# INDOSAIL - EXPERIENCE FROM A MODERN TALL SAILING SHIP

Peter Schenzle

## AN UPDATED MULTI-MAST SCHOONER

INDOSAIL Prototype Sailing Vessel 'MARUTA JAYA 900'

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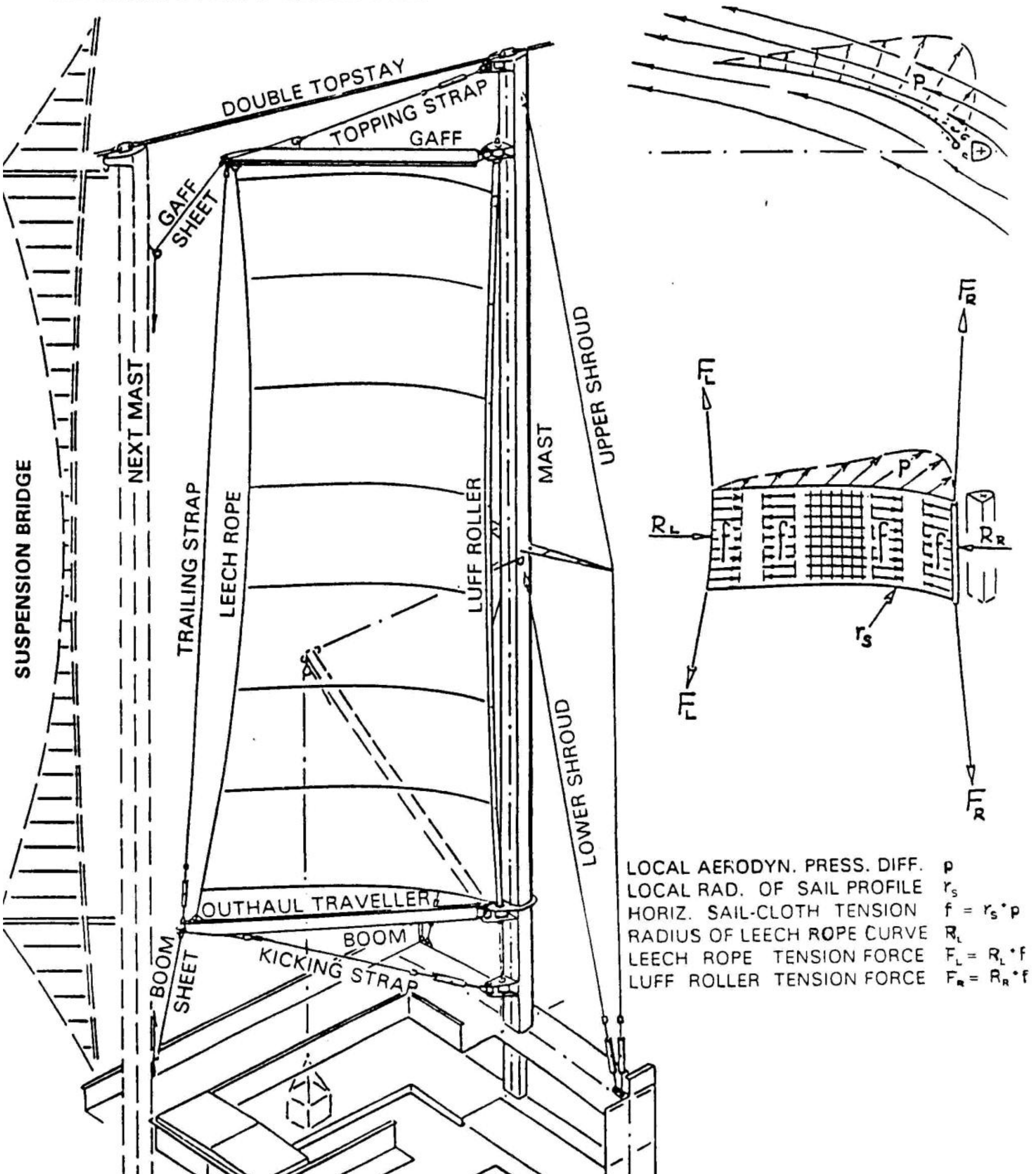
Talking about a modern ‚TALL SHIP', we could imagine a variety of widely differing concepts: from the mechanised but still traditional Square-Rigger, via cargo vessels equipped with auxiliary sails, until futuristic sail cruiser designs with modern yacht technology. For the INDOSAIL-Project of a modern coastal cargo sailer, we were looking for an intermediate way or a functionally appropriate solution. Neither the wheel nor the sail should be invented again, but well proven concepts and components should be combined, to develop a present state functional configuration for a utility cargo vessel with main propulsion by the wind. To this end, a large number of rig- and sail-types were investigated according to the criteria: structural strength and production, efficient aerodynamic propulsion and easy and safe operation.

The result is a consequent development of the multi-mast gaff-schooner with present day technology:

+ into a simple, pre-tensioned trapezoidal rig configuration,
+ carrying an aerodynamically efficient array of soft sails,
+ with simple cut and trim, even in open outboard sheeting,
+ by separating the functions of trimming the sail-shape and sheeting the angle,
+ with continuous sail-opening and -reefing on freely accessible luff-roller rods,
+ by mechanised operation of Rollers, Outhauls and Sheets,
+ on a simple, shallow hull with raking keel for reasonable sailing without fin-keel,
+ with diesel-electric power-plant for both auxiliary propulsion and energy supply.

The continuous steel masts are bolted on solid tabernacles, welded into the hull structure. The standing rigging is made up of single lower and upper shrouds in transverse direction and trapezoidal stays from the bow over the mast-tops to the stern in longitudinal direction. The standing rigging is first adjusted geometrically and then pre-tensioned to a given condition by checking the natural oscillation frequency of the wires.

## INDOSAIL UTILITY SAILING RIG




**CONCEPT OF THE "SUSPENSION SAIL"**

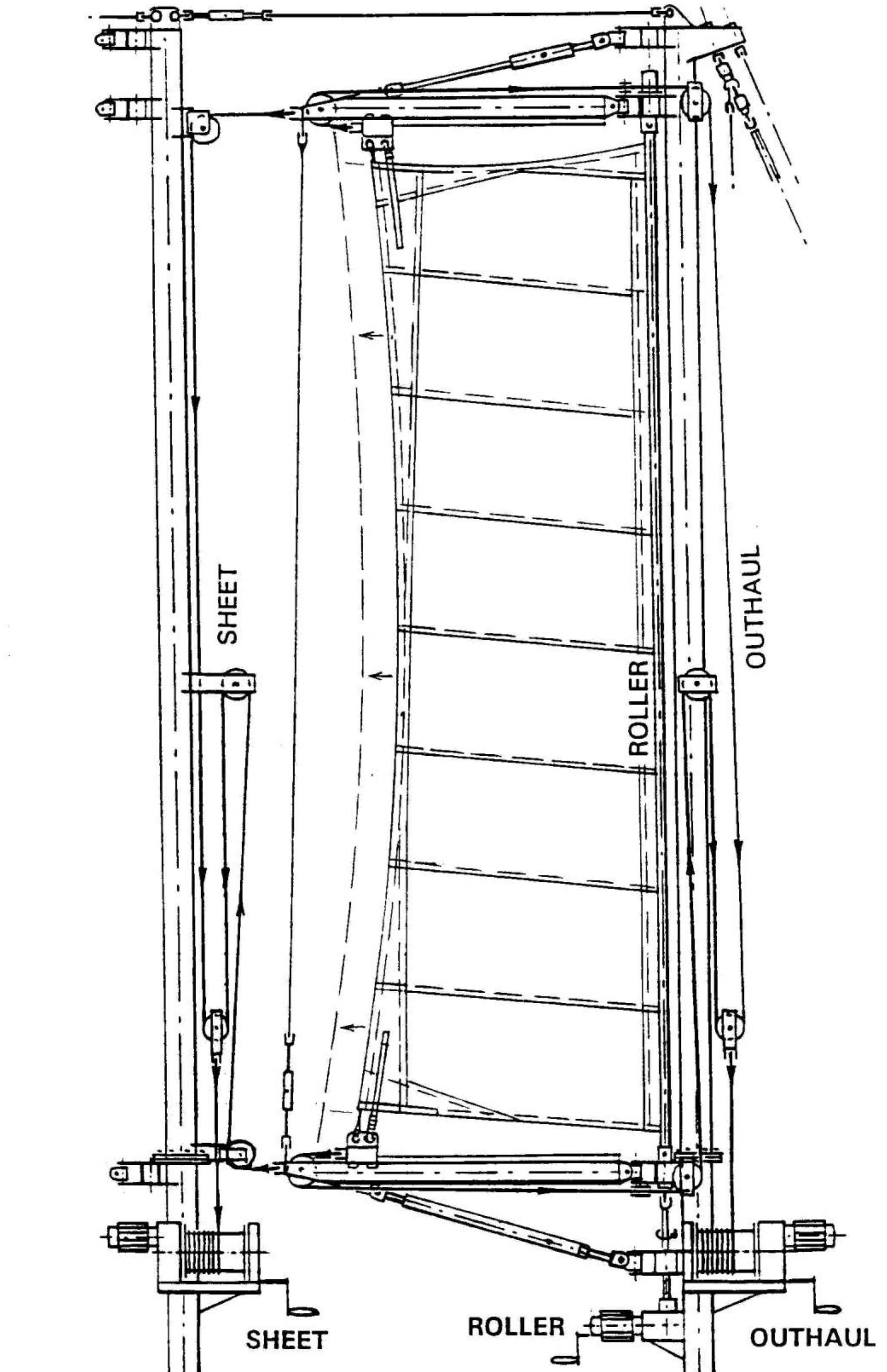
The same principle is applied to the triangular frames of the jib and mizzen sails and to the rectangular frames of the gaff sails, consisting of boom, mast and horizontal gaff. This frame is also pre-tensioned trapezoidally by a fixed boom-kicker, a gaff-topper and a 'trailing-strap' between the peaks of boom and gaff. At the same time, boom and gaff are set to right angles to the mast and thus also to the pre-tensioned luff-roller behind the mast. This geometry is maintained independently of the sheeting position from midships to outboards, and the sail can be set, trimmed and reefed within this relatively stable frame.

