COMPARATIVE PERFORMANCE PREDICTION OF HISTORICAL THAMES A RATER CLASS DESIGNS

10 DECEMBER 2018

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The early handicap system adopted by the Sailing Boat Association (1888) was based on Dixon Kemp’s rating formula (1880):

\[
\text{Rating} = \frac{Lwl \ [ft] \times SA \ [ft^2]}{6000}
\]

This defined the term ‘Rater’
- A One-Rater rating 1
- A Half-Rater rating 0.5

Later, the ‘A Rater’ class was created
- For boats rating from 0.8 to 1
**Design Philosophies**

- **Linton Hope**
  - Longer waterline
  - Smaller sail area
  - Narrower beam
  - Better suited for upwind

- **Alfred Burgoine**
  - Short waterline
  - Larger sail area
  - Larger beam
  - Better suited for downwind

\[
\text{Rating} = \frac{Lwl \times SA}{6000}
\]

\[
Fn = \frac{V}{\sqrt{gL}}
\]

<table>
<thead>
<tr>
<th>Yacht</th>
<th>Designer</th>
<th>Lwl (m)</th>
<th>Bwl (m)</th>
<th>SA (m²)</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ulva</td>
<td>A. Burgoine</td>
<td>4.80</td>
<td>2.15</td>
<td>35.00</td>
<td>0.99</td>
</tr>
<tr>
<td>Scamp</td>
<td>L. Hope</td>
<td>5.15</td>
<td>1.66</td>
<td>33.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>
Wind-up wires
Sliding seats
Removable top-mast
The ‘bell boy’
- Significant evolutions in rig and sails

- Solid wood, hollow wood, aluminium, carbon
- Enabled to achieve higher spans
In the late 1970s
- Introduction of GRP boats based on *Ulva*
- Regain of interest in the class

Latest A Rater
- Full carbon
- Ultra high performance
- BUT missing the tradition

Thames A Rater class rules requirements:
- Minimum lightship weight of 750 lbs (340kg)
- Maximum mast height from the sheerline of 43ft
- Sail area of 350 ft$^2$ (32.51m$^2$)
- Etc...

D2 New Yachts:
- “A new hull will only be considered to be an A class rater hull if it is an exact replica of an existing Rater as defined above, taken from either an existing hull, or original lines, subject in both cases to a tolerance of one and one half inches.”

Two Options:
- The linesplan of an original Thames A Rater is therefore to be found in the public domain.
- Taking the lines off existing vessels.
In 1913, Linton Hope reviewed ‘Dixon Kemp’s manual of yacht and boat sailing and yacht architecture’, and included one of his A Rater Design.

<table>
<thead>
<tr>
<th>Scamp 1902</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOA (m)</td>
</tr>
<tr>
<td>Lwl (m)</td>
</tr>
<tr>
<td>BOA (m)</td>
</tr>
<tr>
<td>Bwl (m)</td>
</tr>
<tr>
<td>Tc (m)</td>
</tr>
<tr>
<td>F (m)</td>
</tr>
<tr>
<td>Disp. (m³)</td>
</tr>
</tbody>
</table>

Figure 7: Replica of the Scamp linesplan.
- Centreboards discrepancy

- Arguments in favour of centreboard 1:
  - Drawn as a solid line
  - Represents 2.30% of the sail area
  - Giving a total 3% of the sail area with the rudder

<table>
<thead>
<tr>
<th>Appendage</th>
<th>Area (m²)</th>
<th>% of Sail Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centreboard 1</td>
<td>0.76</td>
<td>2.30%</td>
</tr>
<tr>
<td>Centreboard 2</td>
<td>0.70</td>
<td>2.12%</td>
</tr>
<tr>
<td>Rudder</td>
<td>0.23</td>
<td>0.70%</td>
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</tbody>
</table>
### MODELLING SCAMP

