MA206 Project #2 (MST ILAP) 300 Points **Spring 1999**
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and MAJs Barraclough, Hansler and Samek (CME) **Due: IPR Lesson 30, Due Lesson 34**

***Each member* of your group is expected to contribute up to 5 hours towards the completion of this project. These four hours come from the advance lesson for lesson 30 (2 hours), the advance lesson for lesson 31 (2 hours), and the advance lesson for lesson 34 (1 hour).**

GENERAL:

1. The project will be worked in groups of three or four as determined by your instructor.
2. For project format, follow the guidance given in the Project and Technical Report Format and Writing Guide. This guide is available on the MA206 home page at http://www-internal.dean.usma.edu/math/CORE/ma206/ by clicking on the "Project Template" link under "Administrative Links." You may modify the format as appropriate for your presentation.
3. You will integrate mathematics, science and technology throughout the course of this interdisciplinary applications project. With this in mind, it is important that you review material from your MA205 (moments) and PH201 (free-body diagrams) courses. If you do not review this material, you may not be able to complete the entire project. In addition, you may find Minitab, Mathcad, and possibly other software packages helpful.
4. Follow the Department of Mathematical Sciences policy on reporting numerical answers. This policy is also available on the MA206 home page. Click on "Significant Digits Memorandum" under "Administrative Links" to access this.
5. This project is due at the beginning of class on lesson 34, 27-28 April 1999.
6. This is a graded homework assignment. You are required to document any assistance that you received in accordance with *Documentation of Written Work*, July 1998.

SITUATION:

You are assigned as a platoon leader in A Company, 84th Engineer Battalion (Combat Heavy) at Schofield Barracks, Hawaii. You and your company are currently deployed to Thailand as a Civic Action Team providing nation building assistance in the form of vertical and horizontal construction during the joint and combined Exercise Cobra Gold. Your company recently completed its base camp construction and has initiated the construction of a school and several roads in the area.

The US Ambassador to Thailand contacts you and requests that you help her investigate a recently rebuilt dam in the area. The ambassador is meeting with the President of Thailand in two days, and wants the results of your investigation tomorrow. The President has been informed that the new dam may not have been designed correctly given the historical data available regarding water height. The major concern seems to be that the dam will tip over, killing thousands in the flood plain below. A secondary concern is that the average maximum water height might be too low in some months to support vital irrigation projects. Finally, the results of compressive strength tests performed on sample cylinders of concrete used to make the dam have recently returned from a lab, and the President wants to know if the concrete used was "up to code." Your report should address each of these concerns. The ambassador's aide provides you with drawings, some water depth data, and concrete sample data (see Annexes A – C). The ambassador wants a **detailed analysis** that includes any assumptions you make, an explanation of all the mathematics and science you use, and recommendations. She also wants to know the details regarding any computer software you use. This is your chance to **show off** what you learned in your core math, science, and technology courses at West Point!

ADDITIONAL INFORMATION:

1. The dam has a footer that prevents it from sliding in any direction. Assume that it can only fail by tipping forward. Also assume that the operators of the dam cannot significantly affect water height. The historical water height data provided (see Annex B) is based on the same type of dam.

