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Research on the Translation of Construction Quality Control Technology of Self-compacting Concrete for High-speed Railway

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Abstract

Against the backdrop of the Belt and Road Initiative promoting the internationalization of high-speed railway technology, this study explores the translation strategies for technical texts on construction quality control of self-compacting concrete (SCC) for high-speed railways. It aims to achieve precise cross-lingual transmission of technical information, facilitate international mutual recognition of technical standards, showcase China's technological strength and innovation in this field, enhance international market competitiveness, and promote infrastructure connectivity under the Belt and Road Initiative. This study focuses on the translation of construction quality control of SCC for high-speed railways. It is conducted from dual dimensions of vocabulary and syntax. It analyzes the semantic characteristics of technical terms (including compound words and polysemous words) and the structural features of zero-subject sentences and long sentences in the texts, and summarizes translation methods. It is found that the translation of construction quality control of SCC for high-speed railways requires a balance between terminological accuracy and syntactic logic. For term translation, semantic specialization can be achieved through morpheme analysis; in syntactic conversion, zero-subject sentences can be transformed into passive voice or imperative sentences in English to strengthen directivity, while long sentences can be decomposed into logical clauses by division and restructuring to ensure the accuracy of cross-lingual technical information transmission. Optimizing translation strategies can help enhance the competitiveness of China's high-speed railway technologies and equipment in the international market, providing linguistic support for infrastructure connectivity.

Keywords

Construction quality control of self-compacting concrete (SCC) for high-speed railways; Engineering English; Translation

1. Introduction

Against the backdrop of globalization, the Belt and Road Initiative (BRI) is thriving, injecting strong momentum into global economic cooperation and cultural exchange. As emphasized by Xi (2018), the joint construction of the Belt and Road is not only an economic cooperation but also a crucial approach to improving the global development model and governance, and advancing the healthy development of economic globalization. As a key sector of BRI infrastructure construction, high-speed rail (HSR) plays an irreplaceable role in promoting connectivity among BRI

countries and facilitating coordinated development of regional economies, emerging as an important bond for international cooperation and technical exchange.

In the technical system of HSR construction, self-compacting concrete (SCC), as the core material for ballastless tracks, has become the cornerstone for ensuring track structure stability and durability due to its technical characteristics of vibration-free, self-leveling, and high-filling ability. The highly robust SCC developed by Li Huajian and his team was groundbreakingly applied in the Zhengzhou-Xuzhou HSR, China's first CRTS Ⅲ slab-type ballastless track demonstration project with complete independent intellectual property rights. This has strongly advanced the independent innovation process of China's HSR. His book *High-Speed Railway Self-Compacting Concrete Technology* focuses on analyzing engineering application cases and construction parameter standards of CRTS Ⅲ track structures, establishing a technical system from performance characterization evaluation to full-process quality control through special technological tests, and proposing collaborative optimization schemes for material properties and construction techniques.

With the accelerated "Going Global" of Chinese HSR technology, precise translation and international communication of SCC construction quality control technology have become key to promoting international technical standard mutual recognition and deepening international cooperation in HSR. Conducting translation research in this field is not only a practical need for technical exchange but also an important path to enhance China's international discourse power in HSR technology and support the high-quality development of BRI-related HSR construction.

2. Translation Characteristics of Control Quality Technology of Self-compacting Concrete for High-speed Railways

The translation of construction quality control technology of SCC for high-speed railways belongs to engineering English, serving as a key subdivision of engineering English in the fields of civil engineering and transportation construction. Construction quality control of SCC for high-speed railways refers to the systematic management of raw material properties, mix proportion design, pouring technology, and quality inspection of SCC in accordance with high-speed rail engineering standards. This is a critical technical practice to ensure the stability of track structures and enhance project durability. The content primarily focuses on construction processes, technical parameters, quality standards, and inspection methods, giving rise to the following prominent translation characteristics: (1) Dense Professional Terminology. The text incorporates specialized terms from multiple disciplines such as materials science, civil engineering, and track engineering. The terminological system exhibits strong industry-specific relevance and semantic uniqueness. (2) Clear Logical Organization. The text logic adheres to the temporal sequence and technical relevance of the entire construction process. From raw material control and mix proportion design to pouring technology and quality inspection, the translation of each link must accurately present the logic. For example, construction procedures like "formwork installation-pinching device-pouring operation" require connecting words to precisely convey the sequence and causal relationships of technical processes, maintaining the rigorous engineering logic framework of the original text.

