International Hydrofoil Society Correspondence Archives...

Wake Energy and Damage From Fast Ferries

Advice, Sources of Information, and Requests For Help

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Correspondence

Thesis Topic: Hydrofoil Wake Patterns

[5 Feb 02] I did and will review all your comments and suggestions many times, and I think I will closely consider redirecting my thesis towards investigation of wake patterns and their effects in shallow and confined waters, though hydrofoil resistance in these types of waterways still tickles my mind. I believe I have already mentioned the fact that due to lack of capacities at the University my research will have to lean on theoretical assumptions only. The prices for model constructions are sky-high, and towing tanks in Spain are very difficult (better to say: impossible) to reach. Unfortunately any kind of eventual scholarship is reserved for people having "something else" apart from good will and knowledge. Again, sad but true... Also there are no hydrofoil operators in Spain interested in pushing up the R&D project like mine. For some reason unknown to me all hydrofoils that once were the masters of the rivers and channels in Yugoslavia, my country of origin, are withdrawn from the service, so no full scale experiments can be performed there neither. But I am stubborn enough to put my self in those waters and I believe I will be able to contribute to the hydrofoil society even in the most modest way. -- Sasha Jovanovic (salespanac@serbiancafe.com)

Responses...

[5 Feb 02, updated 17 Feb 02] According to Mr. VanBibber, the HYPAM program manager at Panama City FL, the hydrofoil induced pressure wave trial data will become declassified in 2008. Until then, I will have to temper my comments. As I read Mr. Patterson's and Mr. Hockberger's comments (below), I have to add my two cents worth. All ships will displace water in some manner. As I see it, hydrofoils also displace water when it gets its lift. Since the foil resembles an aircraft wing, although water is not compressible like air, I believe there is a similarity in pattern where the vortices goes down and out. Thus, the wake is not readily visible from the surface, but still exists. I can attest that with foilborne operations in Lake Washington and Sinclair Inlet in Puget Sound, we received calls from floating crane operators and house boat owners of the rocking motion they experienced causing damage to their property. I believe studies of wake patterns and their effects, especially in confined areas, would be of benefit to operators and designers alike. -- Sumi Arima (arimas1@juno.com)

[5 Feb 02] One of the selling points for the Boeing [fully submerged foil] JETFOIL was that it would have a much reduced wake for operations in shallow/narrow waters, but I don't know whether this was just "hype", observation, or based on research or tests done by Boeing or others. The concern came up when the Golden Gate Bridge Authority was seeking passenger ferries that could make good speeds in restricted waters around San Francisco Bay, especially in the channel to the Larkspur landing in Marin County. One problem could have been that the take-offs and landings might generate wakes that would be unacceptable, even though passing wakes from a foilborne JETFOIL might be minimal. Sorry I don't have any hard data - just recollections of conversations and comments. -- Ralph Patterson (RAPatterson.57@alum.dartmouth.org)

