

# 现代长江水工程结构生态

向友国 闫海青 张大勇 等编著



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# 内容提要

本书为“现代长江生态系列丛书”之一，采用通俗易懂的语言，系统地介绍了现代长江水工程结构生态的相关知识，介绍了长江流域的主要水工程结构，包括大坝工程、水利灌溉工程、堤防工程、水闸、渠系建筑物、泵站工程、渡槽工程、过坝建筑物、桥梁建筑物以及隧道工程等，本书从生态的角度介绍了这些工程结构的概念、特点、分类，以及设计、施工、运行等方面的技术要点，并对每一类结构列举了典型的工程实例。

本书除适用于从事水利水电工程、桥梁隧道工程、水资源与水环境工程技术人员外，还可供相关领域的中职中专、大专院校、研究生院师生和从事水工程结构的勘测、规划、设计、施工、监理、管理及科研人员参考。

# 跋

当前和今后相当长一个时期  
要把修复长江生态环境摆在压倒性位置  
共抓大保护 不搞大开发

新华社重庆1月7日电 中共中央总书记、国家主席、中央军委主席习近平2016年1月5日在重庆召开推动长江经济带发展座谈会，听取有关省市和国务院有关部门对推动长江经济带发展的意见和建议。他强调，长江是中华民族的母亲河，也是中华民族发展的重要支撑。推动长江经济带发展必须从中华民族长远利益考虑，走生态优先、绿色发展之路，使绿水青山产生巨大生态效益、经济效益、社会效益，使母亲河永葆生机活力。

习近平在重庆调研期间召开这次座谈会，就推动长江经济带发展听取上海、江苏、浙江、安徽、江西、湖北、湖南、重庆、四川、贵州、云南党委主要负责同志和国务院有关部门负责同志的意见和建议。在听取大家发言后，习近平发表重要讲话。

习近平指出，推动长江经济带发展是国家一项重大区域发展战略。这一战略提出以来，推动长江经济带发展领导小组、国务院有关部门和沿江省市做了大量工作，在整治航道、利用水资源、控制和治理沿江污染、推动通关和检验检疫一体化等方面取得积极成效，一批重大工程建设顺利推进。这些工作值得肯定。

习近平强调，长江、黄河都是中华民族的发源地，都是中华民族的摇篮。通观中华文明发展史，从巴山蜀水到江南水乡，长江流

域人杰地灵，陶冶历代思想精英，涌现无数风流人物。千百年来，长江流域以水为纽带，连接上下游、左右岸、干支流，形成经济社会大系统，今天仍然是连接丝绸之路经济带和 21 世纪海上丝绸之路的重要纽带。新中国成立以来特别是改革开放以来，长江流域经济社会迅猛发展，综合实力快速提升，是我国经济重心所在、活力所在。长江和长江经济带的地位和作用，说明推动长江经济带发展必须坚持生态优先、绿色发展的战略定位，这不仅是对自然规律的尊重，也是对经济规律、社会规律的尊重。

习近平指出，长江拥有独特的生态系统，是我国重要的生态宝库。当前和今后相当长一个时期，要把实施重大生态修复工程作为推动长江经济带发展项目的优先选项，实施好长江防护林体系建设、水土流失及岩溶地区石漠化治理、退耕还林还草、水土保持、河湖和湿地生态保护修复等工程，增强水源涵养、水土保持等生态功能。要用改革创新的办法抓长江生态保护。要在生态环境容量上过紧日子的前提下，依托长江水道，统筹岸上水上，正确处理防洪、通航、发电的矛盾，自觉推动绿色循环低碳发展，有条件的地区率先形成节约能源资源和保护生态环境的产业结构、增长方式、消费模式，真正使黄金水道产生黄金效益。

