

## **Part 2 Calculations**

Do the calculations on paper, take a photo of each page and upload them to MyCourses. **Only handwritten answers are allowed.** Do not include any captured pictures or text in your files. Total max of Part 2 is 40 points.

**Upload your files in time, the deadline is a hard one, 19 October 2020, at 15:15**

**Check that you produce readable pictures, use dark colored pen rather than light grey pencil.**

**During the exam you can use any material you like but shall not be assisted by another person.**

**Aalto University Examination Guidelines and Aalto information systems usage policies applies also to remote exams!**

1) A stope with rectangular cross-section, with vertical walls and horizontal roof is planned in 600 m depth. The stope width is 18 m, height 27 m and length 60 m. The rock is gabbro-type, coarse grained with density of  $3000 \text{ kg/m}^3$ . The in-situ horizontal/vertical stress ratio is 2 and the longitudinal axis of the stope is to direction 040 (approximately to north-east, NE). There are three joint sets (dip direction/dip):

035/20

120/60

250/50

Joint surfaces are planar, rough and slightly altered. Joint spacing is about 0.5 m and joint length is 2 - 5 m. Only minor local groundwater inflow has been observed. The RQD is 90%. The UCS for intact rock samples is 125 MPa.

Estimate the stability of roof and sidewalls with Stability Graph -method. In this case, you can omit the short endwalls of the stope.

Design cablebolting for roof and sidewalls if needed.

(30 p)

2) Design the reinforcement with applicable design method for 12 m wide, 8 m high and 30 m long hall at 600 m depth in same rock mass described in previous question. The hall is part of permanent underground workshop.

(10 p)