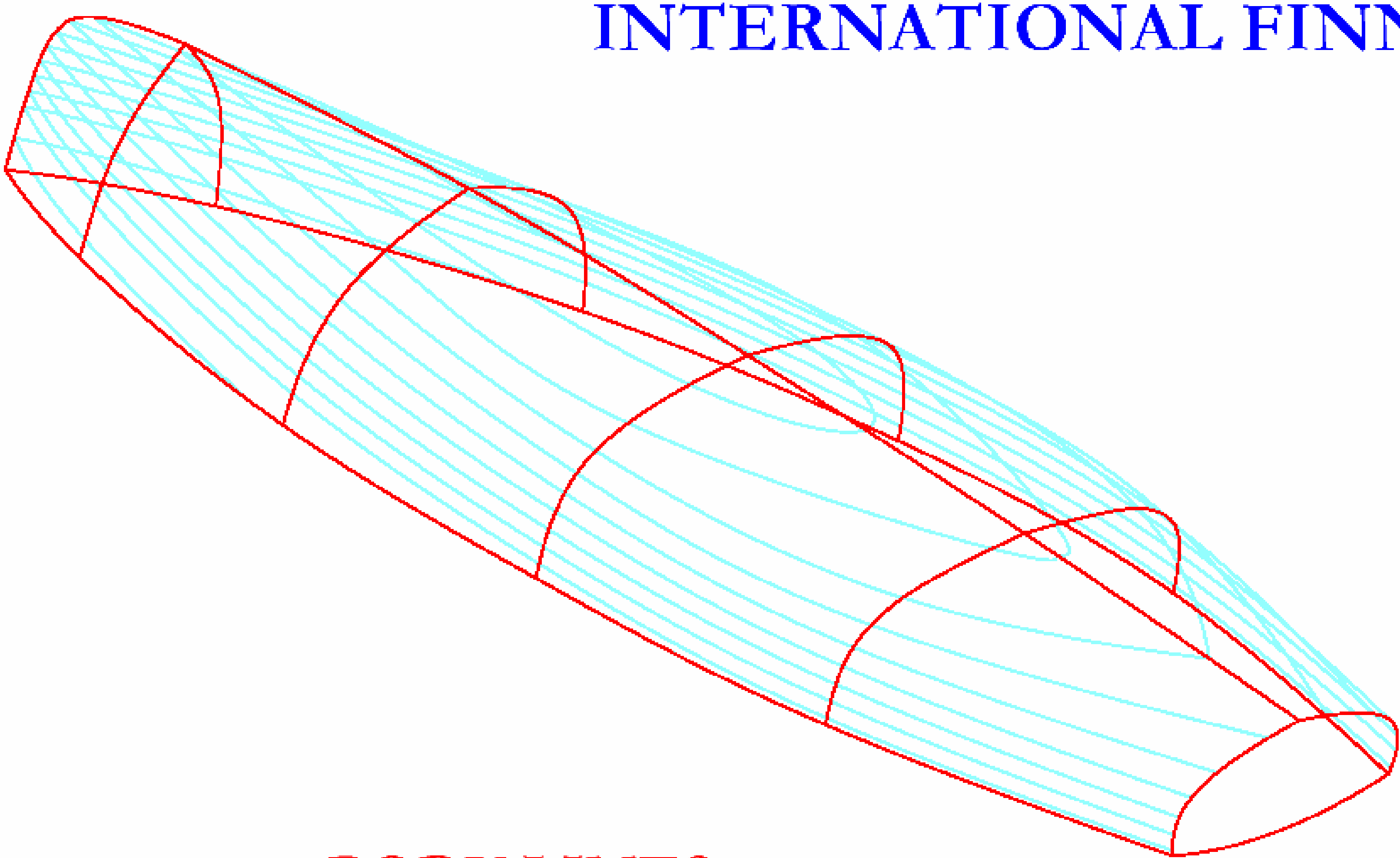
INTERNATIONAL FINN



BODY LINES
DEFINITION and CONTROL

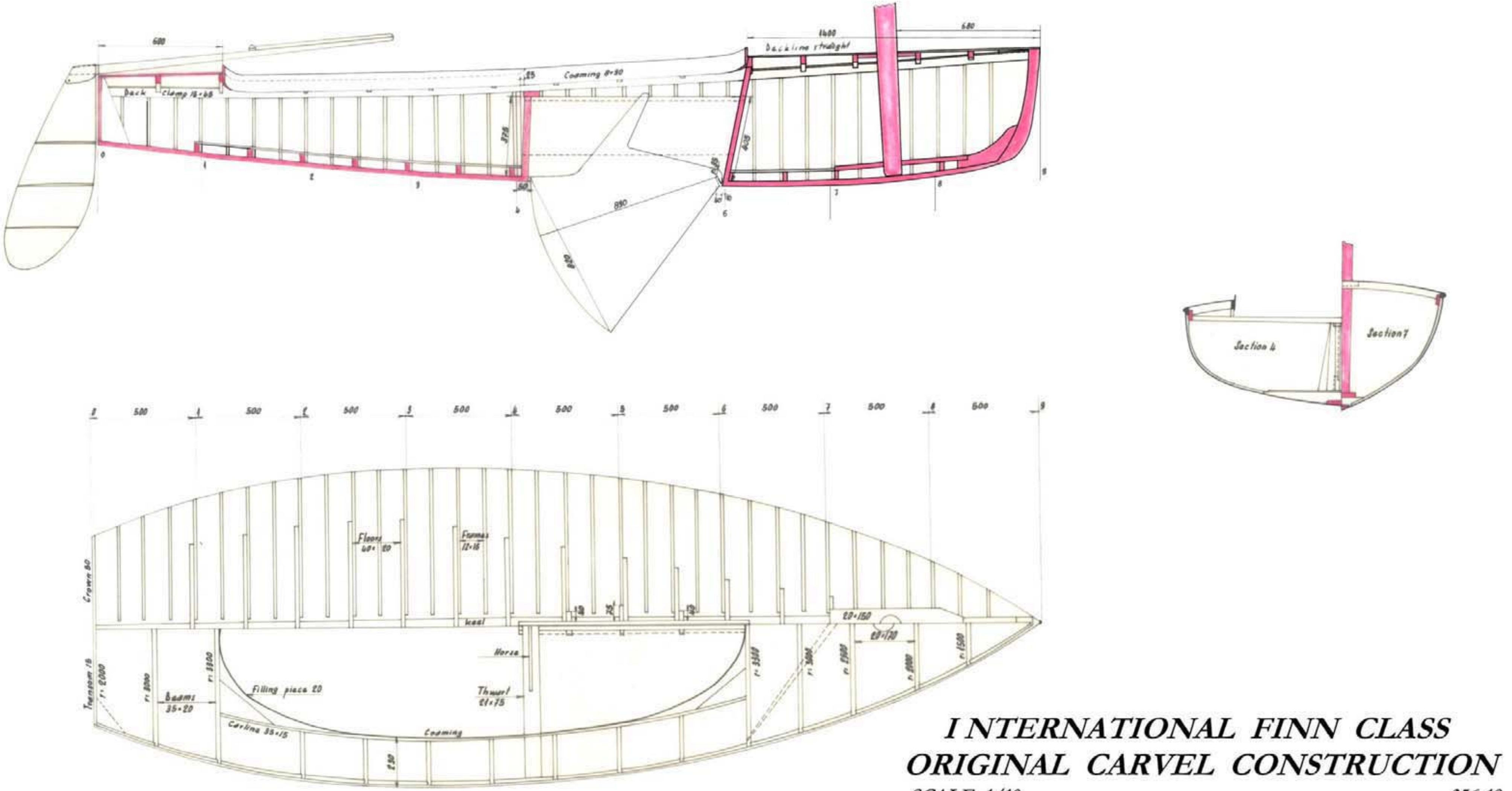
PART I

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

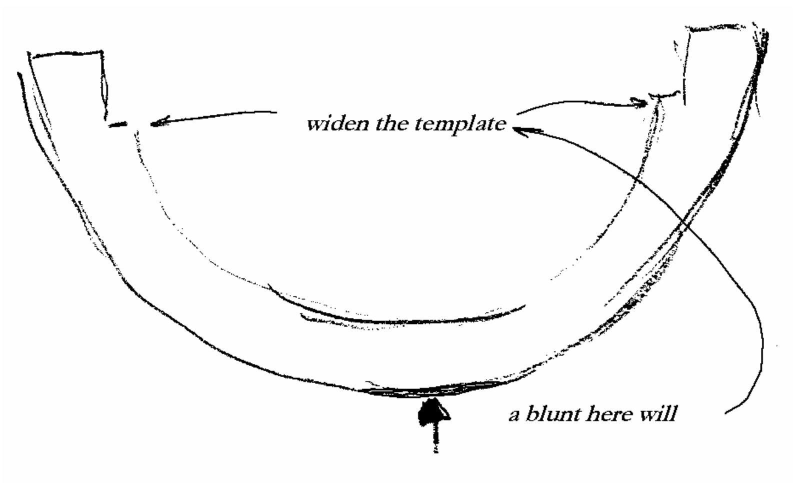
By 1956, IFA had been born and would in its turn bear again the Finn.
Charles Currey, silver medallist at Helsinki, was in charge of building Finns at **Fairey Marine**, one of those times most famous company.
Richard Creagh Osborne who was eager about an actual one design definition of the Finn became 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.

