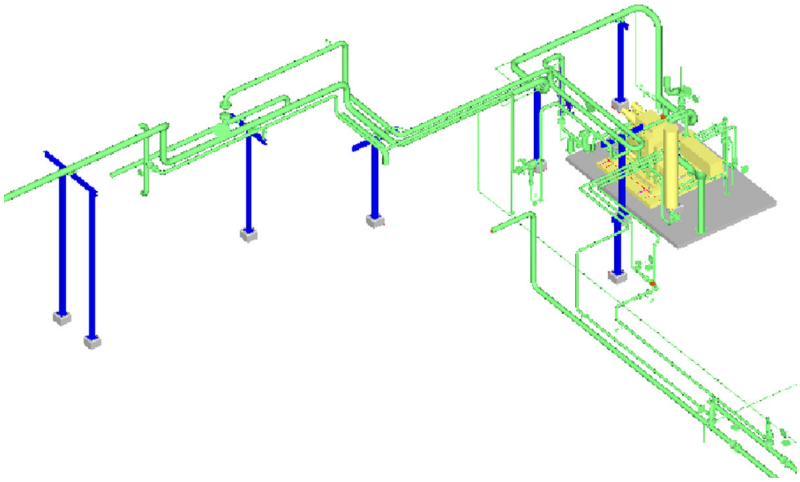
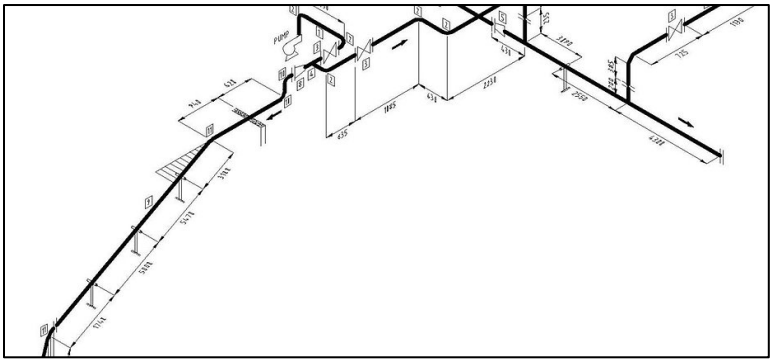
ENGINEERING PROJECT DESCRIPTION

Full Pipeline System Design of a Manufacturing Plant for CONTINENTAL AG





Spring 2019

TABLE OF CONTENTS

INTRODUCTION

This is the final project. For this project I require you to work in your group.

The final project must be delivered during finals week (see schedule). There are grading rubrics that you should be fully aware. I suggest everyone to familiarize with them, for that, read this whole document.

To make sure you are not falling behind, I will meet each of the groups at least once but I will need you to contact me to setup the meeting. Each group should show me what they have done up to the moment we meet and I will give hints to continue the work. There are no points if you attend the meeting but failure to hold it might affect your grade.

Please, read careful the whole document. There is information you might not need.

TASKS

After the previous engineer left the consulting company, you got hired to continue his work on a project described on the next pages. The previous engineer designed the tanks and decided their locations (sketched in figure 1). You are in charge now of designing ONLY the pipeline of the system taking the coolant from the railroad tank to the storage tank. **The transfer must occur in not less than 6 hours.** The specific tasks you are in charge of are:

1. Specify the layout of the piping system (make a hand drawing of it). For the pipe layout consider the distances shown in figure 1 and some of the requirements (such as frost line) in the project description. Propose the material type of the pipe and its diameter. From the layout get the pipe length required. Please remember that for a pumped system, the pipe size is chosen with the critical velocity criteria and the desired flow rate. Remember the pipe size requirement by the company.

2. Specify the number, type, material, and size of all valves, elbows, and fittings. Please remember that for a pumped system, the pipe size (and therefore fitting sizes) is chosen with the critical velocity criteria and the desired flow rate.

3. Develop the hydraulic analysis of all parts of the system; this is to compute the energy losses due to pipe friction and minor losses. You should list the energy losses of the suction pipe, the discharge pipe, and the total.

4. What are the preliminary requirements of the pump (i.e. pump head and flow rate)?

5. Argue why you need a kinetic pump (instead of a positive displacement) and prove that the radial pump is the type of kinetic pump you need.

6. Select the appropriate SULZER pump (use affinity laws when required). Specify the exact point of operation of the pump. Include pump curves with the system curve and point of operation. Keep in mind that if you are required to use affinity laws to get the curves at another rpm, you can just scale the y- and x- axis appropriately of the pump H-Q curve.

7. Specify electrical motor requirement for our pump for our electrical engineering colleagues. Recall that we specify the power of the electrical motor as about 1.10 times the power required by the pump.

8. Evaluate the NPSH available for your design and demonstrate that your pump will not suffer cavitation.

9. Prepare a list of materials. Include everything you designed/selected. The list should contain the materials of the system as well as all the equipment (pump).

