Dutch naval architect Peter van Oossanen has tank-tested over a thousand models, both power and sail. But none more famous than *Australia II*, with her wing keel.

If as a naval architect your specialty is optimizing the hulls and appendages of large motor yachts, you’d be hard-pressed to find a better country in which to practice than The Netherlands, and more specifically, the town southeast of Amsterdam called Wageningen, home of MARIN, the well-known Marine Research Institute, where a great deal of testing is conducted. The studio of Van Oossanen & Associates is located here, in a small office complex with a brick courtyard and many shade trees. Peter van Oossanen is Dutch, but he hasn’t always lived in his native land, and only in the past 17 years has he operated independently under his own shingle. What has remained constant in his career is an insatiable quest for precise data about the efficiency of various hull forms—power and sail. Few men, if any, have spent more time tank-testing models—more than 1,000 by his count. Today, however, he says computers provide him better answers.

**War Baby**

Van Oossanen was born during World War II, June 1943, in Haarlem. His father worked in a shipyard, as did his father before him, at the RDM yard.
in Rotterdam, where he was master carpenter for designing and building the woodwork for some of the great passenger liners built there. Peter van Oossanen treasures a book showcasing his grandfather's grand staircases. When Germany surrendered in 1945, hundreds of thousands of Europeans left their homelands because there were no jobs; there was no economy. The Van Oossanens emigrated to Sydney, Australia. For reasons that only boat lovers understand, Peter wanted to study naval architecture. In 1960 the sole program Down Under was at the University of New South Wales, and only part-time at that, so a bachelor's degree required eight years to complete. Because apprenticeships in design offices or yards were few and far between, Van Oossanen took a part-time job with a building contractor.

In his third year, everything changed. "There was a lecture about hull and propeller design, and the lecturer told us something about a very famous model basin—the Netherlands Ship Model Basin (later renamed Maritime Research Institute of the Netherlands but universally known by its acronym, MARIN; we'll stay with the acronym throughout to minimize confusion). He told us about their capabilities, and of the many publications and books written by and about the Institute staff, I went home that evening. Mom and Dad were sitting at the table, I said to them, 'Were you aware that Holland has such a good name in naval architecture?'" "It was all very quiet for the next few days. Then on a Saturday morning, at breakfast, when my brother and sister and Mom..."
and Dad were seated, my dad said, 'I have an announcement to make: We’re all going back to The Netherlands.’ We sorted out what we wanted to sell and what to take with us. In the Aussie summer of 1963 we moved back here.”

Van Oossanen enrolled at Delft University of Technology, graduating in 1969 with a master’s degree in naval architecture, specializing in ship hydrodynamics. One of his professors was also a director at MARIN, and he invited Van Oossanen to do his doctoral thesis at the facility in Wageningen. Now married, Van Oossanen and his wife moved there and started a family. Van Oossanen joined the research department, specializing, he says, “in hull shapes, propulsors, things like that.” He earned his PhD in 1974, writing his doctoral thesis on propulsors and the prediction of propeller cavitation, noise, and vibration. His involvement in yacht design began the next year.

Van Oossanen: “My hobby really is mathematics. What I like most is solving a problem—whether it be a hull design problem or a hydrodynamics problem—through a mathematical model.

“I was impressed by a paper that came out through SNAM I (the New Jersey–based Society of Naval Architects and Marine Engineers) on what we now call a VPP—velocity prediction program—which was in its infancy in those days. A guy named Hugo Myers had presented a paper at one of the early Chesapeake Sailing Yacht Symposiums [Annapolis, Maryland] on a math model for predicting the speed of sailing yachts.

“I studied that paper very carefully, and then had a conversation with the director at MARIN, which had done some model testing on the J-class Ranger [America’s Cup yacht] during the war. He said to me, ‘Yes, we’ve neglected that area of naval

much wanted to set the record straight. Despite his long-standing affection for Australia, where he grew up, he wished to clarify the roles he and Lexcen played; in short, to give credit where credit is due. Though many of the details of the 1983 differing were reported in the book Ups and Downs, by Michael Levitt and Barbara Lloyd, and in a paper written by Van Oossanen published by the Society of Naval Architects and Marine Engineers (Jersey City, New Jersey) in 1985, Van Oossanen’s present take on those events is quite interesting.

