Concept of the Bulbous Bow

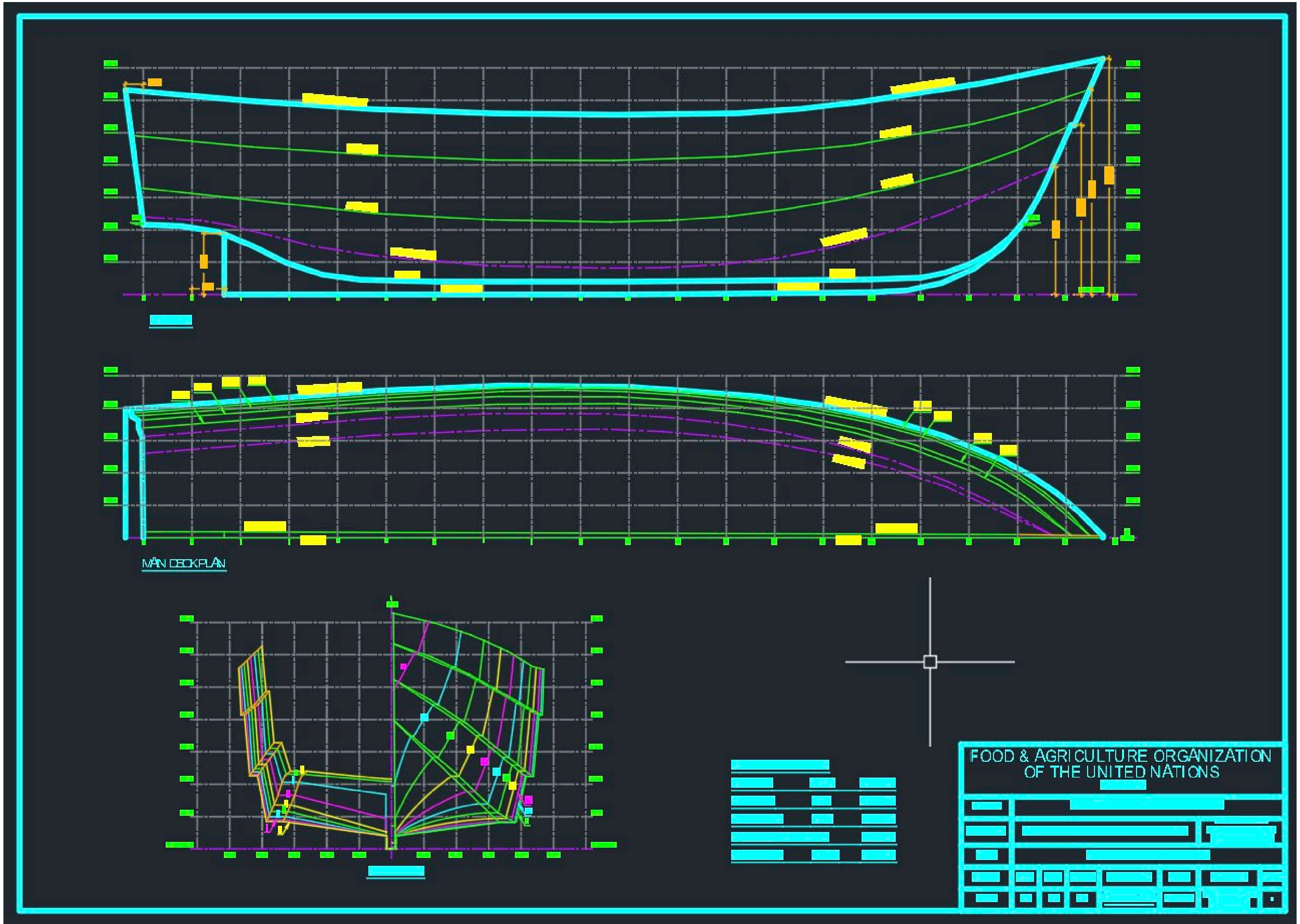
Project (GCP/GLO/352/NOR) Sri Lanka

Food and Agriculture Organization of the United Nations

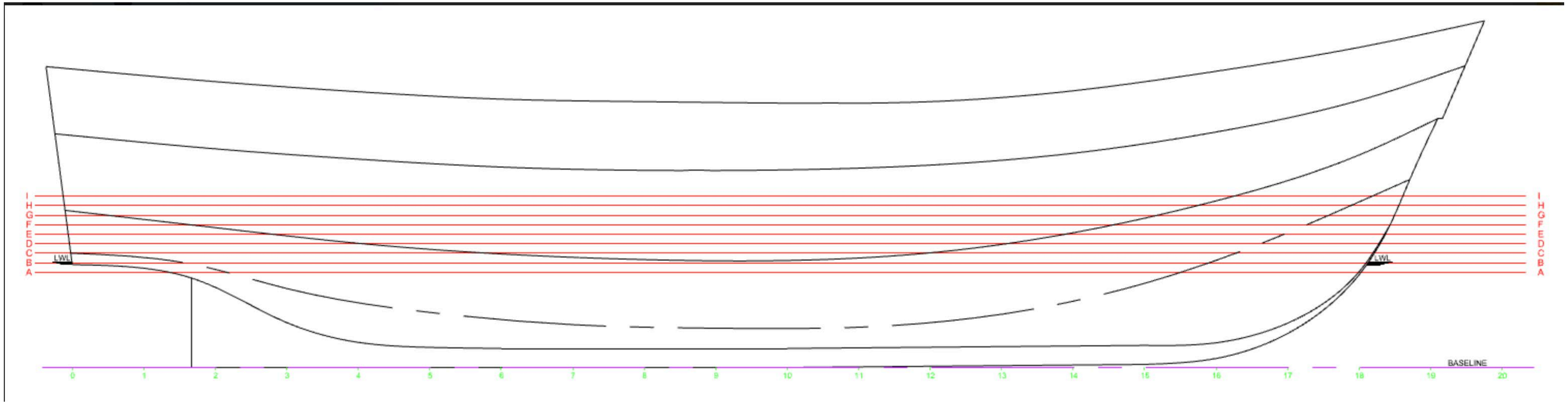
Design Factors

- Vessel Shape
- Operating Speed
- Loading Conditions
- Vessel “Layon 7“ was proposed for the Bulbous bow project
- 49ft vessel doing 4 to 5 fishing trips per year.