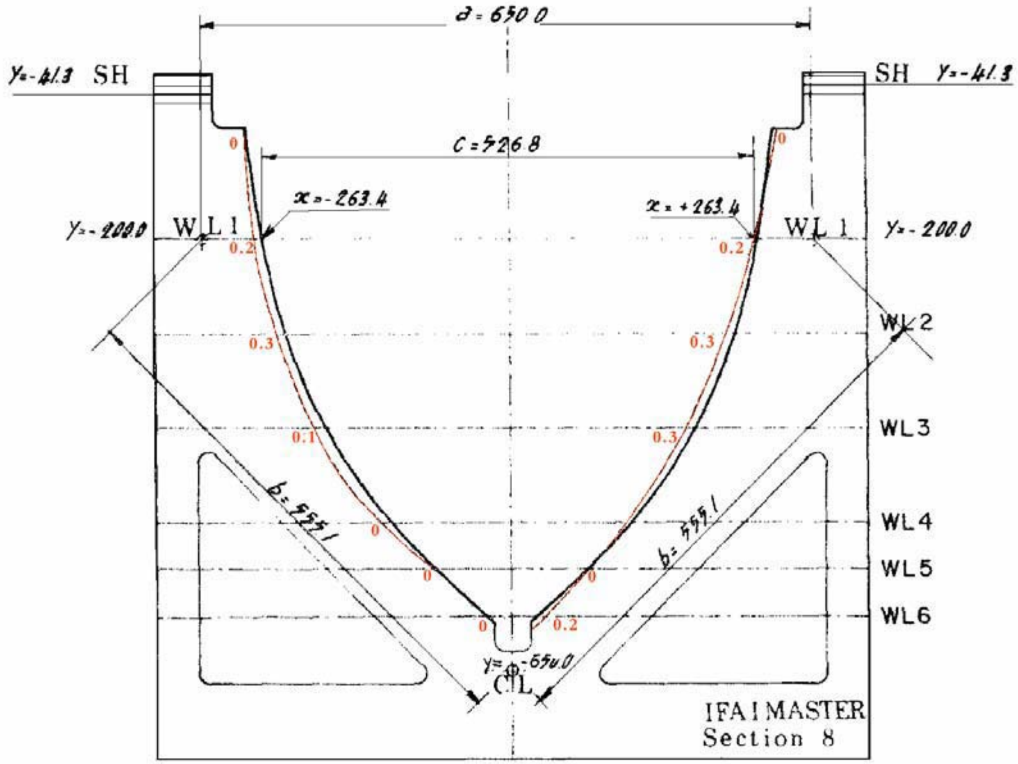
Saved by electronics

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.



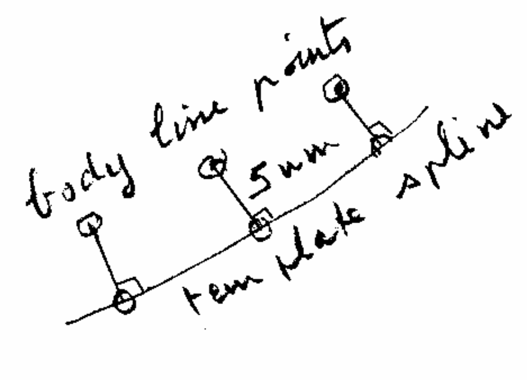
Station 8 template; discrepancies with carving recorded red in mm.

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.



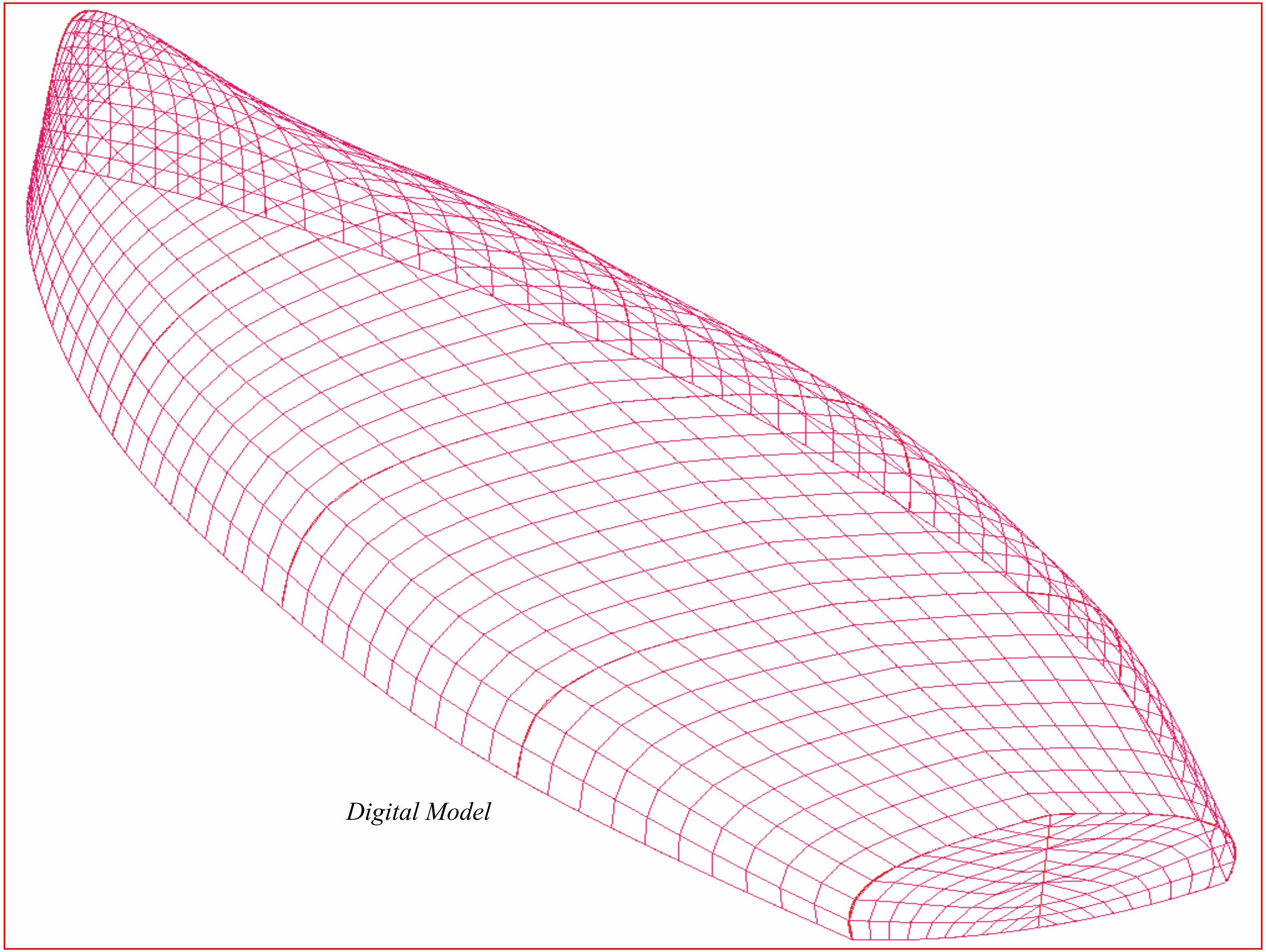
25 years after it should have been done, but with much more powerful tools, I have drawn new "splines" of the templates; then from every point of those splines, I have drawn perpendiculars and recorded points at 5 mm distance so as to draw the quasi perfect original body "splines". Hundreds of points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

