

## Pilot Reform of the Model Course: *Engineering Geology*

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**Abstract.** *Engineering Geology*, as the foundation course of civil engineering, is featured by strong practicality. Aiming at the cultivation objective of the civil engineering undergraduate education, based on the training program, in virtue of the CDIO educational concept and method, this paper suggest a reform scheme of the *Engineering Geology* to establish a course syllabus focusing on ability cultivation and improve the students' abilities of application and innovation by practices and instance analysis.

### Introduction

CDIO engineering education model is a new achievement of the international engineering education reform<sup>[1]</sup>. The teaching concept of the CDIO inherits and develops the engineering education reform concept of America and Europe in recent 20 years. Further more, the 12 operable standards<sup>[2]</sup> of ability cultivation, overall implementation and evaluation, were proposed. CDIO stands for Conceive, Design, Implement and Operate<sup>[3]</sup>. Through the life cycle of the product research to product running, it makes student to study engineering in a positive, practical way. The abilities of the engineering graduates are classified 4 levels: engineering basis knowledge, personal ability, team spirit and engineering system ability, by the syllabus. The syllabus demands that student should reach the scheduled goals in all 4 levels by comprehensive qualities cultivation. Approved by the education experience in both at home and abroad, the CDIO is developed and feasible. And it is suitable for the reform of every process in engineering education<sup>[4]</sup>.

With the fierce talent competition, most employers believe that most civil engineering graduates are lack of the practical abilities and can't meet the demand of the practical work<sup>[6]</sup>. It shows the lack of practical courses in some schools. In order to improve the practicality of *Engineering Geology*<sup>[5]</sup>, the education concept of the CDIO is introduced into the *Engineering Geology* course to structure a course syllabus focusing on ability cultivation and cultivate the comprehensive ability of students by the combination of theory and practice.

### Content and Purpose of the Course Reform

**Purpose of the course reform.** The main contents of this course are the basic theory of engineering geology, the analysis and evaluation method of the engineering geology, engineering geological problems, key points of the engineering geological investigation, etc. In the meanwhile, we improve the students' abilities of application and innovation by the combination of the engineering practice and examples analysis. Specifically, we make students master the discrimination and analysis method of geological condition of construction sites, let students to learn to survey, research and solve all kinds of geological problems about engineering and construction, and make sure students to acquaintance to the prevention measure of adverse geologic phenomena.

We give consideration to the course syllabus and bachelor cultivation scheme of the civil engineering, *Code for Design of Building Foundation*, *Code for Investigation of Geotechnical Engineering* and the cultivation objective of civil engineering undergraduate education, and take the information about the examination of registered geotechnical engineer into considered in the curricula construction. Based on *The Plan for Training Practical Outstanding Engineers of Civil Engineering*, capability demands and 12 standards of the 4 levels CDIO training syllabus and the

syllabus about the key point and difficult point of the teaching content, we structure a course syllabus focusing on ability cultivation.

**Content of the course reform.** (1) Compile and implement two CDIO project guide book, the laboratory experimentation: *The Samples of Mineral and Rock Indoor Identification* and the field practice: *The Rock Type and Geological Structure in Field Identification*, lab report writing demands and grade evaluation index system. By linking the above content and the further specialty courses, we form the basic requirements and cultivation objective of the professional ability syllabus.

(2) Design and implement three CDIO level-4 course projects reflecting CDIO concept and method: *Impact of Groundwater on Civil Engineering and Prevention Measures*, *Effect and Prevention Measures of Adverse Geological Condition*, and *The Method and Application of Geotechnical Investigation*. The specific implementation plan covers the ability cultivation objective of the course syllabus.

(3) We integrate 5 CDIO level-4 projects to structure a level-3 course project: *Engineering Geological Investigation Report for Construction Documents Design Phase*. The level-3 project contains three core knowledge units: principles of engineering geology, engineering geological investigation and the impact of geology on structure in engineering, in *Guiding Core for Civil Engineering Undergraduate Higher Education*, and ability cultivation objective.

(4) In order to encourage students to complete their fieldwork positively, actively and creatively, based on their own knowledge structure and needs, we design and implement a course evaluation system. The purpose of the system is to highlight ability training and explore new evaluation model. So that it can promote the course practice and help students learning effectively by themselves. Then we form new evaluation measures and integrate the *Diversity Geological Practice Comprehensive Evaluation System* at the same time.

