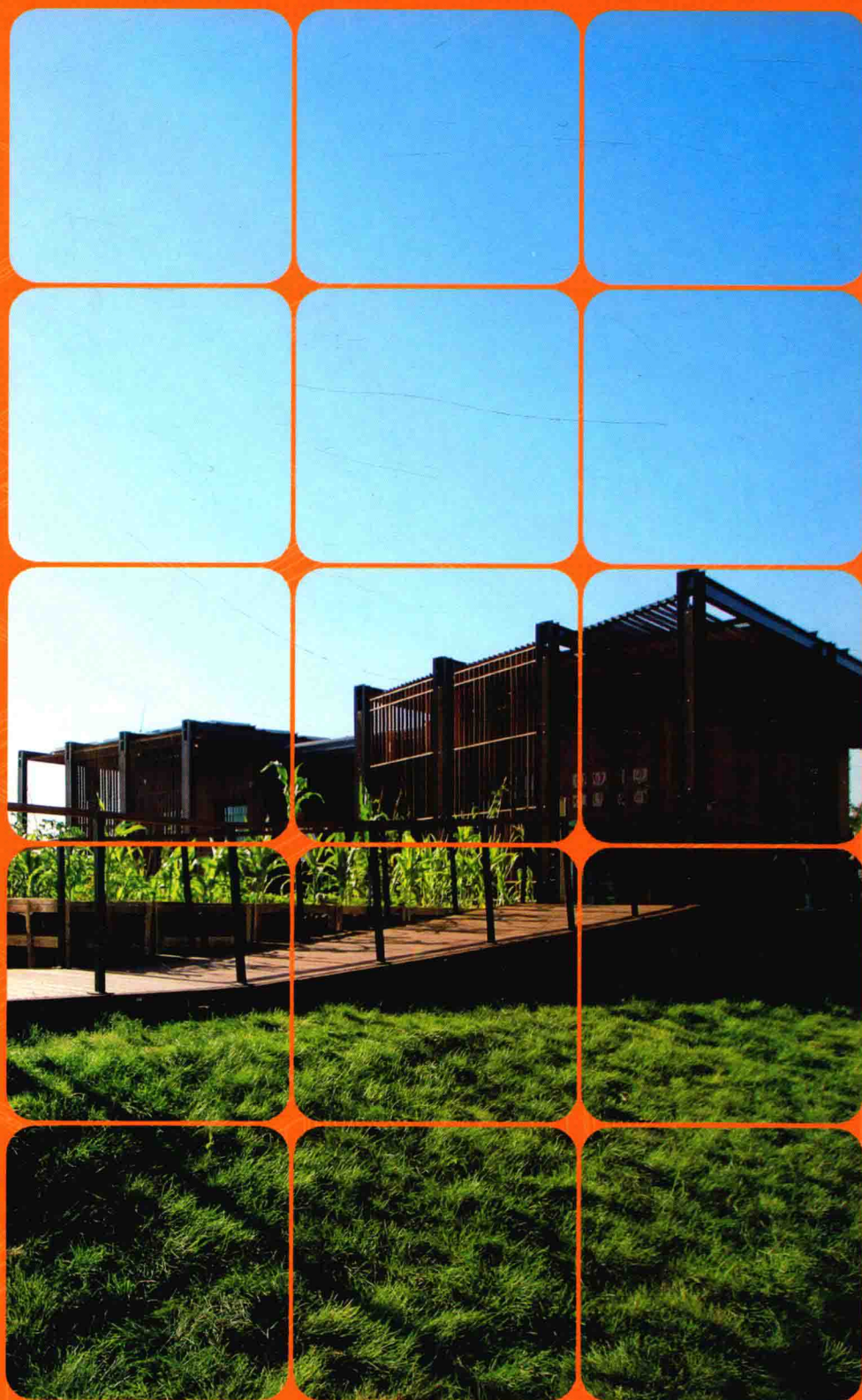


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NET-ZERO ENERGY BUILDING

ECONCAVE

零能耗示范建筑 生态凹宅

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序 / Foreword

进入 21 世纪以来，气候变化与能源、环境问题日益成为国际社会共同关注的热点问题，可持续发展业已成为保障人类永续生存的根本战略。美国政府于 2009 年 12 月颁布的《重整美国制造业框架》，将清洁能源、医学和保健体系、环境科学作为优先重点。2010 年，德国公布《德国联邦政府能源方案》，提出至 2020 年，可再生能源将占其电力总需求 35% 的目标。我国目前已成为世界第一大能源生产国与消费国。我国巨大的能源消费总量及以煤为主的能源结构，是导致大气污染严重、固体废物排放日益增多的根源。

