

# Architecture Design Manual II

## School Building

### 建筑设计手册 II

学校建筑

佳图文化 编



华南理工大学出版社  
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#### 图书在版编目 (CIP) 数据

建筑设计手册. 第二辑. 学校建筑 / 佳图文化编. —广州: 华南理工大学出版社, 2013. 11  
ISBN 978-7-5623-4057-7

I. ①建… II. ①佳… III. ①学校-教育建筑-建筑设计-作品集-世界-现代IV.  
① TU206

中国版本图书馆 CIP 数据核字 (2013) 第 223993 号

建筑设计手册. 第二辑. 学校建筑  
佳图文化 编

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出 版 人: 韩中伟

出版发行: 华南理工大学出版社

(广州五山华南理工大学 17 号楼, 邮编 510640)

<http://www.scutpress.com.cn> E-mail: [scutc13@scut.edu.cn](mailto:scutc13@scut.edu.cn)

营销部电话: 020-87113487 87111048 (传真)

策划编辑: 赖淑华

责任编辑: 陈 昊 黄丽谊

印 刷 者: 广州市中天彩色印刷有限公司

开 本: 1016mm×1370mm 1/16 印张: 17

成品尺寸: 245mm×325mm

版 次: 2013 年 11 月第 1 版 2013 年 11 月第 1 次印刷

定 价: 298.00 元

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# Preface 前言

This series continues our previous "Architecture Design Manual I" to be a new collection for "JTart Architectural Series". In recent years, the economy has been blooming and the construction industry has become one of the most important industries. However, due to social, cultural, art and functional requirements, buildings cannot be duplicated by a large quantity. The forms of buildings must be innovative, diversified and distinctive to decorate the cities. Therefore, the design idea of a building is worth being analyzed and discussed. In this new series, we take a professional perspective of architectural design to select projects and do theoretical analysis according to the latest policies and rules of international construction industry. And we hope this series will bring the architects and other professional readers some visual enjoyment and new inspirations.

In this series, all the projects presented are carefully selected from all over the world, which show the latest trend in contemporary architectural design. For each project, we analyzed its features and design ideas with professional drawings, including plans, renderings, sections, elevations, and high-resolution photographs. Theoretical analysis is combined with typical cases to make good interpretation for every kind of buildings. Additionally, this new series has provided detailed introduction for the mostly used building materials. With rich and professional materials, this new series will be valuable reference manuals for the readers.

本套书为佳图文化“建筑设计手册”系列图书，同时也是已出版的“建筑设计手册 I”的延续之作。近年来，在经济蓬勃发展的大环境下，建筑业已然成为一个重要的基础产业，然而，建筑的社会属性、文化属性、艺术属性以及功能属性等都要求建筑不能像其他产品一样被批量复制，为城市的发展添光加彩的建筑形态应该是不断创新的、多样化的、各具特色的。因此，建筑设计的理论是值得深入探讨的。本套书依据国际现行建筑行业的最新政策、法规和规范，站在建筑设计的专业角度，精心挑选案例和系统探讨设计理论，希望能给建筑设计师及相关行业读者带来视觉享受和设计启迪。

作为“建筑设计手册”系列图书中承前启后的专业读本，本套书精选的案例均为国内外优秀案例，代表了当下建筑设计的方向和潮流。内容编排上，分别从案例的关键点、亮点、设计理论等方面入手，并配合大量的专业技术图纸，如效果图、实景图、技术图等。除继续采用“理论+实例”的模式编排内容，在理论部分还特别增加了建筑材料的介绍。资料丰富、专业且翔实，本套书是读者可以真正信赖的设计手册。

# Foreword 序言

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**Zhang Yingpeng 张应鹏**

**National Register Architect  
Chief Architect in 9 town-studio**

**国家一级注册建筑师  
九城都市建筑设计有限公司  
总建筑师**

In recent years, with the continuous increase of population in China and the accelerated urbanization, the demands for school buildings is growing distinctly day by day; meanwhile, the educational resources as a significant part of social resources are relative to the running of education activities and the healthy growing of students through the spatial quality. Therefore, it is absolutely necessary to arrange the focused, systematic and in-depth examination about school buildings. The publication of Architecture Design Manual II : School Building agrees with the innovative design and development requirement of current school buildings.

