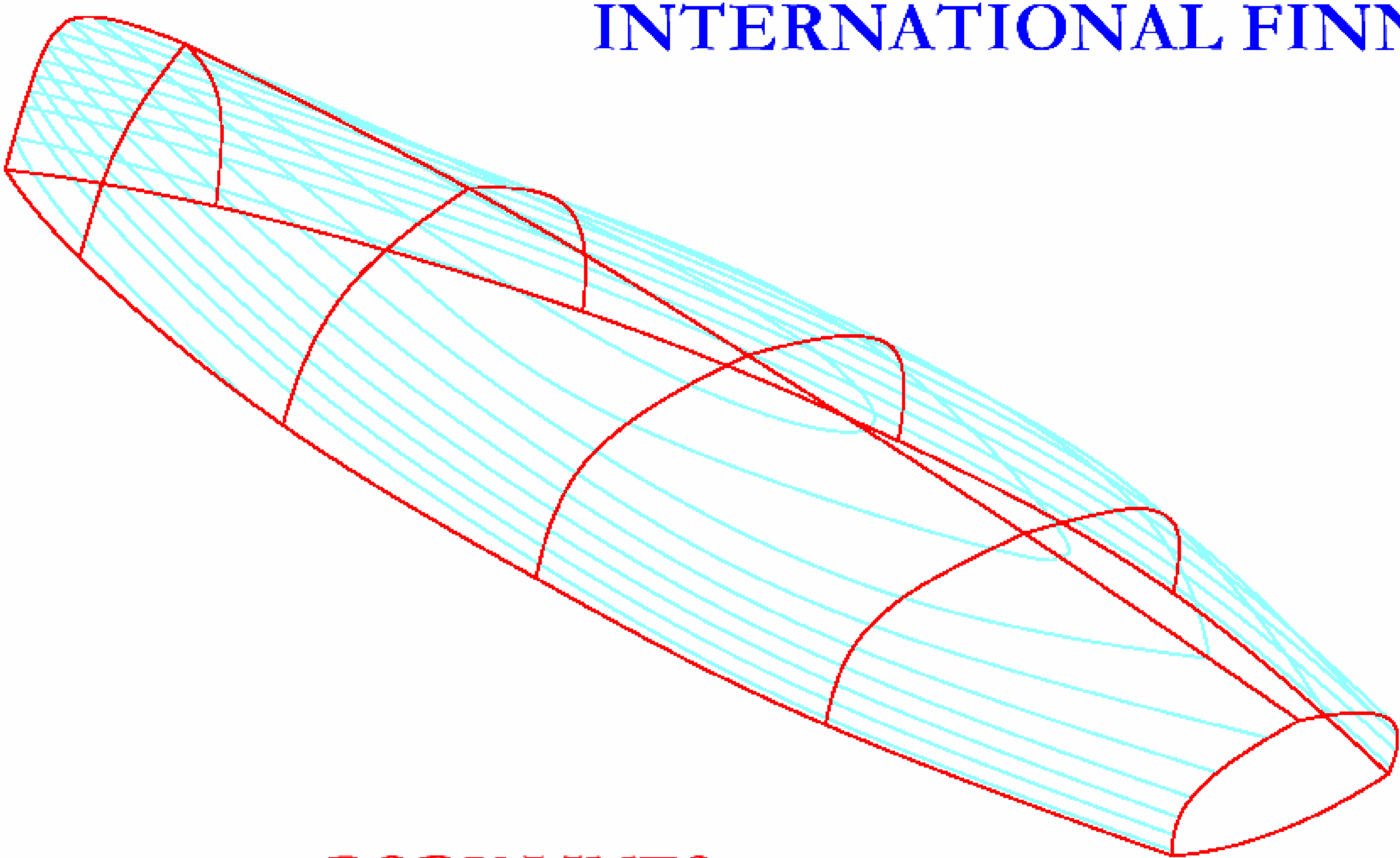
INTERNATIONAL FINN



BODY LINES
DEFINITION and CONTROL

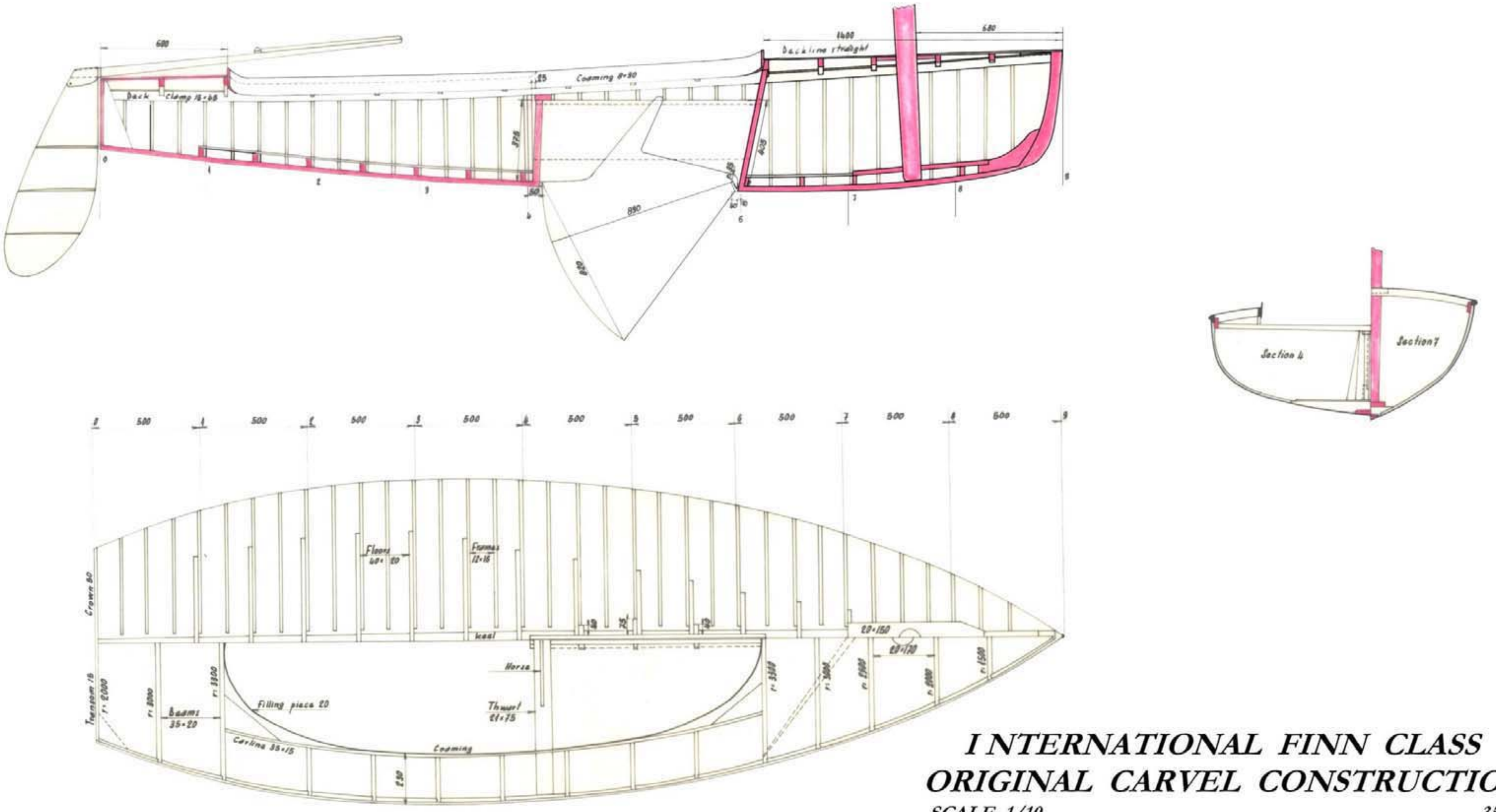
PART I

Gilbert Lamboley June 2003
revised June 2006

PART I

2003 report revised 2006

Please see Part II for final documents



INTERNATIONAL FINN CLASS
ORIGINAL CARVEL CONSTRUCTION

SCALE 1/10 356-18

I, 1 Definition and Control of Hull Shape

First Finn,

as is known, was designed and built in early 1949 by **Rickard Sarby**. The drawings were achieved full size and the first Finn, was afloat on the first week of May 1949.
The drawings were sent to the Jury at Helsinki. The rest of the story is well known. What with those drawings? Gone with the wind? I heard that they had been published by the Finnish

Yachting Association, and that prototypes could be built in several countries for training. I remember sailing one on river Seine, south of Paris.
At least drawings of the original wooden scantlings still exist. They allowed amateur construction of so many boats.

A confused youth

The Scandinavian Yachting Union got the charge of administrating the new Olympic single handed dinghy; but curiously enough that Union did not look very keen regarding Finn definition and destiny (see FINNATICS chapter 8).
Several legendary names, with the strong support of IYRU, kept the babe alive.
I heard that a number of people redrew plans of the hull. Gone with the wind?

Second birth

By 1956, IFA had been born and would in its turn bear again the Finn.
Charles Currey, silver medallist at Helsinki, was in charge of building Finns at **Fairey Marine**, one of those times most famous company.
Richard Creagh Osborne who was eager about an actual one design definition of the Finn became the first Chairman of the IFA Technical Committee in 1962. One of his main advisers was Rickard Sarby, who had become quite pessimistic as he thought that weight distribution would never be controlled.
The continued story is clearer to me as I got it directly from my regretted friends, Richard and Rickard.
Richard Creagh Osborne had only been handed a poor table of offsets as a definition of the hull.
The **Finn owes him her precise definition together with the first serious edition of rules** which were enforced to any Finn in the World, thanks to the new born IFA.

In April 1964, the body lines of the Finn together with the templates lines were carved at Fairey Marine under the control of Charles Currey. Of course those lines took into account as far as possible the Swedish table of offsets. They were carved full size onto a sheet of aluminium alloy specially treated so as to neutralize all residual stresses that appear during lamination.

Fairey Marine was alas to disappear soon after; Charles Currey saved the carving and took it home. A picture of that carving may be seen page 117 of FINNatics.

From the carving, copies of lines and templates had been drawn on “Mylar” tracing material, so that no hydrometric variations might alter their shapes. Copies of those have been issued to many places. Those copies were heliographic “Mylar” reproductions on flat beds (rotation machines induce a more or less important slipping between original and copy). And yet, beware using them as I discovered later on that their dimensions might have nevertheless varied under unknown factors.

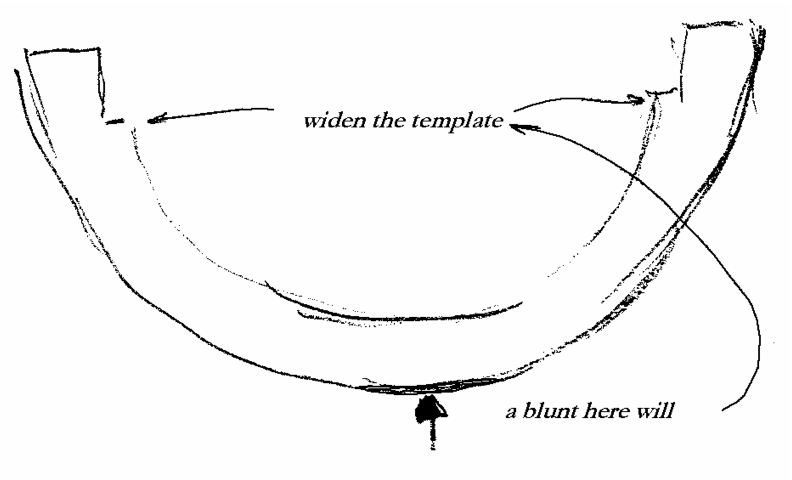
A master set of templates was also made that would prevail among all anarchic templates which had been issued here and there. Vernon Forster, Chief Measurer of IFA, was in hold of them.

New disease,

In 1970 Richard Creagh Osborne handed the job over to me. I soon became suspicious about the stability of “Mylar” copies.

At 1973 Gold Cup at Brest a much worse problem appeared as the wider templates (station two and four) showed wider than “Mylar” drawings by two or three centimetres. Yet, at 1974 Gold Cup at Long Beach, the US templates appeared to conform perfectly to the drawings.

I quickly understood that the round shape of those templates caused them to enlarge when they would fall down as the underneath sketch will better explain.



A new design showed urgent. And a precise copy of the original carving appeared to be vital. Thus Charles Currey handed me that precious carving.

I read coordinates of the carved template lines about every 25 mm with a weaver’s glass (a graduated magnifying glass used by silk men to count numbers of threads in a given area). That allowed me to record coordinates to a 1/20 mm precision. A tremendous work indeed!

The original lines were made of a succession of circles (as was the use in those times drawing offices who always showed so gracious collections of pear tree curves) and it soon appeared that they could not be represented by one mathematical equation.

Another problem was to have a precise cut of the templates.

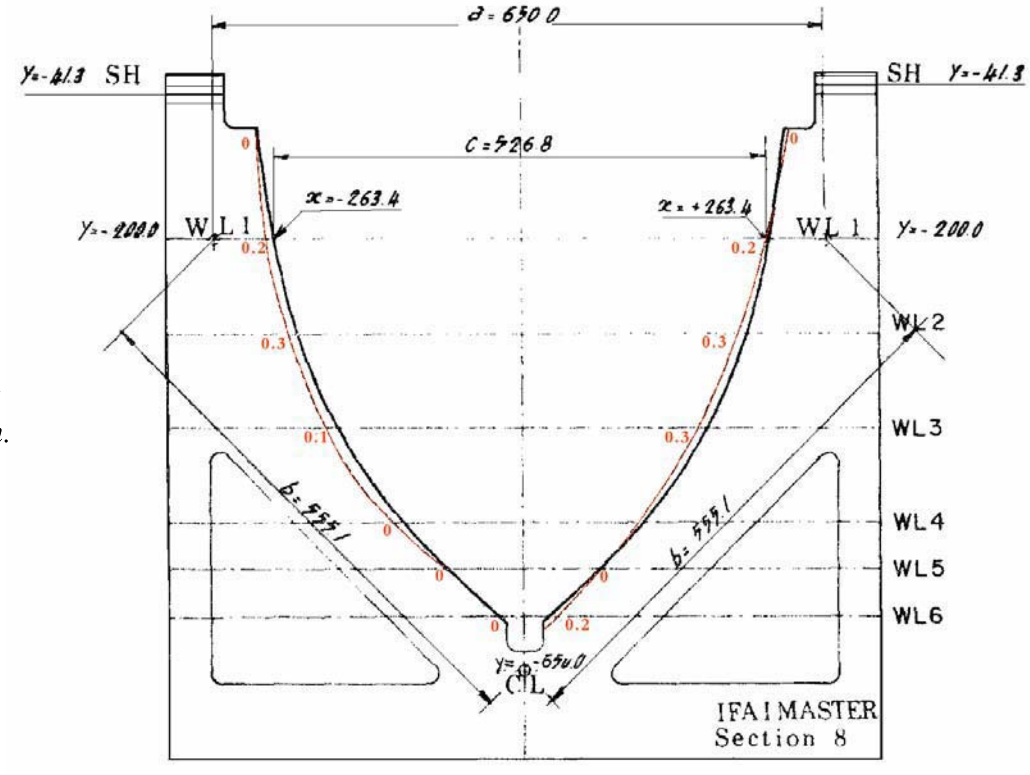
Saved by electronics

The solution was obviously to use one of those newly come electronic milling machines driven by computer. Thus we had to draw continuous lines between the recorded points. This is done by curves called “splines” (as sequential polynomial lines). Between two points, a mathematical curve (a polynomial up to 20th degree) is computerized. All those curves draw an apparently (but not mathematically speaking) continuous line which we compared to the drawings. Where are those curves which were handed back to IFA? Gone with the wind?

The new templates were designed according to the underneath drawing which also show the discrepancies with the original carving as were recorded by a sworn geometrician. The accuracy is quite a miracle as it must be kept in mind that the hand carved lines could not be perfect and that moreover the basic axes were not absolutely parallel or perpendicular.

Any measurement tool must be controlled; that is why each template bears triangle measurements which are to be controlled with certified meters!

A good job had been done. Yet, since the idea of computerizing the lines had started to be materialized, it should have been pursued. But it was not for obscure reasons.



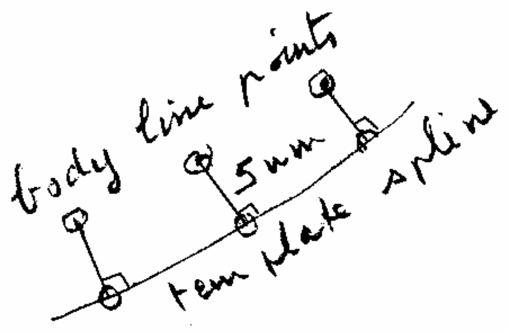
Station 8 template; discrepancies with carving recorded red in mm.

The FINN forever

By mere luck, I have found some spare copies through the documents I brought back from my company when I sold it.

The main discovery was the coordinates with which the new templates were carved. Between my measured points, the University who did the job (INSA in LYON) had retained a number of points of their splines; the milling tool was driven by a program from one point to next one along straight segments of lines; those points were chosen so that the cut never kept apart from the spline by more than 0.01 *mm* (all that being subjected to the frailty of 30 years back memories).

So that, whichever CAO (among serious ones) be used and whichever sort of "splines" be drawn between all points (measured or calculated), our computerized lines cannot be significantly astray from the mother engraving.



