



# මැනුම් සඟරාව

நில அளவைச் சஞ்சிகை  
SURVEY JOURNAL

ANNUAL PUBLICATION OF THE SURVEY DEPARTMENT OF SRI LANKA Dec - 2009 ISSUE - 78

## CONVENTIONAL SURVEY METHODS

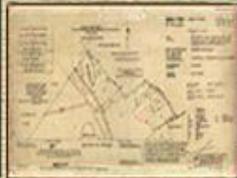
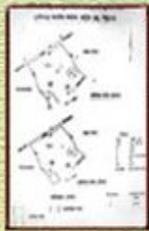
**Plane Table Survey**

**Compass Survey**

**Chain Survey**

**Tacheometry Survey**

**Theodolite Survey**



**Plan**



**Plotting**

### Plotting Instruments

1. Plotting Scale
2. Rolling Ruler
3. Parallel Ruler
4. Drawing Pen
5. Bow Pen
6. Protractor



## MODERN SURVEY METHODS



**Digital Theodolite**

**Total Station**

**Global Positioning System (G.P.S.)**



Data Transfer to Computer Adjusted Coordinates (N,E, Elivation) X,Y,Z



**Plotter**



**Printer**



**Drafting using Computer Software**



**Digitizer**



**Scanner**

**Incorporating Data on Old Plan**

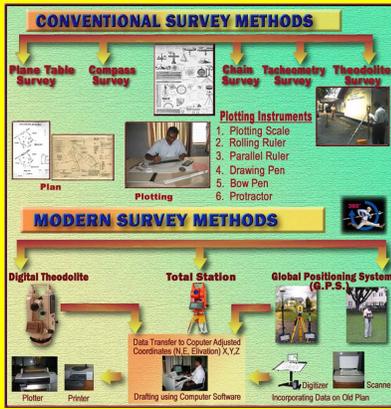
# සුඛසාගරයේ සමීක්ෂණ පත්‍රිකාව SURVEY JOURNAL

December 2009  
ISSUE 78

Published under the order of  
S.M.W. Fernando Esqr.  
Surveyor General of Sri Lanka.

The Surveyor General does not necessarily agree with any opinions or recommendations made in any article in this journal, nor do they necessarily represent official policy.

## COVER PAGE



In conventional surveying, chain and tape are used for making linear measurements while compass and ordinary theodolites are used for making angular measurements. Levelling work is carried out using a Dumpy level and a levelling staff. With such surveying instruments, survey work will be slow and tedious.

Hence modern surveying instruments are becoming more popular. With modern surveying instruments, survey work will be precise, faster and less tedious. However, the periodic calibration is necessary for these instruments.

The cover page pictorially represented about the two eras.

# Table of Content

Page

1	<b>An Unforgettable Character-Mr. B.J.P.Mendis, late Surveyor General of Sri Lanka</b> Mr. W.A.S.Tillekeratne, Land Survey Council	1
2	<b>FLASH BACK OF SURVEY JOURNALS</b> Dr. K.Thavalingam, Additional Surveyor General	4
3	<b>Cadastral Data Preperation in Computer Aided Drafting (CAD) Systems</b> Mr. K.A.B.S.Rupasinghe, Supdt. of Surveys (R&D)	11
4	<b>Acceptable Errors</b> Mr. S.T. Herath, Retd. Surveyor General	18
5	<b>Some of the important tips for Digital Plan making</b> Mr. B.D.A.Chandraguptha, Snr. Supdt. of Surveys (IT)	23
6	<b>The Geo-Database</b> Mr. S.Sivanandarajah, Snr. Supdt. of Surveys (GIS)	25
7	<b>The importance of changes in land surveyors education</b> Mr. A. H. Lakmal, Government Surveyor	29
8	<b>Valuation of Property (Real Estate)</b> Mr. Anil Kollure, Govt. Surveyor	32
9	<b>බිඹු, නිකුත් කිරීම</b> Mr. Kirthi Disanayake, Snr. Supdt. of Surveys	33
10	<b>සමීක්ෂණ පත්‍රිකාවේ සංස්කරණය</b> Mr. S.D.Senaratne, Former Asst. Supdt. of Surveys	35

## EDITOR

**G.D.S.K. Gunaratne**  
Snr. Supdt. of Surveys,  
Research & Development Branch,  
P.O. Box 506, Surveyor General's Office,  
Colombo 05, Sri Lanka,  
Tel: +94-11-2368602, Fax: +94-11-2368601  
E-mail: ssrd@slt.net.lk

## wmf. am% duh

oşx. ; uekum; şuekuzyd i ş buz ; l şsuz  
wdh; kfhaWmfoyl uK æ, fhayd  
bvuzuekuzi Ndfj zi Ndm; ş

nSfc'AmSfukæ's aue; ş ud

1950-2009



ue; ş ukş

Tn j ş kawmf. afomdrA fuka jg; auekuzyd i ş buz  
. ; l şsuzwdh; khg; aoYl ; kl g wOş l d, hl a  
; ş fi al rk , oadj Cfufyh wmuK h' i od wurK ş fj z

Tn j ş kafi jal fi ş dj kg ol ş k , o l reK d . K  
uysifhai j | wm yo ; æ fkduel k fi ai gykaj Swe; '  
**wmsTng i ş doka; æ kşH i e; mş m; uq**

-----  
**uekum; s we; R l dAH uKæ, h**  
-----

## **An Unforgettable Character-Mr. B.J.P.Mendis, Late Surveyor General of Sri Lanka**

by

*W.A.S.Tillekeratne*

*Retd. Map Production Officer / Snr. Clerk - Land Survey Council*

*1<sup>st</sup> Floor, Surveyor General's Office, Colombo 05, Sri Lanka*

*Email : lsc2@sltnet.lk*

All the arrangements had been organized to commemorate 61<sup>st</sup> Independence day celebrations on 4<sup>th</sup> February, Wednesday, this year at the premises of the Survey Department. Chief Guest was the Surveyor General Mr.B.J.P.Mendis. On Monday, I heard that SG had been admitted to Kalubowila hospital due to sudden illness. Since the illness was a “heart problem”, we decided not to go to hospital for he needed a lot of rest. But on Tuesday evening a telephone call from a friend of mine made me cry since what I heard from the friend was simply unbelievable and unacceptable. But it took only a few minutes to realize that Survey Department has lost its one of the most illustrious sons of hers forever.

During my forty years of service in the Survey Department, I have not been able to witness such a shocking news as the one we heard on that day. Within minutes, this heart-breaking news reached almost everybody who knew him. But on the following day we did have our Independence Day celebrations as planned. The National Anthem that we have been used to sing with great reverence on that day was a very silent, hardly audible one which sounded like a song meant for a tragic occasion. It was only audible to those who sang it. That's how we ended of our independence day celebrations. Tears wailing in our eyes, all of us were speechless trying to come to terms with sudden death of our beloved leader, Mr.B.J.P.Mendis, Surveyor General of Sri Lanka.

Mr.Mendis joined the Survey Department 1975 as an Asst. Superintendent of Surveys armed with a BSc. First Class degree, being the batch top with a gold medal, and a post graduate Diploma in Mathematics from the University of Peradeniya. Before he joined the Survey Department, he served as an Assistant Lecturer in the same university teaching mathematics to undergraduates where he himself had learned the same subject under Prof. Nalin De Silva.

Immediately after joining the Survey Department, he was trained at the Institute of Surveying and Mapping, Diyatalawa where all Surveyors including Assistant Superintendents of Surveys are trained for a period of three years. On completion of this training he was awarded the Higher Diploma in surveying with 1<sup>st</sup> Class honours. Thereafter, he was assigned to the field being in charge of a survey party where he was exposed to field experience, for the first time in his life with Govt. Surveyors scattered in different parts of the country.

There he learned the first lessons of the difficulties faced by Surveyors in the field as well as the problems and sufferings of the Menum Sahayakes. This might perhaps be the reason that when, he became the Surveyor General many years later, he had the knack of understanding the pressing problems of Surveyors as well as Menum Sahayakes and

would provide relief to them, be it a delayed promotion, annual transfer which adversely affect family life and children or discriminatory treatment by immediate supervisors or some relief due to disciplinary action taken by the department. This quality itself made him an Ombudsman in the Survey Department.

Due to his excellent career record and having identified the need of Institute of Surveying & Mapping, Diyatalwa (ISMD) he was appointed as a as a lecturer to teach Apprentice Surveyors and trainee Asst. Superintendent of Surveyors . While serving as a lecturer he developed several Surveying and Accounting software packages for the Institute.

Having recognized his exceptional capabilities, he was nominated for a fellowship by then SG and the British Government offered him a fellowship to follow MSc. course in Remote Sensing at the University of London in 1987. Then he was promoted to Superintendent of Surveys in late eighties and assigned as a Senior Lecturer in ISMD His contribution to ISMD as an lecturer and senior lecturer is exemplary, perhaps due to his pet subject, mathematics. His many students, who later became Surveyors as well as Asst Supdt. of Surveys, still vividly remember how he taught intricacies of Maths to them with ease. He also served as a visiting lecturer on Land Surveying at Sri Jayewardenepura University and Open University of Sri Lanka from time to time.

There the students of ISMD found that here was a brilliant teacher with unusual capabilities. ISMD was the first Govt. Institution in Sri Lanka where pay sheets were prepared using computer software package created by him. Later this package was introduced in the Survey Department as well. Only thereafter, Government introduced GPS package to all Government Departments prepare pay sheets. He continued to serve as a Senior Lecturer for about 10 years where he was later promoted to the Post of Director (ISMD)

Apart from teaching he was lover of sports mainly tennis, badminton and cricket. He excelled in batting and bowling. In the playground he treated every player like a friend irrespective of the post he or she held in the Survey Department. This quality he developed in the sports field makes him a true gentleman in treating every employee as equal.

No sooner he was appointed as SG, it was apparent to all of us, here was a leader who we can approach and tell our grievances, be it a personal one or official one. When he became the Survey General, doors of his office were truly opened to anybody who wishes to see him for any matter be it personal issue or official matter. From office laborer to Addl. Surveyor General, his treatment was the same. He knew the art of listening. Even if he cannot provide any redress, nobody, to my knowledge, had any grudge against him. He wasted no time when he was offered an opportunity help a fellow human being. When it comes for a hard decision to be taken he acted according to his heart. If he believes something is just and correct he did it without any hesitation. There was hardly any red tape in his method of administration. Establishment Code, Standing Orders, and Financial Regulations etc. were not a barrier to him when it comes to help a poor man. Sometimes he took bold decisions without any fear. He has little regard for title or post what mattered to him was whether he could help to alleviate the suffering of a fellow worker.

But with all the pressure of work- attending meetings at the Ministry, functions in the Head office, at ISM, at District Offices, ceremonies at the national level, he always found time to have a light chat with us just to ease his pressure of work and laugh. However much he was busy, he always reserved time to ask how things were with the visitor who wanted to meet him. He had a brilliant memory for he knew many of his employees by name even if he had not seen them for many years.

He knew some of his decisions were controversial. He trusted his judgment. When he is going to take a decision he looked far ahead and decided. His love for workers in the department was immeasurable. He knew he has the authority to act. He also knew that if he cannot do something nobody else could do it.

On any normal working day, one would see a queue of people waiting to see him even after office hours, people could approach him. He would listen to the problem. He never felt tired listening to officers of trade union officials. They would come around 4.00 pm and leave about 7.00 pm. He always had the time to listen. If there is anything which waited a long time for him was his lunch.

That might perhaps be the reason for Survey Department is one of the few departments without strikes, at least, during the tenure of his office. He got the full-cooperation of the staff to run Department efficiently.

Any function in the Department , Trade Union Anniversaries, Sports Club Prize Giving, New Year Celebrations, Music Circle, Farewell parties - he always found time to be present for he knew people want him to be there with them. There have been occasions where he decided not to attend important official meeting since he wants to satisfy his fellow worker. This I have seen particularly when it comes to a farewell party of the fellow worker who is going on retirement. Few appreciative words from SG, that's what everybody wanted.

As the Chairman of Land Survey Council, I was able to observe this noble gentleman closely when it comes to deal with professional misconduct on the part of Licensed Surveyors. He told us several times that his main duty is not to allow errant surveyors to go free but to safeguard the interest of general public. He was fully aware of the ignorance of general public in the matters of land disputes where a very few licensed surveyors who would deceive poor people when it comes to land surveying. He always looked at the issue thinking ways and means of offering redress to poor people.

He was in the opinion that poor peasants should not suffer due to the negligence of Licensed Surveyors. He not only looked at the problem but was careful to ensure that the justice be done.

Perhaps the first Surveyor General to meet death in office during the 209-year of history of this prestigious department this sad event would mark as one of irreparable void in the annals of the History of the Survey Department. Good-bye Sir, your name will be with us forever.

## FLASH BACK OF SURVEY JOURNALS

by

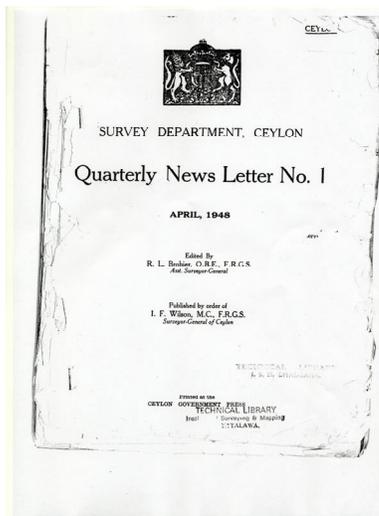
*Dr. K.Thavalingam*

*Additional Surveyor General*

*Surveyor General's office, P.O. Box 506, Colombo-05, Sri Lanka.*

*Email: sgadd@sltmet.lk*

The publication of Survey Journal has been launched with the principal object of keeping the Field staff of the department, and more particularly those officers stationed in remote parts of the country, to acquaint with departmental activities and to serve as a medium for recording the outcome of their activities. The first issue of Surveyor Journal was published in April 1948, after independence, titled as Quarterly News Letter. The Quarterly News Letters contained mainly the Information regarding promotions of staff, conferences held during the quarter, Surveyor General's visits, retirements, appointments, major surveys completed during the quarter, map productions and folklore - stories behind the name the places as well as episodes from field staff and survey progress of each division (western, central, northern, eastern and southern) and Trig. Branch & training school.



**Quarterly News Letter No.1** was launched by order of I.F. Wilson, M.C., F.R.G.S., Surveyor General of Ceylon. This issue was edited by R.L.Brohier, O.B.E., F.R.G.S, Asst. Surveyor General of Ceylon. It gives as mentioned earlier, the promotions, visits retirement, progress etc. One of the retirements given in the Quarterly News Letter was the retirement of Mr. J.E. Jackson, M.A. (Cantab), Assistant Superintendent of Surveys. He is an eminent person in survey profession. He joined the Department in February, 1928 and retired on 20<sup>th</sup> February, 1948.

**The Quarterly News Letter No. 2** was published in July 1948, by order of I.F. Wilson, M.C., F.R.G.S, Surveyor General of Ceylon and edited by R.L.Brohier, O.B.E., F.R.G.S, Asst. Surveyor General of Ceylon.