在能源消耗中，建筑业的消耗占有举足轻重的地位。在我国，建筑的运行能耗已占总能耗的 25%，若加上生产建筑材料如水泥、钢铁、玻璃等的能耗及相应的运输能耗，则与建筑业相关的能耗高达 46%，相关的二氧化碳排放也占二氧化碳总排放量的 40% 左右。可以说，建筑业占据节能减排的半壁江山。另一方面，建筑物又是分布式地利用太阳能与风能的最佳载体。截至 2011 年末，我国城市可利用的建筑面积已达 200 亿平方米，具备安装太阳能光伏电池装机能力可达 20 亿千瓦。美国未来学者杰里米·里夫金在其著作《第三次工业革命——新经济模式如何改变世界》中，就曾指出，将每座建筑物作为能源工作站，来分布式地利用太阳能、风能与地热能等清洁或可再生能源，并与智能电网和储能技术相结合，是解决人类未来能源与环境问题的革命性方案。由此可见发展绿色建筑与生态城市是实施可持续发展战略的关键举措。

正是基于此种背景，由美国能源部发起，以全球高校为参赛单位的太阳能建筑科技竞赛，被誉为太阳能界“奥林匹克”的国际太阳能十项全能竞赛自举办以来，一直为全球所瞩目。迄今为止，已举办过九届。2013 年，该项竞赛移师大同市，由中国国家能源局与美国能源部联合主办，由北京大学与大同市人民政府承办，吸引了来自美洲、亚洲、欧洲与大洋洲 13 个国家 36 所大学组成的 22 支参赛队参与竞赛。最终，华南理工大学参赛队取得大赛综合总成绩第二名，也是国内代表队第一名的佳绩。这为华南理工大学和亚热带建筑科学国家重点实验室争了光，着实可喜可贺！

本书介绍了太阳能十项全能竞赛的概况，系统总结了华南理工大学代表队参赛获奖建筑从策划、设计、建造等全过程，涵盖建筑形体设计、自然通风与采光设计、围护结构设计、宜居设计、结构体系、模块化、可拆卸与运输及建造等内容，并论述了所涉及的绿色建筑科学技术，包括太阳能应用、智能控制、空调、给排水以及雨水收集与中水处理等。太阳能住宅麻雀虽小，却五脏俱全。仔细、深入地解剖这只“麻雀”，当给人以深刻的教育与启示。本书内容丰富、叙述详尽，图文并茂，极具参考与推广价值。

披阅书稿，至少给我以两点启示：其一是真正想要建好与推广绿色建筑，取得节能、环保与宜居效果，一定要精心设计、精心建造，认真选材，设计、制造好每个构件，顾及每一个细

节，方能成为精品。其二是绿色建筑涉及多种专业，包括建筑、结构、智能、暖通、给排水、建筑物理等，必须由建筑师主导，与相关专业与工种的专家与科技人员密切结合，组成设计组，集思广益，综合协调，方能设计、建造出合乎理想的绿色建筑，达到艺术与科技的完美结合。舍此并无它途。我想，本书的其他读者，也不难得出相同的结论。

吴硕贤

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Given that climate change, energy, and environment have increasingly become hot issues under the common concern of the international community since the 21st century, sustainable development has risen up to the fundamental strategy that guarantees the sustainable survival of human being. The Framework of the Reconstruction of the U.S. Manufacturing promulgated by the US government in December 2009 gave priority to clean energy, medicine and health care systems, environmental science. In 2010, Germany announced the Energy Plan of German Federal Government and put forward the objective that by 2020, renewable energy shall make up 35% of its total electricity demand. China, the world's largest energy producer and consumer now, is troubled by its huge energy consumption and the coal-dominated energy structure, which are the root causes to its serious air pollution, and increasing solid waste emissions

In China, 25% of total energy consumption goes to the construction industry, if energy consumed in the production of building materials such as cement, steel, glass, etc. and in corresponding transport enter into the equation, then 46 % goes to it, so does 40% of relevant carbon dioxide emissions. It is appropriate to conclude that the construction industry is accountable for half of the indicator values specified for energy conservation and emission reduction targets. On the other hand, the buildings are the best carrier for utilization of solar energy and wind energy on a distributed basis. By the end of 2011, the utilizable floor space in Chinese cities has reached 20 billion square meters, capable of taking in installed capacity of solar PV up to 20 million kilowatts. As pointed out by the US Futurist scholar Jeremy Rifkin in his book *The Third Industrial Revolution – How the New Economic Model Changes the World*, that distributed use made by every building, as an energy workstation, of solar energy, wind and geothermal energy and other clean or renewable energy, if combined with the smart grid and energy storage technologies, is the revolutionary solution to the future energy and environmental issues of mankind. Therefore, it is evident that the development of green buildings and eco-cities are key initiatives to implement sustainable development strategies.