习近平强调，长江经济带作为流域经济，涉及水、路、港、岸、产、城和生物、湿地、环境等多个方面，是一个整体，必须全面把握、统筹谋划。要增强系统思维，统筹各地改革发展、各项区际政策、各领域建设、各种资源要素，使沿江各省市协同作用更明显，促进长江经济带实现上中下游协同发展、东中西部互动合作，把长江经济带建设成为我国生态文明建设的先行示范带、创新驱动带、协调发展带。要优化已有岸线使用效率，把水安全、防洪、治污、港岸、交通、景观等融为一体，抓紧解决沿江工业、港口岸线无序发展的

问题。要优化长江经济带城市群布局，坚持大中小结合、东中西联动，依托长三角、长江中游、成渝这三大城市群带动长江经济带发展。

习近平指出，推动长江经济带发展必须建立统筹协调、规划引领、市场运作的领导体制和工作机制。推动长江经济带发展领导小组要更好发挥统领作用。发展规划要着眼战略全局、切合实际，发挥引领约束功能。保护生态环境、建立统一市场、加快转方式调结构，这是已经明确的方向和重点，要用“快思维”、做加法。而科学利用水资源、优化产业布局、统筹港口岸线资源和安排一些重大投资项目，如果一时看不透，或者认识不统一，则要用“慢思维”，有时就要做减法。对一些二选一甚至多选一的“两难”“多难”问题，要科学论证，比较选优。对那些不能做的事情，要列出负面清单。市场开放是推动长江经济带发展的重要动力。推动长江经济带发展，要使市场在资源配置中起决定性作用，更好发挥政府作用。沿江省市要加快政府职能转变，提高公共服务水平，创造良好市场环境。沿江省市和国家相关部门要在思想认识上形成一条心，在实际行动中形成一盘棋，共同努力把长江经济带建成生态更优美、交通更顺畅、经济更协调、市场更统一、机制更科学的黄金经济带。

## 跋

The ecological environment restoration of the Yangtze River should be put at an overwhelming position at present and for a considerably long time in the future.

Greatly protect environment not to engage in large development.

According to the report of Xinhua News Agency on January 7th, 2016, XI Jinping, General Secretary of the CPC Central Committee, state president, as well as the chairman of the Central Military Commission, held the forum on how to promote the development of the Yangtze River Economic Belt in Chongqing on January 5th, 2016. He listened to the opinions and suggestions proposed by representatives from the relevant provinces and departments of the State Council. At the meeting, he stressed that the Yangtze River is the mother river of the Chinese nation and is also an important support for the development of the Chinese nation. XI Jinping also indicated that the long-term interests of the Chinese nation must be considered in promoting the development of the Yangtze River economic belt. We should take the road of ecological priority and green development, and let the beautiful scenery produce great ecological benefits, economic benefits and social benefits, so that the mother river can be full of vitality.

Xi Jinping held this symposium in Chongqing during his investigation. He listened to the opinions and suggestions proposed by the principal



responsible comrades of the Party committee from eleven provinces and cities, such as Shanghai, Jiangsu, Zhenjiang, Anhui, Jiangxi, Hubei, Hunan, Chongqing, Sichuan, Guizhou and Yunnan, and the people from relevant departments of the State Council. Then, XI Jinping delivered an important speech.

Xi Jinping pointed out that promoting the development of the Yangtze River economic belt is a major regional development strategy of China, and this strategy has been proposed to promote the leading group of development of the Yangtze River economic belt, the relevant departments of the State Council, the governments of provinces and cities along the river to have done a lot of work. Positive results have been achieved in these aspects, such as regulate waterway, use water resources, control and govern water pollution along the Yangtze river, promote the integration of customs clearance and inspection and quarantine; and a number of major projects has been promoted smoothly. All of these works should be affirmed.