**The Quarterly News Letter No. 3** was published in October 1948, by order of I.F. Wilson, M.C., F.R.G.S, Surveyor General of Ceylon and edited by R.L.Brohier, O.B.E., F.R.G.S, Asst. Surveyor General of Ceylon. In this issue, editor has requested from the members of the department to contribute to design a new departmental crest. There are interesting articles of historical value in this issue and one of them is "Tidal well of Puttur" - it is a square well of unknown depth said by tradition to have been formed from an arrow shot by Hanuman to satisfy the thirst of Seetha. Another such article is "The true location of Somawathi Chaitya". Under the progress of Trig. Branch & training school, it was stated that the paddy field in the Camp (training school), cultivated on a co-operative

and voluntary basis, yielded 100 bushels of paddy. Presently, there is no paddy field in the vicinity of ISM. The other highlight in this issue was the Camp Overseer, H.Dingiappu, to whom the rank of Honorary Arachchi was conferred by the Government Agent, Uva Province, on August 19, 1948, at the Badulla Kachcheri.

**The Quarterly News Letter No. 4** was published in January 1949, by order of I.F. Wilson, M.C., F.R.G.S, Surveyor General of Ceylon and edited by R.L.Brohier, O.B.E., F.R.G.S, Asst. Surveyor General of Ceylon. There are some thrilling stories - “Attacked by Bear”, “How a Rogue Elephant examined an Instrument Box” were published in this issue.

Under the general item it was mentioned about Observatory. This institution functioned for nearly 80 years as a branch of the Survey Department was made as independent administrative unit. The infancy of Meteorology in Ceylon dates to 1850 or perhaps even earlier, when weather observations were taken daily at 9.30 a.m. and 3.30 p.m. at the office of Civil Engineer and Commissioner of Roads, in Peradeniya and at the Royal Engineer Observatory in Colombo. The pioneer attempt to provide an Island-wide analysis of weather was due to the keenness and interest taken in the branch of science by Colonel Fyres, who officiated as surveyor General from 1866 to 1883. It is largely due to his inspiration that a more systematic recording was maintained, which has helped the Colombo Observatory to keep entries/figures. Incidentally, this also explains how the Observatory came to be administered by the Survey Department.

**The Quarterly News Letter No. 5** was published in April 1949, by order of I.F. Wilson, M.C., F.R.G.S, Surveyor General of Ceylon and edited by R.L.Brohier, O.B.E., F.R.G.S, Asst. Surveyor General of Ceylon. There are interesting stories regarding the derivation of place names, as for example, the place name Laxapana is derived from Laxana pani or lovely waters.

**The Quarterly News Letter No. 6** was published in July 1949, by order of I.F. Wilson, M.C., F.R.G.S, Surveyor General of Ceylon and edited by R.L.Brohier, O.B.E., F.R.G.S, Asst. Surveyor General of Ceylon.



The appeal made in a back copy of the news Letter for designs of a crest for the Survey Department, has produced a variety of ideas both from the field and the office staff. Most of the designs received are in the form of a circular scroll, using a miniature map of Ceylon, or the older form - a theodolite, as the central symbol.

Finally a crest, as shown here has been approved. It does not say who has designed this crest.

In this issue, there is an interesting article titled as “An Abstract of Information concerning the Names applied to Ceylon” written by R.L.Brohier. In the dry zone the tiny tick caused more trouble and annoyance to the field officers. These tiny ticks so small and they can hardly be seen with the naked eye. To take precautions and treatment for bites, the welfare officer wrote a note - “Hints to Young Surveyors”. He mentioned in his note that

a mixture of coconut oil and common salt may be applied in the case of less severe wounds. The most effective treatment is to apply the yam of the parasitic plant “Bendura”, ground to a fine paste on the affected parts and left overnight followed with an application of a little boiled rice roasted over dying embers ground to a paste with coconut oil. As a precaution, before starting the day’s field work smear the lower limbs with a good supply of coconut oil.

**The Quarterly News Letter No. 7** was published in October 1949, by order of I.F. Wilson, M.C., F.R.G.S, F.R.I.C.S., Surveyor General of Ceylon and edited by N.S.Perera, Actg. Asst. Surveyor General of Ceylon. Under the progress of Trig. Branch and Training School, it was stated that a batch of 10 Probationary D.R.OO were given training in surveying for 1 week. To take precautions and treatment for blood-sucking worm- land leech, the welfare officer wrote a note - “Hints to Young Surveyors”. He mentioned in his note that “Don’t wear ordinary stockings only; leeches can creep through them”; “Don’t pluck them off forcibly; induce them to leave gradually by applying a little soap”; “Don’t stop bleeding at once; allow it to bleed a little, wash it, and apply a piece of dry paper or little iodine on cotton wool”; Soap and tobacco juice are good repellents; There are some random notes on “tidal Observations and the M.S.L. Datum” ; “The Muthurajawela Swamp”; “Legends of Illumbekanda”; and “Village called Aparekka”. A new Lithographic printing machine imported from England was installed at the Buller’s Road Store, which was converted into a section of the Map Reproduction Branch.

**The Quarterly News Letter No. 8** was published in January 1950, by order of I.F. Wilson, C.B.E.,M.C., F.R.I.C.S., Surveyor General of Ceylon and edited by N.S.Perera, Actg. Asst. Surveyor General of Ceylon. Highlighted items in this issue are:- “A sports (New) Pavilion was constructed at the entrance to the sports grounds, Survey Training School”; “Derivation of Place names in Hikkaduwa area”; “Is the Elephant frightened of the Horse?” - this episode is very interesting and the author related his experiences and asking from readers “is the elephant really frightened of the horse?” ; “Hints to young surveyors to protect from leeches, author says Cinnamon oil has been found to be an effective killer of leeches”.

**The Quarterly News Letter No. 9** was published in April 1950, by order of I.F. Wilson, C.B.E.,M.C., F.R.I.C.S., Surveyor General of Ceylon and edited by N.S.Perera, Asst. Surveyor General of Ceylon. The important highlight in this issue is retirement of Mr.R.L.Brohier. It was mentioned as follows in the issue “Mr. R.L. Brohier, O.B.E., F.R.I.C.S., F.R.G.S., Assistant Surveyor-General retired on January 17, 1950, after over 40 years meritorious service. He joined the Department on January 1, 1910, as a Supernumerary Surveyor, and throughout his long service his work was characterized by thoroughness and efficiency of a high order. Much of his spare time was spent in the study of the Ancient Irrigation Works of Ceylon, and he is recognized as an authority on the subject. Mr. Brohier was the first editor of this News Letter.” Another interesting topic was the reply to last issue titled “Is the Elephant frightened of the Horse?” This reply seems to be substantiating the notation that the Elephant is frightened of the Horse.

Mr. H.V. Hopman, Government Surveyor related his experiences with a python:- “ While proceeding to the field early one morning along one of the cleared lines, with two labourers carrying cattles and poles, following me, I stepped on what I took to be one of the dried logs which littered the place. As I placed one foot on the log and stepped across, I unaccountably tripped and fell forward. Glancing back, I saw the labourer who was immediately behind me shout something and strike something very close to my feet with his catty. It was only then that I realized that one leg-my right, I think-was within one coil of a python. As soon as this labourer struck-he had hit it just below the head-the python released my leg, coiled up and hid it's head under its coils. By this time the other labourer came up and together they prised its head out with their poles and killed it. The python measured 16 feet and it's girth was one foot 7 inches”.

**The Quarterly News Letter No. 10** was published in April 1950, by order of I.F. Wilson, Surveyor General of Ceylon and edited by N.S.Perera, Asst. Surveyor General of Ceylon. The qualifications are not given with their names from this issue. This issue mentioned about how the survey department celebrated its 150<sup>th</sup> anniversary with Rt. Hon. D.S. Senanayake, first Prime Minister and first Minister of Agriculture and Lands of Sri Lanka. To mark this occasion a brass tablet was let into the wall at the entrance to S.G.O.

One of the news mentioned in this issue is that a playground for children was constructed in the Survey Camp which would be the present children park at ISM. Another highlighted issue was Mr. R.T. Samarasinghe, Govt. Surveyor, was granted permission to register himself as Vedarala in 1948 and according to his Superintendent's diary said surveyor practiced Ayurvedic Medicine entirely free of charge from his camp outside his office hours and this work did not interfere with that surveyor's official efficiency and out-turn.

Another interesting topic in this issue was “Where do Elephant die?” raised by the same author who posed the question “Is the Elephant frightened of the Horse?” In News Letter No.8, further he wrote regarding this matter “My believe is that all elephants die in one particular spot unknown to, and inaccessible by human beings. About this possibility that one of you more experienced in jungle life, knows the secret. I too would wish to be left into the secret, if a secret there to be”. Moreover, many interesting experiences of surveyors engaged on Gal Oya surveys in Ampara were also shared in this issue.

**The Quarterly News Letter No. 11** was published in October 1950, by order of I.F. Wilson, Surveyor General of Ceylon and edited by N.S.Perera, Asst. Surveyor General of Ceylon. One of the highlighted items in this issue is an announcement to conduct the examinations of the Royal Institute of Chartered Surveyors under the supervision of S.G. in 1951. In this issue an interesting experience shared by a surveyor for “Prevention of Tick Bites” by applying “skat” instead of coconut oil and it continues as follows, ‘The use of “skat” as a preventive against tick bites does not appear to be sufficiently widely known. “Skat” is termed an insect repellent and was in the Medical Kit issued to field officers of the Department and can be purchased from any chemist. A small quantity of “skat” applied lightly over exposed parts of the body has been found to be highly effective in preventing tick bites. All field officers who are exposed to ticks are strongly recommended to give “skat” a trial. One advantage in the use of “skat” is that it does not

produce uncomfortable feeling which accompanies the application of coconut oils. Another advantage is that “skat” is also very effective against mosquitoes.

There is a sad report by Mr. M.B. de S. Ranatunga, Govt. Surveyor regarding a tragic death of a young survey labourer due to drowning occurred in the Illukkuchenai Tank which is seven miles from Akkaraipattu. According to him two surveyors and about forty labourers paid their last respects to Geeris who was buried at Illukkuchenai itself.

**The Quarterly News Letter No. 12** was published in January 1951, by order of G.B. King, Acting Surveyor General of Ceylon and editor’s name was not mentioned in this issue. The main highlight in this issue is leave prior to retirement taken by Mr. I.F. Wilson, Surveyor General and it was mentioned as follows in the issue “Mr. Wilson came to Ceylon in February, 1921, and was in charge of parties of surveyors engaged on block surveys in the Southern and Sabaragamuwa provinces, until July, 1930. He was then in charge of the Training school at Diyatalawa until may, 1931, when he assumed duties in charge of the province of Sabaragamuwa, and subsequently took charge of the Central province from 1932 to 1934. After a period of leave out of the island, he was transferred to the head office in February 1935, and was superintendent of map publication until may 1937, when he was appointed to act as Assistant Surveyor General and was confirmed in that appointment in June 1937, and promoted as Deputy Surveyor General in April 1943, and Surveyor General in November 1946. In the early part of the world war Mr. Wilson filled the important emergency post of Assistant Censor in charge of Telegraph Censorship, and on reversion to the department acted as Assistant Censor, in addition to his duties, until July 1941. He visited the Survey Department of India in 1942 to co-ordinate our map reproduction for Military purpose with that of India, and did much to assist in carrying out the heavy programme of urgent work which the Department was called upon to undertake. Mr Wilson was keenly interested in encouraging good draughtsmanship and artistic ability in the Department and also in the encouragement of Sports and the welfare of the Staff.”

Further in this issue another interesting story named as “Attack by Bear” reported by Mr. F. Wijeweera read as follows: “I have to report that my labourers, who were transporting landmarks along a traverse were suddenly set upon by a bear. The labourer nearest the animal who was the target for the attack flung the land mark he was carrying with all the force he could muster on the snarling beast. As luck would have it, the missile struck the animal on its head with deadly accuracy and sent it reeling back. Without waiting to investigate any further and carry home their initial success, the labourers who were together fled to safety raising cries. Their cries brought to the scene the labourer, who had gone ahead with the gun. He made short shrift of the animal and had it removed to the camp.”

**The Quarterly News Letter No. 13** was published in April 1951, by order of G.B. King, Surveyor General of Ceylon and editor’s name was not mentioned in this issue too. One of the highlighted items in this issue is that according to welfare officer arrangements have been made to get assistance from Government to provide the field staff with radio sets but it failed. So, arrangements have been made with local firm to buy cheap radio sets at

discount. These sets have been tested at various stations and all but one (at Bible) was very satisfactory. Under the miscellaneous section, there is an announcement by The Prime Minister of that period that he would be glad if specimens of the “Grey Orchid”, that was discovered in the forest are collected and forwarded to Botanical Gardens, public parks, or to the nearest Agricultural Office. Surveyors are also requested to send the same to the Superintendent of Surveys, Diyatalawa.

In this issue, Editorial Notes has been included as a section for the first time and through that the Editor made an announcement to all members of the department to submit their articles on any matters of technical or general interest, accounts of unusual or notable experiences, or of local customs and developments, verses, black and white drawings or photographs of special interest for inclusion in Quarterly News Letter.

**The Quarterly News Letter No. 14** was published in July 1951, by order of G.B. King, Surveyor General of Ceylon and editor’s name was not mentioned in this issue too. In this issue under Examinations section there is an announcement regarding the examination of the Royal Institute of Chartered Surveyors; London was held in Ceylon, after the lapse many years at the Surveyor General’s Office, Colombo from April 9 to 13 under the personal supervision of the Surveyor General. By responding to editors’ announcement regarding articles from members in last issue, three technical related articles were published and namely by Air Surveys and Photogrammetry by Mr. V. Rasaratnam, Cross hairs and their Origin by Mr. W.M. Flanderka, and Radio as an Aid to Survey by Mr. P.U. Ratnayake. Out of these three articles written the one by Mr. V. Rasaratnam was too lengthy so it was issued as a separate paper with this issue and the editor proposed to write short notes for the future issues. And also there is a Camp Notes by a surveyor Mr. Bertram Rulach. According to him, he captured two pythons at Gal Oya and presented them to the Zoo. He received the thanks from Major Weinmen and requested for more live reptiles.

**The Quarterly News Letter No. 15** was published in October 1951, by order of G.B. King, Surveyor General of Ceylon and editor’s name was not mentioned in this issue too. One of the highlighted news is the visit of New Zealand Surveyor General Mr. R. G. Dick. On 4<sup>th</sup> of August 1951, he broke his journey home from Europe to spend a week in Ceylon. His whole itinerary involved a trip round the world, going from New Zealand to the United States of America and back to New Zealand, studying the work of surveyors, and speaking on the subject of reciprocity in the recognition of professional qualifications of surveyors in different countries. In our country he visited some of Engineering survey work at Giritale, Huruluwewa, and Elahera and town surveys at Kurunegala and Anuradhapura and also some sporadic survey work at Kandy and the training school at Diyatalawa.

Another News in this issue is a holiday home for the use of the skilled and minor employees of the Department has been opened at the Survey Camp, Diyatalawa and also a recreation room for the skilled and minor employees of the Head Office is being arranged. There is a lengthy article about New Zealand by Mr. J.L.T.E. Dassanayake, S.A.S. who visited to New Zealand at the end of 1950. In addition to this there is a story by Mr. S.