[5 Feb 02] Like Martin Grimm I have come to think that hydrofoils may provide the best way of enabling fast craft to operate in rivers without causing significant wake-wash problems. My own arrival at this idea was not based on an expected reduction in drag, however, but on the expectation that the disturbance of the water surface would be less than that caused by a hull operating at the surface. My specific design problem has been to determine the maximum combination of speed and size (passenger capacity, really) that a ferry could have before it would start causing damage to the banks of the river. I've read most of the papers written about wake-wash in recent years, hoping to find the solution to this problem based on using conventional monohull or catamaran designs, since ferry operators have shown a general desire to avoid using what they consider to be exotic design features-and they include hydrofoils in that category. Unfortunately, it seems clear that no one has yet discovered any special hull designs that avoid the creation of problem wake-wash. Different combinations of hull characteristics, including shifting from monohull to multihull forms, mainly tend to shift the speed range at which the problems occur or exchange wave height problems for wave frequency problems. It occurred to me that a hydrofoil might solve the problem by taking the energy now expended at the surface in creating waves and expend it mainly underwater, somewhere between the surface and the river bottom. There would be a turbulent underwater stream extending downstream, hopefully without impacting the banks or disturbing other craft on the river. Also, at a given high-enough speed, it seems likely that the power would be less for a hydrofoil than for a surface-supported craft, so the energy going into that underwater turbulence should be less than what would otherwise go into surface waves and wake-wash. One major uncertainty for me has been whether that underwater turbulence would create a problem on the river bed. River beds can have a great range of different compositions, from very soft and mushy to hard rock. The softer types might be stirred up too much. It is already recognized that boats tend to deepen river channels by their passage, by stirring up sediments that get redeposited off to the sides of the channel. That could be seen as a problem in some rivers, if the side areas became too shallow for the boats and activities that had been using them. Martin's comments about the effects of shallow water versus deep water on the performance of an underwater foil are interesting-I've wondered whether such effects would occur, and what their characteristics and magnitudes might be, and how they would propagate toward the river banks or the shore. The effects of forward foils on aft foils is another area of uncertainty to me. (The problem of hydrofoils hitting mostly-submerged floating trees and other large debris at high speed is another big one, but that's not pertinent to this discussion.) I've known that a very large number of hydrofoils have been used for many years on rivers in Russia and nearby countries. I was surprised to read that at least one was designed to operate in water as shallow as three feet! I wonder what their environmental effects have been- was there any concern about the environmental effects of wake-wash when those craft were designed, and have they operated despite causing what we now consider problems? Sasha, your idea for this project started on the basis that something analogous to wing-in-surface-effect might occur for a hydrofoil near the channel bottom. I agree with Martin that that effect wouldn't have a useful magnitude unless the foil were dangerously close to the bottom. Also, as he noted, river bottoms tend to vary in depth and underwater topography, so maintaining that closeness would be an impossibly complex task. I think that focusing your research on the potential for improved L/D due to closeness of a foil to the bottom would not be useful. However, I strongly believe that there is important work to be done in determining the effects of shallow water and relatively narrow channels on the performance of hydrofoils. As I've described above, there is reason to think that hydrofoils could change unacceptable fast craft into acceptable fast craft for use on rivers and other shallow waterways, but we really don't know what the shallow water effects may be, or how to design the best hydrofoils for this application. I really hope you will do your research on hydrofoils in shallow/narrow channels so we can learn to what extent hydrofoils may save us from the problems I've described. -- William Hockberger (w.hockberger@verizon.net)

[5 Feb 02] In the late 70s I had the opportunity to analyze all the Boeing Jetfoil Hawaii operating data from all their jetfoil ship trip logs. It was very clear that no Wake measurements were ever made. I was able to came up with detailed seakeeping data and statistics for all their Hawaiian inter-island routes on a month by month basis for the several years they operated. For some of the months and certain sections of their routes the jetfoils were operating at the limit or just beyond their foilborne capability. -- Bill White (linksout@foils.org)

[5 Feb 02] Thanks to Ralph, Bill and Martin for their contributions on this interesting subject. Ralph has a good point about takeoff and landing, but with care taken by the helmsman (with the throttle), I should think that this disturbance could be minimized to the point of being acceptable for a short duration. -- John Meyer (jmeyer@erols.com)