Statistics says that counted by the national average age, a person will spend 1/4 to 1/6 lifetimes in learning and living at schools of all levels and teachers are responsible to create the healthy education environment. The design of school buildings is more than meeting the primary function of conventional teaching; it requires attention to the spatial vitality. Every architect has his schooldays and we used to be the users of school buildings; we thought and learnt during our close contact with classrooms, playgrounds and libraries. As the designers of school buildings now, the thinking and understanding of educational system and methods, even a slight feeling could be the design engine and lead us further exploiting and creating other functional possibilities of school buildings besides from teaching.

As reported, most Chinese students are not happy now; even in their "territories", their relaxation and delight will be taken away by the pressure. For this reason, I suppose that architects shall not act as assisted oppressors through simply strengthening the existing exam-oriented system; instead, they shall turn the school buildings into a supplement and enrichment of the existing educational system through organization of internal and external space, creating an environment available for students' real happy learning and living. For an instance, we could dispel the authoritativeness of exam-oriented education system by enhancing the non-functional spaces, so as to bring back the vitality and freedom to students, the colorful campus life and more possibilities of youth interpretation.

For some time the design of school buildings is affected by the sectionalism: the coral area of the campus is arranged for office, the building unit with most design features is the administration building while the subjectivity of students is weakened. In fact, student is the exact subject of the campus space, featuring with different characteristics according to different ages: the design of kindergarten highlights children's playful an innocence nature; the design of middle school is supposed to relieve the academic pressure of students through architectural language; the design of college is much more containing and open, with more free presentation of personalities. In addition, the teaching characteristics shall be taken into consideration in designing different types of schools, i.e. vocational colleges and universities are different from general universities, and schools for deaf-mutes are different from general schools.

At present school buildings have obtained more and more attention in architectural design catalogue, and the book selected some new school architectures designed by renowned design companies (institutes), design studios and designers. It provides a multi-perspective presentation through the theoretic analysis, planning, architectural design, structure design and landscape design etc with detailed information. The editing combines graphics and texts; the drawings, renderings and photos are plentiful while the text and description is concise and coming to the point. An systematic layout of these projects offers the chance to present and communicate about the accumulation and reflection of past experience.



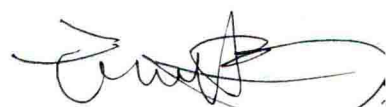
近年来，随着我国人口的持续增长，城市化进程不断加快，整个社会对学校建筑的需求日益显著；同时，教育资源作为社会资源的重要组成部分，其空间品质的优劣直接关系到教育活动能否正常开展，关系到学生们能否健康成长，因此，对学校建筑进行集中、系统、深入地考察尤为必要。《建筑设计手册Ⅱ：学校建筑》的出版很好的契合了当下学校建筑的创新设计与发展需求。

据统计，按全国平均年龄计算，人的一生有  $1/4 \sim 1/6$  的时间都在各级各类学校中学习与生活，创造健康的学校环境，建筑师责无旁贷。学校建筑的设计首先当然是为了满足常规的教学功能，但不能仅仅如此，学校建筑要同时关注空间的生命力与活力。每个建筑师都从学生时代走来，曾经我们是学校建筑的使用者，与教室、操场、图书馆都曾亲密接触过，留下过自己的思考与体悟；现在当我们成为学校建筑的设计者时，过去那些对教育体制、对教育方法审慎的思考与理解，甚至是一些零星的感受都可能成为设计的“引擎”，带领我们走得更远，开拓并创造学校建筑教学功能以外的其他可能。

有报道称，现在的中国学生都不快乐，哪怕是在他们的“地盘”，压力还是让他们轻松高兴不起来。这样的情境下，我认为，建筑师不能是简单地对现有应试体系的进一步强化，成为“压迫”学生的“协助者”，而是要通过内部空间与外部空间的组织将学校建筑变为对现有教学体制的一种补充与丰富，让身处其中的学生真正可以快乐学习、快乐生活。比如我们可以通过非功能空间的加强来消解当下应试教育体制的权威，还原学生应有的活力与自由，让校园生活多姿多彩，为青春的释放提供更多的可能性。

一段时间内，本位主义的不良之风也曾影响到了学校建筑的设计：校园最核心的区域用作办公，最富设计特色的单体建筑是行政楼，学生的主体性反而被弱化。事实上，学生才是校园空间的真正主体，并具有不同年龄段的不同特点：幼儿园的设计需要凸显儿童爱玩的天性，为童真的飞扬提供平台；设计中学时则要通过建筑的语言来帮助中学生缓解升学的压力；到了大学，个性的彰显更显肆意，学校应该更具包容与开放性。此外，还要考虑各个不同类型学校的教学特点，比如职业类的大专院校不同于普通高等院校，聋哑学校不同于一般的中小学……

