DEFERRED MONUMENTATION AND THE SHAKEDOWN FACTOR

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ABSTRACT

Any guarantee of secure title is only as good as our ability to clarify what land is being spoken about. However, in countries where the majority of boundaries are straight lines between marked turning points, experience shows that boundary features such as fences and walls are not always erected in sympathy with corner boundary marks. In other words, legally speaking, what right-holders see is not always what they get. This article explores two questions: first, whether the placing of boundary corner marks should be deferred until occupation lines have shaken down to positions mutually agreed by adjoining right-holders, and second, whether boundary marks should be placed only in specified conflict cases. For the first question, a case study of high density suburbs in Zimbabwe is considered, where legal boundary corner marks are typically placed some years after physical boundary features have been erected. This practice achieves a close congruence between physical and legal boundaries but also has drawbacks that make it difficult to justify deferring monumentation unless the later surveys are done at very low cost. The second question draws on the case of New Zealand, in particular the responses made to a proposal in 2007 to mark boundaries only in conflict cases but also to the implications for disaster situations offered by the Canterbury earthquake. The article finishes with a more global discussion stemming from the two case studies, and concludes that boundary marks placed early on in the development process serve a public as well as a private good function from early on in a suburb’s development through to its more mature phases, especially when related to a network of well defined survey marks. It is further concluded that boundary marks with well defined centres fulfil an important role in densifying urban survey control networks.


INTRODUCTION

Any guarantee of secure title is only as good as our ability to clarify what land is being spoken about. Surveyors and legislators, in their efforts to define land unambiguously have had to consider a number of factors, ranging from the small random movements expected of boundary marks or boundary features over time to the uncertainties and changing precision in measurement as technology advances. One model adopted is the general boundary system, a strength of which is that the exact line of the boundary is undetermined, “as, for instance, whether it includes a hedge or wall and ditch, or runs along the centre of a wall or fence, or its inner or outer face, or includes the whole or any portion of an adjoining road or stream.” [15] Notwithstanding Dowson and Sheppard’s comment that general boundaries are “a euphemism for uncertain boundaries” [15], a degree of give-and-take between abutting neighbours is usually exercised, and the exact line of a boundary is in practice seldom called into question. In another widespread model, the fixed boundary system, corner boundary marks are the norm. However, physical boundary features such as fences and walls sometimes disturb or destroy boundary marks when they are erected, or else are not erected exactly on the legal boundaries either to avoid disturbing boundary marks or else in ignorance of their position. This raises two questions. First, whether it would be better for surveyors to place boundary marks after the erection of physical boundaries, roads and services, and second, whether it is necessary to place boundary
marks at all, or whether these should be placed only to resolve conflict where this arises.

To shed light on the first question, a 1996 case study is turned to, of stands (i.e. land parcels, or sections) in High Density Developed Townships (HDDTs) in Harare, Zimbabwe. [4] The research, which included questionnaire interviews, field inspections and the analysis of aerial photography flown at different dates, offers experiences from a situation where a form of deferred monumentation has been practised for several decades, and contributes to our understanding of physical boundaries and of delayed or selective monumentation. The second question, using New Zealand as a case study, draws on responses to the proposal made in 2007 to place boundary marks only in specified conflict cases, and also to the Canterbury earthquakes. [7]

CASE STUDY 1: HIGH DENSITY DEVELOPED TOWNSHIPS IN ZIMBABWE

HDDTs, which make up a significant percentage of dwellings in Zimbabwean urban centres, typically cater for lower income residents. The townships were originally set out by the Department of Physical Planning [16] to non-title specifications, and core houses were built, amounting to approximately half of the final residential unit. The non-title pegs placed were necessary for the orderly building of roads and houses, and guiding the erection of physical boundaries. Despite having no legal weight, these pegs no doubt also assisted from time to time in arbitrating disputes.