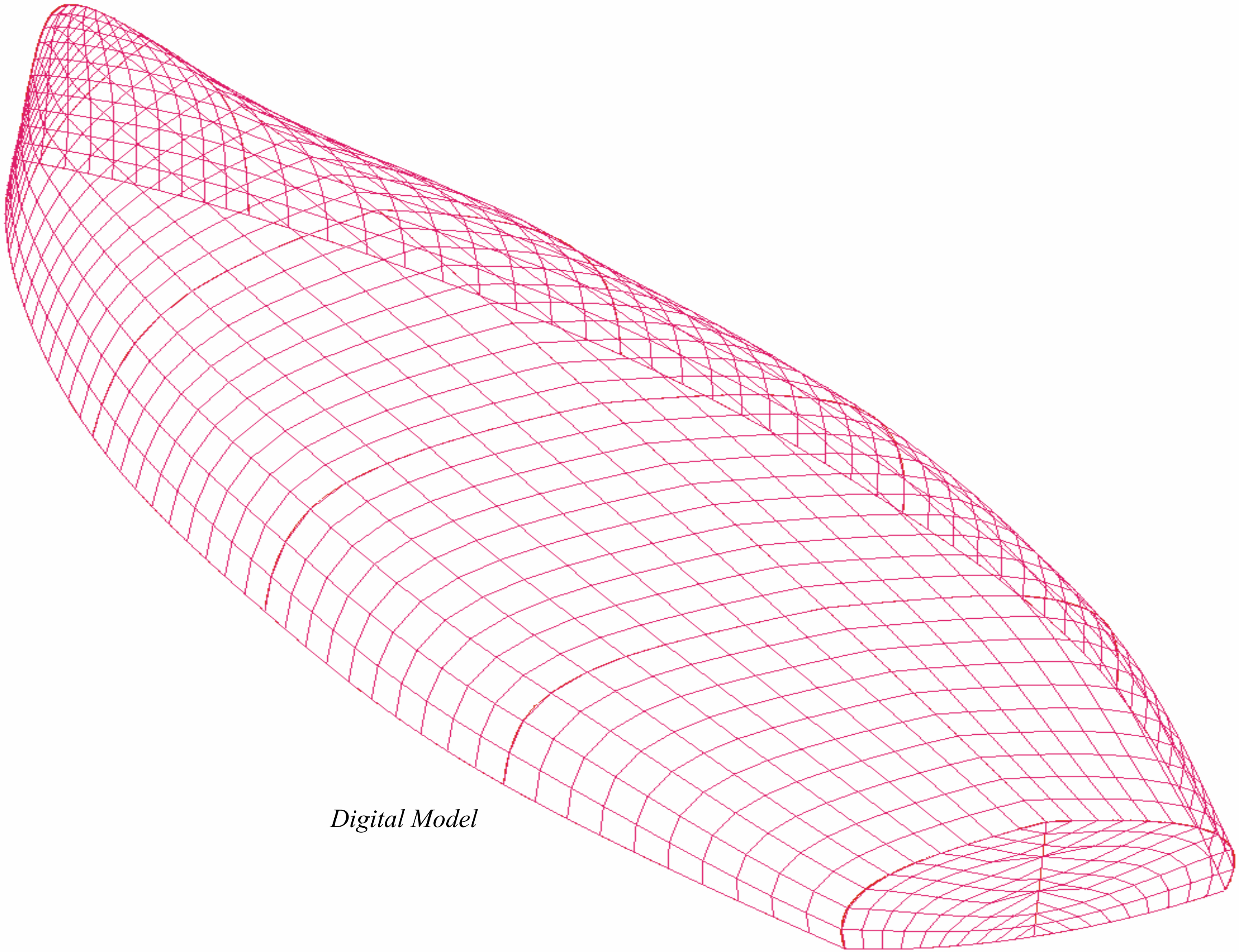
25 years after it should have been done, but with much more powerful tools, I have drawn new "splines" of the templates; then from every point of those splines, I have drawn perpendiculars and recorded points at 5 mm distance so as to draw the quasi perfect original body "splines". Hundreds of points to a precision of half a micron!

From the body "splines" which are the skeleton of the hull, an automatic regular meshing of that hull could be achieved, showing thus, together with the rendering, that no major mistake had occurred.

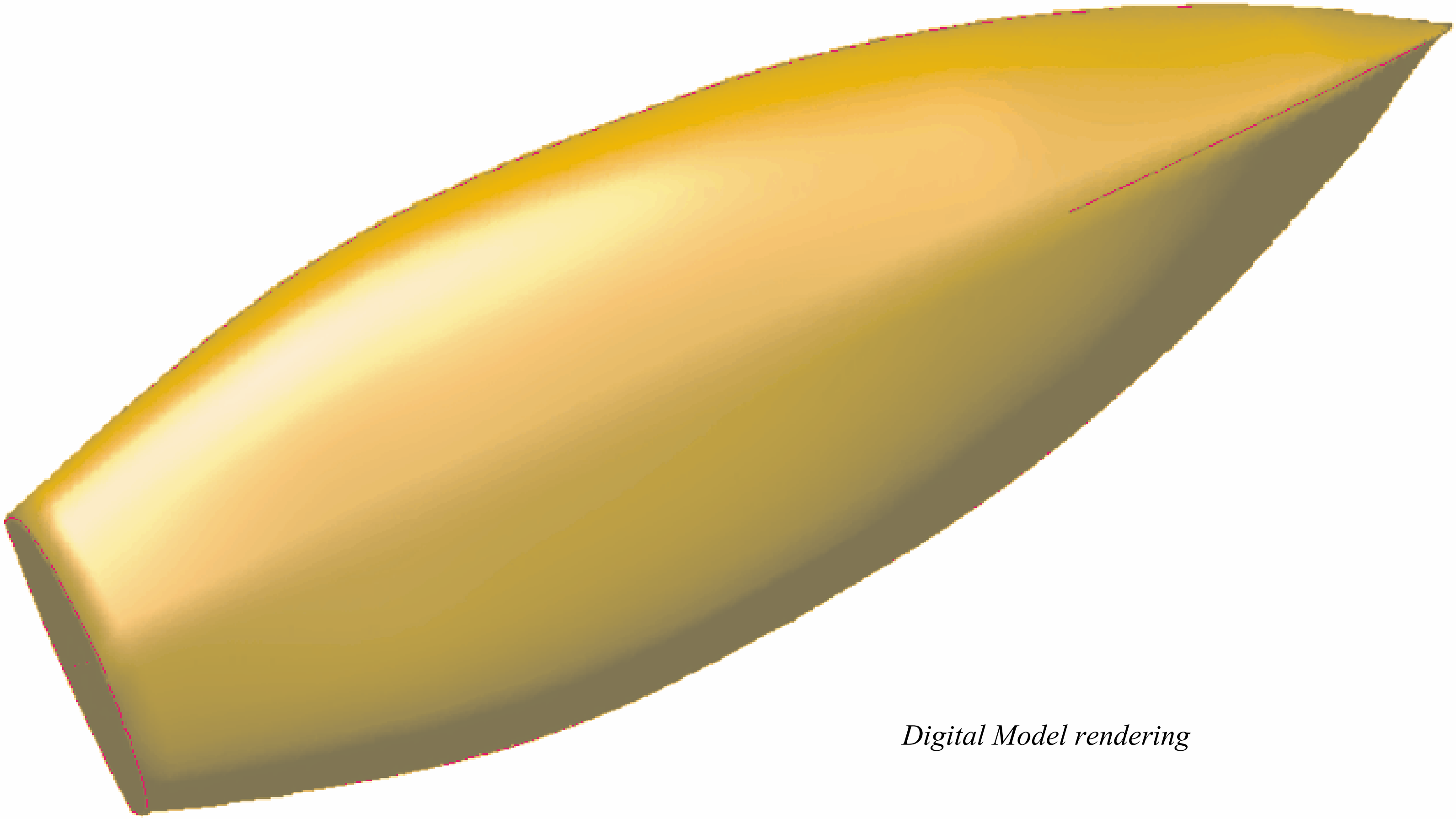
Full size lines have been drawn in vector format on Mylar film with my 15 years old Benson plotter. They have been checked to be all right at Cascais 2003 Gold Cup.
Points of the splines are close enough to allow drawing straight segments of lines from point to point, without letting appear significant gaps with those splines (no more than 0.017 mm could be found along station 0; no more than 0.005mm along other stations).

Nowadays those drawings should be recorded in a vector format such as ".dxf" which allows full size reproductions on current machines.

(See Part II where specialised Rhinoceros program has been used confirming above work within hundredths of millimetres)



Digital Model



Digital Model rendering

I, 2 Consistency with rules and original carving.

Charles Currey drawings are related to original frame of reference. The Ox longitudinal one passes through the top of stem.
The measurement rules define a Keel Base Line related to the flat between hull and keel protection bands.

Distances between those flats have been set in round figures. There arises an inconsistency between those two bases. Underneath sketches at every station show the problem.
The prevailing base is of course the keel measurement one which has been used for about forty years.

Actually measurers are shifting the templates by a slight translation from the theoretical design base to the keel measurement base. We have delivered the amount of translation which should be granted to every template onto a new theoretical Base under condition the keel conforms with exact rule data.

New 2006 rules have retained above Keel Base as the new OX axis of Finn frame of reference.

I, 3 Checking the Templates

Accuracy of design and cutting

A sworn geometrician examined the master set of templates and recorded the discrepancies he could observe with the engraving onto aluminium alloy sheet. He looked at both sides of the templates.
His certificate is given below.
Copies of his records on back side are given further on with discrepancies delivered in mm, red in colour.
On those records we added the discrepancies which the geometrician had observed on front side; we coloured them blue.
Those discrepancies are often naught; when different from naught they keep close to the precision of the geometrician's observation.
Station 6 shows an exception close to sheer with discrepancies comprised between 0.5 and 0.7 mm. We did not think useful to correct a spot which is of no consequence for hull controls.
If we take into account all the adverse factors such as

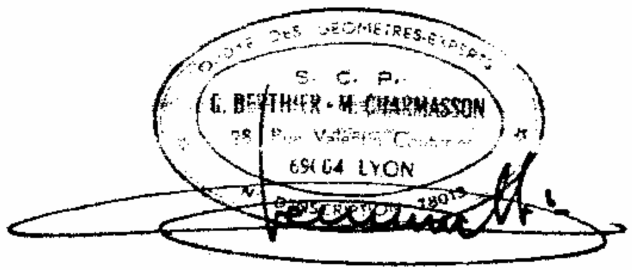
- Difficulty of a hand carving and unevenness of the lines,
- Straight lines of the canvas not being absolutely parallel or perpendicular,
- Difficulty of measuring so many coordinates; indeed the quasi perfect conformity looks like a miracle.

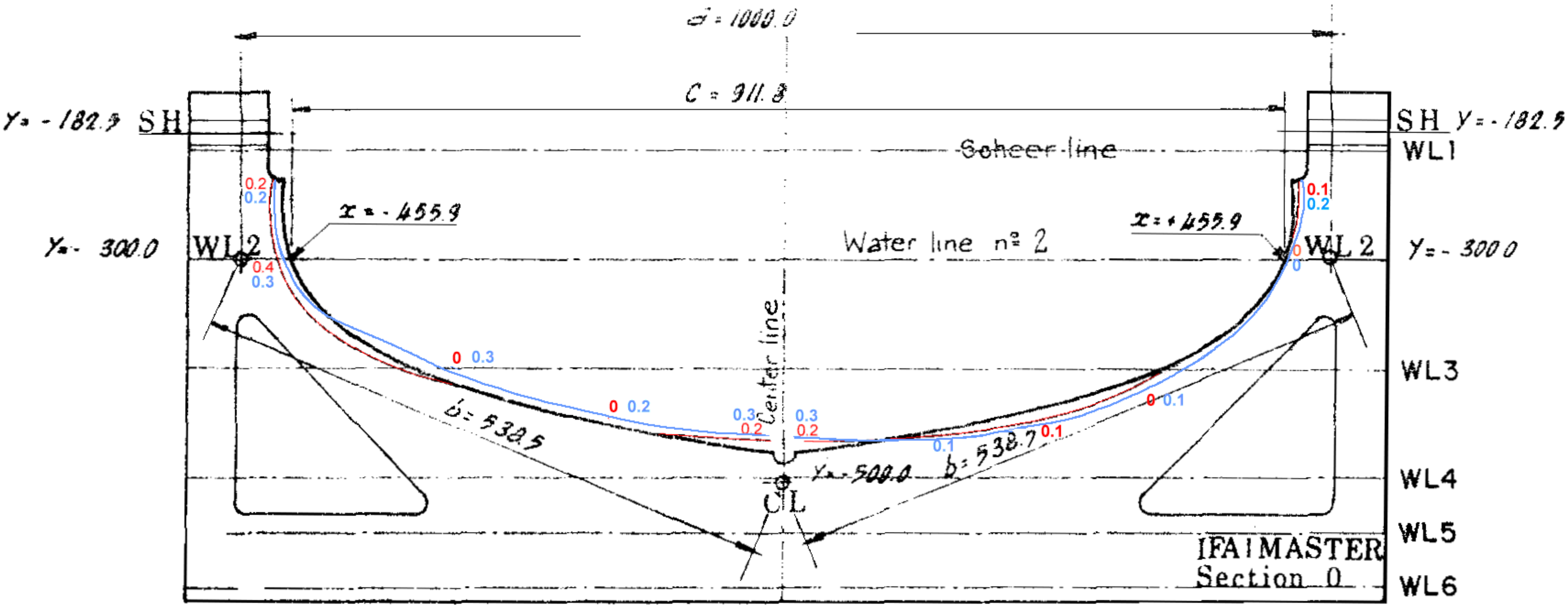
<u>TESTING CERTIFICATE OF TEMPLATES</u>

We, chartered geometricians, on 15th January 1980, examined the set of templates shown together with the original graphs drawn on aluminium sheet.
To wok out, we have set each template on its corresponding graph front side first, back side afterwards.
We have sought for the best coincidence by trying to set as well as possible the template on its graph in such a way that <u>maximum gap</u> between the theoretical graph and the template above mentioned <u>be minimum</u>.
With all imprecision due to lines thicknesses, we have read gaps with micrometer lens.
Those gaps are recorded in millimetres (mm) on the drawings enclosed herewith (theoretical graph being drawn in pecked lines).
Bearing in mind all the factors above mentioned, our measurement imprecision could be estimated to $\pm 0.2\ mm$.

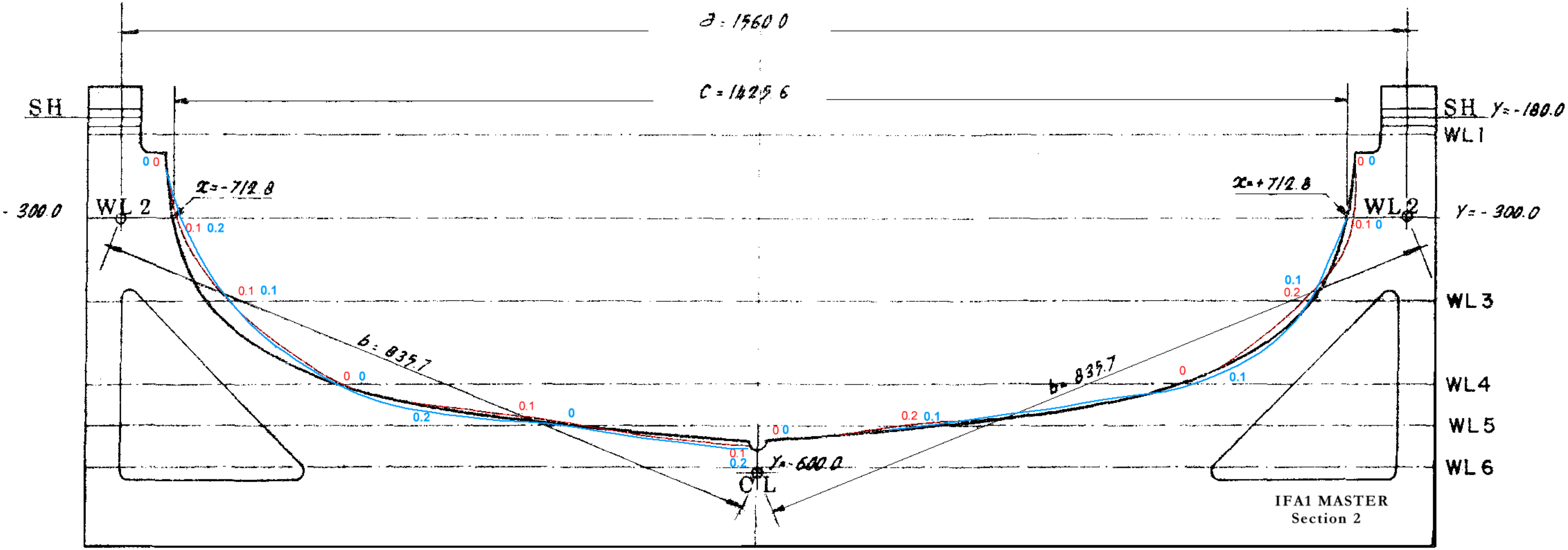
Certifié sincère et véritable,
Fait à Lyon le 15 janvier 1980
Les géomètres experts,
L'un d'eux :

Marc Charmasson

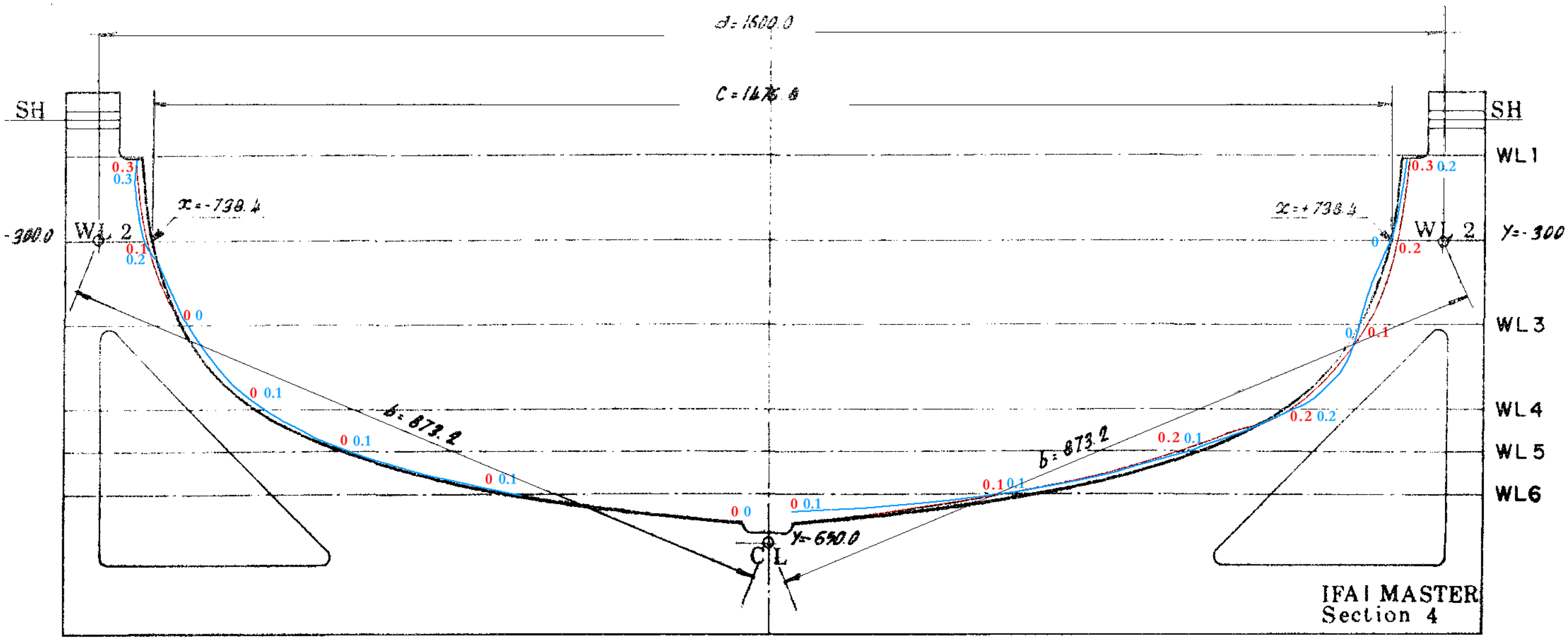



d = 1000.0
C = 911.8
Y = - 182.9
SH
SH
Y = - 182.9
Scheer line
WL1
x = - 455.9
x = + 455.9
Y = - 300.0
WL 2
Water line n° 2
WL 2
Y = - 300.0
Center line
WL3
b = 538.5
b = 538.7
Y = - 500.0
WL4
C L
WL5
IFA MASTER
Section 0
WL6
0.2
0.2
0.4
0.3
0
0.3
0
0.2
0.3
0.2
0.3
0.2
0.1
0.1
0
0.1
0.1
0.2
0
0