In this exact context, the solar building technology contest initiated by the US Department of Energy and open to universities all over the world, is known as the International Solar Decathlon Event, the Olympics in the solar industry, has drawn worldwide attention since the first session. So far, nine sessions have been held. In 2013, the contest was moved to Datong, jointly organized by the China's National Energy Administration and the US Department of Energy, hosted by Peking University and the People's Government of Datong, attracting 22 teams composed of 36 universities from 13 countries in Americas, Asia, Europe and Oceania. Eventually, the team on behalf of South China University of Technology came out the second place in terms of the total combined score and the first place among the Chinese teams. This was really a congratulatory credit to the SCUT and the State Key

Laboratory of Subtropical Building Science!

The book is an introduction to the Solar Decathlon and systematic summary of the award-winning architecture created by the SCUT team from planning, design, construction, etc., covering architectural shape design, natural ventilation and lighting design, building envelope design, livability design, structure system, modularization, removability, transportation and construction, etc. It also addresses the green building technologies involved, including solar energy applications, intelligent control, air conditioning, water supply and drainage, rainwater collection and reclaimed water treatment and so on. As small as it is, a solar house is well equipped. A careful and thorough dissection of the example will be profoundly informative and revealing. The detailed narrative and illustrations recommend this substantial book of a great reference value.

The manuscript gives me two revelations: one, to build and promote green buildings, achieve energy conservation, environmental protection and livability, we must be scrupulous with design, construction, material selection, design, and manufacture, taking every detail into account before we can create an exquisite work; two, green building relates to a variety of trades, including architecture, structure, intelligence, HVAC, water supply and drainage, building physics, etc. A desirable ideal green building requires joint elaboration led by architects in close cooperation with design teams consisting of experts and technical personnel of relevant trades and types of work to achieve the perfect combination of art and technology. And there is no other path. It would not, as I see, be a difficult conclusion to be reached by other readers of this book.

WU Shuoxian

Chinese Academy of Sciences

Professor, School of Architecture South China University of Technology

State Key Laboratory of Subtropical Building Science Director

前言 / Preface

被誉为太阳能界“奥林匹克”的太阳能十项全能竞赛(Solar Decathlon, SD)是由美国能源部发起并主办,以全球高校为参赛单位的太阳能建筑科技竞赛,至2013年已经在美国本土和欧洲举办过六届,曾吸引来自美洲、欧洲、亚洲的一百多所大学参加,2013年首次在中国举行。2013年8月11日中国国际太阳能十项全能竞赛在山西大同落下帷幕,经过与来自全球各地的20支代表队的几个多月的激烈角逐,华南理工大学代表队 Team SCUT 荣获亚军,并取得国内代表队第一名的好成绩。同时,华南理工大学代表队在十个单项奖中有八项斩获前三,获得了“市场推广”“家庭娱乐”“电气应用”3项第一名;“热水应用”“能量平衡”2项并列第一名;“工程技术”1项第二名;“建筑设计”“宣传展示”2项第三名,这是中国代表队自参加此项比赛以来所获得的最高成绩。本书的编写是将团队两年多来在项目上认真扎实的工作经验拿出来和大家分享。

华南理工大学地处中国南端的广州,在亚热带气候区,我们的建筑学科长期关注气候影响下的建筑学研究 and 实践。现在华南理工大学拥有全国唯一的建筑学科国家重点实验室——亚热带建筑科学国家重点实验室。华南理工大学代表队是依托华南理工大学的综合性理工科大学和亚热带建筑科学国家重点实验室的平台,由建筑学院本科生为主体,联合土木与交通学院、电子与信息学院、自动化科学与工程学院、机械学院、工商管理学院等学院的学生组成;并由建筑学院一批具有丰富研究和实践经验的专业教师和专家组成指导教师组。团队表现出的团结、合作、扎实、专注的态度,成就了这一个完善和创新性的成果,也体现了太阳能建筑是由建筑师主导、多学科专业协同创新的系统性工作。

