The Westlawn Institute of Marine Technology and The Boat School are pleased to announce that Westlawn Institute has moved its office to its new location at The Boat School campus on Deep Cove Road, in Eastport, Maine.

We are looking forward to exciting new opportunities created by this move, including working closely with The Boat School, which specializes in teaching boatbuilding, and which is the oldest school of boatbuilding in the United States. The Boat School is an affiliate of Husson University.

An amazing number of connections made this move to Eastport, Maine almost inevitable. Westlawn’s parent company, The American Boat & Yacht Council (ABYC), created the Marine League of Schools to improve marine education, and The Boat School has just become a member of The Marine League of Schools. ABYC is also a training partner in Maine’s North Star Alliance. The director of the Boat School, Bob Turcotte, is a Westlawn Institute alumnus. And, The Boat School is the only school, other than Westlawn, to use the Yacht Design Institute (YDI) curriculum as part of its program. The Maine-based YDI was created by Westlawn alumnus Ted Brewer and Maine resident Bob Wallstrom, to teach boat design via distance learning. Westlawn Institute acquired YDI in 2007 both to support YDI alumni and to further enhance Westlawn’s curriculum. Westlawn Institute’s move onto The Boat School campus brings this all full circle. (Click Here to read more about YDI and Westlawn Institute.)

Westlawn’s director, Dave Gerr, commented that, “All the connections between Westlawn, The Boat School and Eastport, Maine are remarkable. We’re looking forward to working at The Boat School campus and to developing future programs with Husson University and The Boat School. These connections will further enhance the learning process and offer even better service to the boating industry.”

Boat School director, Bob Turcotte, said, “Bringing Westlawn Institute to The Boat School campus in Eastport, Maine and working closely together will further strengthen our curriculum and our training capabilities. We’re enthusiastic about welcoming Westlawn Institute to our campus.”

Continued on Pg. 2
WESTLAWN MOVES TO EASTPORT MAINE continued from pg. 1

Photos
Left: Westlawn director, Dave Gerr, giving a seminar at The Boat School

Right: Faculty and staff in The Boat School front office. From left to right: Brian Moore, Boat School instructor; Caryn Vinson, Boat School office manager; Bob Turcotte, Boat School director; Dave Gerr, Westlawn director; Brian Duffy, Boat School instructor; Pete Hilyard, Boat School Instructor.

Maintaining the Mystic Seaport Connection
The incredible resources of Mystic Seaport Museum, in Mystic Connecticut, including the Ships Plans Library, The G.W. Blunt White Library, over 40 acres of historic buildings, a collection of 500 historic vessels, and the extraordinary staff are simply too valuable to give up. Though the Westlawn school office at Mystic has been closed, we are maintaining the ABYC/Westlawn Research Center at Mystic Seaport. This will continue Westlawn's and ABYC's close affiliation with the Seaport, which is absolutely invaluable to Westlawn Institute and to ABYC.
Dear Westlawn Students and Alumni:

I hope this letter finds you well.

For students: I urge you to continue working hard toward earning your professional credentials. The industry needs you, and although the current economic environment is not favorable, you may be in the best position of all of us. For when the recovery happens, solid design jobs will become available to you. For those working in the industry: Hang in there . . . brighter days are not too far off.

March is a busy month for ABYC. I’d like to invite each and every one of you to attend the ABYC Annual Meeting and reception, which is set to take place on Friday evening, March 26th in Annapolis, Maryland. There, you can learn firsthand about ABYC’s new programs while interacting and networking with many ABYC members, other Westlawn students and alumni. Westlawn and ABYC staff will keep you informed via email as we finalize plans for the annual event.

I’m sure you are aware that Westlawn is an educational affiliate of ABYC. This year, the ABYC Board of Directors has charged me to fully study whether Westlawn should remain an affiliate or officially merge with the Council. Either way, it shouldn’t impact you as a student to any great degree. But rest assured, I will keep you informed of the findings of the study.

Second, I’m very pleased to announce that the Kathy and Jerry Wood Foundation will be awarding Westlawn a scholarship grant sometime later this March. The grant terms and specific amount will not be divulged until officially awarded. However, Westlawn Director, Dave Gerr is already at work drafting scholarship award criteria.

Lastly, learning from the successes of Westlawn, ABYC will be launching its first distance-learning certification course later this year. We are currently working with our education partner, Ken Cook Company, to produce both a DVD and online version of the ABYC Electrical Certification Course. The interactive course will be supported by a streaming video library, a blog, a study guide and more. We expect the course to be widely used, especially in regions of the globe where ABYC does not currently conduct courses.

Well, I’m running out of space so it’s time to sign off. Students: Study hard. Alumni: Thanks for your support of Westlawn and ABYC.

Skip Burdon
President, ABYC

ABYC’s Mission Statement

The Council’s mission is to develop quality technical practices and engineering standards for the design, construction, maintenance and repair of small craft with reference to their safety.

The Council shall also disseminate these standards and be the principal source of related technical information and education for the marine industry.
PassageMaker’s first TrawlerFest of 2010 offered seminars and events for serious voyaging motorcruisers. Created and run by PassageMaker magazine, TrawlerFests have become the venue for boaters interested in long-range cruising and living aboard on motor vessels.

Westlawn director Dave Gerr presented an extensive seminar on thinking out of the box regarding voyaging motorcruiser type and hull form. Speaking to a full room, Gerr challenged the audience to consider the virtues of boats with shoal or even extreme shoal draft, or boats with slender or moderately slender hulls. He related real-world cruising experiences, over more than two decades, on some of these vessels drawn up by his design office. While showing photos and plans of many of these interesting craft and fielding a wide range of questions from an active audience, Gerr also noted that his Walrus design was at G dock in TrawlerFest. The largest of the Gerr-Marine ultra-shoal tunnel-drive motorcruisers, Walrus is 76-feet LOA, yet draws just 50 inches and is fully beachable!

In the afternoon, Gerr presented Yves-Marine de Tanton, with his certificate for winning the Westlawn/PassageMaker 2009 Design Competition. Tanton’s entry was selected from 24 submissions as the winner of the competition. (Click Here to read the full competition details and results in the December 2009 issue of The Masthead.) Tanton followed Gerr’s explanation of the judging process and of some of the other designs submitted, with a valuable description of his philosophy and approach to creating the winning entry.

Click Here to learn about future TrawlerFests, created by PassageMaker magazine, to be held throughout the country in 2010.
In December of 2009 Westlawn Provost Norm Nudelman and his wife Carole cruised the South Atlantic stopping at ports of call in the Falklands, Argentina, and Chile. Here are a few highlights:

December 13, 2009, Stanley, Falkland Islands
The Falkland Islands are located in the South Atlantic 300 miles east of Argentine Patagonia. The several Islands that make up the Falklands have a total land area of 4,700 sq. miles. Port Stanley (Stanley), the capital, looks like a quaint English country village. About a 45-minute drive from Stanley, in a 4x4 Land Rover across very rough terrain, we arrived at the Bluff Cove Lagoon Penguin Rookery to see the penguins. The rookery has about 1,000 pairs of Gentoo penguins nesting on a beautiful beach.

December 14, Cape Horn
At 6:00 pm we rounded Cape Horn (Lat:55º 17.8’S Lon: 064º42.6’W, Surprisingly calm seas). After rounding the cape, we came about and headed for the Beagle Channel and Ushuaia, Argentina. Ushuaia, located in the Argentinean part of Tierra del Fuego, holds the distinction of being the southernmost city in the world. Ocean Conditions are often rough and treacherous; however, during our passage it was unusually calm.

December 16, 2009, Punta Arenas, Chile and the Strait of Magellan
The Strait of Magellan is the most important natural water passage between the Atlantic and Pacific oceans. It is located along the southern edge of the South American continent just south of mainland Chile and north of the Tierra del Fuego archipelago. The passage is about 2 km wide at its narrowest point and is about 570 km long. It is known as a difficult passage to navigate because of the unpredictable currents and winds. The strait is name after the Portuguese sailor Ferdinand Magellan, the first European to navigate the strait in 1520, during his circumnavigation of the world.

Following along the Peel Inlet of the Strait, we found the Amalia Glacier. It appears to be hanging between the peaks of the mountains. It is one of 48 glaciers making up the Southern Ice Fields, which are considered to be the third largest reserve of fresh water in the world. The natural wonders of the strait with its snow toped mountains, glaciers, and waterfalls are awesome.
The J/95
Winner of the Sailing World / Cruising World & Sail Magazine’s 2010 Boat of the Year Awards
Designed by Westlawn Alumnus and J/Boats Founder, Rodney Johnstone

J/95 is the first sailboat from J/Boats in thirty-two years of production to feature a shoal draft lead keel with a lifting centerboard and twin rudders making this boat ideal for exploring shallow rivers and creeks as well as cruising and racing offshore.

Features*
Keel-Centerboard
For sailing in shoal water, in about the same depth as a Sunfish®, J/95 has a low-maintenance, 200 lb. bronze centerboard that pivots and fully retracts up into a slot in the fixed 2,250 lb. lead keel. When fully lowered, the centerboard projects 2' 6" feet below the keel for a board-down draft of 5' 6". Board height is easily controlled by a 5:1 tackle leading to the cockpit. The keel protects the Yanmar 14 HP auxiliary diesel saildrive located immediately aft.