2. The density of the concrete is 145 lbs/ft^3.

3. If the mean maximum water height for any month is below 20 feet, irrigation projects will be adversely effected.

4. Concrete must have a compressive strength of 3000 psi to be considered “up to code.”

5. The hydrostatic force of water on the vertical face of the dam is described in Figure 1.

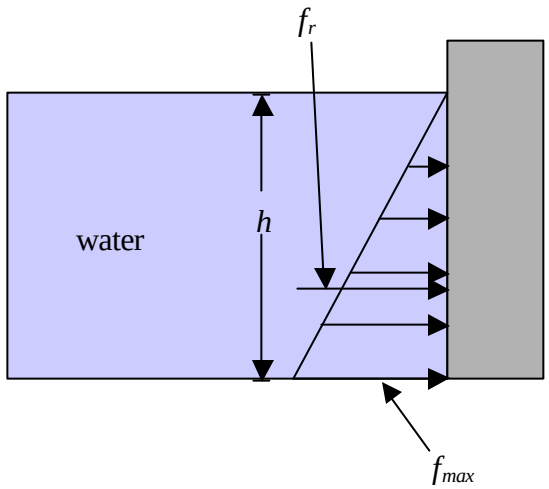


Figure 1. Hydrostatic Force of Water on a Plane Surface

The maximum linear hydrostatic force over the plate area is given by

$$f_{\max} = g\ h\ A$$

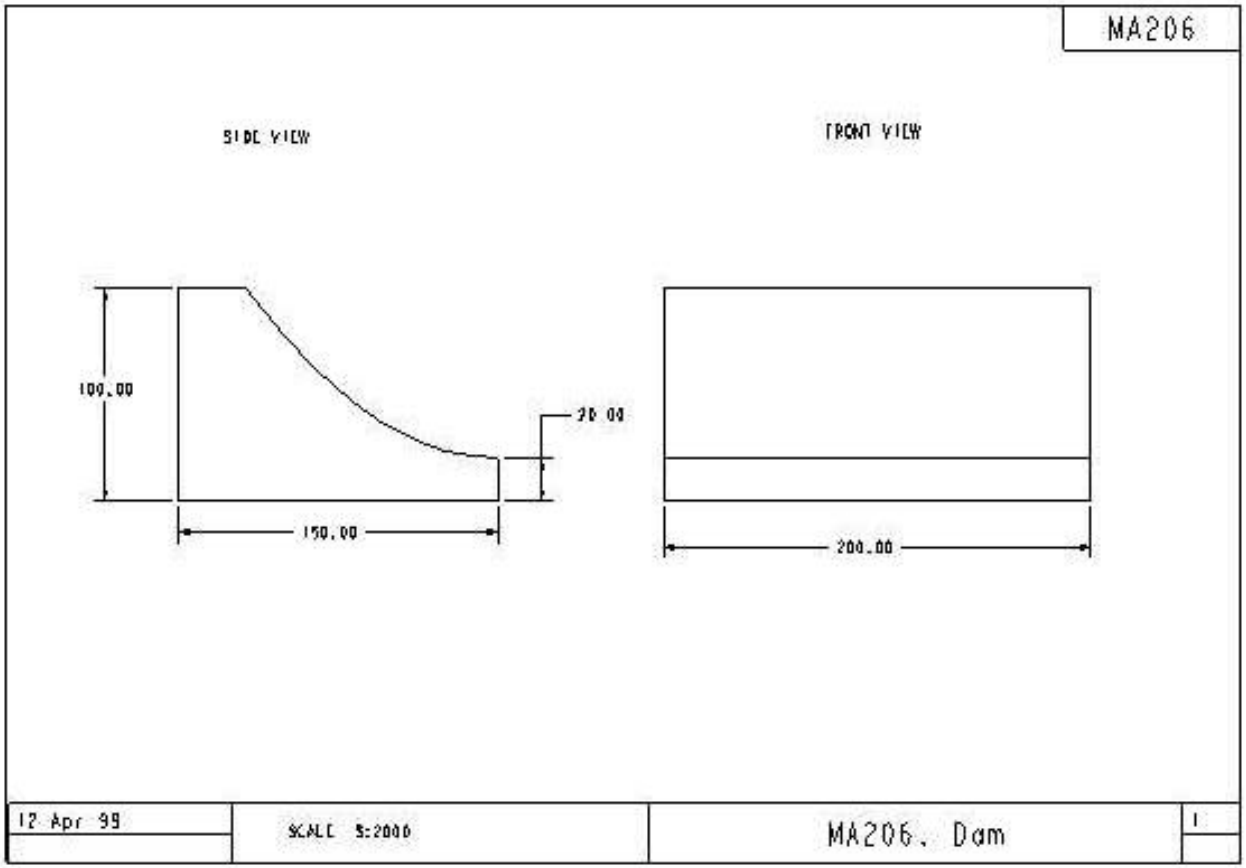
where g is the specific weight of water, h is the height of the water and A is the surface area in contact with the water. The resultant linearly distributed force, f_r, can be found using calculus.

