SAILING FOR EVERYONE

Sailing is a sport, or recreation that is declining in popularity due in part to its complexity, its perceived elite-ness, and the poor way it is promoted in a crowded marketplace.

This is compounded by the entry level craft recommended and used by the peak global sailing bodies being pitched too high:

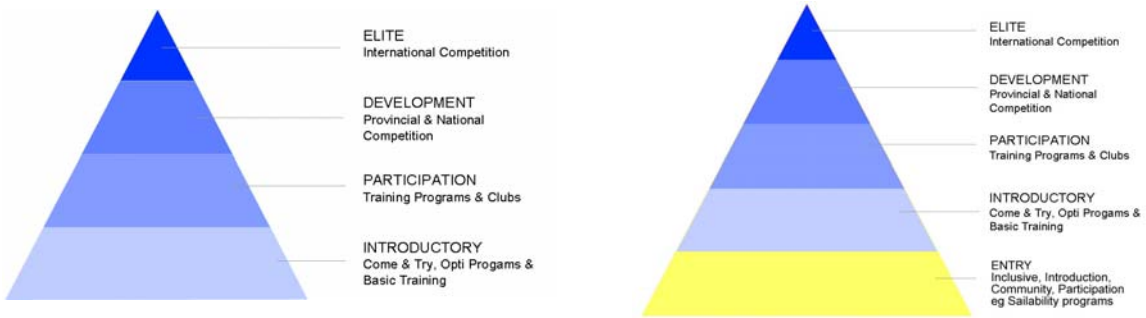
- Skills required to sail them are too high.
- Movement of bodyweight is necessary to prevent a capsize.
- The steering is by a back to front tiller which turns the boat in opposite direction to where you expect to go.
- This results in over complication which leads to capsize and dunking which scare away many more newcomers than it attracts.

Sailing bodies cannot see this as they have entrenched attitudes and are not innovating. There are also commercial interests who benefit from the status quo.

The solution can be extremely simple and lies in the adoption of a new breed of craft which conform to the principals of Universal Design (UD) - beginning at the entry level, and then encouraging more sophisticated UD craft as awareness and demand grows.

The benefits of using boats of UD design are twofold, and profound. It will

- Reverse the current decline in participation in Sailing.
- Allow the inclusion of people with disabilities in everyday sailing activities.



The greatest gift we can give people with a disability is not segregated (sailing) programs and facilities, but include them in everyday activities. By using craft of Universal Design, sailing will become the first sport to offer true integration. There is no need to run segregated disabled programs. This in itself will be something to boast about, and give sailing a leading marketing edge, which will further enhance its profile and popularity.

What is Universal Design

Universal Design is a worldwide movement based on the concept that all products, environments and communications should be designed to consider the needs of the widest possible array of users. It is also known around the world as “design for all”, “inclusive design” and “lifespan

design". Universal design is a way of thinking about design that is based on the following premises:

- Varying ability is not a special condition of the few but a common characteristic of being human and we change physically and intellectually throughout our lives;
- If a design works well for people with disabilities, it works better for everyone;
- At any point in our lives, personal self-esteem, identity, and well-being are deeply affected by our ability to function in our physical surroundings with a sense of comfort, independence and control.
- Usability and aesthetics are mutually compatible.

Universal Design asks from the outset how to make the design work beautifully and seamlessly for as many people as possible. It seeks to consider the breadth of human diversity across the lifespan to create design solutions that work for all users.

Changing Demographics

At the beginning of the 20th century, older adults and people with disabilities were true minorities. The average human lifespan was below 50 years, and people who received spinal cord injuries had only a 10% chance of survival. Most people with chronic conditions lived in nursing institutions.

People are living longer today. The average lifespan has increased to nearly 80 years, largely due to healthier living, better medicine, and vaccines and sanitation that have virtually eliminated many killer infectious diseases. In addition, more people are now living with disability.

These demographic changes result in a population that is older and more disabled than many realize, and these trends continue. The limitations imposed by products and environments designed and built without regard to the needs and rights of all citizens are significant but often unrecognized.

Public acknowledgment of people with disabilities and progress toward Universal Design has developed in the last few decades along three parallel tracks of activities:

- legislation fueled by the disability rights movement,
- the barrier-free design to universal design movement,
- and advances in rehabilitation engineering and assistive technology.

