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# Practice Research on Standardization of Undergraduate Graduation Design of Tunnel and Underground Engineering

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ABSTRACT

Graduation project (thesis) is an important practice part in undergraduate education, which forms an organic whole with theoretical teaching link, and it is the continuation, deepening and examination of the theoretical teaching part. This paper focuses on the constitution that the lack of quality standards for undergraduate graduation design, resulting in different depth and breadth standards; the graduation design materials are scattered and lack of standardization, which leads to the lack of systematic reference materials for students, taking the tunnel and underground engineering major as an example, this paper carries out the practice research on the standardization of the graduation design of tunnel and underground engineering through investigation and combining the teaching resources accumulated in the past decades. Through the study of practice, the content of undergraduate graduation design of tunnel and underground engineering is standardized, the breadth and depth of graduation design is defined, and the "*Guide for undergraduate graduation design of tunnel and underground engineering*" is organized and compiled, which can provide reference for the standardization and guidance of undergraduate graduation design of tunnel and underground engineering.

## 1. Introduction

In recent years, although the school management departments to take various effective measures, and in the graduation design under the premise of overall quality remained stable, its still exist some deficiencies, such as due to the lack of quality standards for professional content in depth breadth have different standard, due to the graduation design materials to prepare scattered, lack of standardization, lead to students lack of system resources, and so on [1]. The reasons for the above problems or situations are various, such as the lack of comprehensive, novelty, depth and breadth to pics, and the lack of attention to the graduation project of few students and even instructors and so on [2]. In short, there is a lack of unified understanding or reference standards for graduation design, whether from the perspective of the instructor or the student, and the relatively loose organization and management of the process, which is the direct cause of the difficulty in quality control of graduation design.

China is in the era of large-scale development of tunnel and underground engineering, and the scale of personnel training in related majors is unprecedented. Universities have invested a lot of manpower and material resources in the construction of main courses [3]. For example, Tongji University, Beijing Jiaotong University, Southwest Jiaotong University and other tunnel and underground engineering majors have published their own textbooks. However, there are few teaching materials for graduation

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design. According to the survey, for the major of tunnel and underground engineering, the only published teaching material for graduation design guidance is "*Guide to Undergraduate Graduation Design of Underground Engineering (Subway Station Design)"* by Southwest Jiaotong University [4]. This book only introduces the construction design, envelope design, main structure design, structure waterproof design, construction organization design and other aspects of the subway station (open excavation) work content and relevant knowledge points. The content does not cover the main knowledge points of tunnel and underground engineering specialty, and cannot fully meet the requirements of teaching auxiliary for graduation design of tunnel and underground engineering specialty.

Combining the above analysis, explore the mission requirements of university undergraduate course graduation design, establish a clear standard of quality and depth control, form unified execution control system, to improve the quality of graduation design itself, to ensure that the teaching goals, improve students and instructors of ideological understanding is the current urgent task faced by the link of graduation design.

## 2. Main Research Contents and Key Issues

Against the main problems of university undergraduate course graduation design, through the investigation and research method, combined with this unit for decades of accumulation of teaching resources, to carry out the tunnel and underground engineering undergraduate course graduation design standardization practice research, and publication of "*the tunnel and underground engineering undergraduate course graduation design guide*", in order to better regulate my professional undergraduate course graduation design teaching.

(1) Statistics of undergraduate graduation design topics of tunnel and underground Engineering

Taking the selected topics of undergraduate graduation projects of tunnel and underground engineering of our university in recent five years as samples, the proportion of selected topics of various structural types (subway tunnel, mountain tunnel, pipe jacking tunnel, immersed tube tunnel, etc.) and construction methods (open excavation method, mining method, shield tunneling method, pipe jacking method, etc.) were investigated and analyzed to provide basis for the compilation of follow-up guidelines.

(2) Investigation on difficulty and depth orientation of undergraduate graduation design of tunnel and underground Engineering

Choice of tunnel and underground engineering in our country as the preponderant discipline North Jiaotong University, Tongji University, Southwest Jiaotong University, Guangzhou university, China university of mining and other colleges, on the basis of the design plan descriptions of the undergraduate course graduation in recent years, contrast and analyze the difficulty of the tunnel and underground engineering undergraduate course graduation design, to determine the depth of the guidelines for writing.

