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CAE in the area of project management (Demonstrated on a Robot translation axis)

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Engineering/CAE/CAD

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Abstract

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(Demonstrated on a Robot translation axis)

This presentation describes the design of a robot translational axis, using CAE-techniques. For the application in a steel mill, the construction performs the gate actuation of canisters. It is composed of a translational unit, which holds the robot upside down and a load-bearing steel beam structure. Over a total length of nearly 30 meters, the accuracy is required to be ±1 millimeter.

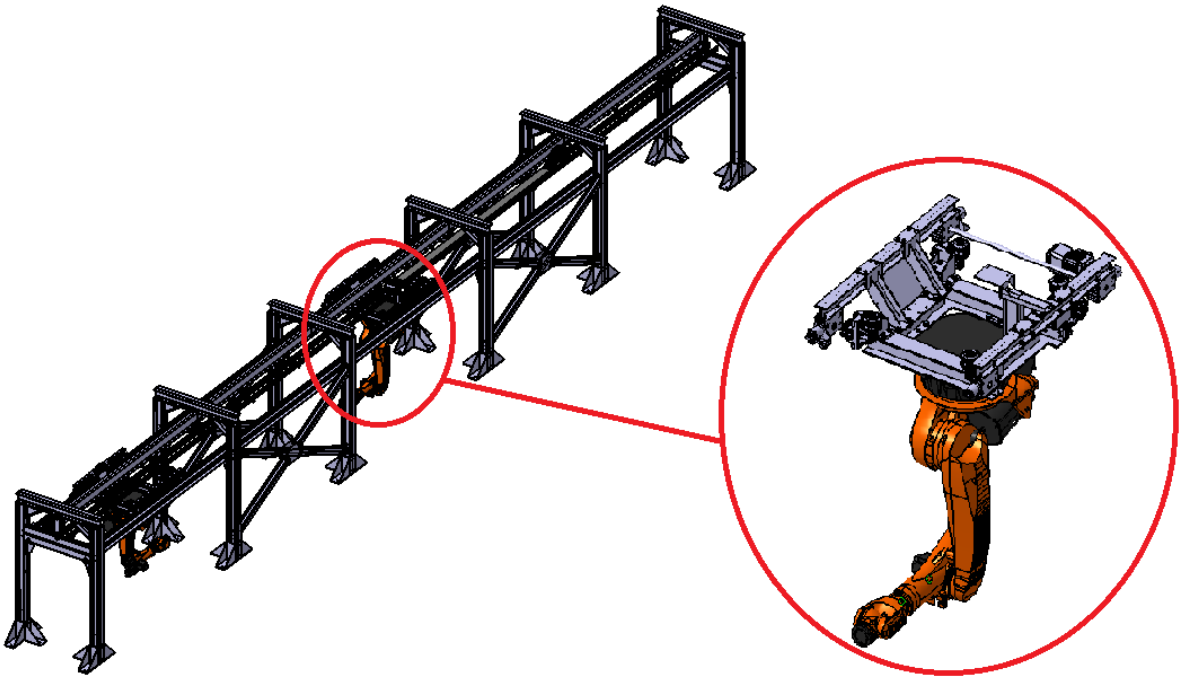
In order to achieve an adequate scheduling, the time frame for the project is presented in a timetable. The given task is then clarified in a requirement specification. To obtain a market overview and to evaluate the state of the art, a patent research has been accomplished. In a next step, the single functions of the device, e.g. signal transmission or force conduction, are constituted and connected in a function structure. Several possible solutions are then provided in a morphological analysis. Combining these solution leads to six different concepts. Then each concept is described. In a K.O.-selection, it turns out that two of them have to be dropped. Thereafter the four remaining concepts are ranked in a weighted evaluation. Because they score a similar result, their individual advantages form the final concept. To investigate the weak points of the design a Fault Tree Analysis and based on that a Failure Mode and Effect Analysis is done. Possible risks can so be identified and rated.

Then it is presented how the dimensioning of the design components is performed. The solution for the drive is an offset geared motor. A FEM-Analysis shows that the stresses in the locking and positioning unit are very high. Therefore the positioning and the interlock have to be separated. Whereas the interlock is accomplished by friction brakes, a pneumatic cylinder manages the positioning. In order to keep the product cost efficient, the supporting frame of the translational unit is designed with norm profiles. The appropriate dimensioning is achieved by strength calculations. The design of the supporting structure is carried out in the same way. A first idea of the supporting structure shows unacceptable high displacements in the FEM-analysis. Thus, diagonal bracings help to increase the stiffness. For the power supply, a drag chain is installed. High accuracy sensor barriers at the frame measure the position.

In a cost analysis the costs for the product are determined. The total costs are calculated by the sum of the costs for purchased parts, assembly and manufacturing.

Then the assembly instructions are shown. Single parts build preassemblies, which then form the main components of the supporting structure and the translational unit. After those two are mounted, the drag chain is set up.

A House of Quality visualizes the quality characteristics and the competitive situations. With reference to the next steps in the project, it is concluded, that a cost-efficient and accurate alternative to competing products has been designed.



Key words:

- CAD (Computer added design) (CATIA V5)
- Timetable (MS Project)
- Requirement specification (Excel)
- Patent research (depatisnet.dpma.de)
- Function structure (MS Visio)
- Morphological analysis (Excel)
- K.O.-selection (Excel)
- Weighted evaluation (MS Visio)
- FTA (Fault tree analysis) (MS Visio)
- FMEA (Failure mode and effects analysis)
- Dimensioning
- FEM (Finite element method) (Ansys)
- Cost analysis (Excel)
- Assembly instructions
- House of quality
- GIMP (GNU Image Manipulation Program)