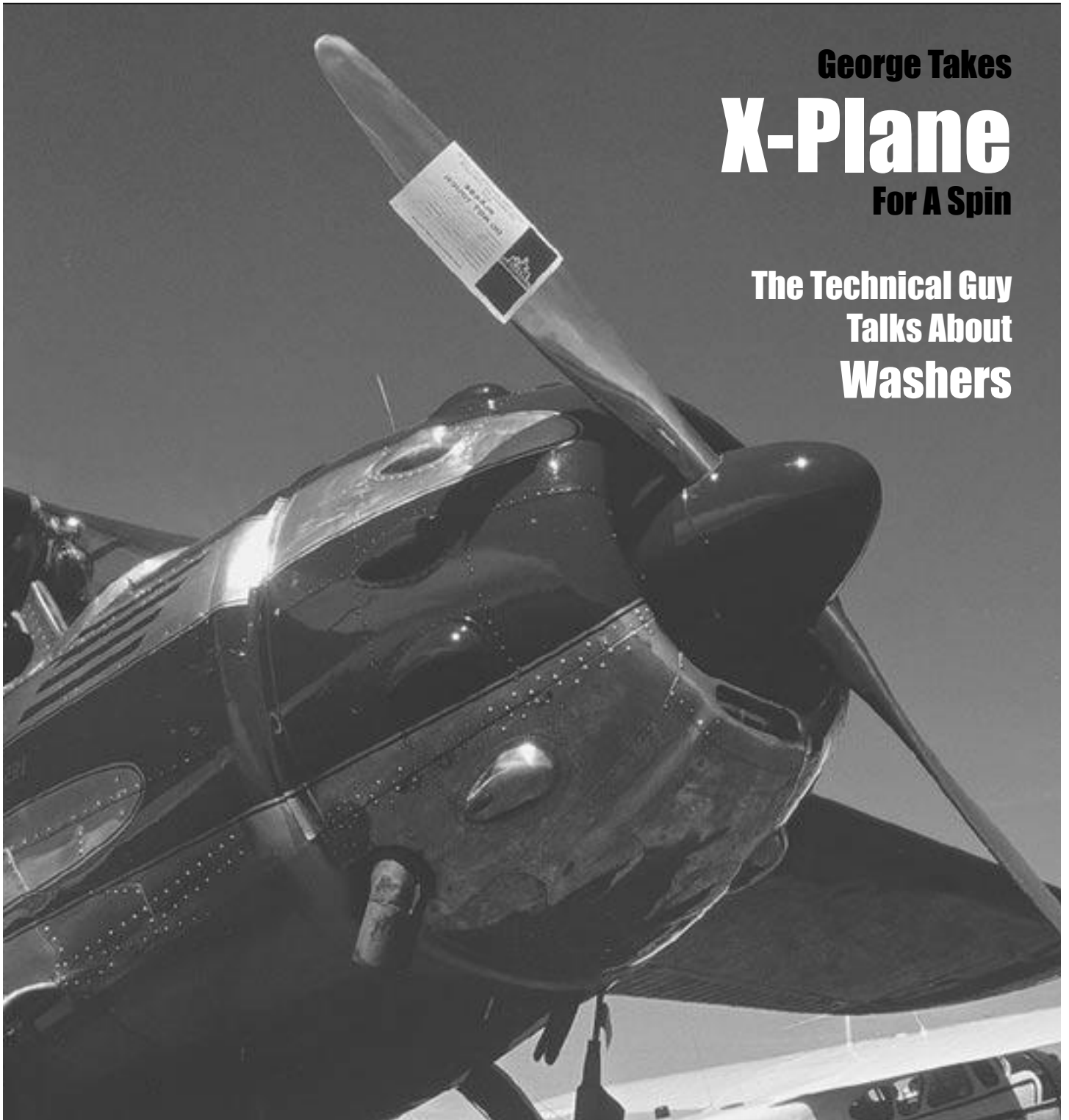


# Turn & Bank



OFFICIAL NEWSLETTER OF RAAC CHAPTER 85

March 2003

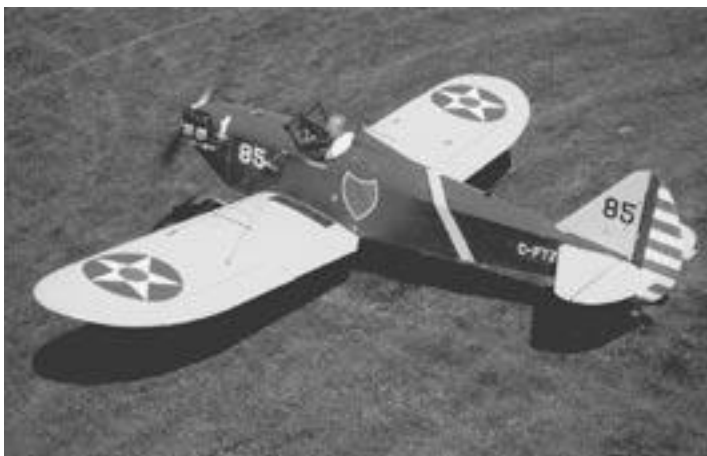


**George Takes**

## **X-Plane**

**For A Spin**

**The Technical Guy  
Talks About  
Washers**



On The Cover:  
One of Delta's 190's. Above: Gogi in his Fly-Baby.  
Mark Munzel Photos.

# Inside

Technical Guy	
by Bill Tee.....	3
Bulletin Board .....	4
Minutes	
by Jim Hunter .....	4
X-Plane	
by George Gregory .....	5
Classified.....	7

The TURN AND BANK is the monthly publication of RAAC Chapter 85 and is intended to keep members informed as to the club's activities, and to promote safety and technical excellence in the field of sport aviation. No responsibility or liability is assumed, expressed or implied as to the content of articles contained in the Turn and Bank: the intention is to provide a forum for discussion and exchange of ideas. Newsletter contributions should be mailed to George Gregory, 19470-88th Avenue, Surrey, B.C. V4N 3G5 no later than the 12th of each month. Business Fax is (604)-469-3495. Please remember to indicate "attention George Gregory" on your fax. George's email address is: gregdesign@telus.net Enquiries to the Membership Chairman should be mailed to Rob Prior, 3032 Carina Place, Burnaby, B.C. V3J 1B5

For inspections of Amateur Built Aircraft Projects contact the MDRA Inspection Services , ph. 1-877-419-2111 fax 1-519-457-0980 email: mdrainsp@on.aibn.com Regular Meetings are held on the first Tues. of each month at 20:00 (8pm) in the clubhouse: Delta Airpark, 4103-104th Street Delta, B.C. Clubhouse phone: 596-3644

Mailing Address: Chapter 85, RAAC  
c/o Delta Heritage Airpark, 4103-104th St., RR#3, Delta, B.C. V4K-3N3

Executive meetings are on the third Tues. of each month at 19:30 (7:30 pm) in the clubhouse.

Chapter aircraft pilots, mail cheques (Payable to RAAC Chapter 85) to:  
Tedd McHenry

RAAC National Homepage: <http://www.raa.ca>  