Barrier-Free to Universal Design

Early on, advocates of barrier-free design and architectural accessibility recognized the legal, economic, and social power of a concept that addressed the common needs of people with and without disabilities. As architects began to wrestle with the implementation of standards, it became apparent that segregated accessible features were "special," more expensive, and usually ugly. It also became apparent that many of the environmental changes needed to accommodate people with disabilities actually benefited everyone. Recognition that many such features could be commonly provided and thus less expensive, unlabeled, attractive, and even marketable, laid the foundation for the universal design movement.

Universal Design in practice.

Universal Design is related to "inclusive design", "design for all" and “accessible design”. Universal Design however differs from accessible design as accessible design means products and buildings that are accessible and usable by people with disabilities. Universal design means products and buildings that are accessible and usable by everyone--older people as well as young, women as well as men, left handed persons as well as right handed persons.

Accessible design has a tendency to lead to separate facilities—for example, a ramp set off to the side of a stairway at an entrance or a wheelchair accessible toilet stall. Universal design, on the other hand, provides one solution that can accommodate all people. It simply acknowledges disability, aging, and other differences as a part of every day life.

Universal design links directly to the political concept of an inclusive society and its importance has been recognized by governments, business and industry. As life expectancy rises and modern medicine has increased the survival rate of those with significant injuries, illnesses and birth defects, there is a growing interest in universal design.

The seven principals of Universal Design.*

The seven principles may be applied to evaluate existing designs, guide the design process and educate both designers and consumers about the characteristics of more usable products and environments. The guidelines however may not all be relevant to all designs.

1. **Equitable Use** - Design for everyone and every ability.
2. **Flexibility in Use** - Flexible design and choices.
3. Simple and Intuitive Use - Design that's simple and easy to use.
4. Perceptible Information - Design that naturally makes sense.
5. Tolerance for Error - Design that protects users.
6. Low Physical Effort - Design that requires minimal exertion.
7. Size and Space for Approach and Use - Design that works for all shapes and sizes.

* Compiled by advocates of universal design, listed in alphabetical order:
Bettye Rose Connell, Mike Jones, Ron Mace, Jim Mueller, Abir Mullick, Elaine Ostroff, Jon Sanford, Ed Steinfeld, Molly Story, Gregg Vanderheiden.

Universal Design and Sailing.

In an ideal world all products and environments would, to the greatest extent possible, be usable by all people, without the need for adaptation or specialized design.

However in sailing, because of the great variety of disciplines, skills, the ever changing field of play, and the broad range of participating players from able bodied athletes to ventilated quadriplegics, with intellectual disability in one corner to genius in another, a compromise has to be reached where a boat is designed and set up to be controllable by the majority, with seamlessly adaptable servo assist winches and equipment for those who need it.

Before discussing the servo equipment which includes and empowers those with even the most profound disability, we should first list the qualities desirable in a monohull sailing craft of universal design which makes it suitable for our majority.

1. Stability.
    - The greater the stability, the more upright the boat sails.
    - More upright means more sail area presented to the wind.
    - Which means more power and speed,
    - More control and better visibility,
    - And more comfort and security for the crew. An excessively heeling monohull can be very taxing on wheelchair users and those with imperfect mobility and strength.
    - Multihulls have an advantage here as they are a relatively level platform.
    - The higher the inherent stability of a monohull the less ballast and less draft needed to achieve a given degree of stability.
    - Access designs employ a concave bottom and low seating position which gives a high degree of inherent stability.
    - The SKUD achieves excellent stability with deep draft and high ballast ratio.

2. Mobility.
    - Having the sailor confined to a seat on the centreline and unable to move around removes the discrimination against the disabled sailor who needs to be strapped into a seat.
    - If the sailor is restricted to a seat and cannot move their body weight to increase and effect stability, then the boat will need to be a good performer at high angles of heel.
    - High performance craft and planning hulls need to be sailed more upright so it may be essential for the crew to be mobile.
    - If mobile seats are allowed then a "standard" unit at an affordable price should be available to prevent an "arms race" where ever sophisticated equipment is developed which discriminates against those with minimal resources.

3. Steering.
    - Directional stability. Generally sailing boats develop excess weather helm when heeled. That is, they try to turn into the wind when heeled. A good UD craft will need to sail in a straight line even when it is heeling over at about 45 degrees.
    - Consistent steering. When sailing at extreme angles of heel a centreline rudder blade can lift out of the water reducing control. With 2 rudders, one each side of the centreline as one lifts clear the other digs deeper. If the boat has good directional stability as well it will track straight regardless of heel and need minimal adjustments to the rudders.
    - Lightweight steering. High aspect or balanced rudder blades reduce the amount of force needed to turn a rudder blade so that people with less muscular ability can use them.