Offshore Stability
J/95 has a limit of positive stability (LPS) of 120+ degrees and is built to ISO CE Mark Category “A” Ocean Standards which is defined as a vessel capable of crossing oceans. Stability is achieved with a beamier hull form and a low VCG (Vertical Center of Gravity) fixed lead keel. The bronze centerboard is a small percentage of total ballast, so you can sail with board up in shallow water without compromising safety or comfort.

Performance
With board down, the J/95 outpoints most race boats and can track upwind at 6.5 knots, tacking inside of 85 degrees. With board up, she still flies at 6.5 tacking inside 90 degrees. To ratchet up the fun factor further, the optional masthead asymmetric spinnaker system with retractable bowsprit (hidden in a flush hull housing) allows for the double digit offwind speeds J’s are known for.

Principle Dimensions
LOA 9.50 m 31.2’
LWL 8.65 m 28.4’
Beam 3.05 m 10.0’
Draft .91 m/1.68 m 3.0’/5.5’
Displacement 2,948 kg 6,500 lbs.
Ballast 1,111 kg 2,450 lbs.
100% SA 41.8 sq.m. 450 sq.ft.
I 11.16 m 36.60’
ISP 12.69 m 41.62’
J 3.35 m 11.00’
P 11.16 m 36.60’
E 3.96 m 13.00’

*Features as reported by J/Boats.
For more information and specifications CLICK HERE to visit the J/Boats website.

J/Boats, Inc.
557 Thames Street
Newport, RI 02840
eMail: info@jboats.com

Photos courtesy J/Boats, Inc.
A trailerable motorboat that is also ideal tender for superyachts. The boat’s lightweight construction makes on-deck storage easy.

The overall lightweight design allows a smaller, fuel-efficient outboard motor or a jet drive to give the boat enhanced performance usually only available to vessels with larger engines. The maximum speed of the YSA tender is around 35 knots, depending on the engine.

The great space and simplicity of the cockpit allows the boat to be customized according to the client’s needs - from standard equipment to luxury accommodations including a huge swim platform or a perfect entry for divers.

Built from the highest quality materials consisting entirely of a carbon-epoxy-Airex® sandwich, the YSA Power’s hull is produced by vacuum infusion. The prototype will be CE certified to meet mass production of the highest quality and safety standards.

The boat can be transport in containers or on a trailer without the need for a special permit! Upon request YSA Yachts will supply the boat with a Harbeck trailer for easy transportation.

**Principle Dimensions**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>8.9 m (29.2 ft.)</td>
</tr>
<tr>
<td>Beam</td>
<td>2.5 m (8.2 ft.)</td>
</tr>
<tr>
<td>Draft</td>
<td>0.55 m (22 in.)</td>
</tr>
<tr>
<td>Motor</td>
<td>Weber Jet 140-hp or outboard</td>
</tr>
</tbody>
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**CONTACT INFORMATION**

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Two New Boats
Designed by Westlawn alumnus Otto Ranchi

Piranha ASD

Hull shape: ASD (Arrow System Design)
Material: Aluminum
Length hull: 13.70 m (44.9 ft.)
Breadth central hull: 3.00 m (9.8 ft.)
Breadth at transom: 3.80 m (12.5 ft.)
Power: 2 x 730-hp MAN
Top speed: + 45 knots
Ballistic protected wheelhouse and Engine room
Weapon: remote controlled 40/50mm + 2 x 12.7mm

This boat has been designed for interception of suspect craft, war missions, anti-smuggler, patrol/escort, border protection, boarding of suspect craft, anti terrorists.

RAPTOR SWOC (Shallow Water Operating Craft)

Hull shape: Low deadrise with tunnels
Ramp: fore
Material: Aluminum
Length hull: 13.00 m (42.5 ft.)
Breadth: 3.40 m (11.1 ft.)
Power: 2 x 550-hp MAN
Top speed: 40 knots
Ballistic protected wheelhouse and Engine room
Weapon: 2 x 12.7mm + AGL 40mm

This boat has been designed for mission in river or in shallow water, amphibious assault, landing, troops transport

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On Dec 30, 2009, Luther Tarbox sent us the following comments re Ed’s article:

“I would like to add some comments to the disappearing saildrive conundrum discussion in the latest newsletter.

1) If you throw an aluminum plate in salt water, connected to nothing else, it will corrode. So will a steel plate. If you paint these plates they will corrode more slowly, but they will still corrode, and once the paint erupts at a failure point crevice corrosion will take over the destruction. Trusting that the paint will completely protect the metal is not realistic. Trusting that the paint job is that perfect is also unrealistic. Try it. Examine a paint job on a piece of metal and note how thin the paint is at any sharp edge. It is also thin in the vicinity of the inside radius of a concave bend if the paint is applied using an electrostatic process. There are manual ways to get around this, but they are not completely effective. Any paint job has thin and thick places. Every paint job has flaws. Every one.

2) In the corrosion literature that I read, even small variations in the metallurgy of a single piece of metal plate from location to location are enough to create a couple, which naturally has a conductor (the plate) to connect the two areas. This is enough to cause corrosion in a damp air atmosphere. The literature I read did not mention water electrolytes, but I suspect they will be worse. Even the shape of the metal, and surface flaws are enough to create variations in potential that will cause corrosion. This last was from a text on preventing corrosion with coatings. This is the basis for electro-polishing. The high points simply go into solution.

3) I had a communication from a reader that had owned several saildrives. He liked the drives very much and did not want to convert to shafts and seals and all that, but he had two drives dissolve right out from under him. When the third drive was installed he put a switch in the negative lead from the battery to the engine, and when he was not using the engine he simply opened the switch so the saildrive was not connected to the negative side of the battery. He claimed to have long and good service from his third saildrive. I did not inquire if he had his boat bonded. I should have.

The boat I'm working on right now will have a switch that breaks the negative side of the line from the battery to the (aluminum outboard) engine. It will be opened when the engine is not running. The only down side I can see is that if someone opens the switch when the engine is running it might harm the charging system. There are ways that could be dealt with.

Luther Tarbox

On January 2nd Dave replied:

“Dear Luther:

“Thanks for the feedback on Ed Sherman's story on saildrive corrosion issues. I'm not sure exactly what point you're driving at. As a designer I like saildrives for many applications. (One problem is their propellers and reduction gears are too small for many larger boats, in my opinion.) Ed is addressing another problem—incorrect wiring causing severe corrosion. If there is no incorrect wiring, then saildrives last a long time with no more than average maintenance. Because saildrives are made of aluminum (low on the galvanic scale and physically soft), they are however particularly subject to serious rapid degradation due to improper wiring, making them essentially an anode for the entire boat (or the entire boat and the entire shoreline and all nearby boats due to improper shoreside wiring). It's so serious that one major manufacturer stopped selling saildrives in the U.S. market due to just this reason.

Regarding throwing aluminum in the water with nothing connected to it and it will corrode . . . No, not too badly. Proper
marine aluminum floating in seawater (say suspended by an aluminum wire) will corrode very slowly, assuming the water has some flow, is clean, and has plenty of oxygen. In fact, aluminum workboat hulls and yachts are often unpainted above the WL—see photo of the aluminum Northwind 50. (Painted below the WL for anti fouling.) Generally, if the difference in potential between two different alloys is less than 200 mV, corrosion will be minimal. The internal differences in a single plate of marine aluminum will be well under 200 mV.

The idea of a switch on the negative to the saildrive would work, but it can't be neglected in operation. A galvanic isolator (Zinc Saver™), installed per ABYC standards, will take care of this issue automatically.

Paint is an important weapon in the arsenal against corrosion. It's only one of the weapons and you can't rely on paint alone, but it's a vital part of the whole picture. I'm not clear on what you're driving at by saying that paint will have flaws. Naturally, it does.

It's not clear to me where you're headed with your email commentary on Ed Sherman's article. I think Ed's article is quite accurate, and think some of the things you mention in your email aren't quite on the mark. Ed isn't condemning all saildrives and all saildrive installations; he's just explaining a serious issue that is common to many saildrives and that the technical readers of The Masthead (designers, surveyors, builders) should be aware of.

Happy New Year
Cheers
Dave

Re: The tech article All About Cores Part 2 by Bob Mazza, Bob wrote:

Hi Norm,

Thank you for sending the copy of the latest Masthead. Just a couple of comments.

The photos of Onrust and Half Moon that appear on Page 10 should have been credited to Jim Luce, of the Nyack Boat Club. I mentioned this in an email to Dave on 11/17 that contained these two photos (not copied to you), but did not mention it on the disc of photos that I gave to Dave at Lunch at the '76 House. The other two photos of Clearwater and the fireboat are mine.

The term "never bond" that appears under vacuum infusion on page 22, should be attributed to Bruce Pfund. I had mentioned this to Dave and yourself, as well, back on 12/08, but was told that this Part II would not contain this material!

Perhaps both of these slight omissions can be covered in the next issue.

Well, done, by the way. Another enjoyable and informative issue.

Rob

Robert Mazza
Director - New Market Development
Alcan Baltek Corp.

Correction:
Our apologies about the photo credits. Jim Luce of the Nyack Boat Club should have been credited for the Onrust and Half Moon photos. However, the credit to Bruce Pfund for "never bonds" is already in the story, page 22, bottom left paragraph.

