Table 4.1: Stages in the creation of the cadastral database of the study area and their characteristics

<table>
<thead>
<tr>
<th>Stage</th>
<th>Group</th>
<th>Date</th>
<th>Area surveyed</th>
<th>Data obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ITC-UNESCO group (Cardona et al., 2000) from Central America and the Caribbean</td>
<td>June 2000</td>
<td>Most of the urban sectors of Turrialba City</td>
<td>Attributes of the physical part of the elements (landuse, number of floors, age, materials). Scarce and general information about hazards (natural and man-induced) and damages, without pointing out the specific event that cause them</td>
</tr>
<tr>
<td>2</td>
<td>ITC group of international students (China, Pakistan, Nepal, Malawi, Costa Rica, Mexico and Italy), including the author</td>
<td>June 2001</td>
<td>Mostly outside the urban areas, focusing on the agricultural sectors</td>
<td>The database for the entire study area was completed. The group was divided in four teams of three people. Again, the hazard and damage aspects were not included in most of the cases</td>
</tr>
<tr>
<td>3</td>
<td>Author</td>
<td>July 2001</td>
<td>Area flooded by Colorado River, Gamboa and Túnel streams and other watercourses, on 02/96 (Figure 4.2)</td>
<td>Attributes and boundaries of the elements were checked and modified. The landuse, age, number of floors and material was determined by visual inspection (see Section refsubsec:elem). Special interest was given to information related to flooding and riverbank erosion. These data were acquired through interviews with the owners or inhabitants of the buildings. The interviews were done, at least, every 4 or 5 buildings.</td>
</tr>
</tbody>
</table>

point map. In addition, a segment map was created with all the boundaries of the elements. Once having this segment map related to an attribute table through a point map, it was possible to generate an attribute polygon map of the study area (see Figure 4.3).

As it was explained in Section 4.2.1, after the first stage of the mapping process, the segment and point maps only covered the urban part of the study area. It became totally covered only after the second stage. During the third stage the segments and points of a specific part of the study area (see Figure 4.2) were checked, and in many cases, modified. All these changes forced the polygon map to be updated several times (see Figure 4.3).

After Stages 1 and 2, the attribute table included essentially four attributes for each element: landuse, age, building material and number of floors (see Section 5.2.1). During Stage 3, more attributes were added to include information about the 1996 flood event and about problems related to riverbank erosion (FloodArea96, FloodDepth, RivErHazZon and RivErDam). An explanation of these attributes and their records is given in Table 4.2.

From the attribute point map showing the water depths during the 1996
flooding, it was possible to do a visual interpolation and digitise by hand, contours for three different maximum depth values: 0, 10 and 50 cm. No depths greater than 1 m were found inside the study area. After this, an interpolation of contours using ILWIS was done and a raster map of maximum flood depths for the 1996 event was obtained. This map will be used as scenario for the further vulnerability and risk assessments (see Chapters 5 and 6).

A parallel process was also undertaken. A geomorphological interpretation was done using colour and black and white aerial photographs at three different scales and dates (1:5,000, unknown date; 1:20,000, 1988; and 1:40,000, 1998), none of them taken during a flood event, and the anaglyph image created using the DEM and the panchromatic Landsat-TM image of January 2001. Complementing this geomorphological map (see Figure 2.5) with field observations done by the author, the flood hazard map of the study area was produced assigning a different degree of hazard to each geomorphological unit, based on
4.2. The hazard assessment process

Figure 4.3: Flow chart describing the method followed during the flood hazard assessment

its characteristics.

In order to consider this hazard **zonation** within the database, an attribute called Flood Hazard Zonation (FloodHazZon) was added to the table (see Table 4.2). Also, the attribute RivErHazZon was updated with this geomorphological information.

### 4.2.3 Analysis of the 1996 flood event

For reasons that have been already explained above and in Section 1.5, the information collected during Stage 3 (see Table 4.1) is only related to the 1996 flood event, and the surveyed area corresponds **mainly** to the area flooded during it (see Figure 4.2). This information includes the dimensions of the flooded area, the variations of the maximum water depth inside it and the location of areas affected by riverbank erosion. All this information was included in the