4. Visibility. If the sailor is seated on the centreline visibility can be a problem at extreme angles of heel. The wider the boat, the bigger the problem. Good design however can take care of this.

5. Minimal control lines.
    - The more control lines and adjustments on the boat the more difficult it will be to make it all adjustable by those with less physical capability.

- The fewer adjustments, the easier it is to make it more universal. Therefore a good UD design has the minimum number of controls necessary for its intended level of use.
- However, an elite racer will usually have more complex adjustments than an entry level craft.
- The very minimum adjustments on an entry level craft will be steering and the mainsheet.
- Sail tuning adjustments like main downhaul and cunningham can be automatic in function.
- Various adjustments can be set before leaving the dock, be adjustable by the sailor either manually or fitted to servo winches.
- Each function can also be double ended with one tail for manual control, the other leading to a winch so the sailor has choice, and the boat is always universal. The Liberty is such a boat.

Multi Crewed Craft.

On multi crewed boats it can be presumed that some tasks can be more easily handled by a less mobile or less able sailor, and other tasks can be handled by someone more physically capable. This allows a range of abilities to work together to handle a boat, but here again the UD principals if applied will produce a design which can be safely handled by the widest range of abilities.

An example of a well designed multi crewed craft is the SKUD18 3P, (SK-skiff, UD-Universal Design) a high performance skiff.

- A three person craft with 60kg ballast bulb where all crew can hike, but if 1 is in a centreline seat then 1 can use a trapeze.
- Allows anyone from an able bod up to a ventilated quadriplegic to steer while strapped into a centreline seat aft.
- In the middle can be anyone up to a paraplegic hiking from side deck to side deck and using body weight to increase stability and adjusting the complex array of control lines.
- Up front can be up to a vision impaired or single leg or arm amputee riding a trapeze to give great leverage to keep the boat upright.
- In a strong breeze the above crew combination has the mobility to keep the boat upright and therefore deliver the power to plane at up to 20 knots and deliver great excitement.
- If the two mobile crew fell overboard the boat would heel significantly but not capsize, and the quad helmsman would remain strapped into the centreline seat well clear of the water.
- That is excitement plus and isn't dangerous in experienced hands, though it does require a high degree of skill to keep it under control.

A further example of a multi crewed craft is the SKUD 2P

- Same hull and rig as 3P SKUD but with 140kg bulb.
- In OPEN format it is a two person craft, both of whom can hike
- If a centreline seat is fitted, one crew can use a trapeze.
- This allows a combination of abilities to competitively sail this boat as two more able sailors hiking have similar righting moment as one in centreline seat and one on trapeze.
- This allows for an able bod to a quadriplegic steering and a crew with functional legs and an arm to trapeze.
- This allows a quad to helm the boat in open competition against able bodied crews. An example of UD in practice.

Contrast this with the single person Liberty which is failsafe when sailed by a total novice even in heavy weather. But both these boats are fine examples of UD.

We should add here that disabled people have just as much right to live dangerously as anyone else, not necessarily more dangerously, but we shouldn't be wrapping them in cotton wool. This is the 'dignity of risk'.

SKUD 2P in Paralympic format.
As a new class for 2008, and as the first Paralympic class to specify a quadriplegic in the crew, and the first class to use a spinnaker it was felt prudent to confine both sailors to centreline seats. With its 140kg bulb and 1.7m draft the SKUD 18 2P, even with both crew on the centreline, has exceptional stability and is fail safe. Important considerations in being fail safe with a Severely Disabled Sailor (SDS) on board in the worst situation, ie, where the boat is lying on its side in wild conditions are:

- SDS need to be strapped into a seat for body support.
- Their head must remain clear of the water even if all systems fail.
- This requires considerable buoyancy under the side decks, considering that the sailor could be strapped into a leeward canted seat.
- There is escalating potential for danger if the sailor is in a sliding or transversely mobile seat, either manual or servo powered.
- Further, as high level quadriplegics are generally restricted to helming and its considerably less complex to organise steering for a centreline seated quad, a fail safe seat for a quad should therefore be fixed on the centreline.
- The forward crew for 2008 was also restricted to a centreline seat for reasons stated above. However this is not the ideal format for the boat, though it does allow those with limited mobility to attend to the other primary function of rig adjustments.