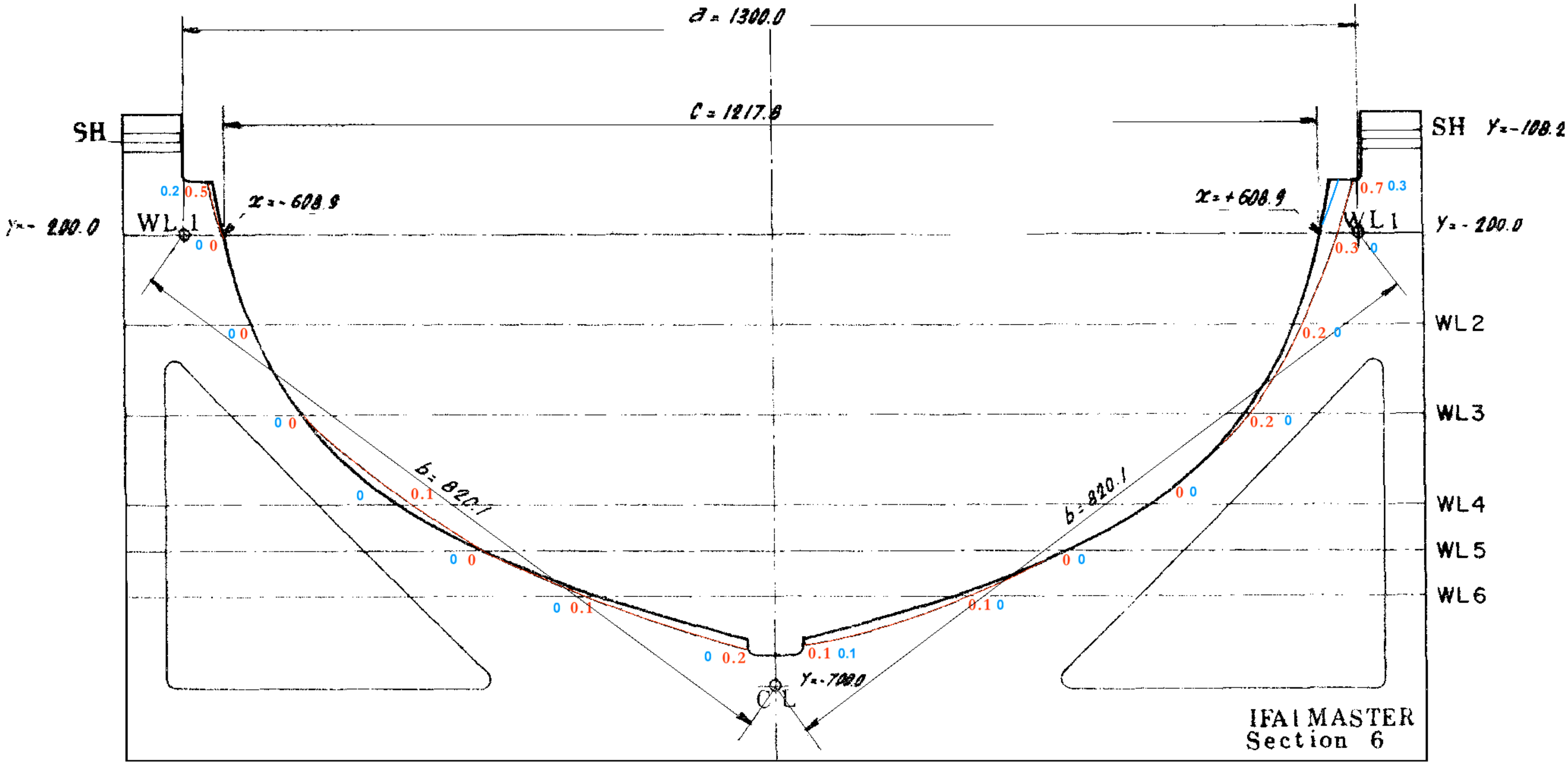
STATION 0


a = 1560.0
C = 1425.6
SH
SH
Y = -180.0
WL1
WL 2
WL 2
- 300.0
Y = - 300.0
x = -712.8
x = +712.8
WL 3
WL 4
WL 5
WL 6
b = 835.7
b = 835.7
Y = -600.0
C L
IFA1 MASTER
Section 2

STATION 2


d = 1600.0
C = 1476.0
SH
SH
WL 1
WL 2
WL 2
WL 3
WL 4
WL 5
WL6
x = -738.4
x = +738.4
-300.0
Y = -300
b = 873.2
b = 873.2
Y = -650.0
C L
IFA1 MASTER
Section 4

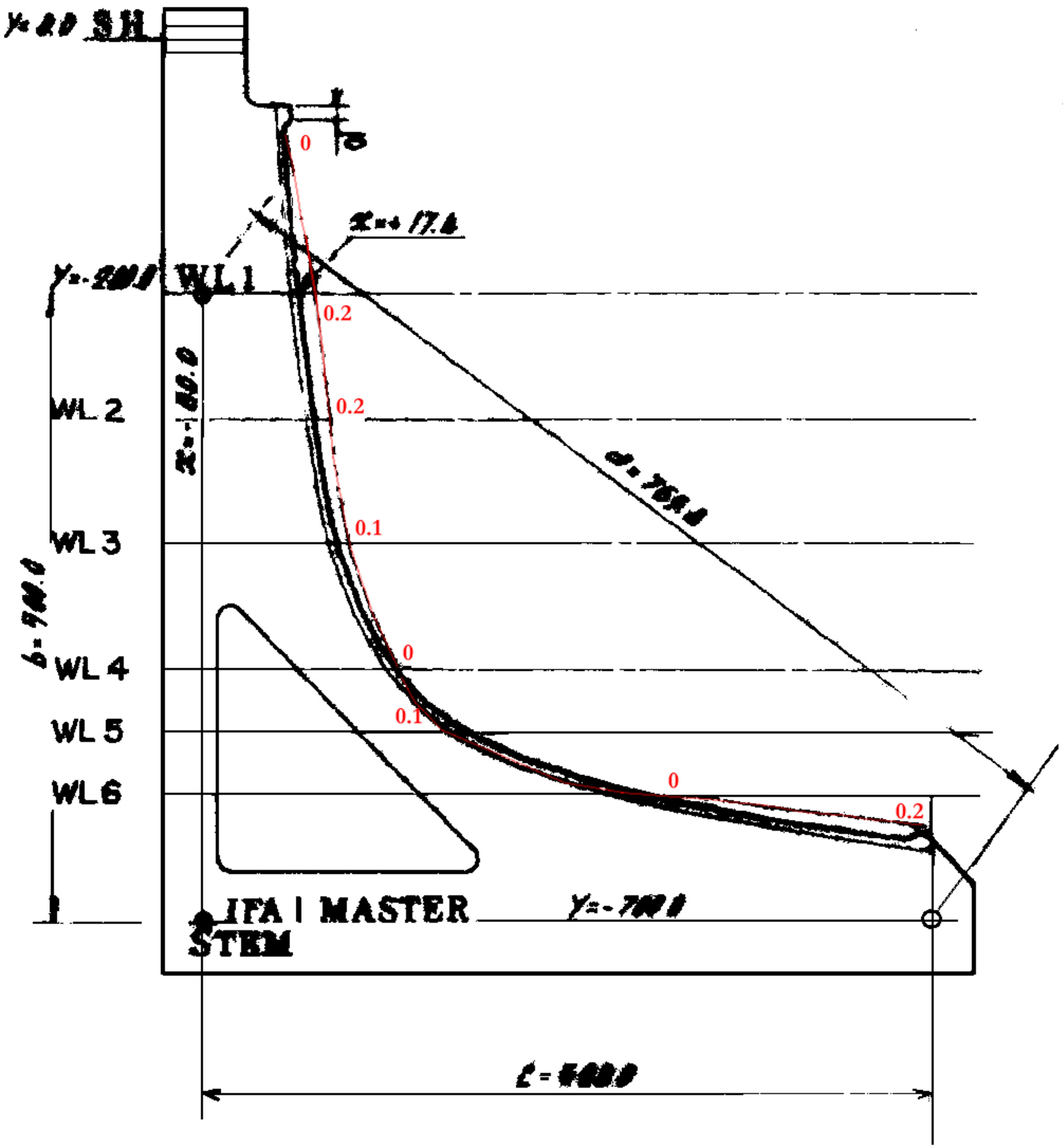
STATION 4


a = 1300.0
C = 1217.8
SH
SH
Y = -108.2
Y = -200.0
Y = -200.0
x = -608.9
x = +608.9
WL 1
WL 1
WL 2
WL 3
WL 4
WL 5
WL 6
b = 820.1
b = 820.1
Y = -700.0
C L
IFAI MASTER
Section 6

STATION 6

STATION 8 : **see page 5**

STEM



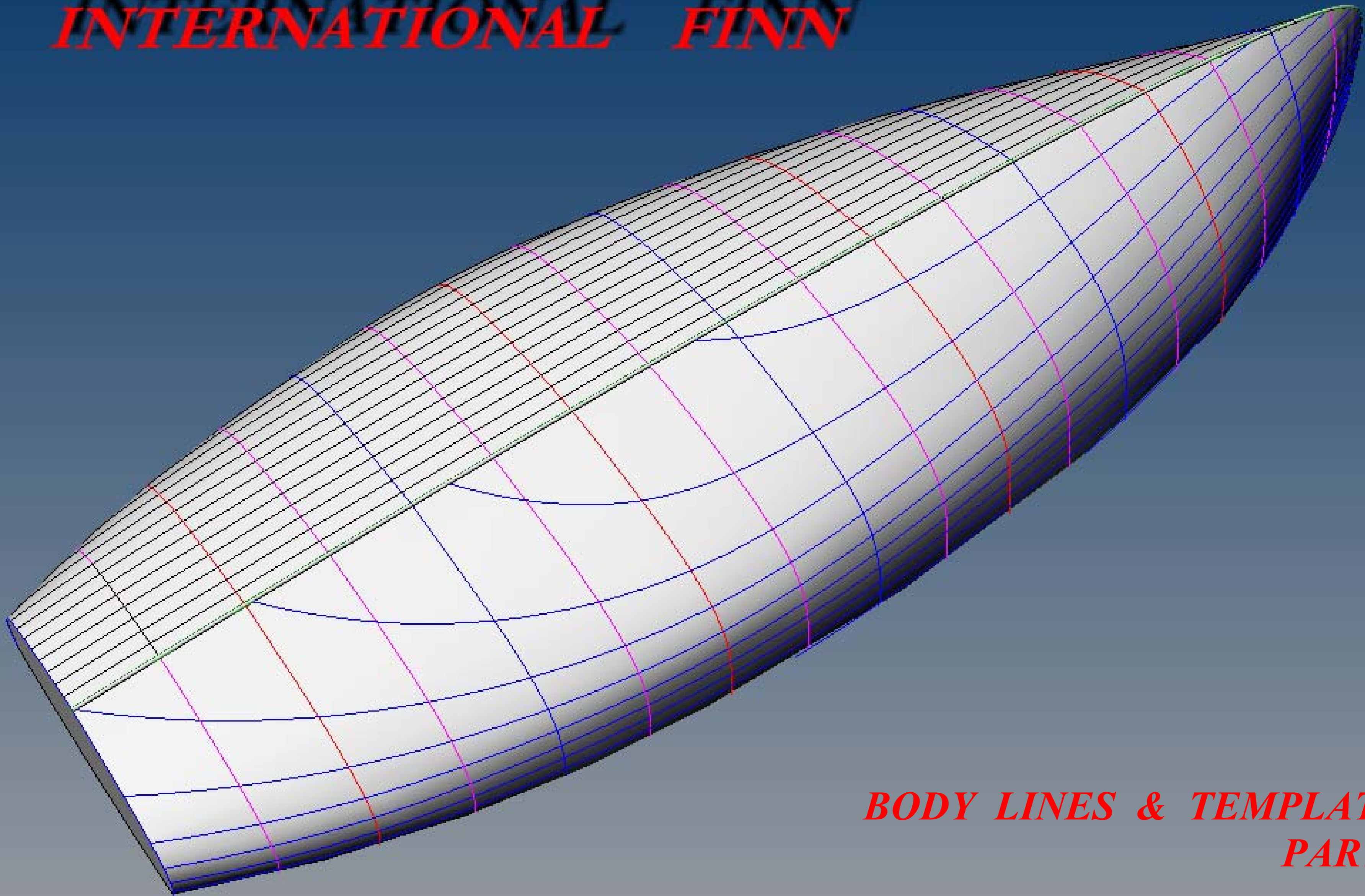
Checking Templates Stability

As any measurement apparatus, those templates are subject to damage and distortion.
That is why triangle measurements have been provided so as to control the templates integrity.
Those control measurements must be checked with certified meter rules.

I, 3 The 1974 digitized lines

They are delivered in **Finn-Lines** tables .

INTERNATIONAL FINN



BODY LINES & TEMPLATES
PART II

Gilbert Lamboley June 2006

PART II

2006 report

Digital model; Water Lines and Vertical Sections

II, 1 Introduction

In Part I, we have been telling how the Templates Lines and thus the Controlled Lines of the Finn (Stations 0-2-4-6-8 and Sheer) had been restored in 2003.

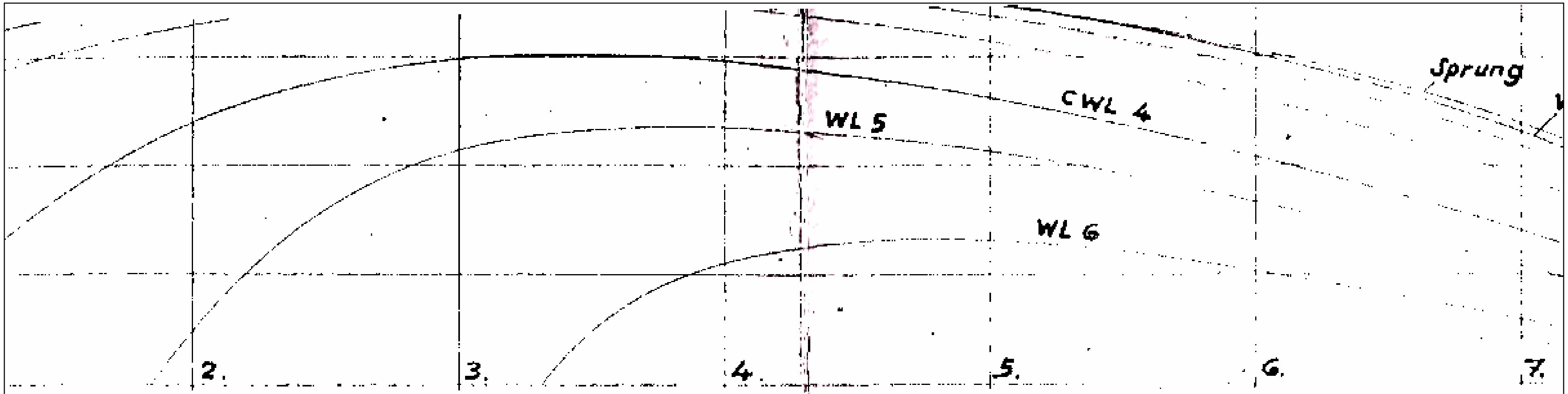
Intermediate stations (1-3-5-7) definition had still to be restored. Easy work if only one print of Finn Lines could have been found back! Since 1964, dozens of prints on stable polyester film had been sent all over the world. Our quest for at least one of them met the silence of a calm sea.

Yet more and more people are asking for those odd numbered stations design. This is how we have been engaged in a patient archaeological restoration.

Remnants of Finn prime ages were, beside the controlled lines:

- Sheets of coordinates, copies of which are delivered beneath,
- An old distorted and faded copy of 1964 drawing which I found when removing my office.

Further on is a report of the work and of its results.



Aufmaßtabelle		Dimensionen in millimetern									
Spanten		0.	1.	2.	3.	4.	5.	6.	7.	8.	9.
Sprung (Oberk. Seite Deck)	von der Basis	182	185	180	174	157	131	112	80	45	
Schnitt A	von der Basis		340	452	500	497	435	212			
–"– B	von der Basis	359	459	519	558	570	558	510	364		
–"– C	von der Basis	434	495	544	583	604	612	601	554	385	
Kiel	von der Basis	468	516	560	596	624	644	654	647	610	
Sprung (Oberk. Seite Deck)	halbe Breiten	445	618	717	754	747	700	618	485	280	
WL 1	halbe Breiten	451	620	717	754	745	690	603	462	259	
WL 2	halbe Breiten	450	616	707	745	733	670	575	434	235	
WL 3	halbe Breiten	319	535	663	717	695	627	520	375	190	
CWL 4	halbe Breiten		146	487	599	593	519	414	275	124	
WL 5	halbe Breiten			125	442	473	420	325	206	72	
WL 6	halbe Breiten					238	260	196	110	13	

Scanned from Internationale "Finn" Klasse Linienplan 1:10, Blatt Nr 1. Berichtigt bis 1.II.1958

Finn Offsets from FinnLog 1. Discrepancies with Blatt Nr 1 (1958) noted.

Stn 4: Buttock C height

Stn 6: Sheer height, Buttock C height

Stn 5: Sheer height

Table of Offsets as valid 1951 to 1959

Stations		0.	1.	2.	3.	4.	5.	6.	7.	8.	9.
Sheer hight	Below baseline	182,	185	180	174	157	135	110	80	45	
Buttock A hight			340	452	500	497	435	212			
Buttock B hight		359	459	519	558	570	558	510	364		
Buttock C hight		434	495	544	583	605	612	599	554	385	
Keel hight		468	516	560	596	624	644	654	647	610	
Deck width	Half width	445	618	717	754	747	700	618	485	280	
Waterline 1		451	620	717	754	745	690	603	462	259	
Waterline 2		450	618	707	745	733	670	575	434	235	
Waterline 3		319	535	663	717	695	627	520	375	190	
Keel Waterline 4			148	487	599	593	519	414	275	124	
Waterline 5				125	442	473	420	325	206	72	
Waterline 6						238	260	196	110	13	

FINNLOG 1

Table of Body Line Offsets taken from Richard Creagh-Osborne's book, first published 1963.
Discrepancies with Blatt Nr 1 (1958) noted:

Stn 4: Waterlines 5 & 6. Stn 8: Keel (5 mm)

Stn 6: Buttock C

TABLE OF OFFSETS DIMENSIONS IN MILLIMETRES

STATION →		0	1	2	3	4	5	6	7	8	9
SHEER	FROM BASELINE	182	185	180	174	157	131	112	80	45	
BUTTOCK "A"		—	340	452	500	497	435	212			
BUTTOCK "B"		354	459	519	558	570	558	510	364		
BUTTOCK "C"		434	495	544	583	604	612	599	554	385	
KEEL		468	516	560	596	624	644	654	647	615	
SHEER	HALF BREADTHS	445	618	717	754	747	700	618	485	280	
WATERLINE 1.		451	620	717	754	745	690	603	462	259	
WATERLINE 2.		450	618	707	745	733	670	575	434	235	
WATERLINE 3.		319	535	663	717	695	627	520	375	140	
WATERLINE 4. (l.w.l)			148	484	599	593	519	414	275	124	
WATERLINE 5				125	442	469	420	325	206	72	
WATERLINE 6							260	196	110	13	

The table of offsets relating to the International Finn Class drawings.

