

Glidepath



*The quarterly newsletter of the
Canadian Museum of Flight*

*Issue #119
Winter 2014*

The Tiger Moth Wing Inspection and Repair

by Vic Bentley

For any aircraft owner, each annual inspection is a nail-biting time. That goes double for operators of vintage aircraft, with all the challenges of out-dated design and construction techniques. This is the saga of recent repairs to the CMF Tiger Moth and, through the efforts and skills of numerous volunteers, its return to the air.

The Canadian Museum of Flight is one of the few museums that have flying aircraft in their collections. This brings special responsibilities for the care and maintenance of our vintage aircraft. As they are certified aircraft, the maintenance must be done to the same standards as modern aircraft. Our two replica aircraft – the SE5A and the P-51B – are in the homebuilt category, however, we choose to maintain them also to the certified standard.

Maintenance of the Museum aircraft is done by volunteers who often have 30 or 40 years of experience in this field. The work is overseen by Rick Church, a licensed Aircraft Maintenance Engineer (AME), who runs an aircraft maintenance business at Langley Airport.

During the annual inspection of the Tiger Moth, a suspicious area on the underside of the lower left wing was noticed. Why had this not been noticed before – or was it a new

problem that had just happened? Aircraft inspections are not done in a laboratory by inspectors in white coats hunched over microscopes. In the real world aircraft maintenance is done looking through inspection panels with a bright light and a mirror – peering, twisting, turning, stretching, often while balanced on one foot to get the best view.



Cyril Meadows watches as Rick Church carefully starts the fabric removal.

In the case of the Tiger Moth, the problem area was the inboard end of the lower left wing rear spar. This area is close to the fuselage where there can be oil and grime and exhaust residue, as well as layers of paint that prevent moisture ingress into the wooden structure. The inspector must clean and inspect each area while lying on a mechanic's crawler moving along a few inches at a time.

Every square inch of the structure, especially the fragile fabric covering, must be examined. Did a tire throw

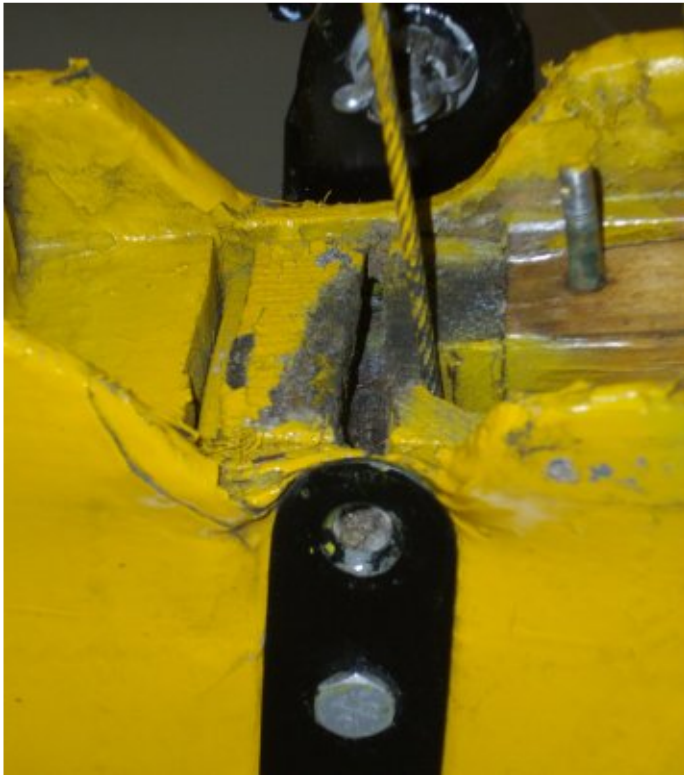
continued on Page 2

***Please visit our website www.canadianflight.org for more news and updates on events.
Follow us on the Museum facebook page and twitter.***

The Tiger Moth Repair *continued from Page 1*

up a rock that damaged the fabric? Did a bumpy landing bend one of the landing gear supports? Did mud wasps build a nest in a secluded corner? Did a blocked drain hole in the fabric cause a water build-up that rotted the fabric?