SKUD 2P in future Paralympic events.
The SKUD, which stands for SK (skiff) UD (universal design) is a high performance planning hull reminiscent of an 18ft skiff.

- Such a hull form isn't at its best at a high angle of heel.
- As everyone has found, if the forward crew is able to move onto the side deck the boat responds with an obvious increase in speed.
- This is a combination of better underwater shape, reduced turbulence from the immersed gunwale, and a more upright rig delivering more power.

We could therefore open the rules to allow those with limited mobility to transfer from side deck to side deck.

- This can allow for the development of transferring aids, both power and manual.
- A possible restriction to prohibit the extremes of hiking which will discriminate against those with less mobility (eg, SB3 type rails).
- By sailing the boat flatter we will allow it to better reach its full speed and excitement potential.
- This improves visibility and the cockpit will drain more efficiently.
- And bring it closer to the open format which can potentially be very popular with mainstream sailors.

The importance of mainstreaming and Universal Design.

Just as entry level UD craft will appeal to, and bring millions of new comers to sailing, with the related benefit of inclusion and integration for disabled people, so will the SKUD attract mainstream sailors, and lead to a flourishing class and active circuit of global events.

- With increased competition comes higher standards and increased opportunities for disabled people.
- More open doors at yacht clubs, more ramps and facilities.
- Ultimately this leads to changes at the highest level and accessible sailing gets accepted and absorbed into the mainstream.

The goal should be to make the SKUD the zappy, affordable, switched on, socially aware class to be sailing, and ultimately to help make UD trendy, for the greater good - the universal benefit of everyone.

Monohull versus Multihulls.

1. Monohulls and lead ballast keels.

Monohulls have deep draft keels or centreboards. These provide 2 functions.

- One is to give lateral resistance to encourage a boat to sail in a straight line rather than drift sideways,
- The other is to support lead ballast which is used to keep the boat upright, against the pressure of the wind trying to cause it to fall over. The deeper the depth of the centreboard and therefore the ballast, the less weight is needed to give sufficient stability.

It is a trade off between lighter weight and deeper draft versus shallow daft and heavier weight. Either combination can and should provide a very safe boat because;

- The more it heels or leans over, the more effective becomes its righting moment.
- Aided by the fact that the more it leans over the less sail is presented to the wind so the less heeling force.
- If the mast and sail are lying horizontal on the water, the lead ballast is at its most effective.

Therefore a monohull can be considered very safe and cannot turn upside down, an important consideration if you have a disabled person strapped into a seat.

The downside of the monohull is lead ballast is heavy and it takes energy to move it around.

2. Multi hull stability.

- Tris and Cats don't need or use lead ballast so they are potentially faster than monohulls,
- The drawback is they can capsize, and when upside down are just as stable as when they were right side up. Cats are particularly vulnerable,
- Trimarans can be designed with side floats that will submerge before the main float lifts clear of the water, theoretically preventing a capsize.
- "Theoretically" because dynamic forces, windage and wave action can flip a tri over.
- Large tris generally can sail on their leeward float, flying both main hull and windward float.

3. Multihull and Universal Design.
    - Tris generally provide a better platform when designing a boat of Universal Design as all the accomodation is in the central hull, and on one level.
    - While on cats there can be a multitude of different levels between the deck, the bridge deck, and the hulls, with the problem compounded by the very narrow hull width.

Universal Design and Servo Assist Equipment.

1. Servo motors are used in all sorts of applications from powering model yacht winches to moving flaps and ailerons on Jumbo aircraft.

2. On sailing boats servo motors are generally used to allow people with mobility problems to enjoy the freedom and independence of sailing by themselves, sailing solo, something that many don't achieve in any other aspect of their lives.

On multi crewed boats (UD18 which is a 2 or 3 person craft), the helmsman may be a severely disabled sailor (SDS) so needs servo assisted steering, while the crew would generally control the sheets, but it is achievable to have a full servo system so that the Severely Disabled helmsman can have input at adjusting the sheets and other control lines also.

3. Sailing is one activity where the use of powered equipment serves only to level the field and not give the sailor an advantage. Its use therefore encourages integration and allows previously disadvantaged people to participate, to compete, and to win against others more physically able.

4. The object of servo systems is therefore to allow the more severely disabled people to sail and then to level up the playing field for them. There are 3 ways to help achieve this;
    - Develop superior electronic systems to give Servo users equity with manual sailors.
    - Allow anyone to decide how they want to control their boat.
    - Develop an equipment based correction system, an ECF.