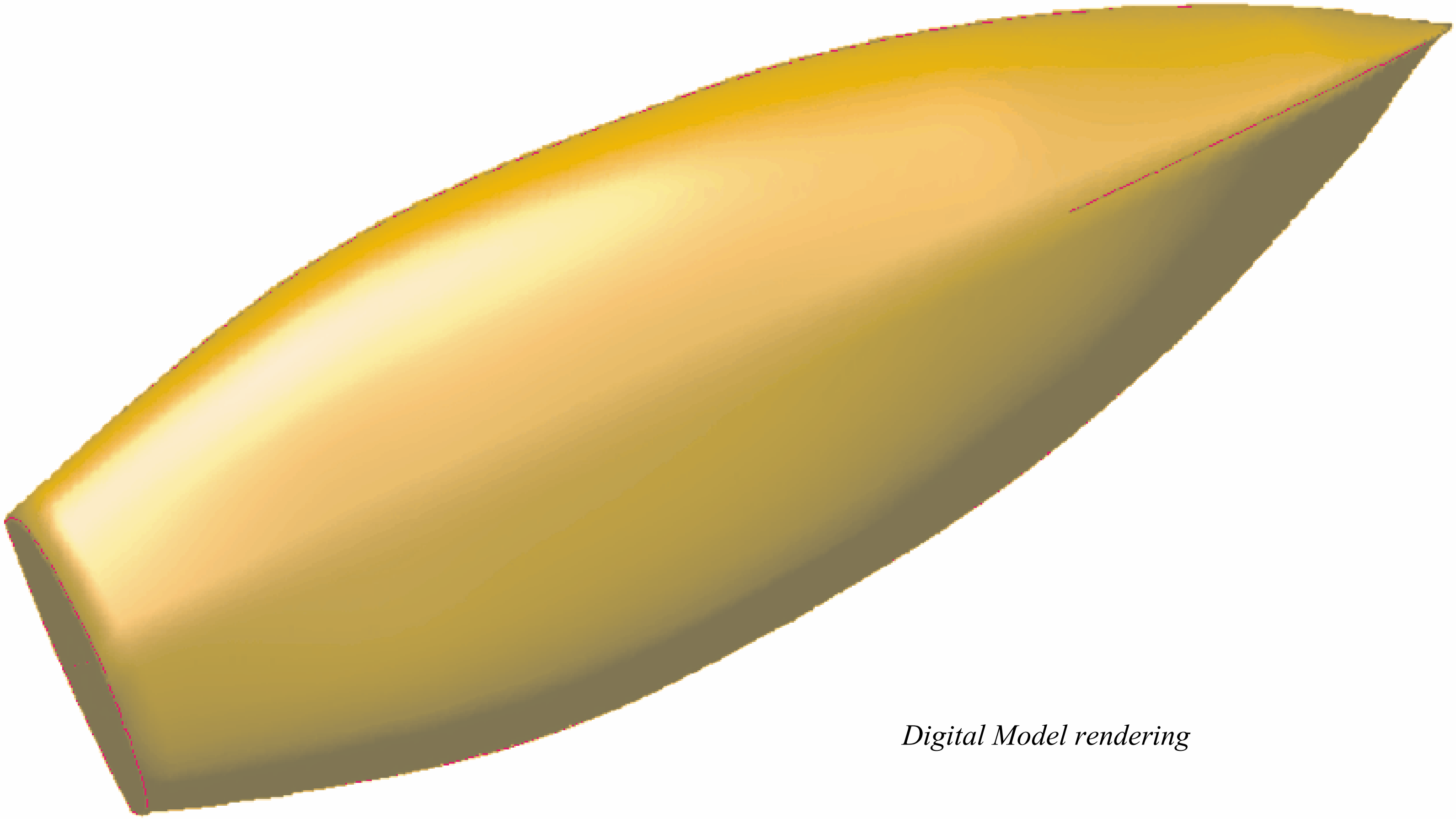
Full size lines have been drawn in vector format on Mylar film with my 15 years old Benson plotter. They have been checked to be all right at Cascais 2003 Gold Cup.
Points of the splines are close enough to allow drawing straight segments of lines from point to point, without letting appear significant 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

