

Advanced Structural Concrete

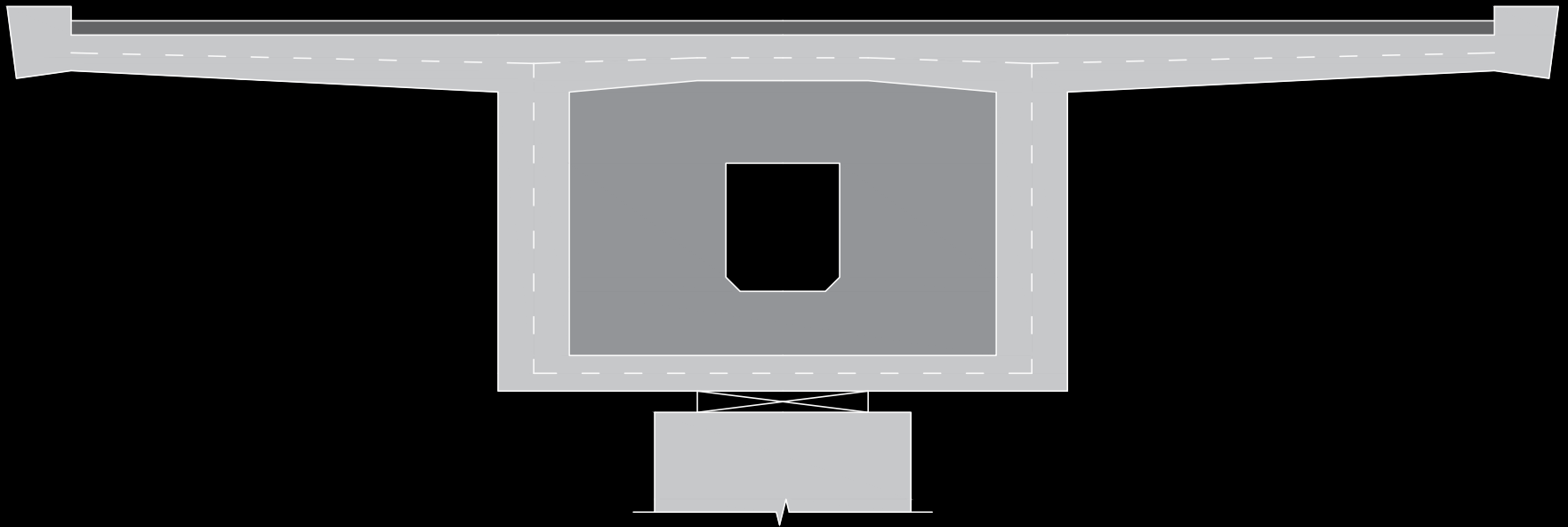
Colloquium 1

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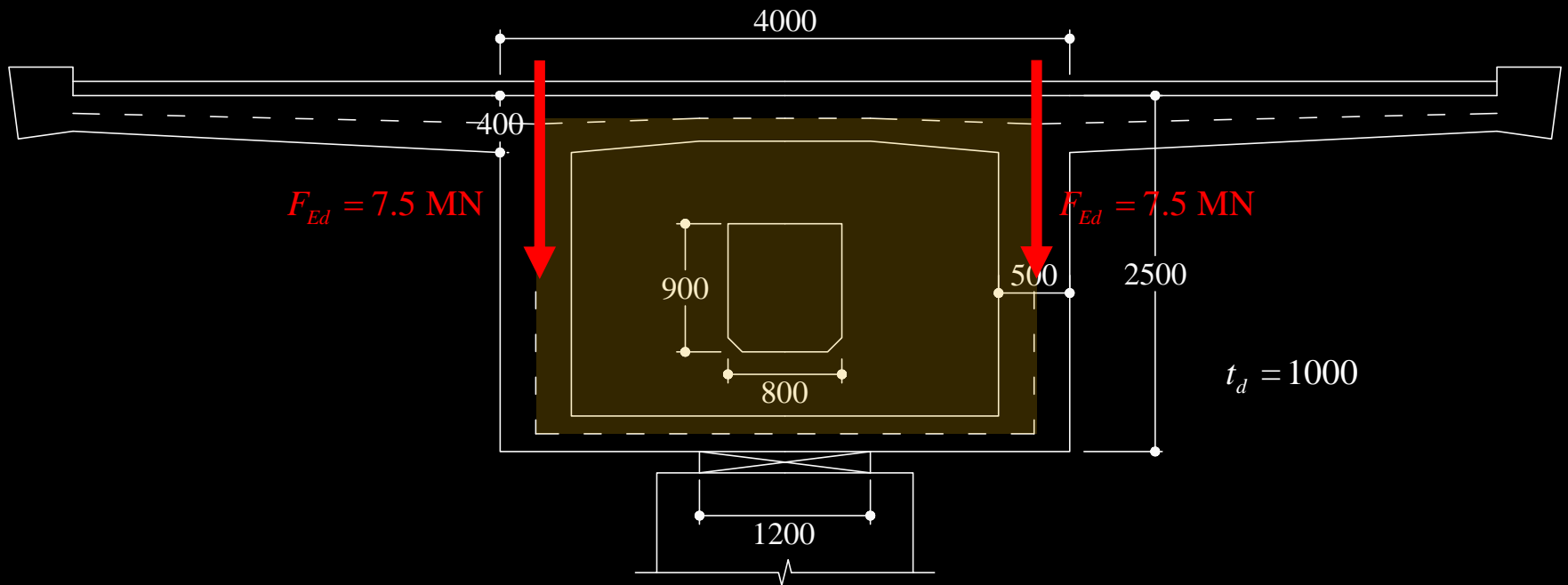
[Quelle: google maps]