II, 2 Back to Controlled Lines definition

In 1974, in order to build a new generation of templates, I had measured sets of coordinates from the basic document of Finn (see Part I). From those sets of points, degree three polynomial lines were interpolated and long files of interpolated points coordinates were issued.

Nowadays, all Computer Aided Design programs have their own interpolating curves joining sets of points; those curves are called "splines". They are composed of sequential polynomial lines of variable degree. Third degree should be used so that any designer may use simplest programs.

Present definition of interpolated curves is not fully satisfactory, as we shall see further on. Up to now, despite many researches, no mathematical and unique definition of one curve running through an important set of points could be found, as far as we know.

From the circular (second degree) curves used in old drawing offices to digital third degree splines, no major progress has been achieved, precision being set apart.

Beneath are the lines built according to 1974 polynomials and lines built with third degree splines (from Rhinoceros program). Both are interpolating 1974 measured points from Finn basic document (engraved Al alloy sheet)..

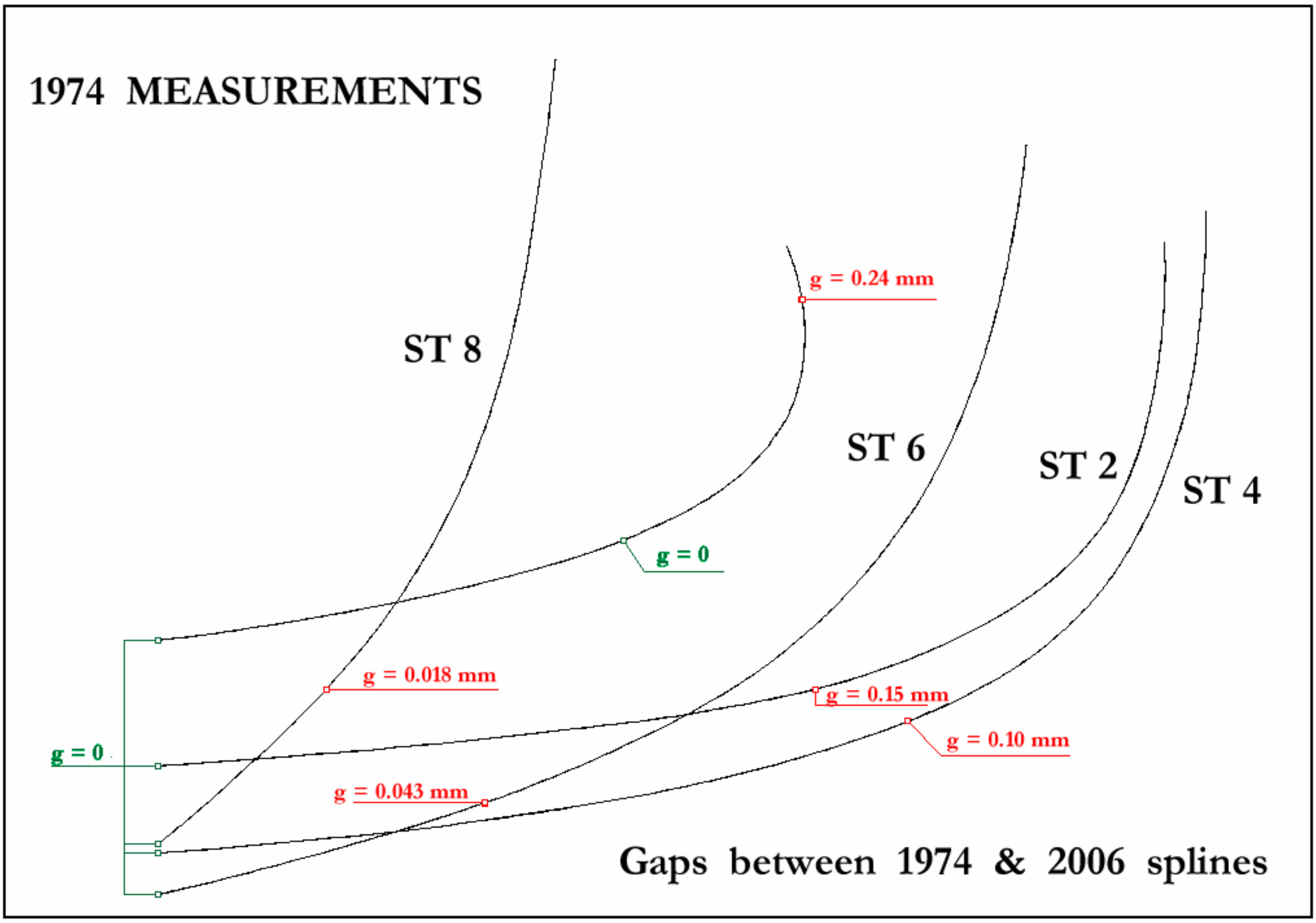


Figure II, 1

Above diagram shows that

- different sorts of "splining" lead to lines which are not significantly different
- it is not necessary to keep dense 2003 sheets of coordinates as regard body lines definition

II, 3 Setting Keel Line

First job has been to build Keel Line and its extension along Stem.

Keel Line is defined by Finn Rules which state distance from OX axis to flat above Keel Band.
Stem Line must comply with existing Template.

Thence Keel Line is actually defined by a line set 6mm aside. Actual Keel Line is deduced from Stations Lines at their lower end as is showed further on. If divergences are weak near transom, they grow up to about 7 mm at Station 8 (see also Part I).

Keel Line must join Stem Line. It has been possible to join those two lines so that they be tangent but alas not with a same curvature. Keel Line could be smoothed, yet running through points defined by Finn Rules. But curvature of Stem Line does not vary smoothly and it cannot be modified because it must conform to Stem Template. A sketch is delivered below.

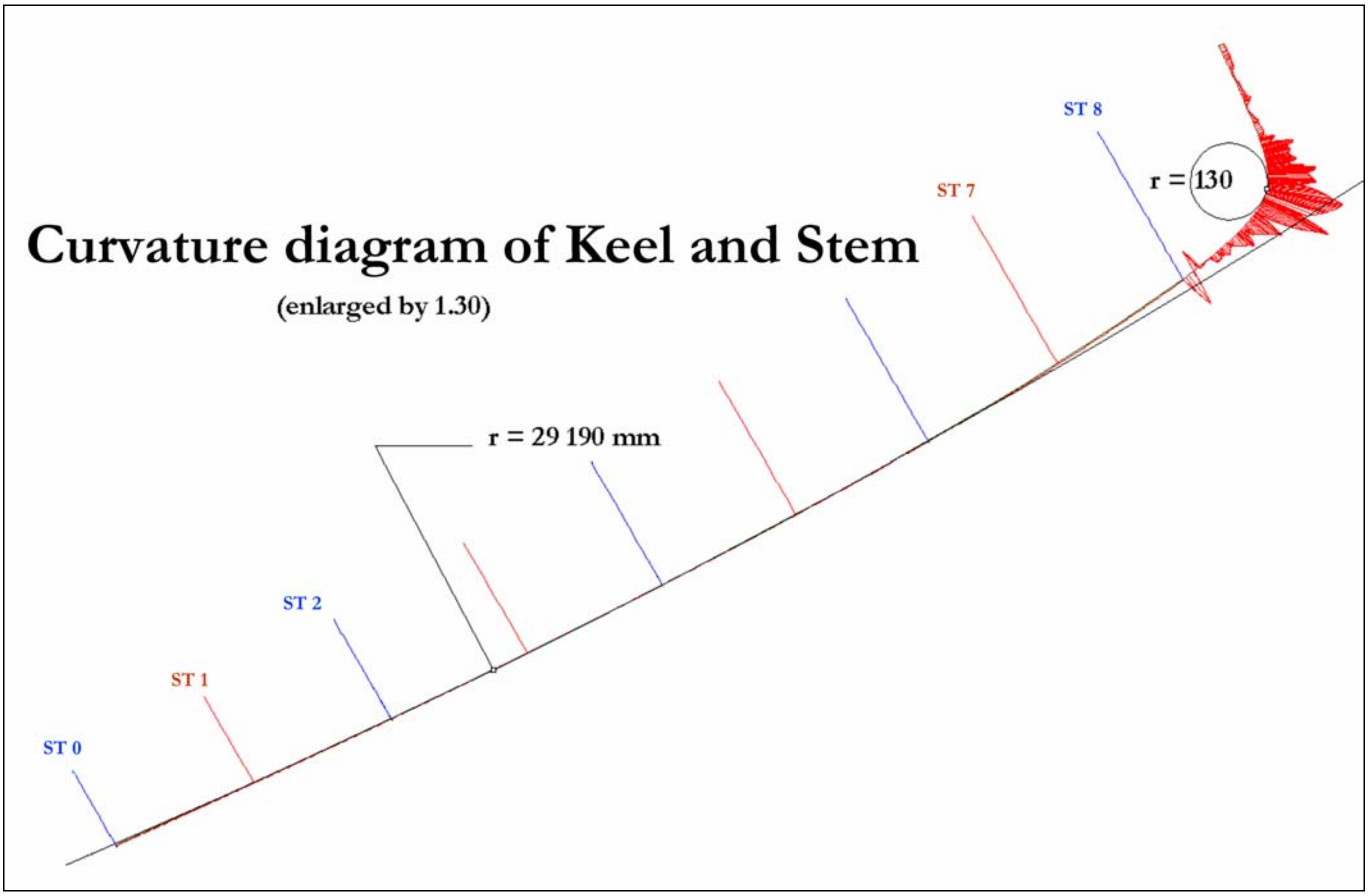


Figure II, 2

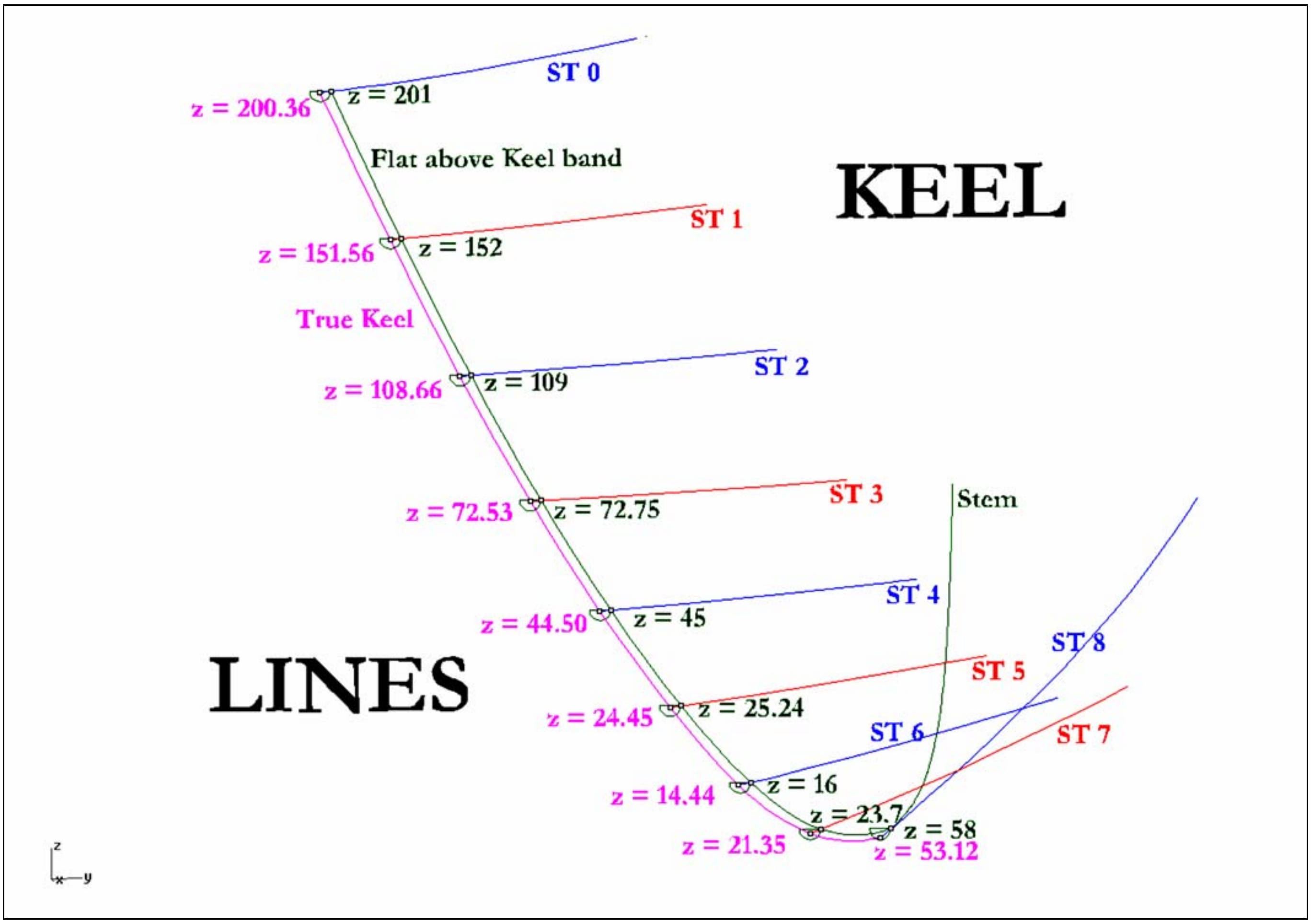


Figure II, 3

II, 4 Finding Stations 1-3-5-7 lines

That has been a delicate job.

Let us recall (also see Part I):

Sarby's Finn first known data were issued in 1958 by the Swedish National Association; they show on a sheet of coordinates with a precision of 1 mm.

1964 drawings of Finn Stations were achieved with best precision allowed by tools of that time (rules and circular curves). Those drawings were laid out onto a sheet of Aluminium Alloy. They were also copied on "mylar" (polyester) films which were distributed all over the world.

In 1974, I had to provide new sets of templates for IFA. So I measured templates lines coordinates from the Main Aluminium Alloy carving, at about every 25 mm. The aim was to make those templates with a digitally driven tool. From my readings were issued third degree polynomial curves (cubic lines): thus, every template line was defined by a succession of tangent cubic lines. The new templates were checked by a sworn geometrician to be distant by no more than 0.3 mm from the Main Carving along significant parts; that is to say with the precision of the engraved lines width. Ten sets of templates were made in 1974 and 10 new ones in 1984.

In 2003, new templates were needed. I could issue 1974 template lines from punched tapes records which had been saved. From the templates lines, I could deduce the controlled Stations lines 0, 2,4,6,8 together with Stem line and Rudder line.

The odd Stations lines ST 1, 2,3,5,7 were still to be drawn. As we have been unsuccessful to get back one of the numerous polyester film copies, I have had no other issue than to estimate coordinates from a distorted and faded copy I have found back.

Reading that copy with the help of powerful magnifying lens, I could now and then find the background grid. And what makes the search more valuable, I could find marked points at many lines intersections and also at points corresponding to 1958 table of coordinates. Charles Currey and Richard Creagh Osborne had attempted to draw lines through 1958 points and have never been much away with a few erratic exceptions.

II, 5 Consistency of FINN Lines from 1958 to 2006

Underneath is a comparison between 1958 data and 1974 splines. I wanted to check what would be the divergences before being confident in my measurements.

The similitude is remarkable, some erratic data yet appearing. Those mainly appear along low water lines, which may be explained by the difficulty of reading intersections of lines crossing at weak angles.
An exception is found at station 6 for y = 600. There was obviously a misprint in 1958 hand made document. Others obvious misprints could be easily corrected; they are marked with a “*”

Further on is a drawing (figure II, 4) showing divergences between lines issued from 1958 data and 1974 or 2006 measurements. Gaps between Lines (measured perpendicular to lines) are much smaller and appear to be local. A major divergence (about 5 mm narrower) has been revealed at lower part of Station 8. Elsewhere, it appears that Lines drawn in 1964 are close to 1958 data.

A delicate and fair job have done Charles Currey and Richard Creagh Osborne !

Comparing 1958 offsets and 2006 readings

1958 data in black; 2003-2006 data in red; divergences x 10 in red. Coordinates are related to original frame of reference. Unit is millimetre

	Station	0		1		2		3		4		5		6		7		8	
z (original frame)	Sheer	-182 / -182.4	4	-185 / -184.5	5	-180 / 180	0	-174 / -174.1	1	-157 / -156.9	1	-135* / -134.9	1	-110* / -109.8	2	-80 / -80.3	3	-45 / -45.2	8
	y = 600			-340 / -339.5	5	-452 / -452	0	-500** / -500	0	*-497* / -496.8	2	-435 / -434.3	7	-212 / -216.0	40				
	y = 400	-359 / -360.3	13	-459 / -458.9	1	-519 / -518.9	1	-558 / -557.7	3	-570 / -569.9	1	-558 / -558.1	1	-510 / -510.1	1	-364 / -363.6	4		
	y = 200	-434 / -434.4	4	-495 / -494.6	4	-544 / -543.7	3	-583 / -582.7	3	*-604* / -604.2	2	-612 / -612.0	0	*-599** / 598.9	1	-554 / -553.0	10	-385 / -385.2	2
	Keel	-468 / -468.3	3	-516 / -516.2	2	-560		-596 / -595.6	4	-624 / -624.0	0	-644 / -644.2	2	-654 / -653.7	3	-647 / -647.3	3	-610 / -612.8	28
Half breadth y	Sheer	445 / 445.0	0	618 / 618.1	1	717 / 717.0	0	754 / 754.7	7	747 / 747.0	0	700 / 699.5	5	618 / 617.8	2	485 / 484.7	3	280 / 279.7	3
	WL1 z = -200	451 / 451.2	2	620 / 620.2	2	717 / 717.7	7	754 / 754.4	4	745 / 744.7	3	690 / 689.7	3	603 / -603.4	4	462 / 461.0	10	259 / 258.9	1
	WL2 z = -300	450 / 450.8	8	618 / 618.0	0	707 / 707.9	9	745 / 746.2	12	733 / 732.2	8	670 / 669.4	6	575 / 574.6	4	434 / 433.3	7	235 / 235.1	1
	WL3 z = -400	319 / 320.8	18	535 / 535.3	3	663 / 663.2	2	717 / 717.5	5	695 / 694.1	9	627 / 626.7	3	520 / 520.2	2	*375* / 374.1	9	*190* / 191.9	19
	WL4 z = -500			*148* / 151.2	32	487 / 484.4	26	600** / 600.0	0	593 / 593.5	5	519 / 518.3	7	414 / 415.8	18	275 / 274.4	4	124 / 121.4	14
	WL5 z = -550					125 / 128.3	33	442 / 440.5	15	473 / 472.6	4	420 / 419.6	4	325 / 324.7	3	206 / 205.0	10	72 / 71.8	2
	WL6 z = -600									238 / 232.8	52	260 / 259.4	6	196 / 196.5	5	110 / 109.3	7	13 / 15.5	25

* Finn log data. **obvious misprint (ST3: 600,-500 at y=600 and 599,-500 at WL4); 600,-500 retained

II, 6 Retaining coordinates and Body Lines

Let us remind that Stations Lines had to be slightly shifted up and down in order to comply with Finn Rules (see Part I).

Lines controlled by Templates must comply with those Templates. Thus the coordinates I have been using are derived from Templates coordinates with as many points as were delivered by 1974 splines.