Xi Jinping emphasized that both the Yangtze River and the Yellow River are not only the birthplace of the Chinese nation, but also the cradle of the Chinese nation. Overseeing the development history of Chinese civilization, from Szechwan to the south of the Yangtze River, there are lots of outstanding people and countless heroes in the Yangtze River Basin. For thousands of years, the Yangtze River basin is linked with water, connecting the upstream and downstream, the left and right bank, dry tributary, forming a large economic and social system. Nowadays, it is still an important link of the economic zone of Silk Road and that of the maritime Silk Road in the 21st century. Since the founding of new China, especially since the Reform and Opening-up, the economy and comprehensive strength in the Yangtze



River Basin has developed rapidly and promoted greatly, respectively, so the Yangtze River economic belt is the core of China's economic focus and vitality. The status and role of Yangtze River and the Yangtze River Economic Belt indicate that promoting the development of the Yangtze River economic belt must adhere to the strategic positioning of ecological priority and green development, which is not only to respect the laws of nature, but also to respect the economic law and social law.

Xi Jinping pointed out the Yangtze River has a unique ecological system, and it is an important ecological treasure for us. At present and for a considerably long time in the future, the major ecological restoration project must be considered as a priority to the development project of the Yangtze River Economic Zone. We should implement well the ecological restoration projects, such as the establishment of the shelter forest system of Yangtze River, the governance of soil erosion and stone desertification in karats area, returning farmland to forest and grassland, soil and water conservation, ecological conservation and restoration of rivers, lakes and wetland, to enhance the ecological functions of soil and water conservation. Moreover, the ecological protection of Yangtze River should be conducted with the reform and innovative method. In the premise of limited capacity of the ecological environment, relying on the Yangtze River waterway, we should correctly handle the contradiction between flood control, navigation and power generation, and consciously promote the green low-carbon development cycle. We encouraged the qualified areas to first form the industrial structure of saving energy resources and protecting ecological environment, and change consumption patterns, let the gold waterway to produce gold benefits indeed.

Xi Jinping stressed that the Yangtze River economic belt which is considered as a watershed economy integrated with water, roads, ports, banks, production, as well as many other aspects of the city and biology, wetlands and environment, so it must be overall planned. Firstly, we should strengthen the systematic thinking, co-ordinate the reform and development of various areas, the regional policy, the construction of various fields, a variety of resource elements, and the synergies between provinces and municipalities along the Yangtze river can be more obvious so as to promote the synergetic development in the middle and lower reaches of the Yangtze River economic belt and interactive cooperation between the East, Central and Western of China. So the Yangtze River Economic Zone will be built to be China's first demonstration zone, innovation driven belt, coordinated development zone of ecological civilization construction. Secondly, we should optimize the use efficiency of existing shoreline and integrate water safety with flood control, pollution control, quay, transportation and landscape, etc., as a whole, and pay close attention to solve the disorderly development of industries along the river and port coastline. Moreover, we also optimize the layout of city group of Yangtze River Economic Belt, adhere to the combination of different scales of cities and the linkage between the East, central and the west of China. Relying on the three major urban agglomerations of the Yangtze River Delta, the middle reaches of the Yangtze River and Chongqing city, we can drive the development of the Yangtze River economic belt.

Xi Jinping pointed out that we should establish the leadership system and working mechanism of co-ordination, planning guide, market operation to promote the development of the Yangtze River economic belt. In this

process, leading group will better play a leading role, and the development planning should focus on the overall strategy, be practical, and have leading constraint function.

Protection of ecological environment, establishment of a unified market, and acceleration of structural adjustment and transfer, are already a clear direction and focus, so we should take action towards it as early as possible. However, in these aspects such as scientific utilization of water resources, optimization of industrial layout, planning of port shoreline resource and arrangement of a number of major investment projects, if we cannot see through the whole situation temporarily, or lack of unified opinions, please calm ourselves down, sometimes it is necessary to think back. For these more difficult problems, scientific verification and comparative selection are needed; for those things we cannot do, it is necessary to list the negative list.