(3) Framework and compilation of undergraduate graduation design guide for tunnel and underground Engineering

Based on the above investigation and analysis and in-depth discussion of the teaching team, the framework of compiling guide for undergraduate graduation design of tunnel and underground engineering is proposed, which covers normative documents, chapter catalogue, compilation depth, time nodes, task division, process control and other contents related to undergraduate graduation design of our university.

The key problems to be solved are the difficulty and depth of undergraduate graduation project positioning. Therefore, the method of professional investigation and consultation is adopted in the research process, which can systematically sort out and clarify the teaching orientation and evaluation standard of undergraduate graduation project according to the training requirements of new engineering.

## 3. Research Process and Main Conclusions

(1) Statistics of selected topics of undergraduate graduation design of tunnel and underground Engineering.

Table 1 shows the statistics of selected topics of undergraduate graduation projects of tunnel and underground engineering of our university in recent five years, from which we can see:

1) The undergraduate graduation projects of tunnel and underground engineering of our university mainly focus on mountain tunnel and subway tunnel, accounting for 44.5% and 52.6% respectively, and there are few topics of other types. Therefore, the follow-up guide compilation should focus on these two topics.

2) In comparison, in recent years, the topic selection of metro tunnel has a trend of increasing volatility, while the topic selection of mountain tunnel has a trend of stable and slightly decreased, which is also in line with the trend of urban rail transit development in China in recent years. During the survey, oral interviews were conducted according to the students' intention of topic selection. Most students believe that, on the one hand, urban subway is in the era of vigorous development and the market demand is relatively large, while with the improvement of China's main transportation network, the market share of mountain

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tunnel represented by expressway and high-speed railway is relatively declining. On the other hand, compared with mountain tunnel, urban subway construction environment is relatively better. Based on the above two reasons, most students are willing to choose subway tunnel as the theme of graduation design.

**Table 1.** Statistics of selected topics of tunnel and underground engineering graduation design of CSU from 2018 to 2022

| Type | Year of graduation | | | | | Total/ person | Proportion/% |
|---|---|---|---|---|---|---|---|
| | 2022 | 2021 | 2020 | 2019 | 2018 | | |
| Mountain tunnel | 32 | 37 | 46 | 37 | 48 | 200 | **44.5** |
| Subway tunnel | 51 | 61 | 43 | 36 | 45 | 236 | **52.6** |
| Pipe jacking tunnel | 0 | 0 | 1 | 0 | 0 | 1 | 0.2 |
| Science class | 4 | 1 | 2 | 3 | 2 | 12 | 2.7 |
| Subtotal/ person | 87 | 99 | 92 | 76 | 95 | 449 | 100.0 |

(2) Investigation on difficulty and depth orientation of undergraduate graduation design of tunnel and underground Engineering

Table 2 is the comparison table of undergraduate graduation design tasks of tunnel and underground engineering majors in representative universities. Analysis shows that:

1) Each university has very clear provisions and specific goals for the design requirements, design content and work tasks of undergraduate graduation design. From the design content and depth, all involve the tunnel structure design, construction organization design, etc., and all attach importance to the tunnel and underground engineering structure calculation this design difficulty. In terms of work tasks, they all include design drawings, design instructions, etc., and the workload is roughly the same, but there are slight differences in the translation of professional English literature. On the one hand, some schools have requirements, while some do not, and those with requirements differ greatly in the number of words (3000-10000 words).

