Zeitschrift: IABSE reports = Rapports AIPC = IVBH Berichte
Band: 57/1/57/2 (1989)

Artikel: Bridge management system for 10,000 bridges in Thailand
Autor: Sørensen, Anders Borregård / Clausen, Per
DOI: https://doi.org/10.5169/seals-44291

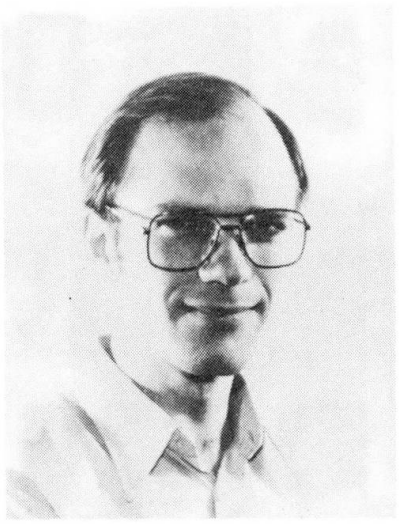
Bridge Management System for 10,000 Bridges in Thailand

Système de gestion pour 10'000 ponts en Thaïlande

Brückenüberwachungs- und Unterhaltungssystem für 10'000 Brücken in Thailand

Anders Borregård SØRENSEN
COWIconsult
Virum, Denmark

Per CLAUSEN
Danish Road Directorate
Copenhagen, Denmark



SUMMARY

The bridge Management and Maintenance System (BMMS) will introduce measures for:

— Inspection and reporting on the condition and load bearing capacity (rating) of the Department of Highway's approx. 10,000 bridges
— Ranking and budgeting of maintenance, repair, strengthening and replacement works in accordance with the current condition and rating results
— Standardized repair and strengthening of the bridges
— Rational administration of heavy transports.

RÉSUMÉ

Le système de gestion et de maintenance de ponts comprendra les points suivants:

— Inspection et rapport sur l'état et la capacité portante pour env. 10'000 ponts de la Direction des Routes principales
— Classement prioritaire et inscription au budget des travaux de maintenance, de réparation, de renforcement et de remplacement conformément aux résultats de l'inspection de l'état actuel et de la capacité portante
— Réparations standardisées et renforcement des ponts
— Administration rationelle des transports lourds.

ZUSAMMENFASSUNG

Das Programm für Ueberwachung und Unterhaltung von Brücken beinhaltet folgende Massnahmen:

— Inspektion und Bericht über Zustand und Tragfähigkeit der ca. 10'000 Brücken der Hauptstrassenabteilung
— Bewertung und Veranschlagung von Unterhaltung, Reparatur, Verstärkung und Ersatz in Uebereinstimmung mit dem aktuellen Zustand und den Berechnungsresultaten
— Standardisierte Reparatur und Verstärkung der Brücken
— Rationelle Abwicklung von schweren Transporten.

INTRODUCTION

Department of Highways is responsible for the maintenance of approximately 10,000 bridges on the routes that form the overall road network of Thailand. In the past, only the seriously damaged bridges were reported - if found - and subsequent budgets for the repair works were given. This situation caused DoH to hold a budget reserve each year, and the unforeseen amount varied from year to year. To manage the maintenance budget in the most effective way and to keep the bridges in good condition, DoH decided to set up a Bridge Management and Maintenance system.

