Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Dr. Lukas Gebhard
Dr. Severin Haefliger
Institute of Structural Engineering
D-BAUG, Master Civil Engineering
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Advanced Structural Concrete

Information Sheet: Strut-and-Tie Model

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Stress fields and strut-and-tie models (STMs) are common tools for practicing engineers to design and assess in-plane loaded structures such as beams and walls. For design, the engineer is free to choose a suitable solution and dimension the reinforcement accordingly, whereas for assessment the engineer needs to verify the load-bearing capacity of the chosen solution. The design principles of simplicity, stiffness, and efficiency should be followed.

Here, a short step-by-step approach for the choice of a suitable STM is given, shown with an example of a simply supported beam subjected to partially distributed load q (see 0. in the figure below). The enumeration corresponds to the number in Figure 1.

1. Solve the static system.
2. Define locations and forces of chords ($F = \frac{M}{z}$).
3. If there are distributed loads, select a suitable stress field inclination α (usually 25..45°)
4. Propose a basic STM. Ensure the force flow and that equilibrium in all nodes is fulfilled.
5. Calculate the forces in the STM.
6. Calculate the required amounts of reinforcement A_s.
7. Detailing (verify concrete forces and define the location of reinforcement)
    a. Nodal zones
    b. Critical details with stress fields

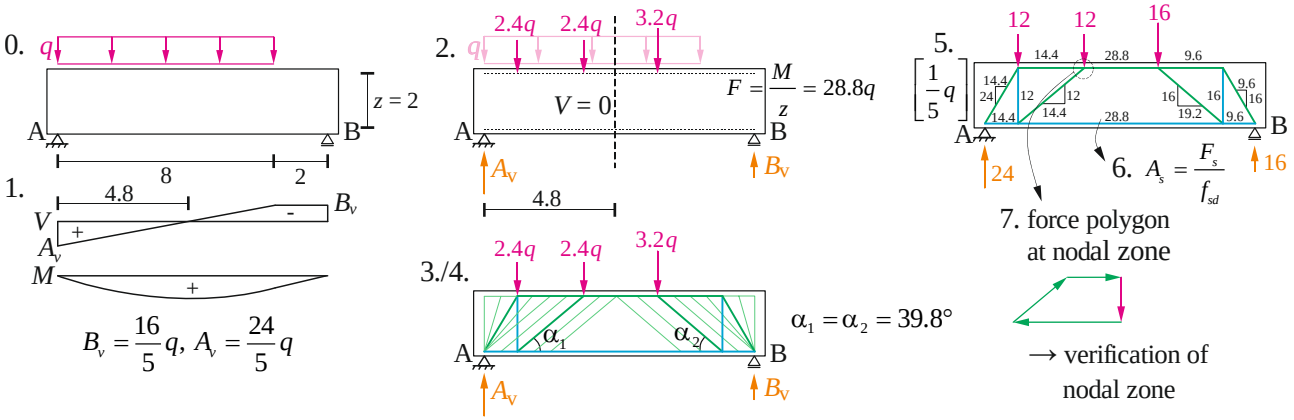

Figure 1: Example of a suitable strut-and-tie model for a simply supported beam with partially distributed load q.