After Alan Bond failed to win the 1977 Cup with Australia (Bond had also funded the 1974 challenge), Van Oossanen wrote a letter to Bond, enclosing an early copy of the paper he would later present to the Chesapeake Sailing Yacht Symposium, in Annapolis, Maryland. Here, we’ll let Van Oossanen pick up the story:

“Lo and behold, I got a letter back from Alan Bond quite quickly, asking whether I could come over and meet with him and Ben Lexcen. I happened to know Ben, a little, because when I lived in Sydney I was sailing Moths at the Balmore Sailing Club. Ben was also a member of that club.

“I went to Perth and met up with Alan. He was particularly interested in organization and cost: what it would cost to enlist the services of the Netherlands Ship Model Basin. He asked me to work out Sydney and meet up with Ben, which I did. We spent the whole weekend together. Ben came over to The Netherlands and two months later it

Winged Victory

In the summer of 1983, in the months leading up to the 25th America’s Cup competition in Newport, Rhode Island, a storm of controversy gathered over the challenging Australian and defending New York Yacht Club syndicates.

At that time, the rules governing the Cup required that each yacht be designed by citizens of the country it represented. The principal designer of Australia II, the eventual winner, was indeed a “national”—Ben Lexcen. Much of the development work on that boat, however, was performed at the Netherlands Ship Model Basin (now known by the acronym MARIN), in Wageningen, by Peter van Oossanen. On seeing Australia II perform in the challenge trials in Rhode Island Sound, the New York Yacht Club sought to disqualify her on the basis of the rules cited above. But to do so, the NYYC had to establish that Van Oossanen, not Lexcen, had designed the boat, or had made a significant contribution. Though he didn’t know how to run a computer, Lexcen maintained an office at MARIN; all insisted he was the team leader. In the end, the issue was dropped. Australia II competed, and won in a stirring seventh and final race.

Prior to my visit with Van Oossanen in Wageningen, I’d been warned that he was tired of talking about the famous wing keel, and that his more recent work was overlooked. When we sat down to an interview in his conference room, it turned out that Van Oossanen very
architecture altogether since the war.' MARIN made a lot of money in those days, and there was a budget for any type of 'hobby' project with merit. He asked me what sort of budget I needed, how much time I needed, the facilities I needed, and if I wanted to do some model testing and computing. Of course I did.

"I elected to first develop a VPP for 12-Meter yachts. I took a generic 12-Meter and after a lot of work wrote my paper; it's got a long title: 'Theoretical Estimation of the Influence of Some Main Design Factors on the Performance of International Twelve Meter Class Yachts.' The math model identified what lengths, displacements, sail areas, and stability a 12-Meter had to have to do well. I presented the paper at the 1979 Chesapeake Sailing Yacht Symposium, where I predicted that the smallest possible 12-Meter with the biggest possible sail area—with maximum stability—would win the America's Cup.

"A guy in the front row got up and he said, 'Very interesting paper, but there's something wrong somewhere. The problem is there's a bit of wind in September in Rhode Island, so you need a fairly long waterline; you don't need a bigger sail area, and those boats are faster than the boats you've described.'

"I pointed out to him that if you can put a little more ballast in the keel and increase stability, then the trend I pinpointed was the correct trend—with the shorter waterline."

Designer Olin Stephens, of Sparkman & Stephens (New York City), also disagreed with Van Oossanen's conclusion that for true wind speeds up to about 15 knots the optimum 12-Meter size (in terms of length and displacement) is less than the designs then adopted for the America's Cup. Later, after Australia II (the smallest 12-Meter was all canceled. Alan was in some financial difficulty. I kept on working at what was now called MARIN for the next two years. Did some studies and model testing. And then out of the blue, Ben visited me early in 1981. Ben said, 'We're on.'