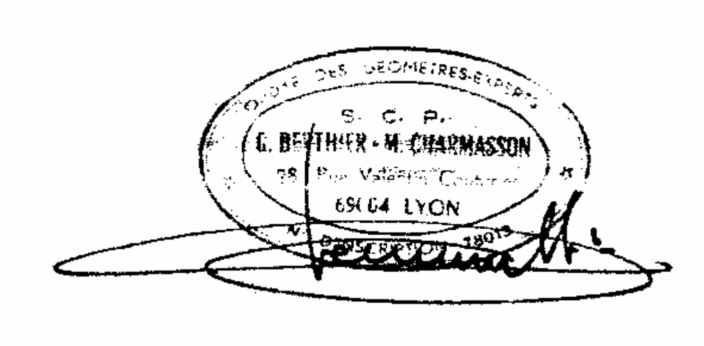
- Difficulty of a hand carving and unevenness of the lines,
- Straight lines of the canvas not being absolutely parallel or perpendicular,
- Difficulty of measuring so many coordinates; indeed the quasi perfect conformity looks like a miracle.

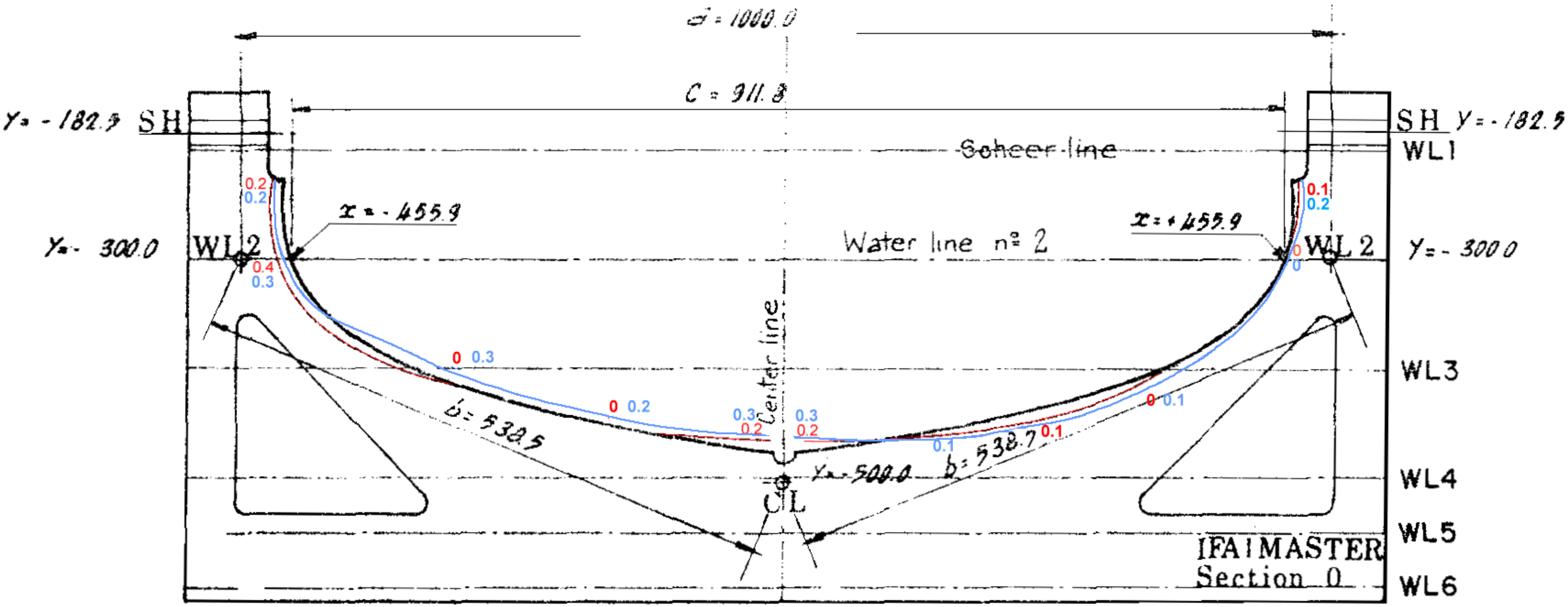
<u>TESTING CERTIFICATE OF TEMPLATES</u>

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 :

