

# The poor man's Ljungström rig

(.. or how a simplified Ljungström rig can be a good alternative on a small boat..)

..by Arne Kverneland...

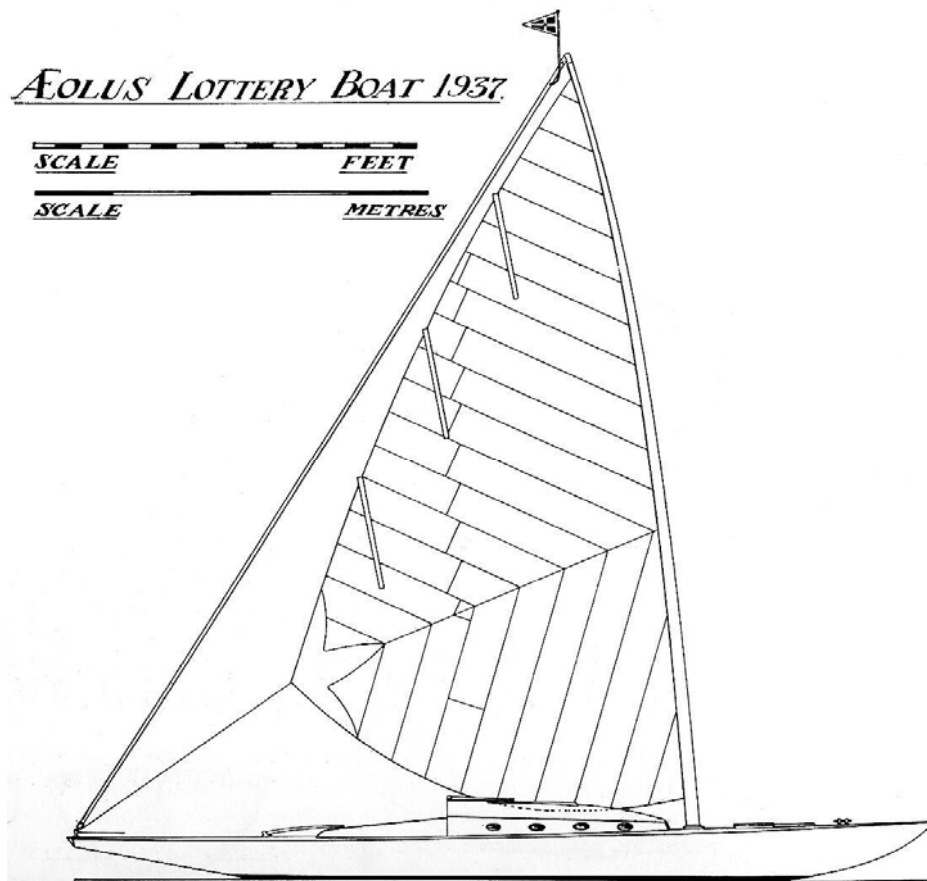
ver. 20110722

## Fredrik Ljungström:

Once upon a time there lived an extraordinary man in Sweden, named Fredrik Ljungström (1875 – 1964). Like his father and brothers he turned out to be an inventor, even greater than the others. Among his over 200 patents (some shared with others) the most lucrative were probably efficient steam turbines to drive electric generators and locomotives (1920) and even more important, the rotating heat regenerator which cut the coal consumption on the steam engines with over 30% (around 1930). Going through the list of patents, it is clear that he must have been a real multi-genius (.. for more info, just google Fredrik Ljungström...).