"We spent the day together in Wageningen. Then I got a telex from Warren Jones [Bond's project manager] asking me to meet him in Perth, Australia, which I did in March or April '81. Contracts were signed and details discussed, such as confidentiality. We started work in April-May. We very quickly built a model of Australia. I had suggested a whole series of keel tests because I felt that the keel was lacking. While this was going on I visited the National Aerospace Laboratory in Amsterdam. I met with their chief aerodynamicist, Joop Slooff, who was also a bit of a yachting bloke. He would play a very important role in what was to follow.

"We identified four different keels with different taper ratios and aspect ratios: a swept-back configuration where the sweep on the leading edge is the same as the sweep on the trailing edge; a keel without any sweep at all; a keel with an upside-down configuration; and a keel with a leaning-forward sweep. One of the things I had learned as a researcher is that if you make small changes in any of your parameters, you're going to get results that are very close together, and it's hard to discern a trend. What you have to do is make big jumps in your parameter field and pick up on the big trends. We elected to do just that, and arranged with the Australians to test different keels in the tank. It was a major cost item.

"During our conversation Slooff said to me, 'We have a computer program that at least for airplanes is capable of pinpointing the viscous drag, the induced drag, and the lift forces.' Slooff also said to me, 'If you give us a contract, we can develop the code a little bit to get some idea about the wave resistance.' Because when you produce any sort of force just below the water surface, like a keel will do, you also have a wave-resistance component.

"Slooff came to Wageningen with his results just as we were about to test the second model in the tank. He pinpointed the inverse taper/upside-down keel as being quite superior to the other three for the low-aspect-ratio configuration we were looking at. I was impressed, because the results were quite a bit better. He said to me, 'The only problem we can see with this upside-down keel is the major tip vortex at the bottom, because the chord length is quite long there. It's a worry. If we can find something to fix it, this keel will be a major improvement.'

"Then he mentioned the word winglets, and he cited a patent by NASA's Richard Whitcomb, in 1978. Nearly the same configuration as on the Boeing 747, except Whitcomb's concept utilizes two winglets, including a small winglet pointing downward at the very front of the wingtip.

"What a winglet does is this: At the tip of any lifting surface there is a major flow from the high-pressure side to the low-pressure side, around the tip. Depending on how highly loaded the wing is, the vorticity in this roll-up mechanism can be either small or major. There's a huge amount of energy in there, and if you can recover it, it makes the wing much more efficient. The winglet has a very special setting. Relative to the incoming flow, it produces a lift force in a plane normal [perpendicular] to the winglet that counteracts the tendency of the flow to want to go around the wing tip.

"If you test a keel with winglets in a wind tunnel and visualize the flow, you see a small vortex coming off the tip of the winglet—but none where the old tip was. It's a very efficient way of getting rid of the tip vortex or decreasing it substantially."

"While all this was going on, Ben Lexcen wasn't in The Netherlands; he was back in Australia. I sent a telex to Warren [Jones] and Ben saying we needed to test this. Ben came over a second time, and he and I started sketching what the winglets would have to look like on a keel. On a keel you obviously need two winglets, for port and starboard tucks, because the lift direction changes.

"We at MARIN made the drawings for the upside-down keel. Ben had nothing to do with it. He wasn't even here when we tested it. The
to race for the Cup, with a waterline length of 44.25/13.5m) had the historic America's Cup in 1983, Stephens apologized to Van Oossanen.

For a detailed account of Van Oossanen's key role in the design of Australia II, see "Winged Victory," the sidebar on page 52. Significant here is that via the Cup, Van Oossanen established himself as a highly credible hydrodynamicist. He worked on several subsequent America's Cup campaigns, even living in Australia again for a while, but ultimately the next few years were spent back at MARIN testing models of designs for the Institute's many clients. Those models total more than 1,000. Of that number, 160 were 12-Meters, with 30-40 of the designs actually getting built.

Eventually Van Oossanen grew tired of evaluating the work of other naval architects. Often he could identify the weakness in a design even before testing, but says it wasn’t his place to critique it, only to have a model built and to test it. When the need to develop his own designs for his own clientele grew too strong, he left MARIN. That was in 1989.