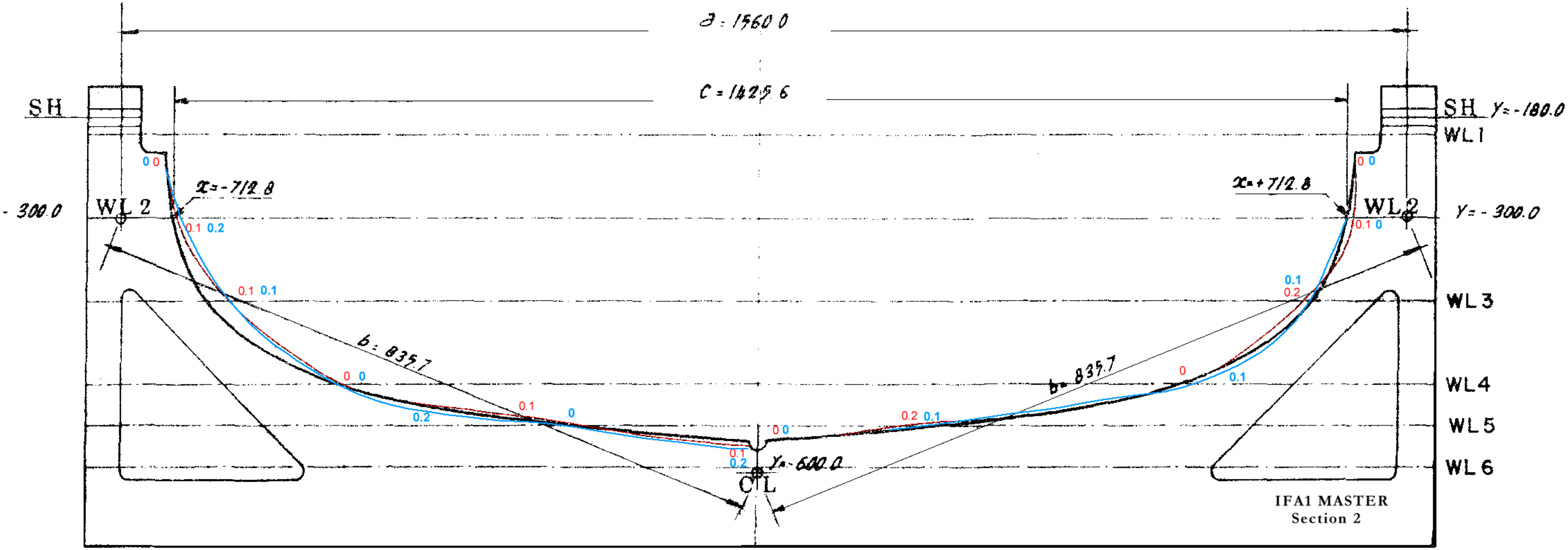
Marc Charmasson





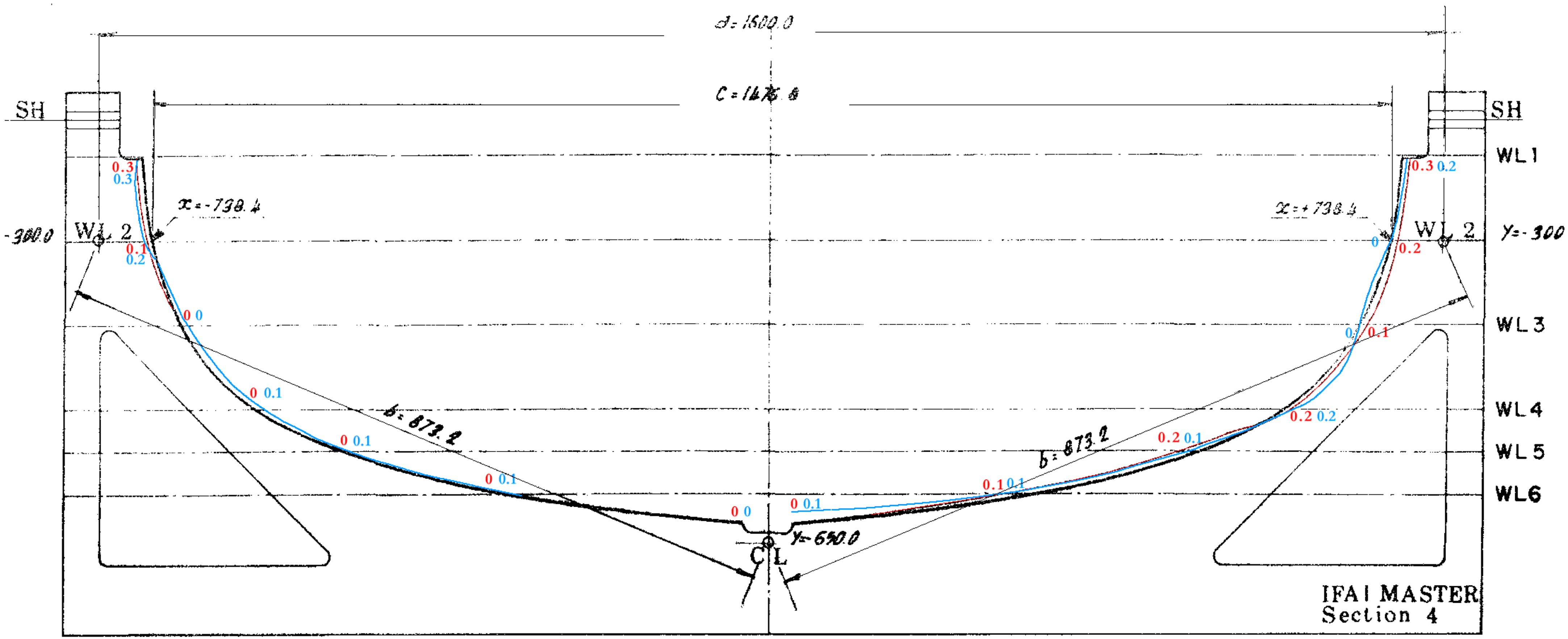
d = 1000.0
C = 911.8
Y = - 182.9 SH
SH Y = - 182.9
Scheer line
WL1
x = - 455.9
x = + 455.9
Y = - 300.0 WL2
Water line n° 2
WL 2 Y = - 300.0
Center line
WL3
b = 538.5
b = 538.7
Y = - 500.0
C L
WL4
WL5
IFA MASTER
Section 0
WL6