当还在读本科四年级的曹祖略(队长)拿着辗转得到的太阳能十项全能竞赛信息跑来咨询我意见的那刻开始,到我们的太阳能建筑立在大同市的比赛现场,确实是一个漫长而艰难的过程。竞赛中的每一项内容对学生团队来说都是全新的挑战。大家一起从研究资料开始,理顺思路,搭建工作框架,确定分工;再根据分工组织不同的工作小组,分头推进各项工作,并最终通过设计逐步落实。我们现在看到这本书的章节结构,对应着团队完成项目的“节能、舒适、模块化、科技”四大核心内容,是通过分析研究逐步确定下来的。

由于太阳能绿色建筑的技术集成设计在中国刚刚起步,全行业对太阳能建筑的认识理解不足,推进太阳能房子建设的过程才是大家真正面临的困难。这里需要大量专业设计、产品供应商、工程建设之间的协调管理工作,而关键是要找到愿意提供资助或帮助的厂商。团队最终能够克服几乎让项目夭折的财务困难,有赖于富有远见的赞助商和团队扎实而有说服力的工作。

团队骨干是建筑学院的本科生,他们从大学三年级开始参与,到毕业离开学校,期间他们还需要完成正常的专业学习;整个过程的艰辛让这些骨干们体会深刻,也得到了极大的锻炼。

我们看到许多建筑学专业学生,从分工负责专业协调,到成为各个方面的小专家:空调、智能化、污水处理、门窗、材料、施工等等,甚至还获得了与本科专业看起来毫不相干的发明专利。我身为指导教师看着学生们在这两年中的成长,创造出让人惊讶的成果,倍感欣喜和骄傲!

本书从介绍太阳能竞赛活动开始,给大家全面地介绍了我们团队的获奖建筑策划、设计、建造全过程的经验。内容从建筑学的立场出发,依次从建筑节能设计的被动策略,符合人体舒适性的空间布局,符合结构、运输和产业化建造的模数化设计,再到能源、物理环境控制、智能化及水处理等科技应用,构建了全面的太阳能绿色建筑模型。每个章节是一个完整的分析研究内容,方便读者查阅。我们在分析中,也将参与比赛的团队成果进行了对比分析,方便读者了解和判断。诚然,太阳能建筑设计中解决问题的方法是无穷无尽的,这里只是希望将团队分析问题的整体逻辑呈现出来。

这本书是全体团队成员辛勤劳动的结晶。感谢我们了不起的学生们,这是他们以百折不挠的斗志和卓越的工作创造出来的成果;感谢我们高水准的导师们,给予团队每一步前进的坚定动力;感谢帮助我们的优秀企业和他们的产品,他们是绿色建筑事业的脊梁;感谢给予我们无私支持的领导和朋友们。

我们谨将这本书献给大家!

肖毅强

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2013 中国国际太阳能十项全能竞赛华南理工大学代表队总指导教师

Solar Decathlon (SD), the Olympics in solar energy field, is a Solar Energy Building Contest initiated and sponsored by the United States Department of Energy and open to contestant universities around the globe. The Contest has been held for six sessions by 2013 in America and Europe and has attracted more than 100 universities from America, Europe and Asia. The contest was held in China, for the first time when the curtain of China International Solar Decathlon fell in Datong, Shanxi on August 11, 2013, Team SCUT won the title of runner-up among all teams and the first place among the home teams after more than one month in competition with 20 teams from all over the world. Meanwhile, Team SCUT was ranked among the tops three among 8 categories out of 10, to be specific, three first prize respectively under the categories of Market Promotion, Home Entertainment and Electrotechnical Application; two first places in a tie under Hot Water Application and Energy Balance; one second prize in Engineering Technology; and two third prizes under Architecture and Communications. This has been the best achievement for Chinese teams since this contest. And this book is prepared to share with all of you our experiences of serious and solid work for more than two years on the project.

Since the South China University of Technology (SCUT) is located in Guangzhou in southern China—a subtropical region. People on architecture subject in this University are interested in architecture research and practice under the influences of climate. Now SCUT possesses the only State Key Laboratory of architecture in China—the State Key Laboratory of Subtropical Architecture. Team SCUT, relying on the platform of this comprehensive university of science and engineering and the State Key Laboratory of Subtropical Architecture, is composed of mostly undergraduate students from the School of Architecture and students from the School of Civil and Transportation, School of Information and Electron, School of Automation Science and Engineering, Mechanics Institute, School of Business Administration and so on and led by the tutor group consisting of professional teachers and experts with rich experience in research and practice from the School of Architecture. In achieving the perfect and innovative accomplishment, the team demonstrated a united, cooperative, down-to-earth and dedicated attitude. That reflects that solar architecture is a systemic innovative work led by architects in collaboration with multiple disciplines.