HDDTs contribute to our knowledge of deferred monumentation because, often a decade or more after the non-title pegs were placed (from the early 1950s in Bulawayo, and 1960s in Harare), [16] registered surveyors have over a period of many years carried out ad hoc title surveys for scattered land parcels. Significantly, new boundary pegs are placed according to occupation lines rather than adhering to the original non-title pegs, except where there are unacceptable departures between the two. An alternative to placing boundary pegs is sometimes to adopt and survey “topographical corner points”, for example hedge or fence intersections. The net result is a situation where visible physical boundaries and legal corner marks coincide. On the positive side, what residents see is, in fact, what they get, and the survival rate of monuments must also be enhanced. [1] However, title surveys are done piecemeal, at a high unit cost unless neighbours can be persuaded to have surveys done at the same time to bring costs down. In addition, road frontages grow ragged (though another option would have been to hold road alignment fixed while respecting side boundary occupation). These and other factors will be explored more fully below.

Before describing the fieldwork, two points of clarification need to be made about HDDTs. First, that even those stands not surveyed for title enjoy secure tenure, and the thrust for title surveys probably originates not from a fear of losing possession but from banks and building societies insisting on formal title for issuing mortgages. Second, not all residents require mortgages. This is because a kind of mortgage exists even for those who do not commission title surveys, in the form of “lease-to-buy” arrangements offered by local authorities whereby regular payments over a long term eventuate in ownership (though not mortgageable title). It is likely that, by the time most right-holders are in a position to have title surveys done, core houses will have been lived in for a number of years and mortgages may be needed to reimburse informal loans, to fund home-extensions or to finance investments other than primary residences, all of which may be associated with different risk factors than a first-home mortgage.

The Harare research project set out to find how soon physical boundaries are erected, whether right holders do in fact come to view physical boundaries as the legal
boundaries and, following a “shakedown” period when right-holders reach informal consensus over the position of boundaries and erect physical barriers, whether low accuracy, low cost surveys are sufficient at that point to “freeze-frame” the as-built position and grant final title. The fieldwork included 47 questionnaires, field inspections and the analysis of aerial photography flown at different dates. Some of the findings and conclusions, including the air-visibility of boundaries and their suitability for photogrammetry, have little relevance to this particular paper and will be omitted here.

Research findings

The following five questions are thought to be the most significant of those asked in the research:

Q1: How long does it take right holders to enclose their properties with some form of physical boundary?

Table 1. Number of years taken to build boundaries

<table>
<thead>
<tr>
<th>Years</th>
<th>0-1</th>
<th>1-2</th>
<th>2-3</th>
<th>3-4</th>
<th>4-5</th>
<th>5-6</th>
<th>6-7</th>
<th>7-8</th>
<th>8-9</th>
<th>9-10</th>
<th>10-11</th>
<th>11-12</th>
<th>12-13</th>
<th>13-14</th>
<th>14-15</th>
<th>15-16</th>
<th>16-17</th>
<th>17-18</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freq.</td>
<td>8</td>
<td>7</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>47</td>
</tr>
<tr>
<td>Cumul.</td>
<td>8</td>
<td>15</td>
<td>20</td>
<td>21</td>
<td>25</td>
<td>28</td>
<td>30</td>
<td>31</td>
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<td>35</td>
<td>41</td>
<td>42</td>
<td>43</td>
<td>47</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Cum.%</td>
<td>17</td>
<td>32</td>
<td>43</td>
<td>45</td>
<td>53</td>
<td>60</td>
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<td>87</td>
<td>89</td>
<td>91</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Synopsis:
- About twenty percent of physical boundaries are built in the first year of occupation
- Approximately half of the properties are enclosed by about four years
- Two thirds of the properties are enclosed after about seven years
- By seventeen years, 90% of properties are enclosed by physical occupation lines

Q2: What form do physical barriers generally take?

Table 2. Forms of physical boundary

<table>
<thead>
<tr>
<th>Form</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fence</td>
<td>56</td>
<td>63</td>
</tr>
<tr>
<td>Hedge</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>Concrete wall (“durawall”)</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Brick wall</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>No physical boundary</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

Synopsis:
The fence is clearly the most common form of boundary, with one influencing factor being that there are at least five home industries supplying fences at keen prices, far lower than concrete “Durawalls”. Hedges, requiring little or no capital outlay, were next most popular, but respondents felt these needed rather a lot of care and water (the latter being an ongoing expense) in contrast with the “one-off” cost of fences. All
respondents who had not enclosed their properties cited cost as the reason rather than principle.

