Theory of the Determining Four-Bar Mechanism Types and Checking Grashof's Law

Figure 1 shows that typical Four-Bar Mechanism. Link $AO_2$is crank, link BA is coupler, link BO_4 is rocker, link $AO_2$is ground.

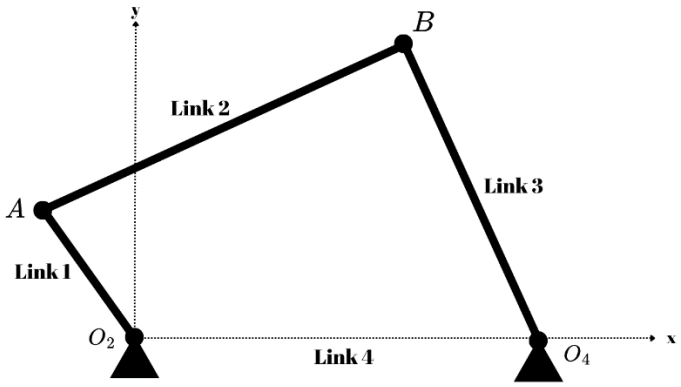


Figure 1 Typical Four-Bar Mechanism

While designing a mechanism, we consider it essential to ensure that the input crank can make a complete revolution. Mechanisms in which no link can make a complete revolution would not be useful in such applications.

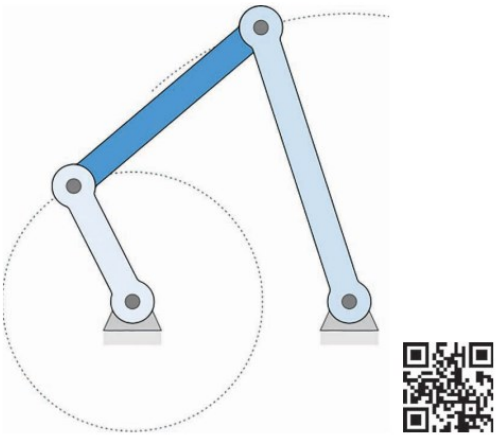
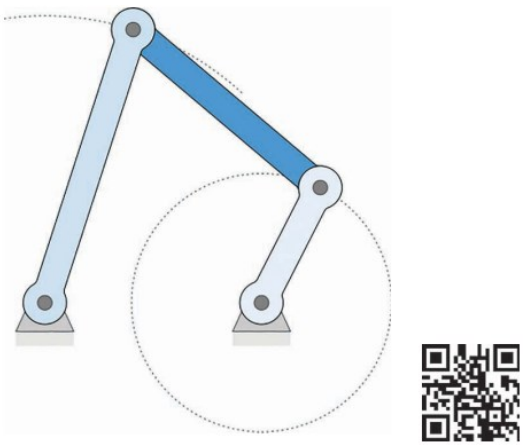
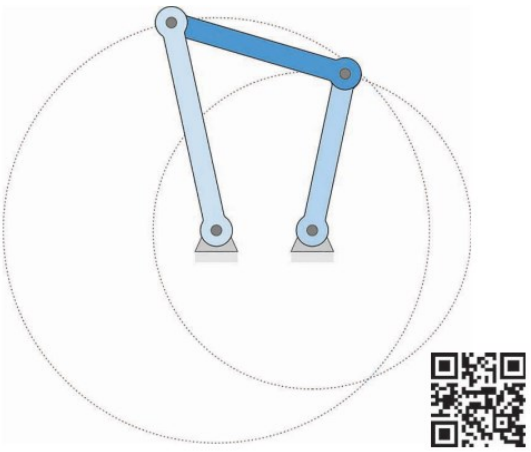
To ensure this, we use Grashof's law, which states that in a planar four-bar linkage, the sum of the shortest and longest link lengths must not exceed the sum of the remaining two link lengths to allow continuous relative rotation between two links. Grashof's law states that one of the links, particularly the shortest link, will make a full revolution relative to the other three links without the linkage binding if and only if

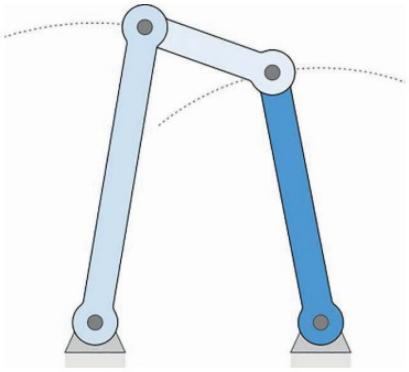
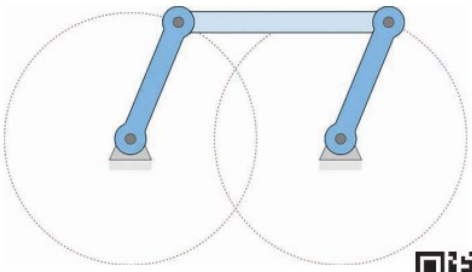
$$S + L \leq P + Q$$

where, S: shortest link, L= largest link, P and Q = remained links

If this inequality is not satisfied, no link will make a complete revolution relative to another. In Table 1 you can see the types of four-bar mechanisms used in the program. From below table the type #5 is a special case.

Table 1 Types of Four-Bar Mechanisms used in the program

Type Name and Number	**Driver**	**Notes**	**Illustration**
#1 Crank-Rocker Mechanism	Crank	The shortest link is crank. Only crank makes full revolution.	
#2 Rocker-Crank Mechanism	Rocker	The shortest link is rocker. Only rocker makes full revolution.	
#3 Double-Crank (Drag-Link) Mechanism	Crank, coupler, or rocker	The shortest link is ground. Crank, coupler, and rocker make full revolution.	

#4 Double-Rocker Mechanism	Coupler	The shortest link is coupler. Only coupler makes full revolution.	
#5 Parallelogram Mechanism	Crank	Two identical, opposite pairs. Crank and rocker make full rotation. This is the parallelogram linkage.	

Mechanism Type Determining Algorithm

According to Figure 1 if the shortest link is:

Link 1, types of four bar mechanism is ***Crank-Rocker Mechanism.***

Link 2, types of four bar mechanism is ***Double-Rocker Mechanism.***

Link 3, types of four bar mechanism is ***Rocker-Crank Mechanism.***

Link 4, types of four bar mechanism is ***Double-Crank (Drag-Link) Mechanism.***

If length of Link 1 = Link 3 and Link 2 = Link 4, types of four bar mechanism is ***Parallelogram Mechanism.***

Checking Grashof's Law Algorithm

If mechanism obey the Grashof's Law: $S + L \leq P + Q$

Console outputs: `This mechanism satisfies Grashof's theorem.`

Else,

Console outputs: `This mechanism does not satisfy Grashof's theorem`