- Each trip lastsan average of 45days at sea.
- Data of fuel consumption, speed, RPM and weather details to be collected during each fishing trip.
- Two trips with data collection before and after the fitting of the bulbous bow

The starting point



Load Lines



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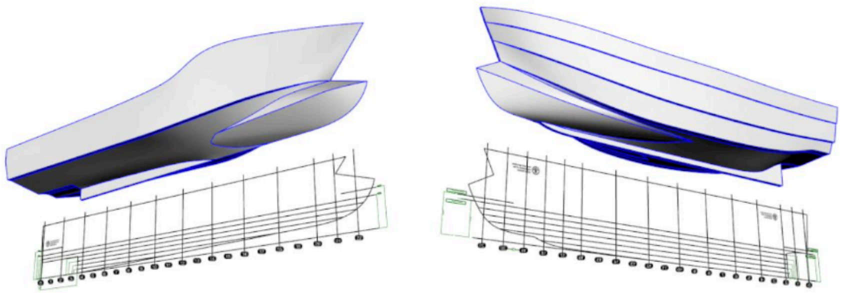
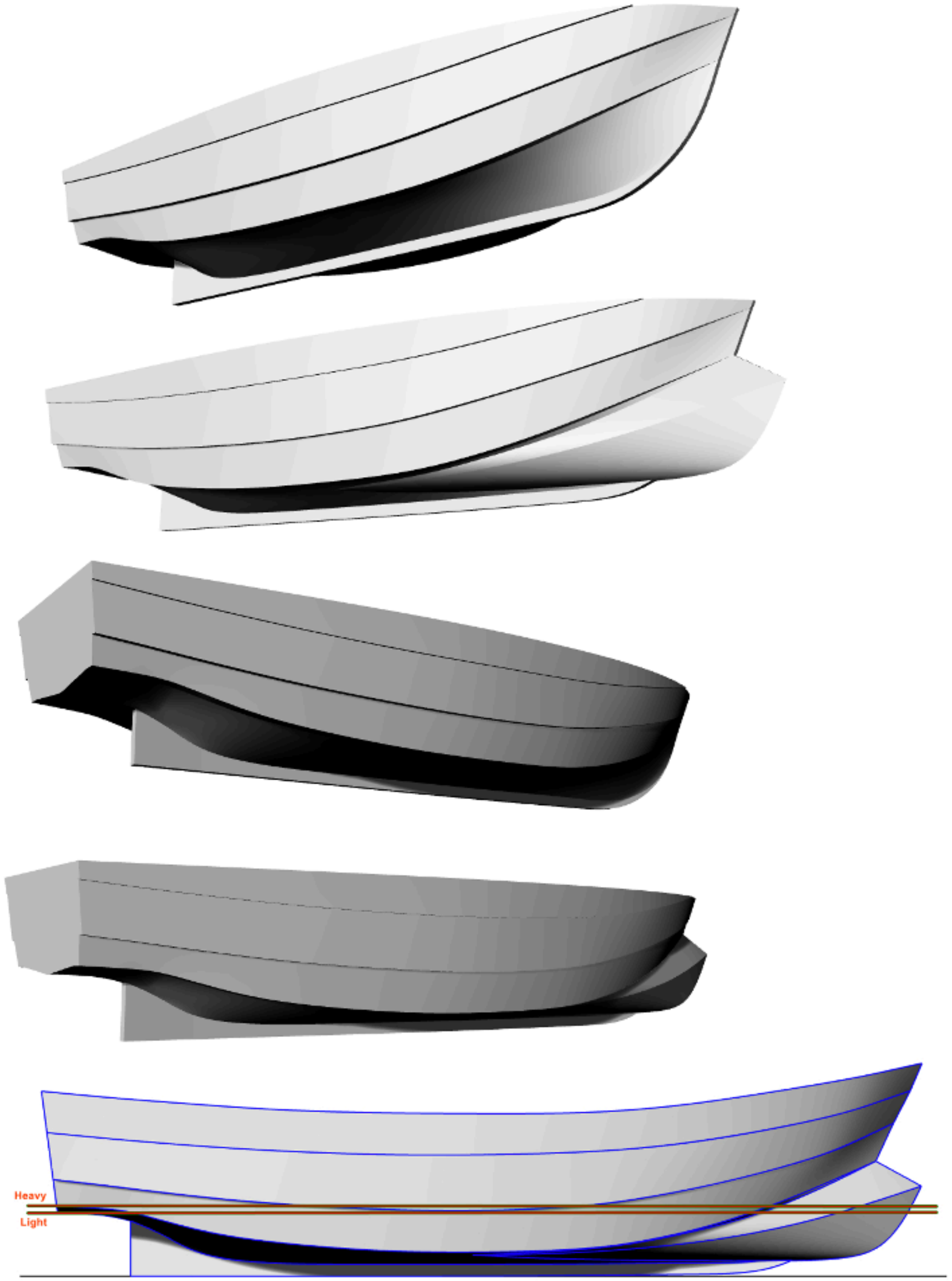
Bulbous bow design process