### Specific measure of the course reform.

Aiming at the content and purpose of the model course, the technical route of the course construction is shown in fig.1. The specific measure shows below:

(1) Design and implement ability course syllabus of the ability cultivation.

The ability cultivation scheme of this course relate to five parts: the samples of mineral and rock indoor identification, the rock type and geological structure in field identification, impact of groundwater on civil engineering and prevention measures, effect and prevention measures on adverse geological condition, and application of geotechnical investigation. Based on the course syllabus, we structure five level-4 course projects reflecting CDIO concept and method.

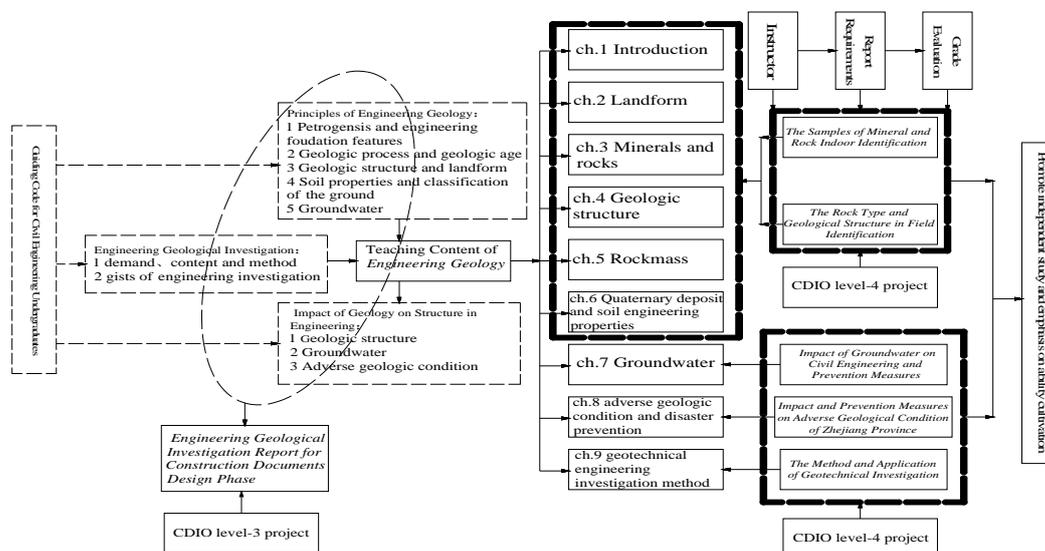


Fig.1 Technical route of the course construction

(2) Based on the five level-4 course projects reflecting CDIO concept and method, we integrate 5 level-4 projects in series into a level-3 course projects. The level-4 course projects and level-3 course projects both set their process corresponding to the 4 process as to CDIO (Conceive, Design, Implement and Operate). The ability cultivation of each process correspond the ability cultivation of CDIO (engineering basis knowledge, personal ability, team spirit and engineering system ability). The implementation plans of the level-4 projects: *The Samples of Mineral and Rock Indoor Identification*, *The Rock Type and Geological Structure in Field Identification*, *Impact of Groundwater on Civil Engineering and Prevention Measures*, *Impact and Prevention Measures on Adverse Geological Condition of Zhejiang Province*, and *The Method and Application of Geotechnical Investigation*, are shown in fig.2, 3, 4, 5, 6, respectively.

Based on specific project and focusing on ability cultivation, the level-3 course projects *Geological investigation report for construction documents design phase* contains project profile, working condition and quality evaluation, physical geography, areal geology, hydrogeology condition, engineering geological conditions, adverse geological conditions, special geotechnical treatment measure, geotechnical evaluation, natural materials analysis, conclusion and suggestion, etc.