[6 Feb 02] The problem of starting up and getting foilborne seems to me, also, to be something that can be managed by careful attention to the course followed during that period -- the waves have a directionality that can usually be accommodated. (Considering the unavoidable hump(s) as the craft gains speed, there will likely be waves of a size that could be of concern, depending on what's in the nearby area.) The fact that waves produced appear to be small and insignificant is something we now know can be deceiving. Only a few years ago it was generally assumed that low wave height translated directly into low wake-wash and minor environmental concern. I think the problem of the fast ferry Chinook in Seattle (and many other ferries) resulted from that error, although they did also attempt to estimate the energy in the waves and use that as a criterion. (The developers of the Chinook were very sensitive to the wake-wash issue and actually carried out an extensive analysis and test program in an effort to diagnose the causes of the problem and build a boat that would not produce it.) Now it's clear that these waves can be very long and energy-intensive, despite low height. Sumi, your comments about the effects of waves produced by hydrofoils in the Seattle area are significant. Certainly the weight of the craft has to be borne up in some manner, and maybe I've been deceiving myself to think that the waves generated on the surface should be small just because the volume of water actually displaced by the craft is small. (I previously said I thought the hydrofoil's effects would consist instead of a turbulent stream behind it, beneath the water's surface.) Maybe the whole pressure field developed by the foils generates large surface waves anyway. I've used basically that argument against the claims of those who believe that just because a planing craft or one supported by an air cushion is substantially out of the water, its wake-wash effects must be greatly reduced. We know that those types of craft can produce unacceptable wake-wash. I think you've pointed out a flaw in my thinking up to now. (I'd appreciate the thoughts of others on this, too. For a couple of years I've been saying I think hydrofoils may at last have found their niche in river and channel operations and that a hydrofoil resurgence may lie ahead, in view of the number of such places where ferries could be used. If we can't find a way around this issue, it's another faded opportunity for many potential routes.) Sumi's recollection of floating cranes and house boats being made to rock by hydrofoils reminds me of another situation. A couple of years ago, two "low-wash" "River Runner" catamaran ferries of the type developed in Australia in the early 1990s by Graham Parker (with Lawry Doctors as hydrodynamicist, I think) were put into service on a river in the Netherlands. It was expected that they would be able to do 30 knots without causing any problems at all. Testing of the first craft before they were delivered showed they had more than met the specified wake-wash requirements (based on wave height, of course). But they ended up having to slow to 13 knots in a couple of zones, to avoid causing fuel barges and other floating facilities along the river to surge and rock. They generated very low surface waves, but undesirable effects resulted nevertheless. The report I read actually referred to them as "pressure waves." I have tried without success to find information on wave-wake-wash measurements for hydrofoils. Bill is sure that was never done for the Jetfoils in Hawaii. Anyone have any other clues on this? Hydrofoils have operated in many other areas, and it's hard to think there was never even a perceived problem and therefore an interest in doing some measurements. The terminology here is a mess. I used to think I knew what wake was, and wash, and waves, but they've gotten all mixed up together in recent years. I'm just going with the flow, here (used to know what flow was, too) and hoping we all know what we're talking about. -- William Hockberger (w.hockberger@verizon.net)

[11 Feb 02] The 'River Runner' catamaran ferries were an in-house design of NQEA Australia that followed on from the experience they gained from building the earlier 'Rivercat' low wash catamaran ferries for Sydney Harbour. The designer of the 'Rivercat' was indeed Grahame Parker and you are also correct that Associate Professor Lawry Doctors provided hydrodynamics analysis and advice in developing the hullform. The 'Rivercat' design was the subject of one or more technical papers at the time, and I have a copy of at least one of those in case it is of interest. Account was taken of the operation of the 'Rivercats' in the relatively shallow Paramatta River when the hydrodynamic analysis was undertaken. At the time, I believe the target was to minimise wave-making resistance as it was reasonably concluded that this parameter had a direct relationship with the severity of the wash that was generated. -- Martin Grimm (seaflite@alphalink.com.au)

[10 Mar 02] As for the Hawaii operations, there was little concern with possible wake damages on the routes where the Jetfoils operated. The offshore areas are very deep, even quite close to shore, and there are few structures along the shoreline, such as in Puget Sound or San Francisco Bay. Honolulu Harbor entrance is pretty wide, and is dredged to forty feet or more, and the boats tended to land before approaching the inner harbor. Maalea, Maui is shallow, but the boats always landed before entering the breakwater, because of the narrow entrance and restrictions in the whale grounds. The waters between Maui, Molokai and Lanai, the basin in which the Jetfoils operated, are about 600 feet deep, and fall off to near that depth pretty rapidly away from the shore. Nawiliwili, Kauai is a good sized basin, still fairly deep [although I haven't looked at any chats] and I think I remember that the Jetfoils were still foilborne in the outer harbor area, but landed well before they approached the pier. Kona, on the Big Island, is very open and also quite deep seaward of the small boat traffic and moorings, and I don't believe the boats were operated foilborne within a mile or so of the pier. Are there any reports of the Russian experiences with hydrofoils in their rivers? -- Ralph Patterson (RAPatterson.57@alum.dartmouth.org)