Your comments and questions are welcome. Space permitting, we will print them in a future issue of The Masthead. Address your comments and questions to Letters to the Editor and email them to: nnudelman@westlawn.edu
The question from the December 2009 issue was:

You are designing a centerboard sailboat. The centerboard is of laminated fir plywood, glued and saturated with epoxy, and sheathed with 12 oz. glass cloth in epoxy. The geometry is as pictured in the drawing on the right. How much ballast should you install in the centerboard to ensure that it drops smoothly and surely when the centerboard hoist pennant is eased?

Several answers were submitted, but all had considerably less ballast than required.

The Correct Answer is:

To determine how much ballast is need to make a centerboard drop you need to determine its buoyancy and the ballast it with three times the weight of its buoyancy to ensure it lowers surely and positively.

Anything that is submerged in water displaces water equal the submerged volume, just like a boat hull. All you need to do is make a close estimate of the displacement (buoyancy) of the object.

We see that the volume of the board is the average immersed length times the average section area (approximately, but quite close). In this case, it’s:

9.1 ft. average length x 0.58 sq.ft. average section area = 5.28 cu.ft. volume
5.28 cu.ft. x 64 lb./cu.ft. saltwater = 338 lb. buoyancy for the volume

The board is made of plywood which has some weight. (We can ignore the light sheathing and epoxy, as it makes up only a tiny fraction of the total volume.)

We need to find the net buoyancy.
Fir plywood has a density of about 34 lb./cu.ft., so:
5.28 cu.ft. x 34 lb./cu.ft. = 179 lb. submerged ply weight

Net buoyancy = 338 lb. – 179 lb. = 159 lb. net buoyancy

Lead ballast to be 3 times the net buoyancy to ensure the board drops positively.
Lead ballast = 3 x 159 lb. = 477 lb.
The density of lead, with 4% antimony, is about 702 lb./cu.ft.
477 lb. ÷ 702 lb./cu.ft. = 0.68 cu.ft. lead required

Looking at the centerboard’s drawings, we can locate the lead ballast in the flat portion of the board, around it’s vertical center and down near the end/bottom to maximize the effectiveness of the ballast. This would make the lead, say, 11 inches high (0.91 ft.) and 3-1/2 inch thick (0.29 ft.).
0.91 ft. x 0.29 ft. = 0.26 sq.ft. section area for the lead ballast (in the region we’ve selected for it)
0.68 cu.ft. lead ÷ 0.26 sq.ft. = 2.61 ft. or 30-1/2 in., round to 30 inches long.

This is the size of the lead ballast in the centerboard, as we’ve positioned it in the flat portion of the centerboard (see the ballast drawn in in blue on the drawing). Located as we have, in this flat portion of the centerboard’s section shape, it’s basically a flat “brick” of lead 11 inches high, by 30 inches long, by 3-1/2 inches thick.
Dudley Dix Yacht Design is located in Virginia Beach, near the mouth of Chesapeake Bay. Started in Cape Town, South Africa in 1980, we moved to USA in January 2004. We are a very small design office, intentionally kept to just my wife Dehlia and myself. That limits us to a small number of new designs each year.

I was born into a boating family, the son of a provincial FD champion. For much of my childhood we lived on the banks of the local dinghy sailing lake that spawned much of the South African leisure boating industry. There I learned sailing and other boating skills, progressing from dinghies, through beach cats to offshore yachts. I spent much of my time surfing, rowing and sailing, developing a feel for and learning the ways of wind, water and waves. My ocean sailing expanded from local bay racing and cruising to coastal racing and eventually trans-ocean sailing, both crewed and short-handed.

While building my first offshore yacht, I became interested in boat design and enrolled in the Westlawn course. Midway through my studies my CW975 design won the 1979 Cruising World Design Competition, which launched me into professional yacht design. That win also brought my first design commission, for the Pratique 35 steel design.

Since then I have designed for most materials and to a wide range of concepts. These include production GRP sailboats for yards in South Africa and metal designs for commercial yards to build from steel or aluminum. I have also drawn a large number of designs for amateur builders, primarily for steel and plywood. This is a direct result of my origins in amateur boatbuilding, which taught me what is important to amateur builders in terms of design features, ease of building and standard of information required. I have developed an affinity to amateur builders and provide as much backup support to them as possible.

Working from South Africa, we used the Internet as our main medium to develop an international market and have continued this in USA. This way we have developed a niche market that has expanded into 78 countries in all corners of the world. We have a good market in some countries where few people are fluent in English, for example Russia and Turkey, where our agents work with us to supply
multi-lingual service to customers. I find it amazing that we have boats as large as 43 feet being built in the middle of Siberia, where it would have been impossible for me to have customers 20 years ago.

Our most successful GRP production boats have been the Cape Cutter 19 and Shearwater 39, both modern boats with classic styling. The larger Shearwater 45 was selected as Traditional Voyager of the Year and Cruising Sailboat of the Year in 2001 at the Annapolis Sailboat Show.

In metal designs, we have had success with a range of traditional radius chine gaff cutters and gaff schooners, the Hout Bay range of 30-70 feet. Our metal designs of modern image are the Dix 38-65 cutters and schooners and a few others, which have modern sleek profiles and scoop sterns.

Our most successful range of designs is the Didi series of radius chine plywood performance cruisers and racers. These range from the Didi Mini, drawn to the Mini 650 Rule, at the lower end, to the Didi 40cr. This range has hundreds of boats in build or on the water. We have also more recently expanded this range into catamarans. Currently on the board is a small monohull cruiser, to be named the Didi 28.

A new variation in the past few months has been the development of a more modern hull shape in this range specifically for box-rule racing designs. The new shape has a radius-chine underbody combined with a topside chine, generating more power and a flatter stern from the maximum beam permitted by the box rules. The Didi Mini Mk3 is the first in this range.

Our other popular range for amateurs is for lapstrake plywood small cruisers. This started with a plywood version of the GRP Cape Cutter 19 and was followed by the Cape Henry 21. These are both internally ballasted gaff cutter trailer-sailers with steel centreplates. I have recently added a bilge keel option to the CH21 and a fixed keel version will follow. A bigger sister in the same image, the Cape Charles 32, is also on the board and will be completed when time allows. This one has a shallow cruising fin keel.

My personal boat in South Africa was the prototype Didi 38 Black Cat, which I built at my home. I raced her 3 times across the South Atlantic and sold her before leaving for the USA. Here, I built myself a new boat of very different image, the prototype of the Paper Jet 14 trapeze skiff. I developed it as a single- and double-handed training skiff for youths, with inter-changeable modular rigs to take it from basic unstayed una rig, through sloop to full skiff mode. It has proven to be an exciting and challenging single-hander as well. It received an innovation award at the 2007 Wooden Boat Show, in Mystic, CT.

There is considerable demand for our radius-chine plywood designs and I have received many requests for conversion of our metal designs to this medium. I have been trying for years to do that but pressure for new designs has prevented it thus far.

My efforts in boat design started with the hope only of making it a paying hobby. It soon took on a life of its own and became a passion, then developed into a lifestyle that should keep me involved the rest of my life.

To learn more about Dudley Dix and his designs, CLICK HERE to visit his website.

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Thom Dammrich Talks About The State of the Industry

In his annual state of the industry address at the Miami International Boat Show, Thom Dammrich, president of the National Marine Manufacturers Association, said that while 2009 was a difficult year for the boating industry with challenges on many fronts, he expressed optimism, stating "While sales are down, the industry is still very much alive and well."

"In challenging times like this, it's important to keep things in perspective," he said. "If we look at 2009, boating remains a big business. Even in this environment, it's still nearly a $30 billion business. While sales are down, the industry is still very much alive and well." Sales in 2009 were down about 28 percent from 2008, with about 150,000 units sold at retail. Dammrich said that these figures are expected to be flat this year, but the good news is that manufacturers will have to increase production to meet the demand.

KCS International Inc., the parent company of Cruisers Yachts and Rampage Sport Fishing Yachts, hired back 100 of its employees to work on new orders this winter. Cruisers Yachts officials said that company has recalled about 100 people; and Burger Boat Co. said it has recalled several people.

Sea Ray plants in Tennessee have called about 150 employees back to work this month.

U.S. wins the America's Cup

Larry Ellison's BMW Oracle routed the Swiss defending syndicate's Alinghi campaigned and skippered by biotech billionaire Ernesto Bertarelli and the America's cup will once again reside in the U.S., this time at the Golden Gate Yacht Club, on San Francisco Bay.

The Swiss catamaran carrying traditional soft sails was no match for the U.S. trimaran propelled by a 223 foot rigid wing. When BOR crossed the finish line she was 1,300 meters - more than 2/3rds of a nautical mile ahead of Alinghi.

Who Will Be The March 2010 Know It All Winner?

Want to see how much you know? Want to show everyone else how much you know? The first three people to submit the correct answer to the following question will win a Westlawn tee shirt and cap, and will also receive a Know It All certificate. The answer and winners to be published in the next issue of The Masthead.