Market and opening environment are the important power to promote the development of the Yangtze River Economic belt. In this process, the market should play a decisive role in the allocation of resources, and the government performs its duties better. So the governments of these provinces along the Yangtze River should speed up the function transformation to improve the level of public services and create a good market environment. In the end, both the ideological understanding and practical action of governments of provinces along the Yangtze River and the relevant departments of the state should be consistent, and we will make joint efforts to built the Yangtze River Economic Belt to be the gold economic belt with more beautiful ecological environment, more smooth traffic, more harmonious economy, more unified market, and more scientific mechanism.

# 这条江

1=C 3/4 宽广优美地 中速

陈彦生 词  
李 进 曲

5-1 | 6 5 4 | 5 - - | 5 - - | 5 - 1 1 | 4 3 1 | 2 - - | 2 - - |

这 条 江 丰 沛 的 水 量

5-1 | 6 5 4 | 1 - - | 5 - - | 2 - 2 2 | 2 7 6 | 5 - - | 5 - - |

这 条 江 啊 远 古 的 辉 煌

1-1 | 1-5 | 6-5 | 6 - - | 4 4 4 | 4-5 | 6 5 6 | 5 - - |

这 条 江 啊 这 条 江 承 载 着 神 州 沧 桑

1-1 | 1-5 | 6-5 | 6 - - | 4 4 4 | 4 5 6 | 6 5 6 | 2 - - |

这 条 江 啊 这 条 江 凝 聚 着 中 国 梦 想

3-2 | 1-5 | 3 - - | 3 - - | 1 6 6 1 | 6 - - | 1 6 - | 1 6. 5 |

这 条 江 奔 腾 的 激 流 唱 响 复 兴 的

4 5 - | 5 - - | 3-2 | 1-6 | 6 - - | 6 - - | 2 2 1 2 | 2 - 2 1 |

凯 歌 这 条 江 文 明 的 生 态 开 启

2 2 1 2 | 5 - - | 3-3 | 3 2 3 | 1 - - | 1 - - | 2-2 | 2 1 2 |

中 华 希 望 长 江 豪 迈 长 江 激

5 - - | 5 - - | 6-1 | 1-6 | 5-1 | 1-1 | 6-1 | 3 2 1 |

荡 一 个 劲 地 向 前 闯 融 入 大 海

2 - - | 2 - - | 3-3 | 3 2 3 | 1 - - | 1 - - | 2-2 | 2 1 2 |

洋 长 江 豪 迈 长 江 激

6 - - | 6 - - | 5-1 | 1-6 | 5-1 | 1-1 | 2-2 | 2 6 7 |

荡 一 个 劲 地 向 前 闯 融 入 大 海

1 - - | 1 - - | 2-2 | 2 - - | 5 - - | 5 - - | 1 - - | 1 0 0 ||

洋 融 入 大 海 洋

# 绿色生活

——“现代长江生态系列丛书”代序

王云飞

呱呱小儿，但饮牛湫(dòng)，至於弱冠，不明犍(jiān)状。眊眊(cǎi)之豚，日食其羮(bā)。洎(jì)其成立，未识玃玃(jiān jiā)。每啖鼯鼯(niè chán nàò)，然竟不知其爰(qūn)兔。方彼之时，窞(zhú)谄之态，非闾闾(huán huì)之中所得见也。

今北方久燠(ōu)，潢沆髡髡(fèn guǐ zhòu yuān)，盆(bèn)埌埌(fó)，焘(dào)天輻(hū)日。土地皴(cūn)崩，罅(xià)可容人。南疆霏霏(pāng pèi)，洚(jiàng)水肆虐，当此之滔(hào)，茅舍尽走。欲苦(shàn)不能，啼口立啾啾(jiū)。