It was a long and hard way, from the moment the senior student CAO Zulue, the leader of the team, brought the hard-won information on the Solar Decathlon contest to ask for my advice until our solar architecture appeared on the contest venue in Datong city. Each category in the contest was a brand-new challenge to the student team. They started to study materials, organize thoughts, develop a working framework, and assign tasks. Then they set up different working groups in correspondence to specific tasks to push forward the work before they finished it step by step eventually. The structure of the book, as you are reading now, was gradually finalized through analysis and discussions and it corresponds with the four core concepts: Saving, Comfort,

Modularization, and Technology. Because the integrated technology design in China is still nascent and the whole industry knows little about solar architecture, the real challenge to everyone was how to carry forward the construction of solar buildings. That would take a lot of work in coordination and management of professional design, suppliers, and construction, and the key was to obtain assistance or financial aid. Thanks to the support from the farsighted sponsors and the convincing endeavor of this reliable team, financial distress that almost ended the project was eventually conquered.

The undergraduates from the School of Architecture are the backbone of the team. They started doing this project at junior year and spent the rest school days on it until graduation, at mean time, they had to complete the required tasks of their major. The hardship in the whole process gave them a profound understanding and good practice. As an advisor, I was gratified and proud of those amazing achievements made in these two years, that many architecture students took far beyond the initial responsibility of professional coordination and became specialists in air conditioning, intelligentization, sewage treatment, doors and windows, materials, construction etc., and some of them even obtained patents of invention unrelated to their undergraduate majors.

This book begins with an introduction to the Solar Decathlon (SD) contest and proceeds with an exhaustive description of our experience in planning, designing and constructing our award-winning architecture in terms of saving, comfort, modularization and technology. In this book, a comprehensive model of solar green architecture is established from architectural perspectives: the reactive strategy of energy conservation, the cozy spatial layout, the modular design allowing for structure, transportation and industrialized construction, and the application of science and technology on energy, physical environment control, smart control and sewage treatment. For the convenience of readers, each chapter is written as a complete and separate analysis where we compare the entries of other contestants to help readers develop an understanding and make their own judgment. In spite of the endlessly emerging solutions to problems in designing solar architectures, this book aims to share with readers the overall logic followed by the team in approaching the problems.

This book is a crystallization of the hard-work of all members. Thanks to those outstanding students for their indomitable endeavor and remarkable performance; thanks to those preeminent advisors for what they have done to encourage the team; thanks to those excellent enterprises, the leading role in green architecture, for their support and products; thanks to leaders and friends that root for us.

For the reasons above, this book is dedicated to everyone!

XIAO Yiqiang

Professor, PhD

Head of School of Architecture South China University of Technology

General Director of Team SCUT, Solar Decathlon China 2013

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建造一座十项全能房子，需要创意来进行设计，需要能力来进行建造，需要智慧来赋予能量，需要毅力坚持到最后。

It takes creativity to design a decathlon house. Strength to build it. Ingenuity to power it. And perseverance to get it here.

国际太阳能十项全能竞赛创始人 - 理查德·金
Founder of Solar Decathlon - Richard King





1-1 背景 / Background

1-1-1 能源状况 / Energy Situation

能源是人类社会赖以生存和发展的重要物质基础。纵观人类社会发展的历史，人类文明的每一次重大进步都伴随着能源的改进和更替。能源的开发利用极大地推进了世界经济和人类社会的发展。

自工业革命以来，煤炭、石油、天然气、水电、核能与可再生能源等相继大规模地进入了人类活动领域。

随着世界经济持续、高速地发展，能源短缺、环境污染、生态恶化等问题逐渐加深，能源供需矛盾日益突出。当前世界能源消费以化石资源为主，其中中国等少数国家是以煤炭为主，其他国家大部分则是以石油与天然气为主。以目前的消耗速度，石油、天然气最多只能维持不到半个世纪，煤炭也只能维持一二百年。

能源结构的演变推动并反映了世界经济的发展和社会的进步，同时也极大地影响了二氧化碳排放量和全球气候。所以不管是哪种常规能源结构，人类面临的能源及环境污染危机都日趋严重。人们对能源提出越来越高的要求，寻找新能源成为当前人类面临的迫切课题。

太阳能正是这样的新能源。照射在地球上的太阳能非常巨大，大约 40 分钟照射在地球上的太阳能，足以供全球人类一年能量的消费。可以说，太阳能是真正取之不尽、用之不竭的能源。而且太阳能发电干净且无害。太阳能被誉为是理想的能源。

太阳能与建筑的结合，是太阳能未来技术发展极为重要而富有前景的方向。形成太阳能建筑一体化，是把太阳能的利用纳入环境的总体设计，使太阳能设施成为建筑的一部分，相互间有机结合，从而实现建筑、技术和美学融为一体。

图 1-1 化石燃料发电站 / Fossil-fuel Power Station

Energy is a vital material basis for the survival and development of human society. Throughout the evolution of human society, every major step of human civilization is taken with energy upgrading and replacement. Development and utilization of energy resources has forcefully propelled the development of the world economy and human society.

