



文、圖 | 陳震武

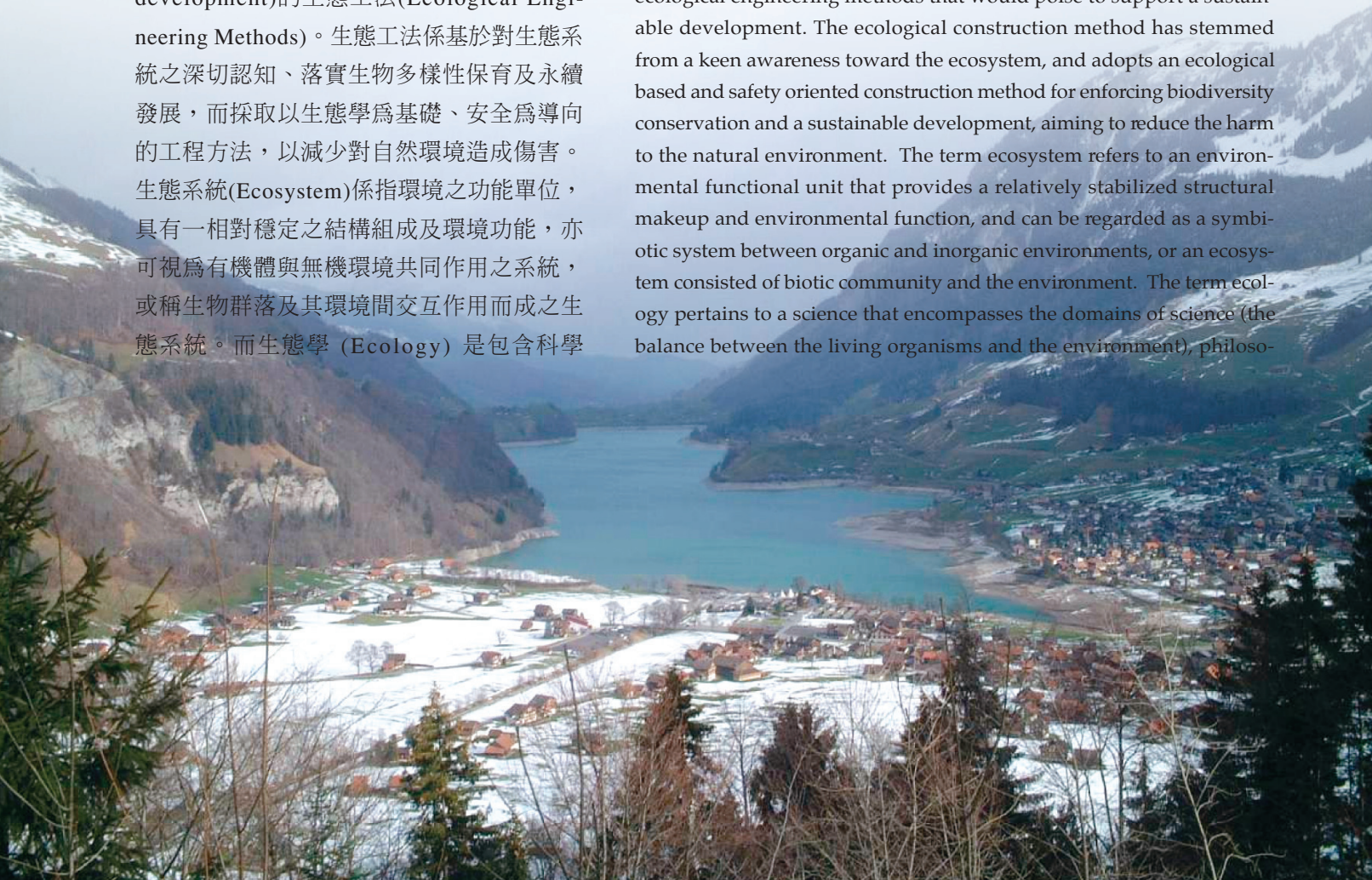
Article, photos | Chen Chen-wu

# 水域、生態 及環境整合規劃

## An integrated development of the sea territories, ecology and environment

近年來台灣經濟發展蓬勃，水域及海洋結構物不啻以安全及經濟考量施工，反而逐漸著重在達到環境及生態平衡，並且更進一步地經營永續發展(Sustainable development)的生態工法(Ecological Engineering Methods)。生態工法係基於對生態系統之深切認知、落實生物多樣性保育及永續發展，而採取以生態學為基礎、安全為導向的工程方法，以減少對自然環境造成傷害。生態系統(Ecosystem)係指環境之功能單位，具有一相對穩定之結構組成及環境功能，亦可視為有機體與無機環境共同作用之系統，或稱生物群落及其環境間交互作用而成之生態系統。而生態學(Ecology)是包含科學