This is also correspondingly valid for the triangular mizzen without gaff, but only conditionally for the boomed jib without its own mast. The balanced jib boom is hanging at its trailing-strap and luff-roller and pivoted to the deck around its forward quarter. By tensioning the triangle, a pre-tensioning ratio of 1:3 is thus automatically maintained between trailing-strap and luff-roller.

The sails are cut absolutely flat and are hanging between the luff-roller and a strong wire in the hollow-cut leech seam. They obtain their profile over the full height by outhauling the hollow leech between traveller-carriages running on boom and gaff. The cloth tension is thus hardly vertical but predominantly in its horizontal sections carried fore and aft by the suspension bridge effect of the vertically tensioned and curved luff-roller and leech wire. The pre-tension of the trailing-strap behind the leech is adjusted so that with rising sail pressure the leech-wire is progressively reducing the strap tension to zero at full rated sail load. The following slacking of the trailing strap is a clear signal to start reefing. In this way both sail-camber and sail-size may be controlled continuously from widely open and well rounded Spinnaker-type on a broad reach to the narrow-reefed flat-trimmed sail in strong wind with full height and full efficiency.

Due to this pre-tensioned system, the sheets have only the task of adjusting the horizontal angles of booms and gaffs without any downhauling function. Due to the consequently low loads, the sheets can be single ropes, even for large sails, and gaff and boom sheets can be coupled over a running block at the mast and operated at equal tension by a single winch.

**INDOSAIL-RIG**



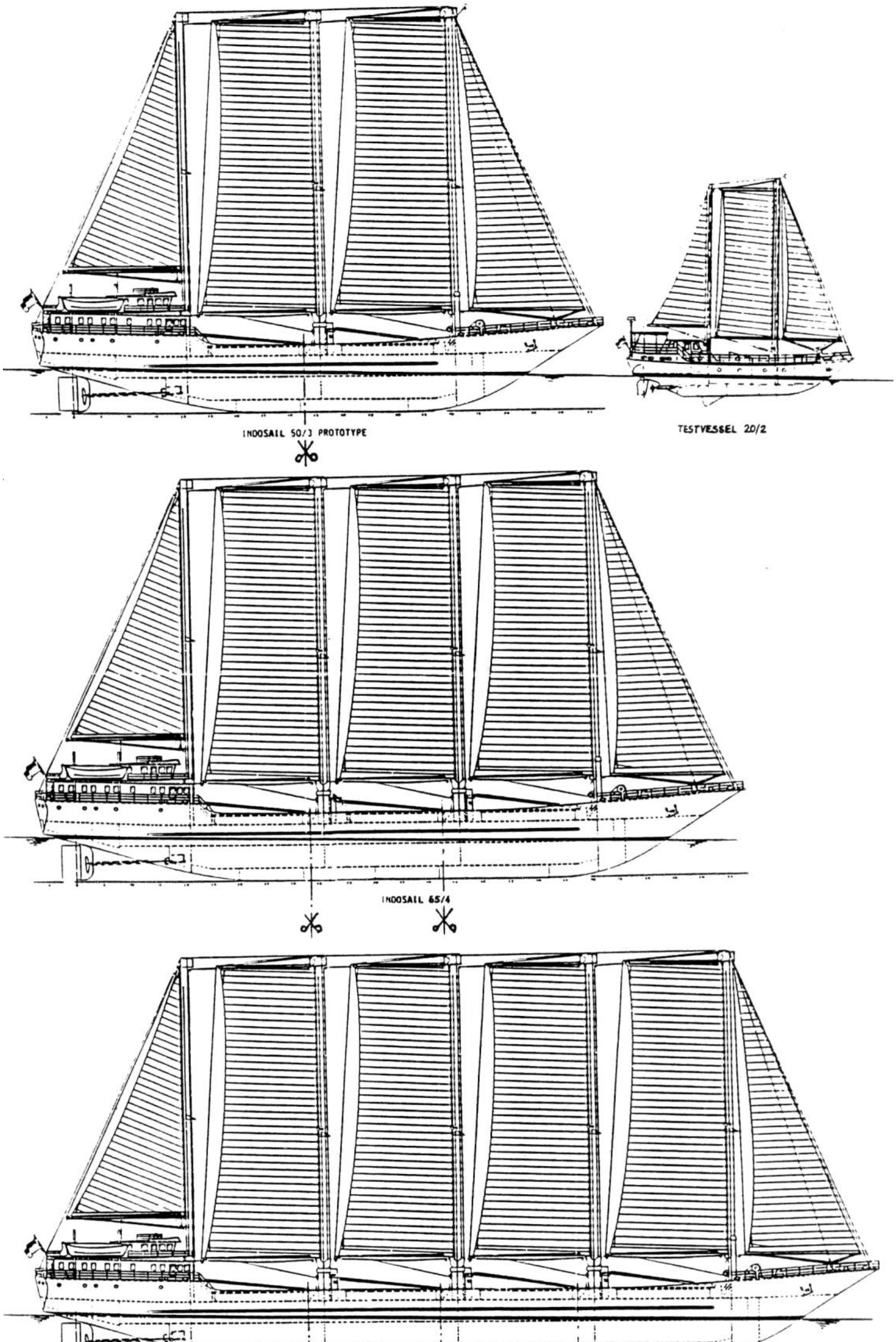

SCHEMATIC OPERATION SYSTEM

All three functions, Outhauling, Rolling and Sheeting, can be operated according to sail size and handling concept, by hand-winches, electrically or hydraulically, they can be controlled locally at the mast, remotely from the bridge or semi-automatically. As a proven solution on the Prototype Ship, the sails were set, trimmed and furled locally at the mast by crane-controller, and the frequent sheeting corrections were remotely controlled from the bridge. Only hauling the sheets must be done by the winch motor while paying-out is better controlled by lifting the winch breaks. These breaks are operated by emergency current and serve also as a safety system: at a suddenly blowing gust, all sheets can be given free by pressing a red emergency button.