凡此异态，非天之咎。

君不见斲(zhuó)榎(pián)焚樟，蛄(hù)之为蝼(qǐ)，睥睨(miàn)之下，万山尽岨(wù)，百尺簣(yún)簣(dàng)，化为竹著。於彼幼蛇，匍(gé)不盈寸，巴蛇王虺(huǐ)，尽化桯(pán)馐。旅(lú)气煇煇(fú)，上格瑶池，贫地徠(lái)贾(gǔ)，以丰其贄(zī)。然千丈方圆，莱菔(lái fú)不生，九天之上，星河不见。

呜呼！漫山设楨(lì)，遍地尽罍(fú)。此天灾也？人祸也！河海黟(yī)然，浊水仍倾，此天灾也？人祸也！斲木剡竹，彊(guō)犇(juàn)待兽，以至鹿不得走，翬(huī)不得飞，蚁不得窘(qún)，鬻鬻(pī ér)不见。此天灾也？人祸也！

翕(xī)合沴(lì)气,终日昏昏(hūn)。天不复蓝,水不复清。未有乌云,天何暝暝?赤乌既出,焜(kūn)耀无复。看天下,鸟飞不下,鲜见狺狺(pī),当此之时,何处賁(dài)青天?

所幸者,人知之也,人更之也。然,上作网法,下俚(fù)几何未可知也。

今天下多灾。北国井采(shēn),阵主复至,当与孔张俱殒(mò)。南域之霖,大禹洧(jiàn)存,只得扼腕而叹息。人不咎己而咎旱魃(bá),不诘(qiào)己而诘共工。未之可也。闾闾所趋,不可恹恹。当思子孙後代,人已知之。然行之效,则体躔(jù)庙堂者思之,嬖倖(ān ē)之徒,弃不嫔(hù)嫔(lào),国之大蠹(dù),捐而必究。

吾所思者,河泮水隈(ào),杨槐蓁蓁(zhēn),町疃(tǐng tuǎn),柳榆其秣(lì)。苾(bì)蓫(jiān)柅柅(nǐ)游中(chè)葳蕤(wēi ruí),见柳而人不攏(lì),视草而众不踈(lìn),日驾双軹(dài)之车,斐斐(fěi)闾(lú)巷之间,目不复睽(hóu),鼻不再鼽(qiú),鸟不惊人,鲋(fù)游沴然。

人者,天地孕育。今其反万物,此獍也。今其不宜睥睨(guī),遗祸擗(nù)孙,当修长远之道以賴(lài)万世。

今吾执笔於此,所思者,舍旁早蟠一株,今当啍啍(fěng),敲(qī)枝水上,当复驾舴艋,才(shǒu)玄其落桃,投於苙(lì)。坐银杏树下,观儿童嬉於树下,延於砖甃(gāi),搯(è)腕而惜水中未置菱藕几株。燠(yù)热之时,而可摘菱取(zuì)药,蕪(ruò)之为饘(zhān),以奉亲房。



## 参考译文

呱呱坠地的小孩，只知道喝牛奶；到二十岁，还不知道牛的样子。幼小的猪，（小孩）每天都吃它的肉；等到成年，也不能分辨猪的公母。人们常常啃吃野兔的兔腿，然而最终却不知道狡兔有三窟。在那个时候，兔子从洞穴里出来的神态，不是街市之中能够看见的。

现今北方久旱，泉涸井枯，尘埃飘拂，遮天蔽日。土地干裂，缝隙大可容人。南疆大雨滂沱，洪水肆虐。遇到这样的水灾，草舍都被冲走。想修缮而不能，人们只能啾啾地啼哭。

凡是这样的异象，并非上天的罪过。

你难道看不见砍伐树木焚毁森林，草木葱郁的山变得荒芜。极目远望，万山都光秃秃的。百尺高的竹子，都做成了竹筷子。对于那些小蛇，粗不足一寸，（与）剧毒蛇王，都成为盘中美味。工厂黑色的废气蒸腾上升，上达瑶池。贫穷之地招徕商贾，以增加他们的财富。然而方圆千丈之内，连萝卜都不能生长，九天之上，星河也不能看见。