Design and model testing of dihedral bows for long line fishing vessels in Grenada and Sri Lanka:
Final narrative report



Research Group CEHINAV

E.T.S.I. NAVALES * UNIVERSIDAD POLITECNICA DE MADRID



Longitudinal Profile and 3-D Views

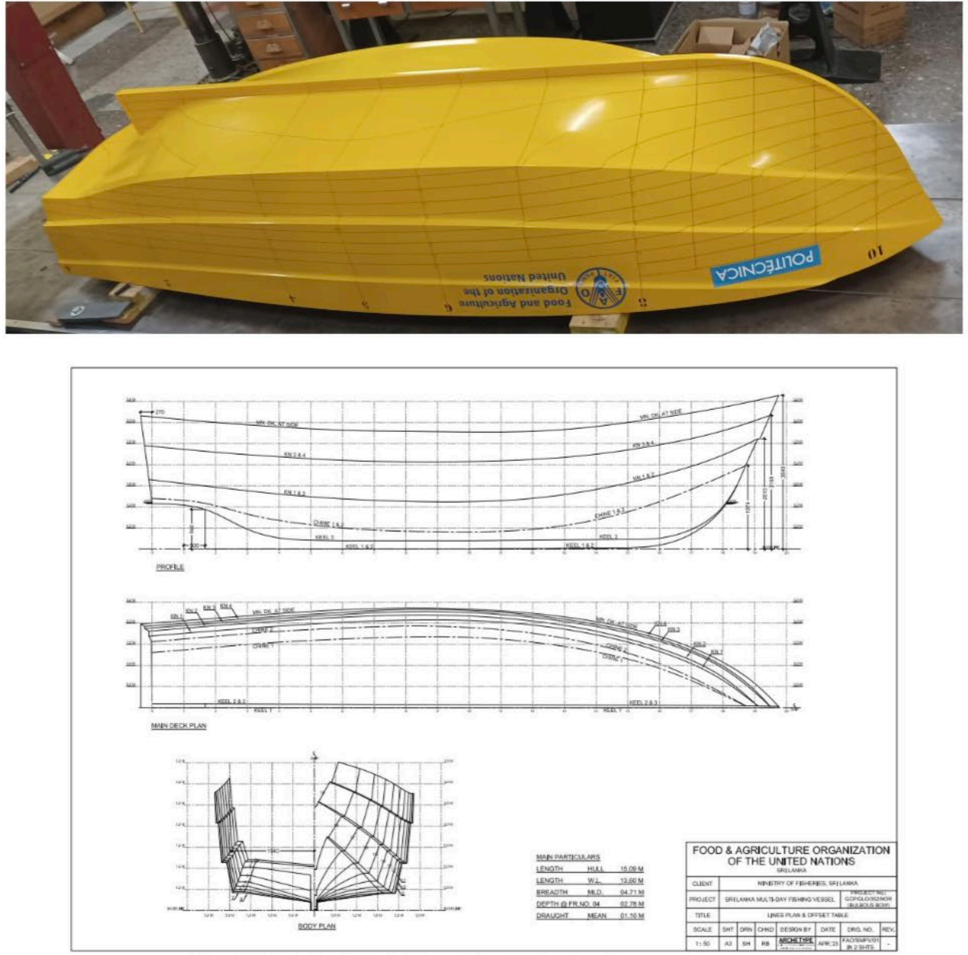
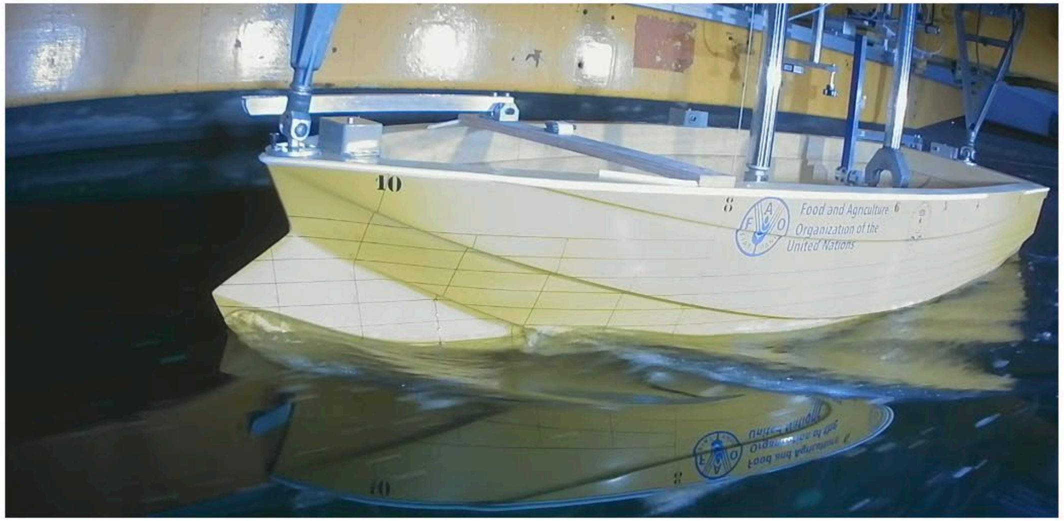


