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# Surveying Records and the Public

And Other Papers Presented at the Second Surveyors Conference
January 27-28, 1931, Ames, Iowa



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Engineering Extension Service
Iowa State College Ames, Iowa

THIS bulletin is published so that those who were unable to attend the second surveyors' conference might have the benefit of the papers and discussion presented there. The need for these conferences arose in connection with the rapidly expanding highway program of recent years.

We have seen hundreds of miles of new highway construction on our primary roads. We are about to see an even larger mileage of new construction on our secondary roads. Our surveying monuments, in the form of stones, posts or iron bars, exist largely in these roads. With every mile of construction there is a chance to disturb at least two of these monuments. In order that the property rights of every land owner be protected, these monuments *must not* be destroyed. They must be carefully preserved and a record kept of their location. The placing of paving over many of these points has created a new set of conditions which must be considered in an endeavor to preserve adequate records.

Surveying records throughout the state are gradually deteriorating. The only provision now existing in our law for their preservation is the one which states: "Said [county] surveyor shall make all surveys of land within his county which he may be called upon to make, and the field notes and plats made by him shall be transcribed into a well bound book, . . . . . which book shall be kept in the county auditor's office, . . . . ." Inasmuch as the *county surveyor* has been practically an extinct office since the office of the county engineer was created some fifteen years ago, it has been nobody's duty to keep up such records.

The discussion at the surveyors' conference looked toward a betterment of these conditions.

# TABLE OF CONTENTS




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# *the Surveyor says---*

*Had we not had this old plat with the records and data it might have been necessary to pay another thousand dollars to the land owner. This would have been public expense.* See page 5.

*We can't tell a man to move his fence back unless we have pretty good evidence of the corner.* See page 7.

*. . . . figures about $3.00 per quarter section, or $1.00 a corner for each farm. Most any farmer would be glad to know he has the right fence line for $1.00 per corner.* See page 8.

*If we had these records from the counties . . . . . we could . . . . . tell a man just how much we would charge for a job and not have to spend a lot of time looking for corners that had been surveyed before.* See page 10.

*I believe there is a slight tendency to value the section corners more highly than the quarter-section corners. . . . . If you preserve the old quarter-section corners you are preserving more property rights.* See page 13.

*In carrying out our road program of recent years, no permanent bridge, culvert or road has been constructed without finding the government corners or relocating them.* See page 17.

*Is the direction of a correction line determined by corners governing the land to the north, or those governing the land to the south . . . . .?* See page 32.

*. . . . . a committee should be appointed consisting of a Highway Commission engineer, a county engineer and one in private practice, to study the provisions of the present code and make a definite recommendation that the surveying records be kept in the county engineer's office.* See page 21.

## Surveying Records and the Public

By R. E. Robertson
County Engineer, Mason City, Iowa

The topic of "Surveying Records and the Public" is one that has received a good deal of attention at this meeting. The keeping of surveying records was mentioned in the laws of 1851, when the state was only 5 years old, and has been mentioned many times since. At that time the legislature stated that the county surveyor should make a record of his survey findings in a book kept in the office of the county auditor provided the interested parties pay him the fee, which I believe was $1.00. I know of no better way of getting at this problem than to mention some specific instances that have occurred in my own office. I hope you will pardon these personal references.

A recent case dealt with cutting off a corner of a man's lot in connection with the relocation of a primary road. The road went down a street that had been surveyed several times and platted twice. Although we asked for only 66 feet of the original street width of 79.2 feet we felt there was some damage to the man's property and awarded him $500. He asked for $1500. When we showed him the original records showing street width, he withdrew his claim. Had we not had this old plat with the records and data it might have been necessary to pay another thousand dollars to the land owner. This would have been public expense.

Our records are like most of yours I suppose, scattered, one from here and one from there, but something happened a few years ago that made me think that perhaps the county engineer's records might be of some value. A man had some property on the lake shore. He had brought a man up with him to look at it, and they had to go back that night. The man was willing to buy if he could be shown the limits of the lot definitely, but the owner had not brought the deed with him. He told me what lot it was and asked me if I could come out and make a survey of it right then. I was not able to do that but told him I would see if there were any records that would be helpful. He knew where three of the corners were but he could not find the fourth. I found the plat and showed him where the corner should be. He came back that afternoon and told me that they had located the corner and he had sold the lot.

