for bridge preservation, improvement, and rehabilitation projects. In 1998, the 20-year plan was developed in part using information available from Pontis.

In the past, District 1 has used items such as NBI condition codes and appraisal ratings, deficient status, sufficiency ratings, maintenance reports, and in-field evaluation

Table 1: Comparison of Results for Project Selection

Bridge No. Identified with High B/C ratio	Trunk Highway	Location	Type of Work from Pontis Project Level Report	Does Project Meet Guidelines?
19808	35	2.8 Mi So. Jct 35E	Paint	Yes
27948	94	At Jct 35W	Paint	Yes
27907	494	At Jct 94	Redeck	No
82806	694	3 mi. N. of 94	Paint, Joints, Bridges	Yes
6688	61	.5 mi. N. of TH 244	New Superstructure	Yes
6517	35E	Over Cayuga St.	Deck, Joints, Paint	Yes
62838	94	At Jct 61	Joints	No
9291	494	Over RR	Bearings, Pier Rehab	Yes
82809	696	Over 50th St.	Railing Rehab	No

by inspectors and engineers to plan for short and long term bridge needs. Priority for projects was determined not only on the condition of the bridges, but also on external factors such as the timing of other road and bridge projects in the area of the bridge.

Methods used in the past worked well to schedule projects on bridges that were already in poor condition, but were lacking in data that would help with long term network and project level planning. In 1998, the district made efforts to improve their long range planning efforts by utilizing the Pontis bridge management system along with the tools they had used in the past.

The 20-year plan that the district completed in 1998 was for the years 2001 to 2020. The district started their plan by trying to determine funding levels that would steadily improve the networkwide conditions over 20 years. Near term project selection had already been determined for years 1999 to 2001, and these projects were entered into the Pontis database before working on the network and project level needs for the district 20-year plan.

Project selection had also been made previous to this study for the years 2002 to 2013. These projects were selected based on past funding levels, but actual funding had yet to be allocated. Although planned for previously, these projects were not accounted for in building the Pontis scenarios so that Pontis project recommendations could be used as a further tool in planning for these later years. For more detailed comparisons of these district selected projects with recommendations made by Pontis, see the report, "Comparison of Pontis Bridge Project Recommendations in Programmed Work for Three Agencies" by Marshall, Robert, Anderson, Floyd, and Corso, Jr., document J-1 (IBMC 99-051).

Suggested network funding levels were determined in Pontis by entering the known funding levels from 1999 through 2001 and entering assumed funding levels for remaining years. The district was able to ascertain average funding levels that would allow total networkwide bridge conditions to steadily improve over 20 years by running various scenarios with different funding levels. Using funding levels that achieved this goal, the district then started to focus their efforts on project selection.

Pontis scenarios for network and project level planning were generated over a 22-year period starting with current element level conditions in 1999 and ending in 2020. As stated before, known projects and funding levels were entered for the first 3 years of the scenarios. The funding levels used for the remaining years were those determined earlier to meet the networkwide goals of the district.

Program project summary reports as shown in Figure 6 were generated by Pontis showing user-generated and Pontis-generated projects over the 22 years. These reports, in conjunction with other bridge management tools, were then used to establish planned project lists through 2005. Some projects were moved to years other than recommended by Pontis based upon other factors which impact the planning, such as funding and the district road construction plan, while other projects recommended by Pontis were not planned at this time due to recommendations from the other bridge management tools.

After 2005, only 1 or 2 projects per year were assigned to the project list. These projects had been scheduled for work previously and were reassigned to the project list based upon the recommendations from Pontis and the other bridge management tools. In the future, other projects will be assigned to the list when funding levels are known. At that time, further Pontis scenarios will be run using the up-to-date element conditions of the bridges so that more accurate project recommendations can be generated.