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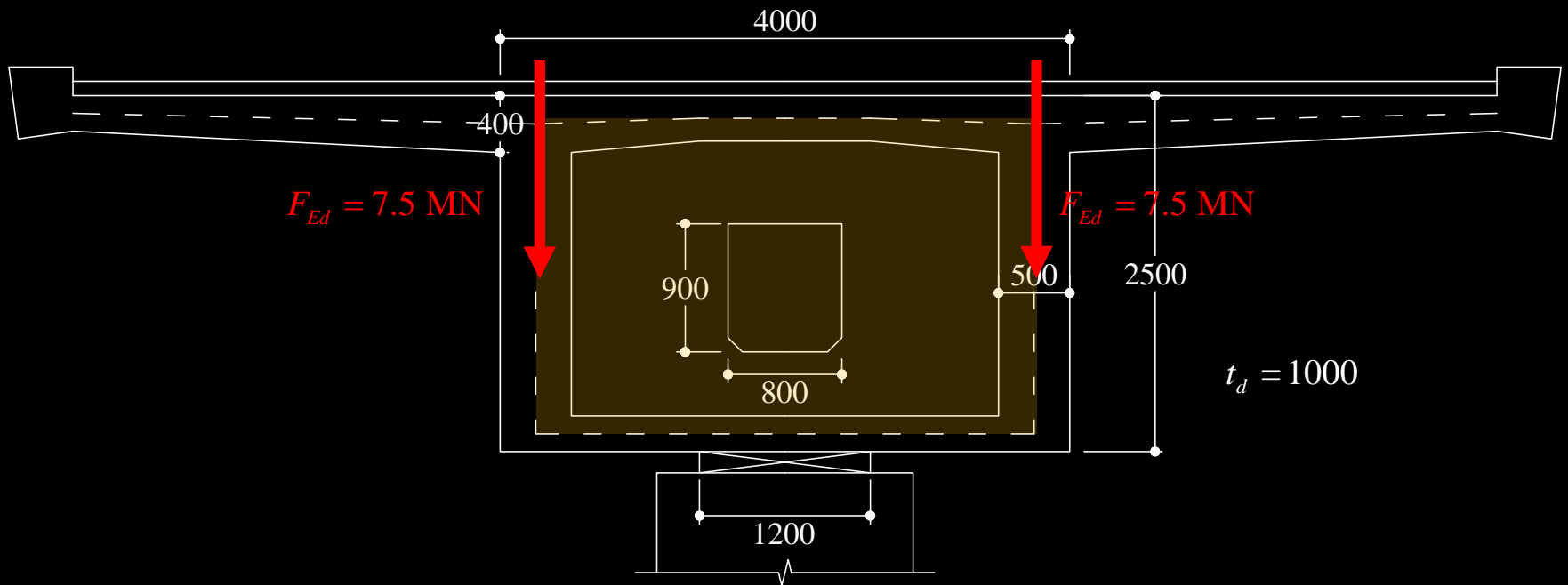
Overview



- Material:
- Concrete C40/50 $\rightarrow f_{cd} = 24$ MPa, $f_{ctm} = 3.5$ MPa
 - Steel B500B $\rightarrow f_{sd} = 435$ MPa
 - Concrete cover $\rightarrow c_{nom} = 45$ mm

