ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL TWO

INSTRUCTIONAL GUIDE

SECTION 7

EO C231.02 – FLY A PAPER COLDITZ GLIDER

Total Time: 60 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-802/PG-001, Chapter 4. Specific uses for said resources are identified throughout the Instructional Guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Copy the paper Colditz glider assembly instructions and templates located at Annex A for each cadet. Figures A-3 and A-4 require photocopy magnification so that the parts layout section fits a 5 x 8 inch standard index card.

Construct a paper Colditz glider for demonstration purposes.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TP1 as it introduces paper gliders, orients the cadets to the topic and generates interest.

An in-class activity was chosen for TP2 and TP3 as it is an interactive way to provoke thought and stimulate an interest among cadets and to confirm the cadets' comprehension of the material.

A group discussion was chosen for TP4 as it allows the cadets to interact with their peers and share their knowledge, experiences, opinions and feelings about paper gliders.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall be expected to construct and fly a paper Colditz glider.

IMPORTANCE

Constructing and flying paper gliders in a fun and challenging way allows cadets to observe some of the principles of flight in action.

Teaching Point 1 **Explain the History and Design of a Paper Colditz Glider**

Time: 15 min Method: Interactive Lecture

During World War II, Colditz Castle in German Saxony was used as a prisoner of war camp. Built on rocks high above the town of Colditz and overlooking the valley of the River Mulde, the huge structure seemed the ideal place for a high security prison. The inmates proved that this was a mistake. Between 1939 and 1945 there was a constant battle of wits between Allied officers and German guards that turned Colditz Castle into an international “Escape School”. Over 300 daring escape attempts earned “Oflag IV c” (Officers’ Camp IV c, Colditz) the reputation of a bad boys’ camp and made the Castle notorious. Allied Officers from Australia, Belgium, Canada, Czechoslovakia, France, Great Britain, India, Netherlands, New Zealand, Poland, Serbia, South Africa and the USA were imprisoned in the old castle.

Flying Officer Bill Goldfinch, a British prisoner of war, designed a small glider for an escape. Fellow prisoners built it using materials in the camp. Floorboards became wing spars, the ribs and frame were made from bed slats and control lines were electrical wires, all stealthily obtained. The covering was cotton, which came from sleeping bags sealed with slurry-type paste made by boiling down prison ration millet.

Colditz Castle is now a museum. Cadets can find out more about Oflag IV c and the prisoners by visiting the museum Website: http://www.colditz-4c.com/index.html.

When developing this escape plan, the prisoners had many things to consider. Ensuring the effective flight capability of their glider required attention to the same principles that concern this lesson.

BASIC PRINCIPLES OF FLIGHT

Weight. The force that attracts all matter and pulls objects to the Earth’s surface. In gliding, gravity provides the power to make the glider move. The wings change this downward pull (gravity) into forward motion (thrust) by acting on the passing air.

Lift. Any force that exerts an upward pull on the glider to overcome gravity.

Drag. The air’s resistance to the glider’s forward motion.

Thrust. Any force that propels the glider forward.

Angle of Attack. The angle at which the wing goes through the air.

Stall. When the wing’s angle of attack is too great, the wing no longer produces lift.

A wing increases the speed of the airflow over its upper surface so that the pressure in this area is reduced. This is accomplished by curving the upper surface, which is known as camber. The distance from front to back along the curved surface is greater than the distance under the straight lower surface. Because the air molecules flowing along the curve have further to travel than the ones beneath, they increase their speed and become spaced further apart. This faster moving air exerts less pressure, which means that a partial vacuum is created above the wing.

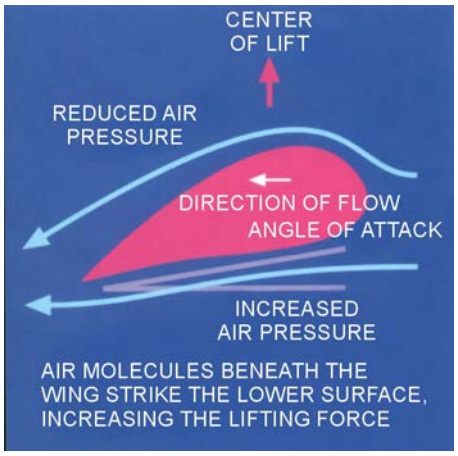

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Figure 1 Lift

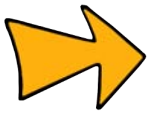
PAPER GLIDER PARTS

A paper glider is constructed with three main parts made up of smaller pieces built up in layers:

- fuselage with a vertical stabilizer,
- wings, and
- horizontal stabilizer.