Kumarasamy, Govt. Surveyor regarding 'Mauled by a Bear'; according to him one of his survey labourer V.Kumaru, stationed at Pan Medawachchiya, was mauled by a bear close to his camp during mid-day. The labourer was taken unawares and the bear bit him on his left leg tearing off a piece of flesh. In the struggle the labourer fell down and whilst pressing his head to the ground was badly clawed by the animal whilst it tried to turn his head up. The labourers' cries brought the other labourers to his aid, and the bear getting scared ran away. The labourer who sustained serious injuries on his left leg, head and shoulders was taken by car to the Trincomalee hospital immediately admitted and got treatment until his wounds were completely healed.

Mr.M.T.M. Rafeek, Superintendent of Surveys helped me to prepare this article. The same topic will be continued in the next issue of the Journal narrated by him.



### Brain teasers :

#### Three 5s to make a target number 1

$$\frac{5 - 5}{5} = 0$$

$$\frac{5 + 5}{5} = 2$$

Using three 5s, you can make equations (as shown) to have target numbers such as 0 and 2. How do you make a target number of 1?

#### Sum of 4 Squares is a square of a number

$$A^2 + B^2 + C^2 + D^2 = E^2$$

A, B, C, D, and E are 5 distinct whole numbers from 1 to 9 where  $A < B < C < D < E$ . What should they be to make the above equation?

You are requested to email your answers to the EDITOR

## **Cadastral Data Preperation in Computer Aided Drafting (CAD) Systems**

by

*K.A.B.S.Rupasinghe*

*Supdt. of Surveys (R&D),*

*Surveyor General's office, P.O. Box 506, Colombo-05, Sri Lanka.*

*Email: jinkabs@gmail.com*

### **1. Introduction**

There are two requirements in producing output of Cadastral surveys carried out under 'BIMSAVIYA' program to issue titles to lands in Sri Lanka. The first requirement is to prepare Cadastral data (Landscape data) in digital format in compliance with the standards and specification of the Cadastral database where such data is stored for re-use, presentation and maintaining data quality (i.e. completeness, accuracy, consistency etc.). The second requirement is the preparation of Cadastral Plans in analogue format based on the standards and specification of the visual output quality in issuing titles to lands. This paper introduces a method employing existing functionality in CAD (Computer Aided Drafting) software (e.g. AutoCAD & ZWCAD) that are used by the Survey Department for Surveying data processing to serve the aforesaid two requirements.

### **2. Problem scope**

In CAD interface, more often, a drawing is completed including plotting in Model Environment (Model tab) display mode which is called single representation of the CAD drawing. Different sections of drawings are also created in the same environment (e.g. preparation of sectional drawings in Cadastral plans). The problem of creating drawings of this nature is that it leads to inconsistency in the original drawing such as duplicating lot numbers, splitting lot numbers, printing insertion point of lot numbers outside land parcels, printing arrows etc. which must be rectified when data is populated in to the Cadastral database.

### **3. Model environment Vs Paper Space**

Model environment is the default view of the CAD interface. It can be used to prepare whole digital Cadastral Map to meet standards and specification for storing data in a Cadastral database.

Paper space is a kind of layout environment to create multiple views of your drawing called floating viewports (Layout views). The Paper Space (Layout View) can be utilized to print analogue Cadastral plans of several layouts (sections). The two Layout tabs appearing at bottom-left corner in CAD interface next to Model tab are specifically geared towards plotting on Paper space display mode (Layout view). The advantages of Layout view are;

- It enables you to control drawing scale, title blocks and different layer settings.
- You can create as many Layout tabs as you like, each setup for different type of output (e.g. have two or three Layout tabs, each setup to create different

section of the drawing, scale of drawing or with different Layer configurations).

- You can setup multiple views of your drawing at different scales within a single layout tab.
- Importantly, you can draw and add text and dimensions in Layout tabs just as you do in Model space.

#### 4. Creating a Paper Space Layout

Gateway to Paper Space is the Layout tab at the bottom of the CAD window. When Model tab is selected, Model environment is switched on and when Layout tab is selected, Paper Space is switched on. Tip: When Tilemode system variable is set to 1 (on) which is the default, Model environment becomes active and when it is set to 0 (off) Paper Space becomes active. Steps to enter Paper Space are;

- Open the required drawing and ensure that CAD display shows all the drawing.
- Click on Model tab and select new Layout to create a new Layout tab.
- Click on the required Layout tab and then right click on Page Setup Manager to open Page Setup Manager dialogue box.
- Click Modify button to open the Page Setup dialog box
- Select the required Paper Size from the Paper Size drop-down list (note: the Paper Size you select here determines the margin of the Paper Space Layout area).
- Set Scale to 1 : 1 (this is compulsory) and close Page Setup dialog box.

**Note:** When Paper Space Layout Mode is on, the White background represents the paper on which your drawing will be printed. The dashed line immediately inside the edge of the White area represents the limits of Printer's margin. Finally the solid rectangle that surrounds your drawing is the outline of the Layout viewport (see figure 1).



Figure 1: Entire Drawing on Layout Viewport

## 5. Setting Properties in Paper Space Layout

- Click the viewport border, which is a solid rectangle surrounding the drawing.
- Right-click and choose Properties from the shortcut menu. You can change viewport layer, color and line-type as any other object in CAD.
- Close the properties palette.
- With the viewport selected, click Erase tool in Modify toolbar. The view of your drawing disappears with the erasure of the viewport. Do not panic because drawing objects in Model Space are still there. Type U or click Undo button to restore the viewport.
- Double click anywhere within the viewport boundary. Notice that the usual UCS icon appears at lower-left corner of the viewport and the Layout UCS icon disappears highlighting the outline of the viewport (see figure 2).

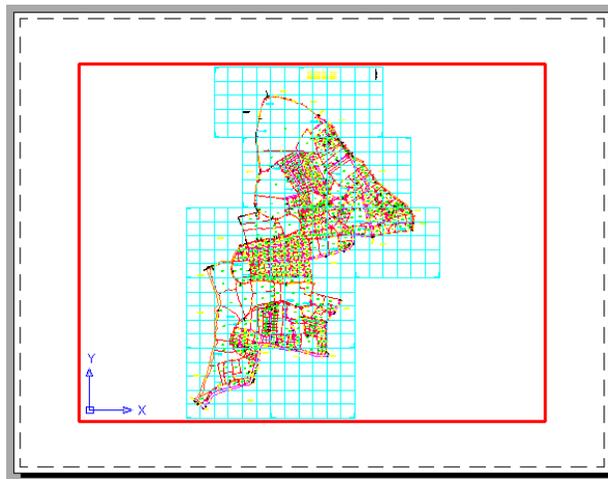


Figure 2: Model Space on Layout View

- Now model space in Layout View is on and your drawing can be zoomed and panned. Changes of the view take place only within the boundary of the viewport.
- Choose View > Zoom > All or type **Z** enter and **A** enter.
- To return to Paper Space, double-click an area outside the viewport

**Tip:** It is also possible to type **PS** and enter to return to Paper Space and **MS** and enter to return to Model Space within the viewport.

## 6. Scaling the Layout

A viewport view can exactly be scaled by making changes to properties of the viewport. It must be ensured that the scale is set to 1 : 1 in Page Setup dialog box by right-clicking the relevant layout tab before scaling the layout. Steps to set the scale of a viewport are;

- Press ESC key to clear any selections. Then select the viewport, right-click, and choose Properties from the shortcut menu.

- Scroll down the Properties palette by using the scroll bar to the left side and then locate the Standard Scale option under the Misc. category.
- Select the Scale required or if the required one is not available, type the Scale by selecting Custom option.
- After fixing the Scale, move/ stretch the viewport border as required (in case of sectioning a Plan, stretch or contract outline of the viewport to Grid border of the Plan using object snap End Point selection).
- Then type the text required on the Layout (e.g. section reference, lot numbers) and draw clitches, arrows to lots as and when necessary.
- Move the entire viewport selecting base as lower-left corner to required position of printing paper based on origin [0,0] of the Paper Space (i.e. lower-left paper margin) by specifying coordinates of new position of the lower-left corner of the viewport.
- Right click on the Layout Tab at bottom and rename it (e.g. Section 1).
- Now your layout is ready for printing (see figure 3).

**Note :** When using Custom option, value entered for scale is derived as follows.

Custom value = 1 / Printable unit

e.g. for 1 : 500 scale, Custom value = 1 / 0.5 = 2; for 1 : 2000 it is 1 / 2 = 0.5.

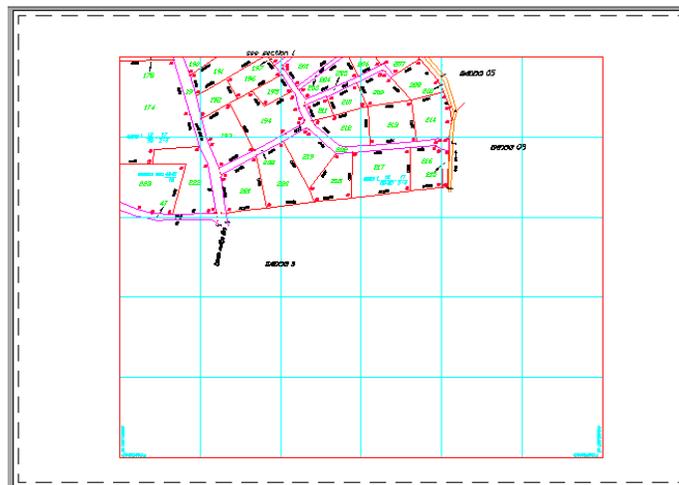


Figure 3: Scaled Sectional Drawing on Viewport

**Note:** Whatever is edited on model automatically updates relevant Layout viewports (e.g. sectional drawings in Paper Space). However, whatever is edited on Layout viewports does not update the original drawing on Model environment.

## 7. Creating Multiple Paper Space Viewports

Steps to create multiple view ports in Paper space are;

- If you are already in Layout view, it means that only single viewport is available. Click on viewport border to select it (viewport border is the solid rectangle surrounding your drawing).
- Click the Erase tool to erase the viewport. Your drawing disappears. Do not panic because drawing objects in Model Space are still there.
- Choose from main menu View > Viewports > 2 Viewports or type MV at command prompt.
- If you type **MV** and Press Enter, then type **2** (i.e. to create two viewports) and press Enter. And then accept the default prompt: <Vertical> and press Enter.
- If you select **2 Viewports** from main menu, select Vertical or Horizontal option and Press Enter.
- Now appears is the prompt: The Specify first corner or [Fit] <Fit>.
- Press Enter to accept default Fit option or create a window by click on lower-left corner and upper-right corner. The Fit option fits the viewport layout to the maximum area allowed in your Paper Space view (you can see now the dashed line showing the margin has disappeared. That is because the viewports are pushed to the margin limits by the Fit option.).
- Now two vertical viewports appear to the margin of the paper (see figure 4).

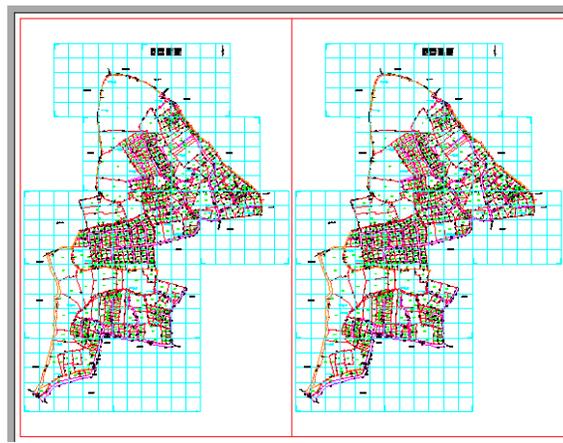


Figure 4: Two vertical viewports fit to margin of paper

## 8. Reaching inside multiple Viewports

Now, suppose you need access to the objects within the viewports in order to adjust their display and edit your drawing.

- Double click inside the Viewport or type **MS** and press Enter to change to Model Space mode (the first thing you notice is that the UCS icon changes back to its L-shaped arrow form and Viewport margin gets highlighted).

- Move cursor over each viewport. Notice that in one of the viewports, the cursor appears as the CAD crosshair cursor, while in the other viewports it appears as an arrow pointer. The viewport that shows the CAD cursor is the active one (also the viewport with bold border); you can pan and zoom, as well as edit objects inside it.

## 9. Scaling Views in Paper Space

This is similar to what is described under Section 4; Scaling the Layout. The only difference is that different scales can be set to multiple viewports (see figure 5).

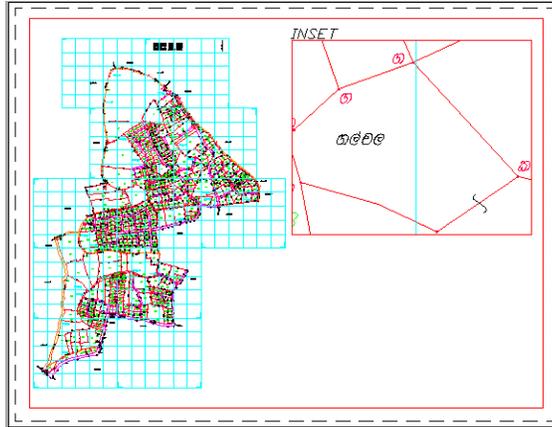


Figure 5: Drawing and Inset at two different scales

Steps to set Scale for multiple viewports are;

- Click border of viewport of which scale needs be changed.
- Follow the same steps as given under Section 4; **Scaling the Layout**.

## 10. Creating Odd-shaped Viewports

There may be situations where a rectangular viewport will not provide a view appropriate for what is necessary to accomplish. For example, there are instances to isolate part of the plan that is L-shaped or even irregular.

Steps to create such viewports are;

- Click Clip in the viewport toolbar or type at command prompt: VPCLIP.
- At the select viewport to clip: prompt; click the viewport border.
- At the select clipping object or [Polygonal] <Polygonal>: prompt, press Enter.
- Draw the outline of the viewport using Polyline option as required.
- After drawing Polyline, press Enter. The viewport changes to conform to the new shape.
- Click the viewport border to expose its grips.
- Click a grip and move it to new location.

Note: Always make sure that the required scale of the layout view is set before launching CLIP operation.

### 11. Understanding Plotter Limits

To accurately place a plot on the computer, plotter's **Hard Clip Limits** must be known. These are like built-in margins beyond which plotter will not plot. These limits vary from plotter to plotter.

Hard Clip Limits for printers often depend on the software that drives them. It is needed to refer to manual or use the trial-and-error method of plotting few samples to see how they come out.

### 12. Origin of Plotter

Location of plotter's origin is important to know when placing a paper on your plotter. In many plotters, lower-left corner is used as the plotter's origin. However, in few plotters, centre of plot is used as the origin.

### 13. Conclusion

This paper describes how model environment and Paper Space can be utilized in CAD software to prepare digital Cadastral data as well as Cadastral plans. Structure of the two environments in CAD helps to maintain Cadastral data in the Survey Department to fulfill the Cadastral database requirement to process original data (Landscape data) and the requirement of analogue Cadastral plans enhancing visual impression by adding various symbols and text.