Van Oossanen moved to Australia for three years while working on Sydney Fishers' America's Cup challenge. Underfinanced, it did not end well, and Van Oossanen regrets his involvement. So in 1992, he returned to Wageningen and set up his own company.

numbers were miraculously better. When we saw the numbers out of the tank there was no doubt to us that the improvement was substantial: about 25% less induced drag going upwind for the same side force. Huge!

"The next noteworthy occurrence came when Alan Bond, Warren Jones, and skipper John Bertrand came over in August '81. That was a very difficult meeting because they only had an afternoon to spare. They flew in on a private jet. We picked them up. John Bertrand set the scene at the start of the meeting. He said, 'Hey guys, you don't think I'm a fool, do you? There's no way we're going to build a boat like that or anything that even resembles it! We'll be the laughingstock of the whole yachting community.'

"Warren was a shrewd character. He had great respect for our ability. He said, 'Well, hang on, John. Let Peter tell his story and we'll discuss this afterwards.'

"I went through it and explained it to them. I had Warren and Alan utterly convinced. John has a degree from MIT, but I think he didn't understand what I was presenting. He doesn't want to take risks, especially when helming the boat.

"Anyway, Warren pulled me to one side as they were leaving, and said, 'Peter, Alan has enough money. We're going to build two boats—a radical boat and a normal boat. So we can cover all our avenues and possibilities.' "And that's exactly what happened. Australia II, with the wing keel, won out. The conventional boat was sold, and also campaigned in '83 as Challenge 12. But I'm getting ahead of the story.

"After all these tests were done and Steve Ward, the builder in Fremantle, was preparing to build, we did a final set of predictions. They showed that in very light conditions, say 6 knots of wind, the wetted surface area of the boat was still more than we wanted—because the winglets were adding wetted surface. In very light conditions the keel performance is not a big part of the makeup of the boat. Because the upside-down configuration has a lot more ballast, I suggested cutting down the waterline length to the bare minimum, which was 443/4' (13.5m), reducing the displacement by 1/4 tons, and increasing sail area. I went back to my paper of 1979. I then had to explain all this to the group in Australia, and they all agreed. We did the final set of full-scale loftings, the final hull design, the final keel design. It was all done by us. I went to see Steve Ward in Perth to get him going. The boat was built in aluminum, of course. Ben made the construction drawings. Lloyd's approved the design and construction drawings. The boat was built.

"Initially, John Bertrand failed to realize the boat needed to be pointed very, very high. If you don't sail at the correct VMG [velocity made good: a measurement of time to cover a distance between two points] then the boat is only as fast as any other good 12-Meter. You need to lift the boat up 3°-4° higher. We discovered that the boat maneuvered very, very well. The waterplane area was a lot less, and there was free flow around the hull because the keel chord at the top was so short.

"There was an Australian Cup event just prior to the boat going to Newport, with three or four other 12s participating. The Americans should have realized something new was going on, because Australia II won all of those races by minutes.

"Later, in the finals at Newport, after four races, Dennis Conner in Liberty was up 3-1. Dennis is a shrewd sailor, one of the very best. In the next few races Australia II won by three minutes and more. On each windward leg she was far ahead. It went to the final seventh race, in light, shifty conditions. Again the Australians were behind, except for the second-to-last leg, downwind, when Dennis didn't cover Australia II. Dennis went over on the port side of the course and Australia went to the starboard side. Dennis should have jibed and covered. When they came down to the bottom mark Australia was ahead by something like 30 seconds, and won the race by 45 seconds."

—Dan Spratt
"We're at least one level up from your average naval architect's office," he says. "We conduct a lot of scientific work here. Many naval architects and yacht designers trust us with their R&D. We're doing a job right now—optimizing a bulb design—for a well-known U.S.-based naval architect, optimizing a bulb design for a well-known U.S.-based naval architect, while for [The Netherlands-based N.A.] André Hoek we recently developed full 3D models of all available lines plans of J-class yachts, and analyzed these by way of VPP and CFD (computational fluid dynamics) to determine which of them was fastest in specific wind conditions."