The hull form of a large cargo sailer is only marginally different from a normal motor vessel. Fro many reasons, e.g. docking, shallow ports and estuaries, a deep fin-keel is hardly practicable. Even a shallow bar-keel may be disturbing for docking and shallow water. The hydrodynamic lateral force on a normal hull on even keel at a low drift angle is acting far forward close to the bow. To use all sails over the ship's length efficiently, the rudder would have to carry the half balancing force and the ship would suffer a heavy windward helm. This effect is even more increased by heeling the hull to an apparent windward curvature. A conventional countermeasure is, to sheet the sails for less rudder load but inefficiently for propulsion. A design measure is to reduce sail area aft and increase the number of jibs on a long bowsprit, but we can also shift the hydrodynamic centre-of-effort backwards by stern trim or rake of keel.

Here a combination was chosen of a raking stem and a raking keel, to be able to use an efficient progressive sheeting order on beating courses, from the jib wide open with increasing wind deflection progressively closer to the stern. This is to achieve the best lift-to-drag ratio, similar to an aircraft wing in the starting configuration of slat, main wing and slotted flaps. Unfortunately, most traditional Tall-Ships are not able to utilise this advantage due to the missing rake-of-keel or stern trim.

The power requirements for auxiliary Propulsion and for Energy supply are in a similar order of magnitude but not in direct temporary correlation. This is particularly valid for the peak requirements during motor-sailing against unfavourable winds and for cargo operations in port.




**INDOSAIL Prototype Cargo-Sailer - Modular Concept**

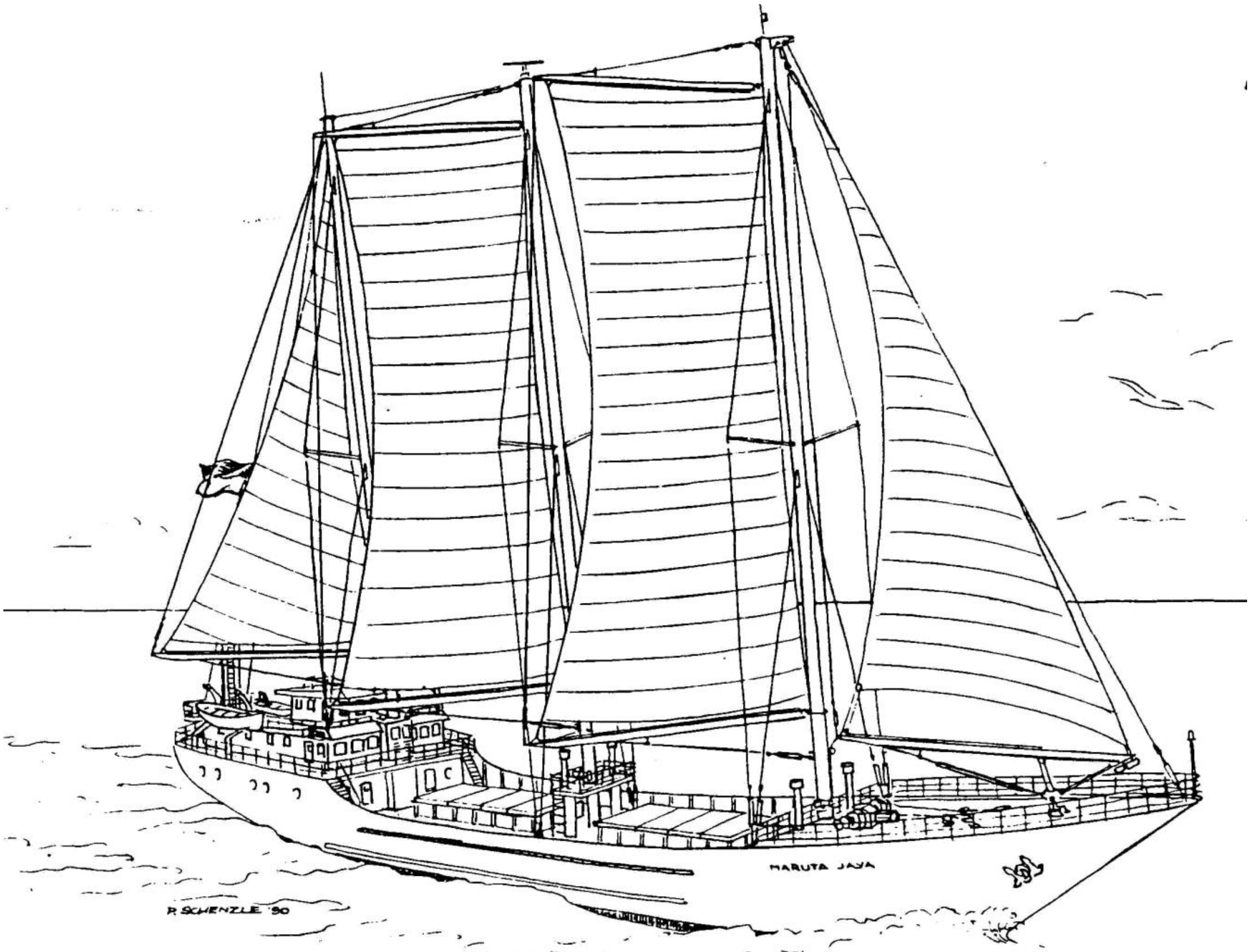
Therefore, a central power plant for a flexible supply for board energy, cargo handling and auxiliary propulsion, appears as the appropriate solution. This offers also the possibility of motor-sailing upwind at very low power rating with reduced leeward helm and improved lift-to-drag ratio. Thus even a small propeller thrust can improve the flow to the rudder to compensate for the missing fin-keel.

## THE INDOSAIL- PROTOTYPE CARGO SAILER

The objective of the INDOSAIL-Project was to develop a Prototype Cargo Sailer for the Indonesian inter-island trade. Based on a four-masted standard design, a modular system was conceived, to derive a smaller and a larger version by subtracting or adding a standard section consisting of one cargo hold and one mast module, without modifying the basic elements of the hull and the rig. At a common beam of 12 m and draughts around 5 m, the main particulars are as follows:

| INDOSAIL TYP | 50/3 | 65/4 | 80/5 |
|---|---|---|---|
| Loa m | 63 | 78 | 93 |
| Lpp m | 50 | 65 | 80 |
| Displ.t | 1700 | 2450 | 3200 |
| Dwt. t | 900 | 1550 | 2200 |
| As $m^2$ | 1050 | 1400 | 1750 |

The Prototype Cargo Sailer 'MARUTA JAYA 900' (Mighty Wind) was built in the smallest Version 50/3 with 900 t deadweight as a test-bed for the newly developed sailing rig and its operation system. The vessel has two cargo holds and hatches, three masts and only four sails. In view of local production and repair, the rig including the moving spars is made completely of steel. A simple cargo gear of two pairs of coupled booms for union purchase operation is mounted at the Mast behind each hatch.




| | | | | | | |
|---|---|---|---|---|---|---|
| $L_{OA}$ | = | 63.0 m | | Displ. | = | 1630 t |
| $L_{BP}$ | = | 50.0 m | | DWT | = | 870 t |
| B | = | 12.0 m | | | | |
| D | = | 6.5 m | | Sails | = | 1050 $m^2$ |
| T | = | 4.7 m | | Motor | = | 75/100 kW |