### Reference:

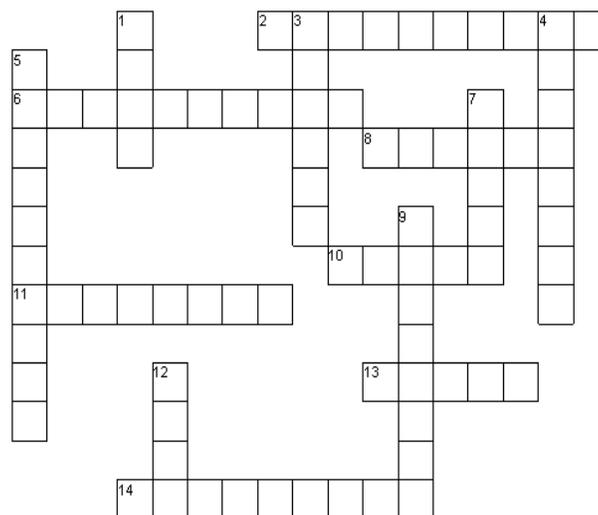
Omura G. (2005) AutoCAD 2006 and AutoCAD LT 2006. Wiley Dreamtech India (p) Ltd., 4435/7, Ansari Road, Daryaganj, New Delhi-110002.

AutoCAD 2010 User Documentation. [WWW documentation]. URL:  
<http://docs.autodesk.com/ACD/2010/ENU/AutoCAD>

## Driving & Traffic

### ACROSS

- 2 increase speed
- 6 circular turning point
- 8 fuel for vehicles
- 10 operate a vehicle
- 11 go past another vehicle
- 13 rapidity
- 14 light in front of vehicle



### DOWN

- 1 money paid as a penalty
- 3 transmission device
- 4 long line of traffic
- 5 intersection
- 7 slow down
- 9 sign indication directions
- 12 division of road for traffic

For Solution see page 24

## ACCEPTABLE ERRORS IN AREA COMPUTATIONS

by

S.T. Herat

Chartered Surveyor, Former Surveyor General

11A/1, School Avenue, Kalubowila, Dehiwala

Email : sam.herat@gmail.com

**1. Abstract**

Before the advent of computers the area of a block of land was obtained from a Survey Plan using a device called a computing scale. This was an estimation procedure and was dependent on the scale of the plan. Hence, two independent computations would produce two different results. The situation has now changed. The area is computed directly using the coordinates of the boundary points. This would mean that there is no error in the computation procedure. The errors will be in the coordinates. Hence two independent surveys of the same block of land will yield two slightly different extents. In this paper an attempt is made to derive a simple formula to calculate this acceptable difference in extent obtained from two independent surveys.

**2. Introduction**

As we are all aware computation of extents should be performed digitally using the original field notes. That is the area should be computed using the coordinates of the boundary points. This would mean that there is no error in the area computation procedure. The error will be in the coordinates. The identification and survey of boundary points are often problematic. It appears that two independent surveys of a boundary point can with the greatest care yield different results. The Research & Development branch of the Survey Department had carried out an investigation and arrived at the value of ten centimeters (10cm) for the accuracy of a boundary point. Hence, the extent obtained by two surveys will differ.

Cadastral Surveys in my opinion should be categorized into classes depending on the value of the land. However, the Surveyor General has stated that all Cadastral Surveys, irrespective of the location should have the same accuracy. Based on this, it is necessary to obtain a formula to calculate this acceptable difference in the extent.

**3. Analysis**

I have derived a formula showing the relationship between the boundary point error and the error in extent. (See annexure 'A' for the derivation)

$$\sigma T = \frac{(3556 \epsilon)}{\left( P \cdot \sin \left( \frac{360}{N} \right) \right)^{\frac{1}{2}}} \text{----- (1)}$$

Where	P	–	Extent in perches.
	N	–	Number of boundary points.
	ϵ	–	Error in the extent in perches.
	σT	–	Linear error in the boundary point.

The Research & Development branch of the Survey Department has obtained a realistic value for the possible error of a boundary point. The value is 100 mm.

That is  $\sigma_T = 100$  mm

So from equation (1),

$$\epsilon = 0.028 \left[ P \cdot \sin \left( \frac{360}{N} \right) \right]^{\frac{1}{2}}$$

It is seen that the error  $\epsilon$  decreases with the increase in the number of boundary points. That is the accuracy increases. The least accurate case will be

when  $N = 4$

Then  $\epsilon = 0.028 \sqrt{P}$

This is the error in extent in perches we can expect.

So the tolerable different in extent between two independent surveys is

$$\Delta \epsilon = \sqrt{2} \cdot \epsilon$$

That is

$$\Delta \epsilon = 0.04 \sqrt{P} \text{ perches, } P \text{ is in perches.}$$

$$\Delta \epsilon = 0.2 \sqrt{A} \text{ SqM, } A \text{ is in SqM.} \quad [1 \text{ perch} = 25.2928 \text{ SqM}]$$

#### 4. Conclusion

- (1) A boundary point should be surveyed to an accuracy of  $\pm 10$  cm in position.
- (2) There should not be any constant or systemic errors in the observations. This means that the Instrument should be calibrated.
- (3) Even for a rectangular plot of land, there should be more than four boundary points, as that will increase the accuracy.

#### 5. Acknowledgement

I would like to express my gratitude to Mr. M.Kalutanthri a former President of the Surveyor's Institute of Sri Lanka for initially requesting me to investigate the accuracy of a surveyed extent of a land parcel. My thanks are due to Mr. H.H. Subasinghe the previous president of the Surveyor's Institute. He had numerous discussions with me along with the officials of the Survey Department in this regard. According to the instructions of the late Surveyor General Mr. B.J.P. Mendis, Mr. G.D.S.K. Gunaratne Snr. Supdt. of Surveys along with the other officials of the R&D branch in the Survey Department contributed a lot to this investigation. They had carried out field investigations to determine the accuracy of a surveyed boundary point. They had also verified the logic involved in this analysis, and finally accepted to include this formula to the next edition of the Departmental Survey Regulations. I am indebted to them for this decision.

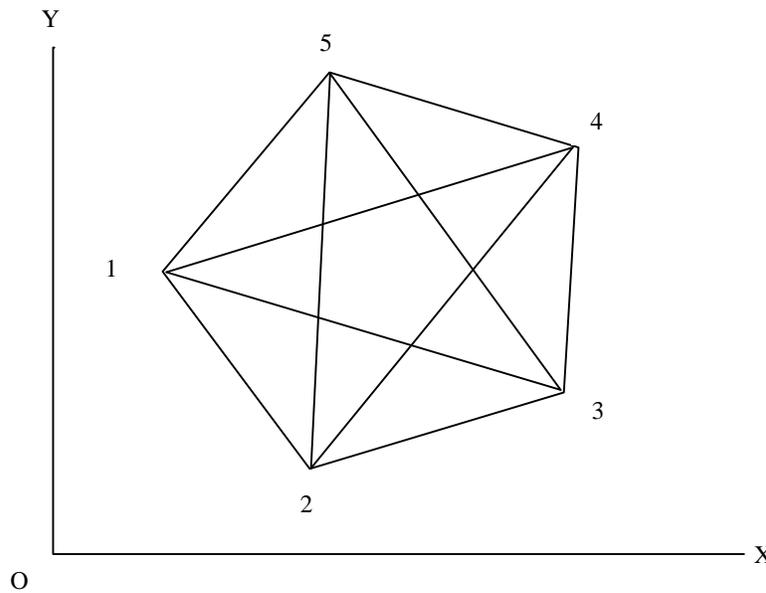
Annexure 'A'Derivation of formulae

Fig. 1

Consider a block of extent "A" square-meters (SqM) consisting of 5 sides.

Then function,

$$f = 2A = Y_1(X_5 - X_2) + Y_2(X_1 - X_3) + Y_3(X_2 - X_4) + Y_4(X_3 - X_5) + Y_5(X_4 - X_1)$$

Where X's and Y's are coordinates of boundary points.

Let the corresponding errors in the boundary points be,

$$(\sigma X_1, \sigma Y_1), (\sigma X_2, \sigma Y_2), (\sigma X_3, \sigma Y_3), \dots \text{ etc}$$

Then using the law of propagation of errors,

$$\left(\frac{\delta f}{\delta A} \sigma A\right)^2 = (2 \cdot \sigma A)^2 = \left(\frac{\delta f}{\delta X_1} \delta X_1\right)^2 + \left(\frac{\delta f}{\delta Y_1} \delta Y_1\right)^2 + \dots$$

Hence, we have

$$\begin{aligned} 4 \cdot \sigma A^2 &= (Y_2 - Y_5)^2 \sigma X_1^2 + (X_5 - X_2)^2 \sigma Y_1^2 + (-Y_1 + Y_3)^2 \sigma X_2^2 + (X_1 - X_3)^2 \sigma Y_2^2 \\ &+ (-Y_2 + Y_4)^2 \sigma X_3^2 + (X_2 - X_4)^2 \sigma Y_3^2 + (Y_3 - Y_5)^2 \sigma X_4^2 + (X_3 - X_5)^2 \sigma Y_4^2 \\ &+ (Y_1 - Y_4)^2 \sigma X_5^2 + (X_4 - X_1)^2 \sigma Y_5^2 \end{aligned}$$

Supposing the errors in the X and Y coordinates at a point are equal. So that,

$$\sigma X_1 = \sigma Y_1 = \sigma x_1$$

$$\sigma X_3 = \sigma Y_3 = \sigma x_3$$

$$\sigma X_5 = \sigma Y_5 = \sigma x_5$$

$$\sigma X_2 = \sigma Y_2 = \sigma x_2$$

$$\sigma X_4 = \sigma Y_4 = \sigma x_4$$

$$\begin{aligned}
 4.\sigma A^2 &= \left\{ (Y_5 - Y_2)^2 + (X_5 - X_2)^2 \right\} \sigma_1^2 + \left\{ (Y_1 - Y_3)^2 + (X_1 - X_3)^2 \right\} \sigma_2^2 \\
 &+ \left\{ (Y_2 - Y_4)^2 + (X_2 - X_4)^2 \right\} \sigma_3^2 + \left\{ (Y_3 - Y_5)^2 + (X_3 - X_5)^2 \right\} \sigma_4^2 \\
 &+ \left\{ (Y_4 - Y_1)^2 + (X_4 - X_1)^2 \right\} \sigma_5^2 \\
 4.\sigma A^2 &= d_{5,2}^2 \sigma_1^2 + d_{1,3}^2 \sigma_2^2 + d_{2,4}^2 \sigma_3^2 + d_{3,5}^2 \sigma_4^2 + d_{4,1}^2 \sigma_5^2
 \end{aligned}$$

Where the d's are diagonals connecting points on either side of each boundary point. For example  $d_{5,2}$  refer to the diagonal joining point numbers 5 and 2, which are on either side of point no: 1.

In addition supposing the errors of all boundary points are the same.

$$\sigma_1 = \sigma_2 = \sigma_3 = \sigma_4 = \sigma_5 = \sigma T$$

$$4.\sigma A^2 = (d_{5,2}^2 + d_{1,3}^2 + d_{2,4}^2 + d_{3,5}^2 + d_{4,1}^2) \sigma T^2$$

$$\text{So that } \sigma T = 2 \frac{\sigma A}{(d_{5,2}^2 + d_{1,3}^2 + d_{2,4}^2 + d_{3,5}^2 + d_{4,1}^2)^{\frac{1}{2}}}$$

In general for a 'N' sided polygon

$$\text{So that } \sigma T = 2 \frac{\sigma A}{(d_{1,2}^2 + d_{1,3}^2 + d_{1,4}^2 + \dots + d_{n-1,1}^2)^{\frac{1}{2}}} \dots \dots \dots (1)$$

The number of diagonals will be equal to the number of boundary points.

Now consider an 'N' sided polygon having equal sides (L). Then, the diagonals (d's) will all be equal say 'd'.

Then from equation (1),

$$\begin{aligned}
 \text{So that } \sigma T &= 2 \frac{\sigma A}{(Nd^2)^{\frac{1}{2}}} \\
 \sigma T &= 2\sigma A / d\sqrt{N} \dots \dots \dots (2)
 \end{aligned}$$

$$\begin{aligned}
 \text{Also, } \frac{d}{2} &= L \cos \frac{\theta}{2} \\
 d &= 2 L \cos \frac{\theta}{2} \dots \dots \dots (3)
 \end{aligned}$$

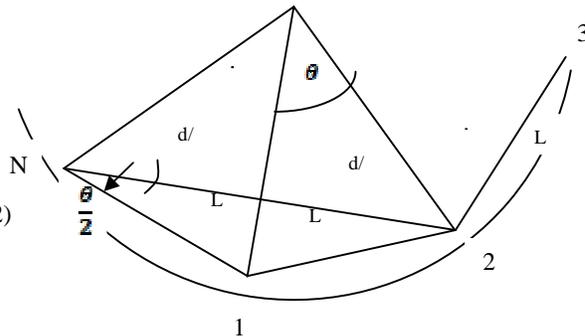


Fig. 2

We should now obtain an expression for 'L' in terms of the area.

Again consider an 'N' sided polygon having equal sides 'L'.

$$\theta = \frac{360}{N}$$

$$\frac{L}{\sin \theta} = \frac{L_1}{\sin (90 - \frac{\theta}{2})}$$

$$L_1 = \frac{L \cos \frac{\theta}{2}}{\sin \theta}$$

$$L_1 = \frac{L}{2 \sin \frac{\theta}{2}}$$

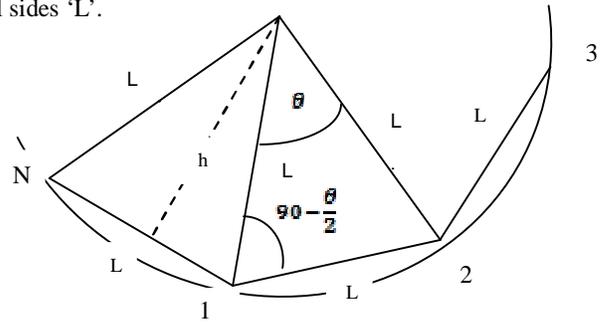


Fig. 3

The area of each triangle =  $\frac{1}{2} L h$

$$= \frac{1}{2} L \left( \frac{L}{2} \right) \tan \left( 90 - \frac{\theta}{2} \right)$$

$$= \frac{L^2}{4 \tan \left( \frac{\theta}{2} \right)}$$

Area of the polygon =  $\frac{N L^2}{4 \tan \left( \frac{\theta}{2} \right)} = A \text{ SqM}$

If the area is 'P' Perches, then  $A = 25.293P \text{ SqM}$

So,  $\frac{N L^2}{4 \tan \left( \frac{\theta}{2} \right)} = 25.293P$

Then  $L = 10.0584 \left( \frac{P}{N} \tan \left( \frac{\theta}{2} \right) \right)^{1/2}$  .....(4)

Let the acceptable error in extent be 'e' perches

Then  $\sigma A = 25.293 e \text{ SqM}$ ,      Then from equation (2),  $\sigma T = \frac{50.586 e}{d \cdot N}$  meters

We had from equation (3) and (4),  $d = 2 L \cos \frac{\theta}{2}$  and  $L = 10.0584 \left( \frac{P}{N} \tan \left( \frac{\theta}{2} \right) \right)^{1/2}$

So,  $d = 20.117 \left( \frac{P}{N} \tan \left( \frac{\theta}{2} \right) \right)^{1/2} \cos \frac{\theta}{2}$

and  $\sigma T = \frac{50.586 e}{20.117 \left( \frac{P}{N} \tan \left( \frac{\theta}{2} \right) \right)^{1/2} \cos \frac{\theta}{2} \cdot N} = \frac{2.5145 e}{\left( \frac{P}{\cos \left( \frac{\theta}{2} \right)} \sin \left( \frac{\theta}{2} \right) \left( \cos \frac{\theta}{2} \right)^2 \right)^{1/2}}$

$\sigma T = \frac{2.5145 \sqrt{2} e}{(P \sin \theta)^{1/2}} = \frac{3.556 e}{(P \sin \theta)^{1/2}}$

Since  $\theta = \frac{360}{N}$ .