[31 Mar 02] There is a photo of *HIGH POINT* that was taken while flying through Rich Pass. We never had any complaints, including from Karl Duff, about wakes in that area. I believe the way the pass contour is, only the waves washing onto the shore affected the bulkheads. The pressure wave must get dissipated before it reaches the shore. The fish farm which sits where the pass starts to widen did complain of us causing their floating cages to rock. The complaints that we generally got were in areas where the water depth was fairly shallow and flat. -- Sumi Arima (arimas1@juno.com)

Thesis Topic: Hydrofoil Vessels in Confined Waters

[3 Feb 02] I am trying to choose a concrete subject for my PhD Thesis on hydrofoils and I thought it might be interesting to investigate the influence of bottom and sidewalls proximity (mostly in inland channels) on hydrofoil performance. Since there is a lot of bibliography on displacement vessel's performance in confined and shallow waters I would highly appreciate if somebody could be so kind to indicate if there are any papers on the same subject but for hydrofoil vessels. Navigating in a shallow channel with relatively flat and uniform bottom a hydrofoil vessel may be a subject of some kind of "wing (foil) in bottom effect". I have reviewed some documents on wing in ground effect and ekranoplans, and an idea occurred to me. Navigating in shallow waters with relatively uniform bottom, say inland channels or some rivers, hydrofoil vessel (fully foilborne) might be affected by the proximity of the bottom, similar to ekranoplans by the effect of the sea surface, causing certain resistance reduction. I have not seen or heard of any investigation of such kind, so I thought it might be interesting to study that phenomena, even if only theoretically. However, I am not sure (I still have to read a lot!) at what distance from the sea (land) surface a ground effect is felt by an airplane or ekranoplan. Hydrodynamic resistance of various high-speed vessels in shallow waters was a part of my graduation thesis, but hydrofoils were exempted from that analysis, because of lack of information. This is exactly the gap I would like to fill in as a logical continuation of my previous work. Unfortunately, at the Politechnical University of Catalonia (Barcelona) where I am studying, not many people can help with guiding me towards this investigation, so I am forced to contact experts all over the world. That is how you good sirs got my message. Finally, if you believe that the studies performed by US Navy might help, I would greatly appreciate your help in this matter. -- Sasha Jovanovic, BEng in Waterborne Transportation (salespanac@serbiancafe.com)

Responses...

[3 Feb 02] This effect has been investigated - it's important when testing hydrofoils in a tow tank. Basically the same as wall corrections in a wind tunnel. See http://naca.larc.nasa.gov/reports/1955/naca-report-1232/. -- Tom Speer (me@tspeer.com) (http://www.tspeer.com)

[3 Feb 02] Try TN 256, 410, 781,782, 2350. Thom was a Brit R&M 2033 British ARC. Wall interference is the same as ground effect. Just forget about compressibility for water. -- Nat Kobitz (KobitzN@ctcgsc.org)

[3 Feb 02] I do not know of any studies of shallow water resistance effects on hydrofoils, since we try to avoid depths that could cause grounding. The US Navy measures the ship signatures of their ships and works to mask or silence them to avoid detection. The measurement of the pressure wave characteristics were made of different hydrofoils while foilborne by the Naval Coastal Systems Laboratory in Panama City, Florida (now part of Naval Surface Warfare Center). The data at the time of measurement was highly classified and I do not know if the information has been declassified. In this case, we did not want any bottom or side reflections to affect the data measured, so the sensors used were highly directional and located in an open area. Unless you are trying to confirm computer simulation of the actual pressure wave, I believe the data taken by the Navy will not be of much use to your studies. -- Sumi Arima (arimas1@juno.com)