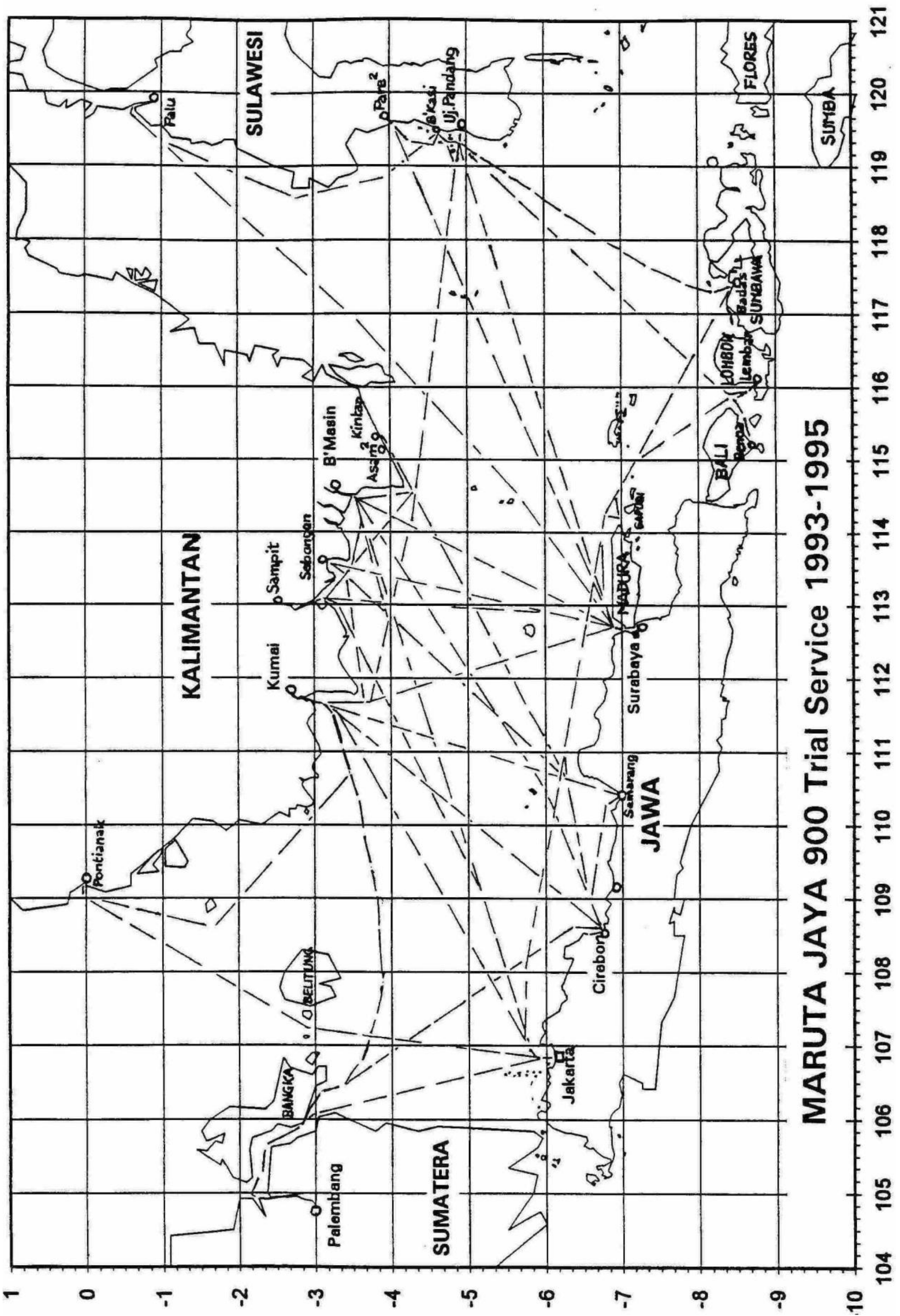
**INDOSAIL Prototype 'MARUTA JAYA 900'**

Two diesel generator sets of only 130 kW each are serving as a power plant to supply AC for board energy and DC fort the propulsion motor. In the normal motor-sailing mode, both functions can be served by one generator set.
After completing the Prototype was extensively tested. The motor-sailing performance and the rig loading confirmed the predictions, and initial technical problems in the electrical operation system of the sail winches could be fixed. Subsequently the vessel went into charter of a local inter-island shipping company for cargo service, which was monitored over two years as a long-term service trial.

**RESULTS OF THE LONG-TERM SERVICE- TRIAL**

For the Service Trial the Prototype-Cargo-Sailer was equipped with a specially developed automatic monitoring system, to record every 30 min the 1 min averages of 16 measurement channels. These included (GPS-) Position and Course, Ship-Speed over ground and through water, Wind-Speed and Direction, Propeller-Speed and Rudder-Angle, Heeling-Angle and Bow-Acceleration as well as Power at the Propeller and for the Board Network. The data were obtained during normal cargo service between June 1993 and December 1995. During this period the ship made 55 cargo voyages, 39 Ballast voyages and 2 voyages fort the Tall Ship Race „SAIL INDONESIA'95“. She made good 34 520 nm in 327 sea-days.

From the monitoring data it was possible to derive not only the sailing and motor-sailing performance but also the ship's own statistics of the encountered wind conditions as approximate true wind-speeds and -directions. The wind was measured more than 40 m above the waterline and the obtained wind-speeds must be reduced by some 15% to be comparable with data valid for the international reference height of 10 m. These values are approximate since the sea current cannot be measured and is therefore neglected as also the apparent wind disturbance by the sail flow at the mast top.




**INDOSAIL Prototype 'MARUTA JAYA 900' – Cargo- Trial-Service 1993 - 1995**

The average wind speed in 10 m height as encountered during 2 ½ years of about 11kts (about Bft 3) is characterising the JAWA SEA (between 3 and 8° south) as a typical equatorial light wind area, governed by the seasonal movement of the trade-winds belt and the local Monsoon-System between the continents of Asia and Australia. The average wind-speed during the long and stable SE-Monsoon was about 12.5 kts (Bft 3-4), while it was only about 8.5 kts (Bft 2) during the transition periods (passing of the equatorial convergence). The maximal wind-speeds found in the coastal thermic circulation or in the open sea areas east of the Jawa-Sea were about 20-25 kts (Bft 6).

The total average of the voyage speeds was only about 4.4 kts, but is confirming with 40% of the average wind speed the predicted level. The average speed of the favourable voyages on reaching and running courses was about 5.5 kts, the best voyages were between 7 and 8 kts and the slowest trips with too close tacking against the monsoon were around 3 kts.

It would be easy to improve this result significantly by additional propulsion power, but the installed power on the prototype was intentionally limited to the minimum level of 100 kW, and the presented result was achieved by using a maximum power of only about 50 kW. It was concluded from the operator's information that the average daily fuel consumption was about 350 kg. The measured average power in the board network was about 25 kW corresponding to about 150 kg fuel per day. The rest of 200 kg/day is well corresponding to the measured average propulsion power of 35kW.

The average time distribution of a typical cargo trip was: 2 days at sea in ballast, 10 days in port or anchoring and only 4 days at sea with cargo. The extreme ratio of port- and ballast-times to the productive time for cargo transport is obviously the main limiting factor for the productivity, and this pattern seems rather typical for the modern sector of Indonesian inter-island trade. An increase in average speed at sea by 20% would be certainly possible by improved sail operation, simple weather-routeing and a moderate increase in propulsion power, but this could only save one of 16 days per trip or 6%. A reduction of the extreme port- and waiting time by only 20% would have the double effect and save 2 days per trip or 12%, and getting cargo for only one of two ballast trips would improve the productivity by at least 25%.

This simple consideration suggests that organisational and operational measures to improve transport productivity, like better education, weather-routeing and port and cargo management, should be preferable to a higher energy expenditure not only for ecological reasons, but it would be also much more efficient and economic!
Without using the potential of these organisational improvements, the economic result shows a typical cost structure according to the operator's account: Insurance and Port >30%, Personnel 35%, Energy 20% and overhead <15% against freight income of 110%. This modest surplus of 10% fort the operator is based on the government, as the owner, carrying most of the maintenance as well as the depreciation of the development and building costs

Here we must recall that the objective of the project cannot be short-term profitability but the long-term replacement of fossil combustion by solar and wind energy. This project is considered as a first step, to use wind propulsion for a significant reduction of the fuel consumption, and it shows still a wide potential for improvements. It is, however, not surprising that new wind-ships, like other technologies for the replacement of fossil energy sources, are only competitive in our present economic environment of still low energy prices, if the distorted energy market is compensated by subsidies. This will remain valid until we are ready to pay ourselves the real (still treated as external) costs for burning coal, oil and gas, instead of passing them to future generations.

Looking at the ‚economic result' we must keep in mind that the prototype is the shortened version of the basic design and that this is the reason fort he relatively low payload. Inserting another module would almost double the payload at constant crew complement and only marginally higher energy demand.