Fig. 1.3 Original Model tested for Sri Lanka: lines and constructed model

Fig. 1.4 Model with the dihedral bow for the Sri Lanka

The hull models were built in samba wood in the CEHINAV facilities. The scale factor used was $\lambda = 6$ for the Grenada vessel and $\lambda = 6.5$ for the Sri Lanka one. This scale has been chosen in order to comply with the ITTC (International Towing Tank



Light condition[6], 5 knots: the dihedral bow is not reducing resistance; water is deflected outside the hull after St. #9 in both ships (See Fig. 2.2 for stations outline). The water deflected by the dihedral bow is encountering the hull again. Wetted surface is higher for the dihedral bow, and trim angle is slightly higher.

Light condition, 7 knots: the dihedral bow starts reducing resistance **15%**. Original ship deflects water from St. #9.5 while the dihedral bow starts in St. #10.5 and maintains the hull dry bellow the chine until St. #9. Notice how in the original ship the water goes over the lower chine in St#9.5 and you can not see this line in the picture. The dihedral bow deflects the water and you can see the chine of the original hull.

Sri Lanka

Length overall (Dihedral bow) .... 2311 mm
Breadth... 726 mm
Depth (no fore part) .... 419 mm
Light condition draft (no trim).............................166 mm
Heavy condition draft (no trim)............................. 185 mm
Scale 6.5

	Light S 1 ORIGINAL	Heavy S 2 ORIGINAL	Light S 1 DIHEDRAL	Heavy S 2 DIHEDRAL
Displacement (t)	25.63	31.05	27.66	33.23
BWL (m)	4.144	4.402	4.144	4.402
Tmean (m)	1.082	1.200	1.082	1.200
Lwl (m)	13.59	13.68	14.56	14.64
Sw (m^2)	59.3	66.6	62.1	69.6

Table 2.2 (Sri Lanka vessel)

1.2. Summary of the resistance tests

The following figures and tables summarizes the results at full scale of the two vessels comparing the effective power (EkW) of the original ships with the ones with the dihedral bows, compared at the two tested loading conditions S1 and S2. The effective power is the product of the towing resistance multiplied by the advance speed in appropriate units, and it is not considering the propeller or shaft efficiency. So, it shows the hull effect on the power reduction.