[3 Feb 02] Hydrofoils seem to be ideal as fast river ferries. I had started to compare their performance against the current generation of river catamaran designs some time ago based on published data. Beyond a given speed, hydrofoils would appear to have the edge in terms of transport efficiency. That information is probably based on performance achieved in deep water and I don't know how the vessels compare in shallow water. As you would probably have already observed, the resistance of catamarans (and of course other displacement vessels) can either be increased or decreased in shallow water compared to the deep water case depending on their speed. At high speed, shallow water resistance (at least wavemaking resistance) tends to be less than in deep water. What happens in the case of hydrofoils I don't know, but surely it should be similar? I have often observed that the wave wake of hydrofoils operating in calm water seems to be quite small relative to other shipping of similar size and the same or less speed. I have long wanted to demonstrate that is truly the case because, if it was indeed demonstrated to be true, that would be a particularly attractive attribute of hydrofoils used in river service where the effects of the wave wake are often a concern to other river users and regulators. Unfortunately, I have neither the mathematical expertise, nor the test facilities, nor the spare time to actually do such an investigation myself! I am not aware of any papers dealing with hydrofoils operating in shallow water. It is however reasonably safe to say that the mathematical theories and CFD codes to deal with such a case would already exist. Some leads may be to look at the theories related to Wing-in-Ground-effect craft (WIG) or Ekranoplans as they are also known. Such aircraft fly very close to the water surface (typically within a chord length). This improves the lift to drag ratio of their short wings. The added complexity for a hydrofoil is that not only do you have the 'solid' river bed to account for, but also the water free surface above the foil. The Russians developed hydrofoil craft that have their foils operating within about a chord length of the free surface. This was done to achieve a stable ride. If the hydrodynamic theories for such hydrofoils and the WIG craft could be combined then perhaps there is a solution! I certainly think your investigation has good sense. If you are able to develop a practical methodology that is able to predict hydrofoil resistance or wave wake, it would have a very worthwhile application for the reasons I mentioned above. If you remain interested in pursuing this proposal for a thesis, there are a number of researchers in Australia that may be interested in hearing more about your work. Much of the past theoretical and experimental work looking at catamaran wakes in shallow water has been undertaken at institutions such as The University of New South Wales in Sydney and the Australian Maritime College in Tasmania. Those researchers may be prepared to offer further suggestions on theoretical or experimental approaches you may like to consider. A final comment on the practical operation of hydrofoil craft. They should never be run in water that is so shallow that they will run aground should a power failure occur. That means that the water depth should at all times exceed their hullborne draft! This means that it is not really necessary to develop a methodology where the foils are in very close proximity to the river bed. Some guidance on the limits that would be of concern to you could be obtained by looking through a copy of *Jane's High-Speed Marine Craft*. The Russians developed river hydrofoils tailored specifically for shallow river use and they have a quite low hullborne draft, including the draft to the bottom of the foils. -- Martin Grimm (seaflite@alphalink.com.au)

[4 Feb 02] I was trying to find an answer to my question at what distance from the sea surface a ground effect is felt by an ekranoplan and you gave me one. When I was thinking of a hydrofoil navigating in shallow waters I did think about minimum depth to be greater than hullborne draft. The question is does the same distance (chord length) have to be applied in case of hydrofoils in order to be affected by "bottom effect". What could be tried is to take a look into motion equations and resistance characteristics for infinite depth when the vessel is fully foilborne and than to try to combine equations for motion near free surface and (relatively) near the river bed. Relatively reliable prediction might be achieved, but, as in your case, I will definitely not be able to perform any tests. I also have to start rubbing off the rust of my mathematics knowledge, since I have not been using it for a while. Russians did actually have a lot of success with hydrofoils designed for shallow rivers. Best known types (to me) are "Meteor" and "Raketa" with shallowly submerged foils. The greatest problem would be pursuing the information on their investigations and experience, since all Internet resources do not have much published material of Russian origin. I have been trying to pursue the book "Hydrodynamics of foil near water surface" but all attempts resulted in failure. You also mentioned Jane's High-Speed Marine Craft as a good reference, but did you think of any special year of edition? -- Sasha Jovanovic, BEng in Waterborne Transportation (salespanac@serbiancafe.com)

[4 Feb 02] I will try to answer your additional questions, but you will find I am getting out of my depth so to speak!

