TEST ARRANGEMENT FOR MEASUREMENTS OF THE PRETENSION FORCE IN HIGH STRENGTH BOLTS

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KEYWORDS: Zinc silicate primer, friction area, high strength bolts, strain gauge, calibration.

ABSTRACT

Slip resistance connections are commonly used for in-situ assembled joints of structures dominantly loaded by cyclic loading, for example in bridges, telecommunication towers, towers for wind turbines. The level of the pretension force in the bolt and the friction coefficients of the surfaces in a connection influence the strength of the slip resistance connection.
The purpose of this experimental research is to quantify losses of the pretension force in high strength bolts (short-term and long-term), which are used in friction connections with zinc silicate primer as corrosion protection. Continuous monitoring of connections with pretension forces, performed over a two-years period, is used to predict minimal value of the pretension force at the end of the life time of a structure. The loss of the pretension force function will be proposed based on the actual experiments and comparison with the available literature.
All specimens consist of three steel plates and three bolts. Plates are in double covered and symmetrical position, with bolts in one row. Experimental research is very comprehensive, see the overview of specimens prepared in (*Fig.1*). Following parameters are studied:

1. *type of the bolt – two types of the bolts: Huck BobTail high strength lockbolts [1] and high strength bolts (HV) according to EN 14399-4 standard [2],*
2. *length of the bolts – three different clamping lengths: 18 mm, 35 mm and 55 mm requiring three different length of the bolts,*
3. *thickness of primer – two types of steel plates: steel plates blasted until degree of cleanliness Sa 2½ and steel plates blasted and coated with Jotun's zinc silicate primer Resist 86,*
4. *type of load acting on specimens – two types of tests: pure relaxation test (only pretension force in the bolts acting on specimens) and dynamic load test (after two months of pure relaxation test specimens are exposed to $2x10^6$ cycles of dynamic load defined for Woehler's class less then 112[3].*

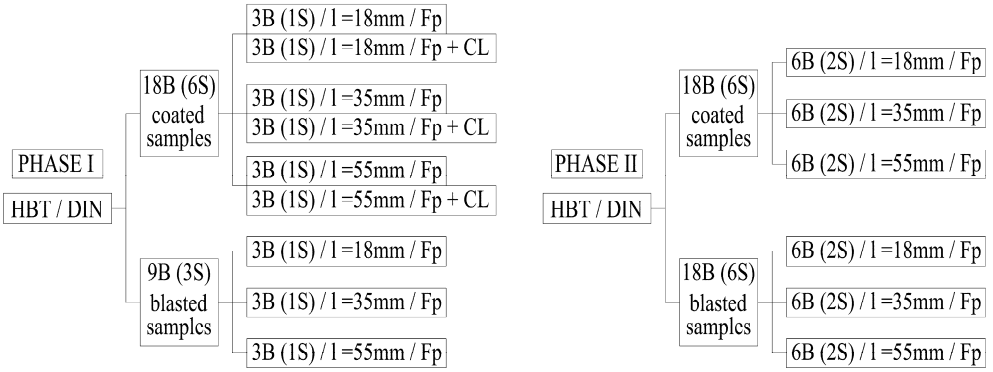

Fig.1. Scope of experiment: B-bolt, S-specimen, l-clamping length, F_p-pretension force, CL-Cyclic load

All the bolts have the same diameter of 20 mm and all steel plates are grade S355.

CONCLUSIONS

The presented experimental study started in May 2013 with the installation of the phase I specimens. Specimens of the phase II were installed in January 2014. At present, phase I of the specimens monitoring has continuously been carried out for 9 months, and the first detailed analysis and presentation of results will ensue after 12 months.
In *Table 1* short-term losses (12 h after installation) of pretension force in phase I bolts is shown. The presented losses are calculated in regard to **maximum** reached value during the installation!

Table 1. Average short-term losses of pretension force [%]

Bolt type	Blasted specimens			Coated specimens		
	Clamping length [mm]			Clamping length [mm]		
	18	35	55	18	35	55
HBT	46,3	26,3	24,4	46,9	30,2	24,3
DIN	10,1	9,8	7,8	14,0	12,1	11,6

Huck bolts were installed using hidraulic installation tool, as shown in [1]. Calibrated manual torque wrench was used to install HV bolts, since this is most frequently used method in Serbia. Value of k-factor [4] was pre-determinated experimentally. For this research, the tightening torgue $1{,}0M_{r,i}$ was applied in one step.

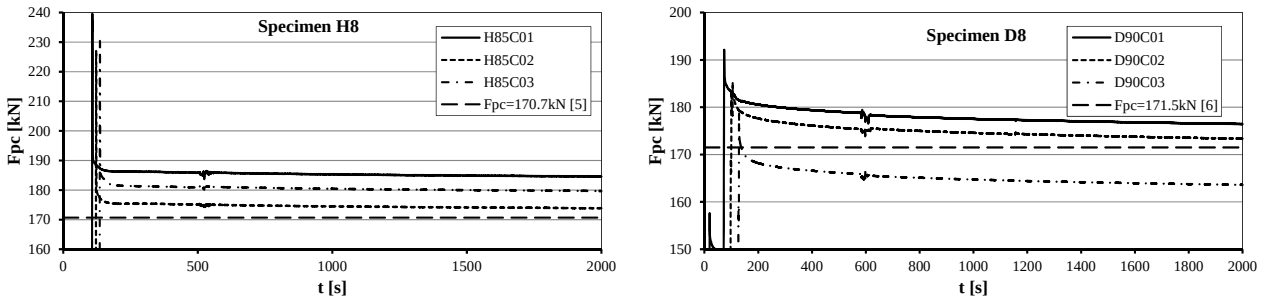

Fig. 3. Initial losses of pretension force

For better understanding of values in *Table 2*, initial losses (in first 30 minutes after bolt installation) of pretension force in six bolts was shown in *Fig. 3*. All bolts are with clamping lenght 55 mm, installed in specimens with anti corrosion protection. Huck bolts have significant loss of pretension force which occure in installation proces. However, for bolt lenght over 70 mm, design value of pretension force is achieved.

REFERENCES

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