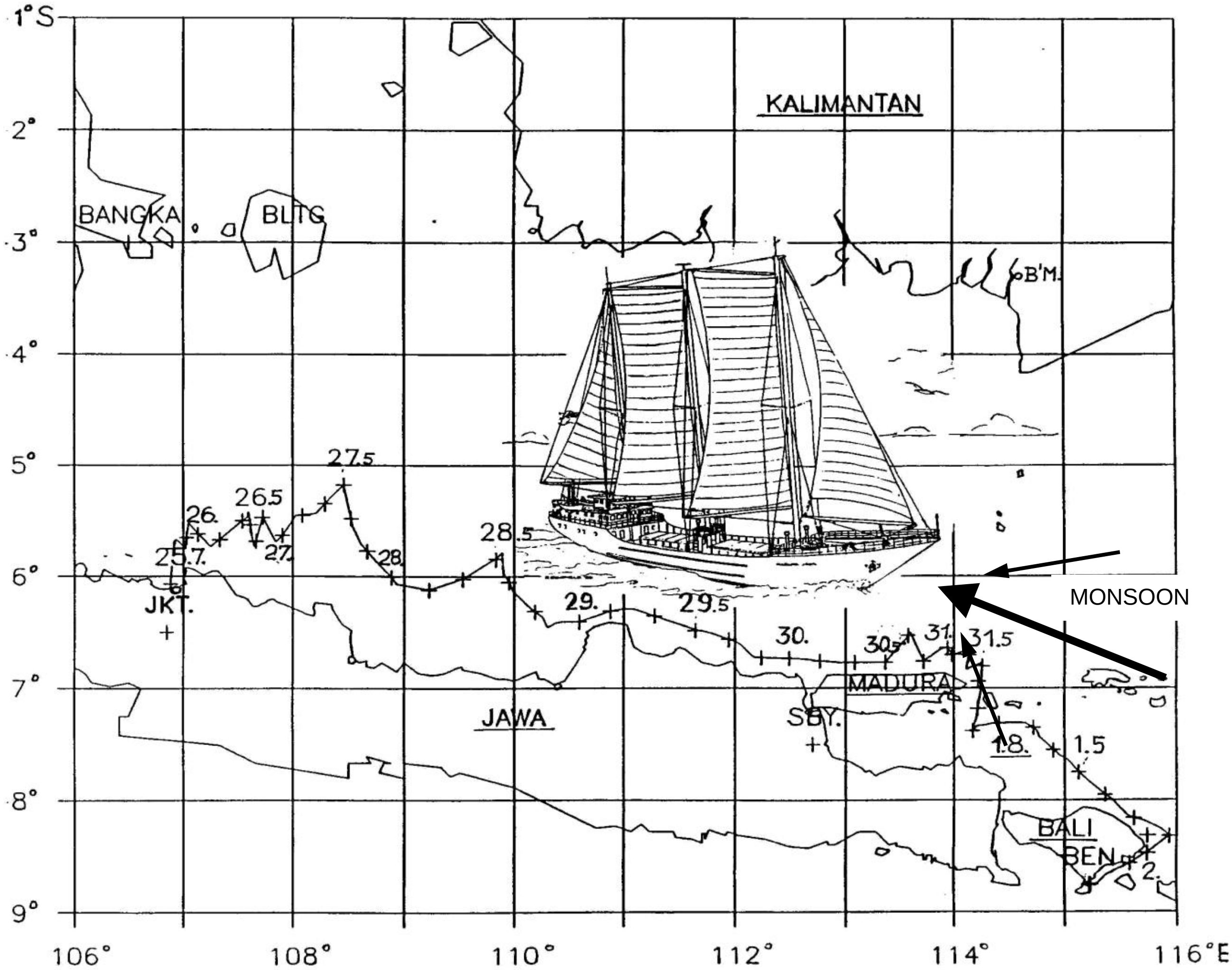
The real crewing demand for sail handling is demonstrated by the example of a private 50 m yacht with the same three-masted INDOSAIL-Rig, which was further improved and simplified according to operation experience from the first vessels. This ship was operated safely and world-wide with two persons on watch and with a complement of four persons.

## OBSERVATIONS ON A ROUND-TRIP

During its trial service, the prototype 'MARUTA JAYA 900' took part in Class A of the Tall-Ship Race "Sail Indonesia'95" to celebrate the 50$^{th}$ anniversary of the Republic of Indonesia in August 1995. Some details of practical sailing can be shown in addition to the general average results on this typical example of trip tacking against the monsoon from Jakarta to Bali and the down-wind race back to Jakarta. The race was also an occasion for a direct comparison with traditional sail-training vessels, all of them rigged as barquentines or topsail schooners with square-sails on the first mast: the 94 m four-masted ‘ESMERALDA’ and the 3-masted ships ‘DEWARUCI’ (50 m), ‘AKOGARE’ (53 m) and ‘LEEUWIN’ (55 m) as well as three smaller vessels.

During the stable East-Monsoon the wind in the Jawa-Sea blows from about 120 – 130° at about (5) 10-20 (25) kts. The direction may vary due to coastal thermic circulation by about ±5 kts in speed and by about ±50° in direction. The local wind in a 50 nm zone along the North coast of Jawa may thus turn to 70° in the afternoon and to 170° after midnight.

The ship was docked in Jakarta before leaving for Bali. She sailed without cargo but with full water-ballast and she started to the hard tacking trip with a set of old baggy sails, chosen for their nice colour and decorated with the sponsor’s logos. She spent the first two days with rather inefficient tacking close to the shore and made good hardly 50 nm a day, INDOSAIL Prototype Cargo Sailer beating for Benoa 25.July - 2. Aug. 1995