And that's hardly all. Among other current projects, the Van Oossanen firm is designing a 180' (55m) motoryacht for Heesen (Oss, The Netherlands), and a 148' (45m) motoryacht for a Russian yard—both styled by Omega Architects (Druten, The Netherlands); a 118' (36m) motoryacht for a German owner; a 138' (42m) motoryacht in composite material; and a 121' (37m) cruising sailing yacht to be built in Turkey. On the scientific side, the company is analyzing the strength and stiffness (using finite element modeling) of the hull and lifting keel for a 217' (66m) Ed Dubois design being built at Vitters (Zwartsluis, The Netherlands), plus a string of projects involving CFD.

In addition to Van Oossanen, Peter's staff includes his son Perry, a graduate of Haarlem University, who is being groomed to one day take over the firm; naval architects Niels Moerke and Geert Verheij; and hydrodynamicists Juryk Henrichs and Sebastiaan Zaatier.

Van Oossanen & Associates does not design marine systems; rather, the firm focuses principally on hullforms, layout, 3D modeling, construction, stability, resistance and powering, and other performance-related areas. "We never subcontract shape, performance, or safety; or behavior in waves, such as rolling with stabilizing systems," Van Oossanen says.

Simply put, hydrodynamics is the shop specialty, and Van Oossanen has invested heavily in computational fluid dynamics. For naval architecture, lines plans, and development of keels, his office runs MaxSurf, finishing it off in Rhino for detailing; AutoCAD for layout; Ship Constructor for detailed structural design, and Van Oossanen's own software for VPP, resistance, and powering. The firm runs FEMAP for finite element modeling, and some special tools for the design of composite yachts.

Following are brief descriptions of several of VO&A's areas of expertise.

### The Fast Displacement Hullform

In recent years, the design of luxury motoryachts has focused on ever-higher speeds. Design briefs often state speeds that would require traditional displacement-type motoryachts to be pushed beyond hull speed, into or just over the primary resistance hump. Van Oossanen says that for a typical motoryacht of 40m to 50m (131' to 164'), speeds between 18 and 20 knots (corresponding with Froude numbers between 0.45 and 0.55) are no longer an exception. For many semi-displacement motoryachts, speeds are typically between 25 and 30 knots, or Froude numbers between 0.60 to 0.85.

The reality, however, is that once the yachts are launched, most of them hardly ever run at top speed; instead, they typically operate at a cruising speed of just 12 or 13 knots (Froude numbers of about 0.30 to 0.35). "Obviously," Van Oossanen says, "a hull well designed for a speed of 20 knots is usually not very efficient running at 12 or 13 knots, and vice versa. This not only affects the economic efficiency of the yacht, but also the environment."

VO&A's solution is the "fast displacement" hullform, intended to attain the high speeds clients want in the semi-displacement speed range, and still be efficient and economical at slower displacement speeds. The firm spent a lot of time working on the problem with CFD and in the towing tank.

"This hullform," Van Oossanen explains, "is a hybrid round-bilge hull that incorporates a chine in the forward part of the hull, a small immersed transom, and has 'smart' running trim control by means of a combination of specially shaped propeller tunnels (fitted with trim wedges), and adjustable interceptors. The bulbous bow is an important feature of this concept, and recent findings have led to the conclusion that at semi-displacement speeds a bulbous bow still considerably reduces the overall resistance of the hull."

"In order to arrive at an optimum bulbous bow shape and solve other specific optimization problems, we now use a fully automated hullform optimization routine developed by Friendship Systems, in Germany. The bulbous bow is modeled in a parametric geometry modeler. Employing a fully automated variation and optimization routine, a large number of designs (10,000 or more) are derived and analyzed in a non-viscous CFD code. The best result can then be verified and further developed by means of VO&A's proprietary RANS CFD code, or by model testing in the towing tank."

The fast displacement hullform, Van Oossanen says, has low resistance...
The model seen on the facing page is prepared at left for tank-testing. Note the “loose” bulb; this model was run with and without the bulbous bow to investigate its merits. The bulb yielded resistance reductions up to 15% at cruising speed, and also proved to be effective at fairly high speeds.

