Design Codes and Standards - Civil Works in Taiwan High Speed Rail Project -

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1. Introduction

Taiwan High Speed Rail Project between Taipei and Kaohsiung about 345km in length is under construction and most of the civil works (about 330km, Cut&Embankment-40km, Tunnel-48km, Viaduct-242km) are design and build contracts placed by Taiwan High Speed Rail Corporation (THSRC). Civil contractors are obliged to design and construct the civil facilities in accordance with the Design Specification (DS) and Construction Specification (CS) provided by the Contract as well as other local and international references specified in the DS and CS for practice.

This report aims to introduce the application of the design codes in this project and point out several remarks obtained through the implementation in order to contribute to the discussions for the design code unification in the Asia Region.

2. Design Specification and Construction Specification

2.1 Design Specification: The DS consists 10 sections, i.e. 1)General requirement, 2)Alignment design, 3)Bridge design, 4)Bridge and Viaduct Foundations design, 5)Earthworks design, 6)Tunnel design, 7)Underground Structure design, 8) System Safety and Systemwide Interface design, 9)Building Structural design and 10)Drainage design. If any design items are not specified in the DS, the codes and standards for practice specified in DS 1) shall be complied as described in section 2.2. There are no evidences which design codes are basis of the DS.

The DS allows both of allowable stress design and load factor design, it is the Designer's choice.

The Contractors are allowed to issue design queries to the ER (Employer's Representative) to clarify the DS and/or referred standards/codes if necessary.

Besides of the DS, there are Standard drawings and Directive drawings in the contract to be followed in principle.

2.2 References and Precedence: A list of the Standards and Codes of practice is given in the DS 1) for the design that is not specified in DS. There are twenty-nine codes and standards in the list, half of them are American codes, e.g. AASHTO, ACI and AWS, and one-third are Taiwan codes. Two Japanese building design codes are included in the list, i.e. Standards for Steel Reinforced Concrete Structures. The edition of the codes and standards shall be fixed as of the Contract signature. The later edition can be used if No-Objection is issued by the ER on the Contractor's demand.

If there is any confliction between the Codes and Specifications, the first precedence is given to the Taiwan codes. The priorities for the other codes are lower.

2.3 Particular Design Items: Despite the above mentioned, several particular design items shall be complied with the specific codes, e.g. Steel bridge design- allowable stress design by AASHTO, Soil liquefaction analyses with SPT-N method- Japan Road Association (Road Bridge Standard Specification), Structural bearing (pot bearing)- European standards, PrEN 1337, Pile group effects- Japan Railway Technical Research Institute (Railway Structure Design Standard).

2.4 Construction Specification: The CS is consists 53 sections (corresponding to working items) and the Civil Contractors are requested to develop the CS into the Works Specifications (taking actual working condition into account) and to establish new sections if necessary. The Taiwan Standards shall be used with maximum extent for material and test specifications. In addition to the Taiwan Standards (Chinese National Standards), American Standard (ASTM) is widely referred in CS. It shall be noted that CS also relates to the design and gives many conditions for

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design implementation.

3. Remarks

Remarks are given below through my "personal experience" in this project.

3.1 Suitability of Codes: Because foreign codes are referred, there are several difficulties for design implementation. For example, European standards, PrEN 1337 shall be followed for the pot bearing design as above mentioned. There are no specification in the standards regarding anti-uplift device design, despite Taiwan is well-known as one of the earthquake region. We used AASHTO for the design of anti-uplift clamp only and it resulted two design codes (they are much different) in one equipment (other contract may use other codes). The suitability of the design codes shall be considered in terms of special condition of the countries and regions. In addition to this, the DS obliged to follow the PrEN 1337 "draft version" (not approved by the European Committee yet) and even some parts were only "under development".

3.2 Local Codes: It should be noted that major Taiwan design codes for bridge design are translation of the corresponding American codes, however Taiwan codes are not up-dated as the latest American codes. For example, as of the contract signed, the (Taiwan) Design Specification of Highway Bridges was translation of major items only from AASHTO edition 1983. On the other hand, AASHTO itself was edition 1996. This differences in edition between Taiwan code and AASHTO gave many inconsistencies, moreover Taiwan codes have precedence in the Contract.

3.3 Local Specialty: There are many Japanese products in Taiwan market including licensed production. The local supplier may provide JIS products despite the CS doesn't refer to the JIS. In this case, the supplier or the Civil contractor/the Designer must provide the evidence that the applied JIS is equivalent or even more conservative than Taiwan/ASTM codes (sometimes, Taiwan codes are same/similar with JIS).

3.3 Nationalities of Engineers: Figure-1 shows the organization chart of the design approval process. There are many nationalities of the companies, i.e. Civil Contractors [Taiwan, Japan, Korea, China, Thailand, Germany, Netherlands], Designers [Taiwan, France, UK, Austria, Germany, Netherlands, US] and CICE [Taiwan, Germany, France, UK, Denmark]. It is assumed that many foreign engineers, UK in particular, are contributing to this project in THSRC and IREG. This variety of the nationalities is resulted in the variety of the basis in civil engineering. There are many cases that differences in the interpretation of the DS and codes/standards are appeared as well as arguments due to different design approach.

4. Conclusion

1) The Design code/standard shall be comprehensive as much as possible in order to avoid conflict between referred codes/standards. References should be as less as possible. 2) The Design code/standard shall take account of the special condition in the country/region, e.g. suitability to design condition/environment, governing industrial production standards, etc. 3) This may be old story but shall be enhanced that "English is a governing language" for both of codes and civil engineering in Asia.

Figure -1 Organization Chart for Design Approval Process