RAA Chapter 85 Homepage: [http://www.b4.ca/raa\\_85](http://www.b4.ca/raa_85)  
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# Technical Guy

## WASHERS

By Bill Tee

Washers are simple little things usually round on the outside with a hole, usually round, on the inside although not necessarily so. Washers can also be flat, or not flat such as a Belleville [wiggly] washer or a lock washer. Lock washers are not too well accepted in the aircraft industry mainly because they have a tendency to damage the surface to which they come in contact. Also their efficiency can deteriorate with time in use.

What we will deal with here is the round flat metal washer made to aircraft standards. The washers are mainly metal [aluminum and steel] AN960 washer with a little bit of the more exotic thrown in for good measure.

The aluminum alloy washers are made from 2024-T3 or T4 material and are the basic airframe washer where high strength bolts are not used or where the operating temperature does not exceed 500 degrees F. These are available in the extra light [extra thin], light [thin] and regular [thick] series. The light ones are .032 thick and the regular are .063 thick, unless less than # 10 size [3/16 dia]. Under # 10 the regular washer is .032 thick and the thin is .015. Above the #10 size the .015 washers are called 'extra light'.

Steel washers come in the same thickness range and can be made from carbon steel per MIL-S-7952 [SAE 1020 or 1025] or stainless steel per MIL-S-5059 [301 alloy] or MIL-S-6721 [321 alloy]. Although the carbon steel washers are suitably coated to make them compatible with aluminum and to delay corrosion the stainless steel washers are sometimes more desirable from a corrosion stand point. However be aware that with aluminum alloys, under the right [damp] circumstances, the stainless steel will attack the aluminum causing extreme corrosion and deterioration. This applies to nuts, bolts and screws as well as washers. A barrier [paint, etc] may be desirable between them.

