ME345 Modeling and Simulation, Spring 2012
Case Study 1
Assigned: Friday February 17, 2012
Due: Friday March 23, 2012

Note 1: You are STRONGLY encouraged to complete the assignment prior to this due date! The extra time for this Case Study is due to Spring Break the week of March 12.

Note 2: Each of the Case Studies will be done in groups of 4 students. Each student is expected to contribute equally to the group work. No two students can be in the same group for more than one Case Study (as discussed in class). Students will be asked to complete an anonymous Group Member evaluation after submitting the Case Study assignment. Each group member should know exactly how the other members approached and solved the problem.

Walking Beam Indexer with Pick and Place Mechanism
[based on Norton Edition 3, Problems 4.19, 6.53, and 7.46]

Shown in Figure 1 is a walking beam indexer with a pick and place mechanism. The mechanism can be considered as two fourbar linkages driven by a common crank.

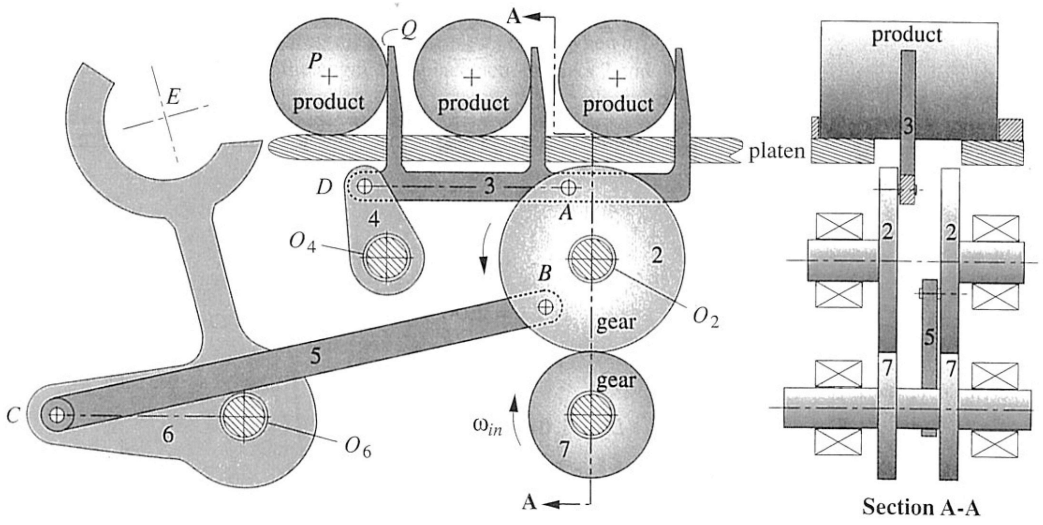

Figure 1. Walking Beam Indexer with Pick and Place Mechanism. From Norton, *Design of Machinery, 3rd Edition*, pg. 203. Note the following dimensions (in millimeters): O_2O_4 = 108,O_2A = 40, L_3 = 108, L_4 = 48 (you may wish to change this to 40), O_2O_6 = 200, O_2B = 32, L_5 = 260, and O_6C = 96.

To start, part A: Identify the two separate four bar mechanisms which comprise the mechanism shown in Figure 1. For each of the individual mechanisms, consider the motion of the smaller fourbar sub-mechanism as a function of the rotation of link 2.

To continue, part B: For one revolution of driving link 2, find the horizontal stroke of link 3 for the portion of their motion where their tips are above the top of the platen. Express the stroke as a percentage of the crank length O_2B. What portion of a revolution of link 2 does this stroke correspond to? Also, find the total angular displacement of link 6 over one revolution of link. The vertical distance from O_2 to the top of the platen is 64 mm. The vertical distance from O_2 to the top left corner of *Q* of the left-most finger is 73 mm (based on this you may wish to adjust the length of the fingers; feel free to do so). The horizontal distance from point *A* to *Q* is 95 mm.

Followup, part C: Now consider that angle CO_6E = 75 degrees, O_2O_6 is at 205 degrees, and the phase angle (angle of separation) of A and B is 120 degrees. The product cylinders being pushed have 60-mm diameters. The point of contact between the leftmost finger and the leftmost cylinder in the position given is 58mm at 80 degrees in comparison from point D. Calculate and plot the absolute velocities of points *E* and *P* for one revolution of gear 2 as a function of the input angular velocity ω_{in}.

Report:

You will need to submit an engineering report of your analysis to the company president (i.e. the professor). The report should be **well-organized, clear, and concise**, and at minimum address the points listed below. The report should also provide a justification of why the results that you have obtained are sensible. **NOTE: just submitting the software output without your analysis and discussion is NOT acceptable.**

While it is natural to discuss your work and progress with your colleagues (i.e. classmates), **individual analyzes and reports for each group are required [this cannot be emphasized enough – work that fails to meet this requirement will not be given credit for the assignment]**. Your supervisor (i.e. the TA) is also available to answer thoughtful questions as you work on the project, but it would be unprofessional to overly rely on your supervisor to complete your project.

- Discuss in detail applications of how such a mechanism might be used.
- Describe briefly the specifics of the creation of your model and the setup of your analysis. In particular mention any aspects that you feel might be 'noteworthy' or unusual.
- Summarize briefly the motion of the TWO SEPARATE FOURBAR MECHANISMS YOU HAVE IDENTIFIED IN PART A for the given initial geometry given. Compare the behavior of EACH mechanism to a simplified analytical model and/or a model of the linkage system using another package.[1] Comment on the similarities and differences between the analytical model and the simulation results
- Summarize the motion of the complete mechanism for the given initial geometry given. Address the specific questions given in Parts B and C of the problem statement. Discuss in detail how the results from the model are sensible, are compatible with your analyzes of the two separate fourbar mechanisms discussed in Part A, and reinforce your understanding of the behavior of the system.
- Explore in detail how the behavior of the mechanism changes by altering the geometry.
- Are their any recommendations to your supervisor regarding 'next steps' in analyzing this suspension mechanism?

[1] If you are not currently in ME358 and have not taken the class in the past, you may work with a classmate who is familiar with these programs when doing this analysis. Be sure to note the assistance in your report, and summarize what you learned about the code. Note that the use of even simpler analyzes (not requiring software from ME 358) would also be appropriate here.