Ferry car ramp operating mechanism re design engineering essay



Introduction

This project is about the ferry MV Saturn in the fleet of Caledonian mcbrayne , she is operating as a car and passenger ferry in the firth of Clyde . and she first started her voyage on the 2nd of February 1978. She has a capacity of carrying 531 passengers and 38 cars. she does a speed of approximately 12 knots . she has 3 decks for passengers accommodation and service and since the ferry is of ro-ro type she has ramps one stern ramp and two one on the port and starboard side for the car to get into the open deck on stern and can move in or out via any of the three ramps

The project given to me is to change the mechanism of the stern ramp of ferry mv Saturn which is being currently operated using hydraulic method and method chosen by me is to use the steel rope winch method. The intended project is done as a part of hnd mechanical engineering graded unit-2 and the tutor guiding the project is Mr. John mcIlnally, the project would explain the ramp operating method and the safety to be followed while operating the ramp.

The project given to me is to redesign the operating mechanism of the ramp which is hydraulically actuated. The new operating mechanism used is the steel rope winch method which has been designed keeping in mind the imo rules of ro-ro safety as main aim of the project is safety and customer satisfaction.

The project explains about the ferry, the different types of ramp and the materials used in the project which would be helpful in identifying the reason for selecting the particular product. The project would cover all the https://assignbuster.com/ferry-car-ramp-operating-mechanism-re-design-engineering-essay/

requirements in the checklist given to me. The project also gives the mass of the ramp, centre of gravity of the ramp and the torque calculation. In addition to that the drawings of the product are also included.

The specification and products used in the product are of accepted standards and cost of the steel is

3 BUTTON LIFT/WINCH CONTROL BOX = 49 pounds Theory

History of ro-ro ferry:

Ro -ro means roll on roll off. The evolution of ro-ro ferry can be traced back to hundred years previously they were used in transportation of steam trains across rivers as it was very wide for the bridges or too huge . these ferry's had rail on them and they can be directly transferred through the rail from one berth and can be transferred or rolled off to the rail in the other berth.

An example of this is the firth of forth ferry that began its operation in Scotland. the idea of using the principle of ro- ro began during the second world war . the application of ro-ro principle on merchant ships began in the 1940-1950's . as the name indicates ro ro ferries was used to transport cars, lorry's on short sea or river routes as they can be directly brought in and taken out easily on the other berth. Due to the advancement in transport roro ferries became popular on short routes and were fast in terms of speed.

The ro-ro ferry became popular in the transportation and tourism. And it became a boon for car makers. Previously cars were transported by ships from one country to other country . the cars were loaded into ships by cranes which was very expensive and took lots of time. The development of ro -ro car ferry brought in a lot of changes UK's first pair of ro-ro berths were built in 1950's t ill then the scale of crane loaded car became less. . by 1994 there were nearly 4600 ro-ro ships operating around the world and the ro ro ships were popular around Europe and there were different type of ro ro ships like the container and freight vehicle combination and only freight.

But the most popular were the short distance ferries used to transport vehicles and passengers.

The different types of ferries are

Cruise ferry

Fast RoPax Ferry

Turntable ferry

Pontoon ferry

Foot ferry

Cable ferry

Ramp :

A ramp is a inclined plane that is used to move objects easily . but additional force is required to complete the task , the main problem face d in this is friction however less force is used over long distance. In shipping terms ramp is an inclined plane used to accommodate vehicular traffic and passengers and it is a large steel structure with longitudinal and transverse beams . this can be used to drive in and drive out vehicles at high tides and low tides

Types of ramp

The different types of ramp are:

Foldable Stern Ramp/Door

Quarter Ramp

Side Ramp

Stern Ramp/Door

Foldable Stern Ramp/Door

This type of ramp consist of two main section fitted together with inner and outer flaps to provided better movement of vehicles. Open and closing of the vehicle is achieved by hydraulic method or by wires and winches. The outer section of the ramp is closed and extended by wire arrangement or by hydraulic mechanism. When the ramp closes the ramps inner section acts as weather tight door. The deployment of ramp may take up to 4- 20 minutes depending on the size of the ramp. The ramp is controlled by control panel located near the ramp providing the operator to monitor the movement of the ramp. The ramp can be opened or closed by manual or through automatic mechanism providing the ramp to operate correctly in a sequence with the circuit

