

CIV-E2040 Maintenance and Repair of Structures L (5 cr)

Please write in every **handwritten** answer paper:

- the name and the number of the course
- the date of the examination
- your name and the student number
- the name of the department and the class of studies
- your signature

Note: Submit your answers within allowed time by using scanned pdf-files!

LEARNING OUTCOME:

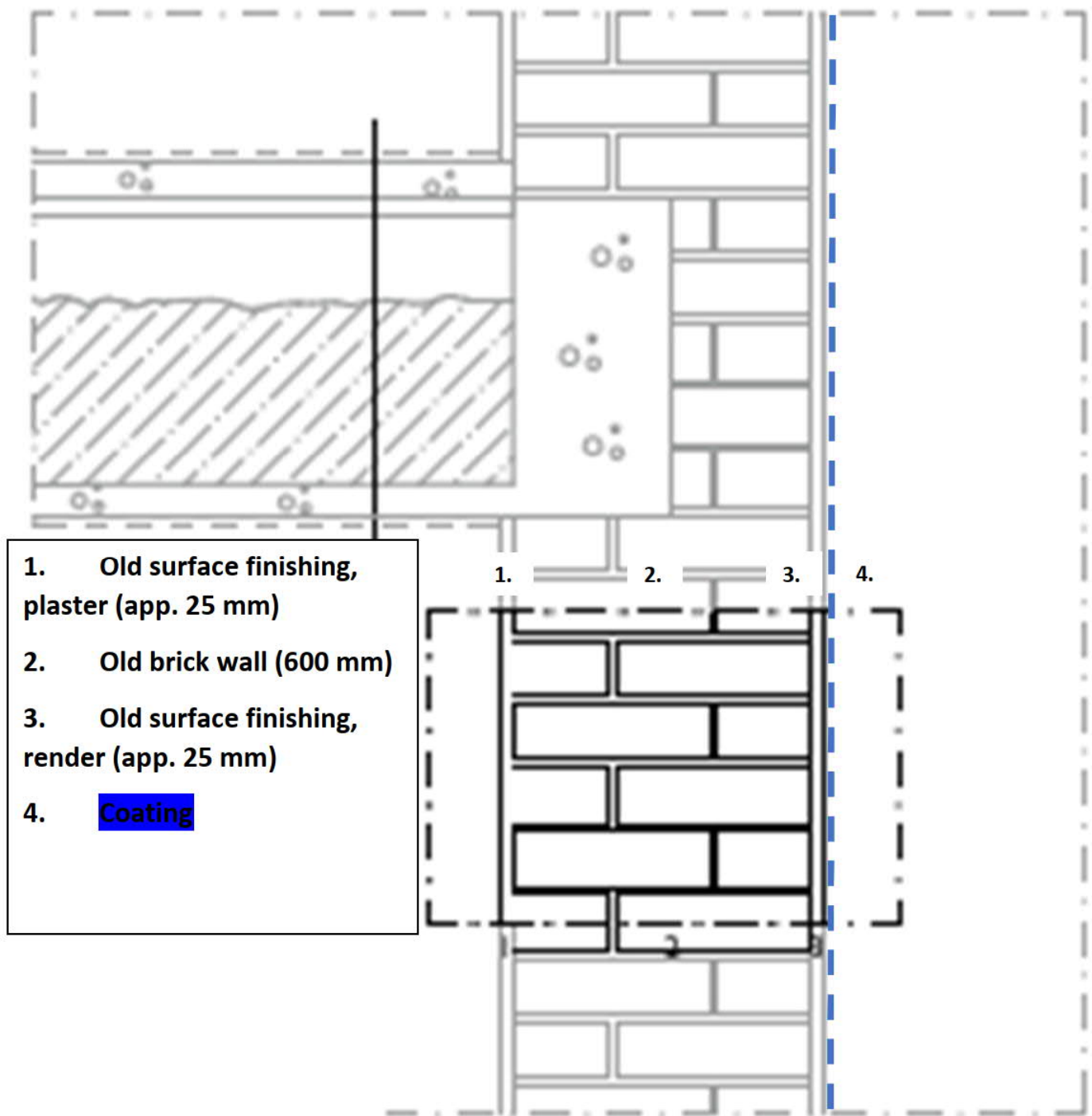
1. Use suitable repairing materials of structures

- 1.1. Define strengthening of the reinforced concrete column or frame structures at the Olympic Stadium (Figure below). Justify your decision. (2p)



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1.2. What is the suitable coating for the old rendered brick wall outdoors (Figure below)? Justify your decision. (2p)