3. Translation of Control Quality Technology of Self-compacting Concrete for High-speed Railways

The integration of professionalism and practicality is the essential feature of civil engineering English (Chen, 2021). Therefore, translators must accurately grasp the technical connotations of vocabulary and convey the logical relationships of construction specifications through syntactic structures, so as to achieve professional cross-lingual transmission of technical information and operability in engineering practice.

3.1 Vocabulary

Scientific and technical terms are characterized by unity and standardization. As Gu (1998) pointed out, "Improper translation of terms will damage the mother tongue, and corrupt academic atmosphere. Especially for key terms of great significance, improper translation will destroy the normativity of the original national language." Therefore, in the translation of construction quality control technology for SCC in high-speed railways, the accurate translation of technical terms is directly related to the international alignment of engineering standards and the cross-lingual implementation of technical specifications.

3.1.1 Polysemy

Many words exhibit the feature of "polysemy". In different contexts, the same word may convey different meanings in translation, so it is necessary to determine the appropriate translation based on the context (Wang, 2022). Many technical concepts, including "pei jin" and "li xi," continuously emerge in the field of concrete construction, and the existing vocabulary can be used to build a terminological system. "Reinforcement" originally refers to the act of strengthening, but in concrete engineering, its semantic specialization is achieved through professional limitation of steel reinforcement, precisely corresponding to the technical action of strengthening component strength through steel bars. Technical terms often expand their semantics by leveraging the core logic of common vocabulary. "Segregation" originally means "group separation", while "li xi" in concrete refers to the separation of mixture components. The metaphorical correlation in the logic of internal separation of a system endows "segregation" with a technical definition. Similarly, the root "blank" of "blanking" originally means "blank material", and in metal processing, it extends to "punching and blanking". In concrete construction, "xia liao" specifically refers to the operation of discharging the mixture from equipment such as hoppers and pump pipes into the mold cavity. Both share a similar action logic of "delivering materials from a container to a target position". This "polysemy" not only continues the core semantics of the vocabulary but also achieves semantic precision through professional domain limitation.

3.1.2 Compound words

The texts of construction quality control technology for SCC of high-speed railways contain many compound words, such as "wu zha gui dao", "guan zhu lou dou", and "jiang gu fen li". In the translation of these words, it is only necessary to master some basic English morphemes in civil engineering, such as ballastless, pouring, paste, and aggregate. Most compound words are translated literally, but the key is to conduct semantic analysis, accurately identify the central word, and correctly understand the structure to express the original meaning precisely (Wei, 2014). For compound words with a modifying-center structure like "wu zha gui dao", "ballastless" as a modifier limits "track", and literal translation "ballastless track" accurately conveys the technical feature of "no ballast". For compound words like "jiang gu fen li" composed of two entity nouns "paste" and "aggregate" and an action word "segregation", the semantic logic should be disassembled first: "jiang gu" refers to concrete components, and "fen li" is the core phenomenon. Therefore, it is translated as "paste-aggregate segregation", with a hyphen connecting "paste" and "aggregate" to clarify the object relationship, and "segregation" precisely corresponding to the professional meaning of "separation". This translation retains the material subject of "jiang gu" and reflects the technical attribute of concrete material defects through "segregation", avoiding semantic generalization caused by literal translation "paste and aggregate separation". When handling "xian jiao hun ning tu jie gou", both its construction technology and structural attributes should be reflected. "xian jiao" is translated as "cast-in-place" with a hyphen to highlight the feature of in-situ casting, distinguishing it from "precast concrete". The translation order is "process + material + structure", i.e., cast-in-place concrete structure, which not only conforms to industry terminology standards but also accurately expresses the technological essence of on-site casting and forms a contrast with terms such as precast components in the document, ensuring translation accuracy and contextual coherence.

3.2 Syntax

The professionalism and logicality of syntactic structures in technical texts of construction quality control for SCC of high-speed railways directly affect the efficiency of technical information transmission. Compared with daily language, its syntactic features emphasize technological accuracy, instruction clarity, and logical rigor, mainly reflected in the frequent use of zero-subject sentences and long sentences.