$\sigma T = \frac{3.556 e}{(P \sin \left( \frac{360}{N} \right))^{1/2}} \text{ m}$  or  $\sigma T = \frac{3556 e}{(P \sin \left( \frac{360}{N} \right))^{1/2}} \text{ mm}$

## **Some of the important tips for Digital Plan making**

*by*

*B.D.A.Chandraguptha*

*Senior Superintendent of Surveys (IT)*

*Surveyor General's Office, P.O. Box 506, Colombo 05, Sri Lanka.*

*Email : sscomp@slt.net.lk*

As far as we know, most of the Surveyors in the Survey Department use digital method to prepare their plans. Some of the important tips for digital plan making can be classified as follows:

1. Always use layers described in DSR chapter for Digital Plan Preparation.
2. Make sure required layer to current before draw the line features on that layer.
3. Make sure OSNAP should be on before drawing line feature.
4. Always use single stroke fonts for texts inside the drawing.
5. Text size should be in accordance with DSR specifications and surveyor should calculate the text height in AutoCAD according to the plan scale.
6. Make sure edge comparison tracing should be checked with hard copy of digital drawing.
7. Make sure all required layers for hard copy should be on before take the final print of digital plan.
8. Make sure correctness of marginal information, scale, north line and other relevant details before take the final print of digital plan & Marginal information of TL should be matched with plan.
9. Make sure correctness of the spelling of textual data appeared on the digital drawing & TL. Use spell checker for check the correctness of spelling.

In my experience, I have found that following mistakes in digital drawings & TL prepared by the surveyors.

1. Not use the correct layer names for layers
2. Some of the line features appeared on text or point feature layers.
3. Use different type of fonts instead of single stroke fonts

4. Edge comparison tracing not match with hard copy of the drawing
5. Many spelling mistakes
6. Incorrect marginal information, in correct scale and missing north line, etc. in digital plan & TL
7. Sizes of the letters are not match with DSR values.
8. Most of the line features connected without considering OSNAP modes.
9. Final digital drawings + TL and final hard copies are not match. Final amendments are not appeared on final digital drawings + TL.

In addition to that proper backing up of digital data is essential to avoid losing of data due to failure of computer system. Therefore you have to make sure proper periodical backing up system to be used by each and every individual whenever they prepared digital survey plan & TL.

As you are aware there are many computer viruses available in everywhere. Therefore use proper virus protection system to avoid of virus infections to your digital data. Make sure all external inputs such as floppy disks and pen drives to be checked for viruses before it use in the computer.

It is your responsibility to make sure correct preparation of digital plans (digital drawing + TL + report). According to DSR hard copy as well as soft copy of survey plans (digital drawing + TL + report) should be stored for future reference. Corporation of all responsible officers in connection with these matters are much appreciated for fulfillment of our tasks.

## Driving-Traffic

(solution)



## The Geodatabase

### A Comprehensive approach to Managing / Storing 1:10,000 Topographic Data Base in GIS Branch

by

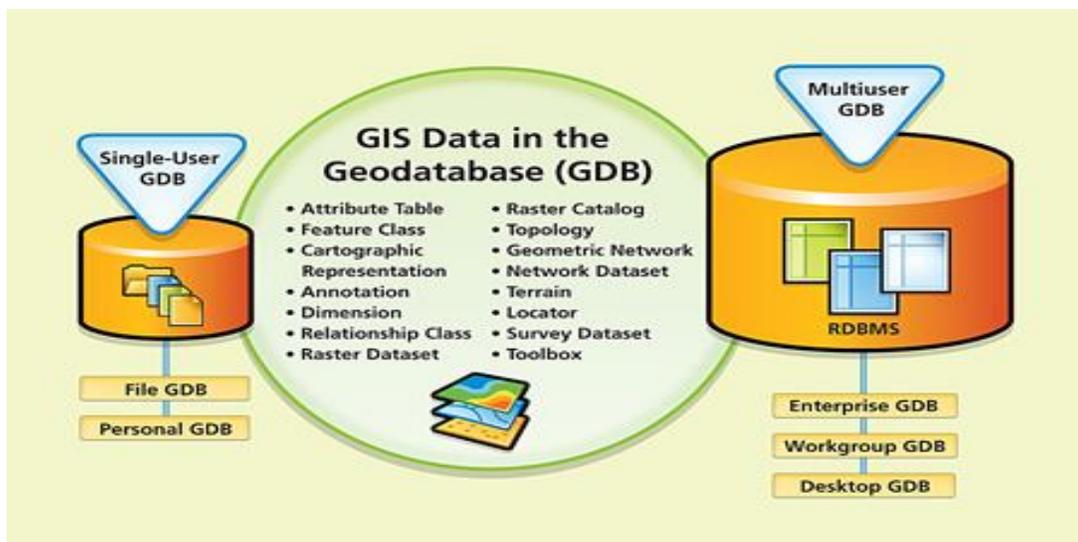
*S.Sivanantharajah, Snr. Supdt.of Surveys (GIS)*

*S.M.J.S.Samarasinghe, Supdt of Surveys (GIS)*

*Surveyor General's Office, P.O. Box 506, Colombo 05, Sri Lanka.*

*Email: ssgis@slt.net.lk*

The geodatabase (GDB) is the common data storage and management framework for ArcGIS. Simply, it is a container for spatial and attribute data. The name combines *geo* (referring to spatial) with *database*—specifically, a relational database management system (RDBMS). The term promotes the idea of having all GIS data stored uniformly in a central location for easy access and management



The geodatabase supports all the different types of GIS data that , such as attribute data, geographic features, satellite and aerial images (raster data), CAD data, surface modeling or 3D data, utility and transportation network systems, GPS coordinates etc. Data conversion tools in ArcGIS has suite of easily migrate existing data into the geodatabase. By storing GIS data within a geodatabase, users can take advantage of its superior data management capabilities to leverage spatial information.

The geodatabase is a more robust and extendable data model compared to shapefiles and coverages. While shapefiles and coverages are outstanding GIS data storage formats, they do not take advantage of the latest data storage technologies. The Geodatabase is design to make full use of the capabilities of ArcGIS supplies.

### GIS Data Storage

Vector data is stored in the geodatabase as thematic layers called feature classes. A feature class is a collection of geographic features with the same geometry type, such as a point, line, or polygon with their same attributes; and the same coordinate system. Feature

classes can be grouped together within a feature dataset, to model geospatial relationships between them. Raster data is stored as raster datasets; each raster image is stored as its own thematic layer. Multiple rasters can be grouped into a raster catalog. They can be mosaicked into a single raster dataset.

### **Modeling Geospatial Relationships**

Geodatabase enables users to take advantage of its advanced data modeling, that represent real-world GIS application workflows. By storing feature classes within a feature dataset, geospatial relationships can be modeled between the feature classes, enabling more advanced GIS analysis. The more common types of geospatial relationship data structures in the geodatabase are

- **Topology**—Defines and enforces data integrity rules for features. For example, there should be no gaps between polygons.
- **Geometric Network**—Consists of a set of connected edges and junctions that, along with connectivity rules, are used to represent and model the behavior of a common network infrastructure in the real world. Water distribution, electrical lines, gas pipelines, telephone services, and water flow in a stream are all examples of resource flows that can be modeled and analyzed using a geometric network.
- **Terrain**—A data structure that is generated from a mass collection of elevation measurement points, typically from remote-sensing data sources. A terrain is used for 3D surface modeling applications.
- **Cadastral Fabric**—A continuous surface of connected parcel features that represents the record of survey for an area of land.

Collectively, geodatabase help streamline data entry and ensure the integrity of a user's data. Therefore, the geodatabase enables users to leverage and optimize their GIS data to its full potential and helps maintain a consistent, accurate repository of GIS data.

### **Types of Geodatabases**

The geodatabase is designed to support both the individual users and organizations of various types and sizes. User can start with a file geodatabase and upgrade to a larger workgroup or enterprise geodatabase as the volume of data increases.

There are two main classes of geodatabase:

1. **Multiuser and**
2. **Single user Geodatabases.**

#### **1. Multiuser Geodatabases**

Multiuser geodatabases use ArcSDE technology and are implemented on an RDBMS platform. Supported RDBMS platforms include DB2, Informix, Oracle, PostgreSQL, and SQL Server. Multiuser geodatabases leverage the underlying RDBMS architecture to provide better data security, such as access permission control for individual datasets, distributed file management, backup/recovery capabilities, and data integrity. ArcSDE

technology provides additional geodatabase functionality that is not available in single-user geodatabases.

There are three types of multiuser geodatabase: enterprise, workgroup, and desktop. The storage capacity and number of possible concurrent users vary with each type.

- **Enterprise Geodatabase**—This is intended for large-scale enterprise application scenarios. It can be scaled to any size and can support any number of users, running on computers of any size and configuration. It is the most robust of all the geodatabase types.
- **Workgroup Geodatabase**—This is for the small- to medium-sized departmental application scenarios. A workgroup geodatabase has a maximum size limit of 4 gigabytes and supports up to 10 simultaneous users, all of which could be editors.
- **Desktop Geodatabase**—This is designed for small teams or a single user who requires the functionality of a multiuser geodatabase. It has a maximum size limit of 4 gigabytes, and only supports up to three concurrent users (one editor and two viewers).

## 2. Single-User Geodatabases

The single-user geodatabase class has two types—the file geodatabase and the Microsoft Access personal geodatabase. Both types of geodatabase are intended for an individual GIS user.

**File Geodatabase**—This is implemented as a collection of binary files in a file system. It has no size capacity limit. By default, each table can store up to 1 terabyte of data. Vector data stored can optionally be compressed into a read-only format, reducing the memory footprint and improving performance. Users can uncompress the vector data to make it editable at any time and possible to have more than one editor in the file geodatabase at the same time. This is recommended that users who will be starting new GIS projects for their own local use. Because they offer more functionality and better performance.

**Personal Geodatabase**—This is implemented in a single Microsoft Access file and has a maximum size capacity of 2 gigabytes. It works for small GIS projects but does not support multiuser editing, versioning, or geodatabase archiving.

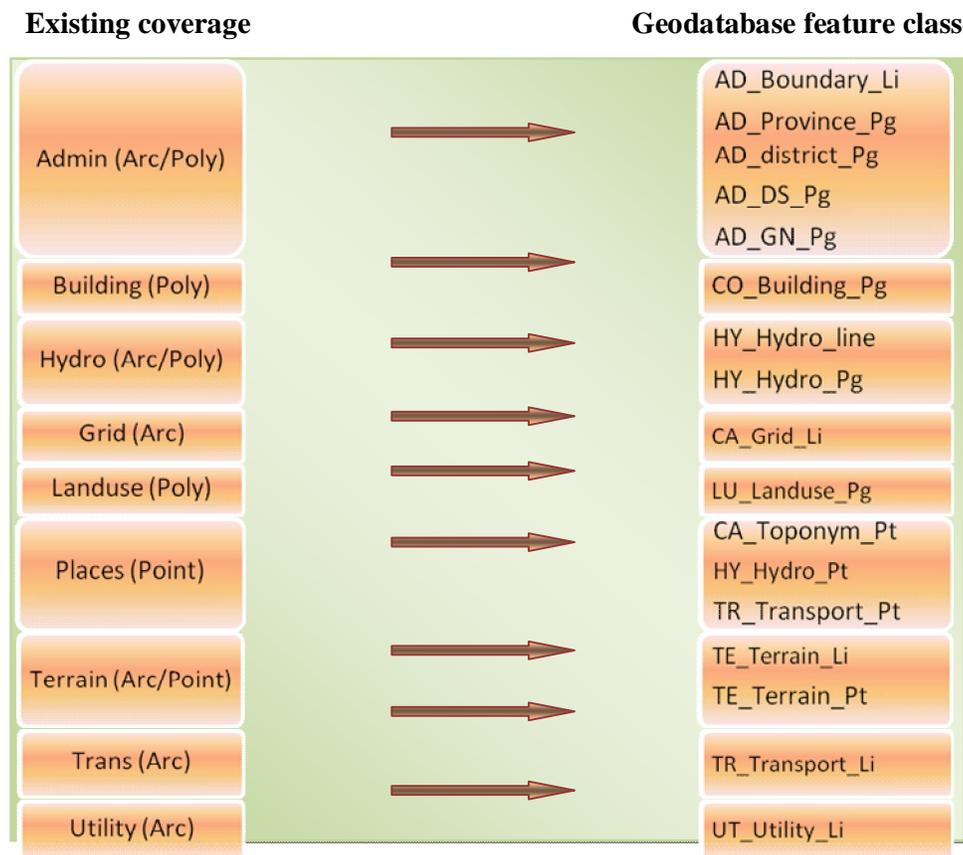
The GIS data storage model is fully supported by all five geodatabase types. GIS datasets can be transferred between the various geodatabase types using the simple migration tools, such as copy/paste and import/export.

### Geodatabase data storage in GIS Branch.

GIS Branch of Survey Department consist of 1:50,000 and 1:10,000 scale Topographic Digital Data base from existing maps and other sources. This 10K tile formed by dividing one 50 K tile into 25 tiles of 8\*5 sq. Km. The total tiles numbers will be 1834.

Each of the tile consists of 10 layers as Coverages and updating process is very tedious. The process of edge matching and editing in Coverages is very difficult and time consuming in ArcInfo or ArcEdit environment. Consider above difficulties it has been decided to transform existing tile coverages to File Geodatabases. It helps to faster the

editing process and more checks on quality control process. Ongoing transform process of Coverages to Geodatabases, existing data fields will not reduce and new fields can be added.



### Conclusion

The geodatabase is the primary data storage model for ArcGIS. It is a container of spatial and attributes data and enables the user to store many different types of GIS data within its structure. Its structure is implemented in an RDBMS or as a collection of files in a file system. With its comprehensive GIS data model, geospatial modeling capabilities, and scalable architecture, the geodatabase is the foundation that enables the assembling of intelligent geographic information systems that can be adapted for many different GIS applications.

The geodatabase is the common data storage and management framework for ArcGIS. This discussion describes what a geodatabase is and how GIS data is stored within it.

## **THE IMPORTANCE OF CHANGES IN LAND SURVEYORS EDUCATION**

by

*A. H. Lakmal*

*Government Surveyor*

*School of Geomatics, Liaoning Technical University, P.R. China*

*Email : lakmalah@gmail.com*

### **INTRODUCTION**

*“Surveying is an immensely diverse career with a wide variety of potential employers. A surveyor can become involved in anything from creating towns or housing projects to environmental or health projects to advising on property deals.”*

*-Zoe O’Connor, Head of Education with the Society of Chartered Surveyors in Ireland.*

It’s a worldwide experience, especially in many developed countries that the interest in the traditional land surveying profession has been decreasing during the recent years. In many technical universities the land surveying and geodesy faculties reduced capacity or closed down due to lack or small number of students.