During this process, our inspector noticed an area where the paint appeared disturbed. When he did more investigating, it appeared that there was some soft wood under the paint. This caused the inspector to go on red alert! The wood was the butt end of the rear wing spar – a vital structural member. This area appeared to be soft and deteriorated. What could this mean? Perhaps the wing would have to be removed, the wing spar repaired or replaced, the wing rebuilt, the fabric covering replaced and the wing re-fitted – a huge undertaking.



Only an experienced eye would spot the problem, here revealed when paint and fairings had been removed.

Research was started on the details of the structure. The Museum's aircraft was built by de Havilland in Toronto in 1941. However, the Tiger Moth was an ab initio trainer and trainers, biplanes in particular, had rough lives with the lower wings being replaced on a regular basis after a 'ground contact' entry in the logbook. In addition, the Museum's aircraft was built up from spares in the 1980s, so there were some unknowns as to the origins of the wing components. To make matters even more complex, this (like most other Canadian-registered Tiger Moths) was a DH82C and different in some details to the original DH82A built in England.

Fortunately, the factory drawings were still available and these showed a mark at the end of the wing spar that was under scrutiny. Others in the small circle of Moth owners were contacted including one of the Museum members who owns a Tiger Moth. The wing of his Moth under rebuild was examined and this clearly showed a slot at the end of the wing spar – possibly a locating point in manufacture when the solid spruce spar was being routed and shaped to reduce weight.

So now we knew what we were looking at – a small area of filler in the spar butt that was not of structural significance. But did the area of distress extend further? Were there other components that were affected by dry rot or age? Coincident with this problem was an adjacent area that was scheduled for attention. This area, the walkway on top of the lower wing, was known to emit squeaks when boarding passengers – a squeaky wood floor in an antique barn is cute, but not so in an antique aircraft!



An original wing spar as made by de Havilland.

The decision was made to remove the wing, open the fabric on the underside and do a complete inspection of the area. So, just remove a couple of bolts and slip the wing off? Not so fast! This is a 1920s design. Being a biplane, the Moth has four wings – two upper and two lower. The upper wings are held in place by 'cabane struts' at the fuselage, and each pair of left and right wings are kept apart by 'interplane struts' at mid span. But the designers had to make this box structure of struts strong in the diagonal direction as well. So they strung wire from the lower corners to the upper corners of the box – lower inboard to upper outboard and upper inboard to lower outboard.

This birdcage of wires may seem like a random arrangement to the casual observer, but every apprentice mechanic and cadet pilot of that age soon learned about 'landing wires' and 'flying wires.' When the aircraft is landing the forces try to make the wingtips touch the ground (and are sometimes successful!). The wires that take these loads are known as the 'landing wires.' Similarly, in flight the lift generated by the wings tends to make the left and right wingtips lift until they touch each other over the top of the fuselage – this effect is resisted by the 'flying wires.'

Removing the left lower wing would destroy the structural integrity of the box of struts and wires on the left side. To prevent damage, a wooden support structure was placed under the left upper wing. Then the struts and bracing wires were identified with tags, the tension released and the bolts that attached the wing to the fuselage were removed. The wing was taken to the workshop for detailed inspection.

Inspection of the interior of the wing showed damage to some wooden ribs, and a glue joint that had failed allowing the structure to flex when walked on, hence the squeaks. To reinforce the area, wooden blocks were shaped to fit against the spar so that the wing ribs could be attached firmly to the spar. Additional support was provided by fitting plywood support plates on both sides of the ribs. The whole area was coated with epoxy for moisture control. Then the fabric covering was replaced using a baseball stitch to secure it to the existing fabric, the fabric was sewn to the ribs, and reinforcing tape applied. The last step was to spray on the special finishing coats, the final coat being the familiar RCAF yellow colour.

This type of repair takes considerable talent by experts and volunteers to ensure the job is completed in accordance with maintenance standards, and is

continued on Page 3

The Tiger Moth Repair *continued from Page 2*

approved by airworthiness authorities. The de Havilland repair manuals together with the 'bible' for this work, FAA publication AC 43.13, go into great detail for wood and fabric repairs for this class of aircraft.



Peter Roberts and Cyril Meadows add stiffness and support to the ribs in the wingwalk area.