Before he left the room a farmer came in to ask about his fence line. I was not able to go with him, and he was in a hurry for the information as he had a man working at that time. I went to my records and found the ties to the corners. He seemed to understand so I gave him these references and trusted that he would know how to use them. I told him how to find the corner and to build his fence back 33 feet from the line.

Before long another fellow came in and said, "How long is my fence, the one north of my house?" I got my records and was able to give him the pluses for the cross fences. We subtracted the pluses and gave him his fence length. He was surprised and delighted.

It is services like that which we render to people that make them appreciate the value of the county engineer. Some of us get discouraged sometimes just putting away and putting away records but if these records help us to do these little things for the public it is worth while even though they might not show much appreciation. It is a little like the boy whose teacher said to him, "It just pleases me so much to give you an 81 in history." "Why don't you make it 100 and have a real good time?" was his answer. If we don't expect too much in the way of appreciation we won't be discouraged.

This fall I had occasion to want to know the depth of a drainage ditch. That is, its established depth, as it had filled up. The bench marks were all gone. At the time the ditch was put in a bridge was built half a mile above. I got the survey for the bridge and it was tied in to the bench mark of the drainage system, so all I had to do was to take the elevation of the floor of the bridge and run the levels down and establish the bottom of the ditch.

Private surveyors often come to the office to get information from our files. These old records contain an immense amount of information. There are records of from 500 to 1,000 different surveys. These had been used so much that the corners of the pages were wearing out and they were getting in pretty bad shape. We saw that they could not last long under those conditions. In the middle of the winter when the work was slack we copied them on heavy bond paper on sheets 14x18, with a section on each sheet. We made transcripts of all of the records. We had two young fellows in jail at that time who were bright chaps so we brought them into the office and had them go over all of these copies with lard oil and gasoline. A different substance might have been used, but we found this satisfactory. We printed two copies of these straight through and arranged them in order in a book. We put the originals away for more copies should we need them. One book is carried in the surveying car all the time. Any time a farmer asks about the survey on his place, we are able to answer his question at any time from the book. We make our references to trees, poles, culverts, etc., and carry in the car a book giving references to all the corners. By having all this information with them the boys are able often, when they finish a job early, to stop and pick up some of this work on the way back. This saves making a special trip at some other time.

A lawyer came into the office one day and said that he thought he had a pretty easy case. His client had told him that the other fellow was fenced over on his land, and the client wanted the fence moved back. I looked up the old records made 25 or 30 years ago which described the wrought iron pipe (and the stone along side) that was



set on a line with the fence and in the center of the road. The lawyer decided to tell his client to drop the case. Thus his client was saved the cost of a law suit and the county also saved on the court expenses. The usefulness of the engineer will be recognized in proportion to the number of people to whom he renders direct service, and this service is bound to be in proportion to the records he has available.

## Cost of Re-Locating Section Corners on a County Basis

By Sam Steigerwalt
County Engineer, Nevada, Iowa

Prior to last year we did not get very much land surveying work as county engineers. In the building of trunk roads there were not many corners to find. We would look for the corners, but as the county supervisors would not order the fences moved it was useless to spend much time locating the corners. About two years ago we started to get the fences moved back, but those out only a few feet were let go. At the present time we are trying to move all the fences back to the right-of-way line and therefore must find the corner stones. We can't tell a man to move his fence back unless we have pretty good evidence of the corner. Our practice has been to locate all the corners we can and get them identified. When we could not find the corners by digging, we did not go to a lot of trouble to re-survey. We took the improvements, and inquired from the farmers. I can see where this might get us into trouble with buildings or trees. I think the better plan is to re-locate corners that are lost. The county engineer is going to get a great deal of this work in the next ten years.

Now that most counties are improving their local roads and there is an increasing mileage each year, I don't see why we can't start right out and make a progressive survey of the entire county. If you make a survey for one land owner it costs almost as much as a survey of the entire section; also if we make a progressive survey it would be considerable cheaper than to do it year by year. We are going to need these corners, and we might as well have the information available. The farmers are building new fences on all of the roads and they want to know where their corners are.

