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[Development of an Alternate Front End](#)

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[Development of an Alternate Front End](#)

by [XBCoupeJota](#) » Sat Jun 16, 2012 11:53 am

During the off season we've been working on some new projects and one has now progressed to a full modelled version of an alternate front-end, care of John Bennett and Andrew Howley at Deniliquin Machinery. John is also working on resurrecting the DPA Laverda sidecar he built in 1974.

We've created a section on Old School Engineering to discuss technology from days gone by and engineering principles that have either been forgotten, misplaced, passed over or simply hadn't made the jump to commercial acceptance and died as a result. We want to ensure Old School Knowledge isn't lost.

One of the areas we have continued to look at is Front-end technology or the fact that developments in this area have been limited to new materials, coatings, valving technology but no change in decades to the fundamental engineering problems associated with Telescopic forks.

Our present model is stage 1 of a front end that can be fitted to any current machine using standard triple clamps, it presently has independently tunable settings for Rake, Trail, Velocity Ratio and Ride Height. We're also going to trial some alternate spring and damping options and all will be based on old school engineering principles and designs.

More to come with pictures of our progress to date...



[XBCoupeJota](#)

Site Admin

Posts: 525

Joined: Fri Sep 17, 2010 5:41 pm

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Re: Development of an Alternate Front End

by [XBCoupeJota](#) » Tue Jun 19, 2012 12:44 pm

Our initial approach for the front end was to build something that could be fitted into a standard triple clamp setup on an existing bike. Design wise we wanted to investigate leading link solutions, which Row and Thorpe investigated in there article posted in the Old School Engineering board <http://www.ozlaverda.com/suck-it-and-see-makes-way-for-science-t194.html>

Also, John was keen to revisit his experience in the 70's building Earls Forks for sidecars and solo's, such as Dennis Skinner's unbeatable Barlow Chasis (Earles Fork) Honda sidecar outfit (prior to the DPA Laverda sidecar).



First source the tubes and find someone like Carrington Products who can bend them correctly
sml_IMG_1611.jpg (59.25 KiB) Viewed 16035 times

So, it was agreed that Stage 1 of development would be an Earls Fork leading link, utilising existing triple clamps.



Initial planning

Our Egli framed Laverda is the test bed for this exercise as the combination of the Earls Fork and Egli frame seemed to fit well into our desire to re-visit engineering excellence from the past.



Assembly of parts

IMG_1627.JPG (31.9 KiB) Viewed 16035 times

All components parts are being designed in a way that allows maximum individual adjustment of steering and suspension dynamics. This will provide easy adjustment and hopefully enable us to find and document optimal setup combinations.



Adjustment capability is a critical design guideline
IMG_1626.JPG (24.17 KiB) Viewed 16035 times

more to come...



[XBCoupeJota](#)

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Re: Development of an Alternate Front End

by [XBCoupeJota](#) » Sat Jun 23, 2012 10:05 am

The modelling exercise allows us to build a full size version of the final product and test different pivots, axle mounting, brake mounting and adjustment options.



A cutting wheel comes in handy

A decision was taken to use cheap exhaust pipe to create our first full size model. This allowed us to test a number of options and not worry about wasting in good chrome molly.



Brazing on the axle bobbins

Another dying art in frame building is brazing, which significantly reduces heat stress on the metal and avoids weak points where welds finish.



The digital mill is invaluable tool when accuracy is critical

The mill came into it's own when finishing off mating surfaces to a thou was required. However, sometimes the good old lathe came into it's own particularly when accurate bearing bores were required, I haven't done much work with a four jaw chuck so seeing it in operation to create our pivot bearing housings was very rewarding.



4 jaw chuck operating
sml_IMG_1614.jpg (49.74 KiB) Viewed 15909 times

The first attempt to see what it would look like on the bike, zippy tied up at this stage but gives an idea of how it fits in with the overall Egli frame layout.



Egli frame Laverda with Earls Fork front-end

This version shows the initial model using the cheap pipe and does not have the curved pipe around the back of the wheel for the leading link as shown in the earlier post with the chrome molly pipe. The model has progressed further with all pivot points now finished and the shocks correctly mounted.

More to come...



[XBCoupeJota](#)

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[Re: Development of an Alternate Front End](#)

by [XBCoupeJota](#) » Sun Jul 22, 2012 12:56 pm

We've had a flurry of progress on the new front end with a visit to Deniliquin Machinery last week it was time to move from our initial model to Mk1 of the front end. Along with working on the new front-end there was much for me to come up to speed with on chassis and suspension geometry. John was doing his best to teach me about how vectored forces worked and explained how the instantaneous center of the motorcycle interacts with the center of gravity.



Initial model for the leading link pivot points may be replaced by another option



Front axle mounts ready to be welded on to the leading link

I think I finally got it and understood the geometry that John was introducing to the new front end and how flawed Telescopic design is. The key goal is to address braking forces and moving to a solution that could deal with anti dive based on geometry rather than altering suspension capabilities, like stiffening up compression damping.