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Task

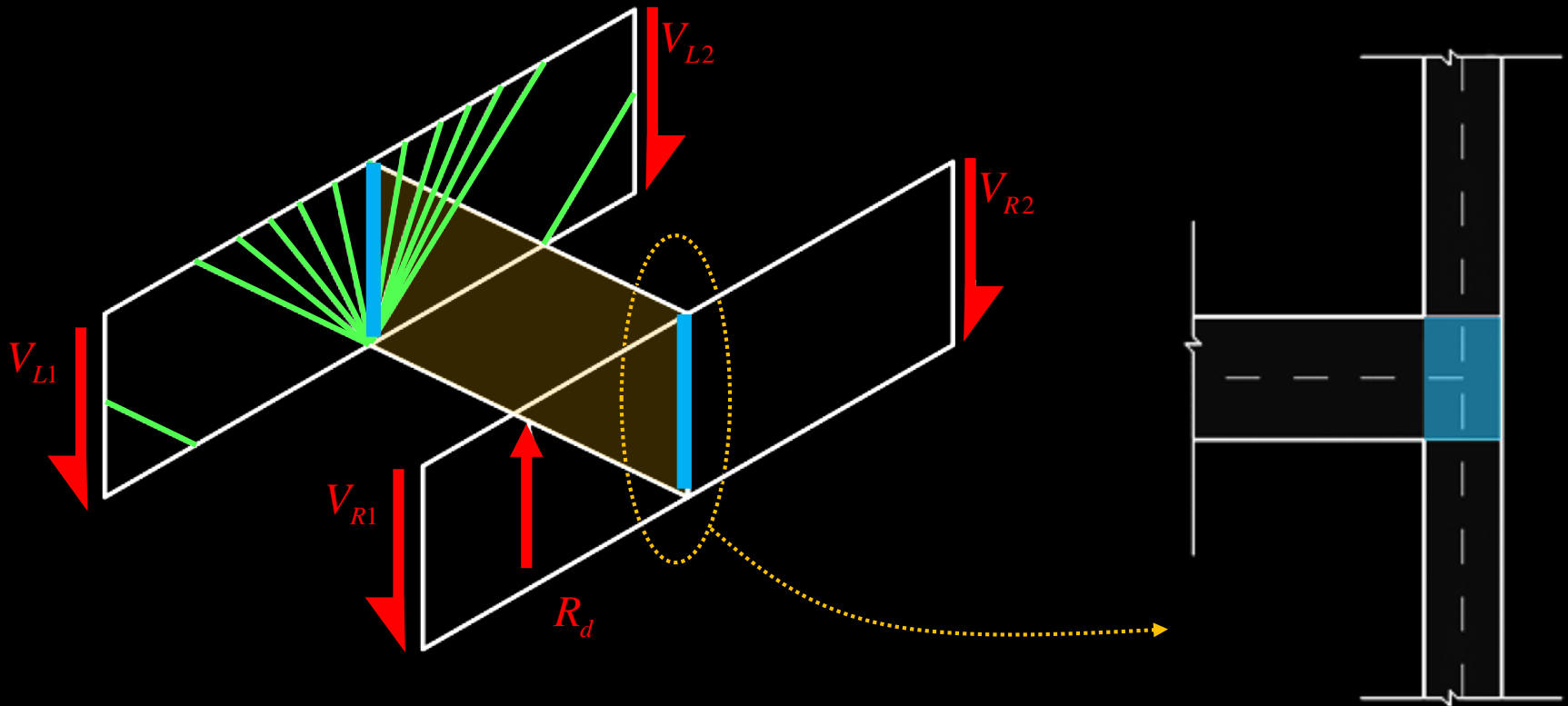


1. Development of a strut-and-tie model/stress field and dimensioning of the reinforcement
 - a. With suspension reinforcement
 - b. Without suspension reinforcement

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Task 1a

Point-centred fan in longitudinal girder for the load introduction in the diaphragm with suspension



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Task 1a

Point-centred fan in longitudinal girder for the load introduction in the diaphragm with suspension

$$F_{tA} = \frac{F_{Ed}}{2} = 7.5 \text{ MN}$$

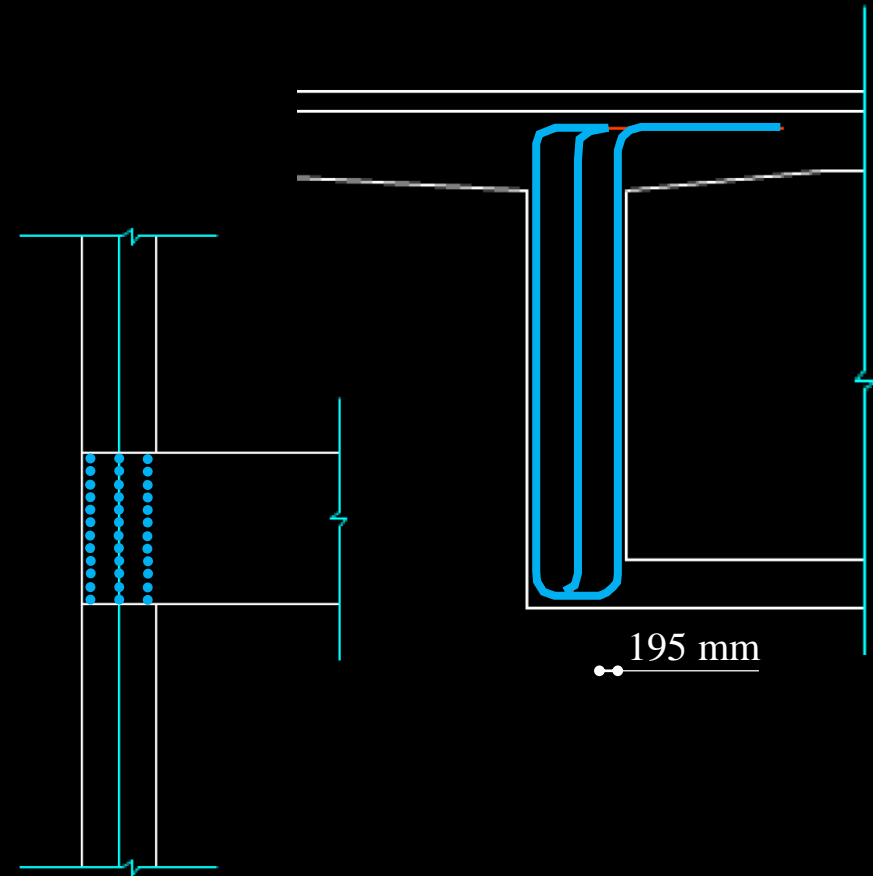
$$A_s (\varnothing = 26 \text{ mm}) = \frac{26^2 \pi}{4} = 531 \text{ mm}^2$$

$$A_{s,reqA} = \frac{F_{tA}}{f_{sd}} = 17250 \text{ mm}^2 \rightarrow \text{Choice: } 36\varnothing 26 \text{ mm}^2$$

$$\rightarrow F_{tA,Rd} = 36 \cdot 531 \cdot 0.435 = 8.3 \text{ MN} > F_{tA}$$

Remark:

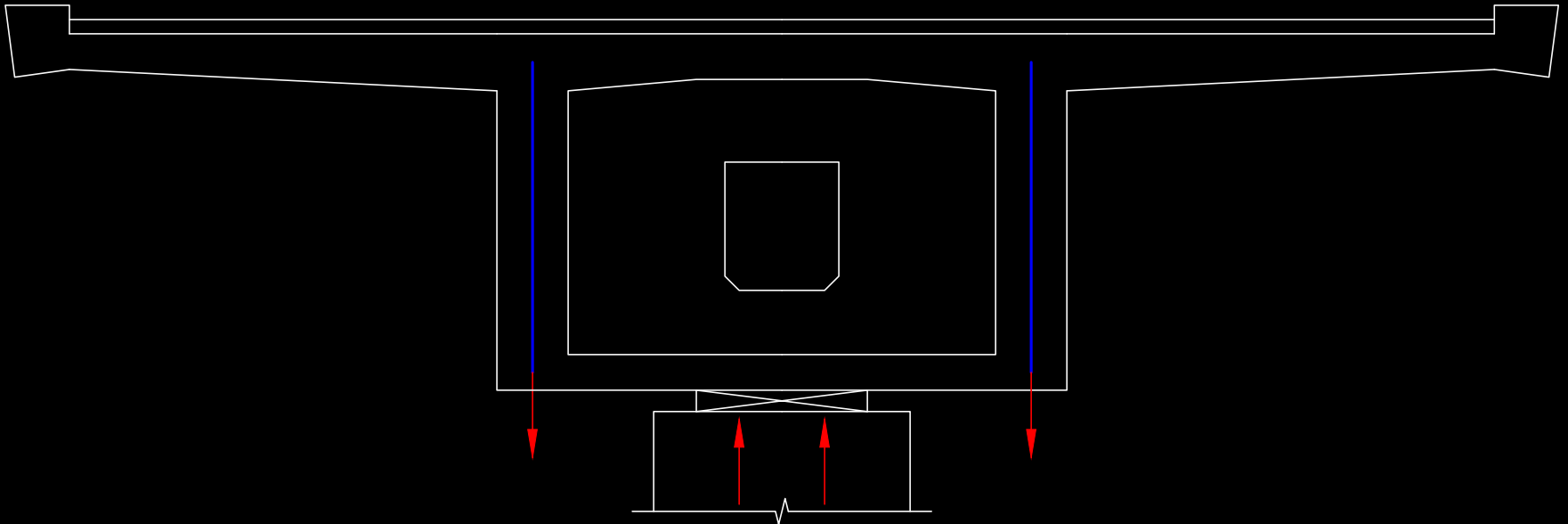
- Large bending radius of $\varnothing 26$ -bars
→ anchorage?