Project ID:	Bridge ID:	Project's Primary Action Type	Total Cost	Total Benefit
New Project	09801	Repl Paint	181,000	181,000
New Project	09805	Repl Paint	75,000	75,000
New Project	09806	Repl Paint	76,000	76,000
New Project	3443	Replace	1,750,000	1,750,000
New Project	5273	Replace	3,600,000	3,600,000
New Project	5516	Replace	2,200,000	2,200,000
MR&R IN 1999	69802D	Repair	111,746	1,560
New Project	3673	Replace	300,000	300,000
MR&R IN 2000	5409	Ovly Deck	165,201	187,889
New Project	5918	Replace	260,000	260,000
New Project	6137	Replace	510,000	510,000
MR&R IN 2000	69802	Repair	152,930	162,041
New Project	69831	Rehab Elem	140,000	140,000
New Project	69832	Rehab Elem	140,000	140,000
New Project	69852	Rehab Elem	125,000	125,000
New Project	69880	Rehab Elem	150,000	150,000
New Project	2158	Replace	1,600,000	1,600,000
New Project	3232	Replace	1,150,000	1,150,000
New Project	3244	Replace	100,000	100,000
New Project	4516	Replace	1,900,000	1,900,000

Figure 6: Programmed project summary—By year.

The district plans to continue using Pontis to help them plan their bridge preservation, improvement, and rehabilitation projects for the future. They have been pleased with the network level results showing the impact of increasing or decreasing funding on their networkwide bridge conditions, and the ability of Pontis to select work on a project level.

Development of Statewide 10-Year Bridge Program

In response to an expected large upcoming bulge of needs as interstate era bridges need rehabilitation or replacement, and older steel bridges start to show the effects of fatigue, the Mn/DOT Office of Bridges and Structures published a statewide project level report (*2*) outlining anticipated bridge needs in the next 10 years. Bridges were selected if they met one or more of the following categories: Pontis element level conditions were below a certain threshold (the Pontis criteria correspond to the replacement criteria outlined in the Improvement Guideline portion described earlier); the bridge was prone to fatigue damage based on HCADT levels and steel details; rehabilitation was recommended by Bridge Office Engineers; or the bridge was already programmed for repair or

replacement. This was the first time Mn/DOT used Pontis reporting for bridge replacement projects.

Once projects were identified, costs were estimated based on replacement cost for the current deck area multiplied by a swell factor to account for an assumed size of the new bridge. The report was submitted to each district for their use in development of a 10-year bridge program, which has been mandated by Mn/DOT. Throughout the process the inclusion of element level summaries and criteria guidelines have helped determine and define good candidate projects. The validity of this process was confirmed by expert review of listed projects.

What Does the Future Hold?

Mn/DOT has started to see some benefits from project level reports available from Pontis. But work remains to be done to improve the project level models in Pontis and to familiarize district bridge personnel with the benefits of using Pontis as a bridge management tool. "Pontis 2000" is expected to contain great improvements to project level modeling and produce even more defensible results. Enhanced cost tracking modules and updated deterioration and cost information will provide more accurate information in the future. The long term predictive models will provide even better information for the 20-year plans. Mn/DOT expects to integrate the management systems to provide the districts with comprehensive information to develop their transportation program. Enhancements to Pontis and integration with other management systems will give Mn/DOT improved tools for managing the bridge network in the state.

Mn/DOT plans to develop maintenance standards which will guide work by bridge maintenance crews in maintaining the bridge system at certain levels. In 1997 Mn/DOT began an effort to develop a "Family of Measures" to show the status of the states' bridges and roads. Three categories were identified for bridges: Structural Condition; Geometric Condition; and Load Carrying Capacity. The measures currently use information available from the NBI bridge condition and geometric database, but we look forward to supplementing the measures with updated information from Pontis as enhancements are made to the system.

As Mn/DOT moves into the next century, we strongly feel that Pontis will remain an excellent tool for bridge managers and planners in the development of statewide transportation programs.

REFERENCES

1. *Fiscal Year 1998 Through 1999 Bridge Improvement and Replacement Guidelines,* Minnesota Department of Transportation, Office of Bridges and Structures.

2. *Trunk Highway Bridge Planning Guide,* Minnesota Department of Transportation, Office of Bridges and Structures.