Quarter Ramp

This type of ramp is used when loading heavy loads. Its designed in such a way that the operating system takes the whole weight of the ramp this reduces the amount of pressure to be put in the quay and it does not require any specially constructed quay for its operation. The other advantage of this type of ramp is that they can be used as weather tight door when stowed. It can also operate at a range of heights above and below the datum point in normal condition the slope will not increase more than 8.6 degree and in extreme conditions the slope will increase to 9.1 degree. This type of ramps can be constructed in all sizes . wire operated ramp has three sections the ramp is open in construction with two girders. The hydraulically operated cylinders are placed in between the first and the second section. the outer third section are the finger flaps that provide link between the quay and ramp and is therefore built with mechanical flexibility . so that the outer section rests on the quay when the ramp is empty or even when the ship list +or 3 degree listing. The ramp also acts as a weather tight door when closed as the ramp has a stainless steel bar which rests on the rubber gasket around the frame work of the ramp. The ramp takes approximately 15/30 minutes depending on the size.

Side Ramp

The side ramp is designed in a way that is suitable for all range of quay heights above and below the datum point the slope can be adjusted to the cars and lorries being accommodated on to it and its built in such a way that the flaps completely rest on the quay even at +or_ 1 degree list. The ramp is normally operated by wires but it can be also operated using hydraulic cylinders. When the ramp door closes it acts as a weather tight door. Weather tightness is provided by the stainless steel bar around the ramp . it normally takes 10 minutes to deploy depending on the size of the ramp . they can be fitted either on the port side or star board side.

Port side or star board side.

Stern Ramp/Door

The stern ramp can be deployed and stowed using hydraulic cylinder located one on each side . when the ramp closes it acts as a weather tight door. a control panel is provide to operate the ramp it takes nearly 3 – 10 minutes depending upon the size of the ramp and they can be operated manually or by using automatically. the ramp can be used as a ramp come vertical sliding door a hydraulic cylinder present at the centre of the opening is used for closing down and opening the ramp , the ramp process can be stopped using sequential interlocking when the ramp approaches its closed position.

Winches

A winch is a mechanical device used to pull in or let out or adjusts the tension in the wire rope or cable. The most common form of winch has a spool and a handle, the winch is the heart of machines in industry like the ramp in ro-ro ferries, tow truck and elevators. In some winches there are gear assemblies and these could be powered electrically, pneumatically or hydraulically. Some of them may also include solenoid brake or mechanical brake that prevents the wire rope or cable from unwinding. The spool in the winch is called the winch drum.

Page 8

History of winches:

The use of winches can be traced back to centuries which can be found in the writing of Herodotus of Halicarnassus the use of it in the Persian war for tightening the ropes of a bridge in Hellespont in 480 b. c. it can be further traced back to use in Assyria. It was used on of the architectural equipment by Aristotle.

Application of winches

They are used largely in industries.

They are used for towing boats, cars, trucks or gliders.

They are used in ships or boats to pull anchor lines, mooring lines.

They are used in large theater production to move large scenery's on or off from the screen.

They are used in water sports and snow sports like wakeboarding, wake skating and snowboarding.

Types of winches:

Trifors

Snubbing winch

Wake skate winch

Electric winch

Petrol powered capstan winch

https://assignbuster.com/ferry-car-ramp-operating-mechanism-re-designengineering-essay/

Trifors:

This is one of the common type are known as grip hoist. They are winches which are different from other these instead of using spool uses a self gripping unit or self gripping jaws. The main advantage of using this type of winch is that it consists of a handle which can be moved back and forth and can be used by one person to move several tons of weight.

Snubbing winch:

These winches are conventional winches that have winch drum with ratchet mechanism they do not have a handle. They have the wire rope wrapped around the spool and can be tightened or loosened by pulling the tail line. They can be adjusted by increasing or decreasing the tension by the operator using the ratchet mechanism using friction. They are used in smaller boats for pulling sheets and in larger ones to give additional tension and remove tension in primary winches.

Wake skate winch:

This is the popular type of winch among the water sports enthusiasts. It is simple and has a spool, engine, rope and handle and a simple gear mechanism for transmission. this type of winch the person pulls the rope and walks away from the rope and the winch is activated on it pulls the person at a speed of 25 miles per hour , these winches can be stored in hitch of the vehicle . To the ground by stake or tied to a tree.