PROBLEM DESCRIPTION

Continental AG is planning for a new manufacturing facility. As part of the new plant, there will be an automated machining line in which five machines will be supplied with coolant from the same reservoir.

The layout of the planned facility is shown in figure 1. The following data, design requirements, and limitations are given.

1. New coolant is delivered to the plant by railroad tank cars carrying 15,000 gal each. A storage tank for new coolant must be specified.

2. The reservoir for the automated machining system must have a capacity of 1000 gal.

3. The 1000-gal tank is normally emptied once per week. Emergency dumps are possible if the coolant becomes overly contaminated prior to the scheduled emptying.

4. The dirty fluid is picked up by truck only once per month.

5. A holding tank for the dirty fluid must be specified.

6. The plant is being designed to operate two shifts per day, 7 days a week.

7. Maintenance is normally performed during the third shift.

8. The building is one-story high with a concrete floor.

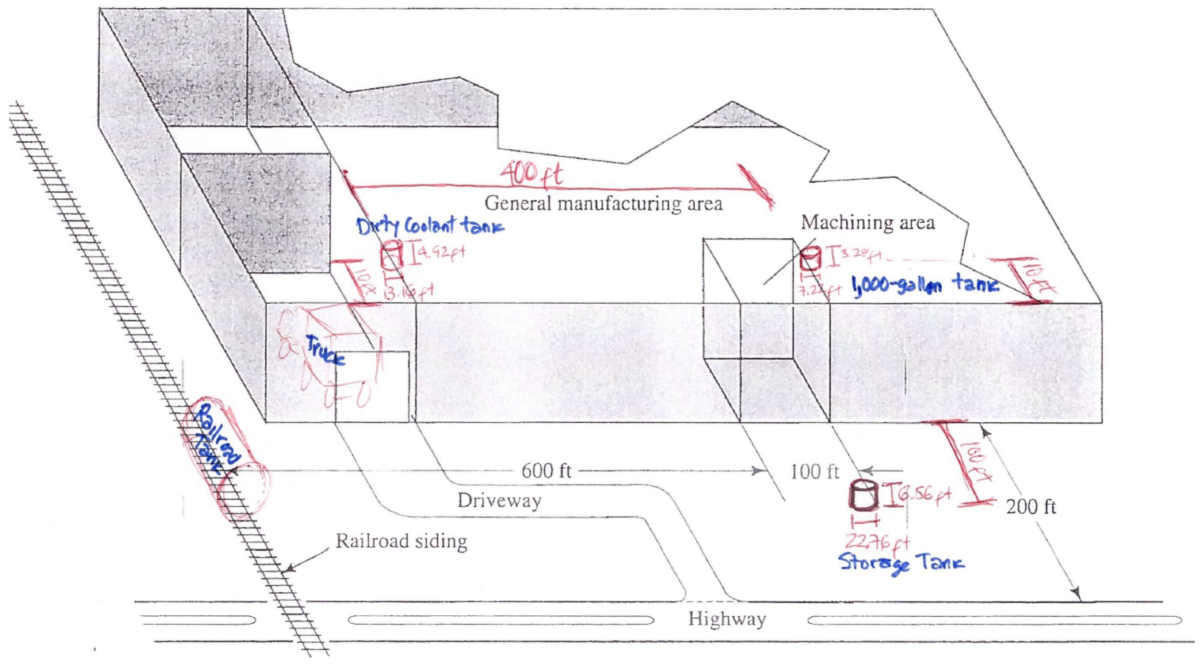


FIGURE 1. Plot plan of a hypothetical factory building for the design problem.

9. The floor level is at the same elevation as the railroad track.

10. No storage tank can be inside the plant or under the floor except the 1000-gal reservoir that supplies the machining system.

11. The roof top is 32 ft from the floor level and the roof can be designed to support a storage tank.

12. The building is to be located in Dayton, Ohio, where the outside temperature may range from -20°F to +105 °F.

13. The frost line is 30 in below the surface. Therefore most of any pipeline outside the building must be below this frost line.

14. The coolant is a solution of water and soluble oil with a specific gravity of 0.94 and a freezing point of 0 °F. Its corrosiveness is approximately the same as that of water.

15. Assume that the viscosity and vapor pressure of the coolant are 1.50 times that of water at any temperature.

17. The basic coolant storage and delivery system is to have the functional design sketched in the block diagram in Figure 2.

18. The company would like ALL of their pipes to be not smaller than 1.5 inches in diameter (nominal). You can select any pipe size larger than that but nothing smaller than that.

