

# Geometric Synthesis of the Folding Bridge Mechanism

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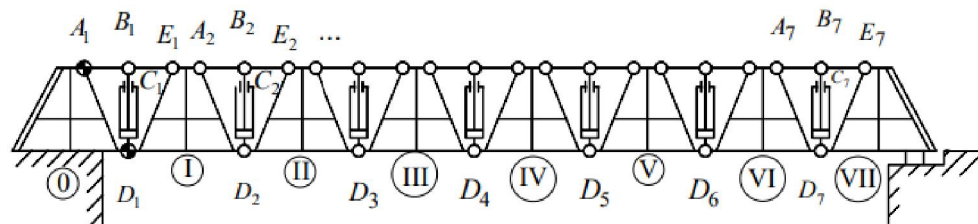
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**Abstract:** In London there is a folding bridge composed of eight platforms articulated between them. One platform is fixed to base (a platform from one end). The platforms have the shape of isosceles trapezoid. When the bridge is folded the large bases of the trapezoids form an octagon. The driving mechanism of the bridge is composed by motor dyads (active RRTaR groups) and RRR dyads. For the eight platform bridge the maximum piston stroke is less than the platform height (trapeze height). In this case, the connections between the hydraulic cylinders and the other elements are usually made, i.e. at the ends of the cylinder. If we want to make a folding bridge with fewer moving platforms, there are situations when the piston stroke is greater than the height of the trapeze. In this case must be performed the geometrical synthesis of the mechanism such that the folded bridge forms desired geometric figures (square, pentagon etc.).

**Keywords:** bridge

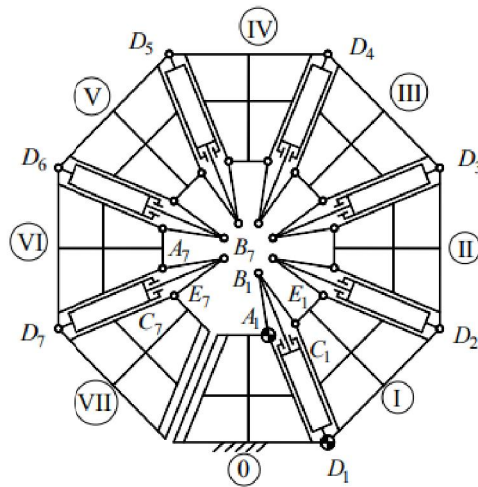
## I. INTRODUCTION

There are different constructions, generally called bridges, which are made for crossing watercourses. These constructions can be fixed or movable. The fixed bridges have a simple structure, but they do not allow the passage of boats exceeding a certain height. The folding bridges remove this disadvantage. Many such constructions have been made in the world, such as: Rolling Bridge, England [1], Slauerhoffbrug, Netherlands [2], Scale Lane Footbridge, England [3], Rhyl Foryd Harbor Bridge [4] etc. Each of the mentioned constructions has advantages and disadvantages. The folding bridge in London has the great advantage that it can be easily folded being shaped like a regular polygon (octagon). At any moment during the folding, the bridge can be stopped in a random position, as ordered. Figure 1 shows the kinematic scheme of the folding bridge in London, in working position, and Figure 2 shows the kinematic diagram of the same bridge, in a folded position. As shown in Figures 1 and 2 the folding bridge has eight platforms, one of them being fixed to the base (end platform).



**Figure 1.** The kinematic scheme of the folding bridge with seven platform in working position

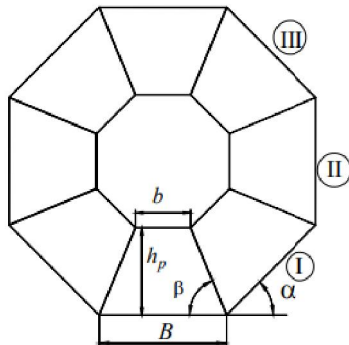




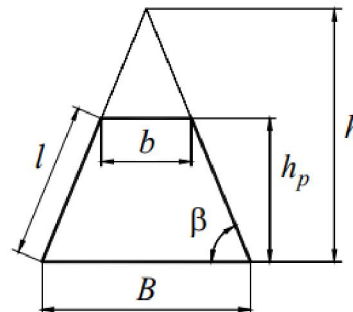
**Figure 2.** The kinematic scheme of the folding bridge with seven platforms in folded position

The geometrical synthesis of the folding bridge mechanisms

After folding, the bridges can form regular polygons, such as: square, pentagon, hexagon etc. In order to obtain these geometrical figures, it is imperative to be well-established relationships between the dimensions of the platforms and the lengths of the mechanism's elements. Given the width of the watercourses over which these folding bridges are built, the number of mobile platforms can be established, as well as their length. The mobile platforms have the shape of some isosceles trapezoids. Figure 3 shows the geometrical scheme of a folded bridge with eight platforms, one of them being fixed. Figure 4 shows the diagram of a platform within the bridge and the dimensions.



**Figure 3.** The kinematic scheme of the folding bridge with eight platforms in folded position



**Figure 4.** The geometrical elements of platform of the folding bridge

Case study example of calculation:

The paper presents the synthesis of the dimensions of the kinematic elements of the drive mechanism and of the platforms for three, four, five, six and seven folding mobile platforms. At complete folding, the following geometrical figures are formed square, pentagon, hexagon, heptagon and octagon. To achieve the synthesis program there were



considered as known the following: -  $B$  - the length bridge platforms; -  $n$  - the number of regular polygons; -  $r$  - the radius of the circle where are the extremities of piston rod on which the ends of the rods of the driving cylinders are located, at the time of the total folding of the bridge.

## II. CONCLUSIONS

The paper covered the geometric synthesis of a folding bridge. Depending on the width of the watercourse on which it is mounted, the folding bridge may have one or more mobile platforms. When completely folded, the bridges shape becomes a regular polygon (square, pentagon, hexagon etc.). For folding bridges with one or two movable platforms the values of kinematic elements are obtained from the geometric synthesis of a folding bridge with three or more mobile platforms, depending on the position of the folding platforms. For example, if it is requested to build a folding bridge with a movable platform, at vertical folding position (the angle  $\alpha = \pi/2$ ), the constructive values are obtained from the synthesis of a folding bridge with three movable platforms, which at full fold forms a square.

## REFERENCES

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