Parts templates and detailed instructions are located at Annex A. Paper glider construction will be explained in TP2.

TRIMMING FOR FLIGHT



The paper glider to be built in TP2 will be more stable in flight if the following requirements for trimming are kept in mind during construction.

The control surfaces of the paper glider should be arranged to reduce roll, pitch and yaw. If the paper glider has an undesirable tendency to turn, bend the rudder slightly away from the direction of the turn. This should push the tail back into a straight line.

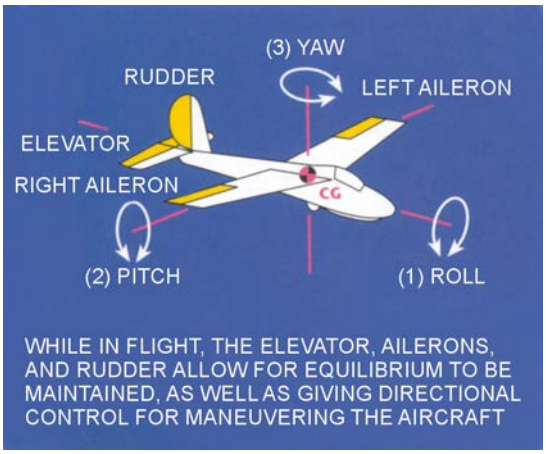


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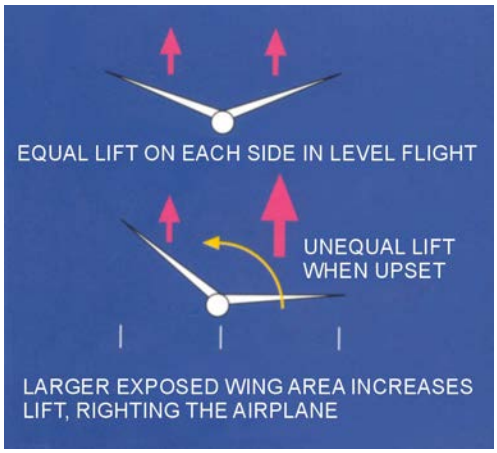
Figure 2 Trimming for Flight

Angle the wings upward from the fuselage to inhibit roll. This is called a dihedral angle. As one wing drops and the other rises, the dropping wing will generate more lift as it approaches the horizontal and the rising wing will generate less lift as it approaches the vertical.



Schmidt, N., Fabulous Paper Gliders, Sterling Publishing Company (p. 21)

Figure 3 Controlling Roll

A paper glider that loses altitude too rapidly may be improved by keeping the paper glider's centre of gravity ahead of lift or by increasing the angle of the elevators at the rear of the horizontal stabilizers to lift the nose.