Odd numbered stations (1-3-5-7) coordinates have been read from the 1964 copy I found back.

Hence the table below comparing final coordinates with 1958 ones.

When lines are too close to axes directions, greater divergences appear; so we are delivering a drawing of lines together with actual gaps between them (Figure II, 4). It appears that Lines issued from Templates engraving diverge by up to 0.9 mm (Station 2) from my copy of 1964 film drawing. I also have applied their corresponding Templates to 1964 Lines; divergences appear to be much smaller despite film distortion; that shows that my present 2006 measurements are pessimistic; but my poor eyes got weeping so much (same taste as sea waves) that I have stopped trying to be more performing.

The aim has been to find back odd numbered Stations. Green figures ensure that using 1964 document has not been too bad although wearying.

Full size Lines are delivered in attached "Body-Temp" files (see paragraph II,9). They are also shown on figure II,5; writings have been lost but that picture bears enlargement.

II, 7 Digitized Finn hull

From its Body Lines, a hull surface could be meshed, delivering shape of cover page. Lights and shades do not reveal any bump.

Comparing 1958 offsets and 2003-2006 retained coordinates

1958 data in black; 2003-2006 data in red; divergences x 10 in red. Coordinates are related to original frame of reference. Unit is millimetre.

Station		0			1			2			3			4			5			6			7			8		
Sheer	z (original frame)	-182	-182.25	2	-185	-185.32	3	-180	-179.72	3	-174	-174.45	5	-157	-156.87	1	-135*	-134.73	3	-110*	-108.93	11	-80	-80.13	1	-45	-46.07	11
y = 600	z (original frame)				-340	-340.32	3	-452	-451.83	2	-500**	-500.35	4	-497	-496.79	2	-435	-433.98	10	-212	-217.98	60						
y = 400	z (original frame)	-359	360.27	13	-459	-459.72	7	-519	-518.74	3	-558	-558.05	0	-570	-570.09	1	-558	-557.93	1	-510	-509.97	0	-364	-363.43	6			
y = 200	z (original frame)	-434	-434.24	2	-495	-495.42	4	-544	-543.59	4	-583	-583.05	0	-604	-604.32	3	-612	-611.83	2	-599*	-598.78	2	-554	-552.83	12	-385	-386.55	16
Keel	z (original frame)	-468	-467.48	5	-516	-516.48	5	-560	-559.48	5	-596	-595.73	3	-624	-623.48	5	-644	-643.24	0	-654	-652.48	15	-647	-644.78	22	-610	-610.48	5
Sheer	Half breadth y	445	444.81	2	618	618.10	1	717	716.99	0	754	754.70	7	747	747.00	0	700	699.50	5	618	618.37	4	485	484.70	3	280	280.18	2
WL1 z = -200	Half breadth y	451	451.22	2	620	621.68	17	717	717.50	5	754	755.17	12	745	745.74	7	690	689.67	7	603	603.94	9	462	467.13	51	259	259.23	2
WL2 z = -300	Half breadth y	450	450.48	5	618	618.25	3	707	707.61	6	745	746.25	13	733	733.21	2	670	669.35	7	575	575.01	0	434	433.23	8	235	235.41	4
WL3 z = -400	Half breadth y	319	320.44	14	535	536.57	16	663	663.60	6	717	717.69	7	695	695.07	1	627	626.59	4	520	520.25	2	375	373.97	10	190	192.88	29
WL4 z = -500	Half breadth y				148	163.60	152	487	486.10	9	600**	600.72	7	593	594.63	16	519	519.03	0	414	415.71	17	275	274.20	8	124	121.94	21
WL5 z = -550	Half breadth y							125	130.66	57	442	442.22	2	473	473.19	2	420	420.16	2	325	323.88	11	206	204.63	14	72	73.61	16
WL6 z = -600	Half breadth y													238	232.77	58	260	258.64	14	196	196.31	3	110	108.95	11	13	18.56	57

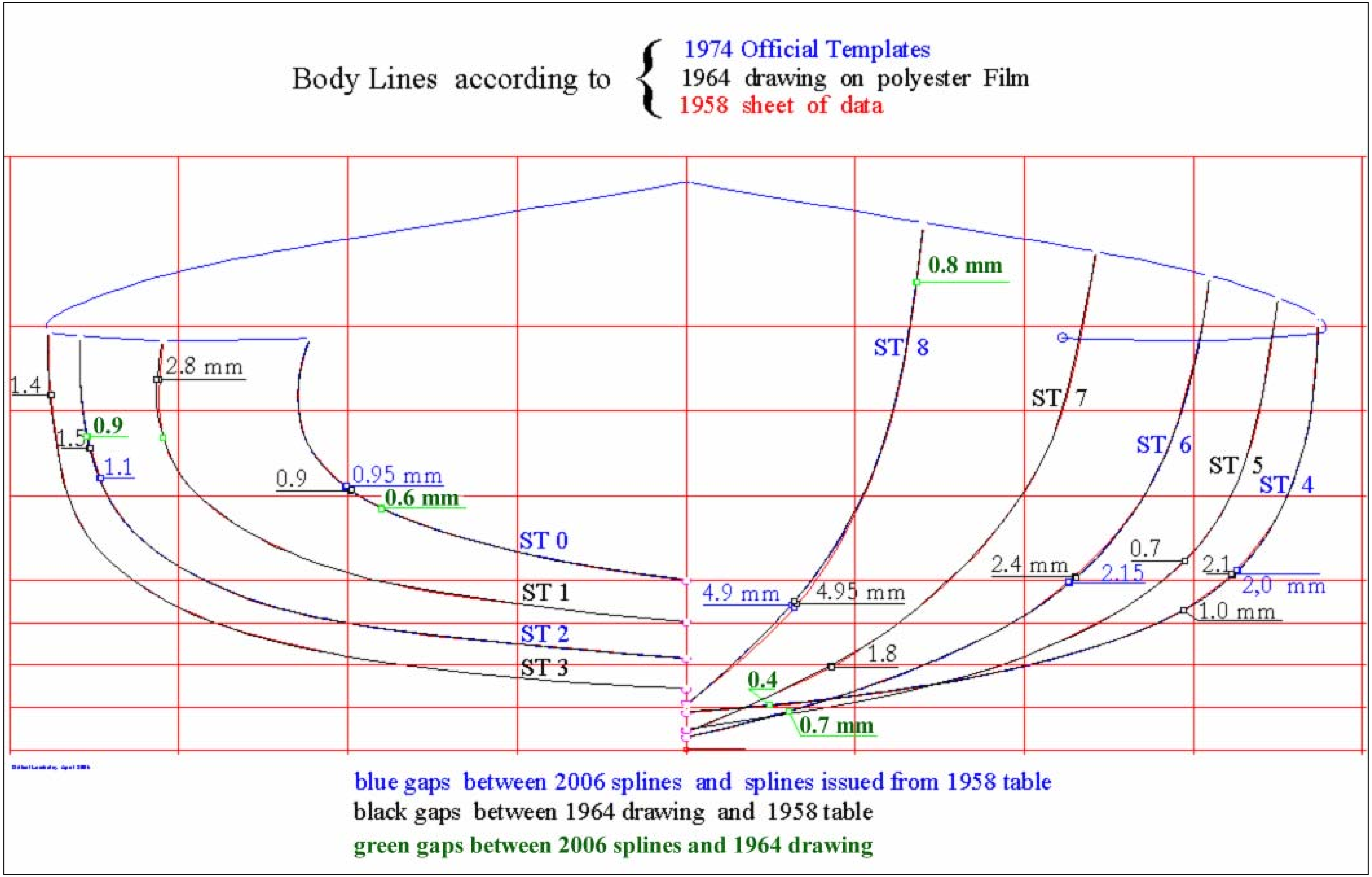
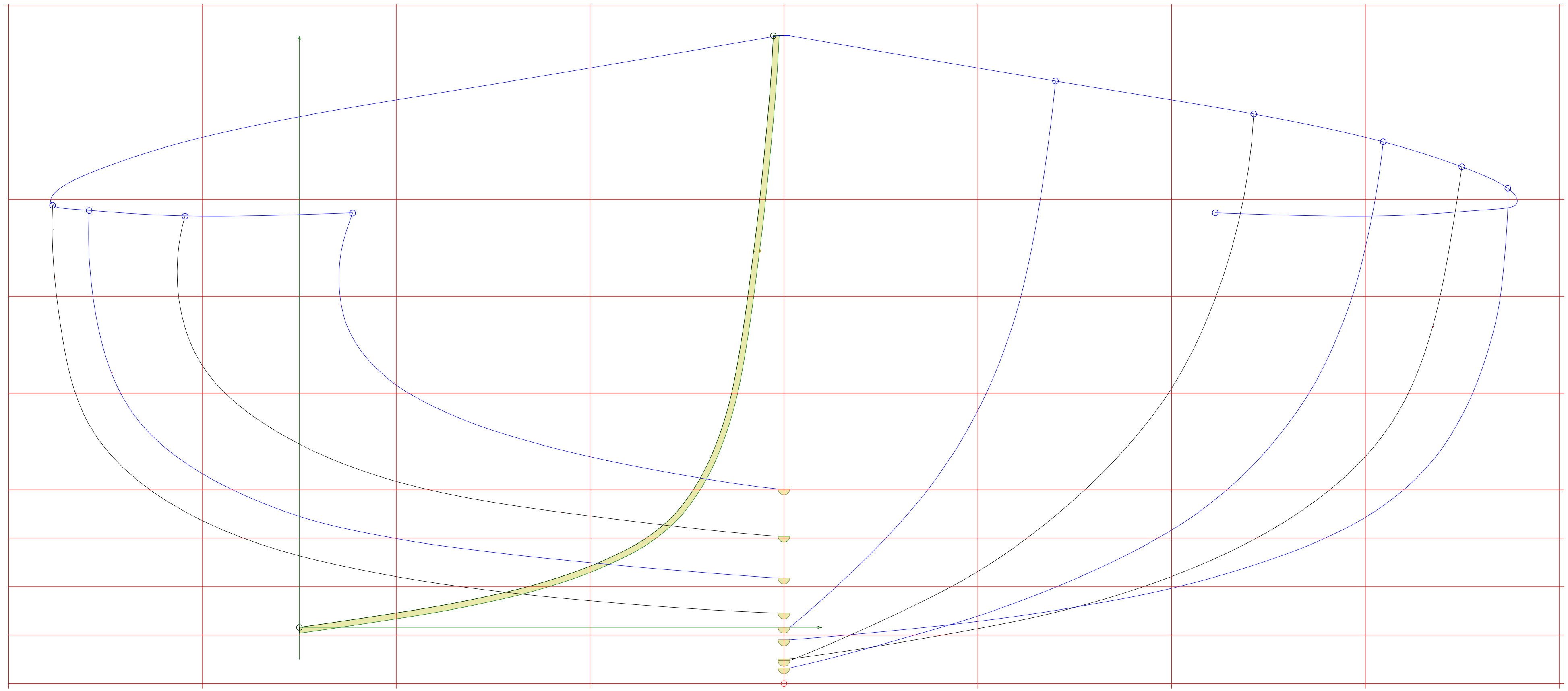

Body Lines according to
1974 Official Templates
1964 drawing on polyester Film
1958 sheet of data
0.8 mm
ST 8
ST 7
ST 6
ST 5
ST 4
2.8 mm
1.4
0.9
1.5
1.1
0.9
0.95 mm
0.6 mm
ST 0
ST 1
ST 2
ST 3
4.9 mm
4.95 mm
2.4 mm
2.15
0.7
2.1
2,0 mm
1.0 mm
1.8
0.4
0.7 mm
blue gaps between 2006 splines and splines issued from 1958 table
black gaps between 1964 drawing and 1958 table
green gaps between 2006 splines and 1964 drawing

Figure II,4

INTERNATIONAL FINN



FULL SIZE BODY LINES & TEMPLATES LINES

Figure II, 5

II, 8 Body Lines Curvatures

A problem is enlightened by mathematical progress. With nowadays electronic programs, it is possible to check variations of curvature along lines. My endeavour was to restore Finn basic documents. But those old curves show unpleasant variations of curvature which water flow cannot like, because increasing the added mass of water trailed by boat.

Drawing gentle curves which keep as close as possible with the original and successful design is a major work. With present state of art, there is no mathematical technique which allows drawing lines the derivates of which be continuous, thus inducing gentle variations of curvature.

The only way is to work step by step, finding fair lines and then fair hull surface. And remind that a set of fair lines does not necessarily lead to a fair surface.

In figure II, 6, I show curvatures variations of stations. They look quite unpleasant and yet, when following with thumb the templates which they are issued from, they look quite smooth. And that thumb is quite a sensitive tool. Indeed if the lines are continuous, actually their derivates (hence their curvatures) are not

In figure II, 7, I have chosen the most unpleasant looking Station 0 and I have tried to smooth its curvature variations.

The faired curve (on right) is only different from original one by a maximal gap of 0.72 mm. It is widely complying with Finn Rules And it would be possible to do still better by first swelling original line a little.

But that is builders’ job. Mine is over.

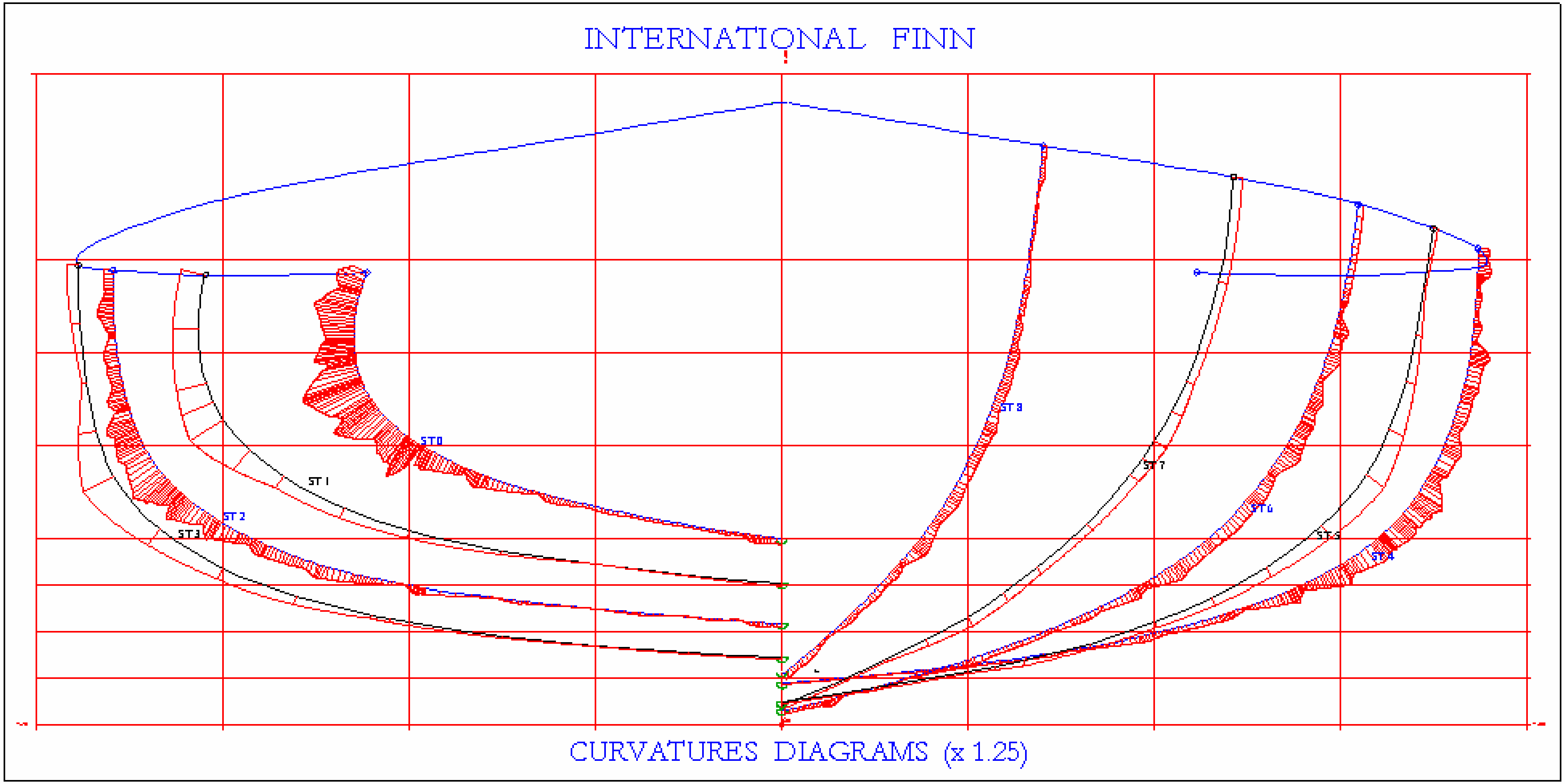

INTERNATIONAL FINN
ST 0
ST 1
ST 2
ST 3
ST 4
ST 5
ST 6
ST 7
ST 8
CURVATURES DIAGRAMS (x 1.25)

Figure II, 6

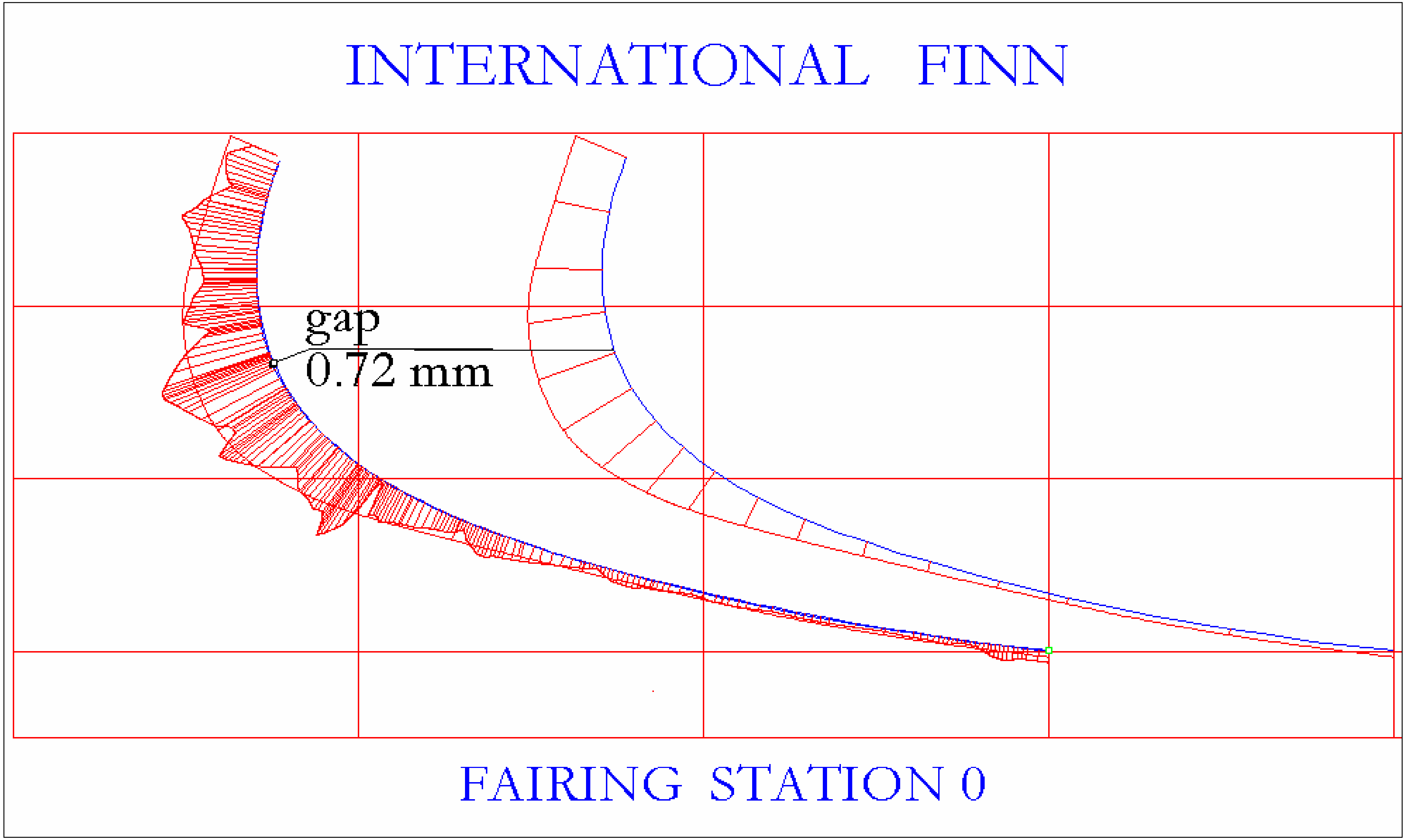


Figure II, 7

II, 9 Body Lines Table of Coordinates

Download attached documents !

finn-Body-coord.xls

This is an "Excel" spread sheet delivering coordinates of water lines every 50 mm and coordinates of vertical sections every 100 mm athwart ship.

finn-Body-coord.pf

This a ".pdf" file delivering sets of close coordinates along Stations, Keel, Stem and Rudder.
Coordinates of Stations **0-2-4-6-8** are derived from 1974 official set of International Finn Templates which were digitized for CNC carving.
Coordinates of Stations **1-3-5-7** are derived from original documents of the Finn.

finn-OverAllLines.txt

This text document delivers all sets of coordinates in a crude list which may be digested by any electronic program. It even delivers coordinates every 250 mm along ship as were taken from Finn Hull digitized model

Finn Hull digitized model

This is the "Rhinoceros" model of the original Finn, for you to play with, to smooth it and to get the magic Finn (of course inside "building" tolerances).