19. The required pumps can only SULZER pumps. **YOU ARE ALLOWED TO USE ONLY SULZER PUMP CATALOG PROVIDED IN CLASS! Which you should have access to for the test.**

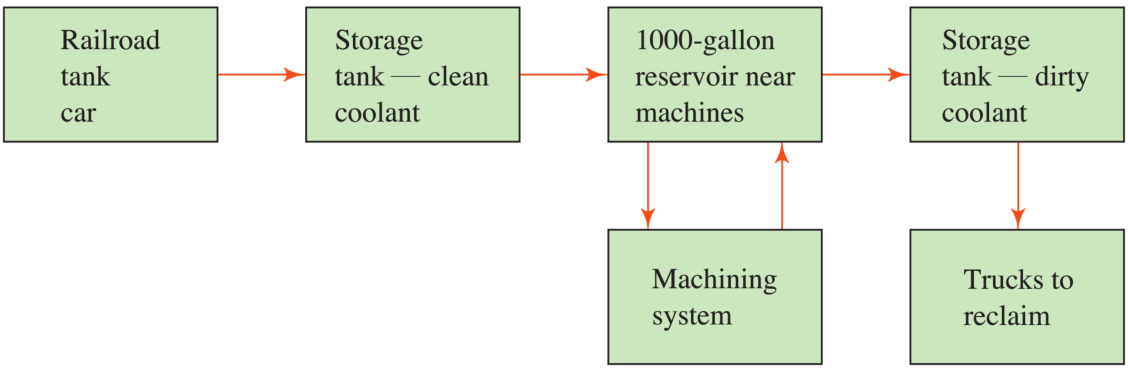


FIGURE 2. Block diagram of coolant system.

ROLE

Consider yourself to be the new engineer working for the consulting company hired to design the system in substitution of the previous engineer.

AUDIENCE

This project report should be written towards the Engineering Head of the company. It should therefore be written formally. Assume the reader is familiar with engineering concepts.

ENGINEERING FINAL REPORT FORMAT

Your design proposal should be submitted in a form of technical report, which should include but limited to:

1. Title Page
2. Abstract

   This is a brief description of the project with relevant elements of the design considerations. The abstract should be written after you have completed the report. The final design should be briefly described here.

3. Table of Contents
4. List of Figures & List of Tables

   You are NOT supposed to include here the actual figures and tables. The figures and tables should be part of the report body but here you will indicate each figure or table, its caption, and the page number where the figure or table is located.

5. Report Body
   a. Job site location
   b. Specifications and design philosophy

      Establish design criteria, design requirements and limitations, and any other criteria you personally decided to use. Background information should be provided and referenced to help justify your decisions in the design.

   c. Sources

      Use correct citation format.

   d. Materials and specifications
      i. Establish the pipe material to use

         Clearly explain the reasons behind your selection.

      ii. Fluids characteristics

         Clearly explain the reasons of such characteristics.

   e. Preliminary drawings and sketches
      i. Plot plan
      ii. Elevations

Every engineering work starts with preliminary sketches that help with the design calculations. You should include pipe layout and tanks. The drawings support the Design calculations section.

f. Methodology

Please, make sure you explain clearly the procedure you followed for the calculations, this is the methodology you used. It should include enough detail that any other engineer with similar coursework should be able to reproduce what you did. This should include equations used.

g. Design calculations
    i. Flow rate
        1. Tank fill/empty time
        2. Desired flow rate
    ii. Pipe sizing
        1. Piping layout
        2. Pipe diameter and lengths
        3. Fittings
    iii. Energy losses.
    (*Make a table of all energy losses for each pipeline section. Analyze them. Which pipeline section has the most energy losses?*)
    iv. Pump selection
        1. Pump requirements
        2. Selection of pump type
        3. Pump curves, and system curves with operating point
        4. Cavitation
        5. Summary of selected pump (includes values at operating point, NPSH_req, pump size, pump weight, pump required power, electrical motor power)

Design calculations must be done by hand.Excel spreadsheets are allowed but the used equations must be explicitly stated for grading purposes. Unclear outputs are not permitted.

Feel free to add as many sub-sections under each of the section of the Design Calculations part.

6. Final drawings
    a. Plot plan
    b. Elevations view
    c. Isometrics

After the design calculations must of the preliminary drawings and sketches must be updated and better represented.

7. Bill of materials and equipment list

   With the help of the isometrics you should list all the material that need to be bought for final construction. You should also include the list of selected equipment.

8. Final remarks

   This is the conclusions section where you tell the reader what the results told you and why findings were significant.

9. Appendix

   Add any additional material you consider related to the project.