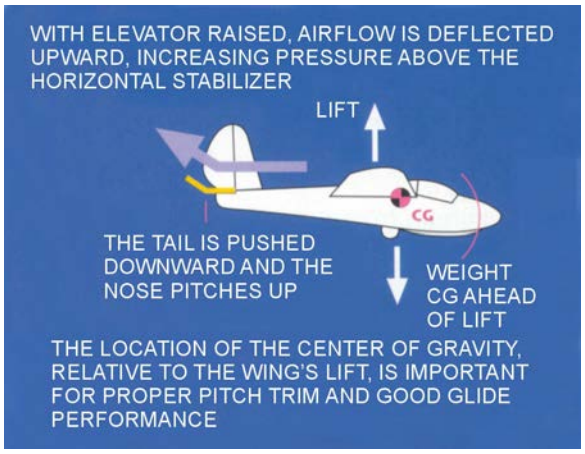


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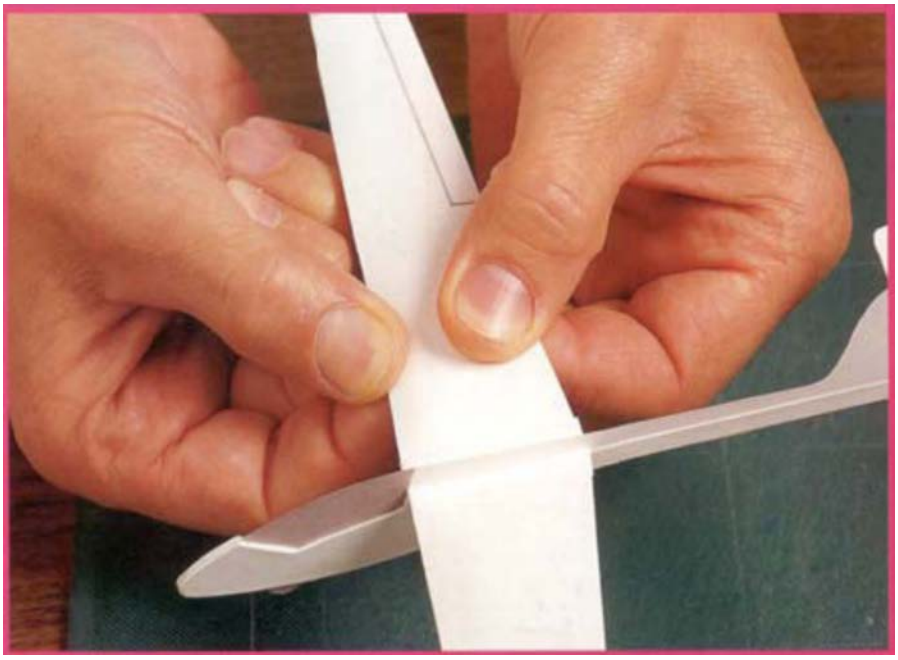
Figure 4 Lifting the Nose

The wing's ability to provide lift can be improved by adjusting the shape of the curvature. The curve should be very slight (refer to Figure A-2).



Schmidt, N., Fabulous Paper Gliders, Sterling Publishing Company (p. 8)

Figure 5 Adjusting Wing Curvature (Camber)

FLYING TIPS

Pick up and hold paper gliders by the nose. Never lift them by the wings or tail; this will distort their aerodynamic shape.

Examine the glider thoroughly from the front, back, top, bottom, and each side. Check for parts that appear bent or twisted. Each side must be exactly like the other. A paper glider must be symmetrical in all respects.

When throwing, hold the fuselage between the thumb and forefinger just behind the paper glider's centre of gravity. Throw it gently with a straight motion, not as if it were a baseball. A paper glider flies best at only one speed. Throwing it too hard will cause it to climb sharply, stall, and dive to the ground, or do a complete loop.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. Why are the wings on most aircraft angled upward from the fuselage?

Q2. When gliding, what force creates thrust to overcome drag?

Q3. When gliding, what motion is necessary to create lift?

ANTICIPATED ANSWERS

A1. The wings on most aircraft are angled upward from the fuselage to provide roll stability.

A2. The force of gravity creates thrust to overcome drag.

A3. Forward motion is necessary to create lift.

Teaching Point 2 **Construct a Paper Colditz Glider**

Time: 20 min Method: In-Class Activity

ACTIVITY

OBJECTIVE

The objective of this activity is to have the cadets construct a paper Colditz glider.

RESOURCES

- Index card stock 5 x 8 inch (two per cadet),
- Scissors (one pair per cadet),
- Fast-drying glue,
- Ruler (one per cadet),
- Pencil (one per cadet), and
- Glider templates located at Annex A (one set per cadet).

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Provide each cadet with the instructions and templates located at Annex A and resources as needed.
2. Have the cadets cut the parts layout section from each photocopy, as indicated on the page, to fit a 5 x 8 inch standard index card. Lightly glue the layouts to the card by applying a small spot of glue to the areas between the parts on the rear side, being careful to align the two parts.
3. Before beginning to cut out the parts, score those parts that will need to be bent later and cut opening slits where indicated. Score and cut precisely on the lines.