Identification of AN washers is given by the '960' designation, with the following numbers and letters. In the designation

such as 'AN960D10L the AN stands for Army-Navy. '960' is the washer part or type number, 10 means the washer has a hole to suit a #10-32 bolt or screw or a #10 pin.

'D' stands for aluminum alloy

'-' [a dash] stands for steel

'C' stands for stainless steel [or more accurately 'Corrosion Resistant Steel {C.Re.S}]

No suffix means regular thickness

'L' means light [or thin]

LL means extra light [or extra thin]

Another example is an AN960D416. This would translate to an Army-Navy 960 series washer of aluminum alloy with a 4/16 or 1/4 dia hole.

Hole sizes progress by 1/16ths up to maximum size e.g. a 5/16 washer is a '516', a 3/8 [6/16] is a '-616', etc on up the line.

For high tensile bolts the MS2002 series washers are used. These are available in only one thickness and either regular or countersunk configuration. The countersunk ones are for use under the heads of high tensile bolts with a significant radius between the head and the shank. A sharp edge biting into this radius would greatly reduce the fatigue resisting qualities of the fastener. If sufficient material to be bolted exists the same thing can be accomplished by chamfering the edge of the hole into which the bolt is installed.

The MS series and the NAS series bolts generally require this consideration. MS 2002 washers are available in steel only [1330 or 4130 alloy]. These washers start at 1/4" hole dia and go all the way up to 1-1/2" hole dia. The size is indicated by a suffix on the end of the part number in 1/16ths e.g. MS2002-4 has a 1/4 "hole dia for a 1/4" dia bolt. -5 is for 5/16-dia bolt and -6 is for a 3/8" dia bolt, etc. For a countersunk washer substitute a 'C' for the dash e.g. MS2002C4.

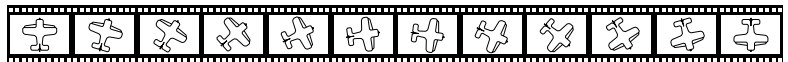
A prime example of the importance of using the correct washer in the right place is illustrated by an example written up in "Light Plane Maintenance". It seems that instead of using the correct and prescribed steel washer under the head of the propeller bolts, aluminum washers were used. Although the propeller bolts were torqued as required on installation of the propeller, the torque values changed [decreased] because of the crushing of the aluminum washer. [More fatigue failures of bolts are caused by under torquing than over torquing] This situation ended in the fatigue failure of the propeller bolts and the loss of the prop from the crankshaft.

The example shown here indicates the importance of adhering to the correct part for the job. A washer may seem to be an insignificant item but in critical places its correct use cannot be over emphasized.

Why use a washer? Well, there are many reasons, the most important of which is probably to protect the surface of any material from the damaging effect that can be caused by contact with the rotating nut or bolt head. A washer should always be placed under whichever item that is rotated in order to tighten a threaded fastener [a screw or bolt]. Washers can also be used as spacers or sacrificial material where corrosion is apt to take place, or in order to adjust a bolt length as required in order to tighten the nut and bolt without bottoming the thread, which can be disastrous. Washers are also valuable for distributing a fastener load over a bearing area larger than the area covered by only a nut or bolt head eg an AN970 washer as used on a wood surface.

Washers probably have as many uses as the imagination can invent, but the forgoing is an overview of the main functions. Happy building and great flying!

## AIRFrame



Aircraft Portraits

Rob Prior

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[rv7@b4.ca](mailto:rv7@b4.ca)

3032 Carina Place, Burnaby, BC, V3J 1B5

604/422.8446

# Bulletin Board

Last I heard, Norm Helmer is looking for someone to help or take over his Paradyne project. The Paradyne is a cutting edge new concept in STOL aircraft that shows promise. He's now residing at the George Kerby Centre in Burnaby. His phone number is (604) 527-8970.

Dan Lawler would like you to send your email addresses to him at:  
dan.lawler@kvaerner.com

He will create a database so he can send announcements about meeting programs, etc. Currently he has a list of about 20 e-mail addresses, and would like to expand it and keep it up to date.