## The Ljungström rig – the original:

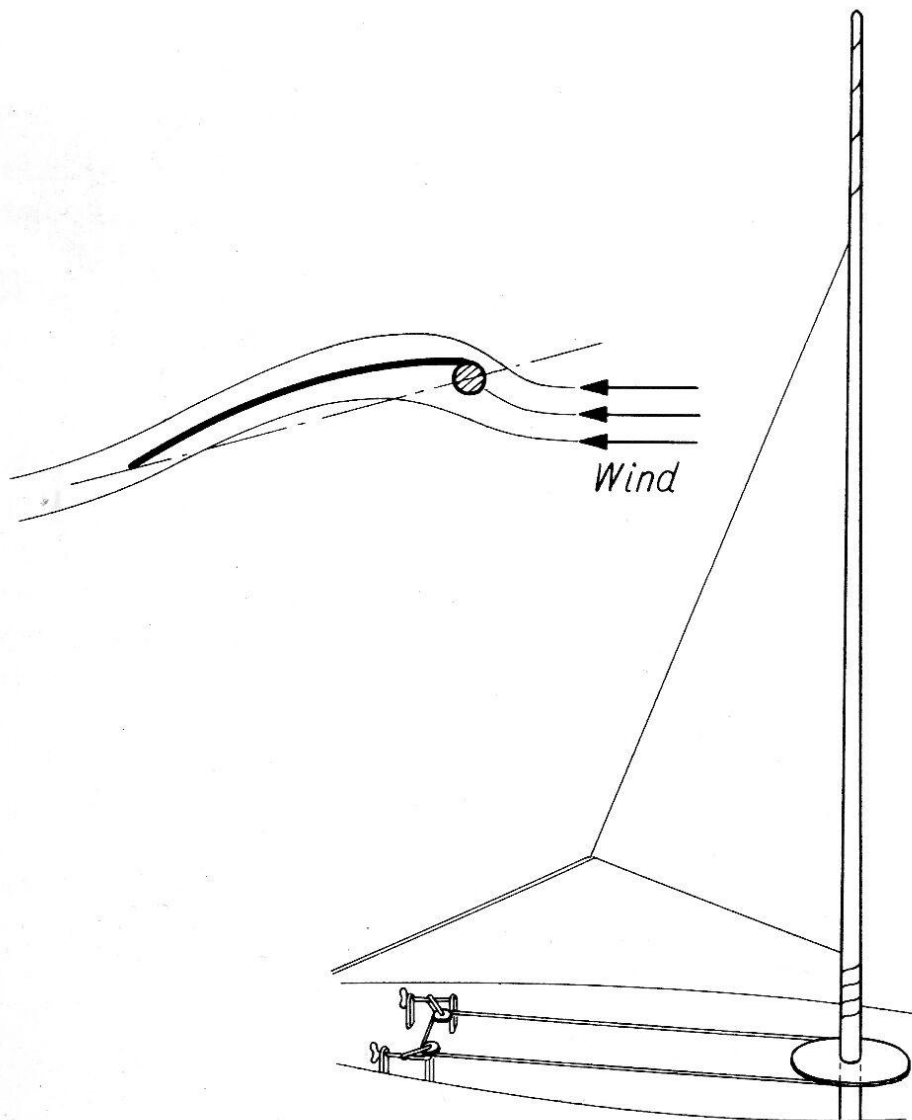
Being also a keen sailor, in 1935 Mr. Ljungström came up with another brilliant idea; the Ljungström rig (Lj-rig). He had learned how dangerous it could be to handle sail on the foredeck of a small boat and his solution was radical:



The diagram above of a Ljungström rig is copied from the book "RACING, CRUISING and DESIGN by Uffa Fox. (ISBN 0-907069-15-0 in UK, 0-87742-213-3 in USA). Great reading!

This is a one-sail rig set on a freestanding wooden mast (.. in later designs the aft stay was omitted). The luff boltrope of the doubled sail went in a track in the mast and just as today's roller genoas it was hoisted in spring and lowered at the end of the season. It was also set, reefed and furled from the cockpit, roller headsail style, but that is where the similarity ends:

The Lj-sail was self-tacking, at least on short tacks. On longer tacks the mast was rotated until the mast track was almost pointing forward to create a very smooth lee side behind the luff.



**The figure above shows how the mast is rotated to give optimal airflow over the leeside of the sail. This diagram is copied from "SAILING THEORY AND PRACTICE" by C.A. Marchaj (ISBN 0 229 11665 5)**

Marchaj's diagram above also shows how the whole free-standing mast is used as a big roller reefing device. Ljungström made it work by using big ball bearings both at the mast step and at the partners. A big pulley clamped to the mast just below deck lets one rotate the mast from the helmsman's position.

