

## **CALCULATION OF PLANNING VELOCITY AND FREE-FLOW SPEED FROM CARTOGRAPHY**

**AUTHOR: VÍCTOR BALBOA CAPARRÓS**  
**TUTOR: AGUSTÍN PEREZ FOGUET**  
**External Tutor: SANTIAGO RIBAS DOMINGO**

### **ABSTRACT**

This Project consists of the programming, calibration and validation of a tool that, starting from cartography, characterizes a route basing on its curvature radiuses, calculates the specific speed for each radius and, finally, calculates the speed of planning for each section, as well as the free-flow speed. This program is applicable as well to roads as to railroads.

Free-flow speed in roads is defined as the average speed at which cars would move if drivers were not influenced by other vehicles (this situation is supposed to be considered when the intensity of equivalent traffic is less than 200 cars/hour). In the case of railroads, the itinerary velocity is always free, except in case of breakdowns or other unforeseen situations.

The programming of this tool is the result of a collaboration grant in the *Departament de Política Territorial i Obres Públiques* (DPTOP), concretely in the *Secretaria per a la Planificació Territorial* (SPT). The developed application is conceived as an utility that will be integrated in a system of territorial planning that is being developed in the SPT: the SIMCAT (Information and Design System for the Evaluation of Territorial Policies in Catalunya).

The real strong point of the developed tool is that, for the first time, a routine of a certain importance for the calculation of itinerary speeds and times has been elaborated. This free-flow speed, once calculated for the whole Catalan net, constitutes very valuable base information for the application of the SIMCAT (or any other similar system of territory management). To be able to make offer analysis, it is fundamental to know the itinerary times; the problem is that the trustworthy methods that currently exist to calculate these values are difficult to carry out correctly and very expensive. In practice, quite vague or even clearly erroneous methods are commonly used.

Calculating free-flow velocity with the developed tool implies evident economical and time saving since it allows us the simultaneous characterization of a great number of routes within seconds (a few minutes at most).

For the calculation of the free-flow speed, the program tries to simulate as precisely as possible the evolution of speed in every point of the route, adapting to its geometry variation, both in plant (curvature radiuses) and in gathering (slopes). The speed, which is determined by the geometry of the route not only in a specific point but in the section to which it belongs, is calculated for every point of the itinerary. To develop the algorithm capable of achieving this calculation, it has been necessary to consider all the factors that can influence the movement of a vehicle.

The process followed by the program to obtain the desired results consists in three big blocks: (1) *Characterization of the cartographic base*; (2) *Calculation of the specific speed depending on the radius*; (3) *Free-flow speed: itinerary time*.

The tool that has been developed interacts with Geographical Information Systems (GIS) obtaining all the cartographic information of the itinerary to be analysed from the GIS. The program is also capable of publishing the obtained results in the GIS as attributes incorporated in the entities that form it. In fact, as soon as the application is registered in the computer, it is possible to generate a new menu in the GIS and to execute the application as one more command.

The developed program has successfully been incorporated to the system SIMCAT. This system is currently being used in the elaboration of the *Pla de Carreteres de Catalunya* (PCC) and will also be used in the elaboration of the *Pla d'Infraestructures Ferroviàries* and the *Plans Territorials (Comarques Centrals, Ponent, Alt Pirineu I Aran)*. The calculated free-flow speed constitutes a trustworthy, homogeneous and consistent indicator for the offer analysis of the SIMCAT. It can also be a valuable tool for the evaluation of different alternatives before a construction project of a new infrastructure.