Want to learn more about aircraft construction? Want to contribute to the community good? Get involved in the J-5 project! Also, we are looking for help from someone knowledgeable in fabric work. Talk to a member of the executive and they'll put you in contact with the right people.

George is looking for pictures you may have of aircraft for his Stock picture collection. These will be used in future issues of the Turn and Bank as needed

as well as use in the Recreational Flyer when a nice picture is needed for articles and fillers. And it goes without saying that I'm always looking for good articles for the newsletter.

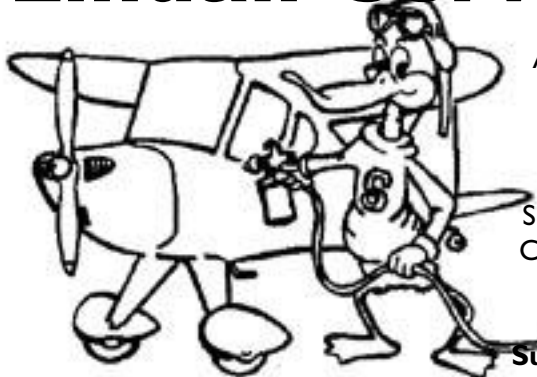
Don't forget the Pancake breakfast, Sunday, February 9.

The Annual Bash has been scheduled for April 5 at the Sundance, same place as last year. Details will be following, or contact a member of the executive. Their

phone numbers are on page 2. The 2003 DHAP Fly-In has been scheduled for July 5. This comes after Langley's Canada Day Celebrations, but a few days before Arlington. See you there!

And speaking of Arlington, the EAA NorthWest Fly-In begins July 9, and runs through to Sunday, July 13. Maybe there'll be a Tailwind there this year...

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## Minutes

Jim Hunter

Minutes of the General Meeting,  
4 February, 2003

Call to order: 8:00 pm by President Tim Baker and we introduce Mr. Chris Buxton of NAVCAN who will be doing a presentation later in the evening. Tim invited visitors to introduce themselves.

Hunter/Meyer: that the Minutes of the General Meeting of 3 January, 2003 be adopted as printed in the newsletter. Discussion Carried.

Committee Reports:

Treasury: Verbal report by Treasurer Don Souter.

Membership: Rob Prior: We have a membership of 102 as of this night which is not too bad for this time of the year. Of that number, 28 are complimentary. February GM is the last occasion to renew at the cheap rate.

Buildings: Dave Bell: nothing but David advised that some of the hangar doors need

work. But actually, plans already afoot this very night to do it.

Library: John McReady: Reminds us that there are scads of books to take out, mostly but not all, on aviation matters.

Vice President: Gerrard Van Dijk: Annual Bash set for April 5 at the Sundance in Delta. More to come.

Newsletter: George Gregory: OK He is still moseying on. (Must have been frightened by an Albertan) [Hey! I grew up in Edmonton don'cha know! - ed].

Program: Our presentation tonight was by Chris Buxton of the Kamloops NAVCAN FIC. The FIC Program will be fully operational Summer 2004. All enroute communications and flight planning in Southwestern BC will be channelled through the Kamloops FIC although, through the wonders of the modern telephone system a pilot will not necessarily be aware of it. Looks good. Obviously more to come on this.

Aircraft: Tedd McHenry: 4.5 hours on the Turbi in January and it's working fine.

DHAPCOM: Terry Wilshire:

1) Breakfast, Sunday February 9

2) The Wright Flyer project has run into a

bit of a snag; with the current unrest in the educational system, they are not able to get any schools' participation in the project (Secretarial observation: When was there not unrest in the educational system?).

3) The rezoning of DHAP to go ahead. When done, more hangars and other works can be done.

4) Corporation of Delta wants to know DHAPCOM's business plan so they can assist us in same.

5) Of interest to the membership: Chapter Executive has struck an "Airpark Committee" to represent its interests with DHAPCOM. Terry Wilshire appointed chairman of the Airpark Committee. For shorthand we can still call it "DHAPCOM".

Old Business: None.

New Business:

1) Chapter Fly In set for July 5. This will not conflict with Langley events.

2) Don Souter gave info on Arlington such as he has it. Lot of changes being made but the event still on. More to come.

Prior2/Baker: that we adjourn which thing was duly dood.

Jim Hunter, Secretary.