Stating that more clients now want “green yachts,” he says the fast displacement hullform results in lower engine emissions.

**Computational Fluid Dynamics**

Van Oossanen selected ISIS CFD software over Fluent and CFX, but it did not come cheap: €100,000 ($138,500) per year for a two-user license. He says only one or two other yacht designers in the world have similar software, and none in the Netherlands. Consequently, he’s asked “to do all sorts of jobs in ship and yacht design.”

Van Oossanen: “We always run CFD
The model of a 43'/13.5m motoryacht is running at 27 knots full-scale speed in the Wolfson Unit towing tank on the Isle of Wight in the U.K. Note the highly effective topsides knuckle, which keeps the hull dry at high speeds. (This boat was delivered last summer by Dutch Yacht Builders, in The Netherlands.)

for our in-house designs—hull and appendages. Fifty percent of our CFD work is for our own designs, and 50% is associated with consulting and doing R&D for others. I like that ratio. It makes us rather immune from crises like the one we’re in now. We work for other naval architects and designers, shipyards, and merchant-shipping companies."

Exploration of new concepts is done by CFD, but, Van Oossanen says, “At the end of the day, you like to see your final design validated in the tank. We have hundreds and hundreds of model tests on file. We run a computer cluster of 76 CPUs [central processing units] in parallel. ‘Meshes’ between 5 and 10 million are common but sometimes as large as 20 million. We can divide a flow space into 20 million little cells. In each cell we solve all the differential equations that govern the flow, pressure, flow
speed...that sort of thing."

He says those jobs take about three
days to run, so he’s thinking of expand-
ing the hardware bank to more than
100 CPUs.

Regarding his decision to invest so
expensively in CFD, Van Oossanen
says that as recently as the 2002
America’s Cup, CFD was not accurate
enough to have great confidence in.
“You could possibly rank best-to-worst
candidate boats, but you couldn’t get
close enough to the actual resistance
or side forces,” he says. “Quite a bit of
progress has since been made in
what we call turbulence models and
other CFD modeling topics. After all,
it’s the development of the boundary
layer and the turbulence in the flow
around any vessel that determine its
drag, together with the waves the
hull produces.

“We decided in 2004 to have a look
at CFD again. To our amazement we
found the results were very, very close
to model tests. We compared CFD pre-
dictions to model test results, and found
they were within a few percent. We
bought a license to the Comet code
developed by CD Adapco, the same
one used by the BMW ORACLE
America’s Cup group. But we were not

happy with this code because the
meshing was basically a manual thing,
which took a lot of time, and the results
were too dependent on code settings.
We then heard about the new ISIS code,
developed by the Ecole Centrale de
Nantes, which yields very accurate
results and utilizes an automatic mesher
developed by Numeca International,
in Brussels. After some discussions
with both parties we became the first
commercial user of ISIS.

“This might sound strange, but if
there’s a difference between CFD pre-
dictions and the model test, I now
query the model test first. That may
seem like putting things upside
down, but having been involved in
model testing for nearly 40 years and
having worked at MARIN for more
than 20 years, I know that in model
testing, if you’re not careful in
preparing the experimental setup and aligning the dynamometers, you can easily get bad data.

“When we explore a design we use CFD. If, at day’s end, we feel happier with a model test—particularly if the client also feels happier—then we’ll do a final model test. Roughly two-thirds of our tests are currently done with the Wolfson Unit [Southampton, U.K.], and a quarter at MARIN. Occasionally we’ll go elsewhere.”

VPP
Between 1976 and 1978 Peter van Oossanen developed the first version of VO&A’s present in-house velocity

A polar diagram of the Dutch Regenboog class yachts, in deep and in shallow water. (Regenboog means rainbow.) These are based on VPP and CFD analyses. The reduction in boat speeds in shallow water is evident. These figures are part of an analysis of the class rules to determine if factors such as crew weight and hull material were correctly included.
prediction program. As noted earlier, Van Oossanen was initially introduced to VPP at the Chesapeake Sailing Yacht Symposium in 1975, when Hugo Myers delivered his paper titled "Theory of Sailing Applied to Ocean Racing Yachts." That was, perhaps, the first VPP ever developed.