当下，学校建筑已被视为一种建筑设计类别得到越来越多地关注，本书遴选了众多设计公司（设计院）、设计事务所及知名设计师的新近学校建筑设计作品，从理论分析、规划布局、建筑设计、结构设计、景观设计等多维度切入，内容翔实；图文结合的排版方式，一目了然：技术图、效果图、实景图等详细图纸悉数呈现，文字说明短小精悍、切中要点；对这些案例系统的编排为过往经验的积累与反思提供了一个极好的展示与相互交流的机会。



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# Chapter One Theory

第一章 理论分析



## 1 Concept

In recent years, the construction of superior school buildings with people-oriented education outlook has been a great advancing measure under the global education reform wave pursuing fair and excellence. However, most school buildings at the moment disregard the education space design and not manifest the modern culture of quality schools; the design of architectural functions focuses on applicability, up-to-standard and security. Therefore, learning the essential concept of school building is significant in real to the design direction of future school buildings and the spatial design and planning of new-type schools.

### 1.1 Image of School Buildings

What is a school or what should a school be? The relevant conceptual and theoretic problems have been the philosophic questions discussed by many educators and educational theory researchers. Professionally, we could view a school as a collection of sites for teaching and learning. Under the research of school architecture development history, it could be classified into five phases:

- A. From Founding to Adjustment Phase;
- B. From Adjustment to Finalization Phase;
- C. From Finalization to Generalization Phase;
- D. Mass Construction of Finalized School Buildings;
- E. Creation of New-type Schools

Concerning the presented images of architectures, school buildings could be roughly split into phase of non-specific image, phase of distinct features and phase of creating school buildings unlike schools.

### 1.2 Definition of School Building

Broadly speaking, a school is composed of school architectures, schoolyard, athletic field and ancillary facilities. School architectures refer to all types of buildings in a school; athletic field covers playground, court, gym, activity center and swimming pool etc.; schoolyard is the garden space in a school outside buildings and playgrounds and ancillary facilities comprise some basic supporting facilities for a school. Narrowly speaking, school buildings merely refer to the architectures. To sum up, school building is

## 一、概念

近年来,在全世界追求“公平而卓越”的教育改革浪潮下,营建育人为本的优质学校建筑成为人们推进教育改革的重要举措。然而,目前大部分学校建筑普遍忽视空间的育人设计,建筑功能基本停留在“能用”、“达标”和“安全”上,未能有效满足现代化的教育需要,也未能恰切彰显现代的品质学校文化。因此,了解学校建筑的本质概念,对于未来学校建筑的设计方向和新型学校空间的规划及设计有着非常重要的现实意义。

### (一) 学校建筑的形象

什么是学校?或者学校应该是什么?有关这些概念性及理论性问题,始终是很多教育家及教育理论工作者谈论的哲学问题。从专业的角度上讲,我们把学校视为包括“教”与“学”及教学行为展开场所的总和。从学校建筑形成发展史研究结果来看,通常把学校建筑分为五个时期:

- (1) 学校建筑从创立到调整时期;
- (2) 从调整到定型化时期;
- (3) 从定型化到普遍化时期;
- (4) 定型化校舍大量建设时期;
- (5) 新型学校创造时期。

就建筑物的呈现形象而言,学校建筑大致可以分为:没有特定形象的学校建筑阶段、具有明显特征的学校建筑阶段和不像“学校”的学校建筑创造阶段。

### (二) 学校建筑的定义

学校建筑以 School Building 作为普遍的专有名词。从广义而言,学校建筑包括校舍、校园、运动场及其附属设施。其中校舍即为校内的各类建筑,运动场包括操场、球场、体育馆、活动中心、游戏场和游泳池等,校园则指除去校舍和运动场以外的校地庭院空间,而附属设施则包括其他一些基本的校园配套。从狭义而言,学校建筑仅指校舍建筑。综合而言,学校建筑是人们为了达到特定的教育目的而兴建的教育活动场所,其品质直接影响到



sites for education activities under the specific education intention, and its quality will cause a direct effect on the development of school education and the talents training; furthermore it embodies the social education thoughts, values, economic and cultural outlooks, which leads it to the absolute significance.

## 2 Planning

A school is built for education and talents training. With the social development and increasingly global diversification, functions and requirements of a school tend to be diversified. Hence the functional zoning and teaching order shall be taken into consideration for rational and reasonable planning and design of a school.