2) In terms of design breadth, the design target of most universities is only tunnel structure or station structure, with a single object. However, the subway tunnel design of our university not only includes interval tunnel structure but also station structure, with a larger design volume. And the calculation of tunnel structure and station envelope structure has made requirements, design depth

**Table 2.** Undergraduate graduation design tasks of tunnel and underground engineering majors in representative universities

| University | A（**Jiaotong University） | B（**Mining University） | C（** Jiaotong University） | Our university | |
|---|---|---|---|---|---|
| theme | Structural design of subway station | Tunnel structure and construction organization design | Tunnel structure design | Subway tunnel structure and construction organization design | Mountain tunnel structure and construction organization design |
| design requirements | Good engineering drawing ability, numerical analysis software use ability, comprehensive use of learned knowledge to carryout scheme selection, structure and construction organization design. | To master the contents and methods of the construction organization design of a specific underground engineering project. Familiar with underground engineering construction drawing design method. Keep abreast of new developments in science and technology related to your field of study. Conduct preliminary training in scientific research methods. | In terms of knowledge structure, master and use professional knowledge, drawing and numerical calculation software. In terms of ability structure, the ability to independently analyze and solve practical engineering problems by applying basic theories and professional knowledge, consult and use engineering technical specifications, have engineering thinking, carry out teamwork and communication, and write technical documents has been strengthened. In terms of quality structure, the quality and consciousness of civil engineering professional quality, academic integrity, career planning and other aspects have been strengthened. | To implement the educational policy of "Cultivating talents through Virtue", and closely combine the university spirit of central South University of "combining knowledge with practice and practical application" and the characteristic education principle of rail transit. Systematically master the basic theories and methods of tunnel planning, design, calculation and construction, and understand the development history and frontier of the industry; Cultivate students' ability of independent exploration and creative thinking, and have professional skills to solve technical problems of complex engineering construction; Willing to take root in the project front line, serve national construction, overcome difficulties of professional feelings and responsibility; Independent learning, good at analysis and expression of comprehensive quality, theory and practice, scientific and rigorous engineering professional attitude. | |



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Table 2 continued

| University | A（**Jiaotong University） | B（**Mining University） | C（** Jiaotong University） | Our university | |
|---|---|---|---|---|---|
| theme | Structural design of subway station | Tunnel structure and construction organization design | Tunnel structure design | Subway tunnel structure and construction organization design | Mountain tunnel structure and construction organization design |
| Design content | Passenger flow and passenger flow organization; General layout of the station; Station structure form and construction method; Structural component design and internal force calculation, structural component reinforcement; Construction plan. | Tunnel structure design; Tunnel construction organization design; The projects section | Plan, longitudinal and cross section of the tunnel; Lining structure parameter design; Surrounding rock pressure calculation; Structural safety check (ANSYS) and reinforcement calculation | Comparison and selection of longitudinal section scheme (buried depth, longitudinal slope) of subway line; Subway tunnel structure design; Subway station structure and auxiliary building design; Subway section and station construction scheme selection, construction support structure design. | Tunnel lining structure-load analysis and application and structure design; Location comparison and selection of tunnel entrance, structural design of tunnel entrance section; Tunnel lining structure design of bifurcation section; Design of blasting excavation scheme for large-span/small-spacing tunnel; Tunnel construction scheme selection and construction organization design. |
| Assignment | Literature review (≥5000 words); Translation of foreign literature (no less than 6 pages of one paper in PDF format; Station architectural design and related design drawings; Station structure design and related design drawings; Structural calculation and reinforcement. | Computer drawing design drawings, the whole design drawings are not less than 4, at least one drawing for manual drawing. The contents of the manual are about 50,000 ~ 60,000 words. | Translate English materials with more than 10,000 characters; Design specification (project overview, design intention, selection basis of design contents, calculation and selection results) | Design specification (more than 15000 words); Structure calculation model, original data and output results; Draw 6 ~ 7 sheets of no.3 drawings; Translated English materials (tunnel related direction) about 3000 words. | |

and more difficult.

Based on the graduation design of undergraduates majoring in tunnel and underground engineering of our university in recent 5 years and the above investigation and analysis, the following suggestions are made:

1) At present, the content of undergraduate graduation design in our school is relatively more comprehensive, and has a certain degree of difficulty and depth. Judging from the completion of students in recent years, students can complete the design task with high quality under the careful planning and guidance.