Electric winches:

The main components of electric winch are

Wire rope

Electric motor

Main gears

Planetary gears

Gear box

Ball bearing

This type of winch comes with a motor which is driven electrically y by means of a motor which is constructed in such a way that it operates efficiently with low noise and has increased life time. They have special main drive gears which are manufactured with solid billet steel to ensure increased lifetime, the presence of planetary gear ensures proper sharing of load thereby reducing the weight of the winch. The transmission of power to the motor is done by means of direct coupling the presence of brakes in this type of winches help in applying the brakes in times of emergency or breakdown of the machinery or power shut down. The winch is constructed in such a way that it has a unique braking system for static and dynamic loading.

Petrol powered portable capstan winch:

This type of winch is driven by a engine which is being run by petrol and are very efficient as they can pull 1. 13 tons in single line and 2. 3 tons in double line, the main advantage of using this type winch is that the y are very powerful, easy to use and safe and have constant pulling power and can be attached or fixed very easily.

Common applications of petrol powered portable capstans winch:

They are used in industry for pulling and lowering things from poles.

They are used in telecommunication industry

They are used for recovery purposes

They are used in marine industry to pull boats and barges

They are used in construction industry

They are used in mining industry to operate wagons

They are also used in offshore e industry to pull buoys and floating objects

Main components of a winch

Motor

Gear system

Solenoid

Motor:

Winches uses two types of motors permanent magnet motors and series wound motor. All motors consist of set of coils called armature present inside another set of coils called stator. The main responsibility of the stator is to create magnetic field which in turn causes the rotor to rotate when current flows through it. As the horsepower rating of the motor is more the power and torque is more. Winches are selected or rated based on the torque of the motor and the gear ratio.

Permanent magnet motors:

In permanent magnet motors there permanent magnets used as stators instead of the coils. These types of motors draws less current from the power supply as the series wound dc motor that uses coils rather than permanent magnet motors. This type of motor tends to overheat due to the usage of magnets . so it's necessary to monitor the winch load time as the motor tends to overheat. Due to this they are used for light to medium winching process. The only disadvantage of this motor is since they use permanent magnets they tend to lose their field strength.

Series wound motors:

This type of motor is commonly used for industrial purpose. This type of motor consist of a field coil connected in series with the

Armature coil. Series wound motor draws more current than permanent magnet motor as they use field coil to generate magnetic file as they use more power they tend to be efficient and powerful and generate more torque for the current used. The series wound winches are heavy and are expensive.

A permanent magnet motor will produce the same pull as the series wound motor when low current is used. But since the permanent magnet motors tend to get warm the decrease in the power produced and draw more current the series wound motor draw the same current throughout the duty cycle.

Gear system

There three types of gearing system. The main aim of the gearing system is to gear down to reduce the speed and torque to turn the winch drum. The gear reduction is how much the motors output revolution is reduced for the gear. The greater the reduction more the speed for the one revolution of the spindle and how less the motor is utilized . the difference in gear system differs in the transfer efficiency.

Planetary gear:

This type of gear is the most common and provides strength and operates very smoothly with good resistance. They have 65 % transfer efficiency and have tendency to free spool. So a brake is necessary for these types of gears. This gear consists of planetary arrangement in which a sun gear is located in the centre. Planetary gear's rotating around out it which is being carried by carrier

Worm gear:

The worm gear has a transfer efficiency of 35%-40% . the advantages of using this type of gear is that they have a built in braking system and thus a clutch is needed for spooling. They are stronger and simple in construction compared to the planetary gear as they lack in a self braking system. this type of winches are used for slow winching speed , and the planetary gears have extremely possible reduction but the worm gears have a noticeable reduction in line speed especially when no load is acted or pulled . in this the planetary gears scores advantage over the worm gears.

Spur gear:

The spur gear is similar to the planetary gear. It has a transfer efficiency of 75 %. Same like the planetary gear the spur gear have a tendency to free spool so a braking mechanism is needed. Only a certain type of winch called the WARN M8274 has a spur gear mechanism in it due to its construction.

Solenoids

The solenoids are electromagnetic se= witches that is the final part of the circuit that decides the completion of the winch circuit, when current is passed through the solenoid a magnetic field is caused that decides in which direction the winch is to be moved either backward or forward depending on the signal from the solenoid, mounting of the solenoid s are the major consideration. The winch can either have a remote on integrated solenoid pack both have their own advantage. In the case of a remote solenoid switch they are mounted off the winch and they have the advantage of reducing the space occupied. But in the case of integrated solenoid they are located on the winch or above the motor the advantage of this type of solenoid is that they offer high protection. There can be two to four solenoids used in winch. The one that uses 2 two solenoid are permanent magnet motors and the one which uses four solenoids are series wound motor.