Since the industrial revolution, coal, oil, natural gas, hydro, nuclear and renewable energy have been put into the field of human activity on a large scale one after another.

But as the world economy advances at a high speed against gradually severe energy shortage, environmental pollution, ecological degradation and other problems, the contradiction between energy supply and demand has become increasingly prominent. In the big picture of fossil resource-based energy consumption around the world, a few countries such as China is coal-based, most among the rest are oil- and gas-based. The problem is, at the rate of current consumption, oil and natural gas can hardly hold out for less than half a century, and coal would only carry us to the next one or two hundred years.

While bringing along and mirroring the world's economic development and social progress, the evolution of the energy structure has greatly affected the global carbon dioxide emissions and global climate. So no matter what kind of conventional energy structure we use, the human would still face the energy crisis and environmental pollution, which have become increasingly serious. In response, we are proposing higher and higher requirements for energy, and finding new energy sources has become an urgent issue before the humanity.

Solar energy is exact an answer to it. Solar energy in the form of radiation to the Earth is so enormous, that such radiation received on our planet in about 40 minutes, if converted into consumable energy, will hold out a year for all the people on the globe. So to speak, solar energy is truly an inexhaustible source. Besides, solar power is clean and pollution-free, which is why it is known as an ideal source of energy.

Therefore, the combination of solar energy and architecture is a very significant and promising direction for the future technical development of solar energy. In integrating solar buildings, we include the utilization of solar energy into the overall design of environment, turn solar energy facilities into part of buildings, and connect them to achieve the architectural, technical and aesthetic integration.