The setout table and jig frame that will be used for all development, fabrication and testing forces

The objective is to ensure the braking forces can be managed independently while ensuring suspension movement is not adversely affected. To undertake this exercise it's vital to have an accurate jig arrangement and to develop the tools to repeat any fabrication, setup and adjustments required.



The setout table and jig with our bike ready for more development

The setout table is a solid cast iron table with over 100 precision drilled and tapped 10mm threads allowing accurate placement of a multitude of jig structures.



John tacking the pivot saddles to the chrome moly down tubes

There was much discussion on the impact of our geometry on the front end and what we wanted to be able to dial in. We agreed on a range of 4.1 Inches of travel, an independently tune-able range of trail from 110mm to 50mm, rake adjustment from 26 degrees to 22 degrees, adjustable velocity ratio (1:1 - 0.7:1) and adjustable anti-dive geometry as a starting point.



Back to Laverda's agricultural roots

Working amongst massive tractors and combine harvesters, makes us feel like we are really getting back to where Laverda began and

fits in perfectly with our approach to reviving "old school engineering".



New front end is coming together

The Egli seems to suit the new front end look and the compliance of the new suspension setup feels excellent. Understanding what rebound damping is all about is a revelation with this type of setup.



Closeup of the new front end

Our brake mounting mechanism is still not fitted and will be a critical component of our approach to revisiting Earls Forks capabilities.



Egli Laverda with Earls Forks

All up the bike stance looks pretty tough, however the proof will be in the pudding when we start testing the braking forces on our new setup. Our intention is to test our race bike setup with telescopic forks and a couple of modern machines to compare the results, only then will we look at advancing to a running bike for testing.

Cheers Crispin



[XBCoupeJota](#)

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Posts: 525

Joined: Fri Sep 17, 2010 5:41 pm

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[Re: Development of an Alternate Front End](#)

by [laverdaian](#) » Mon Jul 23, 2012 1:35 am

Go you maverick you.. looks a bit wierd Crispin, but if it works...! Is the wheelbase length longer than standard..?Maybe it's just the angle but it seems so to me..

Good luck with it mate, lots of time and effort in there.

Ian



[laverdaian](#)

Posts: 325

Joined: Fri Sep 24, 2010 3:32 am

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[Re: Development of an Alternate Front End](#)

by [beamer12](#) » Mon Jul 23, 2012 6:35 am

Ditto on looking a bit odd. I think most of the anti dive arrangement's are long abandoned these day's, and the dive under brake's is used to quicken steering into turn's . Will this arrangement stop suspension "freeze" with the bike layed right over? That seem's to be the most prominent issue with bikes at the moment.

Bye for now Beamer12

P.S. i spot the sidecar in the background of some shot's , whats happening on that front.

[beamer12](#)

Posts: 10

Joined: Wed Dec 21, 2011 10:26 am

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[Re: Development of an Alternate Front End](#)

by [Vince](#) » Mon Jul 23, 2012 7:24 am

Great mad scientist stuff,lots of patter talk in racing these days.Separating suspension action from braking forces is a great concept.That was the biggest gain with all those other funny front ends.Having the suspension still work while the brakes are on.They had trouble with missing the feeling of fork dive,where is the limit of adhesion when its so stable.Going to be interesting with all that adjustment available.

[Vince](#)

Posts: 19

Joined: Tue Sep 21, 2010 7:39 am

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[Re: Development of an Alternate Front End](#)

by [XBCoupeJota](#) » Tue Jul 24, 2012 8:34 am

Thanks for the great encouragement, I'm sure the comments provided are representative of the broader guest community that checks out this site regularly.

Where to start in responding, I guess the look, which Ian and Beamer12 have commented on, as weird or odd. 40 years of industry domination of the Telescopic Forks sinks in and anything different is sure enough just plain weird. We've chosen Earls Fork leading link which for over 20 years was the main front end technology on BMW's and many other models including the standard on sidecar. Back in the 50's and 60's it would have looked, well, probably normal, we've attempted to make sure this iteration of the leading link doesn't look too weird (there are some really awkward looking versions out there).



DKW Earles Fork



Suzuki Wasp Earles Fork

Using standard triple clamps was part of the brief and ensuring the angles of the downtubes and the springs on the leading link didn't create too many competing angles to confuse the eye. Once it's completed and painted it will look different again, also we have a springless version on the drawing board, which will again change the style significantly!

It's worth addressing all the points Beamer12 made as I reckon they are pretty much representative of the greater motorcycle community.

I think most of the anti dive arrangement's are long abandoned these day's, and the dive under brake's is used to quicken steering into turn's . Will this arrangement stop suspension "freeze" with the bike layed right over?