1. The change in aerodynamics of a WIG near the ground is more related to the change in flow around the wing. My understanding is that the losses associated with the tip vortex are reduced due to this changed airflow when the wing is near the surface and that leads to the higher Lift to Drag ratio. While that should also hold true for a hydrofoil traveling very close to the river bed, no hydrofoil operator in their right mind would run a hydrofoil boat with the foil only a chord length or less above the river bed! Of course real rivers are not a constant depth so it would be very difficult indeed to do that anyway. Furthermore, hydrofoils tend

to have a reasonably high aspect ratio (span relative to chord length), so they should not have large losses associated with tip vortices in the first place. Operating the foil close to the river bed would therefore not achieve a significant improvement in L/D ratio. The reason why the lift and drag of a hydrofoil craft would change in shallow water is because the waves generated by the submerged foils propagate differently in shallow water than in deep water, and so the wavemaking resistance is altered. This does not mean the foils need to be close to either the river bed or the water surface. In addition, I imagine the running trim of a foilborne hydrofoil would be altered in shallow water. The wavemaking resistance of a hydrofoil craft is determined by the complete foil layout (both bow and stern foils in combination) rather than the chord length of any part of either of those foils. In fact, hydrofoil designers take into consideration the spacing between the bow and stern foils when considering the downwash effect of the bow foil on the stern foil as that influences the drag acting on the craft. My suspicion is that a hydrofoil may be affected by water depth in a similar manner to other waterborne craft. If you look though some of the work done on displacement hulls operating in shallow water, that may help give ideas about how to apply the wavemaking theories to hydrofoils. The parameter used to define the regime of operation of the craft in shallow water is called the Depth based Froude Number, V/sqrt(g.d), where "V" is boat speed in m/s, "g" is gravitational acceleration 9.81m/s^2, "d" is water depth in metres, and "sqrt" represents "square root".

2. OK, give it a try to combine equations for motion near free surface and (relatively) near the river bed, but sorry I will not be able to help with the maths!
3. A little is mentioned in the following reference of the reduction in lift as a foil approaches the free surface. That is the principle by which the Russian hydrofoils achieved their roll, pitch and heave stability: Tsarev, B.A.; "The Determination of the Stability of Vessels on Shallow-Submerged Foils", Hovering Craft and Hydrofoil, Vol. 4, No.1, October 1964. This paper deals with transverse stability of hydrofoils so is not concerned with the drag or wave wake as the foils approach the surface.
4. The more recent editions of that yearbook indicated their latest designs, but by way of example, even my 1974-75 edition of *Jane's Surface Skimmers* (as it was then called) lists the *BYELORUS* as an example of a hydrofoil developed from the Raketa "for services on winding rivers less than 3 ft (1m) deep and too shallow for vessels of the standard type". I know they developed other types as well, but don't have the details readily available. -- Martin Grimm (seaflite@alphalink.com.au)

[5 Feb 02] For a continuation of this thread, see "Thesis Topic: Hydrofoil Wake Patterns" dated 5 Feb 02 above. -- Barney C. Black (Please use the BBS to reply)

Wave Phenomena Source

[11 Nov 01] I am interested to become a member of the International Hydrofoil Society. My research interests include wave phenomena (especially computational issues), wake wash, dispersive waves. My educational background is academic training in applied mathematics, M.S. , 1983, University of Iowa. Business: CEO, 21st Century Data Analysis. I am in the Portland OR area. Languages other than English: German, French, (some) Russian. I am also interested in assisting with language issues, like your society website. -- Axel Mainzer Koenig (DSPACE21@aol.com)

Wake Problems of Fast Ferries

[11 Oct 99] I have been asked to supply documented support demonstrating hydrofoils produce far less wake when foilborne compared to other hull designs. Do you know of any studies supporting this? -- Robin Beasse (ROYALPACIFIC@bc.sympatico.ca)

Responses...

