Rak-83.125 COMPOSITE STRUCTURES

Examination (for foreign students) 2.4.2004

Write clearly on every paper you hand in:

- the code and name of the course and the date of the exam
- your full name
- your student number
- your signature
- 1. What are the different design stages that have to be considered in structural design of composite slabs and what are the essential things that has to be considered in each stage?
- 2. Explain by using drawings the use of normal force moment (N-M) interaction curve for composite columns.
- 3. Calculate moment and shear resistance of the composite beam shown in the following figure. The beam is assumed to be simply supported (pinned at both ends) and single span with length of 10m. The beam is designed for full shear connection between steel and concrete. Steel grade of the beam is S355 ($f_y=355N/mm^2$). Concrete is C35/45 (cylinder/cube), $f_{ck} = 35N/mm^2$, $E_{cm}=33500N/mm^2$ according to EC4. What is the adequate distance between the shear connectors when using headed studs with d=19mm ($F_{vu}=100kN$)? Partial safety factors for steel, concrete and the shear connectors are $\gamma_a = 1.1$, $\gamma_c = 1.5$ ja $\gamma_v = 1.25$. $b_{eff} = L/8$ (see figure).



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4. Calculate compression resistance of a concrete filled (C35/45, f_{ck} =35N/mm², E_{cm} = 33500N/mm²) square hollow section (steel grade S355) taking into account the composite action. Reinforcement: 4 Ø 25 mm (A 500HW, f_{sk} =500N/mm², E_r = 200 000N/mm²). Partial safety factors: structural steel 1.10, reinforcement 1.15 and concrete 1.5. The safety factor for stiffness is 1.35 and the effect of long-terming loading on the effective elastic flexural stiffness is not taken into account (the value of E for concrete is not reduced) in this case. Buckling curve for hollow sections is a ($\alpha = 0.21$). Stiffnesses:

Concrete:	$0.8E_{cd}I_{c}$
Structural steel:	E_sI_s
Reinforcement:	$\mathrm{E_r}~\mathrm{I_r}$



5. Explain shortly the benefits that can be achieved in structural fire design by using composite steel-concrete structures.