Things to consider while buying a winch:

The amount of winch needed

How often the winch can be used

Budget for the winch

Warranty of the winch

The amount of winch needed:

Winches should be normally selected over the weight of the vehicle or the weight of the purpose its used for. The size of the winch is normally selected based on the principle of thumb rule in which the weight is multiplied over 1. 5. But at times the thumbs rule method of selecting the device would not be suitable because certain characteristics like usage of the winch and the condition in which it is used plays a important role in deciding the winch . understanding the purpose of the winch accessories is also an important part

How often winch is used:

The usage of the winch is decided by the frequent usage and how hard the winch is used . for this purpose the proper selection of the motor should be done . each motor have their own advantage . there are three types used they are permanent magnet motor , series wound motor and hydraulically operated motor . the permanent magnet motors anre used for light to medium winching and the series wound motor is used for heavy winching purpose and the hydraulically operated motor is used when the winching process Is carried out the whole day.

Budget for the winch:

The cost of the winch may be is several pounds or dollars but when the cost of the winch is to be broughout on a budget then the cost of the winch the accessories and the cost of installation should b kept in mind while choosing the winch and some of the other considerations to be taken care while selecting the winch is the warranty and the serviceability of the winch .

safety device in a ramp:

The following should be available in a ramp to ensure safe operation of the ramp

Interlock support:

To ensure proper safety to the vehicle in the ferry the ramp interlock circuitry connects with the vehicles interlock circuitry to prevent the vehicle from depaturing accidentally when the ramp is being deployed . to meet this condition the vehicles must be parked with hand brakes turned on , the vehicles gear should be in park or neutral and the vehicles which are adjacent to the ramp should have their doors open to ensure better safety

audio alert :

this should be an important component that is fitted to the ramp as it activates itself when the ramp is either stowed or deployed giving signal to the passenger or vehicle that the ramp is to be opened or closed .

ramp control interface :

this is the another important component on the ramp that is available to ensure safety . they are normally placed near to the operator or in a place

Page 17

where ther is complete view of the ramp . due to the latest developments the new remote control panels are available which are far more convinent and ensure proper ssafety compared to the fixed ones. The control panel normally has a power on /off switch three switches to control the rampooperation and a indicator light to indicte whether the control panel is on or off . when all the conditions are met the control panel gives signal to the solenoid which in turn gives signal ti the winch whether to be stowed or deployed.

Stainless Steel wire ropes:

Since the stainless steel wire rope used is the main part in the whole ramp . it's strictly followed that only certified BSMA standard ropes are used . Ropes and strands are manufactured from high tensile and high quality AISI 316 grade stainless steel to prevent from corrosion. The stainless steel wire ropes are available in various types as required and suitable for the particular need , some the commonly found ones are the1x19 Stainless Steel Wire Rope, 7×7 Stainless Steel Wire Rope,

 7×19 Stainless Steel Wire Rope, 1×7 Dyform Stainless Steel Wire Rope, 1×19 Dyform Stainless Steel Wire Rope and PVC Coated 1×19 Strand.

The advantage of using AISI 316 stainless steel are that they have high resistance to corrosion.

Project Objectives

Completion of this project will result in

Introduction on ramps

https://assignbuster.com/ferry-car-ramp-operating-mechanism-re-designengineering-essay/ Discussing on the history of ramps

Explaining the types of ramps

Devising a mechanism to be used in operating the ramp

Selecting the appropriate motor

Selecting the winch used in the operation

Selecting the material of the rope to be used

Calculating the mass of the ramp

Calculating the centre of gravity of the ramp

Calculating the rpm of the motor

Calculating the force, power and work done required

Preparing the results

Concluding the project

Project Deliverables

A report on the re -designing of the operating mechanism of the ferry ramp.

A presentation that will explain the selection of mechanism.

Possible Solutions

Torque OF THE MOTOR

Describe your possible solutions to a particular problem within the project. You may possibly have used a bubble chart to arrive at the options. If so, include it in the report.