Standard hull speed—the theoretical maximum speed in knots that a displacement boat can go—is:

\[ \text{Knots} = 1.34 \times \sqrt{\text{Waterline Length, Ft.}} \]

If your Aimless Angler were, say, 25 feet on the waterline, its so-called hull speed would be 6.7 knots [square root of 25 ft. = 5, and 5 x 1.34 = 6.7 knots]. The "1.34" multiplier defines classic hull speed.

Where does the 1.34 multiplier for hull speed come from? What is the scientific reasoning behind it, and what is the mathematical derivation of so-called hull speed?
By Jerry D. Burkett
BMS Yacht Design (BMS, LLC)
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Jerry Burkett graduated from the full Westlawn program in 2002 after 6 years of study. He officially retired in 2000 after an interesting career as a mechanical engineer (BSME 1957, University of Maine). His field was turbomachinery design, power plant design and executive positions involved with turbomachinery equipment and plants for the power industry. In 2000, he became an independent consultant and worked pretty much full time through 2007 and is still engaged but tapering off to test commercial interests in boat design. He grew up in Camden, Maine and worked for Geerd Hendel, naval architect, during summers while at college.

The ProBoat/WoodenBoat Design Challenge I 2009

My BMS Power Skiff entry in the “Design Challenge I” contest was a featured runner-up when announcing the winner during the Professional Boatbuilder internet conference held on October 1, 2009. This skiff was designed to carry a 650 lb load at 15 knots with a fuel consumption of less than 2 gallons per hour per the contest requirements. The BMS Power Skiff has a projected fuel consumption of 1.05 with a 25-hp, 4-stroke outboard. The hull flare and freeboard are very close to that of the Simmons Sea Skiff which earned a great reputation for seaworthiness. But, what separates the BMS Power Skiff from the pack is its performance with a lighter load. This is when the BMSLong.Step™ advantages come into play. With a helmsman and spotter, this skiff will achieve a top speed in the range of 30 knots for water skiing. Slowing down to a cruising speed of 28 knots provides a mileage of 21.5 MPG. The Crouch coefficient at the top speed condition is 196 and 211 for the heavier Diesel/outdrive option (with the speed in knots or 225/242 with speed in mph).

The BMS Power Skiff prototype is currently being built near Washington, NC and scheduled to be completed in early March. The results of the prototype testing along with construction details will be featured in an article in Professional Boatbuilder.

The Concept:
The BMSLong.Step™ concept was a result of being intrigued by the Westlawn Text 117, page 25, which discussed the concept of the “ideal beam for different speeds.” The total residual resistance of the boat with the “low chine beam which is unrealistic in practical terms” is substantially lower than the full beam width boat and the porpoising margin increases. The David Taylor Model Basin work referred to in the text was led by Eugene Clement. He has since retired but gave me a copy of the test reports that proved to be essential to my development work. Other essential pieces were the Daniel Savitsky porpoising limit analysis and his performance prediction analysis including the calculation of CG rise, which he kindly explained. The idea on how to take advantage of the ideal beam concept came to me in 2001 and the patent was awarded in 2007. The concept is guided by porpoising avoidance, rise in CG and optimum beam which dictates the number of longitudi-
nal steps needed to cover the range from zero to the desired top speed, sequentially. The BMS Power Skiff uses two steps to cover its speed range. For especially high speed planing hulls the LCG can also be optimized for the high speed by creating a transom forward of the main transom to reduce the distance from the "transom" to the LCG for the chine in control of the performance. Changing the CG while underway is a little tricky!

The Proof of Concept:
I conducted a model test program after the patent award to confirm the process of sequential planing and its impact on the total resistance. This program was based upon a "back to back" comparison of a Challenger against a Defender. The LOA for each boat was about 30" and their displacements were identical as were their LCGs.

The Defender was a scale of a typical offshore deep-V, slender-beam (LOA to overall beam ratio of 3.5) racing boat with three spray rails per side and a dead rise of 21 degrees. The Challenger was scaled from a new BMS design, High Point. This boat is sports cuddy model with a LOA of 20' - 10 1/4", LWL of 16'6", half-load displacement of 2,627 lbs and powered by a Volvo Penta DE-160 diesel engine through an outdrive. The designed top speed is 54.5 knots @ 140 hp, which yields a Crouch coefficient of 236 (using speed in knots) and volume Froude number of 9.0. The hull has 5 longitudinal steps.

To prepare for the testing the expected total resistance of each model was calculated using the Savitsky long form. A model speed of 20 knots was equivalent to the full scale boat speed of 54.5 knots with equal volume Froude number.

The testing was performed in Bath, North Carolina. The tow boat was provided and operated by Paul Minor, owner of the Bath Creek Marina. The models were towed by a fishing line led thru a long pole to a pulley at it’s end to a sensitive digital scale. (I calibrated this setup with known weights and the scale readouts were exact.) The model speeds were measured by a GPS. The resistance values for the Challenger also fell on their expected value line (about 1/2 the total resistance) at the same speed. The model weight without ballast was substantially lighter than the test weight so I used lead for ballast that was contained within a small plastic container duct taped at the position to satisfy the designed LCG position. The duct tape got wet which may have allowed the ballast to shift slightly. So I made a ballast that could slide in grooves to allow an easy adjustment to the LCG and then could screw it to the cockpit sole to keep it from moving. No more duct tape!

The second test of the Challenger did not repeat the first. It took a succession of tests and analysis to finally resolve the problem. I had to first understand why when moving a weight aft the trim angle decreased before knowing how to solve the problem. The fifth test confirmed the first and I now had developed the analysis tools needed. It was pure luck that the first test was a success. It was that flicker of hope that drove the ongoing effort and provided yet another life lesson. (It was especially interesting to hear a renowned naval architect speaking at IBEX 2008 being puzzled why on one of his boat tests moving a weight forward increased the trim angle and another in the audience confirming a similar experience. The following week I sent an explanation to the speaker but received no response. Oh well! You can find the reason within the Series 62 hull test program where each model was tested over a range of displacements and LCG positions.)

During one of the tests I was positioned directly over the model and could study the wake as the hull transitioned from one step to the next. I observed another phenomenon within the localized wake from each of the submerged chines that confirmed the importance of the treatment of the chine edges on the final product.

The Importance of Benchmarking:
If you have the intention to design state-of-the-art or better boats, the first step is to establish the current state of the art. I found this to be a difficult job.

As recommended by Westlawn, I started collecting the design data and test reports published in magazine articles, engine suppliers and sites such as www.boattest.com start-
The Masthead

ing at Lesson 1. One of the steps I would perform later in the course was to calculate the Crouch coefficient. I became aware that the reporters of such information were not very careful. What was the actual weight of the tested boat? Was the propeller properly selected? Especially for high speed boats what appendages supported the prop, what was the shape of the rudder and what was the expected propulsion efficiency for the drive system tested?

When the test data provides fuel consumption information this allowed a calculation of the engine cycle efficiency. Also, if you know the engine’s rated power, the test power, engine type and fuel you can determine the engine’s cycle efficiency expectations over the complete load range. Knowing the fuel, its density (lb/gallon) and heating value (BTU/lb of fuel) you have the input needed to calculate the cycle efficiency (work performed in hp divided by the heat input provided by the fuel in hp). This should correlate with the engine’s cycle efficiency. If the data does not correlate there is a problem within the reported data. One of the popular boating magazines tested a number of different engines all on the same boat with the intent of confirming the efficiency difference between 2 and 4 stroke engines. The data did not agree with the conclusions in the article. I wrote a letter to the magazine pointing this out and how it could be corrected. I received a nasty response against engineers in general (the kind that I had thought were reserved for lawyers). This exchange was picked up by “Professional Boatbuilder” which created an interchange directly with the popular boating magazine. Later a renowned naval architect jumped into the discussion and confirmed my position.

To establish a dependable core set of benchmarking data, I gathered all of the data I could locate that was associated with the US Navy Series 62 hull form. This provided data at three displacements (tested weight of model, projections for 10,000 lb and 100,000 displacements. Assuming a propulsion efficiency (I used 70% as a target) the SHP can be calculated and then the Crouch coefficient (Ck) calculated. I tried plotting this data against a number of parameters and finally zeroed in on plotting the Ck values against the cube root of the Lp (projected chine length). These plots rather than being scattered formed tight and nearly straight lines at constant values of the volume Froude number and showed the influence of the length on Ck. When scaling to different lengths, the surface area and resistance due to friction increase primarily by the square of the length. But the wave making resistance is primarily dependent on the displacement which by scale follows the length cubed. So an exact scale up from a small to large boat will enjoy a higher relative Crouch coefficient.

Stopping here for a minute—an earlier benchmarking procedure plots a “transport efficiency” (TE = Vp x displacement / 326 x SHP) against the volume Froude number. The volume Froude number is the boat speed, in ft/sec, divided by the square root of the product of the cube root of the displacement times the acceleration of gravity. So, the longer the scaled boat the lower the total relative resistance at the same Froude number. This efficiency improvement does not come from the hull shape, it comes simply by being larger. For this benchmark to be useful you would need to have all comparison data at the same length. Think of the poor designer working on a 30 ft boat trying to match the benchmark Transport Efficiency that was established by a 60 ft boat test?

For this reason I propose that a more meaningful benchmark be based upon plots of the Ck value against the cube root of the Lp. I now have hundreds of points on this benchmarking plot to help test the performance results of a new design.