II, 10 Full size documents

Full size drawings of both Station lines and Templates ones may be obtained by printing underneath electronic files; they are waiting you for downloading. You may also only look at them from your computer screen or get under scaled prints from your personal printer (unless you own one of those huge professional printers).

finn-Body-Temp.3dm

That drawing is the master one; it has been achieved using "Rhinoceros" program and the" .3dm" is a special Rhinoceros one.

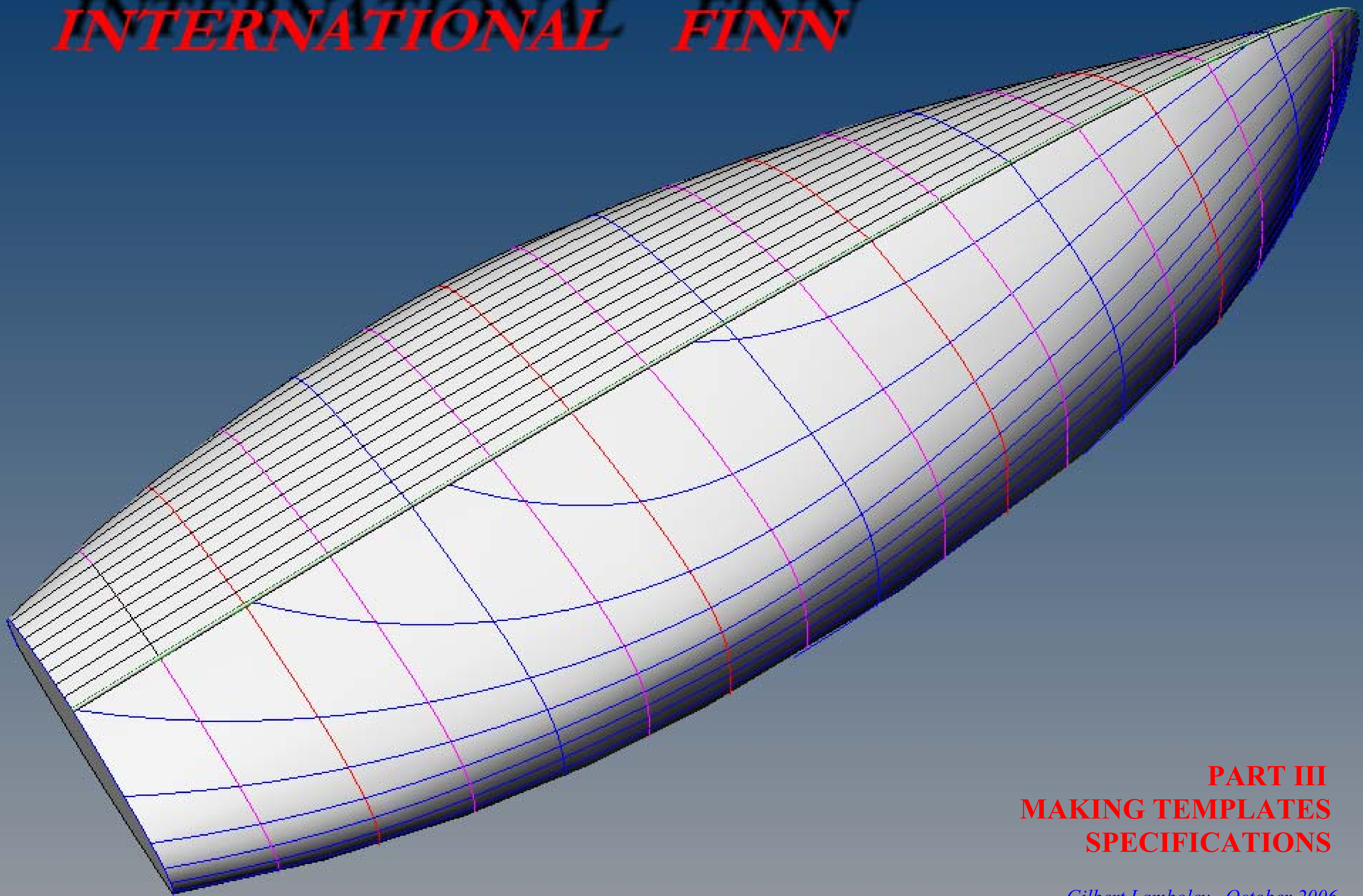
finn-Body-Temp.dwg

This is a translation of Rhinoceros file which may be read by any compatible "AutoCAD" program. It enables to print full size Body and Templates Lines using any professional printer. It may also be read on any PC screen and printed in reduced size by any PC printer.

finn-Body-Temp.pdf

This is an "Acrobat" version of previous ones with same possibilities.

INTERNATIONAL FINN



PART III
MAKING TEMPLATES
SPECIFICATIONS

Gilbert Lamboley October 2006

III,1 General

Templates shall be cut and engraved using digitally controlled tools (CNC) according to attached AutoCAD files which are delivered with two “autocad” extensions.

- **Extension .DWG**

station-0 **station-2** **station-4** **station-6** **station-8** **stem** **rudder**

- **Extension .DXF**

station-0 **station-2** **station-4** **station-6** **station-8** **stem** **rudder**

Those files may get corrupted through Internet; if so, may delivered on CD-Rom.
Other formats may also be provided.
To open files, click onto paper clips.

Below are to be found :

- coordinates of the contours which have been drawn 5 mm wider than Finn body lines according to Finn Class Rules.
- dimensioned sketches of each template

Templates are to be cut from 3mm Aluminium Alloy sheets, at a temperature close to 20 Celsius degrees.
Alloy shall be 5083 and shall be heat treated so as to eliminate internal stresses due to laminating.

Accuracy of shearing shall be 0.01 mm, as well as for 10 mm holes (apexes of control triangles).

Accuracy of engraving shall be 0.01 mm:

- along 5mm inside Control Lines,
- along Sheer control lines.

No work likely to introduce stresses and strains into metal shall be admitted. (Laser cut is thence prohibited)

All writings to be engraved; stamping shall not be allowed.

Templates shall be checked:

- to conform to polyester drawings issued from same CNC files.
- by any sort of precise measurements.

Templates are to be used nearby sea. Although 5083 alloy is not likely to be corroded, a thin protection coating shall be proposed by manufacturer.

Templates shall be delivered inside strong enough boxes so as to ensure their protection against any transport injury.

Templates are to be used nearby sea. Although 5083 alloy is not likely to be corroded, a thin protection coating shall be proposed by manufacturer.

Templates shall be delivered inside strong enough boxes so as to ensure their protection against any transport injury.

III, 2 Templates Lines coordinates related to Measurement Frame of Reference

Bold template coordinates were measured from carved layout; others were "splined".

TEMPLATE LINE STATION 0 x = 0.000 m											
n°	y	z	n°	y	z	n°	y	z	n°	y	z
1	**0,000**	195,384	24	**264,000**	245,274	47	408,711	308,530	70	461,510	389,543
2	6,673	196,042	25	271,592	247,438	48	412,612	311,705	71	**462,150**	393,234
3	13,340	196,750	26	283,450	250,911	49	416,424	314,991	72	462,671	396,695
4	**25,200**	198,134	27	293,688	254,043	50	**420,150**	318,384	73	463,103	400,163
5	32,922	199,136	28	302,909	257,008	51	424,193	322,251	74	463,540	404,678
6	40,636	200,207	29	311,392	259,886	52	428,010	326,090	75	463,844	409,205
7	**50,200**	201,584	30	319,306	262,723	53	431,445	329,750	76	464,027	413,740
8	58,990	202,882	31	326,752	265,550	54	434,566	333,290	77	**464,100**	418,284
9	67,773	204,224	32	**333,800**	268,384	55	437,412	336,743	78	464,052	423,415
10	83,746	206,770	33	340,031	270,989	56	440,016	340,136	79	463,858	428,535
11	**99,700**	209,434	34	346,239	273,644	57	**442,400**	343,484	80	463,515	433,563
12	116,344	212,330	35	354,340	277,233	58	444,494	346,622	81	463,028	438,439
13	132,966	215,355	36	361,654	280,624	59	446,508	349,804	82	**462,400**	443,184
14	**149,350**	218,484	37	368,387	283,905	60	448,809	353,689	83	461,754	447,106
15	160,485	220,691	38	374,657	287,122	61	450,871	357,467	84	460,997	451,002
16	171,607	222,957	39	380,546	290,309	62	452,712	361,153	85	460,024	455,371
17	186,438	226,097	40	**386,100**	293,484	63	454,351	364,772	86	458,939	459,713
18	**200,100**	229,134	41	389,314	295,378	64	**455,800**	368,334	87	457,759	464,033
19	211,189	231,689	42	392,515	297,295	65	456,999	371,652	88	**456,500**	468,334
20	222,262	234,310	43	396,683	299,894	66	458,074	375,001	89	455,389	471,902
21	234,742	237,383	44	**400,200**	302,234	67	459,092	378,596	90	454,216	475,448
22	246,001	240,297	45	402,474	303,834	68	459,995	382,221	91	452,282	480,869
23	**256,400**	243,134	46	404,718	305,472	69	460,796	385,871	92	**450,200**	486,234

TEMPLATE LINE STATION 2 x = 1.000 m											
n°	y	z	n°	y	z	n°	y	z	n°	y	z
1	**0,000**	103,616	31	**400,000**	144,616	61	605,563	214,095	91	700,438	323,671
2	12,403	104,320	32	407,803	146,060	62	609,400	216,471	92	702,276	328,957
3	**24,800**	105,116	33	415,603	147,512	63	**613,200**	218,916	93	704,156	334,827
4	36,514	105,973	34	**423,400**	148,986	64	617,767	221,951	94	705,504	339,313
5	**50,000**	107,016	35	431,186	150,494	65	622,290	225,044	95	**706,800**	343,816
6	62,501	107,957	36	438,964	152,048	66	626,762	228,206	96	708,456	349,952
7	**75,000**	108,916	37	446,728	153,659	67	631,174	231,446	97	710,109	356,660
8	87,351	109,907	38	454,475	155,339	68	635,519	234,777	98	711,468	362,629
9	**99,700**	110,916	39	462,204	157,102	69	639,788	238,208	99	**712,750**	368,616
10	118,483	112,431	40	469,911	158,958	70	643,021	240,926	100	714,339	376,619
11	134,244	113,717	41	477,594	160,920	71	**646,200**	243,716	101	715,797	384,774
12	**150,000**	115,066	42	485,249	163,001	72	649,710	246,909	102	716,520	389,191
13	171,690	117,063	43	492,874	165,211	73	653,167	250,154	103	717,200	393,616
14	185,846	118,426	44	498,296	166,875	74	656,559	253,461	104	718,234	401,087
15	**200,000**	119,816	45	**503,700**	168,616	75	659,879	256,839	105	719,223	409,346
16	217,314	121,526	46	511,519	171,248	76	663,115	260,296	106	**720,200**	418,716
17	234,627	123,254	47	519,300	173,976	77	666,257	263,842	107	720,867	425,858
18	251,935	125,029	48	527,040	176,806	78	668,252	266,207	108	721,452	433,006
19	269,234	126,883	49	534,736	179,747	79	**670,200**	268,616	109	721,813	438,307
20	284,623	128,621	50	542,386	182,804	80	673,261	272,611	110	**722,100**	443,616
21	**300,000**	130,466	51	549,987	185,987	81	676,278	276,806	111	722,361	450,908
22	310,910	131,812	52	557,526	189,297	82	679,255	281,215	112	722,497	458,942
23	321,819	133,159	53	562,299	191,477	83	682,202	285,862	113	722,517	463,779
24	332,726	134,526	54	**567,050**	193,716	84	684,541	289,762	114	**722,500**	468,616
25	343,627	135,933	55	572,662	196,426	85	**686,800**	293,716	115	722,357	478,019
26	354,519	137,399	56	578,249	199,182	86	689,358	298,461	116	722,204	483,368
27	365,400	138,943	57	583,804	201,996	87	691,845	303,406	117	**722,000**	488,716
28	376,269	140,585	58	589,320	204,882	88	694,265	308,568			
29	387,120	142,344	59	594,789	207,852	89	696,493	313,663			
30	393,563	143,454	60	600,206	210,919	90	**698,600**	318,816			

TEMPLATE LINE STATION 4 x = 2.000 m											
n°	y	z	n°	y	z	n°	y	z	n°	y	z
1	**0,000**	39,506	30	424,132	99,259	59	625,002	182,319	88	726,081	326,330
2	28,646	41,828	31	435,156	102,181	60	629,976	186,019	89	728,675	334,048
3	57,280	44,311	32	446,150	105,213	61	634,831	189,803	90	730,216	338,868
4	78,594	46,264	33	457,110	108,363	62	**639,600**	193,706	91	**731,700**	343,706
5	**99,900**	48,306	34	468,034	111,640	63	644,245	197,687	92	733,812	350,960
6	116,913	49,980	35	478,761	115,003	64	648,803	201,759	93	735,800	358,246
7	133,924	51,686	36	**489,450**	118,506	65	653,268	205,927	94	737,111	363,367
8	150,928	53,449	37	496,884	121,010	66	657,638	210,196	95	**738,350**	368,506
9	167,923	55,296	38	504,308	123,543	67	661,742	214,400	96	739,970	375,744
10	183,968	57,141	39	511,715	126,121	68	**665,750**	218,706	97	741,454	383,009
11	**200,000**	59,106	40	519,100	128,758	69	669,694	223,147	98	742,442	388,300
12	216,520	61,242	41	526,457	131,470	70	673,534	227,670	99	**743,350**	393,606
13	233,027	63,466	42	533,779	134,271	71	677,266	232,281	100	744,278	399,756
14	249,520	65,791	43	541,062	137,178	72	680,884	236,981	101	745,208	406,891
15	265,996	68,232	44	548,301	140,204	73	683,269	240,222	102	745,894	412,747
16	282,453	70,803	45	552,057	141,836	74	**685,600**	243,506	103	**746,550**	418,606
17	291,229	72,233	46	**555,800**	143,506	75	688,599	247,950	104	747,510	427,898
18	**300,000**	73,706	47	561,471	146,091	76	691,692	252,807	105	748,228	435,700
19	311,304	75,644	48	567,124	148,713	77	694,949	258,203	106	**748,900**	443,506
20	322,603	77,611	49	572,751	151,385	78	697,909	263,333	107	749,855	455,486
21	333,892	79,622	50	578,345	154,121	79	**700,800**	268,506	108	750,323	461,995
22	345,170	81,695	51	583-898	156,935	80	704,147	274,717	109	**750,750**	468,506
23	356,433	83,844	52	589,405	159,840	81	707,368	280,991	110	751,189	475,718
24	367,678	86,086	53	594,858	162,850	82	710,426	287,265	111	751,537	482,160
25	378,901	88,437	54	599,655	165,627	83	**713,350**	293,606	112	**751,800**	488,606
26	390,100	90,913	55	**604,400**	168,506	84	715,890	299,467	113	752,004	497,517
27	396,054	92,289	56	609,645	171,827	85	718,520	305,918	114	752,052	504,561
28	**402,000**	93,706	57	614,831	175,231	86	720,977	312,270	115	**752,000**	511,606
29	413,079	96,437	58	619,952	178,726	87	**723,350**	318,656			

TEMPLATE LINE STATION 6 x = 3.000 m

n°	y	z	n°	y	z	n°	y	z	n°	y	z
1	**0,000**	9,537	28	290,271	98,283	55	475,169	209,808	82	578,629	364,016
2	12,712	12,384	29	300,360	102,555	56	480,023	214,481	83	**580,600**	369,037
3	**25,400**	15,337	30	310,408	106,917	57	**484,800**	219,237	84	583,270	375,958
4	37,450	18,239	31	320,410	111,386	58	490,373	224,996	85	585,874	382,903
5	43,829	19,820	32	328,575	115,142	59	495,894	230,929	86	587,876	388,456
6	**50,200**	21,437	33	**336,700**	118,987	60	501,369	237,047	87	**589,800**	394,037
7	59,881	23,997	34	344,732	122,877	61	504,327	240,452	88	592,358	401,907
8	67,490	26,066	35	352,735	126,826	62	**507,250**	243,887	89	594,859	410,108
9	**75,100**	28,137	36	360,699	130,850	63	512,136	249,811	90	596,175	414,641
10	87,254	31,419	37	368,615	134,965	64	517,173	256,162	91	**597,450**	419,187
11	**99,400**	34,737	38	376,475	139,189	65	522,034	262,513	92	599,317	426,231
12	115,538	39,263	39	380,823	141,593	66	**526,800**	268,937	93	601,393	434,626
13	**131,650**	43,887	40	**385,150**	144,037	67	530,674	274,281	94	**603,600**	443,937
14	142,404	47,002	41	391,296	147,575	68	534,488	279,665	95	606,245	455,471
15	153,156	50,123	42	397,413	151,159	69	538,224	285,104	96	607,722	462,199
16	163,899	53,274	43	403,491	154,805	70	541,200	289,594	97	**609,150**	468,937
17	174,626	56,476	44	409,521	158,529	71	**544,100**	294,137	98	611,565	480,956
18	185,330	59,752	45	415,493	162,348	72	547,818	300,235	99	613,822	493,000
19	196,006	63,123	46	420,397	165,600	73	551,551	306,657	100	615,922	505,069
20	204,616	65,936	47	**425,250**	168,937	74	555,029	312,916	101	617,863	517,162
21	**213,200**	68,837	48	431,747	173,590	75	**558,400**	319,237	102	619,647	529,279
22	226,445	73,482	49	436,258	178,447	76	561,758	325,827	103	621,271	541,410
23	239,647	78,282	50	444,789	183,517	77	565,194	332,909	104	622,379	550,467
24	252,811	83,239	51	451,265	188,742	78	567,779	338,457	105	**623,400**	559,537
25	265,939	88,354	52	**457,650**	194,087	79	**570,300**	344,037			
26	273,053	91,199	53	463,582	199,228	80	573,348	351,067			
27	**280,150**	94,087	54	469,423	204,467	81	576,626	359,007			