Develop superior electronic systems - this is a noble goal, but there are several factors which render it very difficult.

1) Sheet winches can easily be improved to be as efficient as, even more efficient than adjusting sheets by hand, but steering is more complex as manual steering benefits from subtle feedback from the rudder which is not felt at an electronic controller. A sailor then needs to pick up feedback signals through their body contact with the boat, and intuition.

2) People with quadriplegia usually do not have fine sensory feeling to pick up the subtle feedback, even if it was artificially generated at the electronic controller using complicated electronics.

3) Some people, like those with CP, have difficulty getting their fingers and other extremities to do as they want, even if they did have the fine motor control and could feel the feedback.

4) These CP sailors and others have difficulty controlling complicated control panels so adding numerous adjustable elements only discriminates against them.

5) Servo Assist sailing is a new discipline and sailors are competing against others who have years

of experience sailing manually so servo sailors generally lack experience.

6) For servo sailors to train it generally takes a lot of effort and resources due to a high level of disability, while the manual sailor with lesser disability has it much easier.

7) Even if complicated electronics did overcome and compensate for lack of feel and feedback, there is added cost and high risk of breakdowns.

The message from the above is improve equipment but keep things simple, every gadget that is added makes it more difficult for the more severely disabled to keep up.

Encourage manual and partial servo sailors to sail full servo.

1) Allow anyone to decide how they want to control their boat.

2) There is nothing inherently "disabled" about servo assist equipment.

- If a boat was 1m long it would be controlled by a pair of dual axis joysticks.
- If it were 30m long it would have powered winches and steering and an auto pilot.
- Joysticks are available which control powerboats and override automatic pilots.
- If it was a modern supersonic jet fighter it would be flown with an armrest mounted joystick.

The concept is the same with all the above examples and somewhere in between are servo assist equipped dinghies and small keelboats, so there is nothing inherently disabled about servo assisted sailing.

3) Experienced electric wheelchair users are accustomed to using joysticks and have an advantage over others, so it is a leveller to allow others to sail using a servo assist system.

An equipment based correction system - ECF

1) This is not classifying the sailor according to their ability, but classifying the boat according to mode in which it is sailed.

2) Except for first across the line or line honours, all ocean racing results are calculated by applying a correction factor usually based on time (TCF). This is because all the boats are different and sail at different speeds in varied conditions.

2) Different classes of sailing dinghies are given a yardstick which is calculated from results in mixed fleet racing. The yardstick is also a time correction factor or TCF.

3) Within a particular class, all boats and more or less identical, but if servo assist equipment is fitted to some there are three modes of operation which deliver different potential performance. They are:

- Full servo
- Partial servo
- Manual.

4) Therefore it should be possible to calculate a "yardstick" to level up the difference in potential performance between the 3 modes of operation. We are calling this an equipment correction factor, or ECF.

5) When sheet winches are improved the difference between partial and manual will be minimal so their ECF will be very similar.

6) The main difference in the ECF numbers will be between full servo, who use servo steering, and partial servo/manual sailors who are both steering manually as they will probably always have an advantage.

So in conclusion there are three paths to follow to achieve equity for severely disabled sailors, and we should pursue them all.

1) Continue to improve winches and controllers till they are as efficient as possible, but keep in mind affordability and complexity.

2) Encourage everyone to sail as they choose, controlling their boat by whatever system they choose.

3) Develop an ECF and encourage full servo, partial servo and manual to sail in one big mixed fleet.

The Access International Class Association and ISAF

The SKUD is the flagship of the International Access Class Association which has four member classes:

- The 2.3 which is the entry level and an ISAF International class.
- The 303 is an ISAF Recognised class.
- The Liberty is an ISAF Recognised class
- The SKUD is a Paralympic class.

These 4 classes are all elegant examples of Universal Design and provide a pathway, within the mainstream, for entry level sailors right through to elite competition. The goal has to be to expand the use of UD craft with able bodied sailors. We need to start at the entry level with school children.

Credit for much of the content on UD belongs to the following websites:
http://www.adaptiveenvironments.org/index.php?Itemid=37&option=Project
http://www.ncpedp.org/access/univ-desgn.htm
http://www.design.ncsu.edu:8120/cud/univ_design/princ_overview.htm
http://www.design.ncsu.edu:8120/cud/univ_design/udhistory.htm