This rig is in my eyes very close to being the ultimate one, at least for close-hauled sailing: Practical sailing proved that it could sail faster and closer to the wind than even the best Bermuda rigs. This has been confirmed by aerodynamic tests done by Mr Marchaj. In addition it proved to be safe in the sometimes windy conditions on the west coast of Sweden. Ljungström himself kept on sailing his boat, often alone, until he was quite old – which would have been totally impossible with a Bermuda rig.

Ljungstrom rig (40-footer)



This shows the Lj-rig in two modes: To the left the double sail is closed while to the right one can see how the sail has been folded open on a dead run (from Marchaj).

*So why doesn't my Malena sail with a Ljungström rig today if it is that good?  
..read on...*

***Malena, searching for a better rig for her:***

*(..Malena, mine between 1981 – 99, was originally rigged with a masthead Bermuda rig...)*

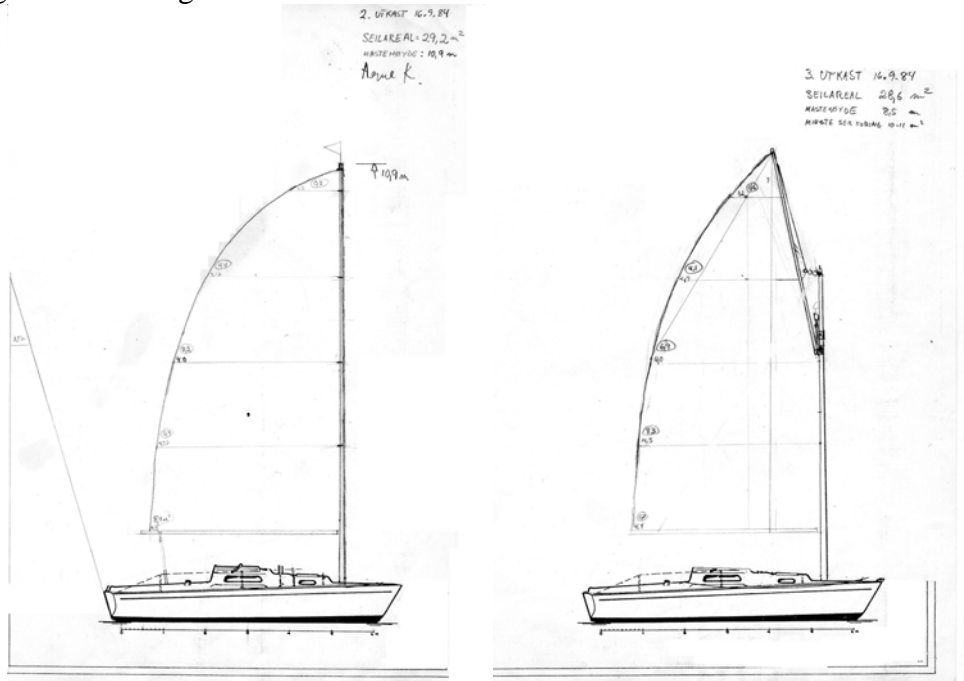
After my first real venture offshore in *Malena* in 1983, from Stavanger to Skagen in Denmark, I concluded that working on the foredeck of a small boat wasn't always fun.

*Malena* then sailed a summer with a gaff sail.