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Task 1a

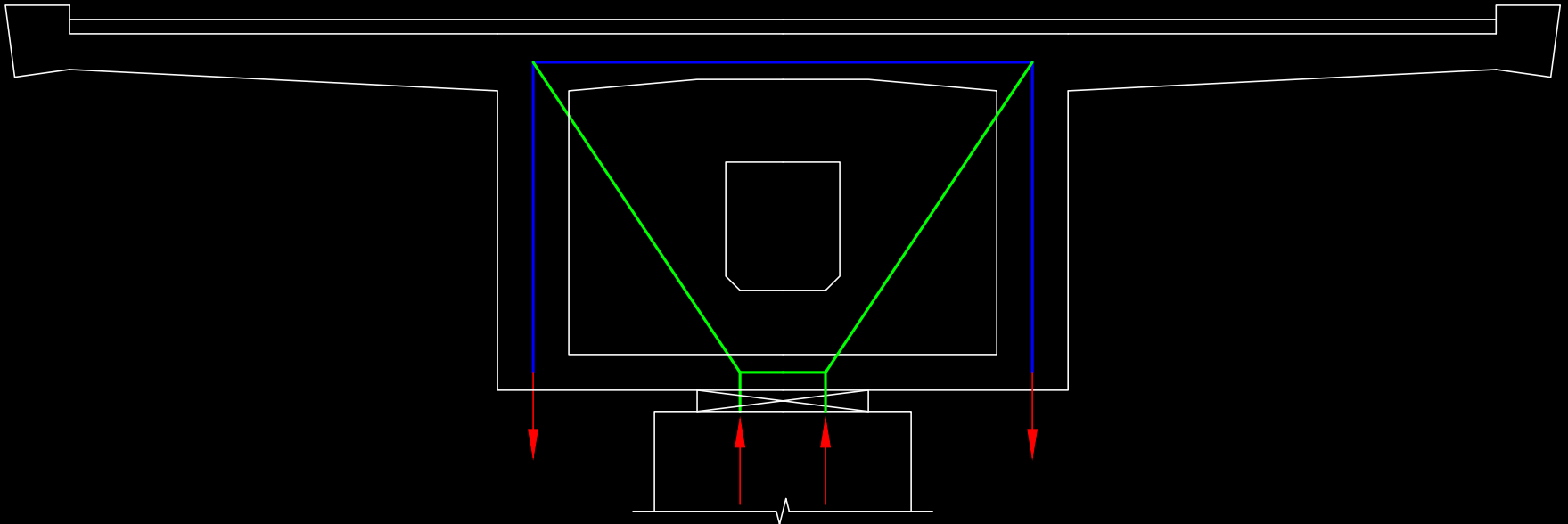
Suspension



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Task 1a

Strut-and-tie model 1

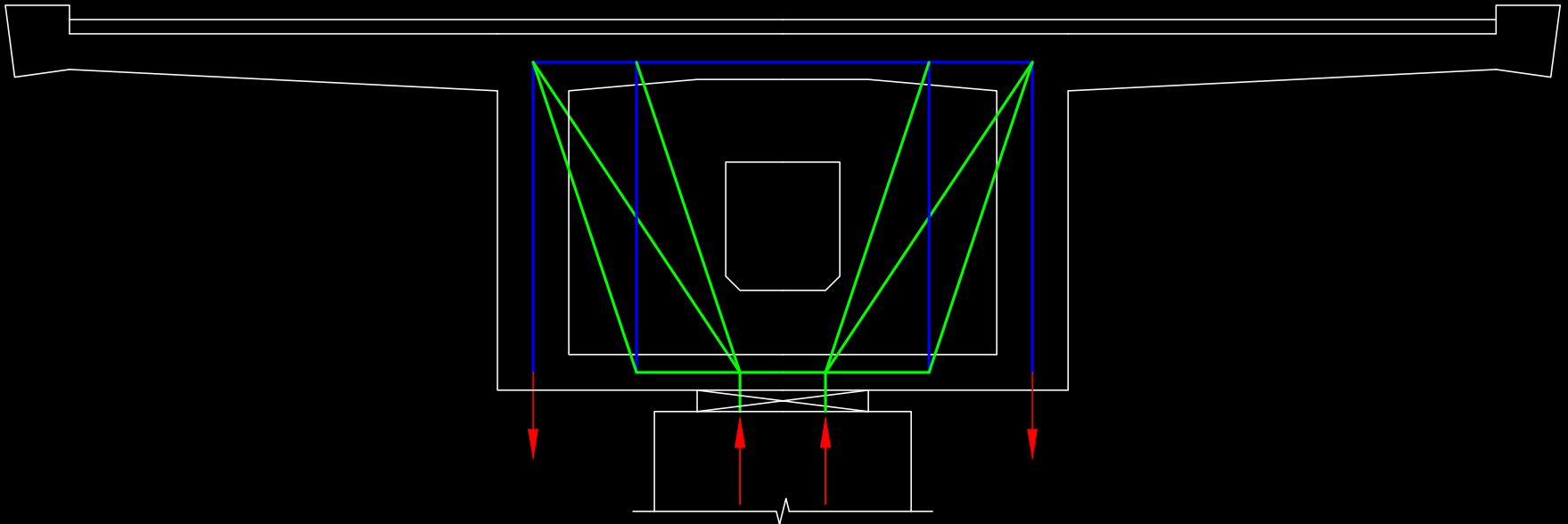


- Membrane shear action rather than bending action (very low slenderness)
→ direct strut-load transfer
- Minimum reinforcement in membrane element is not activated

