CADASTRAL MANAGEMENT AND TRIBUTARY OFFICE FULFILMENT OF CADASTRAL CARTOGRAPHY CADASTRAL DATA BASE

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Abstract

It is pretended to analyse the various competences of the Organism that depends on the Economic and Finance Office, concerning the cadastral cartography generation and the obtain of the cadastral data base, considering the first one as a basic substract of the capture, analyse, treatment and maintenance of the second one. All this is the competencial responsability, of performing, updating and permanent support of the Real State Cadastre, as much Rustic as Urbane.

Nowadays even when the Spanish Cadastre conserves their traditionals taxes functions, each time it is strengthen, as in other european countries, their configuration like a Land Information System or Data Base, of big importance for the country, of multipurpose character and open for multiple uses that are demanded, as much different Public Administrations, as to companies or persons.

The R.D. 1725/1993, 1st. october, modifies the organic estructure of the Economic and Financial Office, disposes, of the "Organismo Autónomo Centro de Gestión Catastral y Cooperación Tibutaria", created in 1987 in the General Direction as a Directive Centre directly dependant of the State Secretary of Finance.

This General Direction asume the functions that has been developing the Autonomus Organism that has been the best in some functions, such as:

- Realization of tecnique work of performing update and revision of the Rustic and Urbane Cadastre.
- The management and disposition of the Cadastre data base as an outward public service.

It is obvious that for the fulfilment of the laid out in the first place it is important to dispose and maintenance of an adequate cartographic support as a base of graphic localization and reference of the Rustic and Urbane real state that concern Cadastre.

In a general way it can be said that the Organism in charge of the cadastral works, used differente cartography, sometimes performed by ourselves and other performed by Oficial Organism, but essentialy by the National Geographic Institute.

Nowadays, the R.D. 585/1989 26th. May, developed the Act 7/1986, of Cartography Standing Order of Cadastral Cartography, it explains clearly and in this way, the following:

"The cadastral cartograhpy is the graphic documentation that defines, among others characteristics that they are considered relevant, the shape, dimentions and situation of the different parcels of land that are part of the National Territory, without mattering their use or activity they were destined, constitute the graphic support of Cadastre".

"It is competence of the Economic and Financial Office, through the "Centro de Gestión Catastral y Cooperación Tributaria", the production and mainteinance of the cartography cadastral needed for the performance, updating and revision of the Cadastre".

Briefly fixed among the basic objectives of the "Centro de Gestión Catastral y Cooperación Tributaria", the revision and update of the Real State Cadastres -with the essential generation of the cartography cadastral inside the compass of competences- and the management and disponibility of the cadastral data base, both subjects are treated separatly: cartography and data base, according to their peculiarities, in the Rustics and Urbanes Cadastres.

1. Rustic Cadastre

If it was at the start of the 80th decade when it starts the important process or update of the Spanish Cadastre, really it was not until 1987 when this process had an important and increasing rythem of ejecution.

In this date it coincided three classes of cartography as a substract of the types of cadastre coexistences:

a) **Cadastral Advance,** with parcel of land cartography of little or none metrical validity at parcel level, but it has cadastral polygon and township boundary, whose perimetral lines were obtained topographically.

b) **Topographic-parcel Cadastre,** parcel plans are obtained by classical topography, at a scale 1:2.000 generally by the Nacional Geographic Institute.

c) **Photographic Cadastre,** it is based on the rapid development of the aerial photography, the parcels boundaries are delimited at field.

1.1 Ortophotography

In the late 1987 it was decided to substitute three types of cartography to one that has fast achievement and enough metrical validity without losing the visual richness of the aerial photography, it was very useful for the countryside work, to identify boundaries, cultivation areas, etc. It was decided for the orthophotos generation, in a uniform proyect of national reach and adapted to the peculiarities of the spanish countryside, of hilly and variable orography, but in general, it has a high class parcelation, mostly in the North Zones of Spain.

The principal fases of obtain orthophotos and their afterwards usefulness on the Rustic Cadastre update are as follows:

1. Photogrametric flight (Scale 1:20.000 or 1:15.000).

2. Ground control.

3. Aereotriangulation.

4. Terrain profiles.

5. Orthoprojection.

6. Orthophotos edition.

7. Parcel identification.

8. Drawing cadastral map.

9. Orthophoto digitising. Automatic plotter.

10. Graphic and literal information.

11. S.I.G.S.A. (Cadastral Geographic Information System).

The principal features of the flight are:

. Scale 1:20.000 or 1:15.000.

. Direction E-W.