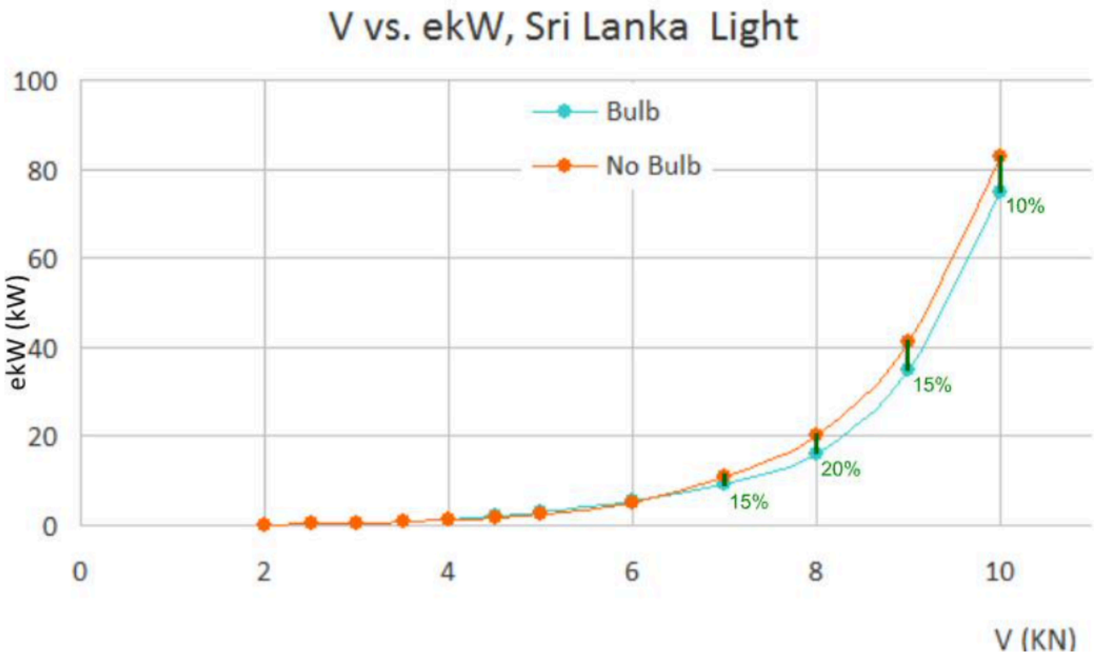


Fig 2.5 EkW of the Light condition, Sri Lanka

Light (S1)	Bulb	No Bulb
V (Kn)	**Pef (kW)**	**Pef (kW)**
2	0.2	0.1
2.5	0.3	0.3
3	0.6	0.5
3.5	0.8	0.8
4	1.3	1.3
4.5	1.9	1.9
5	2.9	2.6
6	5.4	5.0
7	9.3	10.9
8	16.1	20.2
9	35.0	41.1
10	74.6	82.9

Table 2.3: Summary of the Effective Power obtained for the Light Condition, at 15ºC, *Sri Lanka*