2) With the development of knowledge superposition and technology update, it is suggested to cancel the requirement of English translation and manual drawing, which is not in line with the current social situation. For example, all current engineering design has realized comprehensive computer drawing, the actual production process, almost no longer appear the case of manual drawing; English has been attached great importance in China for a long time. At present, students' English level is generally high, and the development of information technology has greatly promoted the improvement of mechanical Translation technology in English. In the actual design process, students mostly rely on such translation tools, which has failed to reach the predetermined goal.

(3) Guidance framework for Undergraduate Graduate Design of Tunnel and Underground Engineering

Based on the above investigation and analysis, and based on the in-depth discussion of the teaching team, a framework for compiling the graduate design guide of tunnel and underground engineering is proposed. In the compilation process, in order to improve the reference of the guide, we also specially included the latest documents and norms of our school on the requirements of undergraduate graduation design work.

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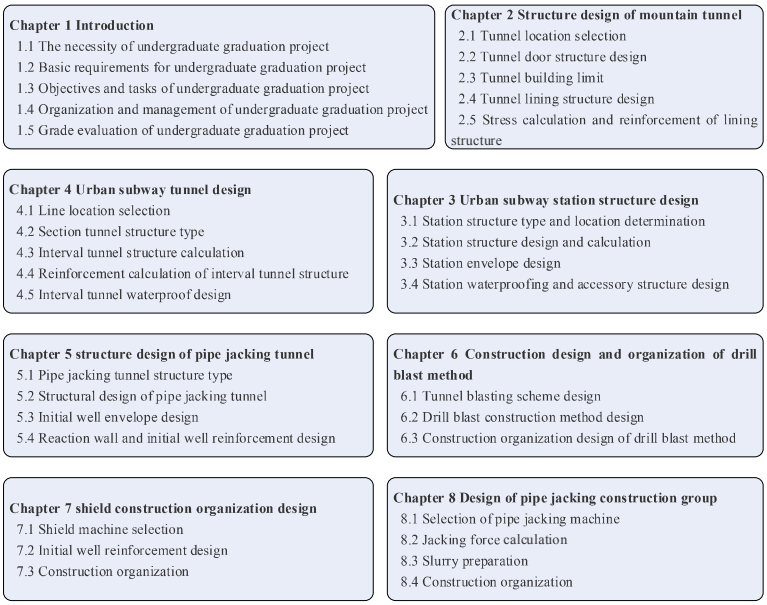


**Figure 1.** Content framework of undergraduate graduation design of tunnel and underground Engineering

## 4. Conclusions

Through specific research, this paper standardizes the content of undergraduate graduation design of tunnel and underground engineering, clarifies the breadth and depth of graduation design, and organizes the compilation of "*Guide to Undergraduate Graduation Design of Tunnel and Underground Engineering*", with specific characteristics reflected in the following three aspects:

(1) In terms of compilation content, it closely combines the development of the industry and the characteristics of our university's rail transportation major, covering the structural calculation, construction method and organization of the main structure types of tunnels and underground projects.

(2) In the depth of the compilation, highlight students' "knowledge, ability, literacy" training requirements, respectively from the scheme selection, structural calculation, construction method selection and other aspects of knowledge integration and application ability.

(3) In practice, the relevant document requirements of undergraduate graduation design are included in this paper, which provides a direct basis for the form quality of undergraduate graduation design.

Undergraduate graduation project (thesis) is an important practice link in undergraduate education, which forms an organic whole with the theoretical teaching link, and is the continuation, deepening and examination of the theoretical teaching link. Through the development of undergraduate graduation design or graduation thesis writing is not only a comprehensive assessment of students knowledge ability; it is also to train students in the basic skills of scientific research. In particular, a systematic and high quality in university undergraduate course graduation design (paper) to cultivate students' comprehensive use of theoretical knowledge and professional skills, to cultivate students to this problem in the field observing ability, thinking ability and analysis ability, judgment ability, innovation ability, language expression ability and the ability to solve practical problems, This will help students develop a scientific attitude of daring to explore and serious, and a rigorous and realistic work style, which will lay a good foundation for students to work in the professional field and write academic papers in the future.

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