Mechanical Design

The Process

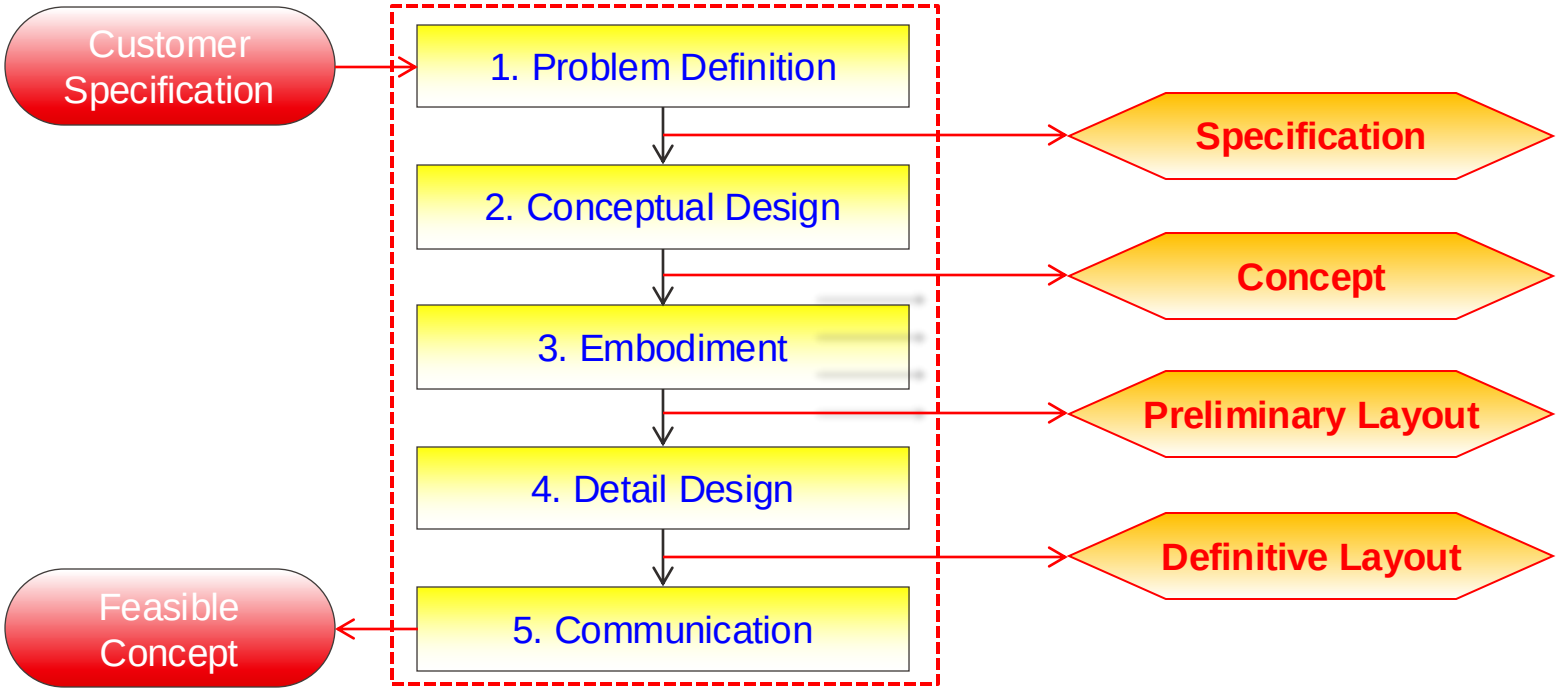
… the end.

Prof. J. Schiffmann

École
polytechnique
fédérale
de Lausanne

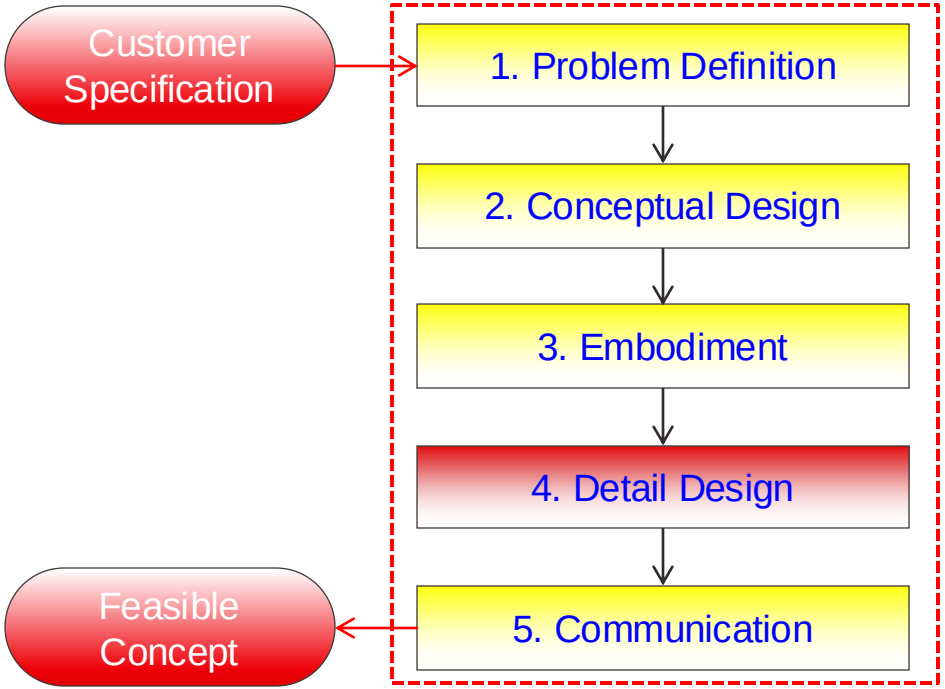
The Process

- Phases of design process(Pahl & Beitz)