Work in progress on the repair of the wing structure.

Now that the wing was repaired, it was time to mount it on the aircraft once again. All the needed hardware and tools were assembled and the wing brought from the workshop – surprisingly light for its size. It was carefully threaded through the temporary upper wing support structure and the wing root bolts put in place. Then the interplane struts and the landing and flying wires were attached.

Ready to fly now – right? Wrong! Now the WW1 technique of rigging had to take place. (Aircraft mechanics that worked on structures were known as 'riggers' from the earliest days of flight). All aircraft, up to the latest products from Bombardier or Boeing, have the wing attached to the fuselage at a specific angle so that the wing meets the oncoming air at the optimum angle. Too much or too little angle will result in not enough lift being generated to fly as desired. As well, the dihedral angle needs to be set – the angle from the fuselage to the wingtip.

For this important step, we consulted with engineers who have been looking after Tiger Moths for decades. The 1940s instruction manual has the important data, but is lacking in some details, as at that time everyone simply knew how to rig a biplane. Special rigging boards were made by Museum volunteers according to factory specifications. These boards were then clamped to the wing spars to give accurate readings of the specified angles.

The tail of the Moth was raised to the 'flying attitude' as measured by the steel cockpit structure being level laterally and longitudinally. To do this, spirit levels were clamped across and along the structure and monitored frequently during the rigging process.

Then the fun began. Previous experience as a piano tuner may be an asset in this process! The diagonal wires between the wings have to be tightened, or loosened, to set the wing at the correct angle of attack as well as getting the dihedral at the correct values; 4 degrees angle of attack and 4 ½ degrees dihedral.

Tightening one set would throw the others out, so a series of tightening and slacking adjustments were made until all values were correct.



An inclinometer is used on the rigging board to get the correct angles.

These flying wires act as turnbuckles, familiar to sailboat enthusiasts. One end of each wire has a left-hand thread, while the other end has a right-hand thread. When the wires are rotated one way the tension is increased; with opposite rotation the tension is reduced. These wires are not just steel cable from Canadian Tire, of course, but are solid steel rods with a streamlined cross section made specifically for aircraft. Because of the geometry of the wing, they are made to specific lengths with a threaded fork end that is attached to the structure by a stout pin. To prevent any possibility of the wire coming loose in flight, each threaded end also has a jam nut that is tightened against the fork end to lock it in place. The final act is to put in place the airflow 'bullet' – an aluminum and wood streamline fairing that connects the four wires at mid-point to reduce the inflight vibration from airflow and engine.



Twisting and turning – the tension on the wires is adjusted by Bill Orbeck, with Ray Fessenden assisting.

A final inspection by our AME was accomplished followed by the vital logbook entry and signoff. Now we finally had a serviceable flyer. The test flight proved to be an anti-climax to the long repair process. The aircraft flew perfectly, as if unaware of the extensive surgery performed on the wing – a tribute to the skill of the wood and fabric surgeons.

Gord Wintrup

Talks about our Museum's future

Interviewed by Terry Brunner

Gord, please tell us a little bit about yourself.

I am President of Bayfield Mortgage Professionals. I'm a mortgage broker. I administer some private investment funds on behalf of others. And I've been doing this since 1972.

How did you become associated with the Canadian Museum of Flight?

After a successful run with the Langley Car Show, The Langley Good Times Cruise In, I was approached by the then executive and director and one of the newspapers to see if I could assist at the Museum with a business plan and whatnot, and that was, gosh, more than 10, 11, 12 years ago now.

You are the Chair of the CMF Building Committee. Can you tell us a little bit about what you envision for the new facility?

Many museums across the country, and this one is no exception, in their minds what is envisioned is a rather large museum that can encompass anything and everything that they have and hope to have in the next 50 years. That is really not a practical reality. What I envision is a planned, sustainable facility. It will be a concrete tilt-up building, for safety. Outfitted with sprinklers of course for fire safety, and built in stages.