In the spring we receive a great many calls from farmers who are building new fences and want to put them on the right-of-way line so they will not have to be moved again. We don't like to have a fellow put in a new fence and in a couple of years tell him that he will have to move it. Story County has been quite successful in getting the farmers to move their fences voluntarily, which has done away with expense and hard feelings caused by having the sheriff serve notices.

Every county that is going to have a secondary or local road program might as well re-survey all of the section and quarter-section corners set by the original government surveys, as all of these corners are needed in order to get the center line of our roads.

I would like to give you an idea of the cost of this work. During the last three years we have run out about 140 miles of this kind of work, and have located nearly all of the corners. The cost has not been very high. It may be that we are working under very favorable conditions here, but it has been at a surprisingly low cost.

It does not take an experienced engineer or land surveyor to do *all* of this work. Ordinary instrument men can do this under the direction of the county engineer or a land surveyor. They would have to work under someone who has a license. The cost of an instrument man would be about $7.00 per day, and diggers about $4.00 per day. And as for diggers, you can't just pick up fellows around town to do this. I tried to use high school boys but they were not satisfactory. You should get men who have experience in digging ditches, as they can do a lot more work than inexperienced help. We have a light truck and the instrument man drives this. The instrument man helps to reference corners, chain, and he also does some digging. The cost is about $32.00 a day; four diggers at $4.00 a day; instrument man at $7.00; maintenance of truck $2.00; material for stakes $6.50.

For stakes we use inch round by 2½-foot reinforcing rods. We have not done very much permanent referencing as yet; have referenced so far with wooden hubs. We have called the attention of the board of supervisors to the need of permanent referencing, and perhaps we will be able to do this later. We would like to reference with permanent iron pins. The problem of permanent referencing was discussed this morning.

In going into this work we locate only the section and quarter-section corners. With the kind of a crew I described we cover 4 miles, that is, 8 corners a day. That gives each digger half a day at a corner, and a digger can do a pretty complete job in that time.

The average county in Iowa has about 800 miles of local roads that have not been lined up. There would be 1600 corners in 800 miles. If the crew can locate an average of 8 per day, in a short season they could locate all of the corners in the county. $8.00 per mile would make the cost about $6,400 per county. This will give you an idea of the cost, though it may vary in different counties. In making a progressive survey each point helps to locate the next point. The cost of $6,400 per county prorated down to cost per farm, figures about $3.00 per quarter-section, or $1.00 a corner for each farm. Most any farmer would be glad to know that he has the right fence line for $1.00 per corner. A separate survey would cost him a lot more than that. If the land surveyor in that county wants to make any surveys inside the section he will have the corners to work from.

The benefits to the county engineer are that he knows where the



corners are when the time comes to make improvements on any road in the county. With the corners located he can ask to have fences moved at any time without having to take time to locate the corners. Many roads have fences very close to the roadway. The brush grows up along the road because it cannot be mowed, because the fences are too close. If the fences were moved back the brush could be cut, and then the new brush could be mowed each year and the road kept clear. Snow removal is being demanded in this county; and with brush along the highway and the fence out in the right-of-way, it is impossible to keep the snow off. We must get the fences back and to do this we must have a survey, and the cheapest way is to make a progressive survey.

I want to mention an idea we have for referencing. We set four stakes, each 50 feet out from the corner stone, and near the fence corner. Any two of these reference stakes will give you the corner. We have been using wooden hubs, but I feel that we need a more permanent reference. We have been setting the wood references outside of the fences, and on the road not being improved, when referencing at a cross road. If a permanent pin was used, I would set it right under the fence. Later when we come to build this road we can pick up this corner without digging. Sometimes we set four stakes and get them back in the field about where the new fence line will come. By using this method of setting all reference stakes 50 feet out, the engineer knows just where to look for the references, and any engineer coming after him will know the place to find these references.

We try to do this as cheaply as possible. The cost of the reinforcing bars is about 25c or 30c each. I think these are better than stones, for in this county we have a lot of glacial drift, and if you don't find a cross on the stone you don't know which is the right one.

About the records that are kept by the county, I think the suggestion made this morning, that all records be kept in the engineer's office, was a good one. It is confusing to have several places where records are kept. We have never made a systematic record of corners found while making road surveys. So far we have only kept indexing the field books in which such references were first made.

## DISCUSSION

MR. DODDS: I think your suggestion is good when you consider that the county engineer is a continuing office.