The measurement and computations have been highly automated for today and not necessarily require university education. The priorities in the wider land surveyor profession have been changed during the last decade, the importance of land and real estate property related activities have been increased rapidly worldwide.

The roles of land administration matters have been changed during the recent decades; land administration is one of the most important infrastructures for the economic growth and the implementation of sustainable development today. In respect of above the establishment, modernization of land administration is an increasing interest worldwide. Land administration activities have been the part of the land surveyor profession since long time but it was not the most important field of the profession.

Priorities in the land surveying mapping activities have been continuously changing and the profession must answer the new challenges if land surveyors want to play important role, supporting the economy, in the future as well. To achieve above goals the land surveyors’ education, especially at university level, must be changed, extended, according to the new requirements and students interest.

The other important issue is the lifelong learning in our profession. This is an individual interest for professionals but also the interest of governmental and other institutions, to keep the knowledge of staff up-to date. Universities have to follow new developments in the profession extending their activities and contact land administration, cadastre, land registry institutions to provide different education, courses, according to the new priorities in the profession and the technical development. This should give additional tasks and income for universities and lifelong education for the professional staff and groups.

## **CHANGING PRIORITIES IN THE LAND SURVEYOR PROFESSION**

The role of land and real estate in the economy has been changed since 1950s land and real estate haven't been properties only but commodities, generating income and profit, before only agricultural land generated income. Investments in land and real estate have been continuously increasing worldwide and investors could find different fields and ways like commercial (shopping centers, plazas, etc.) residential (condominiums, apartment parks), industrial investments. Big investments require more and more capital, financial support, commercial; mortgage banks are providing loans, mortgages to finance land and real estate developments. To do this, the development of mortgage system and market is important as well. Investors and banks require security of ownership and other rights related to properties and guaranty for the repayment of loans, mortgage. To fulfill above requirements a fully operational legal and institutional framework is needed. Land administration and its institutions, especially cadastre and land registry, can provide all of the services, facilities which guarantees the security of ownership and mortgages. The valuation, land management, planning and other land and real estate related activities are also essential parts of land administration. We think it's quite evidence that the development or modernization of land administration institutions, especially cadastre and land registry, is an increasing interest worldwide to support the economic growth and the implementation of sustainable development.

To operate land administration institutions, more and more qualified professionals, experts are needed and the knowledge must be extended. Land surveyors always played important roles in the operation of land administration institutions but primarily in technical, engineering fields.

The increasing importance and changing roles of land administration require professional staff with different, extended knowledge. Land administration institutions are not administrative offices anymore they provide services, value added products, data for money to different players of the economy and citizens. These extended activities require businesslike approach, business plan, marketing and IT knowledge and development. New professionals, so called land professionals are needed especially at management level. They have to be familiar with the traditional surveyor knowledge but also with legal, management and IT knowledge.

The question arises how can land surveyor students, professionals pick up this knowledge, by experience or by education, but I think the answer is by both.

## **THE IMPORTANCE OF CHANGES IN LAND SURVEYORS EDUCATION**

The world is continuously changing. apart from the rapid technical development, IT revolution, the world face new challenges to be solved, implementation of sustainable development, accelerate economic growth, reduction of poverty in the less developed countries, etc. Land and real estate properties and related activities play extremely important roles in the economy, supporting the successful achievement of above goals. The changing priorities in the world also affect the priorities in different professions. The education, especially at university level must follow these changes, new priorities required

by the economy and the society. Sometimes the university education is quite conservative, very theoretical, maybe it would be good to find the balance between the practical and scientific approach.

Concerning the land surveyor education, universities have recognized immediately the importance of IT, extending the education with geo-information knowledge. As a result of this extended education, many of the qualified land surveyors moved to IT fields because of much better salaries.

The increasing importance of land and real estate property related activities and the role of land administration in the economy haven't been recognized by the majority of universities running land surveying faculties. Many of the potential students are not interested in the traditional land surveying and mapping, but quite frequently, they couldn't find other subjects in the faculty which are attractive and useful in practice. I think it would be advised to modify the land surveyors' education introducing new subjects-legal subjects, valuation, management, etc. - and broadening the knowledge of land surveyors.

There are good examples, ITC in Enschede, The Netherlands established the first UN supported University of Land administration in 2006.

More over that, there are several postgraduates, diplomas and certificate courses in GIS, Remote sensing, Geodesy and other surveying related subjects available in worldwide. Furthermore, I would like to mention some of higher education opportunities (with financial supports also) / professional opportunities for career improvements of Land surveyors in Sri Lanka.

## **REFERENCE**

### Higher Education

<http://www.nv-landsurveyors.org/index.php?id=17>

### Surveying

<http://www.earthworks-jobs.com/survey.htm>

### Remote Sensing and GIS

<http://www.earthworks-jobs.com/remotese.htm>

### Geography

<http://www.earthworks-jobs.com/geog.htm>

## **ACKNOWLEDGEMENT**

*I wish to thank Dr. K. Thavalingam, Addl. Surveyor General to encourage me write an article to Survey Journal/Survey Department of Sri Lanka when I met him in P.R. China at ACRS 2009.*

## VALUTION OF PROPERTY

by

*Anil Kollure,*

*Government Surveyor*

*Divisional Survey Office, Homagama II, Sri Lanka*

*Email : sshomagama2@sltnet.lk*

The value of an existing property has to be worked out for various purposes. A man may want to sell his property, and another man wants to buy it. In this case, a valuation has to be carried out, in order to find out the likely value of the property for the sake of the buying and selling transaction. Again valuation of property is necessary for wealth tax, estate duty (i.e. death duty), and municipal taxations etc. That is to say, if a man has got wealth in excess of a certain amount, he has to pay annual tax on that wealth. Now, for determining the exact amount of the wealth, valuation of the lands, buildings etc., in his possession, become necessary. Similarly, when a person dies leaving behind a substantial amount of wealth (the wealth consisting of shares, cash, buildings, jewelry etc) estate duty or death duty has to be paid becomes necessary. Similarly, valuation of the shares is carried out by share brokers, putting down the values on the dated of death of the person.

Sometimes, the owner of a property wants to borrow money from the life insurance corporation, of the banks, or the state industrial finance corporations or such other institutions; in this case, these institutions order out a valuation to be carried out of the property is worth say Rupees five lakhs, they may lend up to say, Rupees three lakhs to him, keeping the rest as safety margin.

So, for various purposes, the value of a property (new or old) has to be found out. Value of a thing depends upon its usefulness. If a property brings annual rent to the owner, and is likely to earn this rent for a number of years, it is its usefulness to the owner by way of rent, and when you assess the value of this usefulness, that is the value of the property. Such a valuation carried out after considering the income from a property is called “valuation based on income approach” Sometimes, the income data is not satisfactory, or is not representative of the true, value, or the property is not rented at all, or the property is quite new (say three of five years old only) in which case, the “valuation based on cost approach” is carried out, i.e. one thinks, how it would cost to build it new to day.

Sometimes the valuation is carried out by finding the market value of another similar property, sold in the same locality in recent months and by comparison, we work out the value of the property. This type of valuation is known as the “market value approach or the comparison approach valuation”

Valuation can be defined as the process through which the mind of the value travels, in order to asserting the value of the property by different approaches and finally, giving due weightage to the various approaches, fixing a satisfactory value of the property.

Often, the valuation is carried out by all the above three approaches, and finally, the value of the property is put down, giving the due importance to each approach. First, the values obtained by each of the three approaches different from one another, and the mind of the valuer goes through the process of weighting the importance of each approach and thus finally arrives at the value of the property; and that process through which his mind works, is the actual process of valuation.

---

### ඉසඹු ලබන්නට පෙර

කීර්ති දිසානායක  
ජ්‍යෙෂ්ඨ මිනින්දෝරු අධිකාරී  
දිස්ත්‍රික් මිනින්දෝරු කාර්යාලය, මාතර  
විද්‍යුත් තැපෑල: ssmatara@slt.net.lk

මිනින්දෝරු දෙපාර්තමේන්තුවේ දීර්ඝ කාලයක් සේවය කර ඉසඹු ලබන්නට සැරසෙන මොහොතේ මතු පරපුර සඳහා මා ලැබූ අත්දැකීම් වලින් ස්වල්පයක් ඔබ හමුවේ තබන්නට අවසර.

1972 වසරේදී දෙවිසි හැවිරිදි වියේ පසු වූ මා, මිනින්දෝරු මහගෙදර හෙවත් මැ.සී.ආ. ට ආවේ මිනින්දෝරුවකු ලෙස පුහුණු වන්නටය. මා ද තවත් අඩ සියයක් මානවකයෝ ද පුහුණුවට පැමිණ සිටියහ.

මහගෙදර මහතැන වූයේ මනා පෞරුෂත්වයකින් හෙබි, සියළු ළදුන්ගේ මන බැඳ ගැනීමට තරම් වූ සපුවක් දෙවියන් වහන්සේගෙන් දායාද ලද, වාග් වාතුර්යෙන් කෙළ පැමිණි, හසල දැනුමැති S.D.F.C. නානායක්කාරයන්ය. එතුමන්ගේ සහායට දැන උගත් ඇදුරු මඩුල්ලේ G.S. විජේපුරයන් ද, කුමාර පෙරේරාවන් ද, රංජිත් අමරසේකරයන් ද සිංහල මාධ්‍ය සඳහා සිටි අතර දෙමළ මාධ්‍ය සඳහා S. ගනේෂයන් ද, ශ්‍රී සිවලිංගම්පු සහ S. වාමදේවයන් වූහ. අද මෙන් දෙබස් හටනක් එදා නොතිබූ බැවින්, අප කණ්ඩායමෙන් හරි අඩක් දමිලයෝ වූහ. සියල්ලන්ම සහෝදර බැම්මෙන් සිටියේ, මහගෙදර එකම මවකගේ දරුවන් මෙනි.

මහගෙදර වසරක් සපිරුන කළ කේෂ්ත්‍රයට ආවේ ගම් පලාතට (මාතරට) නුදුරු තැනකටය. මා භාර කෙරුනේ “මිනින්දෝරු” යන්නට මදක් සමාන වූ තවත් “..... දෝරු” කෙනෙකුටය. දැහැමි බවේ ප්‍රතිමුර්තිකක් වූ S. බෙරුගොඩ මහතා එවකට ගාල්ල කොට්ඨාශයේ මිනින්දෝරු අධිකාරී තනතුර හෙබවිය.

අද මෙන් සැප පහසුකම් නැති ඒ යුගයේ අපට පවරපු රාජකාරි ප්‍රමාණය අතිමහත්ය. කම්කරු පරිපාලනය, ඔවුන්ගේ ලිපි ගොනු පවත්වා ගැනීම, වැටුප් ලැයිස්තු සැකසීම, වැටුප් ගෙවීම, වවුචර් පිළියෙල කිරීම, මැනුම් රාජකාරි වලට අමතර වූ දේය. රොටරින් පැන, කැල්කියුලේටරය පවා නොතිබූ ඒ යුගයේ බොයිලස් වක්‍රයෙන් බණ්ඩාක කර අතින් පිඹුරු සැකසුවත් සැතපුම් ගානක් පයින් ගියත්, එදා අපට කළ යුතුව තිබුණු වැඩ ප්‍රමාණය (Norm) අද මනා පහසුකම් යටතේ වෙනස් වී නැත. එමෙන්ම එදා අප සකස් කළ පිඹුරු වල ප්‍රමිතියට සාපේක්ෂව අද පිඹුරු වල තත්වයට කුමක් සිදුවී දැයි විටෙක සිතේ.

වසරක ඇවැමෙන් කන්ද උඩරට මුනි සිරිපා පියස හඹා එන මද සුළගින් සුවදවත් වූ මස්කෙලිය පෙදෙස මගේ ඊළඟ සේවා ස්ථානය විය. එතැනින් සිරිපා මව්වේ අනෙක් පස පිහිටි රුවන්පුරය මගේ ඊළඟ සේවා ස්ථානය විය. රුවන්පුරයෙන්, “මහවැලි” යෙන් රට සරු කරන්නට, ගම් බිම් මැන දෙන්නට පුලතිසි පුරවරයට පැමිණියෙමි. මහ වන මැද, කුඩාරම් වල නවතම අත්දැකීමක් ලබන්නට වූයේ නොමද සතුටිනි. පුලතිසි පුරවරයේදී (1978 නොවැ.23) මහ සුළි සුළඟට හසුවී මා සිටි කුඩාරම් සුනු විසුනු වී ගියත්, සිරිමක් පවා නොවී දිවි බේරා ගන්නට සමත් වූනෙමි. ඒ මගේ දිවි පෙවතේ ලැබූ පළමු බියකරු අත්දැකීම විය. පුලතිසි පුරවරයෙන් ඇතුගල් පුරවරයට විත් වසර තුනකට පසුව මහගෙදරට නැවත මා කැඳවූයේ සිසුනට උපදෙස් දීම සඳහාය. එකළ P.A. ආර්යරත්නගේ මහගෙදර මහ තැන වූහ.

දෙපාර්තමේන්තු කනිටු විභාගය සමත්ව සිටි මා හට දෙටු විභාගය සමත් වන්නට මහ පැදුනේ මහගෙදර සිටි සමයයි. මහගෙදරින් ගම් පියසට පා තැබුවේ බිහිසුණු සමයකය. රටම වෙලාගත් භීෂණය මධ්‍යයේ තැන තැන මළ මිනි දැවෙමින් සිටි සමයක, භීෂණය දැක දැකත් එය අත්විඳින්න සිදු නොවූනේ භාස්කමකින් ද නැතහොත් පෙර පිනකට දැයි නොදනිමි. හතලිස් විය ලබන්ම දිගාමඩුල්ලට පිය නැගුවේ ස.මී.අ. ලෙස උසස්වීමක් ලද නිසාය. ත්‍රාසය, භීතිය මා පසු පස නිරතුරුව හඹා එන්නේ දැයි මට සිතුවේ 1990 වසරේ ‘කොට්’ කටක සිට රාජකාරි කරන්නට වූ විටය. පොසොන් උළෙලට ලද නිවාඩුවේ මා නිවාසට පැමිණ ආපසු සේවයට එන අතරතුර, අම්පාර සිට ගාල්ල බලා යන බසයේ රියදුරා මා ගමන් කරමින් සිටි (මාතර සිට අම්පාර දක්වා යන) බසය නවතා එහි රියදුරාට කීවේ ආපසු මාතර යන අයට ඒ බසයට එන ලෙසත්, අම්පාර මළවුන්ගේ දේශයක් බවට පත් වෙමින් තිබෙන බවත්ය. අම්පාර ස්ථීර පදිංචිය නොවුනු සෑම දෙන මා සිටි බසයෙන් බැස ගාල්ල බලා යන බසයට ගියත් මා අමාපාරට යන්න තීරණය කළේ, ප්‍රශ්ණයෙන් පැන යාම නිවට කමක් ලෙස සිතනු නිසාය. අම්පාර නගරයට පැමිණි මා, මගේ සේවාස්ථානය වන “මහ ඔයට” යාමට පිළිවෙලක් නැති නිසා දී.මී.කා. ට ගියෙමි. මා එහි යන විට කාර්යාලයේම පිටුපස පිහිටි කාමරයක නවාතැන්