A country wide bridge management and maintenance organization has been established and the future members have been involved in the system design from the very beginning in order to secure its acceptance in the Central Administration as well as in the districts. Fig. 1 shows the main activities in the system:

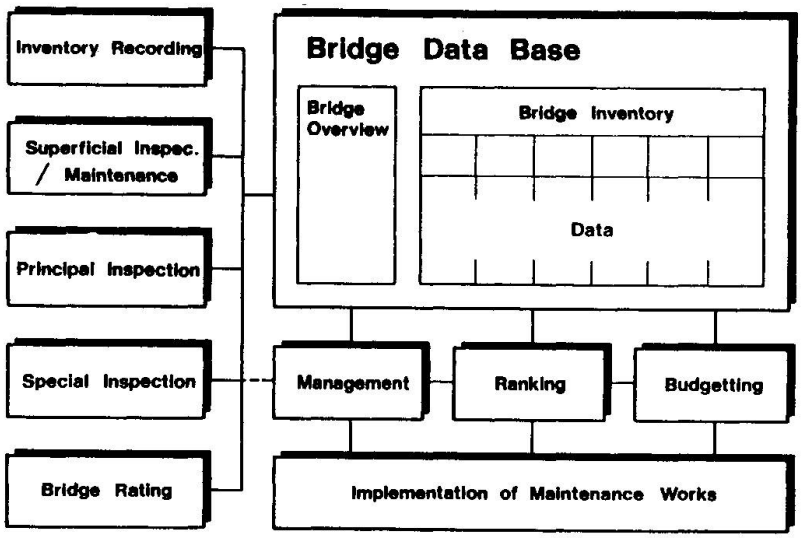


Fig. 1: Main activities covered by the system.

CONCEPT OF THE SYSTEM

General

The BMMS provides manuals for all the activities shown in Fig. 1, and it is run on personal computers.

All bridge information has been categorized and the updated combination of administrative, geometry and condition data is treated as the representatives for an element.

An element can be either the bridge as a whole or a specific part of the bridge. Each single element thus represents - and is limited to - such part of the bridge where unique information is needed. The user can select among elements as shown in Fig. 2, but he must always aim at using a minimum number of elements:

If the bridge is of uniform condition all over, only one element "Bridge" need to be used to represent the bridge.

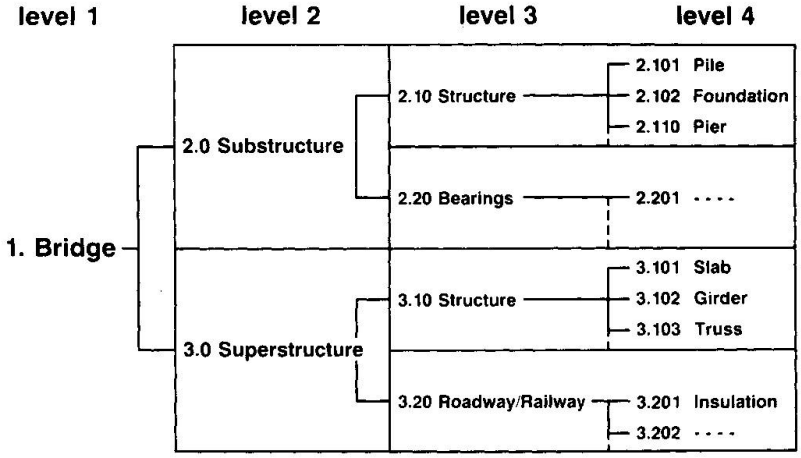


Fig. 2: Hierarchic structure shown with selected elements.

The System Modules

1. The Inventory Module

From April 1988 to February 1989 a full inventory recording of all the DoH bridges in Thailand took place. With all bridge data in a database the Inventory Module facilitates predefined output forms corresponding to routine inquiries. A typical predefined form is shown in Fig. 3.

Further, the user may create individual reports comprising selected data.

