Department of Architecture and Civil Engineering	Key words	Optimization, optimum design, bridge engineering, maintenance management, earthquake resistant design, cable structure

Doctor of Engineering / Professor

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Education

Department of Civil Engineering, Ehime University
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Professional Background

KAWADA INDUSTRIES, INC., Assistant Professor of Ehime University, Lecturer of Ehime University, Visiting research fellow of University of Miskolc, Associate Professor of Fukui University of Technology, Professor of Fukui University of Technology

Consultations, Lectures, and Collaborative Research Themes

Development of optimization algorithm, Optimum design, Bridge maintenance and management, Earthquake resistant design, Structural analysis of cable structures

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Main research themes and their characteristics

「Estimation of Cable Tensions of Cable-stayed Bridge」

In this study, the cable tensions of cable-stayed bridge are identified by using the natural frequency and the least square method. The natural frequency is measured by means of a 3-axis acceleration sensor module. The least square expression is solved by the particle swarm optimization method considering the cable tensions and cable stiffness for each natural vibration mode as unknown variables and the vibration equation for each vibration mode as equality constraint. The effectiveness and reliability have been illustrated by applying it to the existing cable-stayed bridges. Figure 1 shows the experimental situation of forced vibration of a cable.

「Study on Optimum Bridge Maintenance and Management in Fukui Prefecture」

In this study, we analyze the causing factors for deteriorations of bridges and investigate the optimum repair plan by using the bridge inspection data in Fukui prefecture. The deterioration transfer curve for each main member of a bridge is introduced to estimate the future deterioration. The optimum bridge management system(OBMS) is developed for determination of the optimum repair plan considering the annual bridge repair budget by using the deterioration transfer curves. The system is developed considering the practical usefulness such as the reduction of cost for scaffolding and shortening period of closing traffic. The system can determine the best repair plan considering the whole bridge system with minor and major defects of members. Multi-span bridge is taken as one bridge and the best repair plan can be determined considering all members in multi-span bridge at once. Figure 2 shows the deterioration transfer curve and repair plan.

「Development of an Optimum Design System」

In the planning and design of structures, we have to do a best decision-making in several options. We need to use the optimization technique to achieve it. In this study, the optimization techniques such as mathematical programming and heuristic algorism are developed to find the optimum solutions in several engineering problems. Figure 3 shows the initial configuration of a transmission tower truss. Figure 4 shows the optimum configuration of the truss determined by mathematical programming in which the shape, sizing and material of member are dealt with as design variables considering wind load and seismic load.

Fig.1 Experimental situation

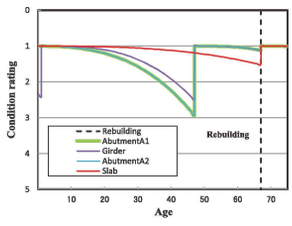

Fig.2 Optimum repair plan of a bridge

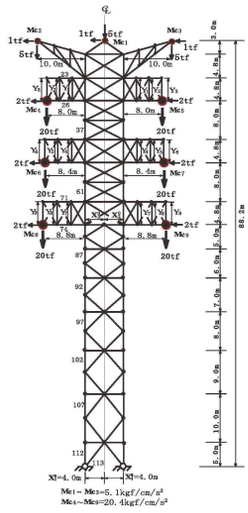

Fig.3 Initial configuration of a transmission tower truss

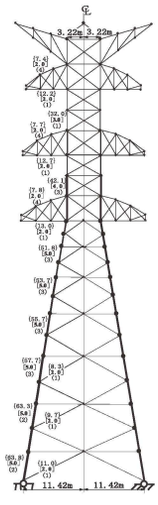

Fig.4 Optimum solution of the truss

Major academic publications

K.Taniwaki, S.Ohkubo; Optimal Synthesis Method for Transmission Tower Truss Structures Subjected to Static and Seismic Loads, Int. Journal of Structural Multidisciplinary Optimization, Vol.26, pp.441—454, 2004
K.Taniwaki, S.Ohkubo; OPTIMUM DESIGN METHOD FOR NONLINEAR FRAME STRUCTURES WITH BOX SECTIONS BASED ON ENERGY PRINCIPLES, Journals of JSCE, No.668/I-54, pp65-81, 2001
Taniwaki,K and Ohga,M., An efficient optimal selection method for repairing components of damaged bridges using two stage branch-and bound method, Journal of applied mechanics, Vol.9, pp.239-250, 2006