Taking this one step further, I have developed a benchmarking index, BMS-I, that is sensitive to boat length, the type of engine, type of fuel and the cycle efficiency of the engine in addition to hull resistance. This index represents a true measure of efficiency of the process is calculated in several ways with one being equal to the square of the Ck times the engine cycle efficiency divided by the constant 17016.93. If you then multiply this BMS-I index value by the ratio of the total resistance to total displacement the result is the overall efficiency of the vessel propulsion process which I refer to as VCE.

Summary:
The BMSLong.Step™ applied to a high speed 18 ft sports boat compared to a Series 62 design improved the Ck value (speed in knots) from 152 to 245. Applying the BMSLong.Step™ to a larger 63’ sports fishing boat of series 62 design improved the Ck value from 223 to 287. This does not include the further advantage of the lighter weight engine and structure supporting it. These results put a BMSLong.Step™ monohulls into the performance class approaching catamarans with transverse

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Atlantic City

It was a crisp January midnight in 1928, several years before my birth, when my old man stepped off the last train from New York to his hometown, Atlantic City. Nobody expected his return from the 1928 boat show that night. He had planned it that way.

He paused a moment as he confidently felt the firmness of a Colt 38 automatic firmly tucked in his shoulder holster. As he proceeded unnoticed toward the Atlantic City ghetto, he gave a sidelong glance at his gleaming new custom Packard, left purposely at the station so that everyone in the town would think he had remained in New York for the night. He couldn’t help but chuckle at the sight of it. He had banged his head about a month ago and then ordered his chief boat builder to remove the Packard body and replace it with a new Martin designed body with full headroom. It was the only full headroom Packard in the world.

As he proceeded up Baltic Avenue, he noticed a Department of Public Works truck parked alongside a manhole. He walked just close enough to notice rumrunners passing five gallon cans of Belgian alcohol from a boat in the drainage canal under the street, up through a manhole, and loading it onto the truck. Obviously, they were unloading the prime ingredient of bathtub gin. As he came closer to his Marine Engine Sales and Service establishment, his mind began to drift to the business at hand. It seemed that every morning when he checked the lines on the boats in his eleven covered slips, several boats were tied up differently, not exactly the way the old man secured them. His plan was to proceed to a point several blocks from the shop, then go along the waterfront until a satisfactory location was found to stake out the covered slips. In the distance, he noticed a truck parked in front of his shop under the streetlight. There was no mistake. What he saw, was a Coast Guard truck with men in Coast Guard uniforms loading boxes aboard. Breathing a bit easier he walked right up to the situation. What the hell, he knew all the Coast Guards. “Hi John,” the boys replied. “Damn Volstead act,” the old man mumbled as he walked the four blocks toward home. Home was across the street from the biggest rumrunner base in the area, later to become the Atlantic City Tuna Club. As the old man approached home, the gunsul (gunslinger) guarding the door to the base greeted him. “Good evening Mr. Martin. You know you never have to worry about your house being robbed as long as I am here.” “I appreciate it,” Pop replied. “You know when you fellows moved here I told you to tend to your knitting and I will tend to mine, and we have since lived in peace for quite a few years.”

A glance between the base and the engine repair shed revealed the million-dollar poker game in the lighted pink house across the creek. As Pop ascended the back stairs, the streetlight revealed the federal man staked out in the apartment next door observing the base with a pair of spyglasses. A last glance at the base revealed lights were on in the fully equipped hospital on the top floor. “Some of the boys must have got shot up tonight,” Pop reasoned. “Damn shame. They just got done fighting for their country, now the country is shooting them.”

About thirty years later Pop, two rumrunner captains, and I were sitting at the Tuna Club bar. Pop, then about 80, told the story just related. Captain A burst out laughing and shouting to Captain B, who proudly sat sipping his beer with the thought that his life’s most outstanding accomplishment was about to be revealed. Captain A pointed, laughing and shouting to Captain B. “That’s the son of a bitch John (my father). Do you know what that son of a bitch did? I’m running a load in one night and the Coast Guard catches me. There’s an officer on deck with a 45 pointed right between
stepped hulls. The benefit comes from the difference from the conventional boats beam to its optimum beam, and longer boats generally have a higher length-to-chine-beam ratio which lessens the improvement potential.

The first test of a full-size boat, the **BMS Power Skiff** will take place in the Spring of 2010.

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**The BMS Power Skiff** (Continued From Page17)

I asked the bartender to serve another round as this was too good to cut short. Captain B began his story.

He had purchased a Coast Guard officer’s uniform and wandered onto the Coast Guard station one night, casually boarded a rum chaser patrol boat, untied it, and went out. No payoffs, no inside man, no ‘nuthin; he just hopped aboard and took off to hijack some rum. He kept it up for five nights then quit while he was ahead.

Captain B continued, “John, you mentioned that Belgian alcohol. The Coast Guard was chasing me up Delaware Bay one night and I was running low on fuel. I told the boys to start dumping those cans of alcohol into the tanks. Those Liberty engines ran smooth as silk on the stuff.”

The familiar voice of my brother John was heard above all others: “Bartender, give everybody a drink and bartender, you have one too.” Everybody cheerfully greeted my two brothers, 20 years my senior. Pop lit up to see them as they both lived out of town.

“Pops,” brother John asked, “You remember when me and Jim here was clammin’ and bumped into 45 cases of Canadian whiskey?” Everyone having settled down a bit, we began to digest brother John’s story.

“Me and Jim was up to the houseboat one day and we wanted to make up a pot of clam chowder. To tell you the truth we was so damn broke we had to siphon gas out of the State patrol boat to run the Mauler up there. (Mauler, my brother’s boat, was a 26-ft. Fay and Bowen runabout with a Model A Ford conversion). Well, damn if my clam rake don’t clunk into something big. Well, I pull and hauls and it turns out to be a case of Canadian whiskey. Me and Jim opens her up and have a little taste. Sure was right nice. To make a long story short we pulled in 45 cases. We decided it wouldn’t be wise to run the boat back to Pop’s shop, so we steams her, running lights out, back to Snug Harbor to old man File’s slip. Jim gets an empty coal bag and walks it across the lot to Pop’s house. Pop wasn’t too pleased with what we found and he hollered, ‘You boys take this stuff back and throw it overboard. What do you want to do, get us all locked up?’”

“Well now,” brother John continued, “Jim opens up a bottle and offers Pop a swig and brings the coal bag of booze up to the bathroom. Mom was unhappy with the entire situation. Anyway, there’s old Pappy here with a bathtub full of soap and water washing the mud off of those Canadian whiskey bottles with a wash cloth.”

“Yep,” brother Jim chimed in, “Washing with one hand and drinking with the other.”

The old man had relinquished the floor for too long now, he finished the story. “Wait till you hear the finish. These two wild Indians sell the 45 cases to a speakeasy operator for a bundle. For about one week, they ain’t worth a damn around the shop. Diamond Jim and Diamond John Martin. Well, about two hours after they spent all the proceeds, the rum-runners who stashed the stuff called me up and wanted 45 cases of Canadian whiskey or the equivalent in cash. If I hadn’t done some plain and fancy footwork on the phone, those two would have been wearing cement boots at the bottom of the ocean.” “How did you straighten it out Pop?”, I asked. “Bub,” he said, “Don’t get too nosey!”

The old man roared “Captain A and Captain B, if the Naval Architects today ever saw what we had in the boats back in prohibition their eyes would bug out.” “That’s right Davey,” everyone chimed in looking right at me.
March 2, 2010, Annapolis, MD: The ABYC Foundation announced the launch today of the industry’s first standards-based online purchasing directory, the Marine Industries Global Purchasing Directory.

“I am very excited to announce that the ABYC Foundation’s marine industry Global Purchasing Directory is now available to all businesses worldwide that manufacture, build, repair or offer and use marine services,” said Skip Burdon, the Foundation’s Secretary and President of ABYC. He continued, “This new service may well revolutionize the method by which customers will research, locate and possibly even procure self-certified standards-based products and services. For the first time, marine businesses that build, maintain or repair boats, or provide standards-based services have a one-stop tool from which to reach local, national, as well as global customers at no or very low cost,” Burdon concluded.

As an added benefit to ABYC Business and Manufacturing members, the Foundation is offering a standard listing in the Global Purchasing Directory at no cost. ABYC Business and Manufacturing members and non-members can enhance their participation in the Directory by selecting various premium package options and/or premium spot advertising spaces to enhance their organization’s revenue generating. ABYC Business and Manufacturing members enjoy premium advertising packages at member discounted rates. Non-member advertisers are encouraged to become ABYC Members to receive discounted member rates in addition to the multiple benefits ABYC members enjoy.

Manufacturers, retailers and/or service providers appearing within the Foundation’s easy to use Global Purchasing Directory self-certify that their product and/or services listed within the Directory meet one or more of the following qualifying criteria:

- Applicable ABYC Standards
- Product is on the NMMA Type Accepted List
- Product is Certified/Approved by a Classification Society
- Product is CE Compliant
- Product is on the NMMA Listed Component List

However, in order to meet the ‘Applicable ABYC Standards’ criteria, the business entity must be a current ABYC member. And, users of the service must acknowledge that self-certification does not, in and of itself, guarantee compliance to ABYC Standards or any of the criteria for appearing in the Directory. The ABYC Foundation does not accept any responsibility for the accuracy of any statement by any self-certifying participant appearing in the Directory.