### 2.1 Understanding of School Planning and Design

#### 2.1.1 Functions and Order

Teaching area is the core of a school and all the other functions are arranged around it. Group and network are two main layout adopted in the design of teaching area.

Courtyard as a form of traditional Chinese architecture layout is encircled by architectures to build the social public space, which is conducive to the communication. A group layout helps to arrange and manage the education activities relatively independent among colleges and departments, and match the reality of a long construction period in different stages. A network layout will be conducive to the profession update and scale adjustment of different departments in the future development, and flexibly alter the application of teaching rooms, which consequently leads to its being flavored in the planning of modern new-type schools.



New Campus of Chengdu Shishi High School  
成都市石室中学新校区

学校教育活动的正常开展,关系到学校人才培养的质量,同时它作为载体还是一个社会的教育思想与价值观念、经济与文化面貌等的具体体现者,因此其重要性不言而喻。

## 二、规划设计

学校是实施教育和培养人才的重要场所。随着社会的发展,世界日趋多元化,校园内的功能和各种需求也趋向于多元化,在规划设计中要充分考虑学校中的功能分区和教学的秩序,才能做到合理地设计和规划。

### (一) 对于校园规划设计的认识

#### 1. 学校的功能和秩序

教学区是校园的核心,学校中的一切其他功能均是围绕其进行的。教学区的布局主要有组团式与网络式两种主要设计方法。

“院落”是中国传统的建筑布局形式,由建筑所围成的庭院形成社交性的公共空间,也有利于学校中的交流。组团式便于院系相对独立地组织教学活动与进行管理,更能适应建校周期较长而分期施工的现实;网络式的发展规划则有利于不同的科系在今后的发展中专业的更新与规模调整,并可灵活调节教学用房的使用性质,因此被现代的新型校园规划布局所偏爱。

### 2.1.2 Traffic Organization

The traffic organization of a school intends to express the idea of human orientation. Modern education is a multi-level three-dimensional network structure and system, thus besides from the three-dimensional intersection in teaching, the planning shall pay attention to creating physical environment conducive to the comprehension development of youth; pedestrian space is turned from functionally traffic space into a multi-level and multi-functional sociality space for information contact and emotional communication, providing a safe and comfortable outdoor space to students and staffs. Modern school requires convenient contact and unobstructedness among the architectures, hence centralized layout is the common application to types of buildings and the architecture complex is arranged as a group to reduce the distance among architectures and the traffic routes. By architectures to build the social public space, which is conducive to the communication. A group layout helps to arrange and manage the education activities relatively independent.

## 2.2 Planning of Primary and Secondary School Buildings

### 2.2.1 Site Selection Principles

The superior environment, plentiful sunshine and fresh air are the factors considered in the site selection. The school site is supposed to be far away from any physical, chemical and biological pollutants, i.e. radio transmission tower releasing electromagnetic wave, factories causing noise and pernicious gases, refuse stations and infectious hospitals. General teaching space allows noise no more than 50DB of Level A while in the meantime

### 2. 学校的交通组织

学校交通组织中，要的是能体现以人为本的思想。现代教育是一个多层次的立体网络教育结构体系，除了在教学上的立体交叉，在校园规划中，应该努力造就有利于青年全面发展的学习环境；改变人行空间单纯的交通功能为多层次交往空间，形成多层次、多功能的信息联系和丰富的情感交流的空间，创造学生和教工安全、舒适的室外活动空间。现代校园要求建筑物之间能联络方便，尽量通畅、便捷。为此，各类建筑物的设计，多采用集中式的布局，建筑群体也多以成团的方式组合，尽量减少楼间的距离及交通路线。

## （二）中小学校建筑规划与布局

### 1. 选址原则

选择校址要保证学校有良好的环境、充足的阳光和新鲜的空气。校址应远离各种物理、化学和生物污染源，如产生电磁波的电台发射塔、产生噪声和有害气体的工厂，以及垃圾站和传染病院。一般教学用房的允许噪声级不得大于 A 声级 50 DB。同时也应考虑学校本身对周围环境的干扰。



Suzhou University Physics Academician Laboratory Building & Information Electronic Building  
苏州大学物理院士实验楼及信息电子楼



the interference to the surrounding environment coming from schools shall be taken into consideration in the site selection.

2.2.2 Layout of Teaching Buildings

The figure of a teaching building is supposed to present the concise and high quality under the artistic conception. A building for learning shall not underline the luxury and extravagance of the materials and decoration; the design is supposed to essentially convey the education concept of a school building, and its artistic creation will highlight the essence of teaching and learning, manifesting the idea of human orientation. Teaching buildings generally have three types of plane layout: central-corridor type, single-corridor type and external-corridor type.