The Process: Detail Design

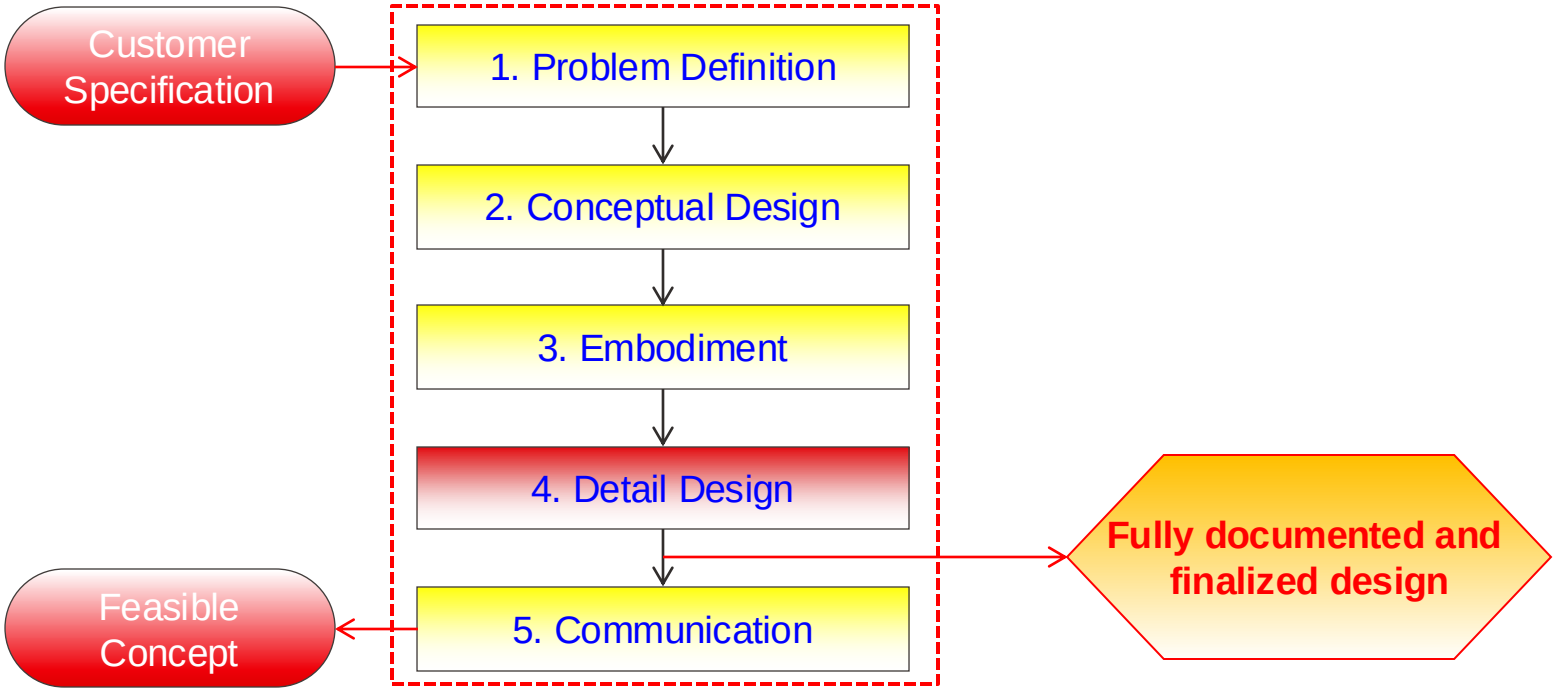
- Detail Design



- Input is a preliminary layout
- Detailed simulation & analysis
- Optimization
- Continuous concept refinement and elimination of weak spots
- Detailed CAD

The Process: Detail Design

- Detail Design



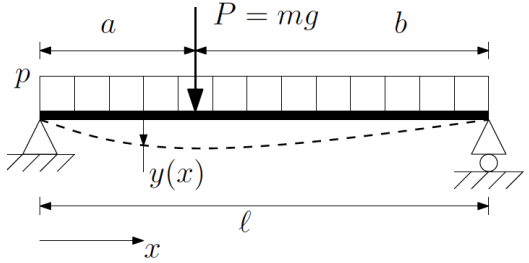
Detail Design

- Essence of task → Take concept to operational, fully detailed design
  - All functions implemented with a working principle
  - All functions sized in terms of their dimensions → simulations
  - Concept is optimized in detail
  - Risks are continuously minimized
  - Detailed design (outcome) does not leave any room for interpretation
  - Assembly drawings, detailed drawings of components, defined materials, bill of material (BOM)