Q3: What is the reason for erecting a physical boundary?
Over half of the respondents gave increased security as the reason. A quarter said it was to keep animals from eating their vegetables, ten percent said it was to remind neighbours of where the boundary was (i.e. it was some kind of territorial statement) and five percent said that it was for aesthetic reasons.

Q4: Is there any dissention with neighbours over the common boundaries?
Ninety eight percent of respondents had achieved amicable consensus over the common boundaries even where these departed from the pegs originally placed. Only one respondent (2%) was aggrieved that his neighbour had more land than he did. However, in this latter case, the non-title pegs used to set out the stands were visible and undisputed, and the disgruntlement was over perceived unfairness rather than correct boundary position. This does suggest that, at least until mutually agreed physical boundaries are erected, pegs are an important source of evidence, especially in the kind of monument-based cadastre practised in New Zealand and Southern Africa, which recognises that both measurement and description may be flawed and assigns most weight to monuments, if undisturbed.

Q5: Are the physical boundaries in the correct place relative to the pegs originally placed?
Sixty seven percent of respondents said that the physical boundaries were in the right place, even if field checks showed the researcher that there were departures from the original pegs. Typically, apart from a deliberate encroachment of 10m into State land, departures were not large, with most being within 0.1m of the pegs originally placed and the maximum departure being a fence 0.6m from the original boundary. Twenty nine percent of respondents said that they did not know but were happy with the physical boundaries as they stood, and four percent said they were aware that the boundaries were not correct according to the pegs but were nonetheless happy with their position. Thus a combined total of ninety six percent of respondents viewed the physical boundary as the legal boundary even where it departed from the original pegs.

Summary of research findings
There are a number of points of interest in the above responses. First, implicitly, the non-title pegs used to set out the township were necessary to guide development, and were also helpful in resolving at least one dispute. Second, even in this low income community residents had devoted time and resources to erecting physical boundaries, citing a variety of reasons for doing so. Third, residents had achieved amicable consensus with their neighbours over their common physical boundaries even if these departed from the pegs originally placed, and most right-holders professed themselves happy with the position of the physical boundaries. In the Zimbabwe case, these findings led on to recommendations that, following a shakedown period of perhaps seven or so years, during which time residents would be expected to erect physical boundaries, far lower specification surveys could be done at that point than were normally prescribed for issuing title. To some extent boundary pegs had by then become irrelevant. The initial layout had proved itself accurate enough for setting out the new developments in a planned manner, and it was envisaged that later title surveys could be done en bloc, perhaps by photogrammetry (another facet of the research showed that physical boundaries often showed up from the air or could be
Corners that did not show up from the air could be surveyed by low order (and therefore inexpensive) surveying methods such as theodolite and EDM surveys from sparse setup points to extra-long prism poles, or else photogrammetry could be dispensed with and only ground methods used. Today, differential code GPS (DGPS) and short occupation times with RTK and infill could also be added to the list of survey options. An aim was to place (and survey) corner marks in sync with the physical boundaries mutually agreed between adjoining right-holders, or else to survey topographical corner marks without the necessity for placing pegs. Deferred monumentation was in this instance felt to be justified by the far cheaper survey methods made possible once physical boundaries had shaken down to positions mutually agreed by abutting right-holders, which were felt to carry a significantly lower risk of doubt or dispute.

It should be noted that a hidden factor reinforcing the viability of the low accuracy surveys described was the requirement to tie them to an abundant network of permanent reference marks on the national trigonometrical system, distributed throughout the township. There is an underlying assumption that survey evidence would always permit corner points and topographical corner marks to be replaced in a tolerably correct relative location to permanent survey marks. In other words, although residents effectively lived with a kind of general boundary system, underlying these was a monument-based hierarchy of evidence, with reference monuments situated not at boundary turning points but instead taking the form of town survey marks and traverse stations situated away from boundaries. Low accuracy ground or photogrammetric surveys done relative to this reference network permitted reinstatement of physical boundaries in cases of doubt, dispute, or natural disaster.