4. Cut out each part shown. This must be done carefully since the success or failure of every other step depends on accurately made parts. Keep track of the parts by lightly writing the part number in pencil on the backside of each part.

5. Build the glider. Begin with the 1F fuselage part, adding the other smaller parts to each side to complete the fuselage. Align parts carefully. Add drawing decoration when the glue is dry.

Ensure every cadet is finished construction before proceeding to TP3.

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 2

The cadets' participation in the activity will serve as the confirmation of this TP.

Teaching Point 3 **Fly a Paper Colditz Glider**

Time: 15 min Method: In-Class Activity

ACTIVITY

OBJECTIVE

The objective of this activity is to have the cadets fly a paper Colditz glider and compare its performance with the flight of other paper Colditz gliders.

RESOURCES

N/A.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

Form cadets into a launching line.

Paper Colditz gliders are to be launched forward of the launching line and the paper gliders which travel the furthest and which fly the longest are to be noted by the instructor.

With the cadets, analyze and correct the performance of gliders that did not fly effectively and have the cadets try again.

The very successful gliders that finally go the furthest and fly the longest will be examined in TP4.

SAFETY

Gliders must not be launched when anyone is forward of the launching line.

CONFIRMATION OF TEACHING POINT 3

The cadets' participation in the activity will serve as the confirmation of this TP.

Teaching Point 4 **Discuss Flying Paper Colditz Gliders**

Time: 5 min Method: Group Discussion

BACKGROUND KNOWLEDGE

The point of the group discussion is to draw the following information from the group using the tips for answering/facilitating discussion and the suggested questions provided.

Paper is a relatively unstable material and it may be necessary to readjust the planes after every few flights. Cadets may feel frustration about erratic performance but this unpredictable quality of paper gliders can be part of the joy of flying them.

GROUP DISCUSSION

TIPS FOR ANSWERING/FACILITATING DISCUSSION

- Establish ground rules for discussion, e.g. everyone should listen respectfully; don't interrupt; only one person speaks at a time; no one's ideas should be made fun of; you can disagree with ideas but not with the person; try to understand others as much as you hope they understand you; etc.
- Sit the group in a circle, making sure all cadets can be seen by everyone else.
- Ask questions that will provoke thought; in other words avoid questions with yes or no answers.
- Manage time by ensuring the cadets stay on topic.
- Listen and respond in a way that indicates you have heard and understood the cadet. This can be done by paraphrasing their ideas.
- Give the cadets time to respond to your questions.
- Ensure every cadet has an opportunity to participate. One option is to go around the group and have each cadet answer the question with a short answer. Cadets must also have the option to pass if they wish.
- Additional questions should be prepared ahead of time.

QUESTIONS

Q1. How do you feel about paper glider aviation?

Q2. What did you enjoy most about this activity?

Q3. What things contributed to the success of the glider's flight?

Q4. How might glider performance be improved?

Q5. How might glider performance be made more consistent?

Other questions and answers will develop throughout the group discussion. The group discussion should not be limited to only those suggested.

Reinforce those answers given and comments made during the group discussion, ensuring the teaching point has been covered.

CONFIRMATION OF TEACHING POINT 4

The cadets' participation in the group discussion will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

SUGGESTED QUESTIONS

Q1. What characteristics were common to the paper gliders that flew the furthest?

Q2. What characteristics were common to paper gliders that turned in flight?

Q3. How can a paper glider be prevented from stalling?

ANTICIPATED ANSWERS

A1. Common characteristics were similar camber, similar pitch, straight rudder, etc.

A2. The common characteristic was that the rudder was not straight in line with the fuselage.

A3. To prevent a paper glider from stalling, the angle of attack of the wing can be reduced.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

Cadets can improve the design and operation of a paper glider even if it is efficient already; careful application of flight principles may improve even successful paper gliders.

INSTRUCTOR NOTES/REMARKS

It is recommended that the two periods required for this EO be scheduled consecutively.

If the weather is not suitable to fly the paper Colditz gliders outdoors, flights may take place indoors.