STATION 0

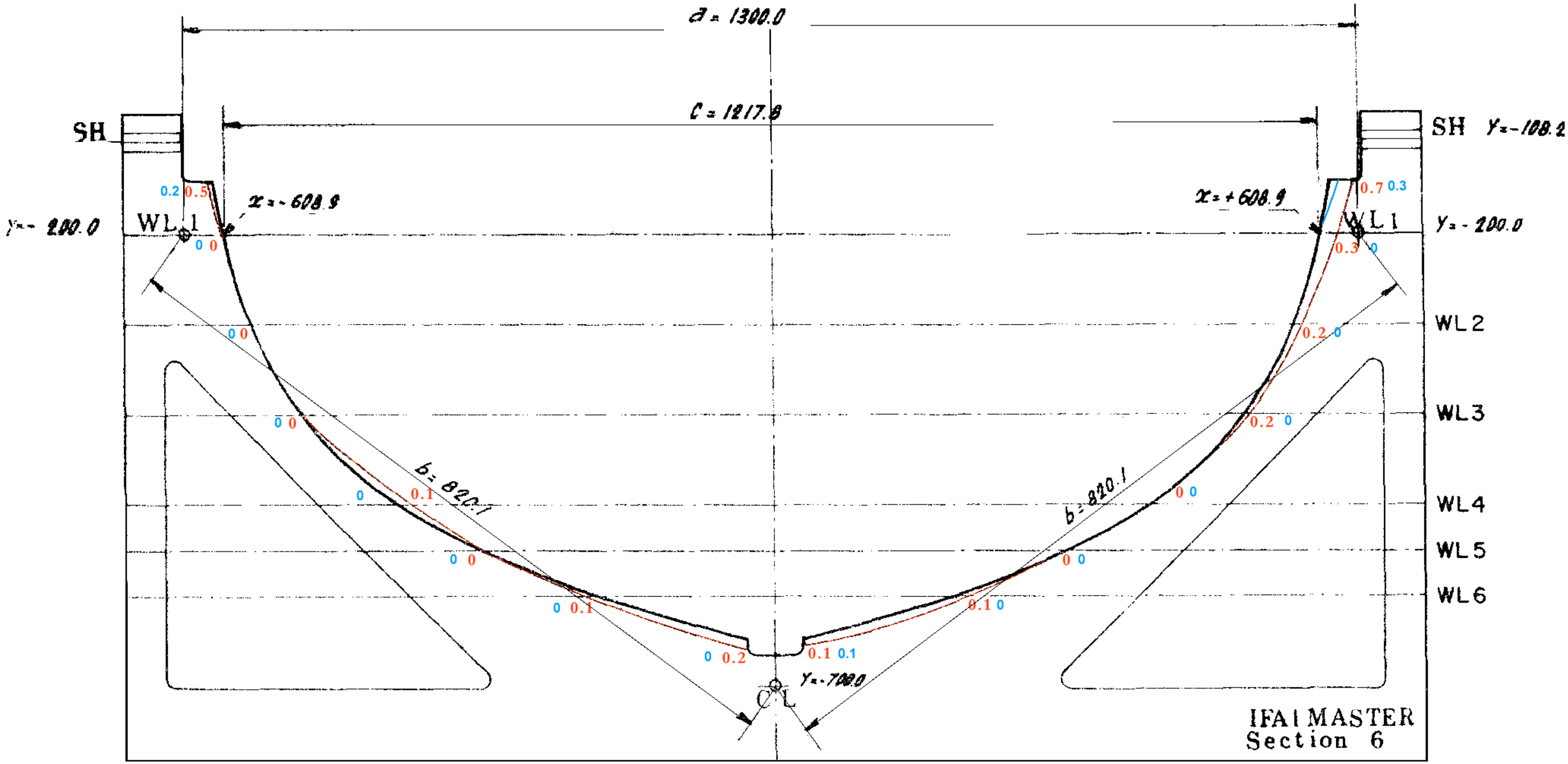


a = 1560.0
C = 1425.6
SH
SH
Y = -180.0
WL1
WL 2
WL 2
- 300.0
Y = - 300.0
x = -712.8
x = +712.8
WL 3
WL 4
WL 5
WL 6
b = 835.7
b = 835.7
Y = -600.0
C L
IFA1 MASTER
Section 2