Potential customers can easily use the site to research a product or service, learn if that product or service vendor self-certifies that the product meets or complies with one or more industry standards, and then if desired, visit the participating vendor or service provider’s site to gain more information, obtain contact information or possibly even make a purchase.

The ABYC Foundation, through a partnership with Naylor, LLC, offers a menu of low cost enhancements and a limited number premium advertising positions to maximize a participating company’s local, national and global exposure (24 hours, 7 days per week). The Foundation is encouraging industry to review the listings of those organizations that have already enrolled in both the basic and various premium packages to learn the full potential of this service to the industry. The Foundation’s Marine Industry Global Purchasing Directory can be accessed by visiting:

http://abyc.officialbuyersguide.net/index.asp

By March 3rd the Global Purchasing Directory can also be accessed at the ABYC website by visiting www.abycinc.org. Burdon stated, “I know once visited, potential users will quickly grasp the incredible marketing utility and value that this site offers to both customers and participants, and, I believe the site will dramatically expand as it attracts more businesses and buyers.” He concluded by stating, “Now, for the first time, when a customer wants to research and potentially purchase a piece of equipment or service that meets ABYC, CE, appears on the NMMA type accepted list or complies with a classification society requirement, the Foundations Global Purchasing Directory is the first place to visit.”

For more information about having your organization listed, premium marketing packages or premium spot advertisement opportunities inquiries can be made to Jason Dolder, Naylor, LLC at (800) 369-6220 ext.2744 or by Email: jdolder@naylor.com

http://abyc.officialbuyersguide.net
In Parts 1 and 2 of All About Cores we explored the details of what cores are available, what core properties are important, and how these cores are configured to allow flat sheets to be curved to adapt to curved surfaces, and the different lamination methods to install cores.

In Part 3 of this series, we will look at what constitutes Proper Core Installation, and we will look in detail at what the ramifications are when cores are not installed properly – wet core. Then we will finish by reexamining the cored-bottoms controversy that we first addressed over 10 years ago.

Proper Core Installation

As detailed in Part 1 of this series, Balsa and foam cores have been used in the composites industry for over 50 years. The marine industry, specifically, was the first to pioneer the use of cored sandwich construction to achieve lighter weights, greater stiffness, and improved performance. However, over that 50 year period a lot of painful lessons were learned about the proper lamination of core. Poorly installed core can allow water to enter the laminate which can result in a saturated core as well as reduced laminate strength and durability. Indeed, the vast majority of cases of reported problems with sandwich laminates in the field can be traced to what can be defined as poor core installation. It is difficult to fault anyone for that situation in the past, since in a lot of respects, back then we were all learning on the job and inventing a whole new industry. However, as we have discovered from those early mistakes, we need to implement those lessons in practice.

In order to avoid future problems, and benefit from the lessons so painfully learned and relearned over the past several decades it is important to list the characteristics that define “Proper Core Installation”. These characteristics are universal and apply equally to foam cores and balsa cores. The four primary requirements are:

1) Avoid “Never Bonds”

Never Bond is a term originally defined by Bruce Pfund. Never bonds, which generally occur in hand lay-up laminates, are areas under the core that were never bonded in the first place. These areas are often diagnosed by the surveyor after the fact as a delamination, or a failure in service. However, further investigation almost always determines that the core never made contact with its bedding layer during construction. As described above, never bonds can be detected by proper “sounding” of the core after installation, and corrected before the closing layer of glass is applied. However, if left in the laminate they can blister badly when exposed to the heat of the sun and will collect water, especially if combined with an unfilled kerf system.

Never bonds can almost always be avoided by vacuum bagging the core into either a resin-rich bedding layer, or preferably into a core-bond adhesive, along with proper quality control. The use of vacuum infusion will also eliminate never bonds.

2) Fill the Kerfs

As discussed in mind numbing detail in Part 2, kerfs, both saw cut and knife cut, are required in order to convert what is originally a rigid inflexible sheet of core to a contoured material that will adapt itself to the compound curvatures found in boat decks and hulls. However, an unfilled kerf system can reduce the strength of a laminate, as well as act as a conduit to transmit water throughout the laminate. No other factor will cause a yacht to fail its survey as much as an elevated moisture reading in a cored laminate. This elevated moisture reading is inevitably caused by water in the kerf system of the core. Often the point of ingress for the water can be determined by “mapping” the area of high

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moisture readings, which will inevitably lead to a cut out which has exposed the core. Water migration through a cored laminate requires an open kerf system. Filling the kerf system means that any water that enters through a puncture of the skin will be isolated to the point of puncture. An open kerf system, on the other hand, will allow any water from that puncture to migrate through the laminate. Therefore to improve the strength of the laminate and to prevent migration of water – **fill the kerf system**.

To fill the kerf system the absolute minimum requirement is to “prime” or back wet the core with catalyzed resin before the core is installed into the bedding layer of mat or the core bond adhesive. When priming, it is desirable to place the core on a curved surface to open the kerfs and roll the resin on with a short nap roller to force the free resin into the open kerf system. This is easier to achieve with knife cut kerfs. If the core contains saw cut kerfs, the best way to assure the filling of the kerf system is to bed the core into a special adhesive putty. The use of a vacuum bag for core installation in conjunction with priming and, if necessary, core adhesive putty, is also highly recommended. Closed mold processes such as vacuum Infusion is a sure way to guarantee the filling of all kerfs and the elimination of all voids. The use of rigid sheets with perfs, or thermoforming the core to shape, also solves the problem of unfilled kerfs by eliminating the kerfs themselves.

3) **Fillet all Core Edges**

Any transition from a sandwich to a single skin laminate must have a fillet on the edge of the core to ease the transition of the laminate skins. Fabrics can never be forced into sharp corners. The skins will not be able to take the two 90 degree turns involved along the edge of the core as the inside skin laminate leaves the core to join the outside skin, and a continuous air bubble will be created. Not only does this introduce a structural weakness, but this continuous-line bubble will allow water to travel along the full length of the core. When combined with unfilled kerf systems, it does not take much imagination to see this leading to the complete saturation of the cored laminate with water.

Proper fillets can be created by using and installing fillet strips, by grinding (beveling) the edge of the core after installation, by using core kits which already have the fillet cut into the edge of the core, or by using core adhesive putty to create the fillet. [Core adhesive or putty fillets, however, are heavy and more brittle than fillets of the core material. They are not the best approach. Ed.]

4) **Segregate the Core from all Openings**

It stands to reason that any opening cut into or through the core can and will be a potential source of exposure to water. If the kerf system is unfilled and open, this water is virtually guaranteed to migrate through the laminate. It is imperative that no openings be cut through the core to expose the core edge to potential contact with water. This applies to all core materials, foam and balsa. It is especially critical with fittings mounted on the hull bottom. It is also important for all openings cut through the laminate including vents and ports in hull sides, hatches and ports on the deck, deck fills, rod holders, etc, etc. Nowhere should a cut out or a hole in the laminate expose the core.

Segregating the core can be achieved in a number of different ways. The core can be phased out by the use of fillets and the opening cut or drilled through built up single skin laminate. A solid high density insert can be introduced into the laminate, replacing the core in the area where the hole or opening is to be cut. Alternatively, the exposed edges of core can be routed back away from the opening and the resulting void between the two skins “potted” with thickened resin (usually epoxy). Merely using caulk or sealing compound to
close out exposed core is not recommended, and will ultimately lead to water contacting the core over time.

Plywood is sometimes used as the “high density” insert in way of a cut-out, but plywood will allow migration of water along the grain structure, and will swell in thickness if it gets wet, potentially cracking the laminate. Use of plywood in a laminate should be avoided.

When Things Go Wrong – Wet Core

How Cores Get Wet
Cores get wet when the core itself is exposed to a source of water. Cores do not get wet by water migrating through the laminate into the core. During the blistering crisis of the ‘80s there was a line of thought that if water vapor can migrate through the gelcoat to form blisters, then that vapor would eventually find it’s way to the core, especially balsa core. A 14-year water immersion study conducted by Alcan Baltek Corp put that theory to rest when typical cored laminates were immersed in water, some samples exposed on both sides, and the moisture level monitored each year. At the end of 14 years the laminates were stripped of their skins and the cores weighed and then dried, and weighed again to determine the level of moisture. In every case, no significant increase in the moisture level of the cores was detected. Cores only get wet if the edge of the core is exposed to water, and there is a means for that water to migrate through the core. That is why it is so important to isolate all core from openings through the laminate, and to fill all kerf systems to prevent the transmission of moisture.

Water Migration within the Laminate
If water does contact the core through a fracture of the outside skin or a puncture of the inside skin, it is important that that water not progress beyond that point. The best way to achieve that is to fill the kerf system with resin or putty. A significant study on water propagation through the kerf system was conducted by Alcan Baltek, where curved, hand-laid, foam- and balsa-cored laminates with open kerfs were punctured with a 2-inch diameter hole and immersed in water for almost a year. Identical panels were vacuum infused with filled kerfs and exposed in exactly the same manner for the same length of time as the hand laid panels. Both the foam core and the balsa core hand laid samples with the open kerf systems absorbed considerable amount of water within the laminate, with the balsa continuing to absorb more water over time. However, the infused balsa and foam cores with filled kerfs both absorbed substantially less water (5% by weight) with the infused balsa and foam behaving almost identically. Filling the kerf systems is essential to prevent water migration and absorption by the core. Vacuum Infusion is the best way to achieve this.