As an exercise in deferred monumentation, the benefits for HDDTs were rather mixed. There were advantages in the (presumably) lower cost, non-title survey done by unlicensed surveyors to set out the township. Also, in the fact that physical boundaries and title pegs coincided and in the probable higher survival rate of boundary marks placed after services had been put in and physical boundaries erected. However, a major disadvantage existed in the high unit cost of subsequent title surveys relative to the land value, in the duplication of work that had already been done in the initial setting out survey, and in the fact that the final township layout became less regular than when originally laid out.

Probably the most important points with which to conclude this section, and whose significance goes beyond the case study, are first, that departures of physical boundaries from the original (non-title) pegs were never large enough to matter and did not warrant the kind of costly deferred monumentation actually practised. The non-title pegs originally placed were probably good enough to have granted title on right from the start, and in cases such as this further survey is probably only tenable where survey costs are ultra-low. RTK GPS has lowered the time taken for setting out surveys, and it could be argued that today it is viable to do both a rough layout survey and a later survey in the wake of road and building construction and fence/wall erection. However, if the original design plan is adhered to, there are bound to be frustrations in setting out the design positions, for example on top of or very close to walls or fences. The alternative of placing marks near to but not coinciding with the design survey can lead to an irregular layout which, apart from offending a sense of neatness in planners and surveyors, may also complicate future surveys. The second salient point is that right-holders came to regard physical boundaries as primary evidence after only a few years, even in a low-income area where the cost of physical boundaries was high in relation to average salaries. Third, that pegs and topographical corner points were
related to a network of well defined control marks, and although residents effectively lived by a general boundary system, a fixed network of survey marks underlay this and allowed reinstatement of physical boundaries where necessary.

The focus is now changed to the second case study, and the question of whether boundary marks should only be placed to resolve conflict where this arises.

**CASE STUDY 2: NEW ZEALAND**

The second question posed in this article is whether boundary marks should be placed only in conflict cases. New Zealand has been chosen as a case study to answer this question first because of a useful body of responses documented to a proposal, in 2007, to place boundary marks only in conflict cases, and second because of boundary issues raised by recent earthquake activity in the South Island city of Christchurch, in the Canterbury province. Both assist in informing a wider global debate on legal coordinate cadastres and deferred monumentation.

As a starting point, it is necessary to understand the implications of a fence not being on a legal boundary in New Zealand. The New Zealand legal system is based on English common law, where the phrase “a little more, a little less” has been current for at least four centuries; as far back as 1609. [10] In New Zealand, every title document has those words in the heading, meaning that what land owners see in New Zealand is not necessarily what they get. Further than this, the position on adverse possession, encroachment and give-and-take fencing is complex [6], [11], [12], [13] and beyond the scope of this article, which will now turn to the 2007 review of the 2002/2 Surveyor General’s rules for Cadastral Survey. This review was followed up by a number of proposed changes, including the following:

1) A requirement to mark only in specified “conflict” cases.
2) No requirement to mark secondary parcels, including rights-of-way.
3) No set specification for boundary mark type, though marks needed to be clearly identified as boundary marks.
4) Boundary marks to be recorded in a Cadastral Survey Dataset (CSD). [7]

The Surveyor General and other senior members of Land Information New Zealand (LINZ) travelled around the country explaining the rule changes and inviting written submissions commenting on the proposals and giving feedback. Many of the submissions received were centred on the proposal to mark boundaries only in conflict cases, with only two submitters out of a total of sixty two wholeheartedly supporting this rule change. [14] Robertson grouped responses to this proposal into twelve issues, including the assertion that the rule change struck at the heart of New Zealand’s monument-based cadastre. Other concerns included a fear that surveyors, in attempting to save time and money, would neglect to place even necessary boundary marks unless compelled to do so. Finally, that boundary disputes might become more common if the new rules were approved, and that clients, generally with limited knowledge of cadastres, were unqualified to decide which boundaries should be marked and should not be expected to make that decision. [14] In the end, the proposal to mark only in conflict cases was withdrawn and modified rules were approved.

