

Towards Sustainable Development of Bridge Engineering: Chinese Lessons and Experiences

Yao Jun GE

Professor
State Key Lab for Disaster
Reduction in Civil Eng.
Tongji University
Shanghai, 200092, China
yaojunge@tongji.edu.cn

Mr. Ge, born 1958, and received his PhD degree in bridge engineering from Tongji University. He is currently the Lab Director and the Chairman of Department of Bridge Eng..



Hai Fan XIANG

Emeritus Professor
College of Civil
Engineering
Tongji University
Shanghai, 200092, China
hfxiang@tongji.edu.cn

Mr. Xiang, born 1935, and received his MSc degree in bridge engineering from Tongji University. He is currently the Consulting Dean of College of Civil Engineering.



Summary

The concept of sustainability is described in this paper by single sustainable principle, two goals of sustainable development, three dimensions of sustainable engineering, four sustainable requirements and five phases of sustainable construction. Four sustainable requirements and their practice in China are particularly discussed. Safe reliability of bridges is firstly compared with the events of bridge failure in China and in the rest of the world, and followed by structural durability including cracking of concrete cable-stayed bridges, deflection of concrete girder bridges and fatigue cracks of orthotropic steel deck. Referred to functional adaptability, lateral wind action on vehicles and its improvement are introduced with a sea-crossing bridge located in typhoon prone area. The Chinese practice of two double main span suspension bridges and a twin parallel deck cable-stayed bridge are delivered as the last sustainable requirement, capacity extensibility.

Keywords: Sustainable engineering, safe reliability, structural durability, functional adaptability, capacity extensibility.

1. Introduction

After John Smeaton of England called himself as the first civil engineer in the world in the 18th century, civil engineers have been facing new challenge in each century. In the 19th century, civil engineers created methods for the efficient use of structural materials such as steel and concrete to build bridges and structures. As learned the fact that lifetime maintenance costs often more than the original construction in the 20th century, engineers developed new design methods to consider the effective maintenance and repair of bridges as part of the initial design problem. Entering the 21st century, we will be challenged towards not only the whole life cycle design of major bridges but also the minimal impact construction at the end of the lifetime of a bridge. This is sustainable engineering, the century's challenge in the world, in particular in China with the unprecedented development in transportation system.

2. Concept of Sustainability

Sustainability comes from the Latin word “sustinere” that means “to bear” or “to endure”, and can be translated simply as long term compatibility. Today the concept of sustainability might be more meaningfully described by the following conceptual framework including single sustainable principle, two goals of sustainable development, three dimensions of sustainable engineering, four sustainable requirements and five phases of sustainable construction, shown in Fig. 1.