Properties of Wet Balsa
We saw above, if water is allowed to permeate a balsa cored laminate with open kerfs, the balsa will absorb moisture. Various studies, conducted by Lloyd’s Register, TPI Composites, Sea Ray and Alcan Baltek, have all shown that balsa will readily transmit moisture in the direction of the grain, but substantially more slowly across the grain. Indeed, once the moisture enters the balsa across the grain it pretty well bogs down at about 1/2-inch into the core and doesn’t go much further. The rapid water migration in the direction of the grain in end-grain balsa means that it will migrate only from one skin to the other, and no further. However, when you are dealing with a 1 inch x 2 inch module in a CK configuration, a 1/2-inch migration across the grain from water surrounding a module has the potential to saturate that module. The question then becomes, what happens to the properties of balsa core as the moisture level increases to up to 100% by weight?
The results of that study indicate that the properties of wet balsa core are directly related to the fiber saturation point. All woods have a certain amount of moisture present. Indeed, the published properties of balsa are determined at a standard moisture content of about 10% to 12%. If exposed to excess moisture, the moisture level of the balsa can increase to the fiber saturation point, where the structure of the wood cannot retain any more water vapor. This is about 28% by weight. Any additional moisture is no longer absorbed by the structure of the wood and is precipitated out as liquid water in the open cells. Incidentally, that’s why all moisture meters will “pin” at about 30% moisture level when reading the moisture level of balsa. It’s intuitively obvious that if the physical properties of balsa are influenced by the moisture content in the structure of the wood, that those properties would plateau at the fiber saturation point, because at this point the wood is stable (saturated) and will not absorb more moisture. And that is what is confirmed in the testing. All properties reduce as moisture levels increase from 12% to about 30%, but then stay relatively constant as moisture levels increase beyond this.

The good news here is that this reduction in properties is predictable, and the all important shear strength and compression strength reduce by a predictable 20%. Considering that balsa has shear and compression strengths that are substantially higher than the equivalent foam core, this 20% reduction in properties is not enough to immediately condemn the boat, or even justifying stripping and replacing the skins and core. Wet balsa core is not a good situation, and should by all means be avoided by the core installation techniques described in detail above. However, if wet balsa is detected, we now know that it has defined physical properties, and the laminate safety factors should be recalculated based on those reduced and defined properties. Stripping the outside skin and replacing the core, if the moisture is extensive, may cause more harm than good. This is especially true for foam cores, where the moisture can often be sucked out of the kerfs, and the presence of moisture has no adverse effects on the physical properties of the core. High moisture levels are a concern, but careful consideration should be given to the best method of addressing it.

Conditions required for Decay
Wet balsa will decay if it is exposed to oxygen. That’s why if there is decay, it is always located at the point of water ingress to the core, because that’s also where it’s exposed to air. The three requirements for decay are:

- Moisture level at 28% or higher (at or above the Fiber Saturation Point)
- Presence of Oxygen
- Temperature range between 50 and 95 degrees F

This explains why you can often have exposed balsa in a deck cut out in a 39 year old boat, as I have, and not have any decay, because the balsa has a chance to dry out if it gets wet. However, I also had decayed balsa in the same deck at a cutout that was improperly sealed that allowed water to stay in contact with the core and not dry out, resulting in decayed core. If you find wet balsa, it’s very important to trace the moisture to its point of ingress, and seal the access point, sealing off both the source of water and the source of air. Then, you can address what you want to do with the wet, but un-decayed core. Decayed core should always be removed and replaced. Wet, but un-decayed core is a more difficult call.

Freeze Thaw Cycles
There is a persistent opinion in the marine industry that wet core can freeze, and a number of freeze/thaw cycles will lead to delaminations. Indeed, surveyors will often attribute water filled delaminations to the effects of freeze/thaw cycles. However, independent researchers have found that if you deliberately create a water filled void in a laminate and subject it to numerous freeze/thaw cycles, it will not increase the size of the existing void. Studies conducted by Rick Strand of Impact Matrix Systems and presented in Professional Boatbuilder Magazine, where deliberate never bonds where filled with water and repeat-
edly froze and thawed, showed no measurable increase in the size or extent of the void. In a similar manner, tests conducted by Alcan Baltek Technical Service showed that when open kerf systems in both foam and balsa cores are filled with water and then repeatedly frozen and thawed, no delaminations of the skin from the core was evident. Again, water in the core is not desirable, and should be avoided at all cost, but there is no evidence that the freezing and thawing of this water leads to any skin to core delaminations.

The Cored Bottom Controversy

I would be remiss in writing an article on cores in marine applications, without addressing the controversy on cored bottoms. This may be an issue that becomes resolved as more builders convert to vacuum infusion, where as pointed out above, using a core is the best way to retain laminate thickness under the vacuum compression of the laminate. However, there is a school of thought that uncored bottoms on high speed boats like sport fisherman, are actually preferable to cored bottoms. This is an issue that Lou Codega and I addressed in a Professional Boatbuilder article over 10 years ago, but we still hear the argument that single skin bottoms are superior to cored bottoms. The rational is that a single skin laminate will have greater impact strength than a cored laminate with a thinner outside skin. A lot of this

Repair Methods

As discussed above, when high moisture levels are discovered in cored laminates, a lot more consideration must be given before a plan of action is determined. The first step in a balsa-cored boat is to determine the true moisture level in the core with a pin type moisture meter, which, as we discussed above, will “top out” at 30%. If the reading is in this range, then a plug should be taken, sealed in plastic, and sent to a knowledgeable lab to determine the true moisture level. The extent and source of the moisture is then determined by mapping the area of elevated moisture in the hull and deck, and looking for signs of decay, then sealing the source of water and oxygen. Once the extent and amount of the moisture is defined, the best solution can be determined in consultation with the owner, the yard, the boat manufacturer, the core supplier, and if necessary an independent designer or naval architect, who can determine the safety factor of the compromised laminate. As discussed above, doing nothing at all may in fact be the least disruptive, and best option.
argument is either based on the past poor performance of improper core installation, which sometimes resulted in the unfilled kerfs filling with water, or worse still, diesel fuel or sewage from integral holding or fuel tanks, or the effects of improper bedding of the core in a hand lay-up situation. All this emphasizes the statement that, “If you can’t do it right, don’t do it at all”. Some of these early problems with cored bottoms may well have been due to inadequate engineering in converting from a single skin laminate to a cored laminate. As mentioned above, a lot of lessons were learned the hard way in this industry, but those lessons have been learned, and builders should now benefit from proper design and installation.

Now that we know what constitutes proper core installation, and follow either the recommendations of laminate engineers associated with a core supplier, or follow the conservative scantlings dictated for bottom laminates by all the classification societies, the advantages we can derive from cored bottoms are considerable.

Lighter Weight
In the same way as an “I” beam is lighter than a solid steel rectangular beam of the same stiffness, a cored panel is always lighter than an uncored single skin panel of the same stiffness. It’s the extreme fibers of the beam or the panel that take the compression and tension loads, not the interior which only sees shear loads. Like the web of an I beam, the core can be chosen to accommodate those shear loads at a greatly reduced weight. However, as much as the weight savings achieved in the bottom laminate itself, almost an equal weight reduction is achieved due to the simplicity of the grid structure that the core construction allows.

Simplicity Of Bottom Structures
While it is possible to design a cored laminate that matches the stiffness of an uncored laminate for a given span, it is quite easy, and much more efficient, to design a cored laminate that greatly exceeds the stiffness of the single skin laminate. When that occurs, you can increase the unsupported span of the panel by widening the space between the structural longitudinals, or eliminate the secondary longitudinals and frames that are often added in single skin bottoms to support that uncored panel. When that happens, you achieve a greatly simplified grid structure that not only saves you further weight, but allows more space for engines, tankage, and storage, not to mention interior accommodation. A cored bottom combined with a simplified grid system is an elegant solution to achieve superior bottom structure.

Quieter Ride
There are two primary sources of noise and vibration on any boat – sea water and the engine. Wave slap, either at speed or at a quiet anchorage, can be annoying and unsettling. In addition, the vibration from the engine and propellers can be transmitted throughout the whole boat which will act like a sounding box to further amplify that noise. Cored bottoms isolate both these source of noise from the general interior of the boat, resulting in a much quieter ride and greater crew comfort and less fatigue.

Increased Safety Factor
Oil tankers have long been required to have double bottoms to isolate the cargo from seawater in the event of a severe grounding. That is, a puncture of the outer hull will not violate the water tight integrity of the ship, and the cargo will remain isolated from the sea. A cored bottom works in exactly the same way. Any impact on the bottom, even if it damages the outside skin and even if it results in a core shear failure, will not violate the watertight integrity of the hull because the inside skin is still intact. This applies to all structural cores, but when you then include a linear core, then the safety factor further increases. You can even take this to extremes and further increase the skin thicknesses beyond what is required structurally for a cored laminate, to further take advantage of the double bottom concept. It is for that reason (and for cosmetics) that the outside skin on a cored bottom is traditionally thicker than the insides skin.