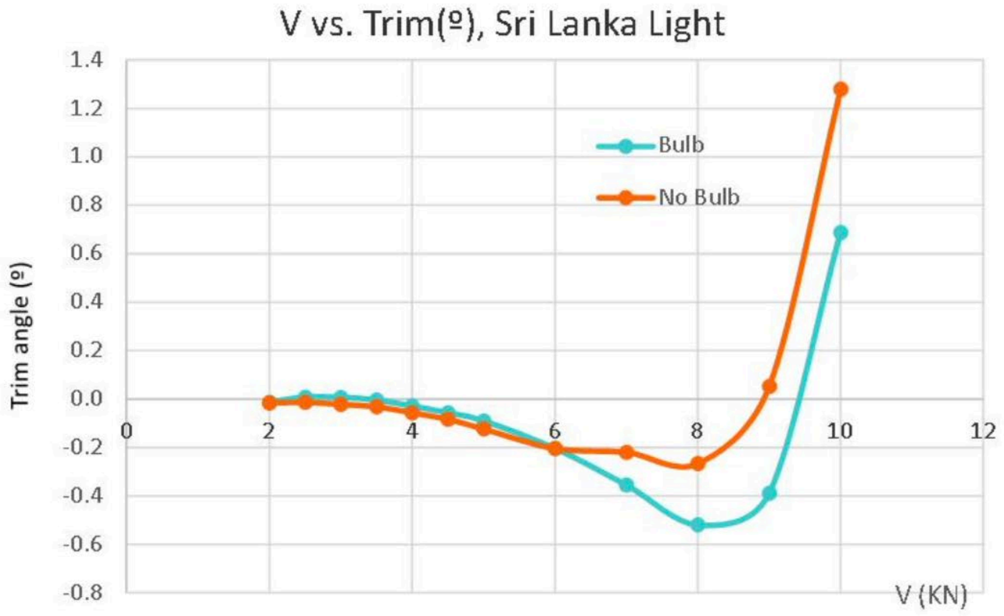


Fig 2.6 Trim angles of the Light condition (+bow up)[5] , Sri Lanka

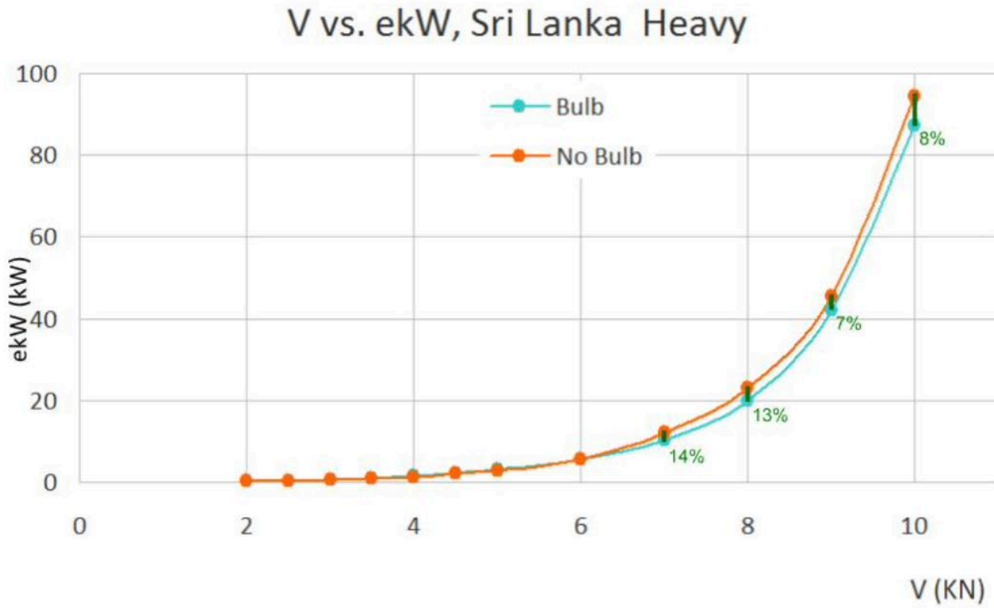


Fig 2.7 EkW of the Heavy condition, Sri Lanka

Heavy (S2)	Bulb	No Bulb
V (Kn)	Pef (kW)	Pef (kW)
2	0.2	0.2
2.5	0.3	0.3
3	0.6	0.5
3.5	0.9	0.9
4	1.4	1.4
4.5	2.1	2.0
5	3.2	2.9
6	5.8	5.6
7	10.4	12.1
8	20.0	23.1
9	42.2	45.5
10	87.3	94.4

Table 2.4: Summary of the Effective Power obtained for the Heavy Condition, *Sri Lanka*

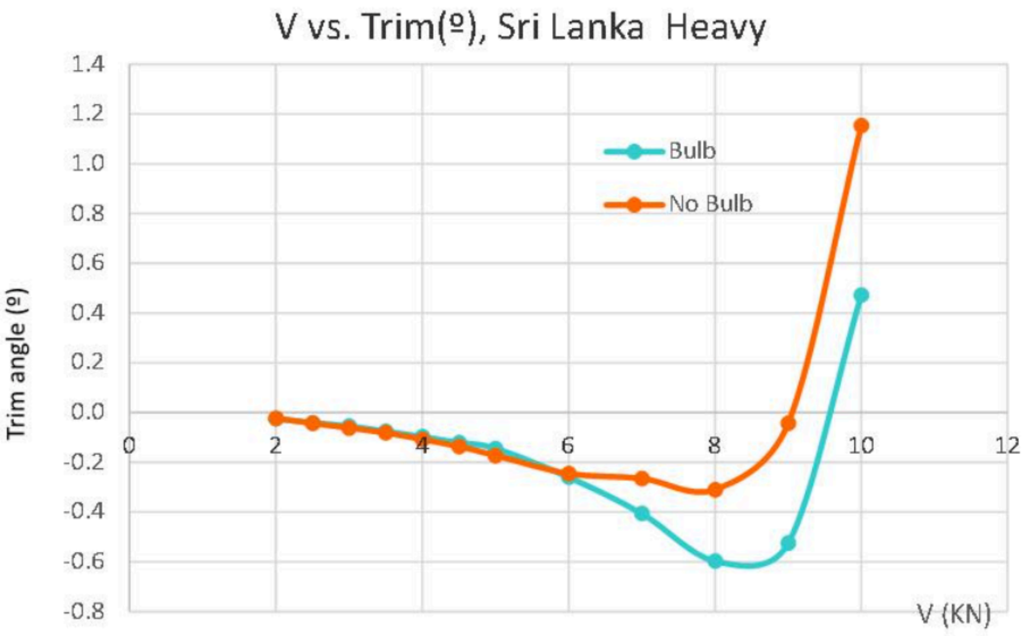
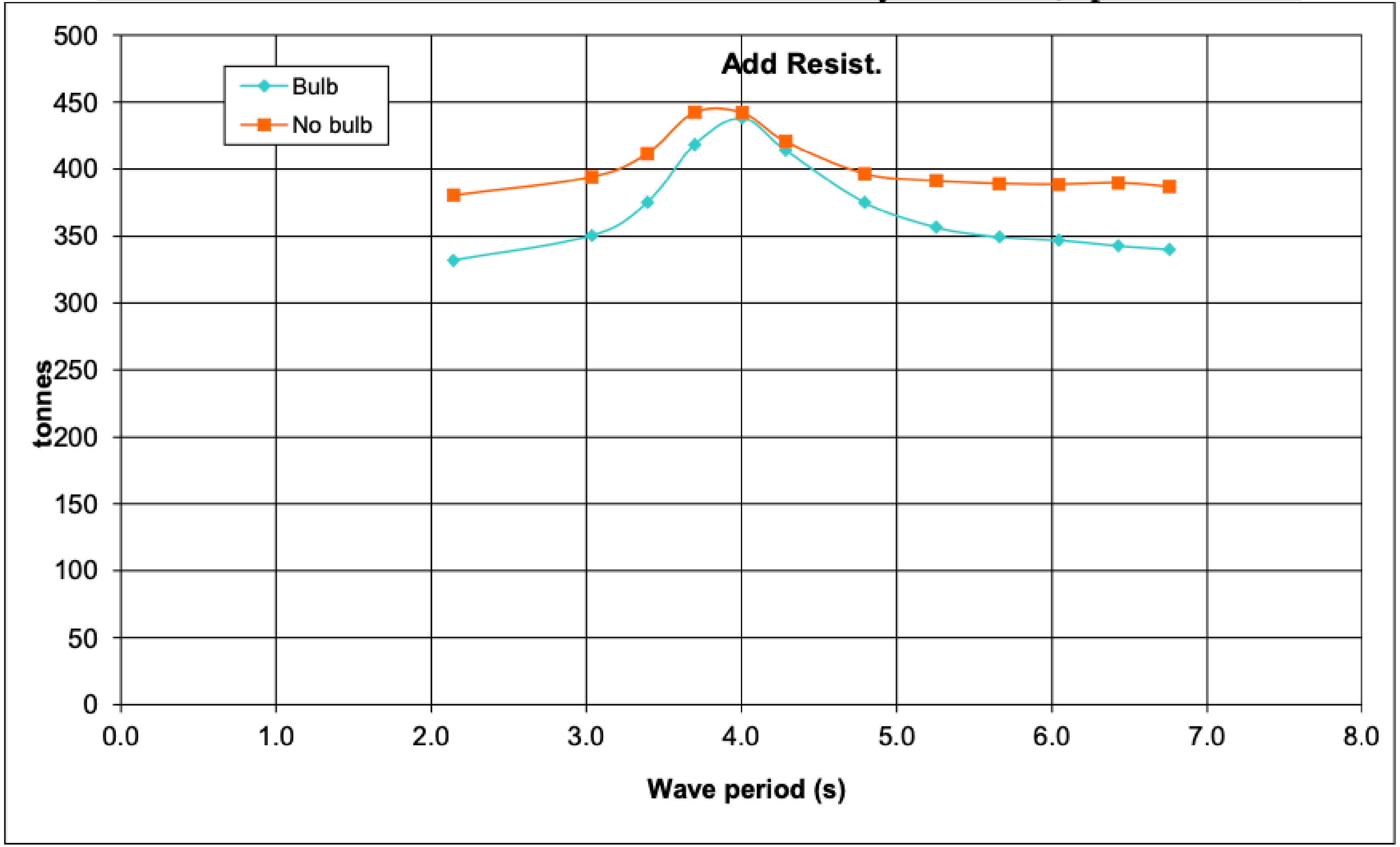