3.2.1 Zero-subject

In technical texts of SCC construction of high-speed railways, zero-subject sentences that omit the subject often appear in construction instructions, specification requirements, and process descriptions, with their core function to strengthen the objectivity and instructiveness of technical actions. This phenomenon is closely related to the Chinese nation's thinking habits of emphasizing integrity and intuitiveness—focusing on semantic logic connection rather than syntactic function constraints in thinking, thus making sentence structures more flexible and concise, and weakening the grammatical compulsiveness of the subject (Hu, 2004). For example, "cai yong gang mu ban jin xing feng bian" and "guan zhu shi zai zhong jian guan zhu kou an zhuang yi ge gao yue 60 li mi de zhui xing guan zhu dou", such sentences make actions like "gang mu ban feng bian" and "an zhuang guan zhu dou", and make the semantics focus by omitting agents, such as construction personnel and technical staff, which conforms to the "action-first,

process-oriented" expression habit of engineering documents. From a translation perspective, zero-subject sentences need to be converted into passive voice or imperative sentences in English to fit professional contexts. For instance, "mu ban yu hun ning tu jie chu mian nian tie zhuan yong tou shui mu ban bu" can be translated as "Controlled permeability formwork liner shall be pasted on the contact surface between formwork and concrete", where the passive voice reinforces the standardization of operational requirements; "shi run 4 xiao shi yi nen yi jin xing zi mi shih un ning tu guan zh" is translated as "Self-compacting concrete should be poured within 4 hours after wetting", highlighting the strictness of time constraints through passive voice. Such conversion not only retains the instructiveness of the original text but also conforms to the syntactic feature of objectivity in English technical documents.

3.2.2 Long sentences

In the translation of professional literature in construction engineering, complex, long sentences are very common. This stems from the fact that construction engineering literature focuses on scientific technology and engineering phenomena, and needs to present professional concepts such as definitions, theorems, and technologies through rigorous and precise expressions, as well as convey factual logic, making complex long sentences a typical linguistic form to carry high-density technical information and ensure semantic rigor (Sun et al., 2011). Long sentences in technical texts are mostly composed of multiple modifiers, parallel structures, or logical clauses, used to precisely describe complex processes or technical logics. For example, "er dui yu kuan du chang de dao cha ban, ji dan ce you sang e zhi cheng jing tiao zhua dian kuai de qing kuang, ze yi cai yong liang dian guan zhu fang shi, guan zhu dian fen bu yu zhong jian dian kuai de zuo you liang ce, tong shi jin xing zi mi shi hun ning tu guan zhu, zhe yang bu dan neng jia kuai guan zhu su du, ye neng bi mian yi dong liu cao er ying xiang zi mi shi hun ning tu guan zhu de lian xu xing." This sentence defines the application scenario through the conditional adverbial "dui yu…", supplements technical details with the explanatory structure "ji…", strings together process steps with parallel predicates "cai yong…", "fen bu yu…", "jin xing…", and finally explains the process advantages through the progressive logic "bu dan…ye neng…". The nested syntactic structure accurately transmits the technical requirements of turnout slab pouring technology, reflecting the expression characteristics of rigorous logic and information layering. In translation, In translation, the strategies of division and restructuring should be adopted. This is because long English sentences are mostly tree-like in structure, with interwoven principal and subordinate structures, whereas Chinese tends to follow a linear narrative. Therefore, in Chinese-English translation, the linear expressions in Chinese can be broken down into independent clauses or combinations of short sentences with interwoven principal and subordinate relations in English through the method of division, so as to achieve a natural transformation of the language (Li, 2020). The above sentence can be translated as "For turnout slabs with a long width (i.e., three support fine-tuning claw pads on one side), two-point pouring is preferred. The pouring points should be distributed on both sides of the middle pad to conduct simultaneous self-compacting concrete pouring. This not only accelerates the pouring speed but also avoids interrupting the pouring continuity due to chute movement." By splitting the original sentence's conditional scenario, process steps, and effect description into three independent clauses, and reconstructing the semantics with the progressive logic of "For...," "The pouring points..., and "This not only...", it not only breaks the long sentence structure of Chinese but also ensures the coherence of technical information through logical words, reflecting the core role of division and reconstructing in cross-lingual conversion.

4. Conclusion

In summary, as an important link in engineering technology communication, the translation of construction quality control technology for self-compacting concrete of high-speed railways needs to balance the precision of professional terminology and the logic of syntactic conversion. Translators should not only deeply analyze the polysemy and compound structure of vocabulary to ensure that term translation conforms to international engineering specifications but also flexibly convert Chinese zero-subject sentences and long sentences into English passive voice, imperative sentences, or clause combinations based on the thinking differences between Chinese and English, so as to achieve cross-lingual equivalent transmission of technical information. Going forward, with the deepening of the Belt and Road Initiative and the accelerating iteration of international standards for high-speed rail technology, translation research in this field needs to further pay attention to the dynamic update of emerging technical terms, explore the collaborative path of intelligent translation tools and manual proofreading, and strengthen the comparative study of Chinese and foreign high-speed rail technical standards, so as to improve the timeliness and authority of translation and build a solid language bridge for the global promotion of Chinese high-speed rail technical standards.

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