2.2.3 Planning and Design of General Classrooms

General classrooms accounts for the most part of teaching space in primary and secondary schools where students will spend 70% of their schooldays, thus the requirements for classroom environment and applied functions are relatively higher. The arrangement of a classroom has to meet the requirements for students' seats, passages, lectures and writing, teachers' counseling and evacuation distance etc. every seat in a classroom requires substantially equal visual conditions, superior lighting, ventilation and acoustics. Apart from blackboard (no glare), platform, cleaning closet, curtain rods, clothing storage bay, the facilities in a classroom have to fit in with the application of audio-visual instruction. Classrooms in some cold regions shall be equipped with heating, insulation and ventilation facilities. To protect students' sights, the daylight factor of a classroom shall not be lower than 1.5, the desktop illumination standard no less than 150 lx, and the blackboard illuminance no lower than 200 lx.

2.2.4 Master Plane

- A. An architecture design of a school will be not arranged before the approval of its master plane design.
- B. Teaching and auxiliary space, administrative space, service space, athletic fields, science corners and living area shall be arranged under reasonable layout, with distinct zoning, convenient contact and no interference.
- C. Covered playground will be set far away from the teaching area and close to the outdoor athletic field.
- D. Music classrooms, piano rooms and dancing classrooms will be located no interfering with the other teaching spaces.
- E. A school gate shall not face the main roads of a town or city, or roads with over 300 motor vehicles traffic volume per hour. A certain buffer distance should be obtained at the school gate.
- F. Distance among the architectures will agree with the following regulations:
  - a. Superior ventilation for the teaching space;
  - b. No less than 2h's full window sunshine in the bottom level of general classrooms to the south in midwinter;

2. 教学楼的布局

教学楼建筑的体形环境应该重在构思艺术上的简洁、朴实和高品质，学习建筑不应该只强调材料、装饰的豪华与铺张，要从设计本质上体现建筑的“教育”概念，在教学建筑的艺术创作上重现“以人为本”，突出教学建筑的本质——“教”与“学”。教学楼的平面布局通常有三种形式：中内廊式、单内廊式和外廊式。

3. 普通教室规划设计

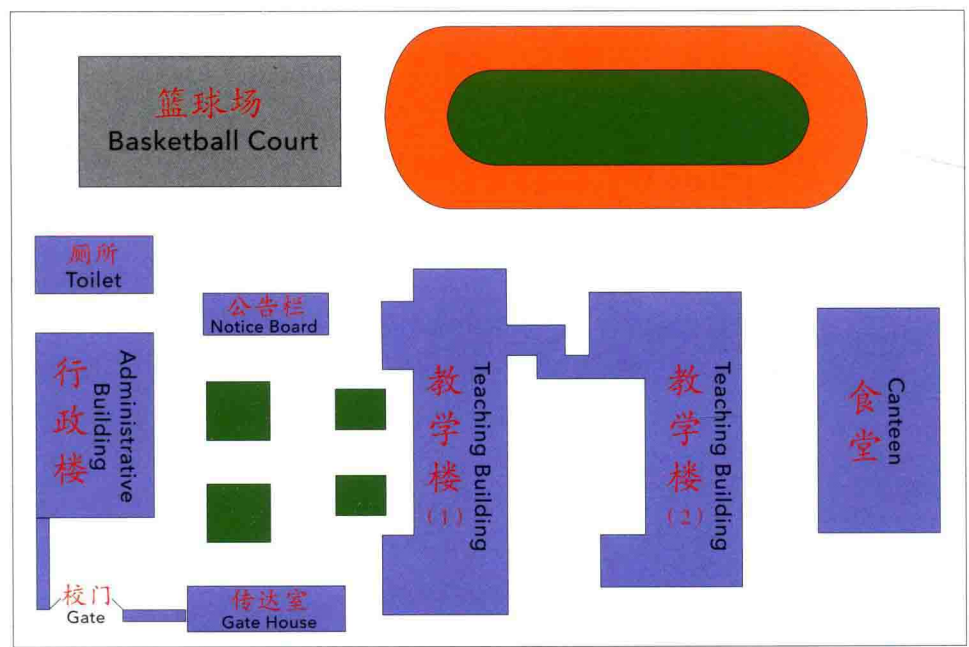
普通教室在中小学校教学用房中占的比重最大，学生在校时间约有 70% 是在教室里度过的，因此对教室的环境和使用功能的要求较高。教室的布置要满足学生就座、通行、听课、书写、教师巡回辅导和学生疏散的合理间距等要求。教室内每个座位要有基本均等的视觉条件，良好的采光、照明、音响和通风。教室的设施，除设置黑板（不产生眩光的）、讲台、清洁柜、窗帘杆、衣物贮存等设施外，还应考虑视听教学的教育手段的应用。在寒冷地区，应有采暖、保温和换气设施。炎热地区应有隔热和降温设施。为保护学生视力，教室里的采光系数不能低于 1.5，桌面照明标准不宜低于 150 lx，黑板照度不宜低于 200 lx。