In recent years as Taiwan's economic development undergoes vigorous growth, constructions in and around its sea territories and maritime structures are created for safety and economic concerns, and furthermore are increasingly focusing on reaching an equilibrium point between the environment and ecology, and turning to deploying ecological engineering methods that would poise to support a sustainable development. The ecological construction method has stemmed from a keen awareness toward the ecosystem, and adopts an ecological based and safety oriented construction method for enforcing biodiversity conservation and a sustainable development, aiming to reduce the harm to the natural environment. The term ecosystem refers to an environmental functional unit that provides a relatively stabilized structural makeup and environmental function, and can be regarded as a symbiotic system between organic and inorganic environments, or an ecosystem consisted of biotic community and the environment. The term ecology pertains to a science that encompasses the domains of science (the balance between the living organisms and the environment), philoso-





(生物與環境間自然平衡之關係)、哲學(機能、組織、結構之平衡,改變任一環節,即將影響全體)以及藝術(大自然之美)之研究的一門學問。這些隨著環境永續經營為導向的知識領域,並非傳統的單一專門學科人員、團隊所能掌控,必須藉由所有相關領域的專業整合,適足以發揮並且達到環境該有之效果。

因為過往從事水域及海洋結構的工程師對於生態環境的認知不夠確實,因此早期的水域、海岸的整治工程比較偏重安全堅固、經濟及防洪防災的考量,如硬式防波堤、胸牆、護岸、離岸防波堤等,已經因為美觀的問題及親水性的考量,其工程結構正逐漸地被改變。這些早期沒有重視整體環境生態與景觀因素的工程物,發生許多水域工程破壞現地自然生態景觀的問題,甚至該工程結構物與現地自然環境有格格不入的感覺。近年來,歐美多數的先進國家,在任何的工程施工時,都將生態保育及永續經營的理念,置於經濟及功能性之上,並且加強落實環境影響評估的審查作業;在台灣,不僅政府開始高度重視生態環境的保護與平衡,國人也逐漸對環境保育的觀念越來越強烈,因此許多官方研究機構及民間團體開始研發許多類型的生態工法,甚至出現許多科技整合成功的實際例子。這些成功的經驗勢必隨之應用於開發實際的水域及海岸結構工程上。

為了營造良好的水域及海岸環境,台灣近幾年在水域及海岸治理方面,除了重視防災問題,也衍生出幾個開發重點。分別有(一)營造親水環境工程問題;(二)水域生態環境保育問題;(三)水域自然景觀復育及永續經營問題。在水域環境治理方面,也引發一些核心價值的問題,如(一)水域自然景觀復育及永續經營的價值觀問題;(二)生態保育的價值觀問題;(三)營造親水環境工程價值觀問題;(四)工程防災的價值觀問題;(五)水域河川及土地開發利用的價值觀問題。這些因素的衡量,讓我們跳脫以往的海洋結構及水域工程中防災的用

phy (an equilibrium of the function, organization and structure, where any change could affect the entire framework as a whole), and arts (the beauty of nature). The knowledge domain taking to a sustainable management orientation goes beyond the control of any specific science or team, but rather through a fully integrated team of professionals in relevant domains that would suffice to excel and attain the expectation yield of an environment.

As marred by earlier engineers' lack of an ecological awareness in water and maritime construction, the earlier water and coastline flood control engineering work tend to focus on safety and sturdiness, economics and flood prevention, such as the rigid breakwater embankment, brace walls, offshore breakwater and the like. Yet as bound by visual appeals and sea compatibility, the design of these construction structures is gradually being modified. The earlier construction structures that lack logistical concern for ecology and landscaping have triggered a series of problems how the water construction sabotaged the natural ecology, and created an incompatible feel to the natural surroundings. In recent years, many developed countries in Europe and America have included ecological conservation and a sustainable management concept preceding the economic and functional concern, with stepped-up environmental impact assessment review process. In Taiwan, not only does the government begins to emphasize ecological and environmental protection and balancing, but the local population are also increasingly aware of the environmental conservation concept, compelling many government outfits and private organizations to delve into developing many ecological friendly construction methods, and spawning many successful field examples integrating many modern technologies. These successful experiences will soon be integrated in future water and coastline structural construction projects.