The first stage would be a main floor area of 15,000 sq. ft. with a mezzanine area of about 7500 sq. ft. The second phase would duplicate the first stage, so we would end up with about 30,000 sq. ft. on the floor and 15,000 sq. ft. as mezzanine space. Also, a lot of the things you see in the existing museum, such as offices, meeting room, lunch room, etc. will be up in the mezzanine area. The Gift Shop would be on the main floor, the rest would be exhibits, artifacts, airplanes, etc.

Explain where we are today in regards to this building project. For example, do we have a site?

We have a site. It is to the west of the existing airport, west of the north/south runway. The Township of Langley has said we may have that site on a potential 30 year lease. The engineers have been out and surveyed the site to see what can be built and how large, parking services, etc.

That is now at the Township of Langley Planning Department; they are going over the engineering report as we speak.

Are we actually at the planning stage? Do we have an architect? Are we taking bids from contractors, etc?

I have had two or three contractors approach me when they learned of our plans to build a new facility. We have not asked for actual bids to date. We are waiting for, hopefully in the next two weeks, some final site drawings from the Township which we can then give to an architect and say here is what we envision, design it and draw it for us.

Do you have a timeline in mind?

Yes. It will be three years.

Can you tell us about where the funding is coming from?

Funding will come from various areas. One of those areas will be our membership. One of our members has graciously stepped up and given us a large donation, already, to assist in

the planning stages, plans, drawings, etc.

Another source of funding will come from the sale of our existing building. We are on leased land, but we own the structure and the infrastructure around it. So with that being said, we feel we are going to get or have anywhere from \$250,000 to \$500,000. So I think it would be realistic to say from \$300,000 to \$350,000 from the existing site.

The Air Cadets -746 Squadron - have pledged, and have in the bank ready for us to start building, \$50,000. And they have also pledged to become a junior partner and therefore a tenant in the building, which will increase the monthly revenue to then help keep our operation sustainable.



Gord Wintrup, Canadian Museum of Flight Past President, resident visionary, and Building Committee Chair.

Where do you see the Canadian Museum of Flight in the next five years?

I see the Canadian Museum of Flight, obviously, in the new facility, working on the second phase of the facility and following a new business plan that will be unveiled with the new facility so that this museum not only in the next five years, but also in the next twenty-five years, will be here, alive, well, growing and prospering.

Thank you for your time, Gord. We are looking forward to seeing the new building.

Canadian Museum of Flight - 2014 Annual General Meeting

Please be advised the Canadian Museum of Flight 2014 Annual General Meeting will be held:

Date: Saturday, April 26, 2014

Time: 7:00 p.m.

Location: Canadian Museum of Flight Hangar

Please join us for this meeting, to help us achieve a quorum, and to help the CMF transact the tasks required by our Bylaws under the Societies Act, including review and acceptance of financial statements and election of Directors. Note the Bylaws require members be in good standing for 30 days prior to the meeting to be eligible to vote.

Four vacant Director positions will be filled at the AGM. As of March 26, five individuals have agreed to let their names stand for Director positions for the next two years. Our thanks go to each of those folks. Their photos and (highly condensed) biographies are provided below for your consideration. Additional candidates may come forward between now and the meeting, or at the AGM itself.



Vic Bentley

Vic has extensive work experience in aviation starting with an apprenticeship in aircraft maintenance and concluding as a Captain on overseas flights. After time as a Flight Engineer, Vic joined Pacific Western Airlines in Edmonton in maintenance, changing to a co-pilot position later. He progressed through piston and turboprop aircraft to jets. He spent much of his career as an accident investigator for the pilots' association. Vic enjoyed his career in aviation and is now a volunteer at the Museum, assisting with both maintenance and flight operations and with input to the Museum newsletter and website. He currently is Secretary on the Board of Directors of the Museum. His technical and operational experience will be an asset to the Museum's Board of Directors.



Mark Capadouca

Mark has 30 years of experience in the fields of engineering and welding. He has built several buildings over the years, including his 14,500 sq. ft. hangar at Langley Airport that houses his two family businesses, AC Airways and MC Welding. Mark has also been active with the 746 Air Cadet Squadron in the past, and volunteered his expertise in welding for repairs to the exhaust systems on both our Harvard and Waco INF. If elected, Mark will look forward to assisting the museum in building a new facility at the Langley Airport.