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Linesplan (m)</th>
<th>3D Model (m)</th>
<th>Diff. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOA</td>
<td>8.28</td>
<td>8.28</td>
<td>0.00%</td>
</tr>
<tr>
<td>Lwl</td>
<td>5.15</td>
<td>5.17</td>
<td>0.37%</td>
</tr>
<tr>
<td>BOA</td>
<td>1.90</td>
<td>1.90</td>
<td>0.00%</td>
</tr>
<tr>
<td>Bwl</td>
<td>1.66</td>
<td>1.64</td>
<td>-1.20%</td>
</tr>
<tr>
<td>Tc</td>
<td>0.16</td>
<td>0.16</td>
<td>-1.25%</td>
</tr>
<tr>
<td>F</td>
<td>0.31</td>
<td>0.31</td>
<td>0.00%</td>
</tr>
<tr>
<td>Disp.</td>
<td>0.548</td>
<td>0.545</td>
<td>0.00%</td>
</tr>
</tbody>
</table>
- 13 different Rater designs
- 1 existing linesplan
- Boats left on trailers
- Hull measured by hand

- Table of offsets created

- Point cloud created

- 3D hull model created
Using the model created from the measurements a new linesplan for each A-Rater can be produced.

<table>
<thead>
<tr>
<th></th>
<th>Spindrift</th>
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<tbody>
<tr>
<td>LOA (m)</td>
<td>8.06</td>
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<tr>
<td>Lwl (m)</td>
<td>5.76</td>
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<tr>
<td>BOA (m)</td>
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<tr>
<td>Bwl (m)</td>
<td>1.85</td>
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<tr>
<td>Tc (m)</td>
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<tr>
<td>F (m)</td>
<td>0.50</td>
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<tr>
<td>Disp. (m³)</td>
<td>0.640</td>
</tr>
</tbody>
</table>
Using the model created from the measurements a new linesplan for each A-Rater can be produced.
- Maximum sail area chosen
- Aerofoil analysis used to choose best cross section for foils
- Foil planforms designed to encourage optimum efficiency
- Wind speeds from past 8 years of Bourne End Weeks
- Range used in the VPP

<table>
<thead>
<tr>
<th>Year</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
<th>Avg</th>
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<tbody>
<tr>
<td>2010</td>
<td>11.3</td>
<td>17.4</td>
<td>9.6</td>
<td>6.1</td>
<td>6.1</td>
<td>10.1</td>
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<tr>
<td>2011</td>
<td>14.8</td>
<td>13.0</td>
<td>10.4</td>
<td>9.6</td>
<td>9.6</td>
<td>11.5</td>
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<tr>
<td>2012</td>
<td>11.3</td>
<td>13.0</td>
<td>11.3</td>
<td>10.4</td>
<td>12.2</td>
<td>11.6</td>
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<tr>
<td>2013</td>
<td>9.6</td>
<td>7.8</td>
<td>16.5</td>
<td>6.1</td>
<td>7.8</td>
<td>9.6</td>
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<tr>
<td>2014</td>
<td>9.6</td>
<td>12.2</td>
<td>6.1</td>
<td>9.6</td>
<td>7.8</td>
<td>9.0</td>
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<tr>
<td>2015</td>
<td>9.6</td>
<td>8.7</td>
<td>8.7</td>
<td>9.6</td>
<td>10.4</td>
<td>9.4</td>
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<tr>
<td>2016</td>
<td>9.6</td>
<td>11.3</td>
<td>13.0</td>
<td>16.5</td>
<td>13.9</td>
<td>12.9</td>
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<td>2017</td>
<td>14.8</td>
<td>4.3</td>
<td>6.1</td>
<td>13.9</td>
<td>4.3</td>
<td>8.7</td>
</tr>
<tr>
<td>2018</td>
<td>16.5</td>
<td>7.8</td>
<td>9.6</td>
<td>10.4</td>
<td>5.2</td>
<td>9.9</td>
</tr>
</tbody>
</table>
- Boat speeds compared
- Hull performance attributed to hull design
CONCLUSIONS

- History of the Thames A Rater Class

- Two approaches to design conservation:
  - Original linesplan
  - Existing Boats

- Enables to generate 3D models for performance analysis

- Ultimately, optimum hull design for performance in given weather condition can be assessed.
THANK YOU

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