In an effort to create a fine waterfront and coastline environment, Taiwan has been focusing on waterfront and coastline irrigation and management work, which not only emphasizes on disaster prevention issue, but has also spawned a few development focuses, which are, (1) the issue of creating a water-friendly environment engineering; (2) the issue of marine ecological environment protection; (3) the issue of natural water landscape rehabilitation and a sustainable management. In water environment irrigation and management, some of the core value problems have also surfaced such as, (1) the issue concerning value perspective in natural water landscape rehabilitation and a sustainable management; (2) the issue of value perspective concerning ecological conservation; (3) the issue of value perspective concerning creating a water-interactive environment construction scheme; (4) the issue of value perspective on construction disaster prevention; (5) the issue of value perspective on the development and utilization of rivers and land. Pondering over these factors not only frees us from being confined to the conventional disaster prevention concept in building marine structures and water construction, but also brings us the need to rethink the value of water and coastal structures.

At present, as public infrastructure constructions fall under the



途外，也讓我們重新去思考水域、海岸結構物的價值所在。

目前國內所有公共工程在工程會的監督之下，各政府機構對於水域生態工法相當積極在推動。但是可惜的是一在國外已具有相當完善的工程法規與施工技術，卻不完全適用於台灣的水域、海洋環境(註解：台灣四面的波、潮、流況極為複雜，加上強烈的熱帶低氣壓影響，許多國外完善的海洋計算模式在台灣皆不適合直接套用)，在這種缺乏本土性專業知識與工程技術情況下，往往造成錯誤的施工，輕者導致材料的浪費，重者則使得結構破壞，環境陷入惡化無法復育。若單純以安全性及實用性為考量，或以水域生態環境的品質為考量，兩者都在台灣皆有相當成熟的工程技術及成功經驗；但是對於兩者都必須兼具的土地、工程開發利用，甚至論及生態的永續經營，在實際的執行面卻困難重重，步履蹣跚。因為這必須結合土木水利、海洋環境、海岸工程、環境生態、人文景觀及土地開發等不同社經知識，且藉由政府制定適當的法規進行配合。

環境建設要能達到其他先進國家的標準，無法一蹴可及，必須要長時間專家學者與政府機構共同去努力。然而，在水域生態環境的建設方面，推動時必須要注意的方向及項目，特別要注重（一）利用地理資訊系統建立本土性基本的水域與生態環境資料；（二）本土性永續生態工法技術的研發；（三）訂定一套本土化生態環境的公共工程管理制度；（四）落實並推廣生態工法之事及實務；（五）加強相關知識教育與宣傳。如此，對於達成永續發展的水域生態環境，必能創造更為美好的生活環境。  
(作者任職於第八一岸巡大隊)

supervision of the Public Construction Committee, various government agencies are actively promoting water ecological construction methods. Yet unfortunately, a host of many perfected construction legal guidelines and construction techniques may not be suitable for Taiwan's water and marine environment, in that the waves and tidal and current movements around Taiwan are rather complex, coupled with the impact of tropical low pressure systems, many perfected foreign meteorological computation models cannot be plotted in for application. Under the circumstances of lacking localized professional know-how and construction techniques, erroneous construction is often the result, causing material waste in minor cases and leading to structural weakness in severe cases, sending the environment to fall into a deteriorated state quite beyond rehabilitation. To gauge from practicality and safety alone, or to consider the quality of the water ecological environment, although both have had rather mature construction techniques and successful prior experiences, yet there are implementation difficulties in respect that both involve land, project development utilization, or even the issue of a sustainable management, moving at a snail pace. In short, the management of this would require integrating civil engineering, marine environment engineering, coastline construction, environmental ecological engineering, humanity landscaping and land development to name a few, as well as the government's efforts to promulgate adequate laws and regulations as part of the logistical support.

It may not be possible for Taiwan to instantly catch up to the criteria of environmental development done in the developed countries; however, it does require a joint effort among experts, scholars and government outfits over an extended period of time. Nevertheless, in the development of the water ecological environment, there are a few cautionary focuses and categories that need to be taken into account, which being, (1) instilling a localized rudimentary water region and ecological environment database relying on the geographic information system; (2) the research and development for localized sustainable ecological construction methods; (3) instilling a localized ecological environment's public construction management system; (4) enforcing and promoting ecological construction affairs and practical implementation; (5) stepping up awareness education and promotion. It is only by doing so can we expect to achieve a sustainable development for the water ecological environment, and be able to create a better living environment.

(The author is a member of Coast Patrol Corps 8-1)

參考網站 Reference web sites:

HYPERLINK "<http://www.chu.edu.tw/~weec/intro.htm>"

HYPERLINK "<http://www.ntut.edu.tw/~wwwec/cabout.htm>"