First Anti Dive or managing dive through geometry is an inherent part of good engineering design for three and four wheel vehicles and was also very much a part of design of non telescopic front end capabilities on motorcycles. Telescopic fork manufacturers tried to address Anti Dive using many options in the 80's which primarily revolved around increasing compression damping as a result of braking. This created more problems as it basically bound up the suspension under braking resulting in a very unstable machine which suffered from considerable chatter and instability.

Blair might like to comment on his first hand experience with these experiments on Telescopic anti dive in the 1980's when riding for the Steve Roberts F1 team in NZ.

Telescopic forks actually deliver an accelerated pro-dive geometry under braking, trying to dampen this dive movement via the

suspension only prevents the suspension from working effectively when it is most needed. There is nothing new in this information it's "old school engineering" that is being forgotten. However, the experts in the field understand it very well. If you want to get a reasonably complete view of the concept then read the summary article from chassis and suspension expert Tony Foale

<http://www.tonyfoale.com/Articles/Dive/DIVE.htm>

Dive under braking used to quicken up turn,s is relevant if you need to run extended trail and rake as a result of inherent instability of the front end. The DPA Laverda sidecar runs about 25mm of trail and it is inherently stable a Norton WASP sidecar with an Earles fork runs about 30mm of trail. They don't need the front end to dive and shorten trail in order to steer quickly. But this is an area that many riders comment on as that's how they've learnt to ride and what they feel comfortable with. We'll build in adjustable dive so we can allow a certain amount under braking, but it will not continue to dive as g-force increases on the front brake. Eventually the rider may learn to ride with less and less dive dialed in. This will be a major part of our challenge 😊

Suspension Freeze is exactly what we are looking at addressing and we have some more ideas on that front we haven't discussed yet. Effectively separating braking forces from suspension means we can ensure suspension can continue to do what it is designed to do "keep the wheels on the ground". Our test Jig will be used to apply 1G of braking force on the front axle and test that as braking force is increased that suspension movement is not degraded (stiffened beyond a useful level) and remains compliant and responsive.

Vince I liked the mad scientist comment 😊 the patter issue in Moto GP is something we want to discuss. We will be posting a video soon of the twin crash events of Nicky Hayden and Valentino Rossi at Silerstone qualification sessions where they both crashed out spectacularly approaching the same corner under hard braking, it should open up discussion on this point further.

Hopefully the limit of adhesion will be more predictable, and less harsh than the high side action we often see today when the front end damper can't control the snap reaction event.

Cheers Crispin



[XBCoupeJota](#)

Site Admin

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Joined: Fri Sep 17, 2010 5:41 pm

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Re: Development of an Alternate Front End

by [laverdaian](#) » Tue Jul 24, 2012 10:35 am

That's cool Crispin, lots of thought there and we all await the practical results. Still curious though as to wheelbase length, and also weight of the Earls as opposed to Telescopic front end. I understand that in concept these are irrelevant, but as an observer, it would still be of interest as to how the chassis may be different..

Good luck with it mate.. me, I'm still trying to get a tiny little 500 going...

Ciao
Ian



[laverdaian](#)

Posts: 325

Joined: Fri Sep 24, 2010 3:32 am

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[Re: Development of an Alternate Front End](#)

by [XBCoupeJota](#) » Wed Jul 25, 2012 1:00 am

Hi Ian,

the wheelbase hasn't changed significantly, we have reduced the trail from 110mm to 75mm for the initial setting which effectively pushes the axle further forward however we can alter the trail independently from the rake and we have made the rake around 23 degrees (previously 26 degrees). Net net the overall wheelbase is slightly shorter. The Egli is a very long and low bike, not ideal for racing (clearance issues) as it's hard to get the engine higher in the frame due to the frame configuration with the large tubular spar over the top of the cam cover. The Spaceframe is far more compact and doesn't have issues with clearance of the engine, our initial front end is being modelled to go onto the Spaceframe 😊

Re the weight, I have no idea at the moment and i've been banned from considering it at this stage as John is adamant we need to build something that won't break, will provide more rigidity, be able to handle massive braking forces and fix many of the Telescopic issues before we focus on "adding lightness".

The practical results are what it's all about and I guess at this stage it's still theory, based on ideas from the past, some accepted better engineering approaches and John's previous experience building earls forks and chassis'. The practical implementation is what counts and it will surely take us a few iterations to sort out. I know Blair is pretty excited to jump on board to test it out, but we will be testing on the jig first to ensure we can benchmark it's reaction to brake forces, lean angle etc with our existing setup and other more modern machine setups.

Beamer12 I forgot to mention about the sidecar in the background of some of the shots. It's basically waiting it's turn to be breathed on by JB. So far the rear swinger has been converted back to the right hand drive Laverda chain arrangement, previous crash damage has been assessed which will require a new front swinger and JB is keen to complete some of the ideas he and Dennis had to streamline the rear of the rig.

Cheers Crispin



[XBCoupeJota](#)
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Posts: 525

Joined: Fri Sep 17, 2010 5:41 pm

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