4. 总平面布局

- (1) 学校应有总平面设计，经批准后，方可进行建筑设计。
- (2) 教学用房、教学辅助用房、行政管理用房、服务用房、运动场地、自然科学园地及生活区应分区明确、布局合理、联系方便、互不干扰。
- (3) 风雨操场应离开教学区，靠近室外运动场地布置。
- (4) 音乐教室、琴房、舞蹈教室应设在不干扰其他教学用房的位置。
- (5) 学校的校门不宜开向城镇干道或机动车流量每小时超过 300 辆的道路。校门处应留出一定缓冲距离。
- (6) 建筑物的间距应符合下列规定：

c. Two rows of classrooms will have more than a 25m distance between the facing two relatively longer sides; the longer side of classroom will be over 25m away from the athletic fields.

G. Fertilizer fermentation field of botanical garden and small animal farm are supposed neither to locate close to architectures nor to contaminate water resource.



General Site Plan for Primary School  
一般小学校园平面图

- ①教学用房应有良好的自然通风。
  - ②南向的普通教室冬至日底层满窗日照不应小于2h。
  - ③两排教室的长边相对时，其间距不应小于25m。教室的长边与运动场地的间距不应小于25m。
- (7) 植物园地的肥料堆积发酵场及小动物饲养场不得污染水源和临近建筑物。

## 2.3 Planning and Layout of College Building

### 2.3.1 General Layout

Teaching center is the core in the general layout of a college and university, which is designed under the consideration of advantageousness, teaching and scientific research convenience. The campus architecture complex may be constructed with public teaching building as the core, or composed of public teaching building, library and relative lab center and research center, or composed of public teaching, assembly hall and student center etc. The layout of teaching center presents the architectural image of a college or university, as well as its nature and characteristic. It occupies spacious plaza and courtyard, along with green land, monument and architectural articles to form an open public space of grace, quietness, decentness and simplicity. Passing through the roadway shall be avoided given the bustling human flows in the teaching center.

### (三) 高等学校建筑的规划与布局

#### 1. 总体布置

教学中心区是高等学校总体布置的核心，应从有利和方便教学、科学研究出发。校区主体建筑群由公共教学楼为核心组成；也可以由公共教学楼和图书馆或有关实验中心、科研中心组成；还可以由公共教学楼和会堂、学生中心等组成。教学中心区的布局是高等学校建筑形象的体现，要表现出学校的性质和特点。教学中心区应有宽阔的广场和庭院，并与绿地、纪念物、建筑小品等组成安静、优美、亲切、朴实的公共性开放空间。教学中心区往来频繁，应避免车行道穿越。



2.3.2 Planning Layout of Teaching Building

A. General Teaching Building. It refers to public teaching building mainly containing general classrooms and lecture halls, comprising small classroom for single class lecture, medium classrooms for more than one class in a lecture, and lecture halls with over 120 seats. General teaching buildings will be designed to be public teaching buildings or lecture hall centers for easy organization of facilities and pipelines, and the enhanced utilization of public classrooms.



Arts Building of New Campus Project, Jimei University, Phase III  
集美大学新校区三期

B. Professional Teaching Building. It refers to types of labs and special classrooms, including labs with precise instrument and facilities, requiring quietness and cleaning; labs with heavy machinery equipments or large transport capacity; labs releasing harmful substances i.e. waster gas, water and residue or noise; special classrooms for painting, piano and practice. This type of teaching rooms is designed in accordance with functional requirements and characteristics.

C. Research Building. Most colleges and universities occupy independent scientific research buildings for types of research institutes, opening to full-time researchers, teachers, students and graduates as the teaching experiments and research labs.

D. Intern Plant. It refers to the teaching internship site and production base built in an engineering college, which will not be oversized considering the teaching characteristics.

