

# Undersøgelse af blok- udrivning i boltede samlinger

- Forsøgs rapport

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Bachelor projekt

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Technical University of Denmark

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# Preface

This project is a Bsc projekt credited 20 ECTS points written in the period 01-09-2014 to 30-01-2015

The project is a final Bachelor project of the Civil Engineering on the Building study line.

The project has been carried out at the Technical University of Denmark (DTU) in the department of Civil Engineering (BYG).

The supervisor of the project is Jeppe Jönsson (BYG, DTU). Great appreciations is dedicated to him for guidance throughout the project.

Lyngby, the 30<sup>th</sup> January 2015

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# Abstract

When calculating the design of structural constructions, certain calculation are used. This is done to make some standardized calculation methods. By having these standards it is a lot easier getting an overview, so all aspects and safety factors are taking into account when calculating the constructions.

The standards currently used, are very conservative in their calculations of the strengths in the constructions. By optimizing these calculations, it would be possible to make use of a lot more of the material properties and strengths. Changing the standards require further studies, and some of those studies are the topic of this project.

Throughout this project bolt connections with a central applied force is taken into account, to avoid moment in the connection. The distance between the bolts perpendicular to the force, is examined for how it effects the bolted connection. There are made tests to give insight on how the distance effects both the strength and the failure mode of the connection. 6 different tests of the bolt connection are performed, 3 tests with 4 bolts, and 3 test with 6 bolts, each with different distance between the bolts. Each test are made 3 times, to give some statistic data, and making it a total of 18 tests. The tests of bearing resistance as well as blockfailure are examined.

The yield stress and the tensile strength are determent for all 18 tests.

It is expected that all tests end in blockfailure.

Beside the 18 tensile tests, a series of material tests are made to determine the properties of the materials used for each test.

The final test all give blockfailure as it was previously expected. The tests also show the strengths increase with the increased distance between the bolts. In addition the increased amounts of bolts in the connection also have a positive influence on the strengths of the connections.



# Resumé

Ved beregninger af bærende konstruktioner bruges en række beregningsstandarder. Dette gøres for at standardisere beregningsmetoderne. Ved at have en standard for beregningerne, er det lettere at få et overblik over alle aspekter og derved sikre at alle forhold bliver taget i betragtning.

De nuværende standarder er dog meget konservative ved beregning af konstruktionernes styrke. Ved at optimere disse vil der være mulighed for bedre udnyttelse af materialernes egenskaber og styrker. Ændringer af standarderne kræver dog videre studier og dette projekt arbejder med nogle af disse undersøgelser.

Gennem projektet undersøges centralt trækpåvirkede boltesamlinger, for at undgå moment i samlingerne. Der undersøges hvilken påvirkning afstanden mellem boltene, vinkelret på kraften har for samlingen. De forsøg der er foretaget skal give indblik i hvordan denne afstand påvirker både styrke og brudform for samlingen. Der er foretaget 6 forskellige test af boltesamlinger, 3 forsøg med 4 bolte og 3 forsøg med 6 bolte, med varierende afstande. Hvert af de forskellige forsøg er foretaget 3 gange, og der er derved 18 tests i alt. Ved forsøgende er det hulrandsbæreevnen og blokforskydning der undersøges. Der er bestemt flydestyrke og brudstyrke for alle 18 forsøg.

Det forventes at alle forsøgende bryder ved blokforskydning.

Udover de 18 trækforsøg, er der lavet en række materiale forsøg, til at bestemme egenskaberne for de test emner der er brugt til alle forsøg.

De endelige forsøg giver alle blokforskydning i som tidligere forventet. Undersøgelserne viser også at styrken for samlingerne stiger i takt med afstanden mellem boltene øges. Derudover giver et større antal bolte en yderligere forøget styrke.