REFERENCES

C3-017 (ISBN 1-895569-23-0) Schmidt, N. (1998). *Fabulous Paper Gliders.* New York, NY: Sterling Publishing.

C3-058 (ISBN 1-4027-3034-9) Schmidt, N. (2005). *Paper Creations Paper Airplanes.* New York, NY: Sterling Publishing Company.

C3-094 Colditz Museum. (2005). *Colditz Glider.* Retrieved 23 February 2007, from http://www.colditz-4c.com/glider.htm.

COLDITZ PAPER GLIDER TEMPLATE AND ASSEMBLY INSTRUCTIONS

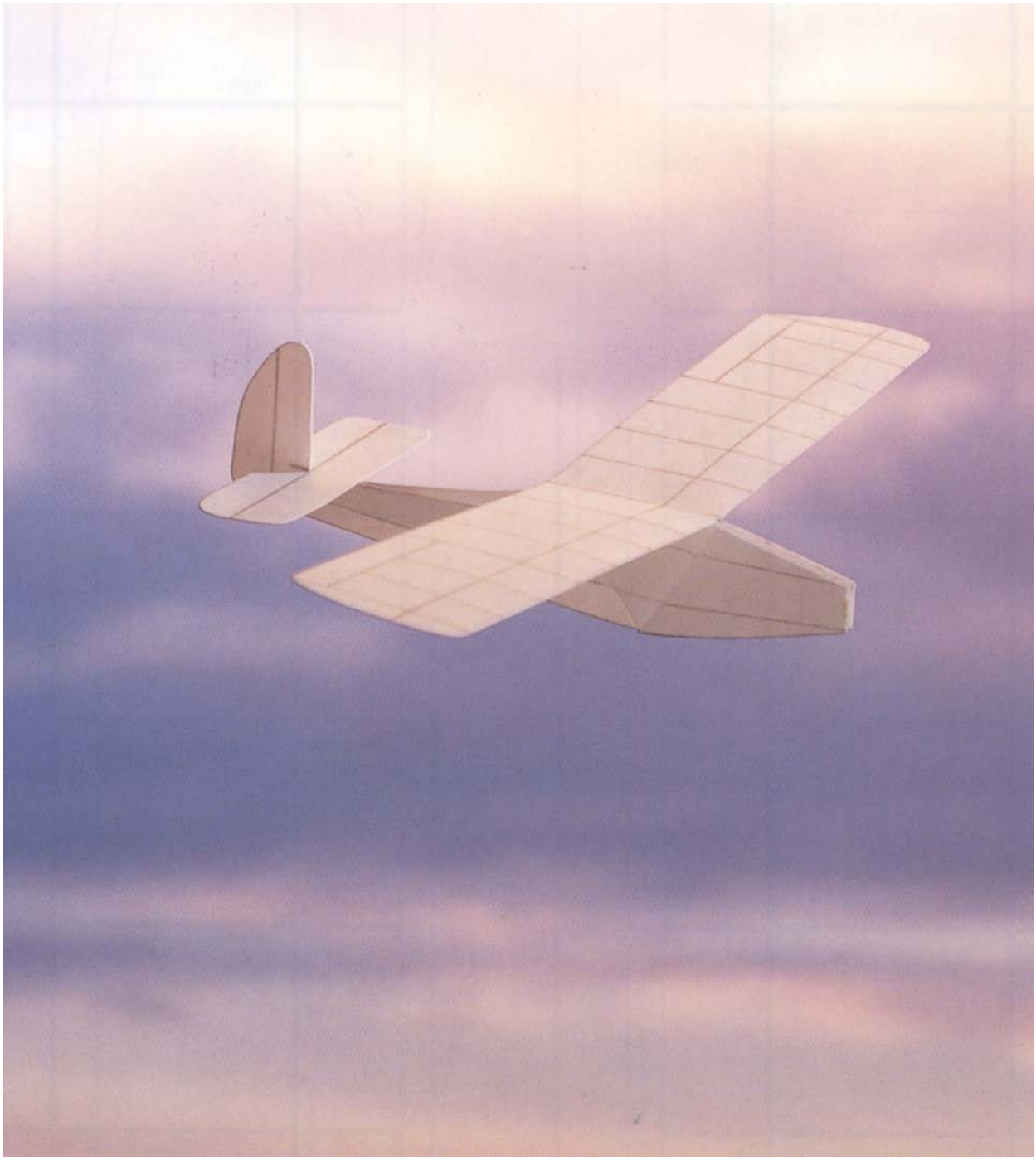


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Figure A-1 Colditz Glider

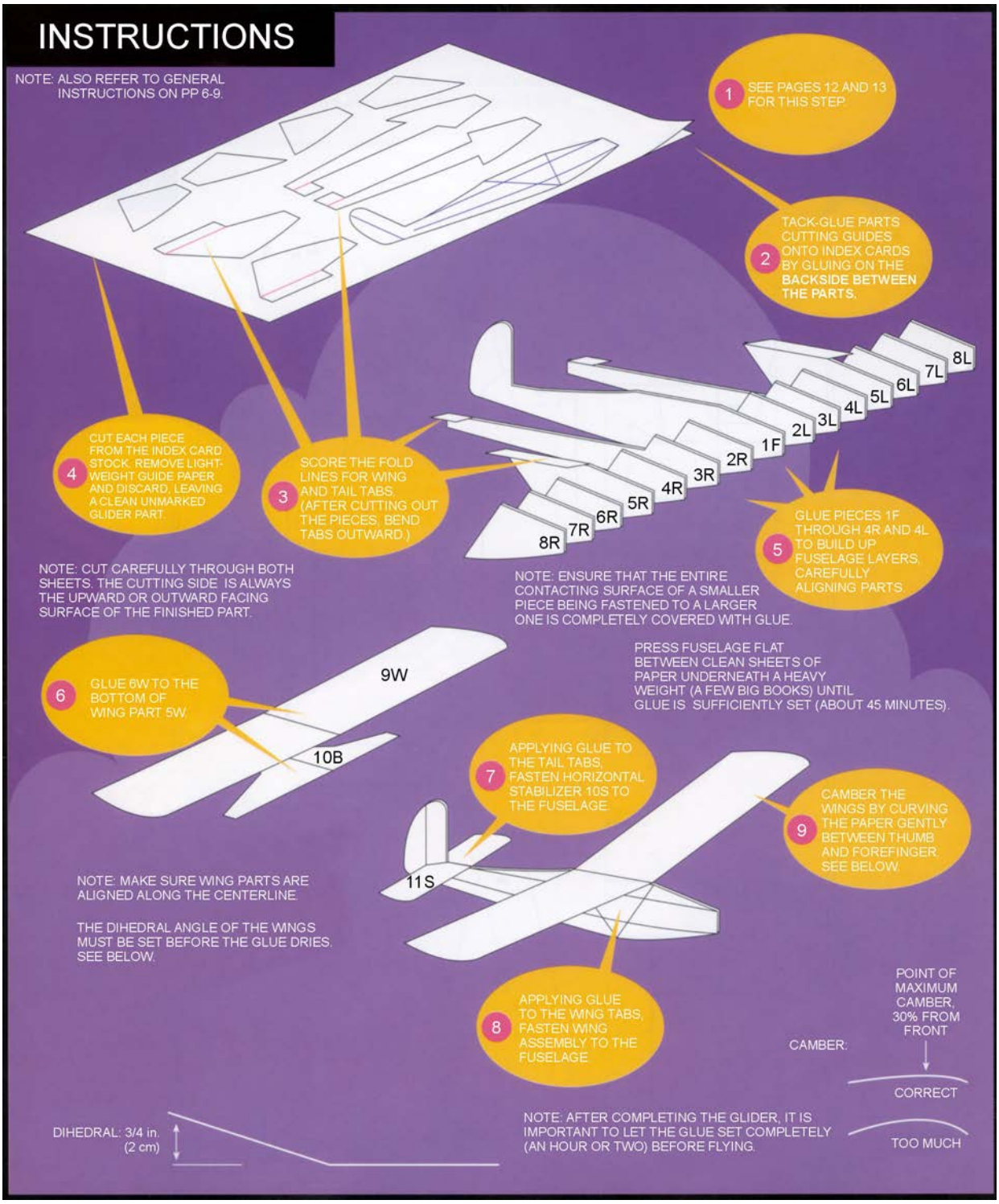

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Figure A-2 Colditz Glider Assembly