# XPlane

*In last month's newsletter I mentioned a little bit about a simulator known as X-Plane, by Laminar Research. It arrived in the mail a few days later, and I've now had a little time to play with it. I have not since been disappointed.* **By George Gregory**

Consumer Reports says: "X-Plane started its life as a commercial product for testing and simulating aircraft during the design phase. These capabilities are still included, so if you ever wanted to design or modify a plane, now's your chance" [I started salivating at this point]. "X-Plane comes complete with two utilities for designing your own aircraft: Plane-Maker and Part-Maker [also called Airfoil-Maker, at least in version 6.26 -ed]. Plane-Maker lets you design your own plane from scratch or modify an existing plane to suit your needs. You can use Part-Maker to create airfoils (wings, flaps, etc.) for use with Plane-Maker. Together, the two programs let you delve into the fascinating world of aircraft design.

"X-Plane's strength lies in its challenging flight simulation. If you have flown an F-105 in other simulators, try it in X-Plane and get a taste of how it really flies. X-Plane's modeling technology is head-and-shoulders above other available simulators. This same technology is used to power the plane and parts modeling programs included with the simulator."

In a word, this is a simulator for pilots and designers. Some gaming reviews have dissed it, preferring the better scenery of more commercial programs; but for pilots,

this is the one.

To start with, X-Planes is a great simulator. It has been FAA approved for IFR training when used with the appropriate hardware, with functioning nav aids, and a huge database of airports, including most of the registered fields I am familiar with in Western Canada. Reviewers besides myself talk about the reality of the flight experience; I must defer to them because I haven't tried too many other flight simulators, but it sounds good to me.

What really sets X-Planes apart, however, is the ability to design and test-fly aircraft within the program. If you design a bad aircraft, it will fly poorly. The software consists of several parts: first, there is X-Plane itself, with the various airports and a selection of standard aircraft to choose from, including a Lancair Columbia, a Glasair, and the erstwhile Cessna 172. A flock of airliners, the Space Shuttle, Concorde, and many others are also included. This is the flight

simulator part.

Next is Plane-Maker. An impressive collection of tools and controls allow you to enter just about any aircraft shape you can think of into the program.

World Maker allows you to customize the environment, terrain and airports in which you fly.

Airfoil-Maker allows you to customize airfoils for your use in various designs should you decide to use one not included amongst those in the program's database.

X-Planes is Mac friendly and I suspect (not confirmed) that it originated on a Mac, though Windows versions are available. That being said, the actual user interface is non-standard. The normal Mac keyboard shortcuts don't apply, which took a bit of getting used to; installation and use are nevertheless straightforward. Like all rich programs, the learning curve kicks in due to the sheer amount of stuff the program can do, but I was up and running in basic mode in no time with the free demo. Like everything else, if you want to utilize the full potential of the software, you need to do some learning.

## **Plane Maker**

This is the aspect of the program I have had the most fun with so far. Flying wings,

*An impressive collection of tools and controls allow you to enter just about any aircraft shape you can think of into the program.*

conventional, 3-surface, even autogyros and helicopters can all be designed in this program; in fact, the CarterCopter has used X-Planes in its design process as well as a new flying wing design, the Atlantica ([www.wingco.com](http://www.wingco.com)). Position and incidence of flying surfaces, airfoils for all surfaces including the propeller, fuselage cross sections, landing gear geometry, propeller position, horsepower, centre of gravity, it's all there - even panel design.

The various components of the aircraft are listed in drop-down menus and dragging down to the chosen component (fuselage, wing 1,2,3 or 4, horizontal stabilizer, engine, weight and balance, etc) opens a window for editing that particular component.

As you enter the variables on the components, you see your aircraft taking shape in the main viewing window in either wireframe or 3-D modelled view. You can rotate the model in any direction to inspect your work, and once done, save the design with a name and description.

Of course, my own proclivity towards roadable aircraft just itched to try it out; I wanted to validate my own design ideas, and this seemed an inexpensive and educational way to do so. My concept needed a bit of tweaking (no surprise there), but not so much as to render the concept unusable.

You can modify any existing aircraft as well. It's tempting to put a PT-6 on a Cessna 172 and see what it would do...

#### World Maker

As I mentioned, this is where you can customize your environment. I've tried it and found it rather arbitrary. I must confess no experience with other sims and I bought the software for its engineering capabilities rather than something to fly in.