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Task 1a

Strut-and-tie model 2

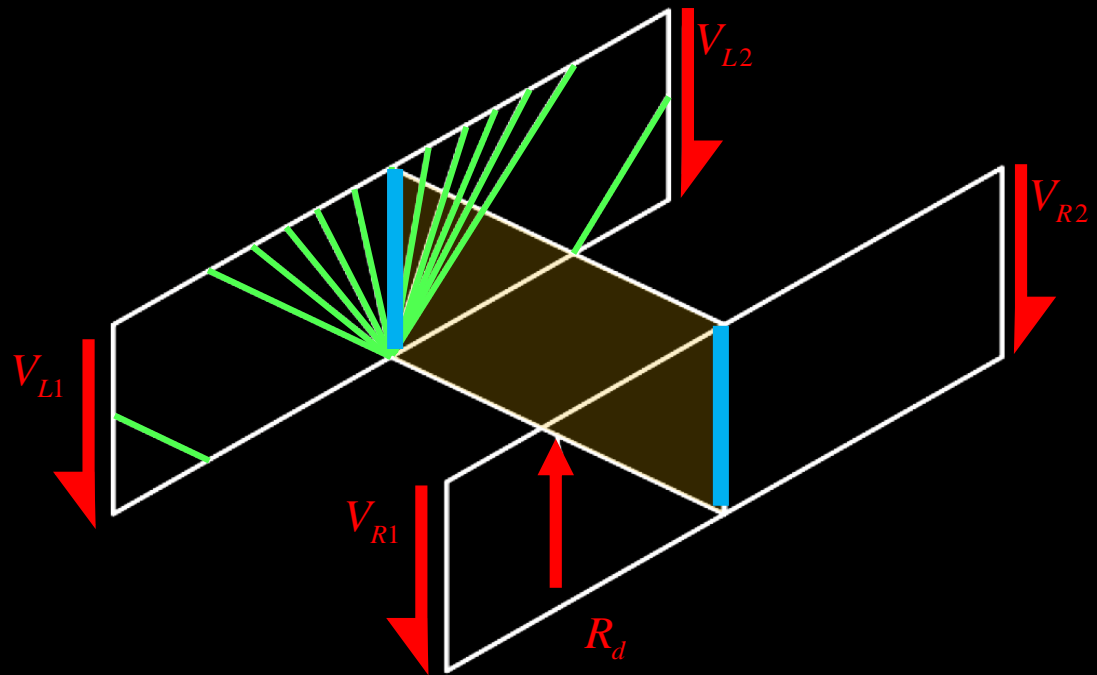


- Activation of the minimum shear reinforcement
- Truss model statically undetermined → «Engineering judgement»

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Summary task 1a

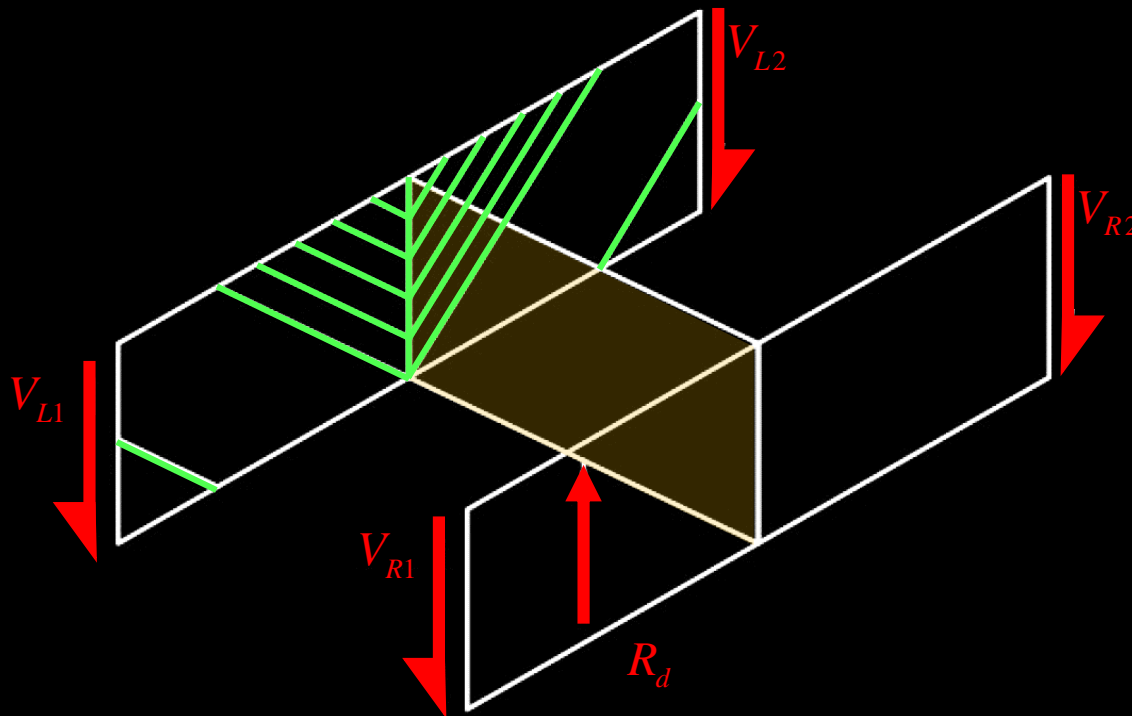
- The reinforcement content necessary for the suspension of the shear forces in the intersection area is very high and results in a very complex design.
- Influence on formwork, reinforcement work and casting of the concrete
- Alternative: Task 1b or approach by Leonhardt/Menn (Task 2, Exercise)