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
IFAI MASTER
Section 4

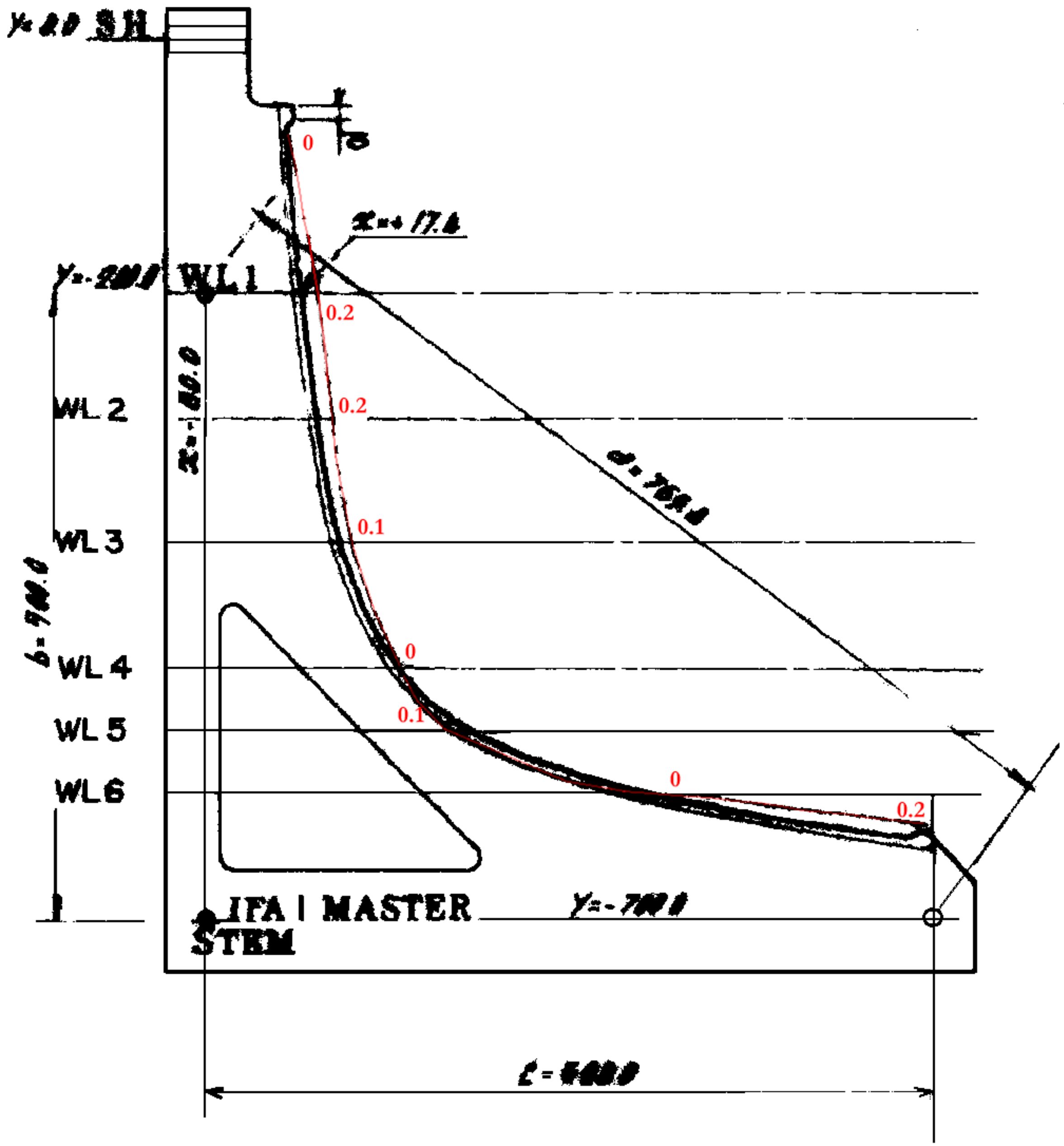
STATION 4



a = 1300.0
C = 1217.8
SH
SH
Y = -108.2
x = -608.9
x = +608.9
Y = -200.0
Y = -200.0
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 .