INSTRUCTIONS:

1. You must explore and discuss the validity of every assumption you make in this project. Explain the consequences of each assumption to your model and what they mean in practical terms.

2. Carefully examine the information you have been given, and obtain the Minitab data as per instructions in Annexes B and C.

Annex A to The Dam Project
Drawings of Proposed Dam



Annex A to the Dam Project (Continued)

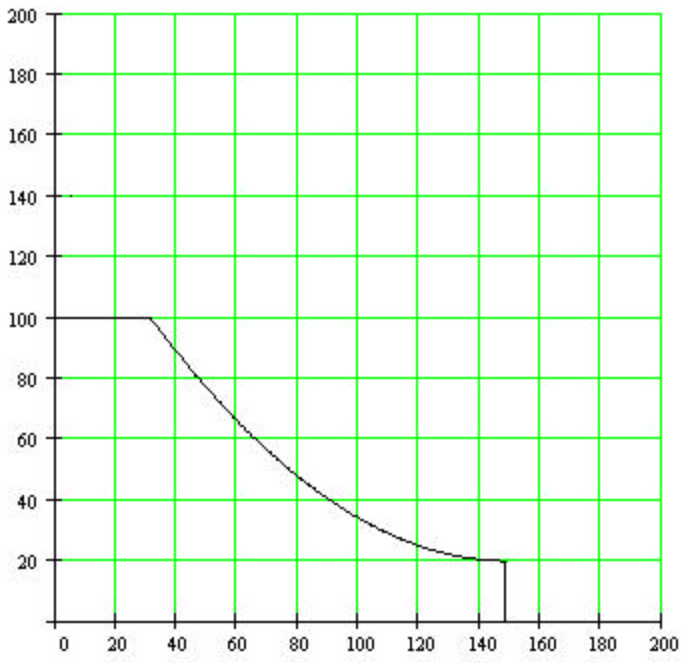


Figure 3. Detail of side view of dam

Annex B to the Dam Project
Water Height Data

Before you begin work you must access a MINITAB file containing the river height data. The file can be found on the MA206 home page. Look under the "Projects" section and click the "River Height Data" link. This MINITAB file contains 12 columns representing each of the 12 months in a year. Each column has 50 water height measurements (ft). Your group will randomly select a sample from each of these monthly data sets. Thus, each project group will work with different river height data for this project. Follow these instructions to create your data set:

(1) Start MINITAB.
(2) Open the data file using the "Open Worksheet" option under the "File" menu.
(3) Using the "Calc" menu, Set Base = xxxxxxxxx, using the SSN of the alphabetically ranking cadet in your project group.
(4) Go to the "Calc" menu and select "Random Data," and then "Sample from Columns." Sample from each column according to the following table.

Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
n	32	15	35	35	25	31	23	32	33	35	15	31

(5) When this is complete, you should have 12 columns of river height data, with sample sizes indicated above.
(6) Save your newly created data set for use during the remainder of the project.
(7) The following is how to interpret your data set. Each column now contains information on the *monthly maximum* water height for some previous year of that month. For example, your first column contains the maximum water height in the month of January for 32 previous years.

Annex C to the Dam Project
Concrete Compressive Strength Data

Also, in a manner similar to that described in Annex B, you must access another MINITAB file containing concrete compressive strength data. The file can be found on the MA206 home page. Look under the "Projects" section and click the "Concrete Data" link. This MINITAB file contains a column of 50 compressive strength measurements. Your group will randomly select a sample from this data set. Follow these instructions to create your data set:

(1) Start MINITAB.
(2) Open the data file using the "Open Worksheet" option under the "File" menu.
(3) Using the "Calc" menu, Set Base = xxxxxxxxx, using the SSN of the alphabetically ranking cadet in your project group.
(4) Go to the "Calc" menu and select "Random Data," and then "Sample from Columns." Select a sample size of ten measurements.
(5) When this is complete, you should have a column of compressive strength data.
(6) Save your newly created data set for use during the remainder of the project.