Mike Luedey

Now 38 years old, Mike moved to BC from Ontario 8 years ago and is now living in Murrayville. Mike's passion for aviation brought him to the Langley Airport where he first discovered the Museum. Mike is a full-time software developer/systems analyst, and has been in the IT field for a number of years, now working for Pacific Blue Cross in Burnaby. He is also an avid aviation photographer appearing in a variety of publications across North America. Mike has been a member of the Museum's Board of Directors for the last two years. In that time, he has taken on various projects including website upgrades, email system conversion, development of a complete social media/online presence and the new Aircraft Sponsorship Program. He also represented CMF last year at the Smithsonian National Air & Space Museum's "Mutual Concerns" conference.



Matt MacCallum

Matt grew up in White Rock and has spent most of his life in the Fraser Valley. He obtained a BBA Marketing and Economics from Bishops University, Quebec, as well as an LLB from the University of Victoria, Wellington, New Zealand. He was called to the New Zealand Bar in 2011 and worked for two years as a solicitor with a large commercial firm. Matt returned to Canada to join the family firm, MacCallum Law Group, a company that has been supportive of the CMF for the past decade. He now lives in Fort Langley with his fiancée Sophie and their black Labrador Axel. He would welcome the challenge of assisting in the creation of a new hangar at the Langley Airport.



Matt Offer

Matt is a past President and a past Secretary of the Canadian Museum of Flight (CMF). He served in the Royal Canadian Navy and RCAF (R), and is now retired living in Langley, BC. His hobbies include studying the history of Canada, military affairs, and aviation. He currently works as a CMF tour guide and works on the CMF inventory. He is Vice-Chairperson of the Ladybug Society, and is the CMF Liaison with the 746 Lightning Hawk Air Cadets Squadron. Matt believes in the future of the Canadian Museum of Flight, and that team work is essential to bring our new CMF hangar to fruition. "Let us work together to make this dream come true."

"Help Raise the Roof" Dinner and Auction

On March 15, the Canadian Museum of Flight held its 2014 "Help Raise the Roof" Dinner and Auction fundraising event. Photos of the event were kindly provided by Mike Luedey.

The Canadian Museum of Flight extends its sincere appreciation to its sponsors for the 2014 Dinner and Auction:

- AC Airways
- Air North/Princess Westmark Hotels
- Bayfield Mortgage Professionals
- Central Mountain Air
- Hawkair
- Helijet
- IMAX Victoria/Royal BC Museum
- Key Largo Jewelry
- Pacific Coastal Airlines
- Street Capital Financial Corporation
- Shearwater Resort
- TD Canada Trust
- Twin-Anchors Houseboats

The 2014 Dinner and Auction was a huge success, thanks to the support of these sponsors, the facility provided by MC Welding, and the hard work of Museum staff and volunteers. Funds raised at this event will be crucial to 2014 Museum operations, and will make a significant contribution to the Museum Building Fund.



The CMF Board thanks all those who attended this event, and all those who support our organization, in so many ways.



Scenes from the 2014 Dinner and Auction, clockwise from top left: Shopping the auction catalogue; Museum G.M. Terry Brunner and wife Doreen; great food for all; anticipating the contents of mystery boxes; Air Cadet honour guard with the Museum Tiger Moth on display.



Canadian Museum of Flight Aircraft Sponsorship Program

Museum Members now have the opportunity to sponsor their favourite flying aircraft in the CMF fleet. This is a great way to make a valuable contribution to bringing BC's aviation past into the future, assisting the Museum with keeping these wonderful examples of flying history in the air where they belong.

Upcoming 2014 Sponsor Fly Days:

April 19
May 17
June 28
July 12
August 2

To become an Aircraft Sponsor, or to get more information on how you can become a Sponsor, please contact the Museum at (604) 532-0035, or visit <http://canadianflight.org/content/aircraft-sponsorship>

Canadian Museum of Flight Upcoming Events for 2014

April 26	Canadian Museum of Flight Annual General Meeting
May/June TBA	Tech Talk: Fleet Finch
June 21	CMF Hangar Dance
July 5	Hope Flight Fest
July 19	Boundary Bay Airshow
July 20	North Fraser Airshow, Pitt Meadows
Aug. 8/9/10	Abbotsford Airshow
August 17	Chilliwack Airshow
September 20	CMF Members' Day
September 22	Battle of Britain Day

Pilot's Prayer

"Oh Lord, when I pass, please don't let my spouse sell the airplane for what I said I paid for it!"