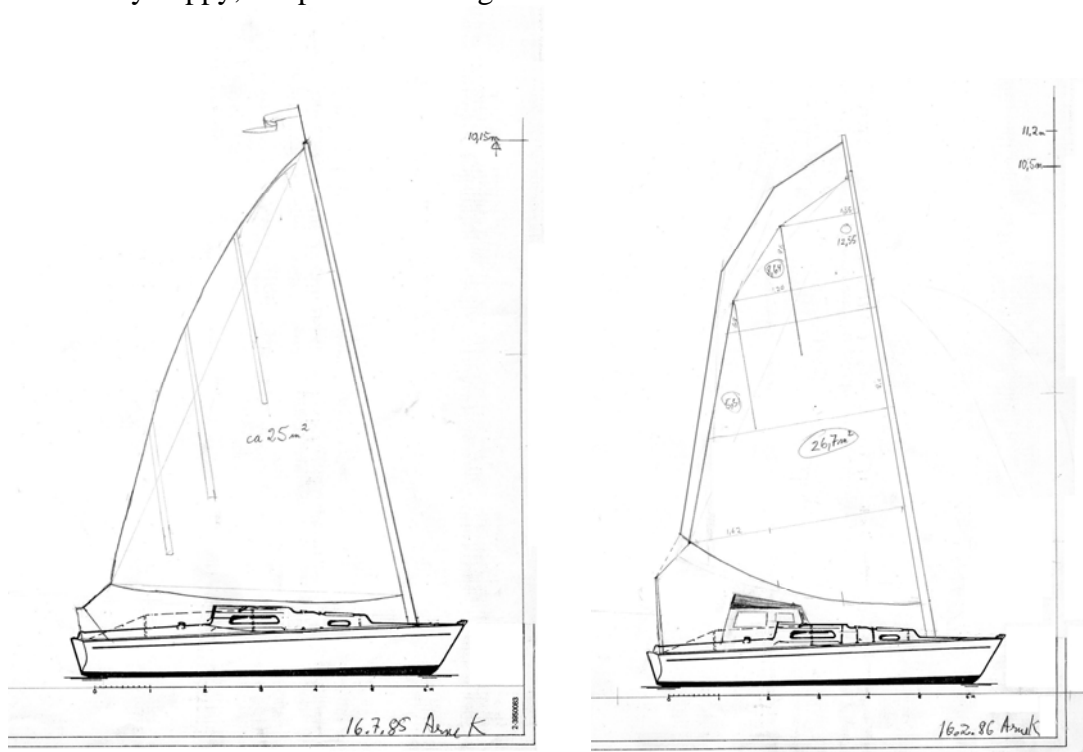


The 23' Albin Viggen, *Malena* with a gaff mainsail fitted in 1985. Note the position of the 3<sup>rd</sup> reef...

The conversion to gaff wasn't as illogical as it may seem. The mainsail's area was nearly doubled which meant that the genoas could be brought ashore for good. A new high-clewed working jib could be fitted on a roll and free me from deck work. The mainsail gave great drive both up- and downwind. Setting and reefing it had to be done at the mast but that was no problem – it was the foredeck work I didn't like; changing or reefing jibs. Still, I kept on searching for something even easier...



For a period my sketchbook was filled with catrigs like those above. If I had not come across the junkrig later, I would probably have landed on a gaff catrig, slightly less radical than the one above. It would save a lot mast-height, about 2.5m compared to the Bermuda version. Still not totally happy, I kept on searching...



The diagrams (above) showing my versions of the Lj-rig were lying on my desk for a good while. Analysing the rig, some problems became apparent:

- It wouldn't be easy to accommodate a large enough rig on such a short boat. The Lj-rig used to be fitted to long skinny boats of low displacement and with plenty of space for sheeting.
- To make the sail work better on a reach and run, a boom or something would be needed; not easy to fit with a rotating mast.
- The sail centre (CE) would move a lot as the sail was reefed. This could be a problem unless I fitted a mizzen (Ljungström even made the mast step moveable on some boats to trim the balance)
- I had no idea about unstayed masts at the time so fitting such a tall mast would be a challenge.
- The roller reefing bearings at the maststep and partners would call for outside help to make.

So I gave it up. Luckily I got my hands on the *Practical Junk Rig* book in 1989 and from then on it was plain (JR) sailing. *Malena's* present mast is only 9.4m tall, but still gives room for a 32sqm JR sail (below).