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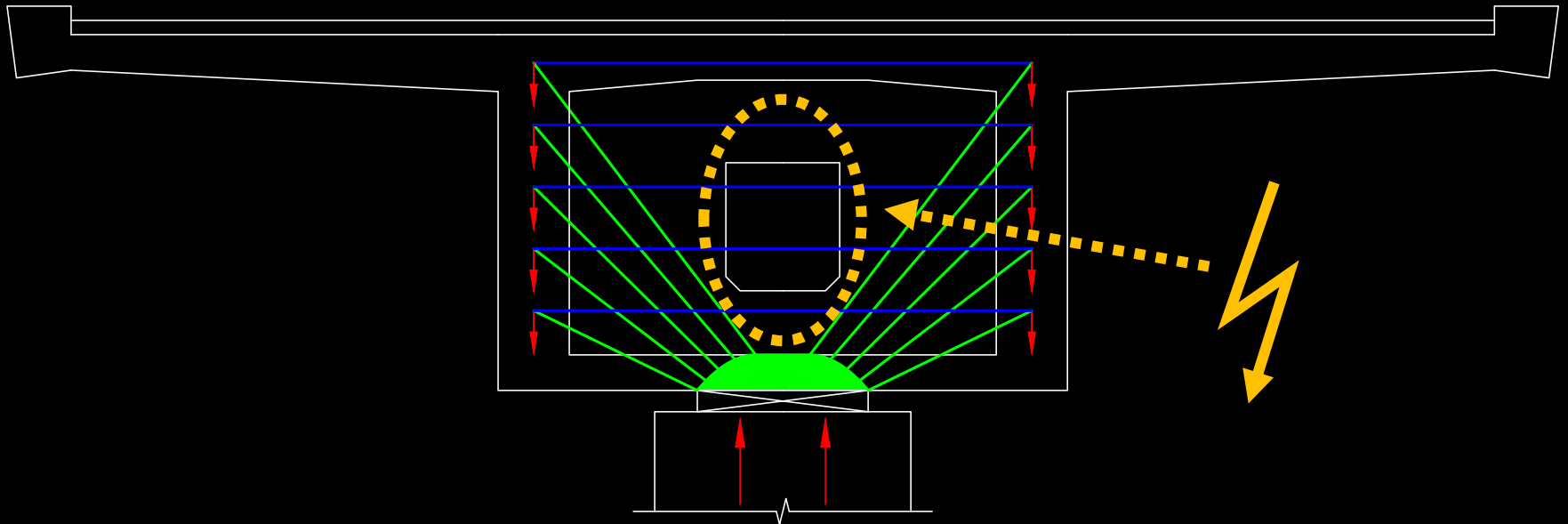
Task 1b

Parallel fan in longitudinal girder for the load introduction in the diaphragm without suspension reinforcement



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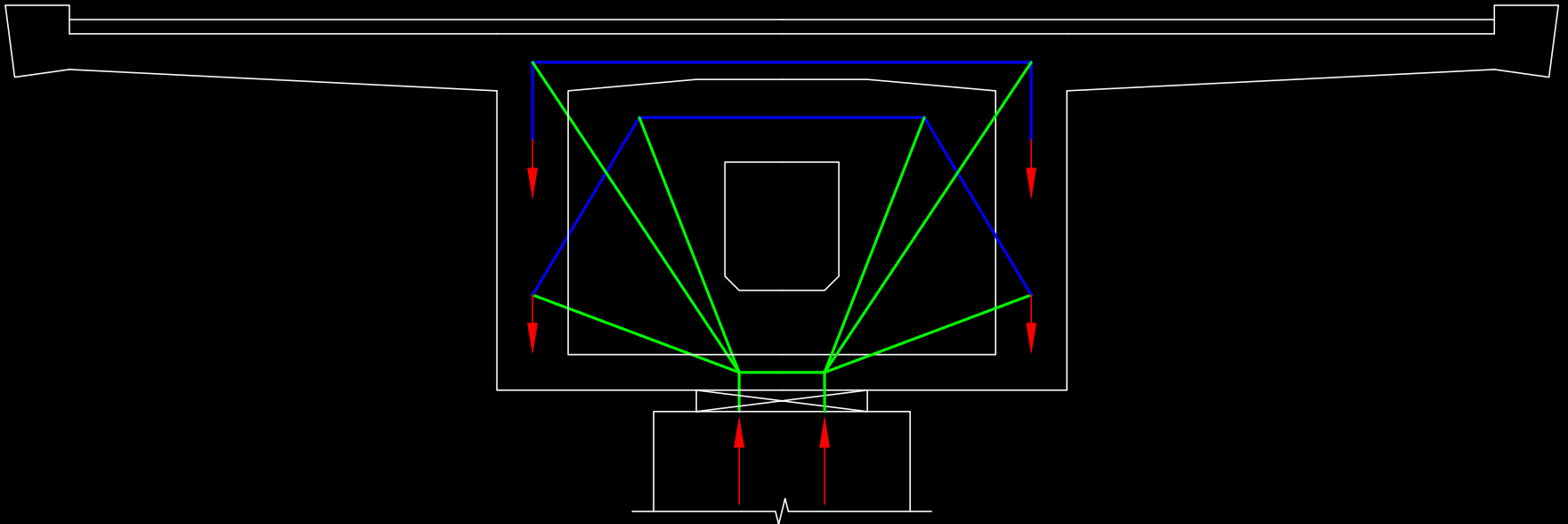
Task 1b