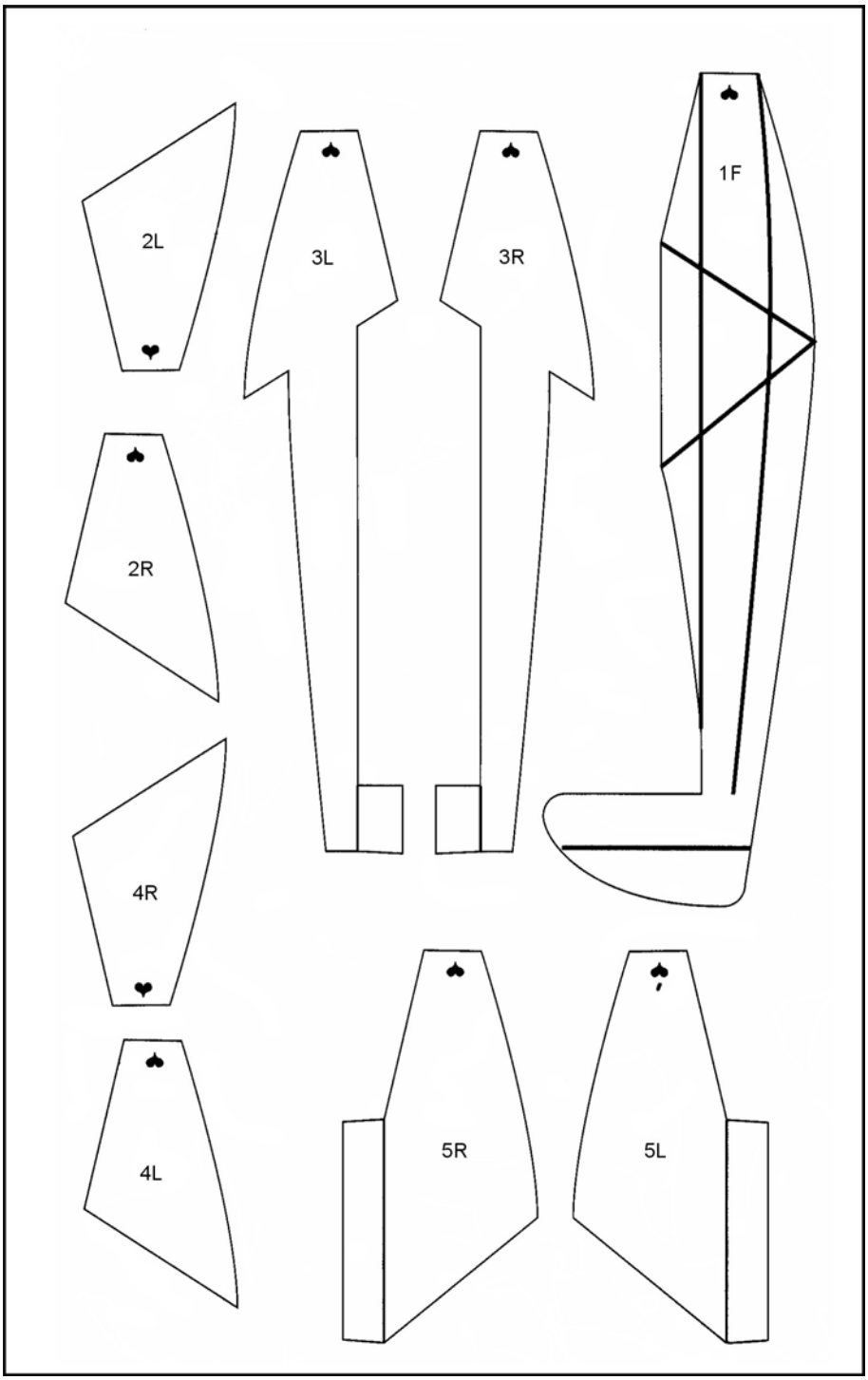

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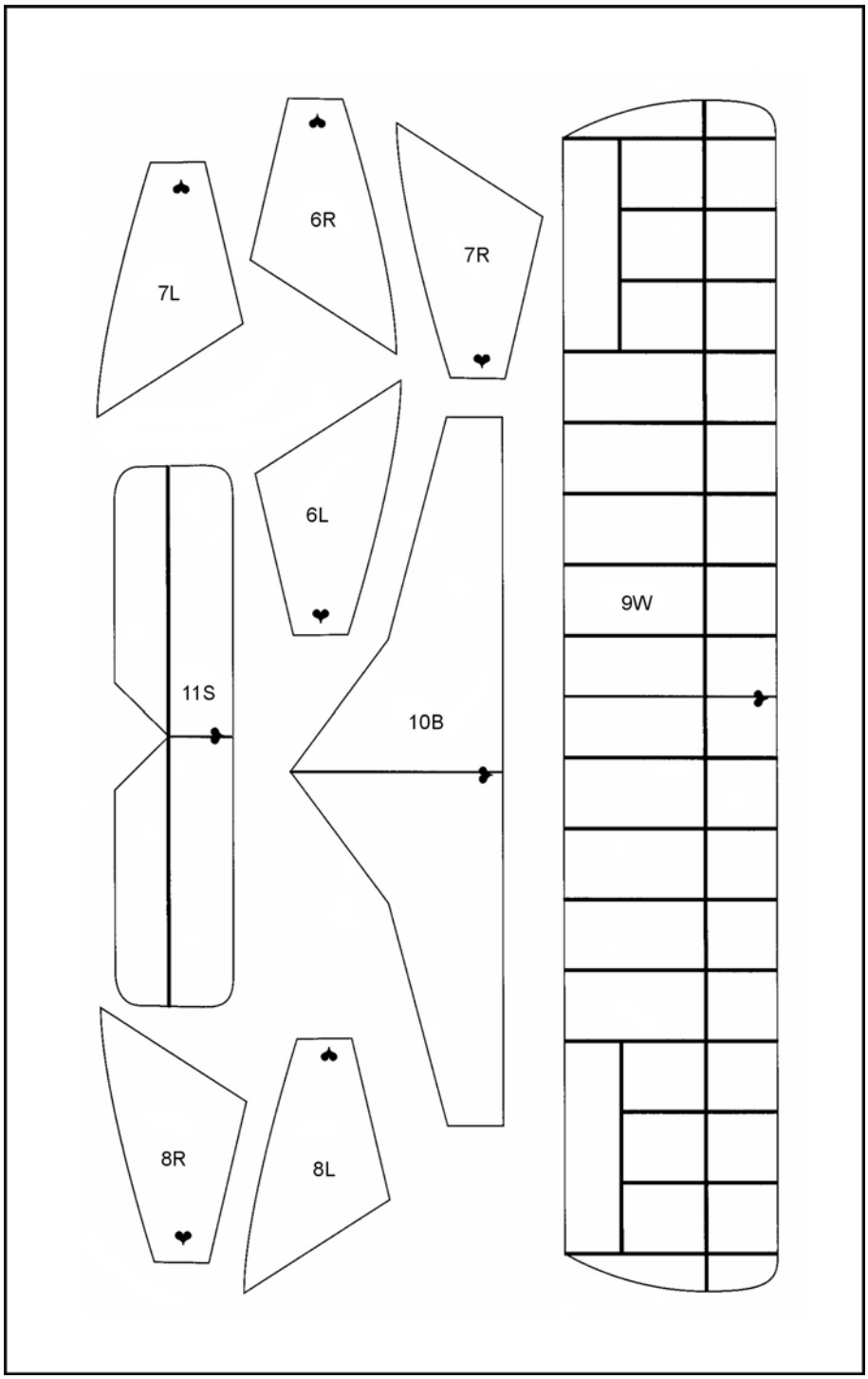
Figure A-3 Colditz Glider Fuselage



N. Schmidt, Fabulous Paper Gliders, Sterling Publishing Company (p. 55)

Figure A-4 Colditz Glider Wing