TEMPLATE LINE STATION 8 x = 4.000 m

n°	y	z	n°	y	z	n°	y	z	n°	y	z
1	**0,000**	46,701	20	**127,800**	167,551	39	206,773	284,237	58	257,778	435,240
2	9,521	54,414	21	132,723	173,178	40	**210,850**	292,551	59	**259,300**	442,551
3	17,295	60,866	22	137,601	178,843	41	214,531	300,359	60	261,793	455,063
4	**25,000**	67,401	23	142,410	184,566	42	218,094	308,219	61	**264,150**	467,601
5	32,783	74,175	24	145,579	188,439	43	220,121	312,850	62	266,090	478,658
6	41,607	82,049	25	**148,700**	192,351	44	**222,100**	317,501	63	268,136	491,182
7	47,362	87,265	26	153,588	198,692	45	225,219	325,141	64	270,174	504,387
8	**53,100**	92,501	27	158,691	205,564	46	228,471	333,511	65	**272,150**	517,601
9	61,393	100,124	28	163,005	211,557	47	**231,850**	342,601	66	273,958	530,022
10	69,635	107,803	29	**167,250**	217,601	48	235,047	351,574	67	**275,700**	542,451
11	74,685	112,583	30	171,924	224,417	49	237,754	359,519	68	277,378	554,923
12	**79,699**	117,401	31	176,506	231,294	50	**240,350**	367,501	69	**279,000**	567,401
13	87,410	124,938	32	180,015	236,723	51	243,230	376,850	70	280,438	578,621
14	95,044	132,550	33	**183,450**	242,201	52	245,518	384,685	71	281,315	585,658
15	99,868	137,455	34	187,806	249,412	53	**247,700**	392,551	72	**282,150**	592,701
16	**104,650**	142,401	35	192,245	257,062	54	249,882	400,910	73	283,703	606,982
17	111,838	149,990	36	195,199	262,316	55	251,932	409,246	74	284,474	614,690
18	118,934	157,663	37	**198,100**	267,601	56	**253,900**	417,601	75	**285,200**	622,401
19	123,389	162,587	38	202,561	275,991	57	256,211	427,899			

STEM BAND TEMPLATE LINE y = 0.000 m											
n°	x	z	n°	x	z	n°	x	z	n°	x	z
100	**4500,000**	669,088	75	4462,487	326,215	50	4409,683	185,444	25	4300,623	109,580
99	4499,143	651,788	74	**4461,000**	318,189	49	4406,975	181,699	24	4293,115	106,744
98	4498,149	634,884	73	4459,728	311,634	48	4404,183	178,017	23	4285,044	103,861
97	**4497,000**	617,989	72	4458,410	305,089	47	4401,297	174,406	22	4276,255	100,885
96	4496,039	605,385	71	4457,154	299,229	46	4398,597	171,211	21	4266,464	97,731
95	**4495,000**	592,789	70	**4455,800**	293,389	45	**4395,800**	168,088	20	4259,241	95,487
94	4493,899	580,336	69	4453,831	285,598	44	4392,535	164,664	19	**4252,000**	93,289
93	**4492,750**	567,889	68	4451,710	277,849	43	4389,051	161,236	18	4243,614	90,846
92	**4490,400**	542,989	67	4450,286	272,960	42	4385,334	157,797	17	4234,689	88,408
91	4489,217	530,687	66	**4448,800**	268,088	41	4381,355	154,331	16	4225,100	85,949
90	**4488,000**	518,389	65	4446,601	261,228	40	4377,088	150,822	15	4214,641	83,425
89	4486,304	501,928	64	4444,283	254,409	39	4372,488	147,244	14	4202,909	80,750
88	4484,525	485,477	63	4442,241	248,732	38	4369,611	145,097	13	4192,562	78,490
87	4483,533	476,731	62	**4440,100**	243,088	37	**4366,700**	142,989	12	**4182,200**	76,289
86	**4482,500**	467,989	61	4438,056	237,920	36	4362,819	140,308	11	4170,162	73,832
85	4480,945	455,511	60	4435,947	232,780	35	4358,652	137,617	10	4157,108	71,326
84	**4479,350**	443,039	59	4433,751	227,678	34	4354,164	134,904	9	4147,560	69,578
83	**4476,200**	418,389	58	4431,582	222,909	33	4349,295	132,142	8	**4138,000**	67,889
82	4474,574	405,835	57	**4429,300**	218,189	32	4343,932	129,277	7	4126,643	65,982
81	**4472,900**	393,289	56	4426,649	213,019	31	4337,892	126,222	6	4113,324	63,868
80	4471,140	380,683	55	4423,886	207,915	30	4330,771	122,786	5	**4100,000**	61,789
79	**4469,300**	368,088	54	4421,004	202,878	29	4325,741	120,427	4	4068,331	56,889
78	4467,399	355,681	53	4418,017	197,946	28	**4320,700**	118,088	3	4036,638	52,154
77	**4465,400**	343,289	52	**4414,900**	193,088	27	4314,358	115,236	2	4018,323	49,494
76	4463,887	334,257	51	4412,322	189,244	26	4307,681	112,404	1	**4000,000**	46,889

RUDDER y = 0.000 m , ξ , ζ coordinates being related to local axes
(see drawing)

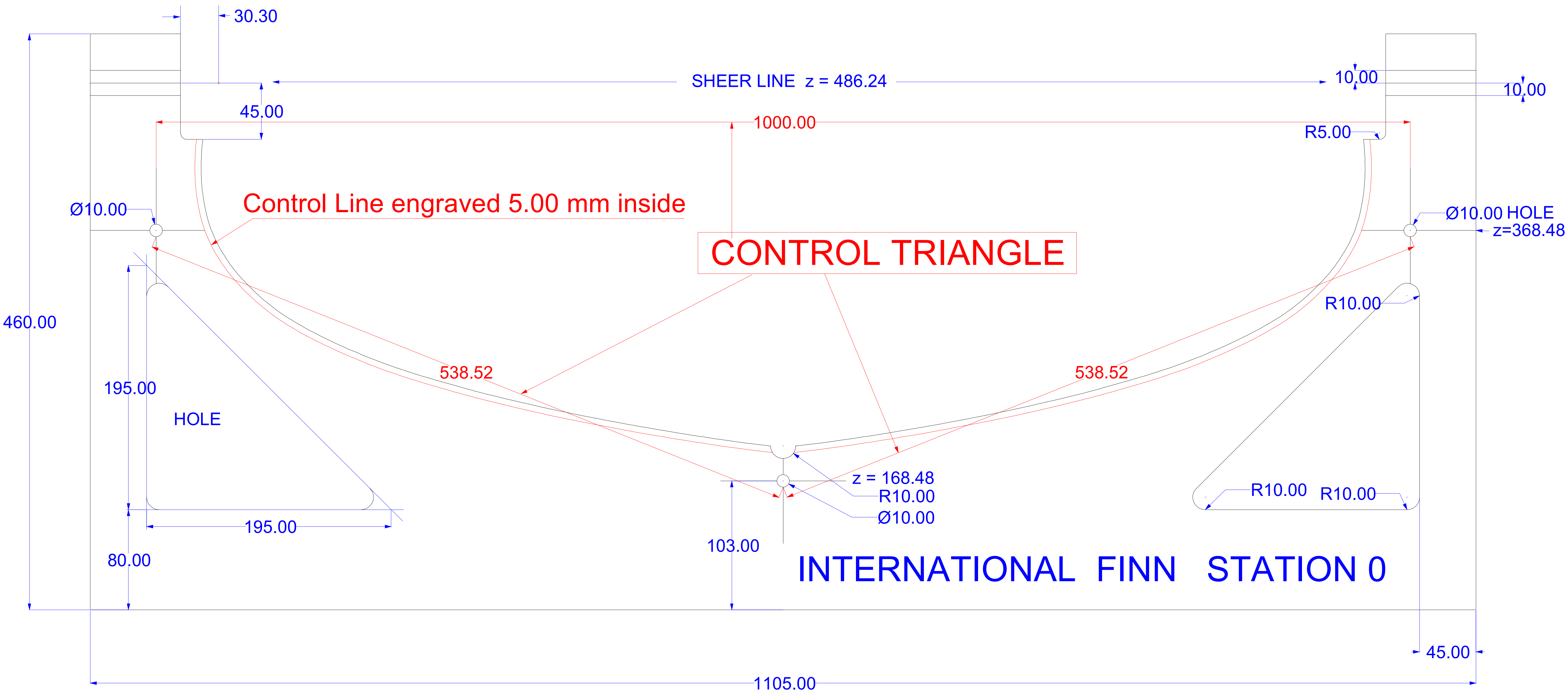
RUDDER TRAILING EDGE

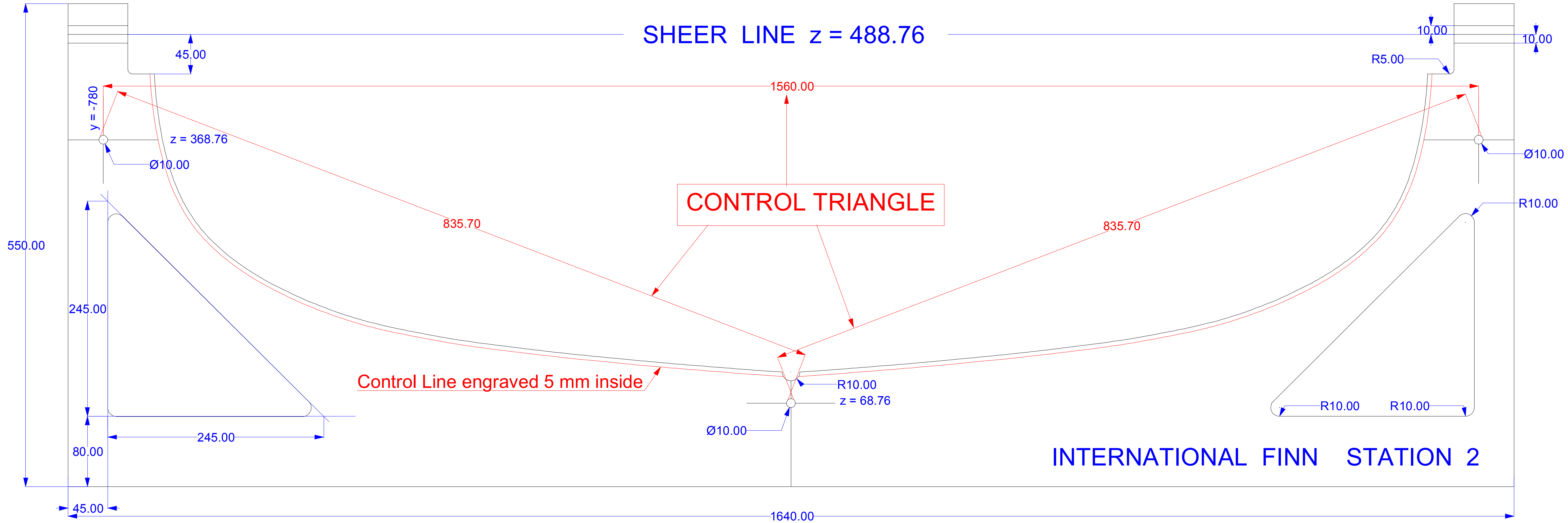
n°	ξ	ζ	n°	ξ	ζ	n°	ξ	ζ	n°	ξ	ζ
1	**134,300**	**0,000**	26	364,240	511,900	51	429,980	769,530	76	402,870	883,690
2	155,000	42,749	27	369,790	527,300	52	430,300	775,910	77	400,460	886,900
3	171,740	77,380	28	**375,200**	**542,750**	53	430,450	781,840	78	398,200	889,910
4	188,430	112,030	29	378,660	552,900	54	430,450	787,440	79	**395,500**	**892,750**
5	**203,100**	**142,750**	30	382,060	563,080	55	**430,300**	**792,750**	80	392,740	895,700
6	213,040	163,700	31	386,880	577,900	56	430,090	797,150	81	389,910	898,570
7	222,940	184,670	32	**391,600**	**592,750**	57	429,830	801,550	82	386,930	901,400
8	237,390	215,510	33	396,120	607,210	58	429,350	807,770	83	384,110	903,890
9	**250,000**	**242,750**	34	400,270	620,800	59	428,770	813,440	84	381,370	906,100
10	261,790	268,480	35	403,680	632,360	60	428,080	818,710	85	378,700	908,070
11	**273,500**	**294,250**	36	**406,600**	**642,750**	61	427,300	823,640	86	376,070	909,830
12	284,840	319,530	37	409,500	653,480	62	426,400	828,310	87	373,470	911,380
13	**295,100**	**342,750**	38	412,320	664,240	63	**425,400**	**832,750**	88	**370,900**	**912,750**
14	302,410	359,460	39	414,890	674,570	64	424,330	836,980	89	369,050	913,640
15	309,650	376,200	40	417,090	683,980	65	423,160	841,190	90	367,190	914,480
16	**316,700**	**392,750**	41	**419,000**	**692,750**	66	421,680	846,040	91	364,330	915,630
17	320,200	401,110	42	420,830	701,710	67	420,140	850,580	92	361,410	916,670
18	323,660	409,470	43	422,570	710,680	68	418,540	854,860	93	358,410	917,590
19	330,460	426,100	44	424,180	719,630	69	416,860	858,910	94	355,370	918,380
20	**337,200**	**442,750**	45	425,510	727,840	70	**415,100**	**862,750**	95	352,290	919,040
21	342,060	454,760	46	426,610	735,500	71	413,660	865,680	96	349,190	919,580
22	346,910	466,770	47	**427,500**	**742,750**	72	412,170	868,570	97	346,060	919,980
23	352,490	480,820	48	428,150	748,690	73	409,880	872,750	98	342,900	920,270
24	**357,100**	**492,750**	49	428,770	754,630	74	407,580	876,640	99	339,710	920,440
25	360,700	502,320	50	429,480	762,540	75	405,240	880,280	100	**336,500**	**920,500**

RUDDER LEADING EDGE

n°	ξ	ζ	n°	ξ	ζ	n°	ξ	ζ	n°	ξ	ζ
101	**0,000**	**0,000**	125	**22,800**	**592,800**	149	104,610	760,650	173	242,220	885,590
102	**0,000**	**343,000**	126	24,050	597,310	150	109,820	767,800	174	248,460	889,230
103	0,064	361,880	127	25,343	601,800	151	114,910	774,520	175	**254,500**	**892,600**
104	0,138	379,450	128	27,891	610,220	152	119,900	780,870	176	261,170	896,210
105	**0,300**	**393,100**	129	30,570	618,520	153	124,820	786,880	177	267,860	899,750
106	0,534	406,290	130	33,384	626,720	154	**129,700**	**792,600**	178	273,770	902,750
107	0,830	419,470	131	36,325	634,810	155	134,740	798,290	179	279,030	905,280
108	1,222	431,980	132	**39,400**	**642,800**	156	139,880	803,890	180	283,890	907,450
109	**1,700**	**443,000**	133	42,226	649,760	157	145,610	809,910	181	288,460	909,340
110	2,151	451,580	134	45,173	656,660	158	151,430	815,790	182	292,820	910,980
111	2,655	460,160	135	48,440	663,970	159	157,330	821,530	183	**297,000**	**912,400**
112	3,463	472,020	136	51,825	671,230	160	163,320	827,130	184	300,610	913,550
113	4,340	482,840	137	55,320	678,430	161	**169,400**	**832,600**	185	304,220	914,670
114	**5,300**	**492,900**	138	58,914	685,590	162	173,610	836,260	186	309,620	916,250
115	6,444	503,470	139	**62,600**	**692,700**	163	177,870	839,850	187	314,320	917,490
116	7,711	514,030	140	65,197	697,590	164	183,680	844,580	188	318,580	918,470
117	9,073	524,200	141	67,839	702,450	165	189,560	849,210	189	322,540	919,230
118	10,499	533,750	142	72,502	710,760	166	195,510	853,750	190	326,280	919,800
119	**12,000**	**542,800**	143	77,274	718,940	167	201,530	858,210	191	329,830	920,200
120	13,505	551,190	144	82,145	726,970	168	**207,600**	**862,600**	192	333,240	920,430
121	15,103	559,550	145	87,119	734,880	169	214,650	867,590	193	**336,500**	**920,500**
122	16,979	568,680	146	**92,200**	**742,650**	170	221,760	872,480			
123	18,875	577,190	147	95,686	747,840	171	228,960	877,270			
124	20,811	585,200	148	99,217	752,990	172	235,750	881,620			