. Coincidence of the flight line axis with the division in six strips of the topographical map 1:50.000.

. Overlapping:
end lap 90%
side lap 35%

. Flight axis displacement < 1/4 side lap.

. Metric camara of high resolution with image displacement correction.

This documents were handed over:

. Croquis of the bands flight strip topographic map 1:50.000.

. Copy of the topographic map 1:50.000 with photograms centre (every 10 photograms).

. Croquis of photograms with drawings of photograms and numeration.

. Original negatives of the flight arranged by strips.

. Positive collection photograms.

. Copy of the last certificate of camara calibration.

With regard to the **photogrametric control points** there are some considerations:

. Obligatory process.

. Forbiden to use control-points of other flights.

. Utilization of the coordinates U.T.M. of the new Third Order Geodetic Network.

. Method to obtain the control-point:

. Triangulation
. Traversing
. Trilateration
. Polar
. Global positioning system by satellite (GPS)

. Planimetric accuracy 0'40 cm.

. Altimetric accuracy 0'40 cm.

The **profile** of the photogrametric models are distinguised by:

. Has to be performed in analytical plotter.

. The profiles are made in the direction Y-UTM.

. The maximum distance between profiles is of 40 m.

. The maximum distances between points will be of 40 m.

. The distances can be minor according to the orography.

. The maximum planimetric errors can be of 1 m.

. The maximum altimetric errors can be of 0'90 m.

. A magnetic tape will be handed over with the profiles.

In relation to the **orthoprojection**, the process can be resumed in this way:

. An orthoprojector Ortocomp Z-2 (Zeiss) will be used.

. With a diapositive and from the profile we obtain a orthonegative in scale 1:5.000 that has aerotriangulation points, with U.T.M. crosses every 500 m., indicating also with crosses the corner of the ortophoto and putting in the margin the number of the ortophoto. The orthonegative has to be done with the adequate film and it has to be developed in a continous processing equipment.

. The width of the slit has to be of 8 mm. as a maximum.

The last **edition** must perform the following requirements:

. The realization of a mask in the negative with this information:

. Marginal expression of the coordinates UTM every 500 m.

. Information of the situation on a plan 1:200.000.

. Situation of the township district.

. Coordinates and numbering of the corner of the orthophotos.

. Coordination and numbering of the control points.

. Name of the company.

. Date of the flight.

. Magnetic decline.

. Meridien convergence.

. Number of orthophoto.

The **material that has to be handed** over from the contracted company:

. Original orthonegative in 1:5.000 set in a mask.

. Orthophoto in photographic paper type R.C., scale 1:5.000.

. Orthophoto in scale 1:5.000 in polyester screened.

. Orthophotos copies on paper.

The project described, of national range, of orthophotos production, as a cartographic base for the renovation of the Rustic Cadastre, is very advanced, an extent of aproximatly 31 millions of hectars equivalent to nearly 70% of the whole spanish territory has been produced; in a digital support there are 13 millions of hectars. It is looked forward to finish the project in three years time.

1.2 The Rustic Cadastral data base

In a brief way it can be said that it is the most important in Spain, not only because of the volume of its data (hundred millions) but also because of the information contained about the distribution of property in number of their owners, surface and parcelation, types and quality of the different cultures areas and its relative and absolute importance.

All this, joined to the cartographic support that is used so frecuently and the growth in the arrangement of the territory, planification or transformation of the farmingland, development of the Political Agricultural Common (PAC), etc. ... permits to be estimated as essential utility, with the obligation engagement of their permanent utility and update.

2. Urbane Cadastre

In this pages we try to clarify the fases and to get deeply inside this process of topographic and mathematics instruments that permit to analyse the metric conditions of the cartographies as the update, symbols, etc. ...

Althoug this process can be used for all types of Cartography, we are going to relate it to the Urbane Cartographic Cadastre, scales 1:5.000 and 1:1.000 that are the surfaces of villages, being this a INVENTATORY that is valuable not only for the tributary area but for other plans of management and urban planification.

Metric Analyse Purpose (AM)

The aim of the Metric analyse consists in knowing the geometric parameters of a determinate cartography, consider if it is needed do without it, and it is made numerically in all their phases, or you can consider mathematically when you do the cartographic digitizing, needed for its incorporation in the Geographic and Cadastral Information System (SIGCA).

2.1 Cadastre and actual state of the Metric Analyse Project

Nowdays the spanish Cadastre develops a tax function other as their homologue to have a multipurpose Cadastre.