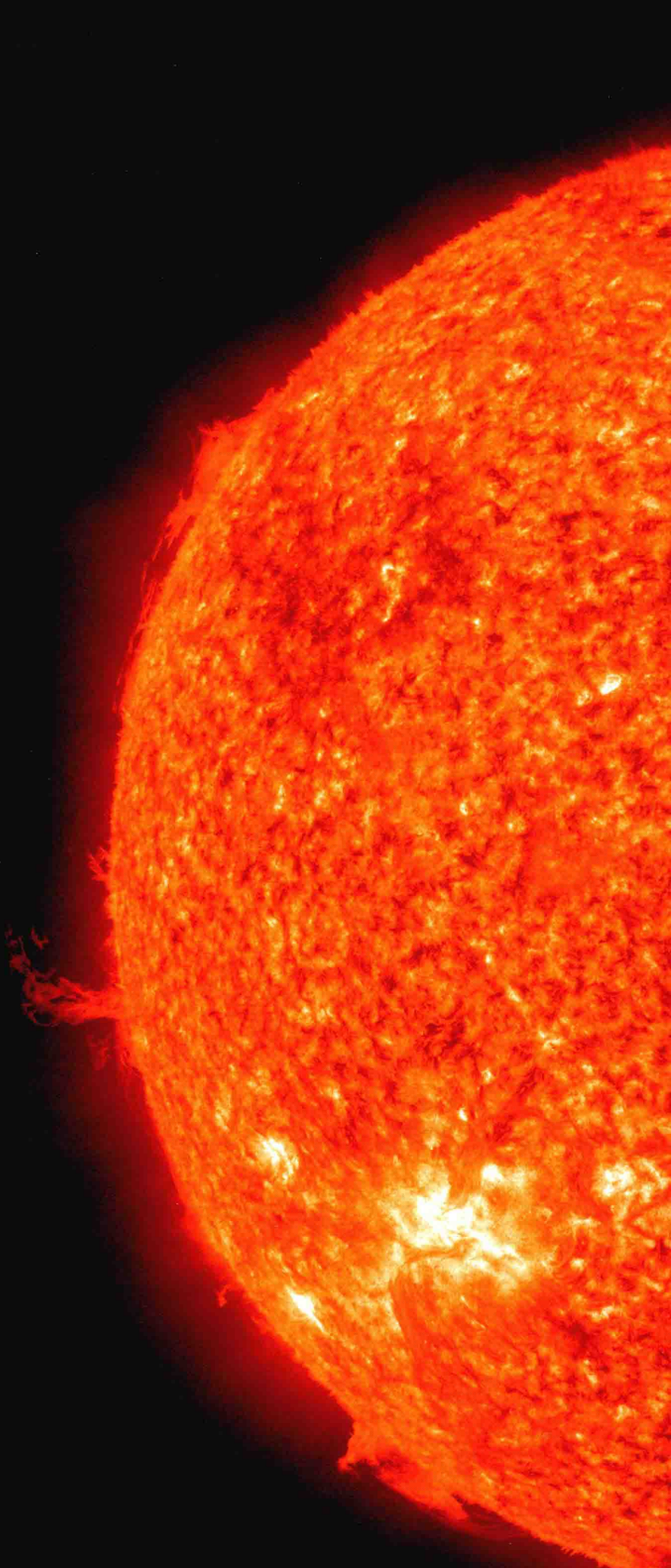


图 1-2 太阳 / The Sun



图 1-3 2009 太阳能十项全能场地鸟瞰 / Solar Decathlon 2009 Aerial View





1-1-2 太阳能十项全能竞赛 美国 / SD USA

被誉为太阳能界的“奥林匹克”的国际太阳能十项全能竞赛（Solar Decathlon, SD）是由美国能源部发起并主办的，以全球高校为参赛单位的太阳能建筑科技竞赛。借助世界顶尖研发、设计团队的技术与创意，将太阳能、节能与建筑设计以一体化的新方式紧密结合，设计、建造并运行一座功能完善、舒适、宜居、具有可持续性的太阳能住宅。竞赛期间，太阳能住宅的所有运行能量完全由太阳能设备供给。SD的本意是希望通过竞赛加快太阳能产业的产学研融合与交流，推进太阳能技术的创新发展和深度应用。

该项竞赛和奥林匹克十项全能竞赛一样有十个单项赛，故称“十项全能”，这十个竞赛项目分别是：建筑、工程、市场潜力、宣传推广、太阳能运用、舒适程度、热水、电器设备、家庭娱乐和能源平衡。该项竞赛于2002年、2005年、2007年、2009年、2011年和2013年在美国本土和欧洲已成功举办了六届，历届大赛吸引了来自美国、欧洲、中国等在内的一百多所大学参加比赛，其世界影响力与日俱增，已逐渐成为全世界最高水准的将太阳能、节能减排、建筑设计紧密结合，涉及多学科综合创新和发展应用的大学生（含研究生）国际竞赛。每届比赛现场都有几十万的民众参观。

Solar Decathlon (SD), which is known as the Olympics in solar energy field, initiated and sponsored by The United States Department of Energy, is an award-winning program that challenges collegiate teams to, on the strength of world top R & D and design teams with great technologies and creativities, design, build and operate fully functional, comfortable and sustainable solar-powered houses combining solar energy, energy conservation and architectural design. As SD is founded to promote industry-university-research cooperation in the solar industry and to facilitate innovation and intensive adoption of solar energy technologies.

Just like the Olympic Decathlon, the contest is divided into ten individual contests, hence the name of “Decathlon”, which are: Architecture, Engineering, Market appeal, Communications, Solar application, Comfort zone, Hot water, Appliances, Entertainment, and Energy balance. This event, already held for six times in the United States and Europe in 2002, 2005, 2007, 2009, 2011 and 2013, attracted more than 100 universities from the United States, Europe, China and other countries. With its growing influence in the world, it has become the international competition of the highest level in the world where university students (including graduate students) to combine solar energy, energy conservation and emission reduction, and architectural design, involving multidisciplinary innovation and the development of application. At each session, the contest venue teemed with hundreds of thousands of visitors.

