

EME152 Computer-Aided Mechanism Design, Project Description

Dr. Harry H. Cheng

Winter Quarter, 2004

(200 points)

Project Due Monday, March 14

**Project: Computer-Aided Design and Analysis of
the Whitworth Quick Return Mechanism**

Design and implement a software package for the computer-aided design and analysis of a Whitworth quick return mechanism as shown in Figure 1.

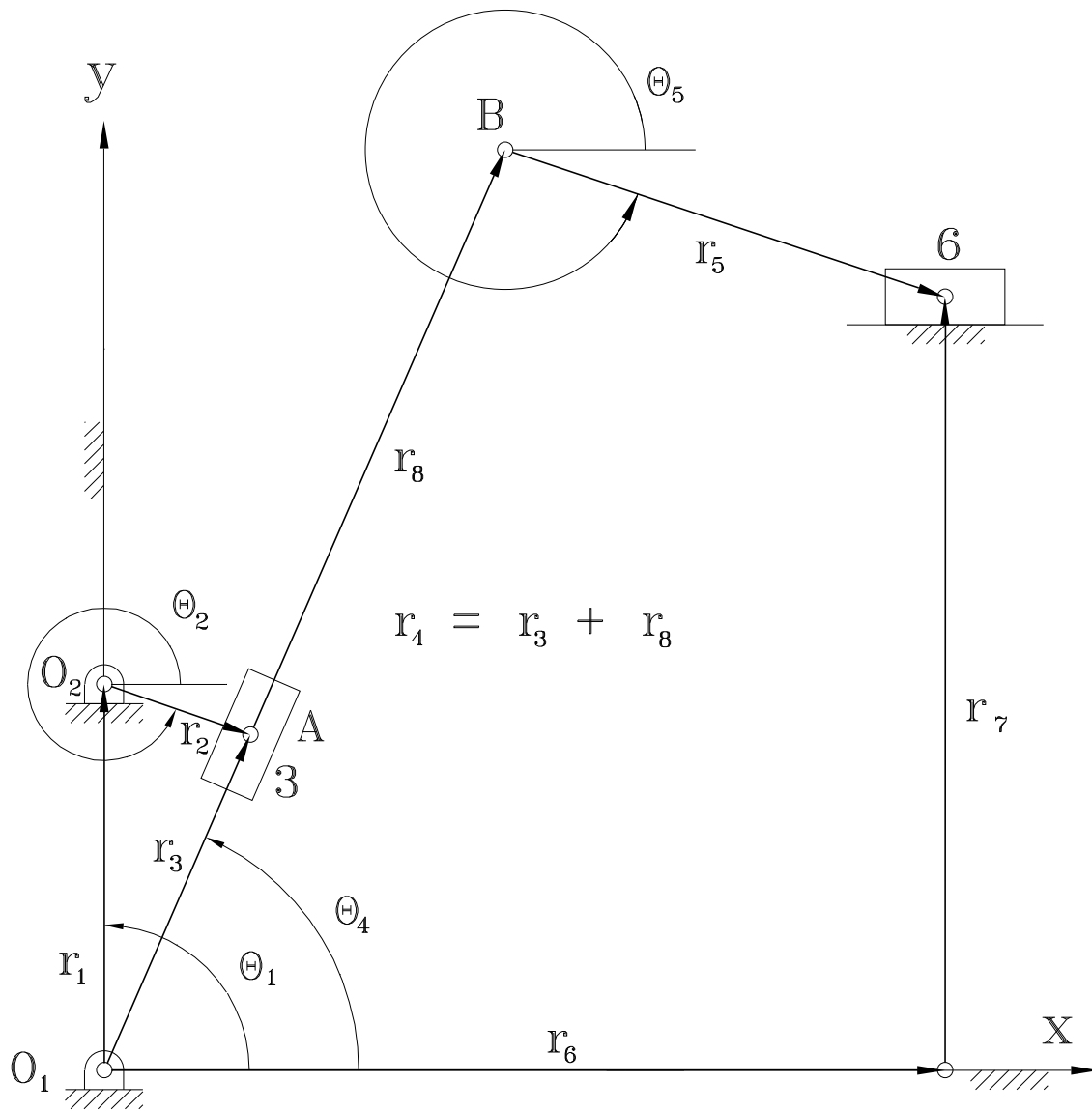


Figure 1: The Whitworth quick return mechanism.