Its aim is to dispose of an actual and bigger amount of information about the ubication, how and what are the value of the real property and the land of all the country. Evidently with this aims you can have a lot of information that can be used for other purposes such as: market studies, politic decisions of national, regional or province character, Geographic Information System, planning, etc.

The A.M. project fits into 1989 Plan by the "Subdirección General Urbana" of the Cadastral Management and Tributary Office. This acts on top of the cartographic patrimony that exist in all the Territorial Management. The surface projected for a plan of six years was **400.000 Has.** The extent was the surface covering all the **municipalities over 200 Has.**

Until now (March 1995) **423.366 Has.** has been contracted, so their is an analysed land of 440.752 Has., because in some cases you analyse the whole group (centre + subsidiary) and also the same zones separatly. The **total Urbane centres analysed are of 1.030.** And **31.337 Has. are going to be done in 153 urbane centres.**

The distribution of centres analysed is spread all over the national territory (except Navarra y Pais Vasco).

Over the total analysed **75% of urban cartographies have been accepted and 25% have been rejected.**

For the achievement of the A.M. in small groups (<200 Has.) the classic methodology has been displaced for the use of Global Positioning System GPS, through this utility the vertices of the local net are fixed, and from them the necessary random topographic analysis is carried in order to know the absolute and relatives parameter to find out the Cartography "quality".

Nowdays the GPS project is in this way:

Urban centre analysed	300.
Surface	35.083 Has.

2.2 Achievement of the Urbane Cartography Cadastre

The Urbane Cartography Cadastre patrimony showed, in general, a loss of jugdment in all the National Areas. A study showed that in general, cartography did not have the necessary geodetic support or had some faults for that reason.

Because of the quick growth of a lot of the cartographied urbanes centres, a great part of the development and expansion zones were not reflected in that cartography.

In 1984 the CGCCT found an amount of **1.000.000 Has.**, which **210.000 Has. were done again in digital form and 201.000 Has. are going to be done.**

Even if the aim of this project is not to talk about new cartography, it is convinient to comment some steps to their achievement.

The cartographic possibilities when considering an urbane centre are essentialy three:

a. To have a **conventional analogic cartography**, an A.M. will be done.

b. The **cartography has to be already informatized.** Its numeration has been done by the direct compiling or digitizing the conventional cartography if the A.M. results are positive.

c. The Urbane **centre has not any type of cartography or the A.M. has given negative results.** A new cartography Urbane Cadaster will be done. The CGCCT does not count with its own infranstructure that permit the achievement of work of new cartography nor in A.M. centres of great entity; this work has to be contracted with private companies in a public concur from the more important companies on this subjet and following the technical specification and standards of the CGCCT.

2.3 Urban Cadastre Cartography A.M.

The main object of AM is to know the quality and metrical characteristics of a cartography, this process can be undertaken by different ways, but we will analyse that we use at the CGCCT. In broad outline the process compare the coordinates of points well distributed extracted from the cartography to analyse with the coordinates of the some points captured in the countryside and been referenced very precisly to the National Geodetic Network. After this comparison we get two different conclusions about quality, one is the precision of cartography and the other the conexion with the "Geodetic System".

The steps to perform an A.M. are:

2.3.1 Setting up the Cadastral Local Network (RR.LL.CC.)

A R.L.C. is integrated by a Basic Network and a Secondary Network. The **Basic Network** links with at least two Geodetics control points, this link can be made by topo-geodesic conventional methods or bay G.P.S, technology, using this in case geodesic does not exist or it is not near enough, because of the big distances.

To set down the **Basic Network** it is possible to use different observation methods:

Triangulation, trilateration, traversing and G.P.S. systems. All this methods must guaranty the accuracy required.

In the last few years with the improvement of the G.P.S. system, we have obtained geodetic precisions, that is why is possible to use it in local nets. The working method will be the "relative", with at least two static receptors, observation time will be off at least 45 minutes and PDOP optimum with four satellites minimum. If they are receiving set double frequency and software adequate it is possible to make use of the "quick static positioning". It is essential that the control points have intervisibility beween them in pairs and with the geodetic control points of the R.O.I.

The calculation of the Basic Network must be adjusted by the "Minimum Squares" method. The steady points have to be as a minimum three control points of the Geodetic National System.

The **Secondary Network** (R.S.) will be always formed by traverse that come from a control point of the R.B. and goes to another control point of it. This traverse will have to cross themselves preferably orthogonally and some of them will cross the old centre of the town. The medium axis length is of aproximatly 200 m. The stations will be situated in the network intersection and will be marked in the most solid elements by a normalized nail of the CGCCT. In this adjust the control point of the R.B. will be left as "steady points". In this way you get homogeneous precision in all the system and between this one with geodesy.