You open up a folder containing the latitude and longitude of a particular area; you can zoom in on it and adjust the ground cover, modify the shapes and elevation of the terrain, add built up areas, vegetation, and so on. It's rather tedious business and I suspect the majority of people won't bother, unless, like me, they want to tweak



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the area around their home airport or some port-of-call they are familiar with.

Major roads and terrain are already in place, but not super accurate. I had no problem on a cross country from Langley to Chilliwack, however, and the mountains, airports and Fraser River were about

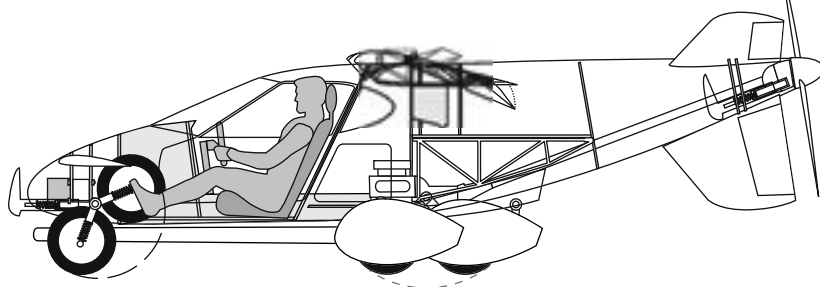
*Continued on page 8*

#### Always Learning...

*The analytical utility of X-Planes has caused me to modify my concept in several key areas. Flying the design in X-Plane, I've found the low-mounted canard with the front wheels perched on the ends not great as the canard would get airborne in ground effect before the main wings had enough lift to keep the aircraft balanced on its single rear wheel; I since have moved to a high canard and a more conventional (relatively speaking) tricycle gear. Another set of calculations independent of X-Planes, seems to indicate that with the wings stored in a low position, the vertical centre of gravity is low enough that the vehicle would not tip in a 1-G turn, so I'm going with that. I've been able to optimize the size of the surfaces involved, and play with airfoils (not done with that yet!) and experiment with different weight and balance situations. My very first try was quite tail heavy, and was, as would be expected, highly unstable in pitch. The corrected values entered were verified with a cardboard toss-glider.*

*I'm happy to report that at least in X-Planes, it seems to be a reasonably good flying aircraft. With only 80 feet of wing area, it's not the best glider in the world, but the slots and slotted flaps seem to get the aircraft off and back on the ground expeditiously. This is WAY fun.*

*With 160 hp, 80 square feet of wing and a gross weight of 1600 lb., the design indicates a top speed of about 180mph, a rate of climb of 2000 fpm, and a stall speed of around 65 mph with flaps and slats out. Seems about right...*



# CLASSIFIED ADVERTISEMENTS



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Ads that have been in for more than 6 months are subject to removal if space is required for other stuff. Please contact George the editor if you want it kept in.

For Sale: SIROCCO PROJECT

*Notice: The author of the following advertisement having returned to his right mind has come to realize that saying \$15,000 firm and etc. in the ad was a decidedly unbright thing to say. Therefore, being anxious to sell and unable to work on it himself, he is now willing to (Saints Preserve Us!) NEGOTIATE. Please read on - and call!*

Fuselage, canopy, tail group complete. Air frame control components done except for cable. Main-wheel gear, wheels and brakes done. Tail-spring and wheel included. Panel made, no instruments. Lycoming 0-290 GPU Zero-timed. Will Neubert stainless cross-over exhaust with stainless muffler/shrouds. Bendix PSC5 carb. Bendix mags with

non-shielded leads. no starter, starter ring or alternator. Weldtech engine mount. McCauley prop.

Wings: ribs and minor spars done. Spar diaphragms done. Two spar-grade spruce planks. No other wing parts.

Jim Hunter 576-2678

FOR SALE:

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E-mail: tmw@industriallaser.com

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Pat O'Donnell 533-1839

FOR SALE: Zenith 250 plans and parts, wing rib moulds \$360. Christavia Mk IV project, 4130 steel tube, wing ribs, flaps ailerons, gear legs, wheels and brakes, tail stab and rudder, \$3600.

Paul Trudel 532-8570

FOR SALE: Headsets -2 David Clark H10-30 \$125/\$100 Bendix starters for Lycoming -2@\$250 each.

