WG141 RECOMMENDATIONS ON DESIGN OF INLAND WATERWAYS
APPLICATION TO BRAY NOGENT PROJECT

by

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One of the important results of WG141 was a table showing the recommended dimensions of waterways compared to the width of the boat (see Table 1).

For the decision-makers willing to understand what they sign, for the Boeotian, or for an engineer faced with a waterway design for the first time, this table is of great interest, yet they lack understanding on how to choose one value rather than the other, and why/how these figures were arrived at.

There are factors of utmost importance, and to be answered before starting to calculate.

First, what is the Design boat, its width, draught, length and vertical “draught”. Most of the rest is based on this design boat. (But to fix the Design boat, you may need to study the waterway, first, see below).

Second, is it a free-flowing river, an impounded river or a canal? The table to use is different in every case, although the usual reference is the table for canals.

Third, what is the design traffic, calculated in boat/year? Of course the margins of safety are not the same in light or very heavy traffic, but quite often the table is read as if the traffic were 200 Mt/year, while it may be far less than a million.

Fourth, assuming the waterway is a canal, what is its shape? Trapezoidal, rectangular, KRT? For each, the speed obtained by the design boat for the same consumption will be different, up to 30%.

The paper will give insights on how to gauge each factor, leaving intricate details to further, modelling studies.

At times, we know the size of the waterway rather than the size of the boat, and we try to understand what will be the largest Design boat which can be accommodated in it. The same rules apply, turned the other way. The rationale for that will be explained.

It may happen that it is only one bottleneck which will limit or size the Design boat, a bridge or a lock; again, we can use the same references, read in a specific way, weighting the impact of the bottleneck in the global voyage.

In this way, it will be easy for the newcomers to fully make use of the WG141 Report, leaving to the full text of the report to provide all details of the calculations, formulas, modelling process, etc.

To better understand the methodology, one example will be fully described, the process being applied to the Bray-Nogent upgrading project in France, on the Seine River.

The various criteria will be pinpointed, and their relative influence brought to light in 2 tables, one to describe the existing situation, to know where we start from, the other to gauge the extent of improvements and thus the quality of safety & ease to be achieved to reach the objective.

The importance of thinking globally, here also, will be shown, with the inclusion of the Bray-Nogent project into a route from Paris to the head of navigation on the Seine, i.e. Nogent sur Seine. It would be useless to design a waterway without knowing the limits brought about by the neighbouring waterways. Thus the quality of ease will be calculated for other parts of the Seine River, before being done for the project itself.

Another important point is to describe the existing situation on the waterway to be improved, so that weighing all parameters can be fine-tuned to fully reflect the feeling of the pilots. Here, we had to make 3 trials before reaching an adequate figure. Once the weighing is satisfactory, we can examine how to improve the situation to reach the goal set. This is done through another table.

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The type of criteria are arranged in 3 groups, one for criteria linked with the waterway and the crew, the second for those linked to the speed, and the third for those linked to traffic.

Once the final note is obtained, the report provides a table ascribing a category, between A to C, to these notes. Following that, designers should turn to 2 tables (and in French case a third one) that gives the dimensions of the fairway for canals, for rivers (and for impounded rivers in France). The canal table is shown below:

Waterway	Fairway width for alternate single-lane				Fairway width for two-way (approximately also for two-lane, including overtaking manoeuvres)			
	Ease quality			Remarks	Ease quality			Remarks
	C	B	A		C	B	A	
min W_F (straight canal sections)	2·B[1)] *1.9·B*	*2.1·B*	*2.3·B*	For security reasons	3·B[2)] *2.8·B*	*3.5·B*	4·B[3)] *4.5·B*	2.5 B can damage the canal
min n	2.5	3.5	4.5	To keep on speed	3.5	5	7	To keep on speed
min D (over bottom width)	1.3 d			Because of squat & efficiency of bow thrusters	1.3 d		1.4 d	Because of squat & efficiency of bow thrusters
min R (ΔF needed for R ≠ ∞)	4 L	7 L	10 L		4 L	7 L	10 L	
max v_{flow} (longitudinal)	0.5 m/s				0.5 m/s			
max v_{cross} (averaged over L, ΔF needed for $v_{cross} \neq 0$)	0.3 m/s				0.3 m/s			
design v_W (inland) (ΔF needed for empty/ballasted or container vessels at $v_W \neq 0$)	5-6 BF *(8.0 – 13.9 m/s; 10.5 m/s according to Dutch Guidelines)*				5-6 BF *(8.0 – 13.9 m/s; 10.5 m/s according to Dutch Guidelines)*			
design v_W (costal) (ΔF needed for empty/ballasted or container vessels at $v_W \neq 0$)	6-7 BF *(10.8 – 17.2 m/s; 13.5 m/s according to Dutch Guidelines)*				6-7 BF *(10.8 – 17.2 m/s; 13.5 m/s according to Dutch Guidelines)*			

Table 1: Canal dimensions relative to breadth of vessels and ease quality (source: WG141)

From there, the actual dimensions enabling to totally fulfill the designed objective can be calculated, and proposed for implementation.

In case conditions are not clearly gauged, separate studies have to be undertaken, such as on site simulation, modelling, comparative analysis or shiphandling simulations.

WG141 explains all calculations involved in these studies, which are recommended in any case, since their cost is small compared to the investment involved.

Such Detailed Safety & Ease Approach will enable a full confirmation that the goal is achieved, and will give to the decision-makers peace of mind on their decision.