Fig 2.8 Trim angles of the Heavy condition (+bow up)[6], Sri Lanka

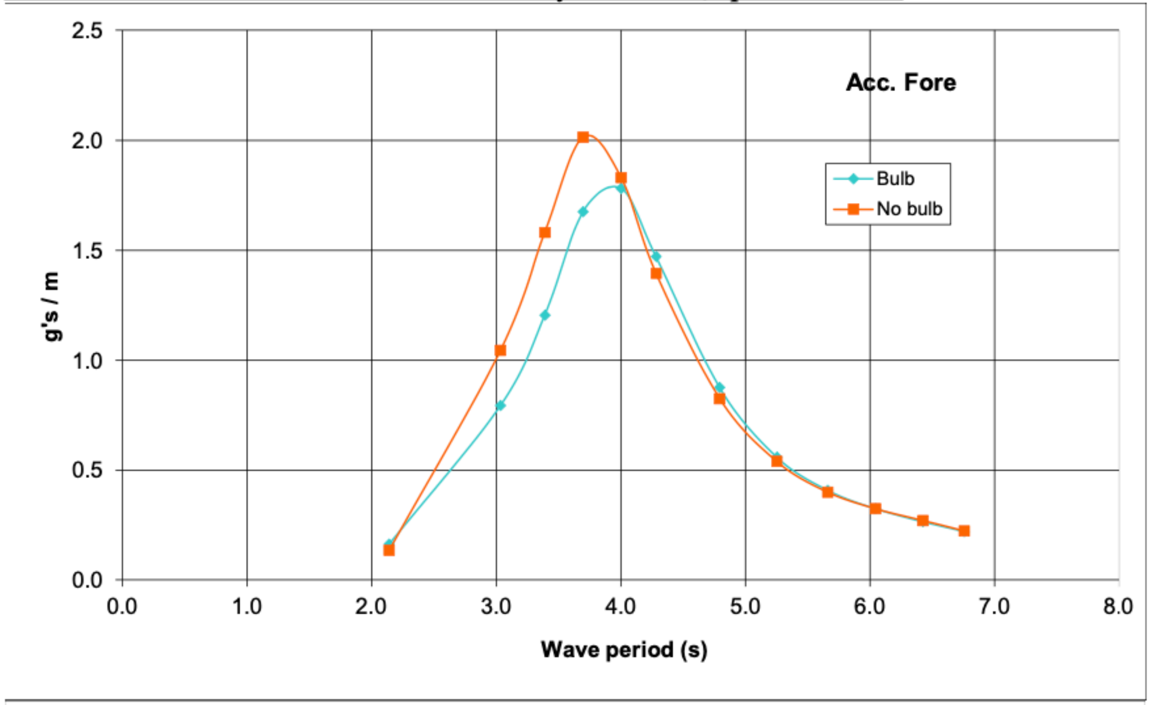
Conclusions and Lessons Learned (Fuel Saving)