2.3.2 Control and Radial checking points

One of the two more important aims of the AM is the obtention of coordinates of identified points in the cartography to get to know the errors. This can be get by polar method from the stations of the traverses that go over the Urbane Centre. Polar points have to be preferably the corners, inflexions, etc., trying the non existance of the eaves that can give a wrong identification.

The total number of points is not below (n°. hectars/2). The accuracy of polar points will be 15 cm. in planimetry and 20 cm. in altimetry. The denomination of this points will be **Polar Checking Points (PCH).**

With the AM we try to know the absolute errors of cartography (Geo-referentation), as much as relative errors of the same. For the knowledge of the first we use the **Control Points.** A control point will be an identifying point with great security on the map and on the land. The distance of these points must be less than 200 m. All the control points have been referencied in detail in the land por its correct identification. The number of control points will be one every 50 Has. as minimum in small centres of 4 PP.CC. All points will have a homogeneous distribution on the covered surface by the cartography to analyse.

The control points as well as the polar checking points have to be reflected in the cartography simultaneously when getting the data in the country-side. The aim of this is to supply the obtention of graphic coordinates of the points that are going to be studied. The obtention of these coordinates is made of the digitalization of the originals, using any of the multiples softwares (C.A.D.) that exist in the market.

In this phase of the process we have graphic coordinates and high precision country coordinates of the same points, some of them are control points and the others are polar checking points.

2.3.3 Obtention of Absolute Parametres of Cartography Transformation.

Now we have to know the mathematic relation that exists between the cartography to analyse and the "reality" in the land. For that we use the HELMERT TRANSFORMATION, bidimentional in our case.

A transformation of this kind requires the coordinates of the same points in both systems. In our case the two systems are cartography and land. The parameters to find out are those allowing make coincident both systems and they are: Rotation, Translation and Scale factor.

To get this parameters have a double use, first to know the precision of cartography and second eliminate the geo-referencing errors.

2.3.4 Intrinsic o relative precision of Cartography

Until now we know how cartography is in relation to a steady system and much more general that is the R.G.N., it is pretended to know the errors and the precision that we will find when working in a map-sheet that compose the cartography of the centre. It is useful to know when a graphic operation is made, like length of frontals, or in general the adjustment of a previous parcel of land, etc.

To know these parametres we have to eliminate other causes of errors that can camuflage this, these causes are the lack of homogeneity between the cartographic an Geodetic systems. **For that we will apply the absolute parametres of transformation to all the digitised points** (control points + polar checking points) in this way the only errors that are left are the digitised points that are the intrinsic errors of cartography.

Only the transformed coordinates are left to compare with the coordinates obtained in the countryside of all Checking Points, these differences are considered like **intrinsic errors or relative to cartography**, and it give us a very reliable estimate of its accuracy.

In order to make easier the interpretation we do a Statistic Graph that permit to appreciate quickly the quality of the cartography. If the intervals errors more convinient are placed in the "abscissas" axis (p.e. O mts. < e <0,5 mts., 0,5 mts. < e < 1 mts., etc. ...) and in the ordinates axis the times that the error is presented in the analysed points set, we will have an **Statistic Graph about the distribution of errors**, interpretable as the "Gaussian Distribution".

The detailed analyse of this graph will permit **to take the decision** respect the validity of that cartography with Cadastral aims. To do that three modalities will be established:

1 **"Good" cartography**, the 75% of the points have errors < 1.0 m., without existing points with big errors (> 2.5 m.).

2 **"Acceptable" cartography**, the 75% of the points have errors < 1.5 m. and can appear some points with rude errors.

3 **"Unacceptable" cartography**, most of the points have errors > 1.5 m., appearing a great deal of points with rude errors.

2.4 Final considerations

For this methodology to work properly it is essential the homogeneous distribution of all the points, both P.C. and P.CH., in a way which they "touch" the biggest number of cartographic sheets. If this does not happen the cartography is "not acceptable" because it has only touched some sheets badly elected, because sometimes the cartography of a nucleus was done by two different companies having different parametres according to the area selected.

The proces to follow when the cartography is "good" or "acceptable" is its digitising or numerizing. In this process it is of capital importance to consider the absolute parameters of transformation applying them to all the points that compose the multiple elementes to digitise. Apart from Analysing metrically the cartography, the importance of this method lies on the establishment of Cadastral Local Networks. A lot of work has to be put in the perfect signposting, referencing and conservation of all the control points that make up the two networks, due to the importance of permanent marks with geodetic accuracy in the urbane nucleus for future works.