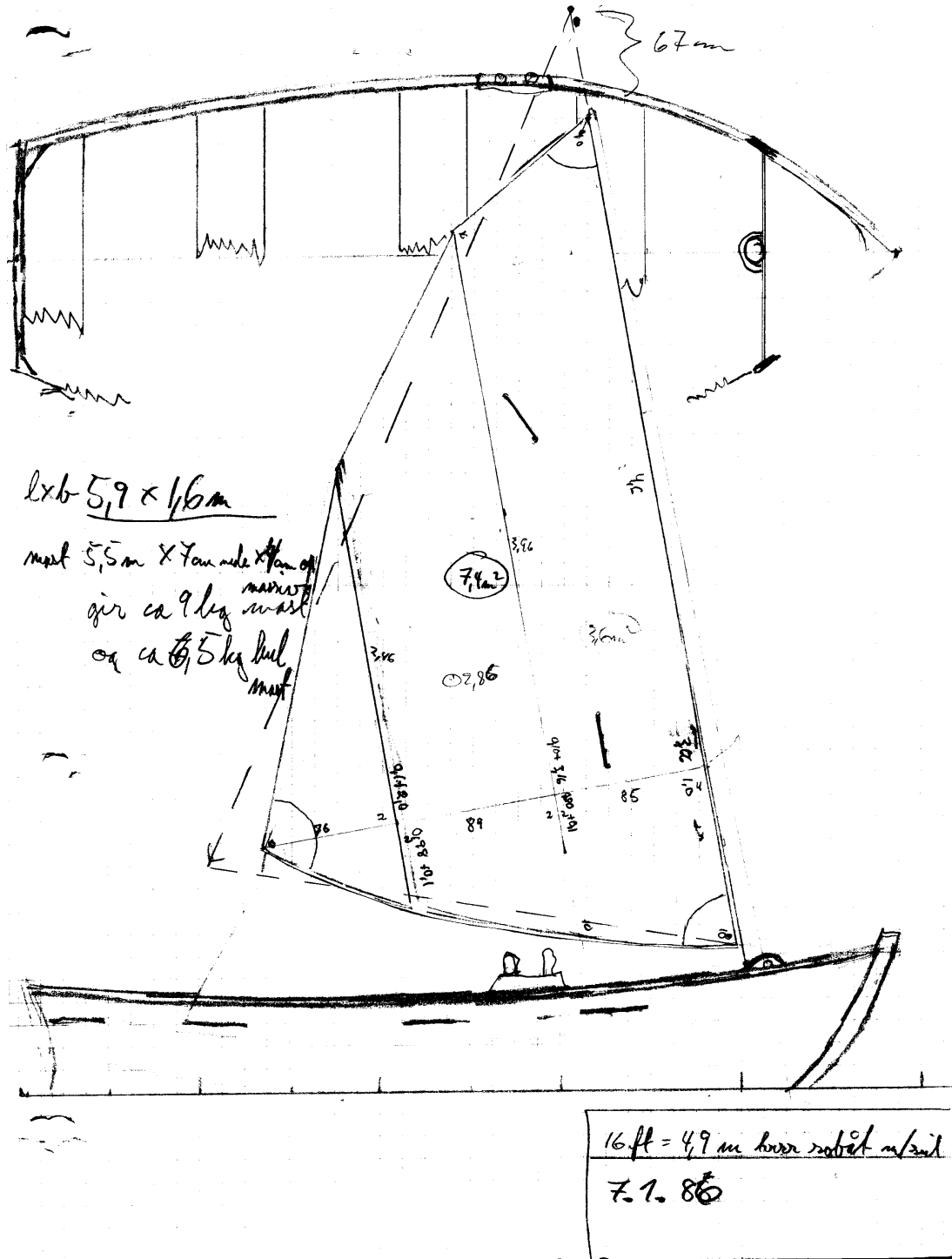
(Photo: Andrew Bailey, 2010)



.. ragged glory. The sail from 1994 has big holes in it, but that doesn't seem to affect its performance...

**The poor man's Ljungström rig:**

While sketching all sorts of rigs for *Malena*, I actually designed and made a much simplified Lj-rig and fitted it to a friend's rowboat. Its sail wasn't doubled as were most of Ljungström's originals, and there were no ball bearings or roller reefing pulley on the mast either.



.. the very rough sketch from which the poor man's Lj-sail was made...

As can be seen from the sketch, the sail was given a generous roach on the leech and this added to the sail area while saving mast height. The result can be seen on next page...

(Photos: Slieve McGalliard, 2004)



.. Curtiss with his Lj-rigged rowboat (LOA=4.9m, SA =7.4sqm, mast 5.5m/7.0cm)..



.. he sailed over to greet the first JRA-rally in Stavanger in 2004. The rig was then 18 years old...

### **Some more construction and rigging details of the simplified Lj-rig;**

#### ***The poor man's Ljungström rig:***

- The mast was not meant to be rotated for perfect setting after each tacking like the mast of the original Lj-rig was. For this reason this sail was simply laced to the mast. No mast track or halyard was needed.
- The sail was cut flat with a straight luff. Camber can be varied by how the sail is sheeted.