2.3.3 Sports Facilities and Student Activity Center

Sports facilities and student activity center are significant in a college or university. A stadium or gymnasium shall be positioned between student living area and teaching area, closer to student living area. Some colleges overseas build a student activity center of a large architecture scale, comprising sports facilities and other service facilities for students and teachers' physical training, recreation and activities.

2. 教学建筑布局

(1) 一般性教学建筑。指以普通教室为主的公共教学楼，以教室、讲堂为主，包括供一个班级教学用的小教室，合班用的中型教室和 120 人以上的讲堂。为了便于设备、管线布置和提高公用教室的使用率，一般的教学建筑常设计成公共教学楼或讲堂中心。

(2) 专业性教学建筑。主要指各种实验室和专用教室，包括：拥有精密仪器仪表设备或要求安静、洁净的实验室；拥有重型机械设备或运输量大的实验室；排放废气、废水、废渣等有害物质和产生噪声的实验室；绘图、练琴、练功等专用教室。这些教学用房应根据功能要求和特点进行设计。

(3) 科研性建筑。高等学校大多设有各种研究机构，常建造独立的科学研究建筑，供专职研究人员、教师做研究工作之用，也作为学生和研究生进行教学实验和研究实验的场所。

(4) 实习工厂。工科高等学校中的教学实习场所和生产基地。要充分考虑教学特点，规模不宜过大。

3. 体育设施和学生活动中心

体育设施和学生活动中心是高等学校必不可少的。体育场和体育馆的位置应安排在学生生活区和教学区之间，靠近学生生活区。国外一些大学设有建筑规模很大的学生活动中心，其中有体育设施，还有其他服务设施，作为学生和教师健身、休息和活动之用。





New Campus of Central University of Finance and  
Economics Living Quarters, Phase I  
中央财经大学沙河新校区一期生活区

#### 2.3.4 Design of Living Area

Living area in a college or university is composed of student living area and staff living area. Student living area will be closer to the teaching area while staff living area will be beyond the teaching area. It had better to set the graduate dormitory detached but it is no problem to set with staff dormitory for single person and student dormitory. Student canteen shall be located near the roads between student dormitory and teaching area.

## 3 Architecture Design

### 3.1 Structure Selection of School Building

#### 3.1.1 Architectural Structure

The fundamental factors of structure selection: School buildings in China are generally with large bay, large depth, few transverse walls, relatively large floor height and a plane layout of external corridor or single corridor; all the mentioned features are the fundamental factors of structure selection.

Structure Selection: In accordance with the above features, school building will generally adopt a concrete frame structure, especially with a light frame; underlining the characteristic of lightweight, lightweight materials are applied to the architecture to reduce the self weight and cost, so as to enlarge the space for use. Frame structure could be another option in capable cities; masonry bearing walls will not be taken into consideration unless in a small building of 5 floors or less.

#### 4. 生活区设计

高等学校生活区包括学生生活区和教员工生活区。学生生活区可以同教学区近一些，教员工生活区应布置在教学区以外。研究生宿舍最好单独设置，但可以和单身教工宿舍、学生宿舍布置在一起。学生生活区中学生食堂宜布置在学生宿舍通往教学区的道路附近。

## 三、建筑设计

### (一) 学校建筑的结构选型

#### 1. 学校建筑的结构选型

结构选型的基本因素：我国学校建筑的基本特点是开间大、进深大、横隔墙少、层高相对较高而且常要求做成外廊式或单内廊式平面布置形式，这些特点是影响其结构选型的基本因素。

结构选型：根据以上特点，学校建筑一般应该选用混凝土框架结构较为适宜，特别是选用框轻结构，突出“轻”这一特点，在学校建筑中使用轻型材料，以减轻自重，降低造价，扩大空间，满足使用。有条件的城市可以考虑框架结构；仅在5层和5层以下的小型建筑才可考虑砌体承重墙。



### 3.1.2 Concrete Frame Structure

**Frame Column:** Besides the general rectangle column, specially shaped column is applicable; the column section is made in T and L shape so as to hide in a wall, and the length could be increased to adjust the horizontal and vertical stiffness of the architecture.

**Floor:** Cross dense ribbed floor, cross beam floor, unbonded prestressed slab, multi-ribbed floor and ribbed floor etc. are applicable.

**A. Cross dense ribbed floor:** A 600–1,200 mm spacing, a 1/20–30 span in the short side of the ribbed height with horizontal and vertical frame beams around, a 60 mm thickness of the panel, sound insulation blocks as the replacement of frame; it is widely applied for its distinct technological and economical advantage.