   Also, add a reflective section where each of you separately reflect on or evaluate what was learned in this project and in this class. Answer the following questions:

   - *Do you think what you learn is important for your professional career?*
   - *Where do you think you will be using everything you learned?*
   - *How would you explain the project and your contribution to the project in a job interview?*
   - *How would you explain how your strengths helped you contribute to the project in a job interview?*
   - *How would you explain in a job interview how your weaknesses affected your ability to work on this project and how did you address them (or what part of the class helped you address them)?*
   - *Explain the technical strengths and weaknesses in your project.*
   - *If you were starting the class over again, what advice would you give yourself to ensure that you had a successful semester and a successful final project?*

NOTE: *Verbally explain your ideas and add images, diagrams and graphs needed to explain your solutions. As far as preliminary and final drawing, there is no need for detailed drawings, just simple high-level sketches. Hand sketches are fine, you may take a picture with your camera, phone and insert them to the document or just attach image drawn to your exam. Use appropriate number for images, diagrams and equations used (e.g Figure 1, Figure 2, etc.) for easier understanding and explain what they are in the body of the report*.

GRADING

For the grading of the final report, I will follow the attached content rubric and the writing rubric. I will also check for correctness in the calculations. The percentage of each of them in the final grade is shown in the table.

Final Engineering Report	Content	25%
	Writing	25%
	Correctness	50%

RUBRICS

Content Rubric

	POINTS
1. Title Page	
2. Abstract	200
3. Table of Contents	25
4. List of Figures & List of Tables	25
5. Report Body	
a. Job site location	50
b. Specifications and design philosophy	200
c. Sources	100
d. Materials and specifications	100
i. Pipe material	
ii. Fluids characteristics	
e. Preliminary drawings and sketches	100
i. Plot plan	
ii. Elevations	
f. Methodology	400
g. Design calculations	1000
6. Final drawings	200
a. Plot plan	
b. Elevations view	
c. Isometrics	
7. Bill of materials and equipment list	300
8. Final remarks	200
9. Appendix	100
TOTAL POINTS	**3000**

(The total points will be converted to a 100-point based grade)

Final Project Writing Rubric

Student Learning Outcomes	Exceeds Standard	Meets Standard	Approaches Standard	Needs Attention
	100 points	**70 points**	**40 points**	**0 points**
1. **Students will be able to clearly state a focused problem, question, or topic appropriate for the purpose of the task.** **Sections 2, 5a, and 5b**	The topic is **comprehensive, clearly stated, creative, focused, manageable**, and demonstrates a **clear understanding** of the purpose of the task.	The topic is **clearly stated**, **focused, manageable**, and demonstrates **adequate consideration** of the purpose of the task.	The topic is **ambiguous** and **too broadly or narrowly focused**, but demonstrates **awareness** of the purpose of the task.	The topic is **weak (or missing)** and demonstrates **minimal knowledge** of the purpose of the task.
2. **Students will be able to identify relevant knowledge and/or credible sources** **Sections 5c, and 5d**	Identified knowledge or sources are **relevant, credible, and high quality**.	Identified knowledge or sources are **mostly relevant and credible.**	Identified knowledge or sources are **minimally relevant and credible**.	Identified knowledge or sources are **not relevant or credible (or are missing).**
3. **Students will be able to synthesize information and multiple viewpoints related to the problem, question or topic.** **Section 5f, and 5g**	Evidence is synthesized to **reveal insightful patterns, differences and similarities** among multiple viewpoints.	Evidence is synthesized to **reveal patterns, differences and similarities** among multiple viewpoints.	Evidence is minimally synthesized and **may not reveal patterns, differences and similarities** among multiple viewpoints.	Evidence is **not synthesized** to reveal patterns, differences and similarities among multiple viewpoints **(or is missing)**.
4. **Students will be able to apply appropriate research methods and/or theoretical framework to the problem, question or topic.** **Section 5f, and 5g**	The critical elements of the methodology or theoretical framework are **skillfully developed or described** to address the problem, question, or topic.	The critical elements of the methodology or theoretical framework are **satisfactorily developed or described** to address the problem, question, or topic.	The critical elements of the methodology or theoretical framework are **minimally developed or described** to address the problem, question, or topic.	The critical elements of the methodology or theoretical framework are **weak (or missing)**.
5. **Students will be able to formulate conclusions that are logically tied to inquiry findings and consider applications, limitations and implications** **Section 6,7, and 8**	The stated conclusion **thoroughly evaluates** and organizes **all essential** information and is the logical outcome of inquiry.	The stated conclusion **evaluates** and relates logically to **all essential** information.	The stated conclusion **minimally evaluates** and relates logically to **some essential** information.	The stated conclusion is **absent or weakly evaluates** essential information **(or is missing)**.
6. **Students will be able to reflect on or evaluate what was learned.** **Section 9**	Reflection of results shows a **strong relationship** among content, lessons learned, and/or changes in personal perspective.	Reflection of results shows a **relationship** among content, lessons learned, and/or changes in personal perspective.	Reflection of results shows a **minimal relationship** among content, lessons learned, and/or changes in personal perspective.	Reflection of results shows a **weak or no relationship** among content, lessons learned, and/or changes in personal perspective **(or is missing)**.