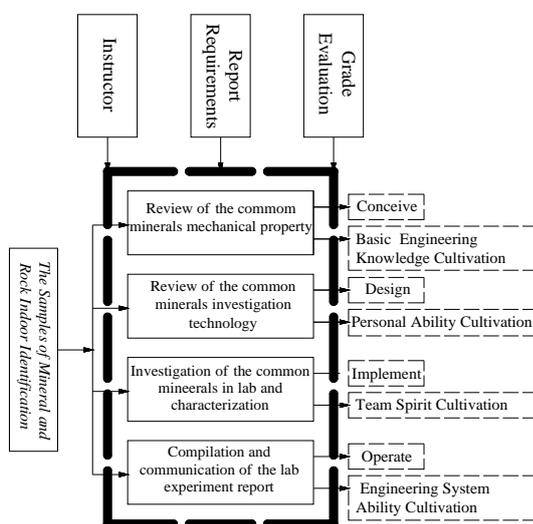


Fig.2 Level-4 project: *The Samples of Mineral and Rock Indoor Identification*

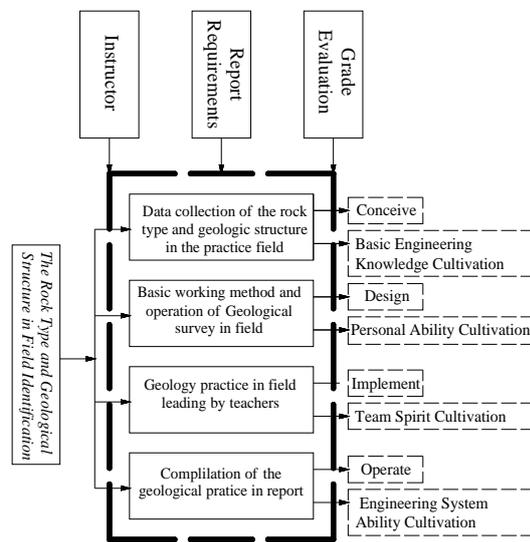


Fig.3 Level-4 project: *The Rock Type and Geological Structure in Field Identification*

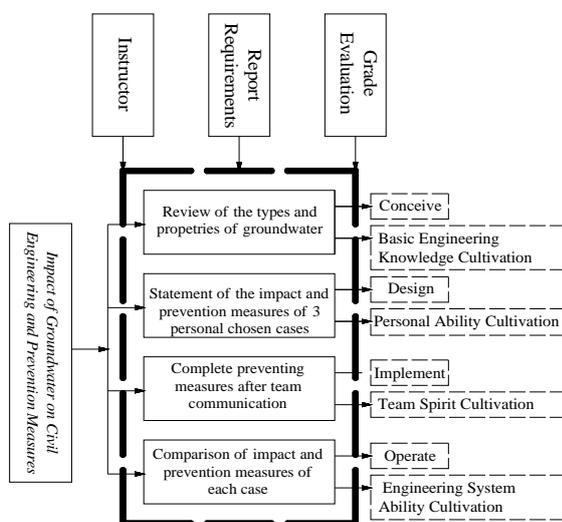


Fig.4 Level-4 project: *Impact of Groundwater on Civil Engineering and Prevention Measures*

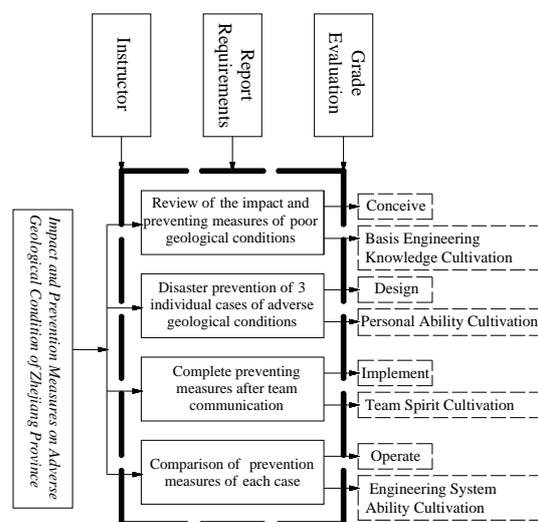


Fig.5 Level-4 project: *Impact and Prevention Measure on Adverse Geological Condition of Zhejiang Province*

(3) Design and implement pilot reform aiming at practical work and related ability.

In order to encourage students to complete their fieldwork positively, actively and creatively based on their own knowledge structure and needs, we design and implement the reform plan to the new evaluation implementation measures of the fieldwork practice course. The implement plans of *Diversity Geological Practice Comprehensive Evaluation System* is shown in fig.7

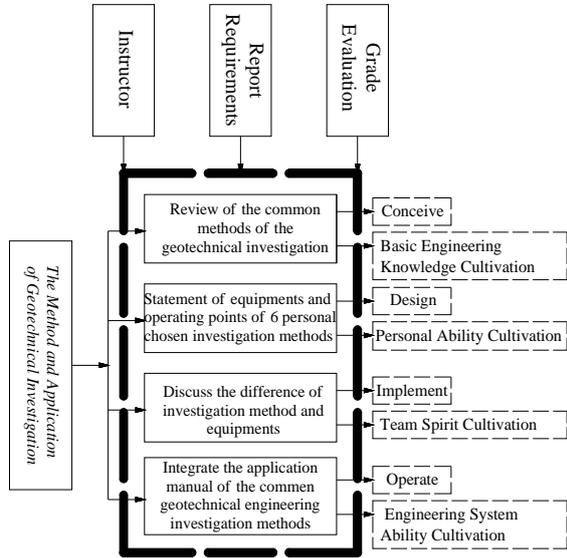


Fig.6 Level-4 project: *The Method and Application of Geotechnical Investigation*