冠军 /1st Place

亚军 /2nd Place

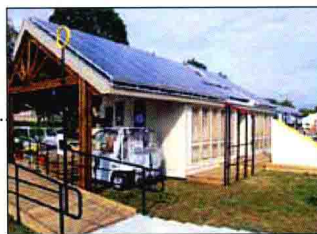
季军 /3rd Place



科罗拉多大学队
/ Team University of Colorado



弗吉尼亚大学队
/ Team University of Virginia



奥本大学队
/ Team Auburn University

2002



科罗拉多大学队
/ Team University of Colorado



康奈尔大学队
/ Team Cornell University



加州理工州立大学队
/ Team California Polytechnic State University

2003
2004



达姆施塔特工业大学队
/ Team TU Darmstadt



马里兰大学队
/ Team University of Maryland



圣塔克拉拉大学队
/ Team Santa Clara University

2005

2006

2007



达姆施塔特工业大学队
/ Team TU Darmstadt



伊利诺斯大学队
/ Team University of Illinois



加利福尼亚大学队
/ Team California

2008

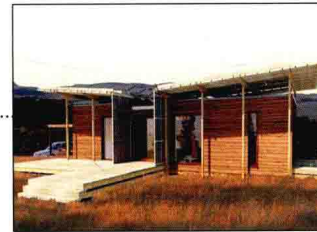
2009



马里兰大学队
/ Team University of Maryland



普渡大学队
/ Team Purdue University



新西兰大学队
/ Team New Zealand

2010

2011



奥地利队
/ Team Austria



拉斯维加斯队
/ Team Las Vegas



捷克队
/ Team Czech Republic

2012

2013

表 1-1 历届太阳能十项全能竞赛获奖队伍
/ Successive Prize-winning Teams of Solar Decathlon



图 1-5 2010 欧洲太阳能十项全能场地鸟瞰 / SD Europe 2010 Aerial View

1-1-3 太阳能十项全能竞赛 欧洲 / SD Europe

从 2005 年国际太阳能十项全能竞赛美国赛区第二届竞赛到 2009 年第四届竞赛，西班牙马德里理工大学 (Universidad Politécnica de Madrid, UPM) 一直参与其中，成为欧洲参与度最高的学校。基于在欧洲推动太阳能利用和可持续性建筑研究的想法，通过马德里理工大学、西班牙驻美大使馆和美国能源部有关代表的协商，双方签订了合作备忘录，达成了由西班牙政府组织，美国政府支持下于 2010 年在欧洲举办第一届“太阳能十项全能（欧洲赛区）竞赛” (Solar Decathlon Europe) 的协定。

2010 年欧洲太阳能十项全能竞赛于西班牙首都马德里举行，共有 17 支队伍参赛。中国同济大学、天津大学参与了赛事。时隔两年，2012 年，马德里再次举办欧洲太阳能十项全能竞赛。吸引了共 20 支团队参赛，中国同济大学再次参赛。2014 年，欧洲太阳能十项全能竞赛来到法国凡尔赛，共 20 支团队再次展开激烈角逐。欧洲太阳能十项全能竞赛，在欧洲已经成为一项成熟而富有吸引力的赛事。

Polytechnic University of Madrid (Universidad Politécnica de Madrid, UPM) was a contestant from the Second Session in 2005 in the United States to the fourth session in 2009. It is the most active participant school in Europe. With a view to promoting the use of solar energy and research of sustainable building in Europe, UPM, the Spanish Embassy in the U.S.A and the representatives of the United States Department of Energy sit down for negotiation and signed a memorandum in regarding the first session of the Solar Decathlon (European region) (Solar Decathlon Europe) to be organized by the Spanish government under the auspices of the US government in Europe in 2010 by agreement.

The 2010 Solar Decathlon Europe was held in Madrid, the Spanish capital, among a total of 17 teams, including Tongji University and Tianjin University from China. Two years later, i.e., in 2012, Madrid hosted the event again, in which a total of 20 teams participated, including Tongji for the second time. In 2014, the event moved to Versailles, France, where 20 teams plunged into fierce competition. Clearly, the Solar Decathlon Europe has become a mature and attractive event on that land.

1st Place

2nd Place

3rd Place

2006

2007

2008

2009

2010

2011

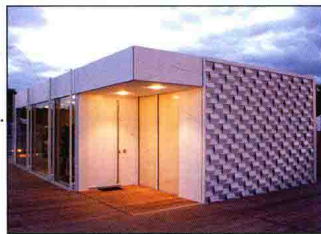
2012

2013

2014



弗吉尼亚理工大学及国立大学队
/ Team Virginia Polytechnic Institute & State University



罗森海姆应用技术大学队
/ Team University of Applied Sciences Rosenheim



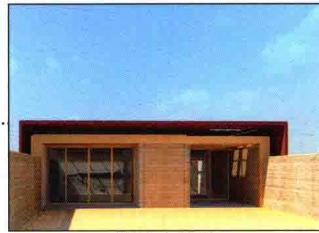
斯图加特大学队
/ Team Stuttgart University of Applied Sciences



罗纳大学队
/ Team Rhône Alpes



塞维利亚大学队
/ Team Andalucía Team



罗马大学队
/ Team Rome



罗马第三大学队
/ Team Università degli Studi Roma Tre



法国队
/ Team France



代尔夫特大学队
/ Team Delft University of Technology

表 1-2 历届太阳能十项全能竞赛获奖队伍
/ Successive Prize-winning Teams of Solar Decathlon