It was only subsequently, in 2010 and 2011, that the first Canterbury earthquake struck, raising the question of boundary monumentation once more, in a different guise.
Disaster scenarios

Earthquakes, and the Tsunamis sometimes associated with them, have underlined a public good function of cadastral systems globally, namely their ability to reinstate land rights following natural disasters. For many New Zealand surveyors, the fact that different parts of Christchurch city and the wider Canterbury district moved relative to one another, sometimes by metres, underlined the importance of a dense network of survey marks to aid in establishing the manner in which land parcels had distorted and occupation lines had moved. It seemed that, although a legal coordinate cadastre (i.e. official coordinates of boundary positions, with no requirement for ground marks) could successfully have allowed re-instatement of the absolute positions of boundary points (i.e. positions relative to a fixed global reference framework), this might have resulted in anomalies such as parts of buildings appearing in adjacent parcels. Clearly, the movement of houses, fences and boundary positions relative to one another was better represented by physical markers attached to the earth’s skin than by absolute coordinates.

Of course, control survey markers would be affected no less than boundary marks by large scale earth movements, but the reinstatement of any kind of mark is tackled in an identical manner whether following an earthquake or dealing with a century old survey “stretched” by the scale factor in a measured base line (perhaps measured by a Gunter’s chain and propagated by triangulation). In other words, a core business of cadastral surveyors is to reinstate correct relative positions, whether bearing swings and scale factors are generated by improved generations of survey instrumentation or by tectonic forces. In either case, the drill is the same. Sufficient marks are found, in a particular area, whose relative positions compare tolerably well (i.e. having a reasonably consistent bearing swing and scale factor, which will be the case provided that marks in the same locality have experienced the same general trends). Following such a comparison, the average bearing swing and scale factor are applied to the original survey data, and the position of any missing or excessively disturbed boundary marks is calculated from the current position of the closest accepted mark. [5]

The paramountcy of maintaining correct relativity is captured in the LINZ guideline following the Canterbury earthquake. This guideline, in unpacking some of the implications of the quake and the best strategies to be followed, emphasises the importance of reliance on “reliable local survey marks and other physical evidence”, stating that even where deep-seated movement affects boundaries, the boundaries “must retain their same spatial relationship with survey marks in the same manner as that prior to the earthquake”. [8]

The task of proving that marks in a surveyed network still occupy their correct relative locations is made easier if there are abundant marks from which to choose, and in the light of the quake, survey control marks and traverse marks in New Zealand urban centres could be viewed as generally being on the sparse side. This raises the question of whether boundary marks, if they had better defined centres than the ubiquitous 75mm x 50mm wooden peg, could help to densify control marks. Two criticisms could be levelled at the idea of boundary pegs serving a function in densifying control. The first is that boundary pegs are particularly vulnerable to disturbance because they are situated on or close to where physical boundary features are erected and water pipes and telephone cables are typically sited. The second criticism is that, if wooden pegs continue to be a permissible option in New Zealand, they are insufficiently well defined to be of any use as survey control. Addressing the first of these criticisms, the Canadian experience is that 60 – 70% of boundary marks are reliable, [1],[2],[3] and in the absence of better evidence it seems reasonable to assume that percentages are probably similar in New Zealand. Coordinate
transformation techniques, widely available today as part of Coordinate Geometry (COGO) software for GPS and Total Stations and surveying software packages, are ideal for confirming which points can be relied on and which not.

Turning to the second criticism, already many New Zealand surveyors already use a new generation of boundary markers, made of aluminium, plastic and other materials, all of which have clearly defined centre marks. For those who do not (and the familiarity of wooden pegs to land owners is sometimes cited as a consideration here), a requirement could easily be introduced for pegs to be "tacked" with brass or stainless steel nails [5] and checked with a “double-tie”. In addition, it might be a good idea if it became practice in subsequent surveys to relate boundary marks (which are generally located in zones of high activity, including fence building and introducing services such as telephone, water, sewerage etc), to witness marks and stable physical features situated away from boundaries, such as wall or foundation corners. The more boundary marks and witness marks there are supplementing the survey control, the more options are available for determining a previous survey system in terms of a current survey with a healthy degree of redundancy.