1.3. Explain how corrosion protection of reinforcement bars can be evaluated based on Pourbaix-diagram? (2p)

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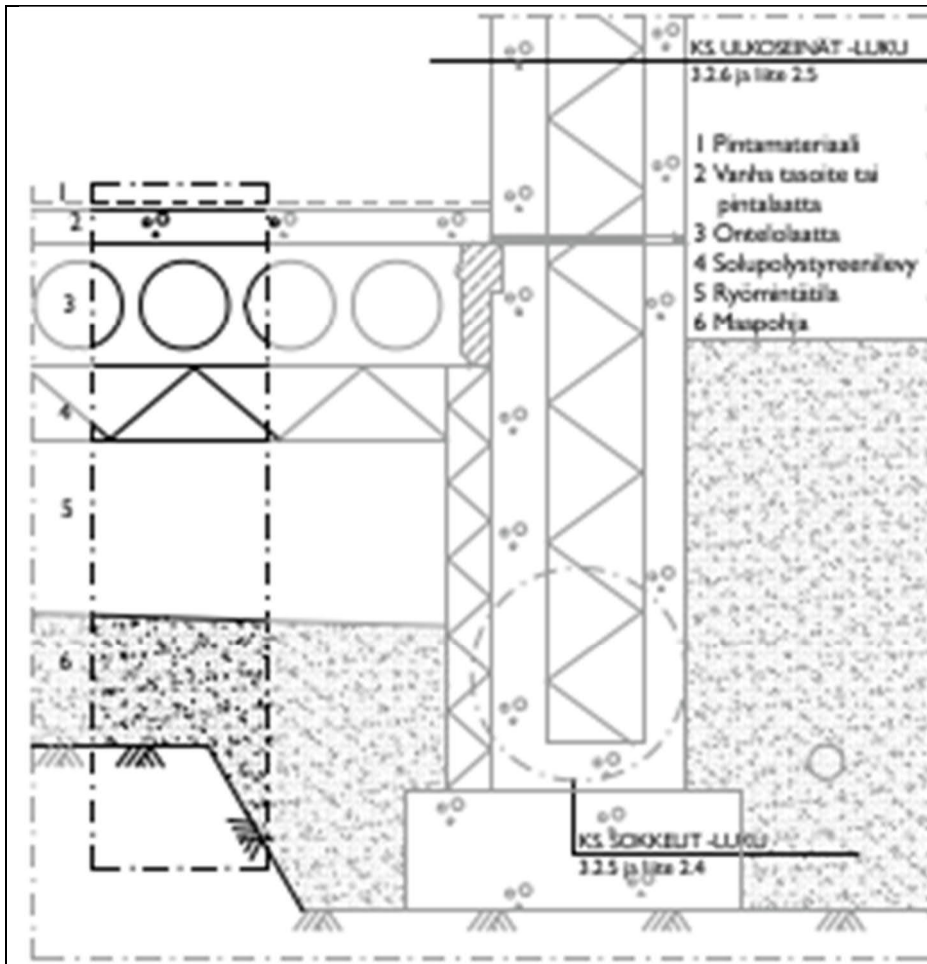
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LEARNING OUTCOME:

2. Specify suitable maintenance methods of structures

- 2.1. Describe demolition methods of reinforced concrete structures at Lauttasaari Bridge. Justify your decision. [**Assignment**]. (2p)
- 2.2. Describe typical maintenance methods of structural steel bridges. How will change Young's modulus and the yield strength of structural steel after 100 years' service? Justify your decision. (2p)
- 2.3. How to repair ventilated crawl space floor slab (Figure below) according to the guide, Renovation and Repair of Buildings with Moisture and Microbial Damage (Publications of the Ministry of the Environment)? Determine the quality assurance methods to be used during the construction phase and decide the measures needed to verify and monitor the success of the renovation work. Justify your decision. (2p)

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1. Old surface coating
2. Old surface finishing
3. Old prestressed hollow core slab
4. Old expanded polystyrene insulation
5. Old crawlspace
6. Old landfill

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LEARNING OUTCOME:

3. Predict the residual service life of structures

- 3.1. Reinforced uncoated concrete façade structure was built in year 1970. Condition survey has been made in year 2000. Measurement values as average were the following: carbonation depth 10 mm, and concrete cover depth 15 mm. What is the estimated residual service life for the façade structure in year 2020? Justify your calculation. (2p)
- 3.2. Brick wall with render façade structure was built in year 1960 and repaired with an external thermal insulation composite system (ETICS), i.e. render façade wall structure in year 1995. Condition survey has been made in year 2015. Measurement values for the new render as average were the following: frost scaling of the render 5 mm, thickness of the render 25 mm, hot-dip galvanised mesh (nominal diameter approximately 1 mm) located in the middle of the render. The allowed deterioration depth is reached when the hot-dip galvanised mesh is visible (Figure below). Deterioration is assumed to be uniform. What is the estimated residual service life for the façade structure in year 2020? Justify your calculation. (2p)

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- 3.3. Prepare systematic durability planning tables for **chloride induced corrosion deteriorated reinforced concrete edge beam structures** and **fatigue deteriorated structural steel box girder structures** at Lauttasaari Bridge. [Assignment]. (2p)

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LEARNING OUTCOME:

4. Choose repair methods of structures

4.1. How to repair patch repaired concrete structure (Figure below)? Justify your decision. (2p)



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4.2. How to repair sewer pipes (Figure below)? Justify your decision. (2p)



4.3. How to repair rendered structure of listed building (Figure below)? Justify your decision. (2p)