For more information on Canadian Museum of Flight collections and events, please visit our website at www.canadianflight.org and the Museum Facebook page "[Canadian Museum of Flight](#)".

**Please consider supporting our work.
Join us as a Member, volunteer, or make a financial contribution.**

Yes, I want to support the Canadian Museum of Flight!



MY CONTACT INFORMATION:

Name: _____
Address: _____
City: _____
Province: _____
Postal Code: _____
Telephone: _____
email: _____

OPTION 1: A ONE-TIME GIFT

Donation amount: \$ _____
by Cheque Credit Card
Credit card issuer (e.g. VISA) _____
Credit card #: _____
Credit card expiry date: _____
Signature: _____
Date: _____

OPTION 2: A MONTHLY CONTRIBUTION

I would like to donate \$ _____ once a month

- for _____ months, or
 until I tell you to stop
 I would like to make these monthly donations by credit card:
Credit card issuer (e.g. VISA) _____
Credit card #: _____
Credit card expiry date: _____
Signature: _____

- I authorize the Canadian Museum of Flight to withdraw these monthly donations from my bank ("voided" cheque is attached).
Signature: _____

I understand I can cancel my monthly contributions at any time by contacting the Museum at 604-532-0035.

The Canadian Museum of Flight

Bringing British Columbia's Aviation Past into the Future

Board of Directors

Bruce Bakker	President
Bruce Friesen	Vice President
Inder Matharu	Treasurer
Vic Bentley	Secretary
Mike Luedey	Director
Dave Arnold	Director
Chris Ryan	Director
Gord Wintrup	Director
Bill Thompson	Lifetime Director



Museum Staff

Terry Brunner
Douglas Tait
Jocelyn Statia

Museum Coordinates

Telephone 604-532-0035
Fax 604-532-0056
e-mail tbrunner@telus.net
Website www.canadianflight.org
Facebook Canadian Museum of Flight
Address Hangar #3
5333 - 216th Street
Langley, BC V2Y 2N3

Museum Hours

Open daily from 10:00 a.m. to 4:00 p.m.

Membership Benefits!

- **Partnerships!** Members are entitled to visit, free of charge:
 - Flight Museum in Seattle*
 - West Coast Rail Museum in Squamish*
 - Military Education Centre in Chilliwack*
- **Discounts in the Gift Shop increased from 10% to 15%**

Volunteers Welcome!

The Canadian Museum of Flight is always looking for new volunteers. We are always in need of history and aviation enthusiasts of all kinds, for aircraft restoration, gift shop operations, facility maintenance, and many other tasks. No experience is necessary. We invite everyone, from young students to retirees, to join the team. If interested, please contact the Museum General Manager, Terry Brunner, at 604-532-0035.

The Runway Café

The Museum of Flight is pleased to welcome to its facility The Runway Café, now open for business and serving customers in the north-west corner of the Museum building, affording diners a great view of airport operations.

Key elements of the new operation, designed to attract airport "traffic", include: all day breakfast; call-ahead for take-out or for food ready to serve when the customer arrives; and a promise of good pie. We wish them good luck with their new venture!

The Runway Café has created "Brunch in the Hangar", a by-donation opportunity for good food and good company, held each third Sunday of the month, in the Museum hangar. Proceeds from these brunches flow directly to the Museum Radio Fund. We encourage everyone to come out for brunch, support the Café, and support the Museum's efforts to acquire modern radio equipment for the safe operation of its vintage aircraft.

Cover Photo

A lovely study, by Vic Bentley, of the Canadian Museum of Flight Tiger Moth, on the morning of its post-repair return to the air.

The Glidepath Newsletter is published quarterly by the Canadian Museum of Flight; Editor Bruce Friesen. Contributions in the form of articles, news items, letters and photos are always welcome, as are comments and suggestions, although no payments are made for manuscripts submitted for publication in the Newsletter.