- To support the generous roach the sail was fitted with two full-length battens along the mast. These were positioned only after the trial-installation of the sail and rolling it up on the mast. If you look carefully on the photos, you will notice that the batten pockets are not fully parallel with the mast: With the mast being almost twice as thick at the partners as in the top, the sail will of course be rolled in faster in the lower end.
- The mast rake was found by trial and error. The gunwale-to-gunwale mast thwart was just held in place with clamps on the first trip. The final position which gave easy steering shows quite some aft rake of the mast. Luckily I had cut the sail with a high clew, so the end result didn't look so bad.

### **Sailing the poor man's Ljungström rig:**

First of all, the mast and sail sums up to about 10kg so most people can raise the mast easily. The mast fits into a square mast step. A 10mm bolt is screwed into the root end of the mast, right in the centre, and the bolt head is cut off, leaving about 20mm sticking out.

When rolling out or in some sail, the mast is lifted out just enough to get the square end free from the step, but with the bolt still holding the mast from falling totally out of it. In this position it is easy to revolve the mast by hand. Then the mast is dropped back in the mast step. With a little practice, this is a quite easy and fast method for setting, reefing and furling the sail.

The only running line in this rig is a single jib-style sheet. On the inside of each gunwale a number of thumb cleats have been screwed on. The sheet is passed over one of these which fits the sailing and sail area at the moment and which gives the right twist. When tacking, the helmsman just moves the sheet over to a cleat on the other side; quick and simple.

The performance of this rig has proven to be very good. I have tried to sail many rowboats to windward, both with sprit- or gaff-sloop rigs and also one with a sprit-sail cat rig. To be honest; their upwind progress was not much to write home and tell about.

(.. Norwegian rowboats in the færing tradition were never meant to be sailed to windward so they only have a 3-4" deep full length keel...)

The Lj-rig is no doubt better than all the others I have tried – with a big margin. One really makes progress to windward with that rig. Another fine thing is that it seems to produce less heeling moment than the others. I guess this has to do with the pronounced mast rake which actually shortens the heeling lever compared to that of a vertical mast.

### **Summing up:**

*The poor man's Lj-rig* for small boats is both cheap and easy to make and also easy to rig and handle. The furled bundle is very tidy and will not flog about when stored or when being trailed. Its combination of economy, performance and safety in use is simply hard to beat.

I am undecided on how far one can expand this mini Lj-rig until it starts to get too heavy and complicated, but as long as it can be man-handled in this rowboat fashion (up to 10sqm?), it should be among the cheapest and simplest rig you can get.

I am happy with the two full-length battens: They save mast length and the sail also seems to be more docile when left flying than jibs do.

Could this be something for your dinghy, dory, skiff or færing?? It's up to you now...

Stavanger, 11<sup>th</sup> July 2011

*Arne Kverneland*

**PS: But now have a look on next page...**



### **Lj-rig reborn?**

A couple of weeks ago I stumbled over an article where two small trailable cruisers were tested. One of them was new to me; a French twin-keeler, *Ocqueteau Tilapia 6.50*, with only 60cm draught. The test crew became very surprised and impressed over how quick and close-winded this wide-body hull with twin keels and rudders was.



**Ocqueteau Tilapia 6.50**

I took the photo above from a videoclip I found on Youtube. Look up:

<http://www.youtube.com/watch?v=CP4d4IXEaK0> ...

.. or simply go to [YouTube](#) and search for [Tilapia 6.5](#).

I have no idea if the builders know about Ljungström and his rigs; maybe they have just re-invented the rig. Today, after 30years with the freestanding Freedom rig and with roller reefing headsails, plus the advent of more affordable carbon masts, this rig is a natural step forward, not so radical at all. Fredrik Ljungström just happened to be 70 years ahead of his time...

This full size Lj-rig is obviously more hi-tech to make and therefore better suited for professional production. My poor man's version of the Lj-rig is just meant for us humble DIY-ers and our dinghies...

Enjoy the videoclip. The music following it may be more affordable than the boat. It is clips from the "Peer Gynt Suite" by *Edvard Grieg*...