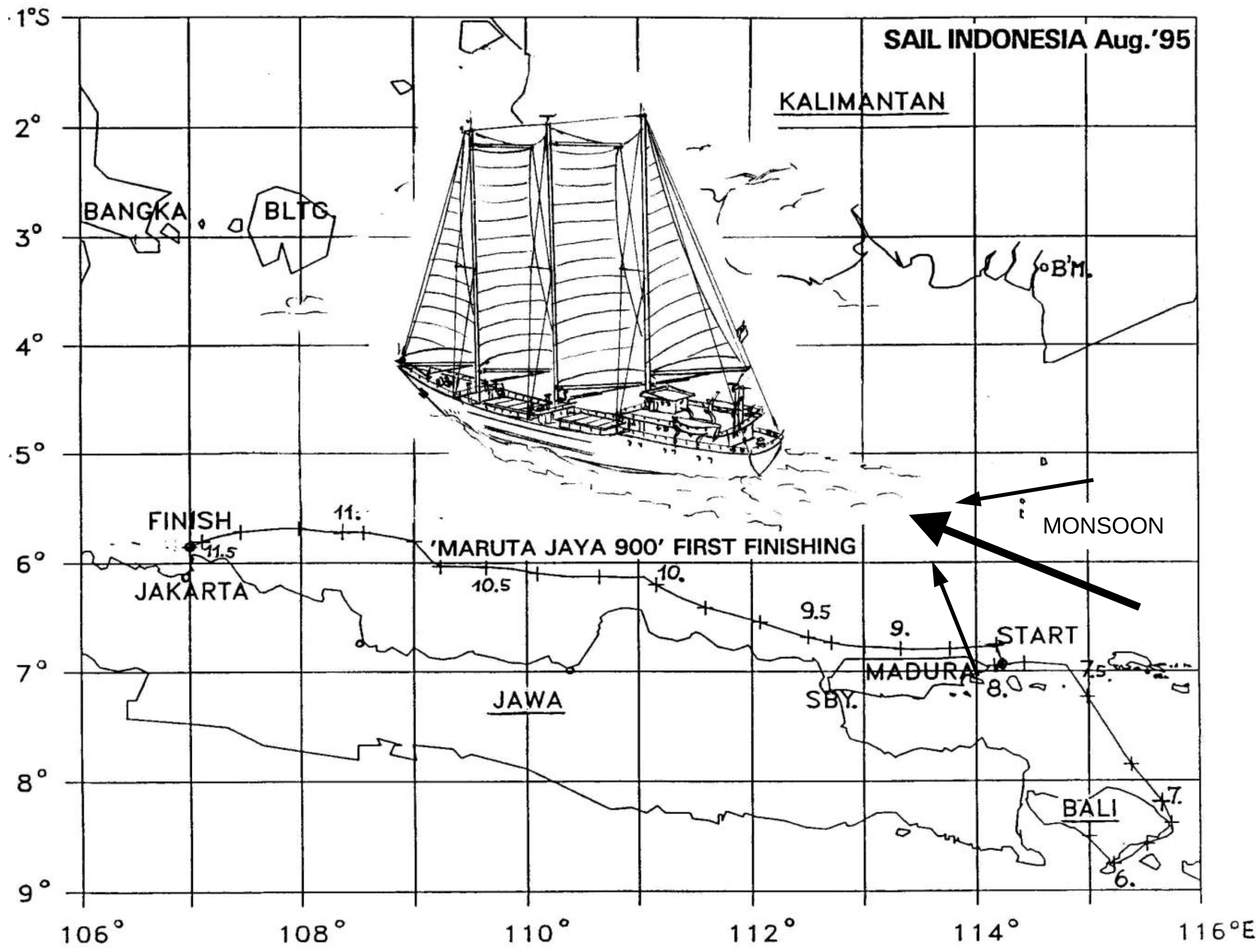

**'MARUTA JAYA 900': Beating against the MONSOON**

At midnight the second day, we got hold of the daily thermical pattern turning the wind at midnight to the South and at noon to North-East. That means: tacking offshore at midnight, when the wind starts blowing from the coast, and tacking inshore at noon, when the sea-breeze is starting – or only one tacking cycle a day, tuned to the cycle of the coastal thermic circulation. This sounds nothing new for an experienced Yachtsman, but it is still impressive, how efficiently it works on a tropical coast even with a multi-mast Tall-Ship, handicapped by baggy sails, light displacement and missing keel. The result was: halving the true tacking angle and doubling the speed-made-good or 100 nm made good on average during the next three days. This is including the effect of about 50 kW of auxiliary power at the fixed-pitch propeller. This result shows also clearly the significance of short-term weather-routeing and of information on the actual and expected weather on the ship's route.

The race was started east of the island of Madura and led over 440 nm westward with the Monsoon to the finish line north of Jakarta. 'MARUTA JAYA 900' with only four fore-and aft sails, without special down-wind sails and with a passively milling fixed-pitch propeller, was not expected to have a real chance against the competitors with higher rigs, forward square-sails and finer hull lines.

She was lucky to cross the starting line just in time, the towering sails of the Barquentines directly behind her. The first leg was a broad reach and everybody was happy but expecting, the impressive competitors would soon overtake her. But surprisingly they fell more and more back, and after four hours, by sunset, only their sails were still showing over the horizon. They were missing at least one knot!

INDOSAIL Prototype Cargo Sailer on Sail Indonesia'95 - Race, 8.-11.Aug.1995




**'MARUTA JAYA 900': Running down the MONSOON**

During the night she made 5 to 7 kts due west, only 10 nm off the coast of Madura. This turned out in the morning as a serious tactical error, when she was almost becalmed during the thermic change too close to the coast. All other ships had obviously done better, to seek more North and to go West rather 50 nm off the coast.

For the rest of the race it became a routine, to follow the general bearing, almost right down the average Monsoon direction on a broad reach of about 150° apparent wind, from Port- or Starboard side, depending on the daily thermic wind shift. Both of the following nights brought fresh breezes of 22 kts average and 26 kts maximum. Then she started running at 9 and 10 kts average and exceeding even 11 kts on occasions, thus making up for some of the calms, at least.

The last night, after passing a calm period again, the main competitors 'ESMERALDA' and 'DEWARUCI' could be traced on the Radar, still far off the coast but already slightly to the West! In the morning, close to the finish, they could be seen to the aft in a dizzy calm, while 'MARUTA JAYA' left them behind again at only 4 kts, long before crossing the finishing line after just three days as 'first ship home'. The next Tall Ships in Class A followed 2, 4 and 5 hours later, the last two one day later.

The joy at the unexpected success was beyond description! The surprise and disbelief on the side of the competitors caused a protest, suggesting she must have used her engine during the race. A record from the sailing performance monitoring system was sufficient to prove that this was not true and even more: the fixed-pitch propeller had been milling all the time as a brake. Even the Indonesian-German project team was surprised at the good result on a down-wind course, with more than 1000 t displacement and only about 1000 m2 fore&aft sails and no downwind sails. Additionally, with more experience, two coastal calms could have been avoided, but always, if the competitors could be seen, i.e. sailing in the same wind, they fell back.

Obviously, the INDOSAIL-Rig, a simple modernised schooner-rig, allows quite efficient down-wind sailing. The most likely explanation is as follows:
At about 150° apparent wind i.e. making good about 160-170° to the true wind, all booms can be set far outboard to about 70° under perfect control of the pre-tensioned system. All four sails, Jib, Fore, Main and Mizzen, are trimmed as round as possible and stand well in the wind. They perform like a series of Spinnakers or Gennakers, not stalling the wind flow but deflecting it by some 120° back to the aft.

This Effect can be utilised much better with the simple and clear sail pattern of this new rig than with the complex and overlapping pattern of traditional rigs.

An enormous thrust is created by using the lift- instead of the drag-forces also when sailing down-wind, i.e. sailing with attached flow instead of separated flow. Obviously, the sail area is less significant than the area of the deflected wind flow. This had not been so clear from the wind-tunnel test results, where the rigid metal sail models had been tested with a constant flat camber of about 10%.

While the Sail-Training Vessels with their finer hull lines and partly new light-weight hulls had shown the performance of well operated traditional rigs on fine hulls, the INDOSAIL Prototype had demonstrated the performance of an even better modern rig on a heavy cargo-ship hull.

## STILL UNEXPLORED POTENTIAL

The operation experience and the success of the INDOSAIL Prototype Vessel show the technical potential provided by a modern efficient and easy-handling soft-sail rig. They can however give also hints on still unexplored potential in the technical and operational field.

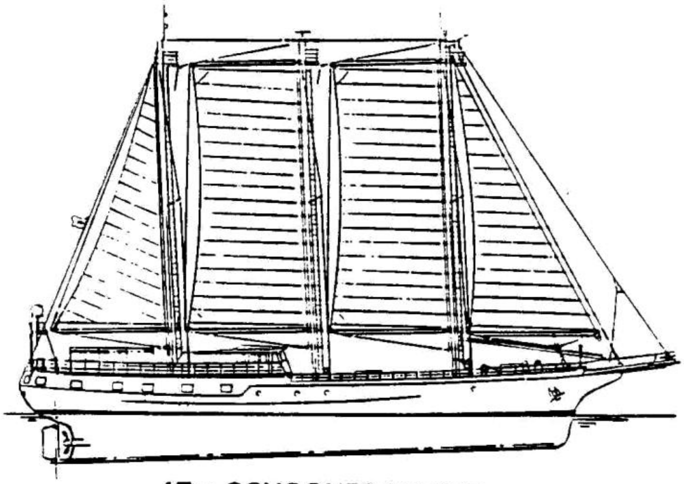
For the commercial use of sail propulsion, also in tropical climate, a strong and stable and particularly durable sail-material is needed, since the operation profile would be significantly different from that of present pleasure- and racing-sails. In the new rig, the sail cloth carries much lower loads and mainly in one direction. On the other hand, the annual operation times and thus the exposition to UV-radiation are significantly higher than in pleasure yachting.

Almost all currently used fibres are breaking down under UV-radiation and moisture sometimes after only 1000 hours of exposition. A promising test with the only durable fibre Polyacril-Nitril (PAN) showed its high UV-stability but also its brittleness at seams and edges. Moreover, technical endless filament of PAN is too expensive in production, cannot be recycled and is hardly anymore available. An interesting possibility could be a new development of a Polyethylene-Copolymer with outstanding properties: higher tensile strength, comparable UV-stability, easy welding and complete recycling at low production cost. For the development and production of suitable filament and sailcloth however, “only” a sufficient market niche for durable sails is needed. – Could that be the joint demand for Charter Yachts, Sail-Training Ships and Sail-Cruising Ships?

