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Computer-Aided Quality Monitoring of Bridge Construction

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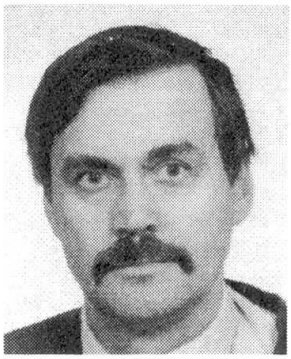

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Summary

This paper describes the Computer-Aided Quality Assurance system used in Finland for bridge construction. An exhaustive list of Quality Requirements is recorded by the consultant in a data file, which is submitted to the construction site. The contractor makes his checks and documentation in the same data file.

1. Introduction

Site Control and Inspection by the client supervisors have gradually been replaced by the companies' self-control and by applying of Quality Assurance Systems. This has been a necessity, since a lot of the production takes place in subcontractor's workshops and their time schedule is so tight, that no client can provide enough supervisors to implement a comprehensive control.

2. Quality Requirements

According to contracting praxis in Finland, the client is not providing the contractor with any guidelines how to implement his works. Instead, the Quality Requirements are precisely and in detail defined particularly for the end result of different structural components. Most Quality Requirements to be applied are found in the General Quality Requirement for Bridge Construction handbooks published by the Finnish National Road Administration [1]. The consultant shall define Quality Requirements for each work step of a bridge project. This rather long list is created easily by computer using the database of the software, which include the most common Requirements as well as National Codes for different construction materials. Requirements for a new bridge project also may be copied from that general database or from a previous project.

The consultant does not need to produce any text such as guidelines, but instead he shall define the Requirements in charts, which are easy to use for Quality verifications. Typical and commonly used Requirements for a foundation pit are presented in Table 1. The digits 1, 2 or 3 indicate the type of the Requirement. The Requirement types are as follows:

Type 1. This bridge specific Requirement is set by the consultant. In this case the consultant has decided to have the water to be pumped from the pit so that the water level shall be 0..0.5 m below the bottom level. This is set to avoid hydraulic collapse in case the water is lowered too much. On other hand the pit shall also be dry, which is set by putting an upper bound on the water level.

Type 2. This is a standard Requirement, which is found in the General Quality Requirements of the Finnish National Road Administration and references thereto. Type 2 Requirements are in fact the dominating ones. The type 2 Requirements do not need to be printed out for Tendering and not necessary later either. The list of Requirements shall be sent to the site in a file on a diskette or by e-mail and after that handled only by the computer.

Type 3. This is a non-obligatory Requirement recommended by the consultant. The slope of the pit is here set to 45 degrees (1:1), but the contractor may also excavate in a strutted pit or apply any other acceptable working method.

7110 Excavation and blasting of the foundation pit
7111 Excavation without strutting

Code	Work Specification	Type	Required	Lower limit	Upper limit	Unit
100	Level of ground water measured from the bottom level	1		-500	-100	mm
200	Horizontal location of bottom measured from the theoretical level	2		-300	50	mm
300	Base levelness measured from the lowest point	2		0	150	mm
400	Slope of the pit	3			45	degrees

Table 1. Quality Requirements for excavation without strutting.

3. Work Steps

The Quality Requirement items shall be defined for each Work Step, which describe the implementation of works and also constitute the structure for the Quality Requirement file and the Proof of Acceptability documentation. These are typically:

BRIDGE CONSTRUCTION (General features)
EXCAVATION AND BLASTING OF THE FOUNDATION PIT
EARTHWORKS, FILLING, PILING WORK
FOUNDATION
ABUTMENTS AND PIERS
SUPERSTRUCTURE
DECK SURFACE STRUCTURES
EQUIPMENT AND ACCESSORIES

The Work Steps are divided into subdivisions, and those are for example for a prestressed superstructure as follows:

SUPERSTRUCTURES
- Scaffolding and formwork
- Reinforcing
- Concrete casting
- Prestressing
- Finished product

4. Quality Assurance

The proof of acceptability shall also be done in a straightforward manner. A computer system is used to store and sort out such essential data such as deviations. The data file of Quality Requirements for a particular bridge gathered by the consultant is a natural base for site Quality Documentation. When all measurement and check data is logged into the data block of each individual Quality Requirement, acceptability is easily and sufficiently proved. This will also facilitate the systematic analysis of the entire work performance.

References

[1] *General Quality Requirements for Bridge Construction SYL parts 1 – 7.* Finnish National Road Administration, Helsinki 1996. 600 pp.