This is a team project in which both team members will receive the same score. You may team-up with a classmate to complete this project. You shall form a team by Wednesday of this week.

The software package should be usable by engineers to solve practical problems related to the Whitworth quick return mechanism. It can also be used by students to understand the working principle of the mechanism. The important point is that the software package is designed for others to use.

The software package shall be general and flexible. It shall be readable and easy to maintain. It should include both on-line and off-line documentation. The software shall include the following components.

- The software shall allow a user to input the parameters for the mechanism. A user can input parameters in either US Customary or SI units.
- The package shall be able to perform position, velocity, acceleration, and dynamical force analysis.
- The package shall be able to perform animation of the mechanism.

Follow the implementation of the class CFourbar for analysis and design of fourbar linkages as an example. Read its off-line documentation in Chapter 2, and Appendices A and B in *Ch Mechanism Toolkit User's Guide*. The source code for class CFourbar is located in C:/ch/toolkit/include/linkage.h, C:/ch/toolkit/include/fourbar.h, C:/ch/toolkit/lib/mechanism/CFourbar.chf. Demonstration programs for using class CFourbar is located in directories C:/ch/toolkit/demos/mechanism/chapters/fourbar and C:/ch/toolkit/demos/mechanism/appendix/CFourbar. You may implement the software package as a class called CQuickReturn with a header file quickreturn.h, which includes the header file linkage.h, and class member function file CQuickReturn.chf. The class may contain, at the minimum, the following member functions with proper arguments.

```
uscUnit()
setLinks()
setMass()
position()
velocity()
acceleration()
force()
plotSliderPos()
plotSliderVel()
animation()
```

All these member functions should be tested and documented somewhere in the document.

For testing purposes and the ability to check the status of your program with other teams, initialize your parameters with the values provided in the following table. With these values set as default, users should be able to use your software package without having to input any data.

Link	Length r (cm)	mass (kg)	I_g ($\text{kg} \cdot \text{m}^2$)	C. G. r_g (cm)	δ
1	2.5	—	—	—	—
2	1.0	0.8	0.012	1.25	30°
3	—	0.3	—	—	—
4	6.5	2.4	0.119	2.75	15°
5	3.0	1.4	0.038	2.50	30°
6	—	0.3	—	—	—

The phase angle for link 1 is $\theta_1 = 90^\circ$. Assume that the input link 2 is the driving link that rotates at a constant cw angular velocity $\omega_2 = 15 \text{radian/s}$ and that $\theta_2 = 0$ when $t=0$. Also assume that the sliders are point masses and that the vertical distance between the lowest groundpin, O_4 , and the output slider, link 6, is to remain 5cm as the slider slides across the ground. The slider should remain in contact with the ground

at all times. The output force from the output slider, link 6, should be $F_l = 100\text{N}$. Calculate the position, velocity, acceleration of the slider at this point. Also calculate what torque on link 2 is required to achieve this output force.

EME-152 Project Report Organization
Winter 2004, Dr. Harry H. Cheng

A. Title Page

Include title, authors, and class.

B. Table of Contents

Write your report with pager numbers.

C. Abstract

Summary of the project report.

1: Introduction

Describe the need and outline design specifications.

2: Kinematic analysis of the Whitworth Quick Return Mechanism

1. Details of position, velocity, and acceleration analysis.
2. Sample code with output in numerical data and plotting for position, velocity, and acceleration.
3. Sample code with animation snapshot.

3: Dynamic analysis of the Whitworth Quick Return Mechanism

1. Details of force analysis with freebody diagrams.
2. Sample code with output in numerical data forces.

4: Description of the Software Package

1. Describe how to use the software package with examples.
2. Kinematic analysis and dynamic analysis.
3. Plotting of position, velocity, acceleration, and force.

5. Conclusions

Highlight contributions and outstanding features. Discuss the significance of the software package.

6. Bibliography

7. Appendix

Details of CQuickReturn class. Detailed description of each member functions.
Details of CQuickReturn class.
Describes details of each member function of class CQuickReturn.