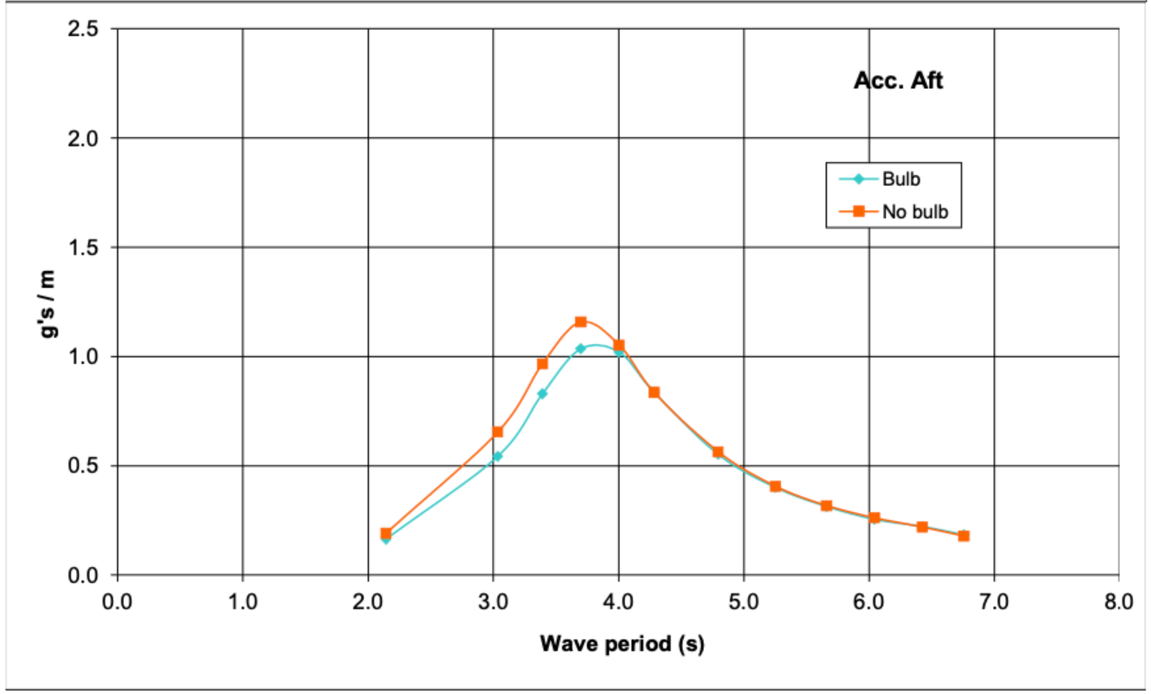
- Resistance tests indicate an important reduction in effective power(EkW) with a dihedral bulbous bow.
- Hence a drop in fuel consumption.
- At 7 knots the bulbous bow works most effectively in both loading conditions.
- @8 knots Power reduction is 20% in light load condition and 13% in heavy load condition.
- The bulbous bow positively reduces trim angles thus reducing hull resistance.
- Lateral resistance also reduced by deflecting the water outside the hull at speeds over 7-8 knots.
- Videos of resistance tests available at https://drive.upm.es/s/uT0nMgGiVLBle00 (Sri Lanka)
- Fuel consumption reduction is 14% at a service speed of 7 knot in the heavy condition.

Resistance in Waves for Sri Lanka vessel at Heavy condition, speed 7 knots:



Accelerations for Sri Lanka vessel at Heavy condition, speed 7 knots:





Seakeeping conclusions and lessons learned:

- Seakeeping tests indicate a reduction into the peak value of bow vertical accelerations.
- These accelerations are related with safety and comfort aboard.
- The reductions are 14% for the Heavy condition and 4% for the Light condition.
- A 15% lower resistance in waves, for the Heavy condition and 12% in light conditions.
- Lesson learned: Dihedral bows are improving the seakeeping properties (reducing motions and vertical accelerations) in bow waves.

THANK YOU