哎！人们漫山遍野地设下捕兽的机关和抓兔子的网。这是天灾吗？是人祸啊！河海里的水已变得漆黑，各种废水还在不断向其中排放。这是天灾吗？是人祸啊！砍木伐竹，张弓等兽，以至鹿不能奔跑，鸟不能自由飞翔，蚂蚁不能群居，野兽鬃毛竖起也不能看见。这是天灾吗？是人祸啊！

人们呼吸着浊气，整天昏昏沉沉。天不再蓝，水不再清澈。没有乌云，天空为何阴沉？旭日升起，太阳光彩明亮的样子也不复存在。看人间，鸟飞而不敢落下，很少能看见野兽成群奔跑，在这样的时候，



到哪里去能乞求到青天？

庆幸的是人知道这种灾难，人能够改变这样的状况。然而，国家制定法令，民众有几个能遵守执行，就无法知道了。

现在天下多灾多难。北国井枯，（即使）陈后主再次到来，（也只）当与姓孔与姓张的两个妃子一齐死在井底；南疆大水，（即使）大禹还活着，（也）只能扼腕叹息。人们不归罪于自己而归罪于造成旱灾的鬼怪，不责备自己却责备共工。不可这样做啊！城市的发展不能急功近利，应当考虑到子孙后代。人们已经知道后果的严重性。然而力行改变，则是那些当权者要思考的。阿谀奉承的小人，舍弃而不要怜惜；国家的蛀虫，舍弃而必定要追究。

我所梦想的是，河流边上，杨柳青翠丛杂，舍边空地上，柳树榆树稀疏而均匀地排列着。芳香的兰花和野草长得十分茂盛。看见柳枝，但人们不去折断它；看到草坪，但众人不去践踏。在街巷之间徘徊散步，眼睛不再迷茫，鼻子不再堵塞，鸟悠适而不怕人，鲫鱼偶尔被水边的动静惊走。

人是天地所生。现在反而残害万物，这（如同）是生下来就吃母亲的野兽。现在不应当目光短浅，遗祸子孙。应当作长远之计来福荫万代。

今天我执笔于此，所想的是，屋旁长有早蟠桃一株，如今应果实累累。桃树的枝丫斜伸向水面，我想再驾小舟，拾起它落入水中的桃子，扔进猪圈。坐在银杏树下，观看儿童在树下嬉戏，在砖铺的小道上闲适地散步。扼腕叹息水中没有种植菱藕几株。夏天炎热的时候，就可以摘菱聚莲，烧煮成粘稠的粥，侍奉亲长。

# 编著者的话

## ——只有一个长江

长江在中国乃至地球系统中具有独特的、不可替代的作用和功能。

在全球自然演化和人为演化过程中，长江的自然演化和人为影响显得较为突出，长江流域哪怕是微小的异常都会在中国乃至全球变化中反映出来。因此，无论是资源保护论者、环境保护论者还是泛保护论者，虽然他们对长江在如何进行保护和保护的程度与措施方面有分歧，但都几乎一致地认为中国乃至全球只有一个长江，鉴于它在中国乃至地球系统中独特的重要性，需要中国乃至全球共同行动来保护它。

实际上，早在 20 世纪末到 21 世纪初，资源保护论者就提出多重、持续和最大限度地利用自然资源。他们提出资源不仅要满足我们这一代的需要，也要满足后代的需要。许多国家的大学的自然资源和生命研究课都以资源保护论者的哲学为指导。他们强调以大气、水和土地的内在联系的综合方式来解决环境问题。他们把世界水量和生物量看作是维持人类生命必需刚落需的生命保障系统，他们把人类作为自然界的一部分，而不是与自然界割裂开来。

受现代生态学影响，环境保护论者寻求淡水资源与野生生物适宜的持续的种群数量、最高的生物生产力和生物多样性，而不管其商业价值。他们对地理和功能方面的关注超过了资源保护论