Centre of gravity of ramp

Motor for operation

Material used for ramp actuation

Ferry car ramp operating mechanism redesigning

Cost of the ramp

Material for ramp

Mass of ramp

Selection

This topic would explain the reason for selection of the material and the components used in the project . the whole project is about re-designing the operating mechanism of the ferry ramp which is operated using hydraulic mechanism. So the method selected should be built in such a way that all the components used are of approvable standards and are of increased life time. The method selected was to use a electric winch equipped with wire rope and motor to drive the winch keeping n mindthe mass of the winch and the condition in which its operated,

The reason for choosing a electric winch is that it is more efficient in terms of cost and power and does not occupy much space and in addition to this it

Page 20

comes with a motor on it designed to meet a particular load and the winch selected is selected with more than the capacity of the mass of the ramp so that its able to pull in extra load if acted on the ramp. The motor used is a series wound dc motor the reason for selecting this type of motor is that generate high torque and can be operated at low speed. they are used in lifting heavy loads and maintain the same torque throughout the duty ccycle. The reason for using a 7×19 galavanised grade wire rope of aisi 316 is that since the ferry can be in salt water or in condition where corrosion is possible they are very economical and aisi 316 grade steel are resistant to corrosion

Equipment

What equipment did you use (if any)

Test Results

Discussion

This topic gives a brief discussion on the progress through my calculation . since i had to re-design the mechanism of the ramp . its essential to know the details like mass centre of gravity , force , , workdone and power for my selection of components and the kind of material to be used for it. I found calculating the mass and the centre of gravity of the ramp and the force which i had been learning through my course . the power and workdone took me a much longer time to understand what has to done exactly for finding them. Then it was very

Conclusions

What can you conclude from the results? Write it here.

Recommendations

References

The project contains a combined selection of information from the books in the library and the internet . some of the books and websites i had referred are:

The internet:

http://en. wikipedia. org/wiki/MV_Saturn

http://www. sciencetech. technomuses. ca

http://en. wikipedia. org/wiki/Winch

http://www. offroaders. com/tech/winches/Winch-Terminology. htm

http://www.riconcorp.com/pdfs/32dfr103/32dfr103A2.pdf

the books i referred are:

reeds naval architecture for marine engineers by e. a stoke

imo safety

Bibliography

List the material you used in the production of your project. Reference properly.

Appendices

Appendix 1 Drawings

Appendix 2 Project plans

Appendix 3 Calculations

Appendix 4 Progress reports

Appendix 5 Log book

Etc.

Appendix 1

Drawings

Appendix 2

Appendix 3

Calculations

Appendix 4

Progress reports

Progress reports

HND MECHANICAL ENGINEERING GRADED UNIT -2[DV1235 35]

Tutor: John McInally

Progress report-1

From the date of submission of my project report-1 my progress through the

project till 11/03/2010. I have done the following:

https://assignbuster.com/ferry-car-ramp-operating-mechanism-re-designengineering-essay/ Started the project by collecting information about the introduction on ramps.

Completed collecting information on the history and types of ramp.

Selected the mechanism to be used.

Identified the motor used for operation.

Completed 40% calculation for finding the mass of the ramp.

To further progress for the project if will:

Complete the calculation of ramp mass.

Calculate the centre of gravity of the ramp.

Calculate the power and motor speed for ramp operation.

Select the material to be used for ramp operation.

HND MECHANICAL ENGINEERING GRADED UNIT -2[DV1235 35]

Tutor: John McInally

Progress report-2

From the date of submission of my progress report-1 my progress through the project till 29/04/2010. I have done the following:

Completed collecting the theory part of the project.

Selected material to be used for operating mechanism.

https://assignbuster.com/ferry-car-ramp-operating-mechanism-re-designengineering-essay/ Completed 100% calculating the mass of the ramp.

Completed 100% calculating the centre of gravity of the ramp.

Completed the drawings and the bubble chart.

To further progress for the project I will:

Complete the project specification.

Complete the project objectives.

Complete the torque, horsepower and rpm calculation.

Complete the log book.

Complete the recommendation.

Complete the conclusion.

HND MECHANICAL ENGINEERING GRADED UNIT -2[DV1235 35]

Tutor: John McInally

Progress report-3

From the date of submission of my progress report-2 my progress through the project till 8/5/2010. I have done the following:

Completed 100% of the calculation.

Completed 100% of the drawing .

Completed project specification and objectives

Completed 100% of the log book.

Completed 100% of the conclusion.

Completed 60 % for the presentation of the project

To further progress for the project I will:

Complete 100% of the presentation of the project.