DEPARTMENT OF HIGHWAYS - BRIDGE OVERVIEW, IN GENERAL - THIS DATE: 31/08/02

Area Code: 610 Nakhon Ratchasima Division Rev. Date: 31-06-01
Route No.: ALL , Control Section No.: ALL , km: -
km: - BK

Route No.	Ctrl Sect No.	Structure No.	P S	km km BK	Name	Fc n	Con/ Chan	Superstructure - design - material
2	0702	16	P	350.077	Ban Sida-Phon Huaisokkabuong	1	2506	-slab -reinforced concrete
2	0702	19	P	352.630	Ban Sida-Phon Huaiphailon	1	2506	-slab -reinforced concrete
2	0702	26	P	357.056	Ban Sida-Phon Huaisokkhong	1	2506	-slab -reinforced concrete
2	0702	28	P	357.519	Ban Sida-Phon Huailuk	1	2506	-slab -reinforced concrete

Fig. 3: Bridge overview

2. The Inspection and Bearing Capacity Module

There are three types of inspections: Superficial Inspection, Principal Inspection and Special Inspection.

- **Superficial Inspection** is carried out by the local road personnel with short intervals. They clean the structural members and repair minor damages in accordance with manuals. The maintenance level for each bridge depends on the importance of the bridge.

- **Principal Inspection** is carried out by local well trained engineers, who typically deal with about 500 - 1000 bridges. Inspection intervals are normally 3 years with a range of 1 to 6 years depending on condition of the bridge.

  The inspector evaluates damages and gives a condition mark to the elements - general or detailed - required to describe the condition of the bridge. Only significant damages may be registered if required for documentation. Further he estimates the remaining life and corresponding repair costs of each element, and recommends the time for the next Principal Inspection.

- **Special Inspection** is a detailed investigation of a bridge structure or parts of it, when the condition or load bearing capacity has reached an unacceptable level. This inspection is either initiated on basis of the recommendations by the Principal Inspector or on basis of the ranking list. Laboratory tests will normally be required. The findings in connection with an inspection will normally lead to alternative proposals for rehabilitation with corresponding budgets.

DEPARTMENT OF HIGHWAYS - SPECIAL INSPECTION REPORT - THIS DATE: 31/08/02

Route No.: 2 , Control Section No.: 0702 , Structure No.: 19
Stationing: km 352.630 and km BK

Repair Proposal No.: 1

Superficial Inspection/Maintenance:
Maintenance level (I minimum, II normal, III high) : II
Yearly budget (1,000 Baht) : 5

Repair Works in 1,000 Baht:

Year	Element Code	Element Name	Method	Estimated repair costs (1,000 Baht)
2531	BRIDGE	Bridge	Repair	850
2535	ABUWAL	Abutment Walls	Strenghtening	250
2541	EXPJOT	Expansion Joints	Exchange	60
2560	BRIDGE	Bridge	Exchange	3000

Fig. 4: Special Inspection report

The system comprises **Bearing Capacity** programmes for a continuous rating of the bridges based on the inventory data, including the inspectors' reports on current conditions, and for rating of actual trucks.

The bridge rating programme refers to a Standard Rating Truck and expresses the load bearing capacity in terms of this truck - the result is given as a bridge class. If the condition has deteriorated, the material strength is normally affected, and thus the actual bearing capacity of the bridge shall reflect a deficiency in material strenghts.

A similar vehicle rating programme expresses the effects of any actual vehicle in terms of the same Standard Rating Truck as mentioned above - the result is given as a vehicle class.

By a simple comparison of the vehicle class and the bridge class it is checked whether a given truck or specific truck type can pass the bridge.

Actual traffic along routes is analysed, and each bridge is given a rating mark that reflects the bridge class in relation to the maximum vehicle class on the route that passes the bridge.

```
------------------------------------------------------------------
DEPARTMENT OF HIGHWAYS     - BRIDGE RATING -     THIS DATE:31/08/07
------------------------------------------------------------------
Route No.:     2 , Control Section No.: 0702 , Structure No.: 16
Stationing: km 350.077 and km          BK
------------------------------------------------------------------

Rating Document
---------------

Element: 3.10 Carrying Superstructure
Last Principal/Special Inspection: 31-08-02
Element's Condition Mark: 1
Remarks:

Load Case 1:

- Load factor on Dead Load       = 1.10
- Load factor on Standard Truck = 1.25

Inventory Rating Class: 133 %
Operating Rating Class: 104 %

Rating Mark: 0
```