The first iteration of Van Oossanen's VPP was largely based on the Myers formulations, and in its initial application he carried out a systematic study of the performance of 12-Meter yachts, the class of yachts that competed then in the America's Cup.

After leaving MARIN in 1989, Yan Oossanen further developed his VPP to include the effect of helm angle. Standard VPPs, he notes, solve the equations to find boat speed, heel, and leeway angle. Van Oossanen also included the solution of the equilibrium rudder angle, solving for moment equilibrium in the horizontal plane, which necessitated adding equations on the location in space of the point of application of all force data acting on a sailing yacht, in terms of the x, y, and z coordinates of that location.

In 2001 Perry van Oossanen took over responsibility for VPP development at VO&A. Like his father, he has considerable mathematical ability. Perry since refined the method of solving the system of equations, and of solving for the four main unknowns (boat speed, heel angle, leeway angle, rudder angle), for modeling more types of appendages. These include: canting keels, dual rudders, leeboards, daggerboards, propeller shafts with struts and bossings, the propeller—along with other factors such as the effects of shallow water, and the aerodynamic forces on a range of rig types.

Winglets

Since playing an instrumental role in developing the so-called wing keel for Australia II (again, see the sidebar, "Winged Victory"), VO&A has designed hundreds of keels with winglets, for both racing and cruising yachts. Van Oossanen says the main benefit of winglets is the associated increase in effective aspect ratio, causing a steeper lift-curve slope and a reduction in induced drag. In addition, when given substantial volume and filled with ballast, winglets increase stability.

Van Oossanen: "It follows that winglets are of particular benefit when the keel has a low aspect ratio—meaning, a low keel span-to-chord ratio. For the International 5.5-, 6-, 8- and 12-Meter classes, where the span-to-chord ratio is less than 1.0, winglets easily increase the lift of the keel by some 20% and reduce the induced drag by a similar amount. In those cases, it's possible to reduce the lateral area of the keel, to compensate for the added wetted area of the winglets.

"But even for high-aspect-ratio keels such as are employed on modern racing yachts, slender winglets will still enhance performance when sailing to windward, although the gains in that case are only on the order of 5% or so for both lift and induced drag. For racing yachts this is still very worthwhile, whereas for cruising yachts it is usually not significant
The winglets for Ethereal, a 190' (58m) ketch built by the Royal Huisman Shipyard, in The Netherlands. The winglets span about 13' (4m) from tip to tip. Van Oossanen performed CFD calculations to verify the performance gains attributed to the winglets. The winglets for Ethereal, a 190' (58m) ketch built by the Royal Huisman Shipyard, in The Netherlands. The winglets span about 13' (4m) from tip to tip. Van Oossanen performed CFD calculations to verify the performance gains attributed to the winglets.

near the leading edge of the keel. The winglets need to effectively reduce this cross-flow—the cause of the well-known tip vortex at the keel tip. It is this effect of the winglets that increases the lift curve slope and reduces the induced drag. Van Oossanen served as chairman of the Netherlands Society of Naval Architects and Yacht Designers for 10 years and calls it a job and a half, requiring one day a week of his attention. A noteworthy achievement of his tenure was Van Oossanen’s securing liability insurance for society members at acceptable rates. The 35-member group meets four times a year, visits yards, and listens to lectures on a wide variety of topics, such as developments in materials and construction processes. It's an august group, including the likes of Andre Hoek, Gerard Dijkstra, Frank Mulder, and Hugo van Wieringen, among others.

Some people are so devoted to their work that they keep at it until they drop dead. Others segue from their life's work into less demanding activities. Perry van Oossanen is poised to take over the helm of VO&A, assuring the successful future of the firm.

So what does the elder Van Oossanen hope to do in retirement? He's quick to answer, "Rent a camper and tour the U.S." His wife, he adds, has never been in the States, and he aims to show her.

About the Author: Dan Spurr is Professional BoatBuilder’s editor-at-large.