Terry Elgood 604-279-2062

email: elgood@aebc.com

FOR SALE: Murphy type floats 1500's. \$9600 CDN. New, comp[lete with rudders.

Harold Schapansky (604) 826-5068

## **X-Plane** *Continued from page 6*

where they belonged. A jaunt from Friday Harbour to Victoria to Boundary Bay was likewise satisfactory.

### **X-Plane**

This is where it all comes together. The airplane you've designed, the terrain you've modified/enhanced/whatever, are displayed and used here.

Having a variety of common aircraft available for flying in the simulator is handy when you want to compare the characteristics of your budding design to a benchmark aircraft like a Cessna 172. This is important, because to anyone not used to flight simulator programs, the initial feel is awkward. Lacking the many peripheral and seat-of-the-pants clues that we receive flying a real aircraft (and especially if you are flying your sim with a mouse and no rudder pedals) the feel is a little unnatural. Not X-Plane's fault, just the nature of the beast: other sims would be no better. When you're not used to simulators you don't know whether your design is snaky or it's just your unfamiliarity with the program's feel; comparing it to a known quantity can be instructive.

One really neat thing is the ability to view the aircraft from the outside during flight and examine the lift and drag vectors, displayed by coloured lines coming off the flying surfaces in real time. This is helpful in determining if you have to adjust your angles of incidence,

*You can connect to the internet and set X-Planes to use the actual real-world weather presently occurring at the airport you select, or you can select your own weather conditions, failure modes for various parts of the aircraft.*

airfoils, and so on. You can play the flight back in replay, watch in chase mode, and a variety of other useful views.

At this time I don't have rudder pedals (there is such a thing for programs like this, I'm just cheap and broke). I found my aircraft displayed the characteristics I would expect without rudder input: adverse yaw in roll, which makes precise adjustment on short final somewhat of a chore. The initially high thrust line was faithfully reproduced in the test aircraft. I subsequently gave the tail-mounted prop an 8 degree cant which gave a better thrust couple, dropping the nose when the power was reduced, and pulling up when the throttle was advanced. In a similar fashion, yaw due to torque was also displayed, both when high settings were applied, and yawing in

the other direction as power was reduced.

You can connect to the internet and set X-Planes to use the real-time weather at the airport you select, or you can set your own weather conditions, as well as failure modes for various parts of the aircraft, and all sorts of other variables. One thing I have found (no surprise here) is that during the initial testing of a new design you should set the weather to the most benign values for gauging its basic flying characteristics before giving yourself more challenging weather, gusts, thermals and the like.

I planned a little cross country from Chilliwack to Pitt and onto YNJ to see how the nav aids worked. Tuning into the Bellingham VOR as I approached Pitt Meadows, I set the instrument to the 330 radial, and sure enough, the needle came alive, crossed over on final to Pitt. I did a touch and go, picked up the radial eastbound, and followed it south to final for 19 at Langley. Cool! Now I've got to learn how to use a GPS...

A functional demo with Southern California scenery can be downloaded from X-Plane's website (see below for the URL), but the controller is disabled after 6 minutes, and you have to restart if you want more flying time. You can buy the full version (\$99 USD), with Mars included in your program; you can fly there (if you really want to) with its 1/10 atmosphere and 1/3 gravity; I'm told crashes are rather long protracted affairs. Needless to say, it takes a very special aircraft to fly under such conditions, and several are included with the program. Earth-only runs a paltry \$80 in U.S. funds. They paid the shipping, but with exchange and duties, I was out about \$150 CDN. A bargain at that price! I bought my copy from X-Plane's website ([www.X-Plane.com](http://www.X-Plane.com)). I have since learned that a local company, Aero Training Products, Inc. ([www.aerotraining.com](http://www.aerotraining.com)) retails it for about \$130 in Canadian Funds, but with GST and PST, I suppose it would come out to the same. I think you can even

buy it on Amazon.

The program's creator, Austin Meyer, has done the aviation community a great service in creating this software. The ease that people can explore new concepts in ways that would have been impossible just a few years ago. A program like X-Planes seems just the ticket for a design wannabe such as myself.

Now, if I could just get that joystick...



**The Chapter's second aircraft carrier trailer is for sale. It's a gem! \$480 or best reasonable offer. It's at John Keon's place 16301 - 20 Ave., Surrey ph. 536-8589 or call Jim Hunter at 576-2678.**