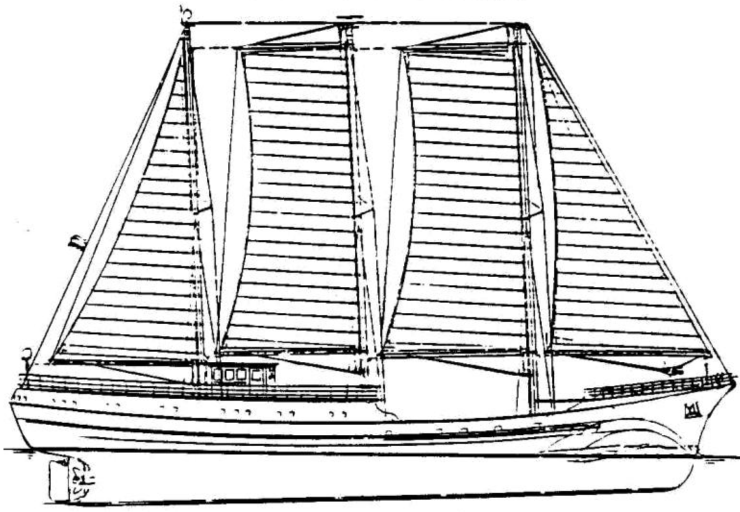
Every use of scarce renewable energy sources, like solar and wind-energy, must care for ultimate efficiency and minimisation of losses. For slowly sailing ships this is mainly the frictional loss, particularly caused by fouling and roughness. This leads directly to a dilemma, if energy saving is sought by toxic coatings with unpredictable dangers for the maritime food chain. Interesting developments are using other effects like extra smooth surfaces, anti-adhesion- or low-energy-surfaces. In general, fouling is hardly growing at speed but almost exclusively during port- and waiting-times, that should be reduced anyway for better productivity.

The energy demand on board of a Wind-Ship could be partly covered by a combination of consequent efficiency and savings e.g. in air- and water-conditioning, by electric and thermic buffering, by electric and thermic use of solar radiation and of surplus wind energy by using the propeller as turbine and the electric motor as generator. This intelligent energy management could certainly cover the demand to such a degree that the diesel generator-set could be turned-off at times of low demand or even used only in exceptional cases as an emergency-generator.

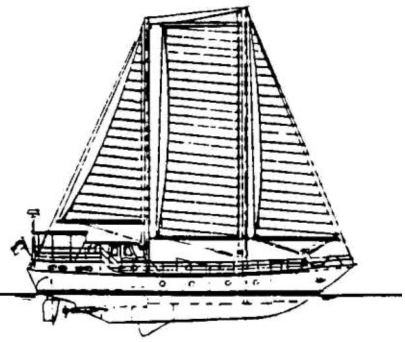
These measures would be technically feasible right now, but would become economically feasible only with still rising fuel costs, e.g. due to rising standards of fuel quality to be enforced by the IMO. There is however a class of organisational and operational measures in the field of training and education, of information-acquisition and –processing, that could significantly improve productivity and economy. These indicated measures include in the first place the know-how transfer from experienced nautical experts on the efficient and safe use of the sailing rig and on suitable voyage-planning and use of the weather data. They also include the implementation of information- and consultancy services covering weather and routeing as well as the whole field of planning and management of port activities.



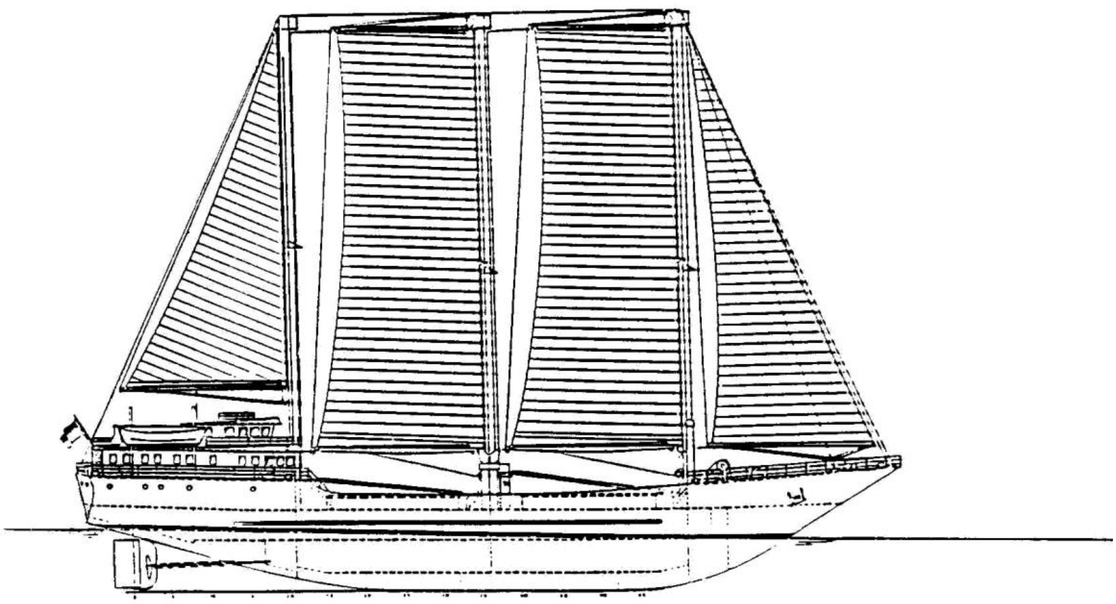
47m SCHOONER YACHT



56m GREENPEACE ACTION VESSEL



25m INDOSAIL TESTVESSEL



63m INDOSAIL CARGO VESSEL PROTOTYPE

EXISTING SAILING VESSELS WITH INDOSAIL-RIG

Why must a rigid schedule be fixed and followed long-term, if in many trades current and advanced telecommunication and management-techniques allow short-term weather-dependent arrival dates to be announced early enough, to start the necessary preparations ashore?

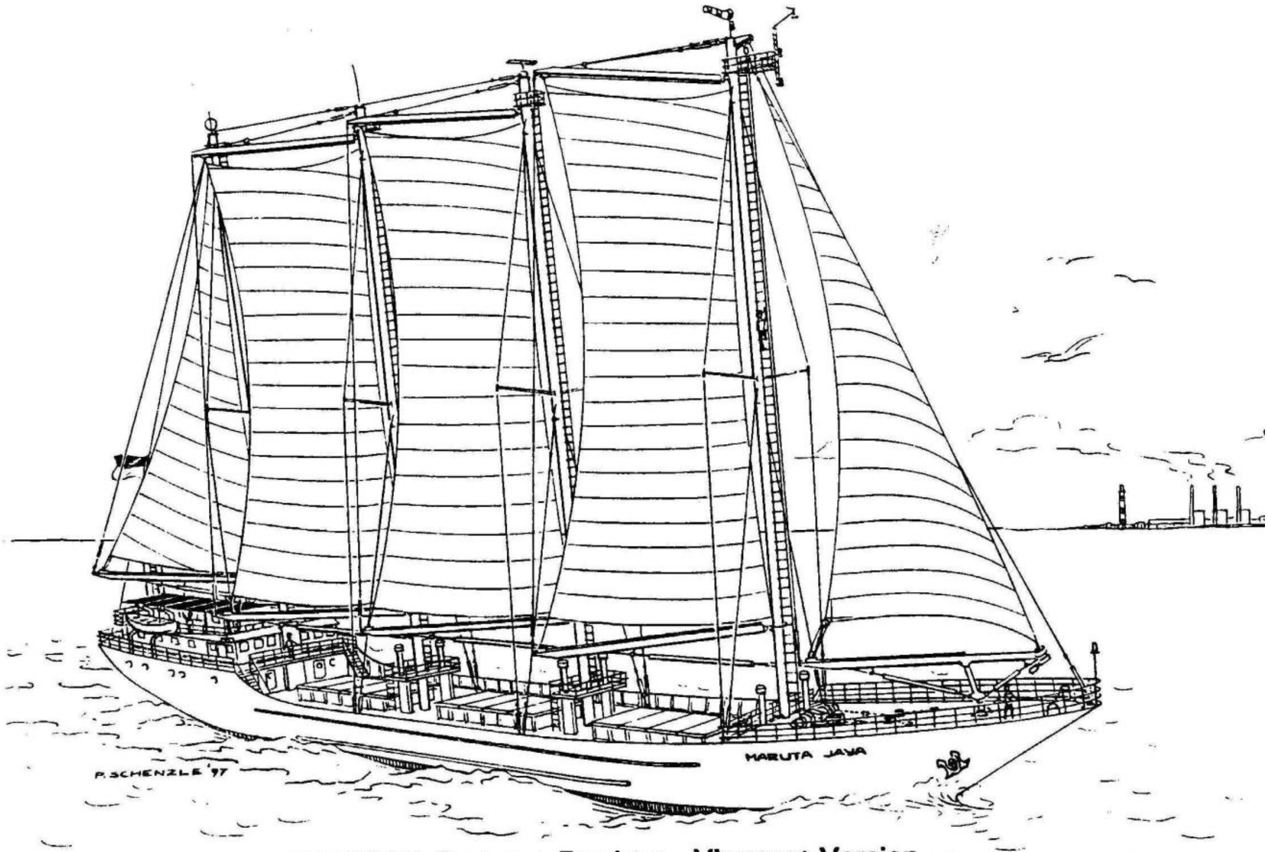
In basic terms, nobody (except for the seller) is really interested in energy consumption, but rather in the benefit it offers. The greatest energy potential is the intelligent and efficient use of the available sources, i.e. achievement of a wanted benefit with less energy. The necessary will, the motivation and interest cannot be created only by material or economic reasons, but perhaps by the desire, to look openly into our children' eyes.