In summary, the Canterbury earthquake has served as a reminder that ground movement may vary in magnitude and direction from one locality to the next, and that if relative positions of boundary parcels are to be preserved, [8],[9] any mathematical representation of these movements, even with high order transformations, would be impracticable over all but a small area. It would be far easier to prove, for each locality, which nearby survey marks (both coordinated building corners and well defined boundary marks) have maintained tolerable relativity, to compute an average local bearing swing and scale factor for accepted marks, and to apply these to the original data from the closest accepted marks to re-establish positions of missing or excessively disturbed marks in their “same spatial relationship”. [8] The circumstances in Christchurch make the point that boundary marks, if well defined and sufficiently accurately surveyed, can provide a valuable densification of a survey control network that is particularly crucial in disaster situations, and that the earlier such marks are placed in the development process, the better.

CONCLUSION

There are several factors in tension when considering the advisability of deferred or selective monumentation. First, boundary marks placed early on are usually indispensible in guiding roads, services, houses and fences. Home owners have said as much. [3] Second, in the early stages of development there is theoretically a higher risk of dispute, making reliable, checked evidence important from an early stage in a suburb’s development. If accurate pegs are only placed later on, this will allow uncertainty to creep in at a time when there is the greatest need for knowing the extent of land parcels. Third, our research has shown that people tend to erect physical boundary features even in low income areas, and that even where these features are only more-or-less correct, residents regard them as the primary boundary evidence. Fourth, available technology today, including RTK GPS and free-stationing by Total Stations, has made replacement of disturbed or missing marks far simpler than in the past. Fifth, especially in areas of high earth movement, surveyed marks are valuable in re-establishing relativity of points originally agreed to, and boundary monumentation, if sufficiently well defined, may help to supplement survey control marks. Based on the Canadian experience, it is likely that half to three quarters of all boundary marks will survive unmoved and such marks have the potential to supplement off-boundary monuments such as control, traverse and witness marks.
It is concluded that accurate boundary marks serve a public good function both early on in the development process and also at more mature phases of the life of a suburb, particularly when there is doubt, dispute or disaster. In short, the gains accruing from deferring boundary monumentation are seldom justifiable, and boundary marks should have well defined centre-marks and be surveyed to accuracies comparable with survey control marks in order to densify control and to act as witness marks. Although attrition of such marks is inevitable, collectively they could facilitate replacement, dispute resolution and fresh surveys in the future. Subsequent surveys for mutations of land or redefinition, in addition to replacing missing marks, should where possible also connect to stable off-boundary marks such as concrete footings and wall corners, again in order to densify control and provide additional witness marks. The research summarised in this paper suggests that, although right-holders generally regard physical boundaries as the primary boundary evidence, departures with legal boundaries are seldom a threat to secure title. Finally, wherever there is doubt, dispute or disaster, it is important that a dense network of surveyed points exists – whether control marks or boundary marks – that can be used in arbitration and re-instatement.

Regarding prescriptive rights, countries have made different calls on whether major departures of de facto occupation from de jure boundaries should ever be upheld in law, and if so, after what time has elapsed. New Zealand provides an admirable model of more-or-less boundaries being accommodated in title without the fear of adverse possession. Even in countries where acquisitive prescription is allowed to run, the survey cost entailed in amending the title for small departures of physical boundaries from legal boundaries is usually disproportionate to the area of land gained, which provides a significant disincentive that effectively equals give-and-take boundaries.

In conclusion, a quotation from Mohandas Gandhi, who writes:

*All compromise is based on give and take, but there can be no give and take on fundamentals. Any compromise on mere fundamentals is a surrender.*

Physical boundaries erected by abutting right holders exhibit a degree of give-and-take, and right-holders tend to regard these positionally-flawed physical boundaries as the primary source of boundary evidence, but the underlying fundamentals of well defined marks – both control marks and well defined boundary marks – should not lightly be surrendered.

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**References**