**B. Cross beam floor:** The ribbed space is enlarged to 1,500–3,00 mm without frame, 1/20 span in the short side of the ribbed height, a 50 mm thickness of the panel; its cost is relatively less.

**C. Unbonded prestressed slab:** The utilization of unbonded prestressed steel could get over the ponderousness of the slab caused by its thickness, with horizontal and vertical frame beams around.

**D. Multi-ribbed floor:** Precast hollow slab (series model of SP slab or SPD slab), produced continuously with wire reinforcement, and the span could be set in accordance with orders.

**E. Ribbed floor:** The most common floor constructed with primary and secondary beams, simple design and construction; pillar distances shall not be large since pillars in the middle of a classroom will affect the use; it is applicable under low standard conditions.

### 3.1.3 Steel Frame Structure

It is one of the most appropriate structures for a school building, and generally adopted in developed countries. It will be popularized gradually, fully demonstrating the new-type structure system of urban school buildings in China.

## 2. 混凝土框架结构

**框架柱:** 除常用矩形柱外, 还可考虑采用异形柱, 即将柱的截面做成“T”形、“L”形以便隐含在墙体中, 并可适当地增大其肢的长度来调整建筑物的纵横刚度。

**楼盖:** 可采用双向密肋楼盖、井字楼盖、无粘结预应力平板、密肋楼盖及肋形楼盖等。

(1) 双向密肋楼盖: 其间距为 600 ~ 1200mm, 肋高 1/20 ~ 30 的短边跨度, 四周就是纵横向的框架梁, 露面厚度通常为 60 mm, 模壳也采用隔声砌块代替, 双向密肋楼盖有显著的技术、经济优点, 运用广泛。

(2) 井字楼盖: 在不用模壳的情况下, 将肋间距增大到 1500 ~ 3000 mm, 肋高通常为 1/20 的短边跨度, 面板还是 50 mm 厚, 其造价略低。

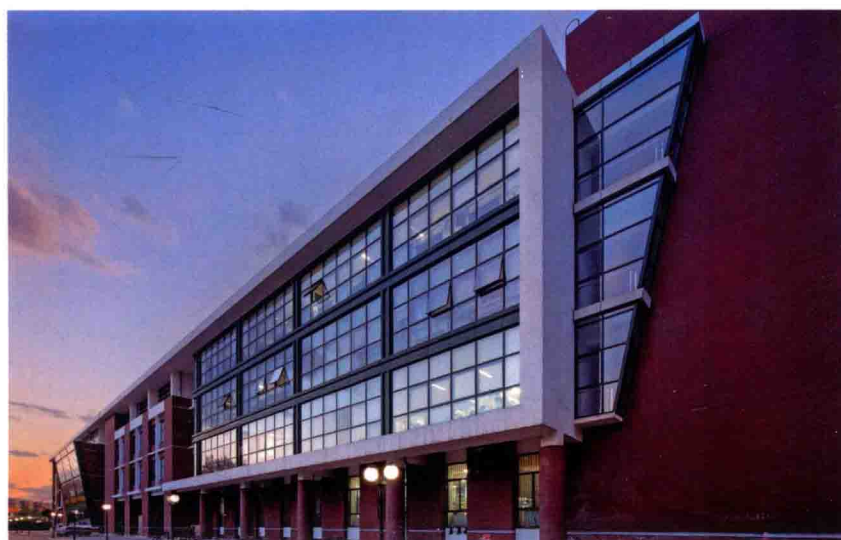
(3) 无粘结预应力平板: 其设置了无粘结预应力钢筋可以克服平板做得太厚而显得笨重, 其四周同样应该是纵横向的框架梁。

(4) 密肋楼盖: 预制空心板 (系列型号为 SP 板或者 SPD 板), 这种板采用绞线配筋连续生产, 跨长在订货时可以任意选定。

(5) 肋形楼盖: 最普通的一种主次梁结构形成楼盖, 设计、施工均较为简单, 其柱距不宜做得很大, 因此在教室中间会出现柱子影响使用, 低标准条件下, 可以考虑采用。

## 3. 钢框架结构

钢框架结构是特别适宜于学校建筑特点的一种结构形式, 发达国家基本普遍采用, 它将作为我国城市学校建筑的新型结构体系充分的展现, 并逐步推广。



Structure and Outer Appearance of Life Science Building (China Agricultural University)  
中国农业大学生命科学楼外部结构造型



College of Civil Engineering of Tongji University  
同济大学土木工程学院大楼