Fig. 5: Results from the bridge rating

3. The Ranking and Budgeting Module

The condition marks and the rating mark of each bridge or it's elements form the basis of the ranking of bridges in need of repair. The importance of each element for the function and safety of the bridge is included in an element weight model, and also the importance of the route is considered before a final ranking point is calculated for the bridge. The rank of each element thus reflects:

- the current condition
- the bearing capacity in relation to the current traffic
- the importance of the element for the function of the bridge
- the importance of the route that passes the bridge

```
------------------------------------------------------------------------------
DEPARTMENT OF HIGHWAYS     - RANKING OF STRUCTURES -     REPORT DATE : 31/09/12
------------------------------------------------------------------------------

Ranking Points have been calculated  Year/Month/Day: 31-09-08

Structures are reported for the following unit(s) only:
 - Code: 610 Nakhon Ratchasima Division
```

Route No.	Control Section No.	Structure No.	Km	Km BK	No	Ranking Points			Cond. Mark
						Total Pr	Cond. Pc	Bear Cap. Pb	BRIDGE
219	0500	14	14.961		3	49.2	24.6	24.6	3
2057	0100	27	16.117		10	11.0	12.3	0.0	2
2149	0101	28	11.933		43	5.5	6.1	0.0	2

Fig. 6: Ranking of bridges in need of repair

Alternative maintenance plans are considered for the bridges in the top of the ranking list for which maintenance works can be carried out within available budgets. Initial selection among alternative maintenance plans are normally based on net present value of the maintenance plan with possible considerations of traffic costs imposed on users by the work programme (detours etc.).

Alternative maintenance plans are only required for the immediate maintenance works and for accurate short term budgets. The estimates of replacement costs from the Principal Inspectors are generally used for the long term budgets where no detailed proposal is yet required.

The investment schedule for the selected maintenance alternatives or inspection estimates are summarized for all bridges and compared with available budgets.

When discrepancies between available funds and estimated maintenance costs are found, the user indicates from which period and to which periods activities shall be moved. The system then directs the identification of bridges where alternative maintenance activities exists in the "move to" period instead of the previously selected ones in the "move from" period.

DEPARTMENT OF HIGHWAYS - BUDGET - REPORT DATE : 31/09/12

The budget has been accepted Year/Month/Day: 31-10-01

Budget Report for the following unit(s) only:
- Code: 610 Nakhon Ratchasima Division

Year Cost in 1,000 Baht		2531	2532	2533	2534	2535	2536-2546	2547-2567	2568-2593
Route No.	Contol Section No.								
2	0702	0.9	0.2	0.3	0.0	0.3	2	4	2
2	0800	0.0	0.0	0.0	0.0	0.0	1	3	6
2	0901	0.0	0.0	0.0	1.0	0.0	0	0	2
23	0101	0.0	0.4	0.0	0.0	0.2	3	0	0
23	0102	0.0	0.0	0.0	0.5	0.0	0	1	4
23	0103	0.0	0.0	2.4	0.3	0.0	1	0	0
202	0500	1.0	0.5	0.0	0.0	0.0	0	0	0
207	0202	0.0	0.7	0.0	0.0	0.0	0	0	1
207	0300	0.0	0.0	0.0	0.0	0.0	0	0	0
219	0500	2.8	0.0	0.5	0.0	1.0	3	2	3

Fig. 7: Final budget for a Field Division.
* The Thai year 2531 corresponds to the Gregorian year 1988.

Conclusion

The majority of the 10,000 bridges have now been inspected, and it proves that the Bridge Management System will lead to:

- consistantly updated and objective information on each bridge
- improved basis for budgeting and maintenance planning by objective ranking of the bridges
- savings from more reliable and flexible budgeting due to the minimization of unexpected repair works
- savings from a more rational administration of the bridge network with a minimized need for inspections and data collection.