III,3 Templates dimensioned sketches

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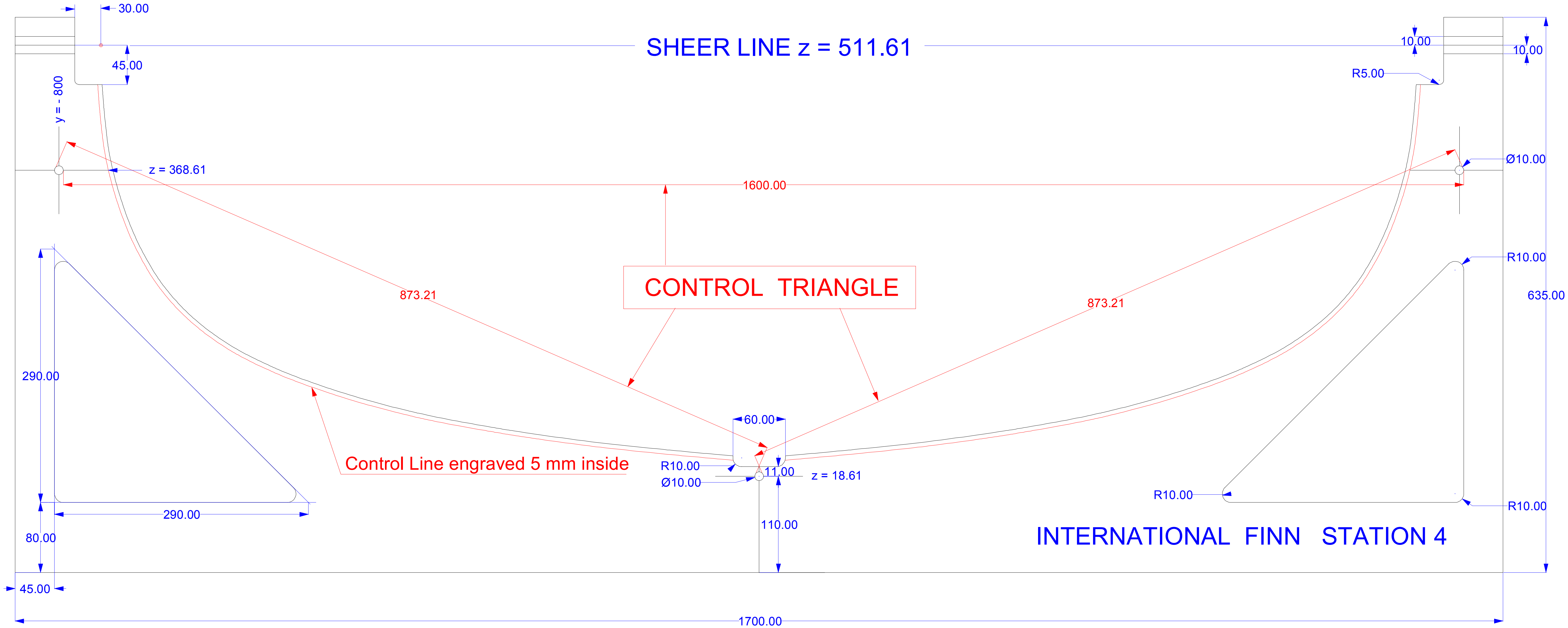
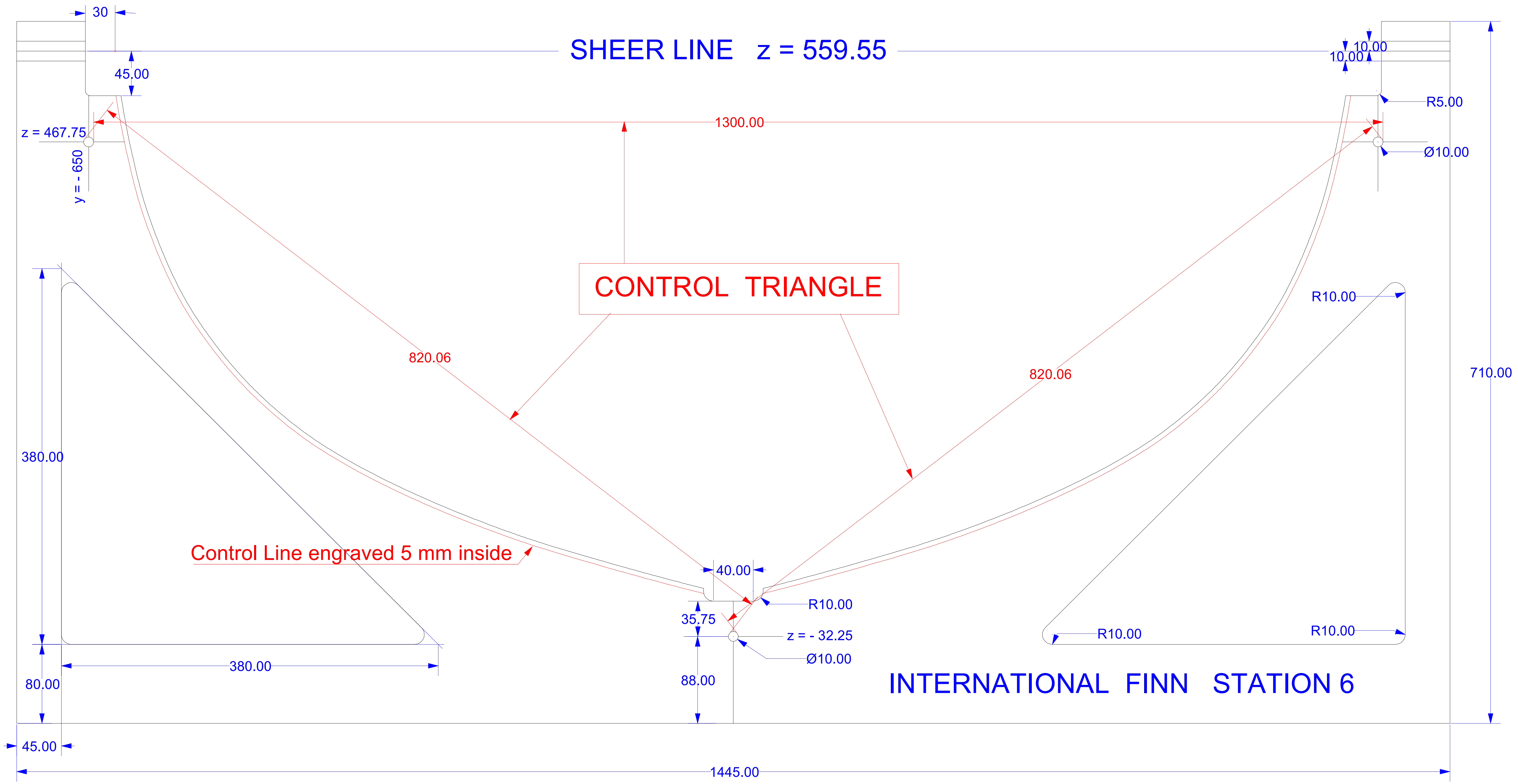
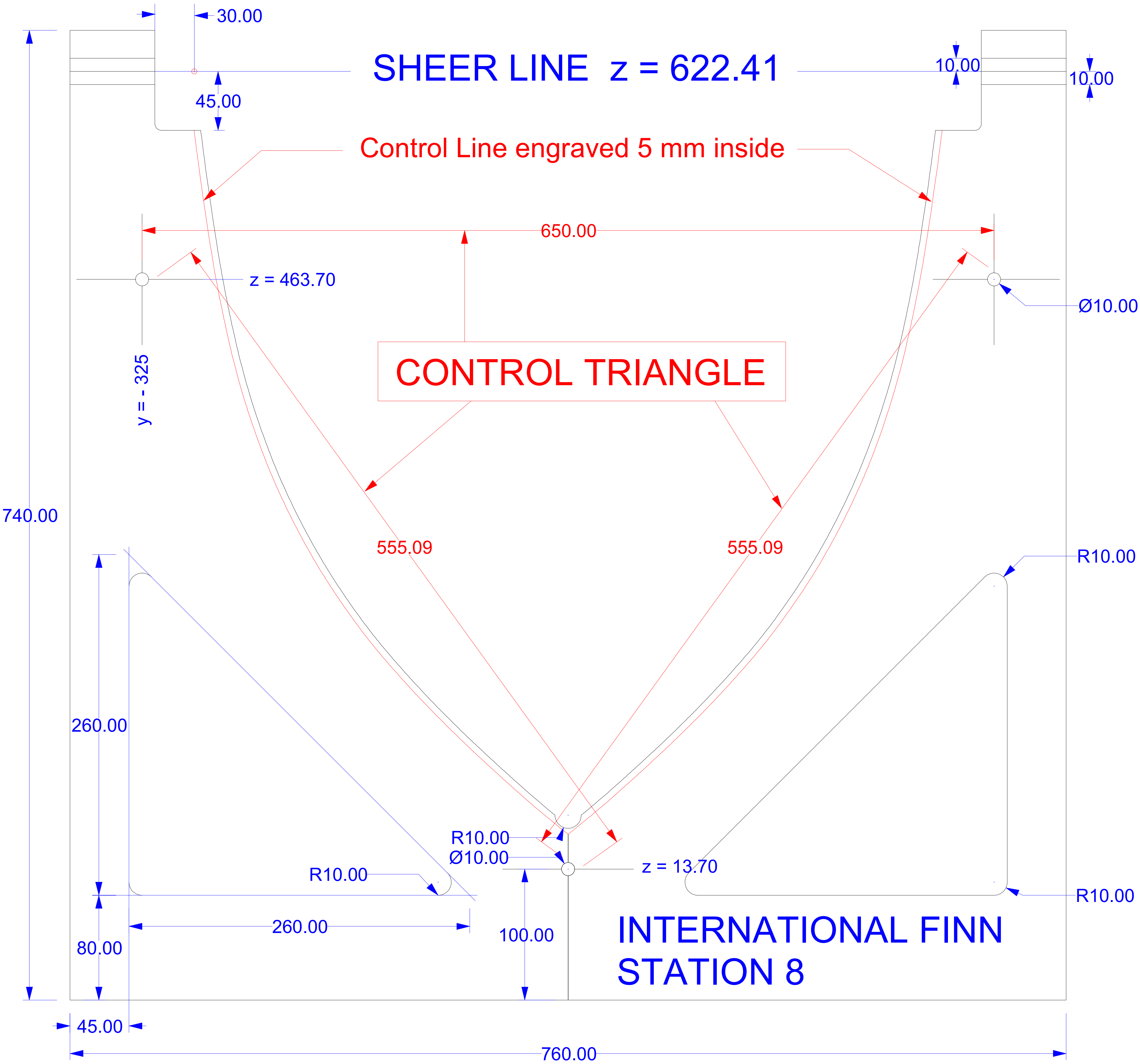
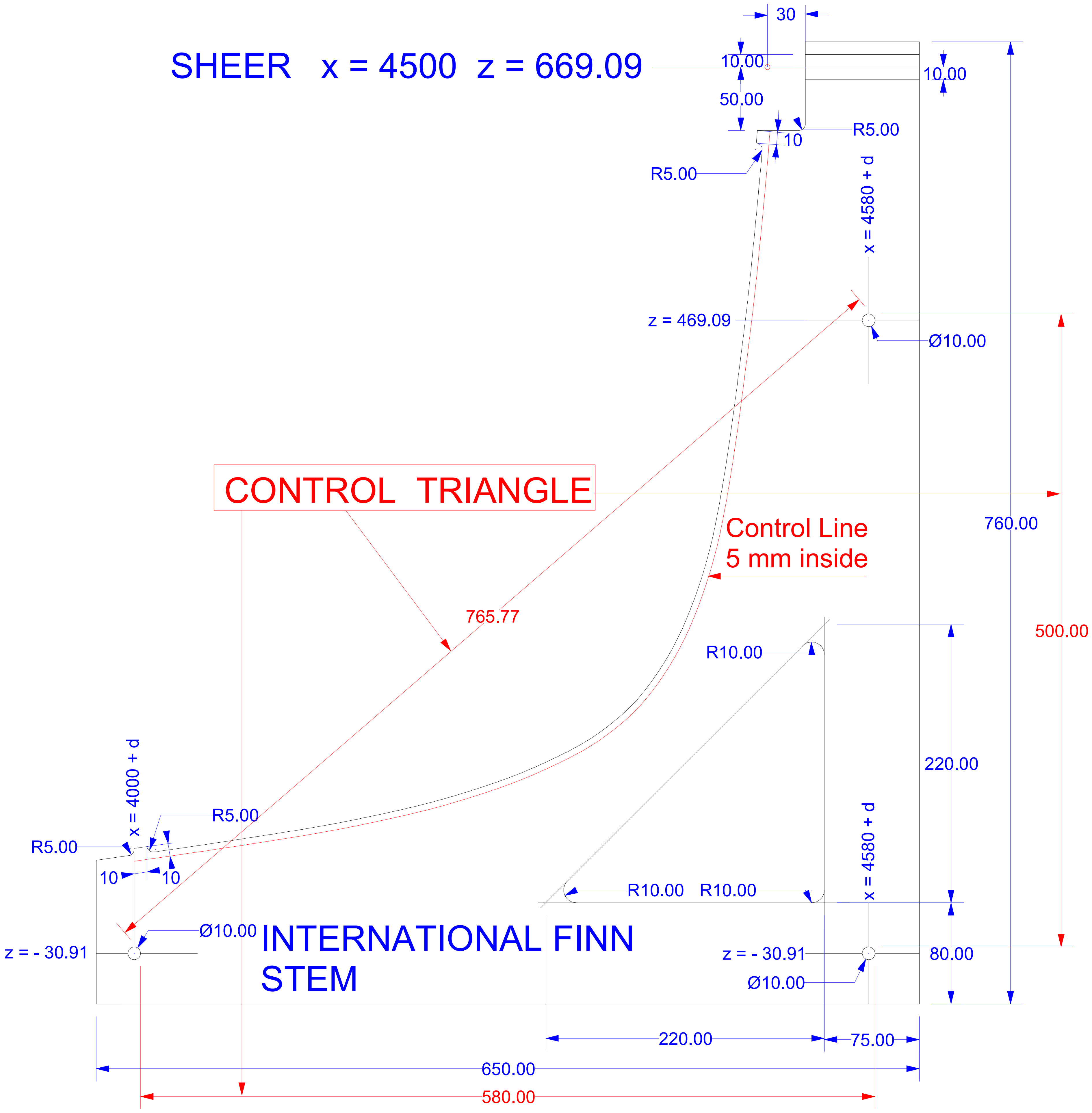
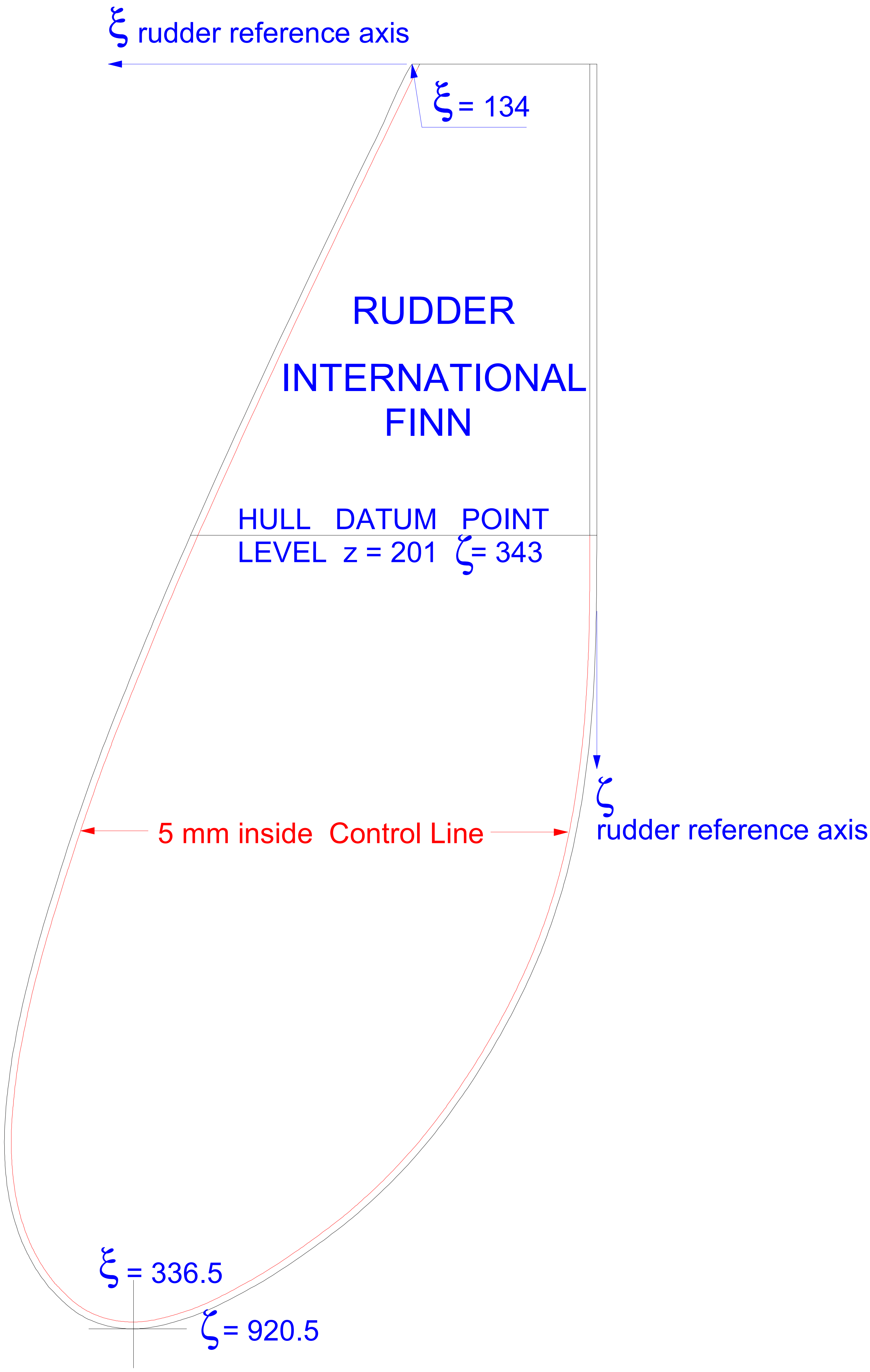
10.00
10.00
R5.00
1560.00
y = -780
z = 368.76
Ø10.00
Ø10.00
CONTROL TRIANGLE
835.70
835.70
R10.00
550.00
245.00
Control Line engraved 5 mm inside
R10.00
z = 68.76
Ø10.00
R10.00
R10.00
80.00
245.00
INTERNATIONAL FINN STATION 2
45.00
1640.00


30.00
SHEER LINE z = 511.61
10.00
10.00
45.00
R5.00
y = - 800
z = 368.61
Ø10.00
1600.00
R10.00
CONTROL TRIANGLE
873.21
873.21
635.00
290.00
60.00
Control Line engraved 5 mm inside
R10.00
11.00
Ø10.00
z = 18.61
R10.00
R10.00
290.00
110.00
80.00
INTERNATIONAL FINN STATION 4
45.00
1700.00


30
SHEER LINE z = 559.55
45.00
10.00
10.00
R5.00
z = 467.75
1300.00
Ø10.00
y = - 650
CONTROL TRIANGLE
R10.00
820.06
820.06
710.00
380.00
Control Line engraved 5 mm inside
40.00
R10.00
35.75
z = - 32.25
R10.00
R10.00
Ø10.00
380.00
88.00
80.00
INTERNATIONAL FINN STATION 6
45.00
1445.00


30.00
SHEER LINE z = 622.41
10.00
10.00
45.00
Control Line engraved 5 mm inside
650.00
z = 463.70
Ø10.00
y = - 325
CONTROL TRIANGLE
740.00
555.09
555.09
R10.00
260.00
R10.00
Ø10.00
R10.00
z = 13.70
R10.00
260.00
100.00
80.00
INTERNATIONAL FINN
STATION 8
45.00
760.00


SHEER x = 4500 z = 669.09
30
10.00
10.00
50.00
R5.00
10
R5.00
x = 4580 + d
z = 469.09
Ø10.00
CONTROL TRIANGLE
Control Line
5 mm inside
760.00
765.77
500.00
R10.00
220.00
x = 4000 + d
R5.00
R5.00
10
10
R10.00
R10.00
x = 4580 + d
Ø10.00
INTERNATIONAL FINN
STEM
z = - 30.91
z = - 30.91
80.00
Ø10.00
220.00
75.00
650.00
580.00



ξ rudder reference axis
ξ = 134
RUDDER
INTERNATIONAL
FINN
HULL DATUM POINT
LEVEL z = 201 ζ = 343
ζ
rudder reference axis
5 mm inside Control Line
ξ = 336.5
ζ = 920.5