## ACTUALLY POSSIBLE APPLICATIONS

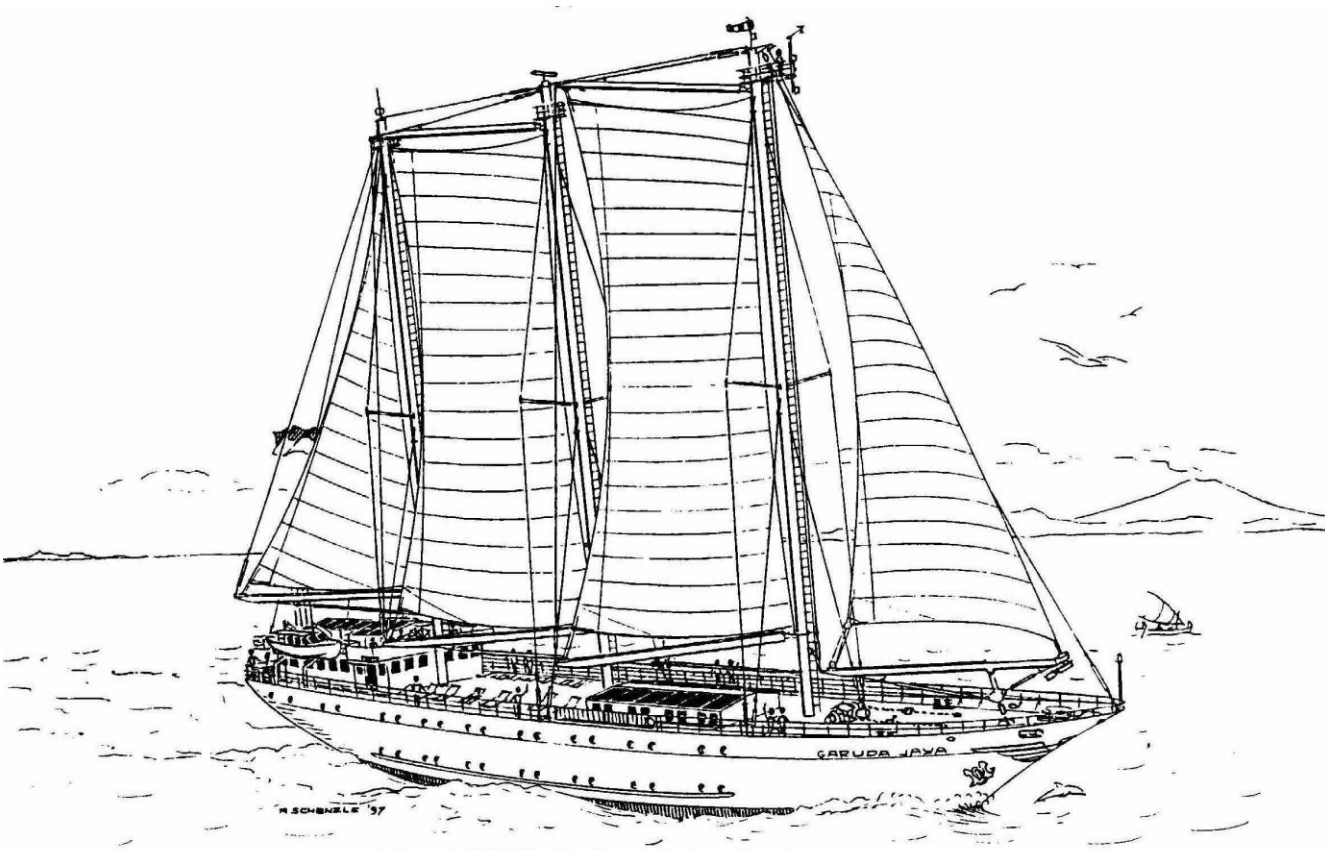
The collected experience of now four years of cargo service has proven the potential of a modern utility sailing rig:

+ easy and safe handling by a small crew,
+ efficient sailing on all headings,
+ well controlled sail trim in every sheeting,
+ easy control of pre-tension by frequency-check,
+ short-term sail opening, continuous reefing and fast furling,
+ safety by ,sheets-off' function,
+ flexible level of mechanisation from hand-winches to semi-automatic. . .

This empirical basis is encouraging to apply this technology and to proceed on the way to the ,SOLAR SHIP' as Prof. Habibie has called the long-term objective of this cooperation project. And just since then, the urgent necessity of a basic change in our relation to energy and environment for future generations has become so obvious that it seems incredible that governments still ignore the fact.




**INDOSAIL Prototyp-Frachter - Viermast-Version**




**INDOSAIL Kreuzfahrt-Segler**

The paradox situation at the turn of the millennium is the general awareness that the natural environment is urgently calling for a change, while the economic environment is still not ready for it. This can certainly not be extended permanently, but meanwhile sustainable or ‘solar-‘ technologies are in some sort of stand-by condition and can be developed only with the aid of subsidies or in certain ‘niches’, where criteria other than short-term profitability play an important role, such as silence, cleanness, independence, fun or recreation. Such niches with special boundary-conditions have ever been playing a significant role in the evolution of life on this planet, and they offer a chance to develop new technologies and to train new patterns of thinking and behaviour towards equilibrium of Economy and Ecology or of Energy and Time.

A suitable test-bed for wind-propulsion and solar energy would be handy research vessels for oceanographic, biological and environmental investigations, where silent ship, clean air and water as well as long endurance at sea at limited fuel capacity are more important than high ship-speed. It is also a general experience that working and living conditions on small ships in rough seas can be significantly improved by the stabilising effect of sails. These arguments are valid also for smaller fishing vessels with careful fishing techniques, where endurance and working conditions are of special significance, and where the trip home under sail could be better used for the processing of the catch.

Perhaps a still more interesting niche could be a new concept for a natural recreation at sea, where the route and the port-sequence would be less important than experiencing the sea and the wind and the precious bays, reefs and islands visited. Solar and advanced sail technologies could be installed on larger Charter-Yachts and handy Sail-Cruising Ships, where fast and easy sail handling and higher beating angles offer more chances of real sailing adventure hours per cruising week than nostalgically beautiful but too labour-intensive and performance-limited traditional rigs. This would be also a suitable occasion to communicate knowledge, experience and responsibility for our endangered environment to a wider public. Why not offer ‘ecological adventure turns’ for the younger generation as a stimulating training for tomorrow.

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