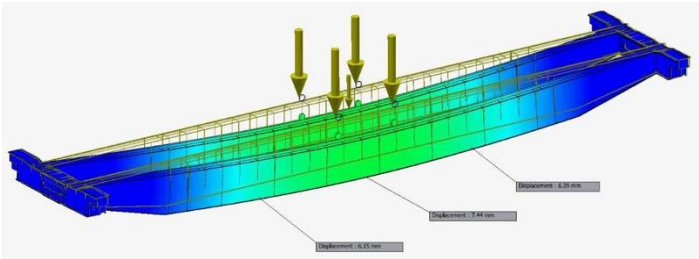
Detail Design

$$y_1(x) = \frac{P}{6\ell EI}\left(2ab^2x + a^2bx - bx^3\right)$$

$$y_2(x) = \frac{p}{24EI}\left(x^4 - 2\ell x^3 + \ell^3 x\right)$$



- Simulations and sizing



- Start with reduced order models (embodiment)
- Continue with more complex simulations when close to final solution (detailed design)

Characteristics of Detailed Design

- High complexity → Many simultaneous, highly interdependent activities
- Analysis and synthesis continue to alternate at increasingly high pace
- Focus is set on concept optimization and on dimensional quantification
- Objective is customer satisfaction → comply with specifications!

Tips and Tricks I

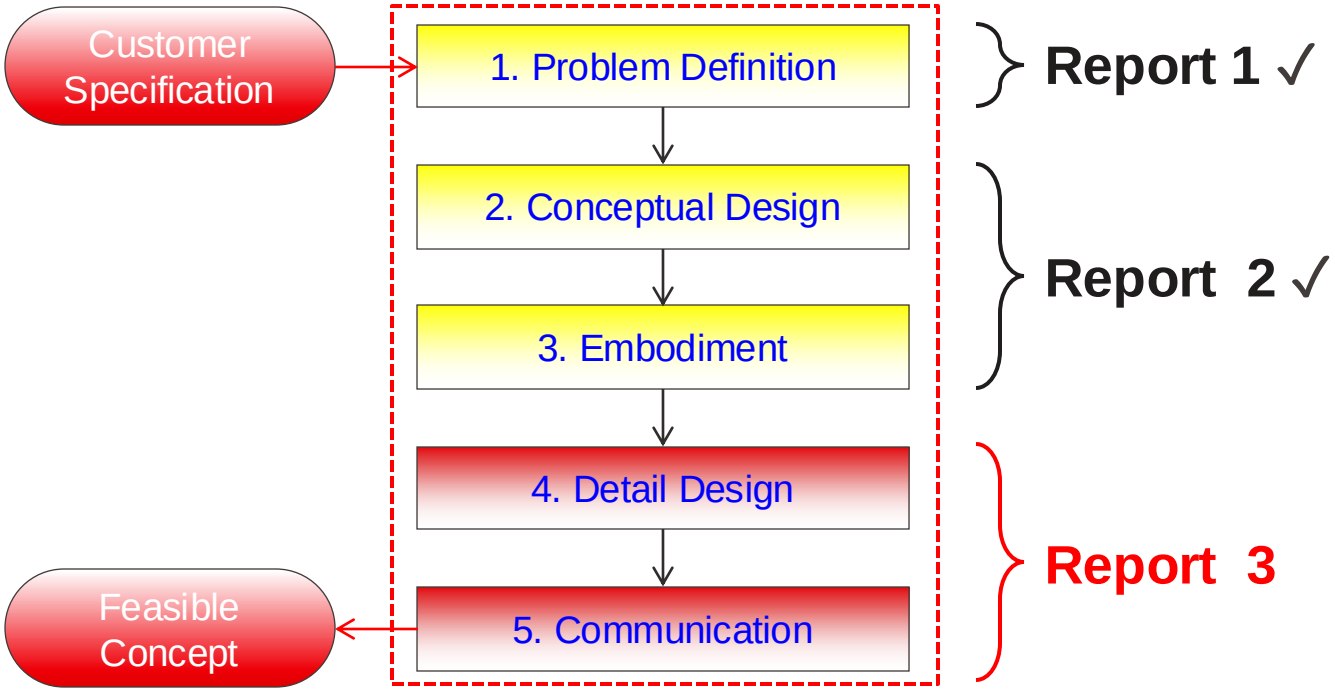
- Easy to get lost in details → use clear task repartition
- Keep looking back at your preliminary layout as a reference
- Keep identified risks in mind when detailing
  → think about what could go wrong → how to avoid → fix it
- Think about screws, linkages, bearings, and seals
- Make sure parts can be manufactured
- Make sure system can be assembled

Tips and Tricks II

- Use rapid prototyping to leverage remaining risks
- You need to be fully convinced and satisfied by your design
- Do not get frustrated by iterations…

Deliverables

- Three reports



?