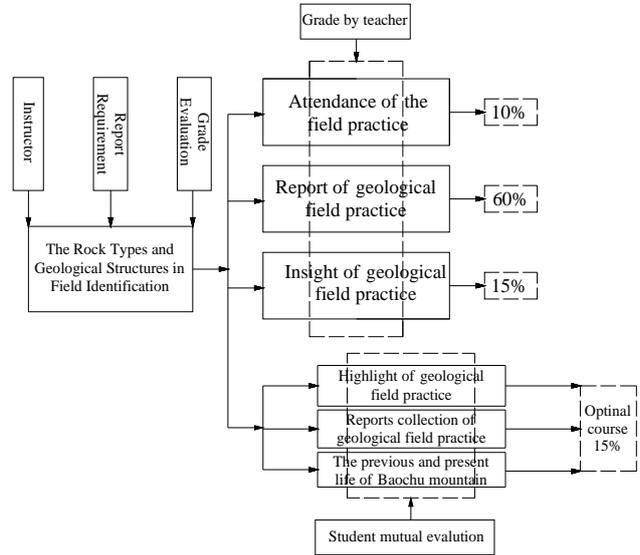


Fig.7 Implementation plan of *Diversity Geological Practice Comprehensive Evaluation System*

### Expected outcomes analysis of the course reform

*Engineering Geology* is the foundation course of the civil engineering. The reform can be applied to students of all grades of civil engineering. Lots of the civil engineering students can benefit from this course reform. The achievements of the reform are shown below:

#### Visible achievements:

(1) Compile the level-4 project instructors: *The Samples of Mineral and Rock Indoor Identification* and *The Rock Type and Geological Structure in Field Identification*, lab report writing requirements and the *Evaluation Implement Method*.

(2) Integrate a level-3 course projects: *Geological Investigation Report for Construction Documents Design Phase* with 5 CDIO level-4 projects to structure the ability course syllabus focusing on ability cultivation and the *Evaluation Implement Method*.

(3) Based on students own knowledge structure and needs, integrate the *Diversity Geological Practice Comprehensive Evaluation System*, in order to encourage students to complete their fieldwork positively, actively and creatively

#### Invisible achievements:

(1) Improve the student abilities of application and innovation by the combination of the engineering practice and examples analysis. And the ability cultivation links the further specialty courses effectively. Focusing on the abilities of engineering concept, design method, engineering consciousness and solve the practical engineering problems and the innovation ability, we accomplish the unification of the knowledge, ability and quality.

(2) Structure a new compound, innovative and applied talent cultivation model, lay a foundation for cultivation senior specialized applied talents with creative spirit and practice abilities. At the same time it is helpful for students to conduct scientific research, get vocational certificates and continue the postgraduate learning.

### Summary

Based on the requirements of CDIO training syllabus, considering undergraduate education's training objectives, training program and course syllabus of civil engineering and some related information in the examination of Registered Geotechnical Engineer, we carry on the thorough analysis of the building of *Engineering Geology* course syllabus and the setting of course systems, aiming at ability training.

Based on the five level-4 course projects reflecting CDIO concept and method, we integrate 5 level-4 projects in series into a level-3 course projects reflecting CDIO concept and method. The level-4 course projects and level-3 course projects both set 4 sections, aiming at the 4 sections of the CDIO (Conceive, Design, Implement and Operate). The ability cultivation of each section correspond the ability cultivation of CDIO (basic engineering knowledge, personal ability, team spirit and engineering system ability). At the same time, we suggest the implementation plans of the level-4 projects: *The Samples of Mineral and Rock Indoor Identification*, *The Rock Type and Geological Structure in Field Identification*, *Impact of Groundwater on Civil Engineering and Prevention Measures*, *Impact and Prevention Measures on Adverse Geological Condition of Zhejiang Province*, and *The Method and Application of Geotechnical Investigation*.

### **Acknowledgements**

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