

Summary

Cargo handling at the quayside is done by lots of cranes and lifting devices. Most of these cranes need to be movable and are mounted on a rail track. The crane drives on travelling mechanisms, or bogiesets. These bogiesets are made statically determinate; with equilibrium equations the forces and moments can be calculated. With balances and hinge points the loads of the crane are distributed to the wheels equally. The goal of this assignment is to make a design of a bogieset that is statically indeterminate. No use of balances, but finding another method to overcome inequalities in the rail surface and other deflections. The design is focused on the design of a three wheeled travelling mechanism where the middle wheel is suspended in a flexible way between the outer wheels. The solution must meet with strict requirements for the stiffness.

In order to design a system that can be compared and compete with common systems, average loads and sizes for three wheeled travelling mechanisms needs to be clear. The choice for rail and wheel are determinate for loads that may act on the system. This bogie design is made for a three wheeled bogieset is made with a A120 rail and wheels with a diameter of 710 mm. With several normalizations for crane design, the loads and maximum deflections can be calculated. With the knowledge of these numbers the stiffness that the wheels need are calculated. The design is made in such a way that the outer wheels are connected by a construction where the total load works on. Between these wheels the middle wheel is suspended. The requirements for stiffness strongly depend on the chosen wheel center distance. The stiffness for the middle wheel can be reached in different ways, for instance with springs, rubbers or hydraulics. Either these methods are quite expensive, require high maintenance, are not very reliable or need lots of space. The suspension will be designed making use of a flexible beam, a simple solution with fewer disadvantages compared to a normal statically determined bogieset. The flexible beam is made of high strength construction steel in order to handle the maximum stresses that occur. The S690 construction steel can handle 420 N/mm^2 . Flexibility is easy to generate with a long construction, but a longer construction needs to be stronger too. The best option is the design of a bogieset where the middle wheel is supported by a beam at both sides. The constructed beams are 3000 mm long and due to the shape it is possible to handle the loads and be as flexible as possible at the same time. The profile is like a channel beam, with the difference that the middle section is the highest and the beam becomes lower towards both ends. The load of the middle wheel acts on the middle of the beam and causes a moment in a 'mountain' shape. The section modulus of the beam is related to that figure of the moment. The maximum effectiveness of the beam that can be reached is 90% of the total load, so the middle wheel acts for 70% in this case.

The statically indeterminate bogieset is possible but the system is more complex than a bogie design with balances. The loads in the system are most of the time distributed in such a way that there is a large difference in load per wheel between outer and middle wheels. This makes the system ineffective and requires maintenance at different intervals and causes dissimilar wear. But overall the flexible beam is a good option for the design of a statically indeterminate bogieset.