[12 Oct 99] First off, are you interested in surface wake or the overall effect? I do not know of any measurements made of the surface wakes from hydrofoil ships. Displacement of the ship's weight, regardless of whether it is hull or foil supported produces a pressure wave. Trials were conducted by *PLAINVIEW*, *HIGH POINT*, Jetfoil, and PHM to make specific measurements under a highly classified project. Naval Coastal Systems Center, Panama City, Florida was the primary laboratory in making the measurements and reporting the results. I do not have any of the data available to me. Maybe someone at NAVSEA or the Navy laboratories could advise me as to present classification and availability of the report. -- Sumi Arima (arimas1@juno.com)

[17 Feb 02] Sumi, Van [Vordaman Henry VanBibber] asked me to pass along to you the info that the ranging data for HYPAN will be declassified in 2008. I looked up the publication date on the Lab letter report and found it to be April, 1982. If you need the full citation for the report, let me know. -- Thomas C. Watson (tcw1960@bellsouth.net)

Wake Problem

[9 Mar 99] I suppose the wave damage from the *MV CHINOOK* of the Washington State Ferries is probably not news. It is a 34 knot boat and much superior to the previous fast ferries, but puts out a very long wave length/high velocity wave that really tears up the shale bedrock, bulkheads, sea life, and a few boats and boat houses, too. It is turning into quite a donnybrook because now that the ferry run is down to 30 minutes for pedestrians, it is a political issue, and the Washington State Ferry System had advised us that they will keep up the current speed until we take them to court. We are now only days away from that. The ultimate fix, as Chief Naval Architect (!) Stan Stumbo of the WSF acknowledges, is to place a supplemental foil span on Chinook and its forthcoming sister ferry. I have given them Dennis Clark as a point of contact at David Taylor Research Center or whatever it is called nowadays *[it is called Naval Surface Warfare Center, Carderock Division - ed.]*. If any of you want to volunteer to help Stan and the WSF out of a box, you should contact him at (206) 464-7496. It might also be news to some that I've become even more politically active and am now chairman of my county's Republican Party. Please prepare a hydrofoil for a fast getaway! For background, *MV CHINOOK* is a catamaran... about 350 tons, and it moves right along, too. At 34 knots, it's the fastest Rich Passage has seen since the glory days of hydrofoils. I'll look up the specs, propulsion horsepower, etc. and send some of that along later when I find it. It is an offshoot of the *VICTORIA CLIPPER II* class, which succeeded in reducing wake considerably, but of course all that horsepower has to go somewhere, and we're experiencing some real high- period, low-wavelength waves that are creating damage. Say! Does anyone there know how to derive the wave energy equation, E = 1961(H)(H)(T)(T)? (Sorry, exponents don't work on my e-mail!) In words, Energy (in joules per linear meter of wave) equals 1961 times wave height (in meters) squared times wave period (in seconds) squared. I can't find it in my fluid and wave mechanics books, and I need to understand the whole field of wave energy better. Have you a reference or a short primer paper you could provide? -- Karl Duff (kduff@linknet.kitsap.lib.wa.us)

Response...

[25 Mar 99] Regarding wave energy, Vol. I of the Army Corps of Engineers "Shore Protection Manual" (p. 2-27) gives the following total (P+ K) energy equation: E = (rho)g(H squared) divided by 8, where H = trough to crest wave height. The energy flux for waves of uniform height = 1/2 EC where C is the phase velocity of the waves, which is given by C = gT/2(pi) with T = the wave period. A bit of information regarding wake problems of high speed ferries is contained in a Danish Maritime Authority report Chapter 1 of which has been translated into English and can be down loaded from the Internet. You can track the SNAME high speed ferries initiative which leads to this report on the Internet. Incidentally, Stan Stumbo is a Corresponding Member of the 044 Panel. A second bit of info is that Gabor Karafiath at the David Taylor Research Center (301-227-7005) is the person to talk to about ship wakes. He is acquainted with the wake problems of the M/V *CHINOOK* and indicates that with a set of lines he could investigate the benefit of bow and stern modifications which might lead to wake and concurrent drag reductions. He has not heard from Stan Stumbo. -- Bill Buckley (wbuckley@erols.com)

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