ගෙන සිටි W.A. සිල්වා නම් වූ ලිපිකරු මහතා බියට හා දුකට පත්ව අසරණව සිටියේය. ඔහු පැවසූ දෙයින් මා සළක විය. කාර්යාලයේ කා.ප.නී. විනයාග මූර්ති මහතා, කොටියකු නොවුනත් ද්‍රවිඩයකු බැවින් සිංහලයන් අතින් සාකච්ඡා වී තිබිණි. අම්පාර නගරයේ තැන තැන දැවෙන මළ මිනිය. කඩපිල්ල. මී.අ. හා අනෙකුත් කාර්ය මණ්ඩලය කාර්යාලය හැර ගොස්. මා පසු දින මහ ඔයට ගියේ මගේ කාර්ය මණ්ඩලයට වූයේ කුමක්දැයි දැන ගනු රිසියෙනි. දෙමළ නිලධාරීන් ආරක්ෂිතව ගම් පෙදෙස් කරා ගිය බවත්, සිංහල නිලධාරීන් ඔවුන්ගේ කඳවුරු වල සිටින බවත් දැක ගන්නට ලැබිණ. මේ අතර තුර මා පිළිබඳව කිසිදු තොරතුරක් මගේ බිරිඳට දැන ගන්නට නොමැති බැවින් ඇ කලබල වූවාය. මගේ ඥාති සහෝදරයා ද මට වුනේ කුමක් දැයි සොයා ගන්නට බිය වූ මොහොතක ස.ජ. ගේ නියමයෙන් මා සොයන්නට ගියේ දැන් නැගෙනහිර පලාත් ස.ජ. / K.W. කරුණාරත්න මහතාය. (එවකට ඔහු මොණරාගල ස.මී.අ. තනතුර හෙබවිය.) එතුමාට මගේ හදපිරි තුනිය දැනුත් පුදකරමි. භීතිය, ත්‍රාසය තෙවන වරටත් මා වෙලා ගති. ප්‍රදේශයේ පැවති අයහපත් වාතාවරණය මැද මගේ සේවා ස්ථානය අම්පාරට නුදුරු පරගහකැලේට මාරු කරන්නට සිදු වුණි. දිනය 1991 මාර්තු 24 දාය. මා අම්පාර දි.මී.කා. සිට මගේ සේවා ස්ථානයට යද්දී කොණ්ඩවටුවාන වැව බැම්මේ හැපුනු ජීප් රිය පෙරළී ගියේ මා අන්ද මන්ද කරමිනි. ත්‍රාසය නැවතත් මා පසුපස විය. සුළු තුවාලයක් ලබා බෙරුනත්, ජීප් රියේ පසු පස කිසිවකු සිටියා නම් ඔහුට දෙවියන්ගේම පිහිටයි. දෙවසරක් දිගාමඩුල්ලේ සේවය කළ මා නැවතත් ගම් පියසට යන්නට වරම් ලදිමි. හරියටම තෙවසරක් ගම්පියසේ රාජකාරි කළ පසු මුප්පනේට (මොණරාගලට) මාරුවී ගියෙමි. එහි තරමක් දිගු කලක් සේවය කළ මා හට සර්වේයර් ජනරාල් තුමාගේ අණ පරිදි මිනින්දෝරු අධිකාරි ලෙස ත්‍රිකුණාමලයට යන්නට සිදුවිය.

2004 වසරේ ත්‍රිකුණාමලයට ඉතා කැමැත්තෙන් පැමිණියේ දුෂ්කර පලාත් වල සේවය කිරීම මගේ විනෝදාංශයක් වූ නිසාත්, ස්ථාන මාරු සඳහා අභියාචනා කරන සිරිතක් මට නොතිබූ නිසාත්ය. ත්‍රිකුණාමලය යනු “කොට්” රජ දහනකට යාව පිහිටි අනාරක්ෂිත ප්‍රධාන නගරයකි. මගේ අධිකෂණ නිලධාරියා වූ නි.ස.ජ. / U.H.D. පියසිරි මහතා හැරුණු කොට සිංහල කථා කරන්නට වෙනත් අයකු නොවීය. එහෙත් කාර්ය මණ්ඩලයේ සියළු දෙනා දමිළ හා මුස්ලිම් වුවද, ඔවුන් මටත්, පියසිරි මහතාටත් දැක්වූ ආදරය, කරුණාව, සහයෝගය සහ සැපයූ රැකවරණය තුනි පිරි හදින් මෙනෙහි කරමි. මා පසු පස පැමිණි භීතියට ත්‍රාසයට මෙනෙක් මා හසු කර ගත නොහැකි වූ නිසාදෝ නැවතත් එය මා පසු පස පැමිණ පැරදි පලා ගියේය. ඒ 2004 දෙසැම්බර් 26 සුනාමියයි. “රුදුරු රළ පෙළ කළ හදිය”ලෙසින් පසුගිය සහරාවේ ඒ ගැන ලිවෙමි.

2007 වසරේදී නැවත වරක් මහගෙදරට යන්නට සිදු වූයේ උසස් ඩිප්ලෝමාව (HDC) හදාරන්නටය. 57 වියේ පසු වූ මා (මා භිතන විදියට මැ.සි.ආයතනයේ සිටි වයසින් වැඩිම ශිෂ්‍යයා මාය) ‘වයස අධ්‍යාපනයට බාධා නොවේ’ යන්න සැබෑ කරමින් උසස් ඩිප්ලෝමාව සාර්ථකව නිම කළෙමි. උසස් ඩිප්ලෝමාව හදාරන්නට මා සමග සිටි තවත් අයෙකි, යාපනයේ සිට පැමිණි P. සිවදාසයන්. වාර්ගික අර්බුදයක් රටෙහි පවතින සමයක, එක කුස හොත් දෙසොහොයුරන් මෙන් එකම නිවහනක වසරක් කල් ගෙවුවේ දුක සැප බෙදා ගනිමින් සතුටිනි. මහගෙදර අදියුරු ද, ඇදුරුමඩුල්ල ද, අනෙකුත් සැමගේ ද ආදරය, කරුණාව සහ උපකාරය නොඅඩුව ලබන්නට අපි වාසනාවන්ත විමු. එදා සිවදාසයන් රිය අනතුරට පත්ව අසරණව රෝහල් ගත ව සිටියදී ද, රෝහලින් නිවහනට පැමිණ සිටියදී ද, මැ.සි. ආයතනය අපේම “මහගෙදර” බැව් පසක් වූයේ දරුවකුට, සොහොයුරකුට, හා වැඩිහිටියකුට දක්වන සෙනෙහසක් ඔහුට මෙන්ම මටද මහගෙදර ඇත්තන්ගෙන් හිමි වූ බැවිනි.

ඉසබ්බු ලබන්නට දෙවසරක් තබා හෝ නැවත ගම් පියස වූ මාතරට පැමිණ දිස්ත්‍රික්කයේ මුල පුටුව හොබවන්නට හෙවත් දිසානායක වන්නට ලැබීම මා ලැබූ භාග්‍යයකි. සිහිනයක් හැබෑ විමකි. උපන් පෙදෙසට සේවයක් කරන්නට ලැබීම සතුටක් නොවේද? ආඩම්බරයක් නොවේද?

සියළු දෙයින් සපිරි බස්නාහිර පලාතේ සේවය කරන්නට මට නොලැබීම ගැන කණගාටුවක් නැත. එහෙත් උතුරේ පැවති අයහපත් තත්වය නිසා උතුරේ සේවය කරන්නට අවස්ථාවක් නොලැබීම දුකකි. අනෙක් හැම පලාතකම මා සේවය කළේ, දුර බැහැර, දුෂ්කර පලාත් වල ද සේවය කිරීම රජයේ සේවකයකු ලෙස මව් බිමට කළ හැකි මහඟු සේවයක් ලෙස සලකාය.

දැන් ඉතින් යුද්ධය හමාර නොවැ. ඒත් කෙසේ නම් උතුරට යන්න ද? හැටෙන් පසුත් සේවය සපයනවා නම් මා උතුරට යනවාමයි.

### මිනිස් ශිෂ්ටාචාරයේද පෙරගමන්කරු මිනින්දෝරුවෙකි

එස්. ඩී. සේනාරත්න  
හිටපු සහකාර මිනින්දෝරු අධිකාරී  
ලියපදිංචි බලයලත් මිනින්දෝරු සහ උසාවි කොමසාරිස්  
සුධර්මාරාමය මාවත, උඩුපිල, මිරිස්ස

මිනිසාගේ පූර්ව ඉතිහාසය තවදුරටත් ලියා තිබුණේ නැත. එය අදටත් හමුවන ද්‍රව්‍යමය සාධක මගින් පුරාවිද්‍යාඥයන් විසින් ගොඩනගා ගනී. එය තවදුරටත් ලැබෙන සාධක මත තහවුරු හෝ ප්‍රතික්ෂේප වීම විය හැක. ප්‍රා ටෙප්නිකාසික යුගයේ දී අවධානයට නොගත් බොහෝ දේ අදටත් ඉතිරිව ඇත.

වර්තමාන යුගය දක්වා අප ආ ගමනේ පියමං කළ මං සලකුණු නැවත නැවත සොයා යාම අපේ ප්‍රගතියේ රහසවේ. තවත් ඉදිරිගාමී පියවර තැබෙන්නේද නිවැරදි ඉතිහාස විමර්ශනයන් නිසාමය.

අපේ ශිෂ්ටාචාරයේ මුල්ම ඉදිරිගාමී පියවර එඬේර යුගය විය. මෙම යුගයේ පළමුවන හීලෑ කරගත් සතුන්ට ජලය හා ආහාර එකවිට හිඟවීම අනුව අළුත් කෙම් බිම් සොයා යාමේ පුරුද්ද ඇතිවිය. මේ ගමන සඳහා භූ ලක්ෂණ, දිශාව, දුර (මූලික මිනින්දෝරු සාධක) ගැන නිසි අවබෝධයක් නොවිණි නම් මූලදී සතුන්ද දෙවනුව එඬේරුන් ද නිශ්චිත අවසානයක් ලබනවා ඇත. දිනයක් අවසානයට පෙර ගමනාන්තයට යා යුතුම විය. මෙහිදී ඔවුන් සතු මූලික දැනුමට සාපේක්ෂව මිනින්දෝරු ශිල්පීය සාධක භාවිතයන්ට ගෙන ඇත.

එඬේර යුගයේ අප ලද අත්දැකීම් මත ඊළඟ යුගය ආරම්භ විය. සතුන් ගෙන යාමේදී ඉබේ වැවුණ ධාන්‍ය, පළතුරු, එළවලු හඳුනාගෙන ඒවා මූලදී ප්‍රයෝජනයට ගෙන පසුව ඒවා වැවීමට ඉගෙනගෙන ඇත. මේ සමගම සාරවත් භූමියද හඳුනාගත හැකි විය. සංක්‍රමණික එඬේර ජීවිතයට ආයුබෝවන් කීමට සුදුසු කාලය පැමිණ ඇත. දැන් ගොවිතැනට අවශ්‍ය ම හමුදාව එනම් හීලෑ සතුන්, ජලය, සරුබිම් ඔවුන්ගේ ප්‍රධාන සාධකය විය.

සමූහ වශයෙන් ජීවත් වීම ද අවශ්‍යම කරුණක් විය. මේ අතුරින් දක්ෂම, ශක්තිමත්, එඩිතර පුද්ගලයා ගෝත්‍ර නායකයා ලෙසට ඉදිරියට එන්නට ඇත. නීතිය, සාමය, දඩුවම, ඉහළ මට්ටමේ චින්තනය, ආගම, පවුල් ඒකකය බිහිවිය. බුද්ධියේ නිම් වළලු පුළුල්වී නව සොයාගැනීම් භාවිතයට ගැණුණි. මේ සියල්ල අතිරික්ත ධාන්‍ය නිෂ්පාදනයේ ප්‍රතිඵලයන් විය. ඉඩම් ඔවුන් අතර සාධාරණව බෙදා දීම ගෝත්‍ර නායකයන්ගේ වැදගත්ම රාජකාරිය විය. පසුව ගෝත්‍ර නායකයා රජු ලෙස හඳුනාගන්නා ලදී. ඉඩම් වල බිම් ප්‍රමාණය මායිම් නිර්ණය කිරීමට වැට කඩොලු ඇතිවීම යන සංකල්පයන් සඳහා යම් තාක්ෂණයන් අවශ්‍ය විය. මේ වන විටත් ඔවුන් දන්නා දිශාව දුර හෙවත් දිග මහ සලකුණු Dead measurements ඇතත් ඒකක හා ක්‍රමවේදය සෙවිය යුතුව තිබුණි. මේ වනවිට බුද්ධියේ උසස් තලයක සිටි මිනිසා විසින් එය ජය ගැණුණි. එය අනෙකක් නොව මිනින්දෝරු තාක්ෂණයයි.

මිනින්දෝරු තාක්ෂණයෙන් එතෙක් තිබූ ප්‍රධානතම ගැටළු සඳහා විසදුම් ලැබුණි. එය මෙසේ පෙළ ගස්වීම්.

- ◆ ගංභාධාර වල තිබූ ගොඩ ඉඩම් මායිම් ගංවතුරෙන් පසු මැකී යන විට යලි පිහිටුවා ගැනීම (පැපිරස් හෝ පිලිස්සු මැටි පුවරු වල සටහනක්)
- ◆ ඉඩම් මැනීම හා වෙන් කිරීම

#### විජයාවතරණයට පසු යුගය

- ◆ ජල සංරක්ෂණ (වැව, අමුණ, බියෝ කොටුව, වාන, සොරොව්ව)
- ◆ ජලයේ පිහිටි උසට භානි නොකර ගනිමින් ඇළ මාර්ග ඔස්සේ අවශ්‍ය තැන් වලට ගෙන යාම.
- ◆ භූ ලක්ෂණ තාක්ෂණිකව හඳුනා ප්‍රයෝජනයට ගැනීම (සමෝච්ච රේඛා අනුව යන අඩු බැස්ම සහිත ඇළ මාර්ග)
- ◆ පාවිච්චියට පසු ඉවත් වන ජලය ගලා බසින ස්වභාවික බස්නා ඇළ හරස් කර නැවත නැවත වැවක් තැනවීම, මෙසේ වැව් පද්ධතියක් නිර්මාණය වේ. (තිඹොල්කැටිය අහලේ සිතියම බලන්න)

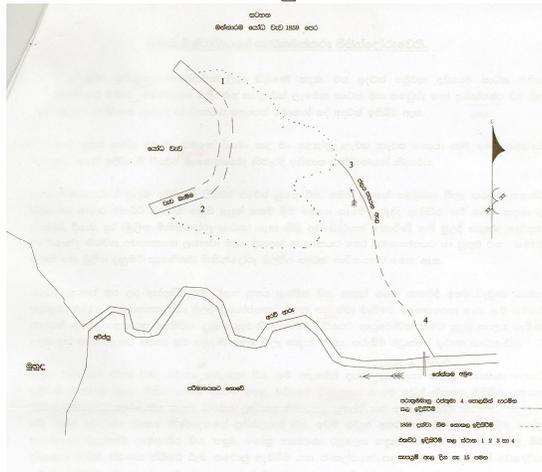
ඉහත කරුණු සියල්ල සඳහාම මිනින්දෝරු තාක්ෂණය නිසැකවම යොදා ගැණුණි. පූර්ව කාලීන, මධ්‍ය කාලීන, නූතන වාර්මාර්ග ක්‍රම ගැන ගැඹුරින් විමර්ශනය කළ බොහෝ විද්වතුන් අතරින් අපගේම කෙනෙකු වූ නියෝජ්‍ය සර්වේයර් ජනරාල් ආචාර්ය ආර්.එල්. බ්‍රොනියර් මැතිතුමා සහ හෙන්රි පාකර් මැතිතුමා ඉහළින්

අගය කළ යුතුය. සියවස් විසිපහක විශ්මිත වාරි තාක්ෂණයේ අතිතය බ්‍රොහියර් මහතා සොයා ලෝකයට දායාද කර දී ඇත. ඔහුගේ ලක්දිව පුරාතන වාරිමාර්ග ග්‍රන්ථයේ දෙවන කාණ්ඩයේ 29 වන පිටුවේ උපුටනයක් මෙහි දැක්වේ. එය මන්තාරමේ යෝධ වැව සම්බන්ධවය.