Summary
Cored laminates have been used in the boating industry for over 50 years, and the lessons learned have allowed the introduction and adoption of cored composites in aerospace, transportation, military, and alternative energy. However, cores should be chosen carefully to suit a specific application, and their installation should never be taken lightly. Fortunately, with the introduction of vacuum bagging techniques, and more recently the conversion to vacuum infusion by a number of reputable builders, proper core installation becomes a natural part of the building process. If you have a question on anything to do with core selection or installation, never hesitate to contact your core supplier. Most have a wealth of experience and assistance available.

CLICK HERE to read Part 1 of “All About Cores.”
CLICK HERE to read Part 2 of “All About Cores.”

Rob Mazza is manager, new market development, at Alcan Composites. With a degree in mechanical engineering and a masters in naval architecture and marine engineering, he has 25 years experience in custom and production yacht design, with the original C&C Yachts Design Group, Mark Ellis Design, and the Hunter Marine Design Group. He spent 14 years in structural cores with ATC Chemical (now part of SP under Gruit) and currently with Alcan Baltek Corp, part of Alcan Composites. Rob has been with Baltek 6 of those 14 years. Currently living in Bergen County, NJ, Rob sails his 40 year old C&C Corvette out of the Nyack Boat Club, on the Hudson River.
METAL CORROSION IN BOATS
(Course No: TT500)

This comprehensive distance-learning course will provide you with a firm foundation in the causes of metal corrosion and the current practices in its prevention, reduction and cure.

Topics include: galvanic corrosion, electrolytic corrosion, wastage, pitting, velocity effects, and cathodic protection. The causes and mitigation of corrosion of stainless steel, copper and nickel based alloy, aluminum, iron, and steel are studied. Special consideration is given to problem areas underwater, on deck and aloft, and in engine and fuel systems.

CLICK HERE for a detailed syllabus
CLICK HERE for more details and enrollment information on this and other Westlawn essential continuing education courses

FIBERGLASS BOATBUILDING: MATERIALS & METHODS
(Course No. BC401)

This comprehensive distance-learning course provides instruction in the fundamental concepts of sound fiberglass boat construction practices and basic structural calculations.

This course focuses on current information on fiberglass and related boatbuilding materials, and the best techniques for using them. Topics include: reinforcement fibers, resin systems, core materials, mold construction, production facility requirements, boatbuilding methods, elements of strength of materials, laminate design, assembly of components, and design examples.

NOTE: This course is included as lessons in Westlawn’s larger Elements of Technical Boat Design course and also in the full Yacht & Boat Design Program.

CLICK HERE for a detailed syllabus
CLICK HERE for more details and enrollment information on this and other Westlawn essential continuing education courses

ABYC Courses and Schedule for 2010

The ABYC Education Department has been providing industry certifications, training, high school and college curriculum, and industry seminars for over twenty years. They are providing the marine industry with the skilled workers required to build and maintain modern small craft of all types.

ABYC is currently scheduling on-site factory training for 2010. Please call ABYC for custom tailored, flat rate, instruction by top industry trainers at your facility (410-990-4460, Ext. 31).

The Marine Technician Certification Program developed by ABYC with “NOCTI Certification” has proven to be the industry standard. ABYC continues to provide the highest quality marine education and training throughout the country and throughout the year. For course dates and descriptions Click Here or see listing on Masthead Page 28

*NOCTI (National Occupational Competency Testing Institute) is a regular provider of the assessments on which many certifying bodies depend for measures of applicants’ standards-based knowledge and skills. Certificates benefit employers by showing that applicants have acquired specific skills. The status of having a certified staff can lead to higher sales and customer satisfaction.
## Training Links & Events Schedules

### Training Links - For Current In-Class ABYC Courses

To register for an ABYC Education Program, click on the event name you would like to attend.

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### Westlawn Distance Study

Click on Topic for more information:

- **Professional Yacht & Boat Design, 4-Module Program**
- **Elements of Technical Boat Design** (Formerly Yacht Design Lite)
- **Continuing Education**
- **Applications & Enrollment**

All Westlawn Courses are nationally accredited by the Accrediting Commission of the DE TC

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## 2010 NMMA Boat Shows

### 78th Northwest Sportshow
March 24 - 28, 2010
Minneapolis Convention Center
Minneapolis, Minnesota
[www.northwestsportshow.com](http://www.northwestsportshow.com)

### Liberty Boat Show
April 29 - May 2, 2010
Liberty Landing Marina at Liberty State Park
Jersey City, New Jersey
[www.libertyboatshow.com](http://www.libertyboatshow.com)

### 45th Tampa Boat Show
September 10 - 12, 2010
Tampa Convention Center
Tampa, Florida
[www.tampaboatshow.com](http://www.tampaboatshow.com)

### Toronto In-Water Boat Show
September 16 - 19, 2010
Ontario Place
Toronto, Ontario
[www.torontoinwaterboatshow.com](http://www.torontoinwaterboatshow.com)

### Norwalk International In-Water Boat Show
September 23 - 26, 2010
Norwalk Cove Marina
Norwalk, Connecticut
[www.boatshownorwalk.com](http://www.boatshownorwalk.com)
The Masthead

Training Links & Event Schedules (continued)

For an expanded list of U.S. and International Boat Shows Click Here http://www.boatshows.com/calendar.aspx

2010 Conference & Training Programme

SHIP DESIGN & OPERATION FOR ENVIRONMENTAL SUSTAINABILITY
10-11 March 2010, London, UK
http://www.rina.org.uk/environmentalsustainability

HIGH PERFORMANCE MARINE VESSELS
9-10 April 2010, Shanghai, China
http://www.rina.org.uk/HPMV2010

FUNDAMENTALS OF CONTRACT & CHANGE MANAGEMENT FOR SHIP CONSTRUCTION, REPAIR & DESIGN
14-16 April 2010, London, UK
http://www.rina.org.uk/fundamentalsapril2010

MARINE RENEWABLE & OFFSHORE WIND ENERGY
21 - 22 April 2010, London, UK
http://www.rina.org.uk/renewable2010

BASIC DRY DOCK TRAINING COURSE
11-14 May 2010, London, UK
http://www.rina.org.uk/drydock2010

WARSHIP 2010: DESIGN CONSTRUCTION & OPERATION OF NAVAL TECHNOLOGIES
9-10 June 2010, London, UK
http://www.rina.org.uk/warship2010

INNOVATION IN HIGH PERFORMANCE SAILING YACHTS (INNOVSAIL 2010)
30 June – 1 July 2010, Lorient, France
http://www.rina.org.uk/innovsail2010

HIGH SPEED MARINE CRAFT
29 - 30 September - 2010, London, UK
http://www.rina.org.uk/highspeedcraft2010

FUNDAMENTALS OF CONTRACT & CHANGE MANAGEMENT FOR SHIP CONSTRUCTION, REPAIR & DESIGN
13-15 October 2010, London, UK
http://www.rina.org.uk/Fundamentalsoct2010

SYSTEMS ENGINEERING IN SHIP & OFFSHORE DESIGN
21-22 October 2010, Bath, UK
http://www.rina.org.uk/systemsengineering

PRESIDENTS INVITATION LECTURE
November 2010, London, UK

THE WILLIAM FROUDE CONFERENCE
24-25 November 2010, Portsmouth
http://www.rina.org.uk/Williamfroude

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CLICK HERE for a rate card, information, and instructions.
Did You Know About Dellenbaugh?

One of the more important coefficients used in sailboat design is the Dellenbaugh Angle. It provides a useful indicator of the approximate heel angle a boat will experience with all working sail. (CLICK HERE for a detailed discussion of the Dellenbaugh Angle, in the June 2007 issue of The Masthead, on page 9.)

Florida based naval architect, Eric Sponberg, was able to track down information on the creator this indicator. After several dead ends, he received an email back from Brad and David Dellenbaugh which provided the details:

“Dellenbaugh Angle was developed by F.S. Dellenbaugh Jr., in the 1930s. He was our grandfather. Warren was our father. Yachting Magazine did an article on the Dellenbaugh Angle in the 1990s I think, but it could have been earlier. I recall reading some correspondence between FSD II and Olin Stephens from the 1930s in some old family files, though no idea where those might be now. Our great grandfather was FSD I. He was an explorer, artist, author, etc., but not a Naval Academy grad. He was 17, in 1871, when he joined Major Powell’s second expedition down the Colorado River.”

The Masthead

The Journal of the Westlawn Institute of Marine Technology

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Who We Are

Westlawn is a not-for-profit educational affiliate of the American Boat and Yacht Council (ABYC). Our school is nationally accredited by the Distance Education and Training Council (DETC), and is listed as an accredited school by the U.S. Department of Education and by the Council for Higher Education Accreditation.

Our Mission

Founded in 1930, the mission of the Westlawn Institute of Marine Technology is threefold:

■ To provide our students with the skills and knowledge required to build a rewarding career in the profession of yacht and small-craft naval architecture.
■ To support continued growth of the recreational and small-craft marine community through the development of well-trained, safety-oriented, boat designers developing better products for the benefit of the boating public.
■ To provide continuing education to marine-industry professionals.

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