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Task 1b

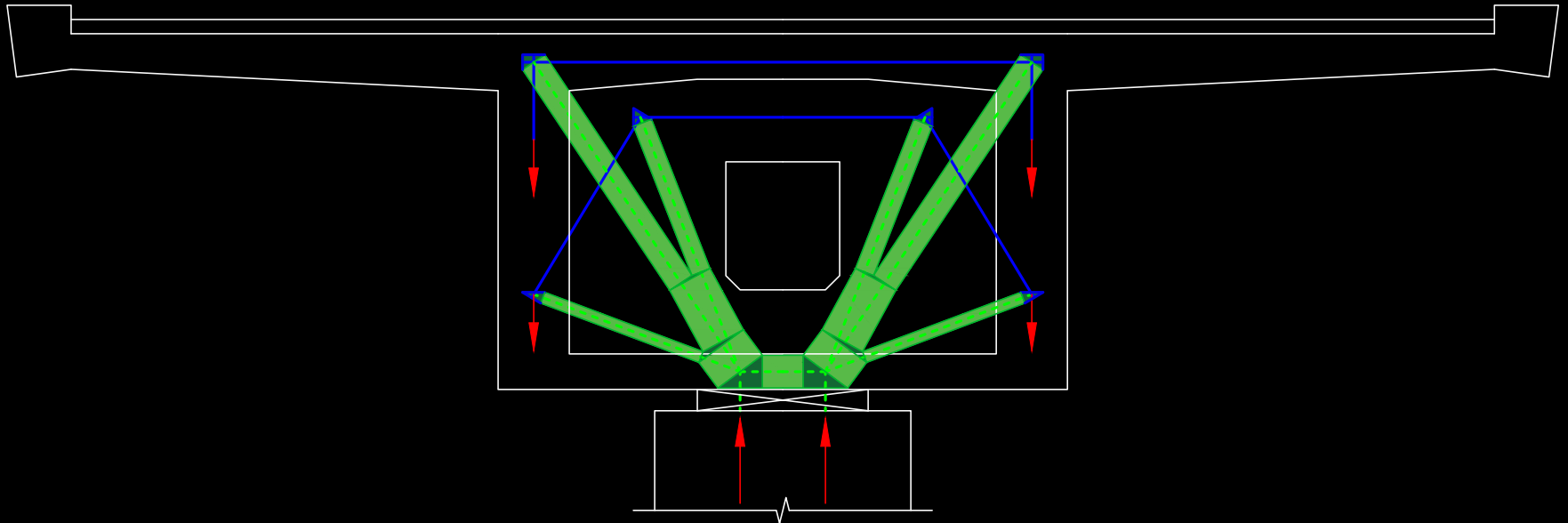
Strut-and-tie model



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Task 1b

Strut-and-tie model

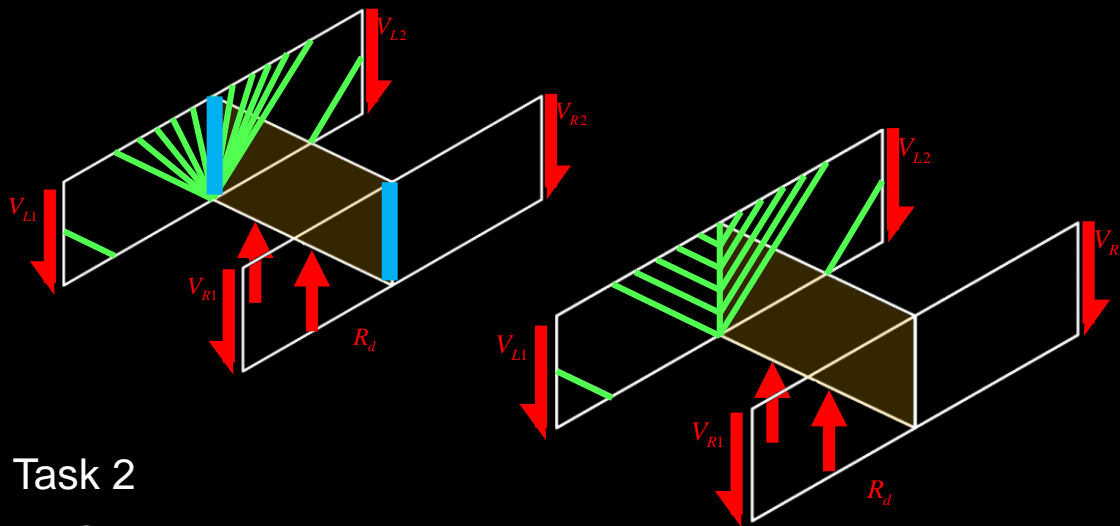


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Hints for the exercise (*slender diaphragm*)

- Task 1

Procedure analogous to colloquium, choice of diaphragm's thickness: $t_d = 1$ m



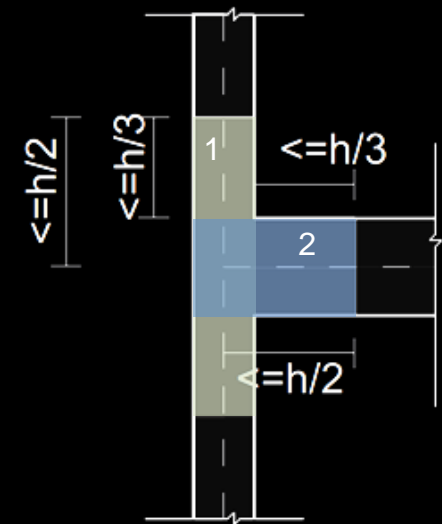
- Task 2

- Stress fields

- Task 3

- Prestressing as anchorage and deviation forces
- Evaluate the introduction of the anchorage forces

$$u = \frac{8P_{\infty} f}{l^2}$$



Leonhardt, Koch & Rostasy (1971)

Colloquium 1

Hints for the exercise (*slender diaphragm*)

- Task 3
 - Prestressing as anchorage and deviation forces