ජලාන් ඇදීම හෙවත් සැලැස්ම සැදීම ක්‍රිස්තු වර්ෂයට පෙර දෙවන ශත වර්ෂයේදී පුරුදුව සිටින බව අනුරාධපුර ලෝවාමහා ප්‍රාසාදය බැඳීමේ විස්තර වලින් අපට නිශ්චය කිරීමට පුළුවන. ඒ සමානව යෝධ වැවේ සහ ඊට ජලය සැපයූ ඇළේද වැඩ කරගෙන යන්නට ප්‍රථම සැලැස්මක් සාදා තිි ටෙංණ් යැයි යන සත්‍යයට වැටේ. තැන් තැන් වල කොටස් කර පටන් ගැනීමෙන් අවබෝධන සාක්ෂි ලැබේ. වැව බැමීමේ දෙකෙළවර පස් වැඩ ද, දිය ගෙනා ඇළේ වැඩ ද, එහි අඩංගු කර නොතිබුණේ නම් එසේ කරන්නට බැරි බව විශ්වාස කිරීම නීත්‍යානුකූලය. මන්තාරම් අඩවියට තෙමීම අදහස් කොට පටන් ගන්නා ලද මෙම සිංහල ජල කර්මාන්තය කිසි කළෙක සම්පූර්ණත්වයට නොපැමිණි බව ප්‍රශ්ණ රහිතව ඔප්පු වන සාක්ෂි ඇතැයි විශ්වාස කටයුතු ලියුම් කරුවන් බොහෝ දෙනෙක් එකඟ වෙතත් එය අත්හැරීම පිළිබඳ විශේෂ කරුණක් පෙන්වා නැත. බ්‍රොහියර් මහතා මෙහි කියන්නේද යෝධ වැව බැමීම දෙකෙළවර ස්ථාන 2 කින් ද ජල සැපයුම් ඇළ ස්ථාන 2කින් ද අමුණ ද එකවර කරගෙන ගොස් සම්පූර්ණ නොකර අතහැර දමා ඉංග්‍රීසින් රට භාරගත් පසු සොයාගත් බවය. මේ වැව හා ජලමාර්ගය ඉංග්‍රීසින් රට භාරගන්නා විට ද අතහැර දැමූ ආකාරයෙන්ම තිබී ඇත.

1859 හෙන්රි වෝඩ් කුමාගේ පරික්‍ෂාවෙන් පසු මිනින්දෝරු මහතකු කළ මැනීම හා මට්ටම් පරික්‍ෂාවෙන් පසු අප සතුව ඉහළ තාක්ෂණයක් තිබූ බව තහවුරු විය. එතෙක් ඉංග්‍රීසින් සිතුවේ ජලය ගලා යාමට සලස්වා සිංහලයන් ඇළ මාර්ග තැනූ බවය. එනම්, තාක්ෂණික දැනුමක් නැති ලෙසය. මෙම කර්මාන්තයෙන් මුල්වරට ඔවුන් අපේ තාක්ෂණික දැනීම පිළිගත්තේය. පහත සටහන බලන්න.

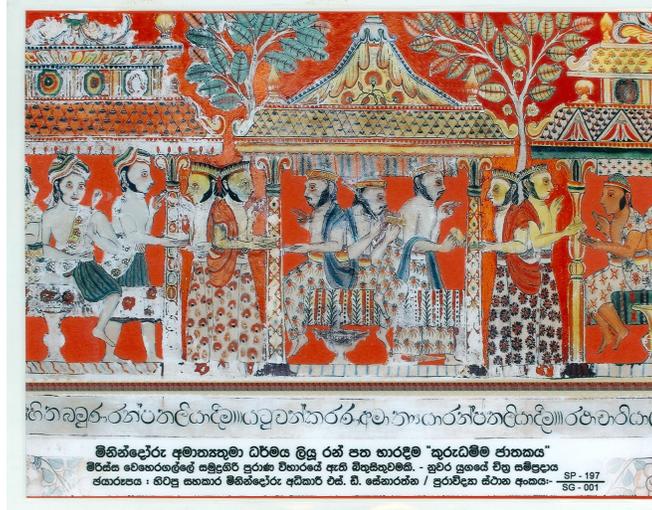
යෝධ වැව පෙන්වුම් කරන සටහන



ලක්දිව පුරාතන වාරිමාර්ග ග්‍රන්ථයේ දෙවන කාණ්ඩයේ 10 පිටුවේ සඳහන් ජයගහ ගැන විස්තරය ද සිත් මවින කරන සුළුය.

බැල්ෆෝර් නම් ඉංජිනේරුවකු 1887-1888 ප්‍රතිසංස්කරණ වලදී දිය දොරක් දැමීමට අධිකාලම කැණීමේදී එතැන පුරාණ දිය දොරක නටඹුන් හමුවූ ආකාරය එහි කියයි. මීටත් වඩා විශ්මය නම් 5 වන සියවසේ ධාතුසේන රජු තැනවූ ජය ගංහි .පු. 2 වන සියවසේ තැනවූ තිසාවැව හා බසවක්කලමට (සියවස් 7 ට පසු) ජලය ගෙනයාමට සැතපුම් 54ක් දිග ඉතා අඩු බැස්මක් සහිතව ඇළක් නිර්මාණය කිරීමය.

මේ කුලින් ප්‍රාග් ඉතිහාස යුගයේ ඉඩම් මැනීම පමණක් ද විජයාවතරණයෙන් පසු යුගයේ මැනීම හා මට්ටම් ගැනීම යන දෙයාකාරයෙන්ම මෙම තාක්ෂණය දියුණු වී ඇති බවද මෙම සාධක මගින් තහවුරු වේ. 1980 පමණ මාදුරුඔය ජලාශය මහවැලි ව්‍යාපාරය සඳහා නිර්මාණයේදී මිනින්දෝරු දෙපාර්තමේන්තුවේ මැනීමක පදනම්ව එහි බැමීම, සොරොව්ව, සැලසුම්කර පසුව සොරොව්ව සඳහා කළ කැණීමේදී නියමිත ස්ථානයේ පැරණි සොරොව්ව හමුවිය. පැරණි සොරොව්ව හා වැව ක්‍රි.ව. 3 වන සියවසේ සිට මහසෙන් රජු කරවන ලද මහාදාරකගල්ල වැව බව හඳුනාගෙන ඇත. මැනුම් ශිල්පය ගැන අප සතුව තිබූ දැනුම ගැන මෙම සාක්ෂි හොඳටම ප්‍රමාණවත්ය.



( මිරිස්සේ සමුද්‍රගිරි විහාරයේ බිතු සිතුවමකි )

දැන් මා යොමුකළ මෙහි එන වර්ණ ඡායා රූපය හා සම්බන්ධ පූර්ව ඓතිහාසික පුරාවෘත්තයට යොමු වෙමි. එය අපේ පන්සිය පනස් ජාතක කථා පොතේ සඳහන් කුරු ධම්ම ජාතකයේ රූප රාමුවකි. එයින් කියවෙන්නේ ධර්මය සොයා යන රජුගේ දූතයෙක් රජුවෙත ගෙනයාම සඳහා යටවුම් කරන අමාත්‍ය වෙනින් (මිනින්දෝරු අමාත්‍යය) ලියු රන්පත් භාර ගැනීමය. යටවුම් කරන අමාත්‍ය සිටි යුගය මහා භාරත් කාච්ඡා ලියවූ යුගයට පෙර හෝ අනුරූප විය හැක. එහි කුරු - පාණ්ඩව යුද්ධය ගැන කියවේ. එය මීට අවුරුදු 3500 - 5000ත් අතර බව අනුමාන කෙරේ. (පූජ්‍ය බඹරන්දේ සිරි සිව්ලි හිමියන්ගේ ධම්ම පදයේ පෙරවදන හඟවත් ගීතාව ගැන සඳහන බලන්න) කුරු ධම්ම ජාතකයේ එන මිනින්දෝරු ඇමතිතුමා, රජතුමා විසින් ගොවියකුට දෙන ඉඩමක් මැනීමට ංක්ෂ්ත්‍රයට ගොස් සිටියේය. නියමිත ඉඩම මැනීමේදී මායිම් ලකුණ (Stake) සිටවීමට නොහැකිවිය. එම ස්ථානයේ කකුටු බෙතයකි. සතා සිටි බව දැන ඌ මරණයට පත්වීම වළකා ගත් මිම්ම කෙටිකර ගනිමිදෝයි සිතිය. එසේ කළ විට ගොවියාට පාඩුවන නිසා මිම්ම වැඩි කරගනිමිදෝයි සිතිය. එසේ කළ විට සේවා යෝජක රජුට පාඩු වන බව සිතිය. එසේ වුවද නියමිත රාජකාරිය අකුරටම කරමියි සිතා කකුටු බෙතය මත ලකුණ සිටවිය (Stake). කකුටුවා මරණයට පත්විය. එය පවක් ලෙස සලකා ධර්මය ලියාදීම ප්‍ර ංක්ෂ්ප කර පසුව එයින් පවක් නොවූ බව තේරුම්කර දුන් පසු ධර්මය ලියාදුන් අයුරු විනයේ දැක්වේ.

දැන් ඉහත සිද්ධිය අපේ තාක්ෂණයට අනුව විමර්ෂණයකට යෙදෙමි.

- ◆ කලින් සැකසූ පිඹුරක් අනුව විශාලත්වයට අදාලව කැබලි ලකුණු කිරීම කර ඇත. (Staking out)
- ◆ සුදුසු පරිමාණයකට සැකසුණු පිඹුරෙන් නියමිත දිග කෝදුවෙන් මැන (Plotting Scale) පොළවේ ලකුණු කර ඇත.
- ◆ පිඹුරෙන් ලබාගත් දිග පොළවට දැමීමේදී දිශාව වෙනස් කළේ නම් කකුටු බෙතය මග හැරිය හැකිව තිබුණි. එය නොකළේ දිශාවකට අනුව පිඹුර සකස් කළ නිසාය.
- ◆ ජාතක කථාවේ මැනුම් දණ්ඩ (Pole) මනින හුය (Chain) විය හැක. මෙහි කථාවේ ඉලක්ක අරමුණකට නොවූ නිසා මැනුම් ක්‍රමය හා උපකරණ නොකිය වුනා විය හැක. ජ්ලේන් ටෙබල් ඉන්දියන් ක්ලිනෝ මීටර් වහාබ් වක්‍රය වැනි දෑ උපකරණ භාවිතා කරන්නට ඇත.

අදටත් මනුෂ්‍යයින් යැපෙන්නේ කෘෂි නිශ්පාදන වලින්ය. තාක්ෂණය ඉහළ මට්ටමකට පැමිණ ඇත. කෘෂි නිශ්පාදනය ද තාක්ෂණික සහාය ලබමින් සිටී. කෘෂිකර්මාන්තයට මූලික සහාය සලසන මිනින්දෝරු තාක්ෂණය ද තාක්ෂණික පරිණාමය මගින් ඉහළ මට්ටමකට අද පැමිණ ඇත.

කුරු ධම්ම ජාතකයෙන් කියවෙන ප්‍රා ඓතිහාසික අවස්ථාව ද මහා වංශය වූල වංශය හා වෙනත් ඉතිහාස මූලාශ්‍රයන් ගෙන් දැක්වෙන අපේ ඉතිහාස යුගය තුල ද මිනින්දෝරු ශිල්පය විසින් අපේ ජල ශිෂ්ඨාචාරයට දුන් අත්වැල කෙලින්ම සඳහන් නොවුනත් තාර්කිකව හඳුනාගත හැක. මාතෘකාවට සෘජු සම්බන්ධයක්

නොවුවද අපට ඇගයීමක් ඇති ආචාර්ය ආර්.එල්. බ්‍රොනියර් ඔහුගේ “ THE STORY OF WATER MANAGEMENT IN SRI LANKA DOWN THE AGES” හි පසුවදනින් මාගේ ලේඛණය නිමා කරමි.

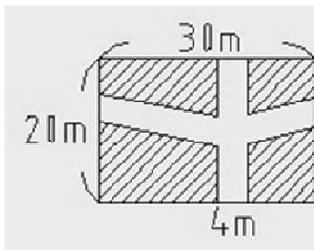
“ මිනින්දෝරු වෘත්තීය තරම් ඒ වෘත්තීයෙන් කරන වැඩ කටයුතු මහජනතාව නොදන්නා වෘත්තීයක් තවත් නැත. එහෙත් ඒ වෘත්තීය තරම් ජනප්‍රිය ද ගැමි විශ්වාස ද පුරාවෘත්ත ද පැරණි ශිෂ්ටාචාරය ද තුළට කිඳාබැසිය හැකි අන් වෘත්තීයක් ද නැත. “

**ස්තූතිය**

මිහිඳු සමුද්‍රගිරි විහාරාධිපති තාරපේරියේ සරණසිරි ස්වාමීන් වහන්සේ බිතු සිතුවම ඡායාරූපය ලබාගැනීමේදී හා අවසරය දීමේදී දක්වන ලද අනුග්‍රහය ගැන ගෞරව පූර්වකව ස්තූතිවන්ත වෙමි.

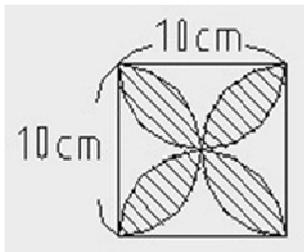
**As a Surveyor you should solve following types of problems within a short time!  
Check your thinking power by yourselves!**

**1. How many square meters are in the shaded area?**



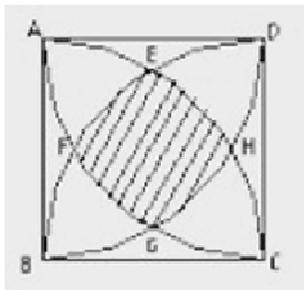
Udurawana has a 20m by 30m garden. Within the garden he opens up a 4m wide walkway. The shaded areas are for plants and grass. How many square meters is the garden excluding the walkway?

**2. How many square cm are in the shaded area?**



How many square cm are in the shaded area? Assume each side of the square is 10 cm. The diameter for each half circle is also 10 cm.

**3. How big is the shaded area EFGH?**



The length of each side of the square ABCD is 10 cm. The shaded area EFGH is surrounded by 4 curves of quarter circle. How big is the shaded area EFGH?

Ref: <http://www.freepuzzles.com>

You are requested to email your answers to the EDITOR