MR. STEIGERWALT: After a road has been improved and you know where the center is, it does not take long to locate the corner. If you have a rounded corner, 50 feet might not catch it, but you could use some other definite number of feet in that case, 75 feet, for instance. If surveyors knew that references were uniformly 50 feet out it would eliminate a lot of digging. We had occasion to mark the center of a section in which five land owners were interested. They were all positive that the old post was right so we got together and took out the

old post and put in a steel post in its place. Any time you run out the center of a section it would be a good idea to get the owners together and have them witness the placing of the corner. If you leave it to be done later it will be neglected. It is just as easy to have the material ready and do the whole thing at once, and record it. The land owners will all be interested, for they would not want the survey unless they were interested in the corner.

MR. DODDS: Well I am willing to concede to Sam that his method is good. Those wooden hubs of his are very useful, and if they are replaced with something permanent they will be that much more valuable. All of this work that is being done in the various counties is making land surveying something besides digging. When a man asks me what I will charge to survey his land, I hate to tell him that I do not know. If we had these records from the counties, we could easily find our starting points, and so we could estimate our time accurately and could tell a man just how much we would charge for a job for we would not have to spend a lot of time looking for corners that had been surveyed before.

MR. ROBERTSON: I wonder if we could not, through the legislature, make it the duty of the county engineer to reference in these corners? If that were hooked up with a penalty for destroying references, we would have some pretty good references. People in general have respect for reference points. At a corner I surveyed I had referenced the corner to a willow tree. The man who owned the land had cut down the row of trees, all except this one, and he came and asked me what he should do about that. He said that it looked bad standing there alone, but that he did not think he had a right to destroy it. The money saved on re-surveys would more than pay for the cost of making permanent references.

MR. DODDS: In this work of making a progressive survey there should be some extra provisions made for the corners that are difficult to find. It is well to estimate it at $8.00 per mile, but there should be a fund that will provide for calling in other men in unusual cases, to supplement the work.

MR. ROBERTSON: I recall that in Madison, Wisconsin the township was resurveyed by the government, and permanent markers were put in. Is it possible to have a government survey in any township?

MR. DODDS: It is possible, through some sort of a cooperative arrangement to have the government do such work. However, I have yet to see a very thorough job on that type of a survey. They usually cause a lot of trouble. I think more satisfactory results are obtained when the work is carried on by local men who know the people of the county and understand their problems.

MR. OWEN: I think Mr. Robertson refers to a provision in the Wisconsin statutes which allows the townships to enter into a contract to replace all government corners. I had such a contract once. There are 133 government corners in a township. I agreed to replace the



corners with 6x6x36″ concrete posts, at a cost of $5.00 per corner. We hauled the stones out with oxen. It took the original surveyors 6 days to make the survey and it took me six weeks to make the re-survey.

## Methods of Referencing Corners

BY JOHN S. DODDS
Associate Professor Civil Engineering
Iowa State College

When corners are found, some definite and permanent method of referencing them should be used, or it is almost useless to find them. I want to ask you if you don't think that the time has passed when the land surveying profession should feel justified in digging for corners which could be found by using references, and if the time has not passed when we can justify any duplication of effort which is unnecessary. I think you will agree with me that the profession of land surveying would be more profitable and interesting if we could substitute head work for digging. I am always disgusted when, in looking for a corner monument, I have to spend a lot of time digging a hole big enough to bury a horse. A number of you have had the experience of looking for a corner that has been used in recent years, but which has been dislocated and which could have been found easily if there had been good references. We ought not to need to do that work over.

I had occasion a while ago to make a survey in a nearby county. I went to the auditor's office and asked for the survey records. They did not know what I was talking about, and were sure that I was in the wrong building. The janitor overheard this discussion and suggested that I see Mr. McClure and that he would be able to steer me to a source of information. I found Bill when he came in from some construction work and told him my trouble. He said that he had a book in his office which contained a lot of information that might be useful. I used the book, which he had inherited from his father, a charter member of the Iowa Engineering Society, and found that it contained a lot of information from original notes and notes from his own surveys. I was able to check and find the corners for this piece of property in a hurry, but I had to be a detective to get started. It is hard enough to decide whether a piece of dark colored mud is evidence of an original corner, and to decide whether a row of trees is 20 or 30 feet from a line, without having to use a great deal of deduction in getting started.

The resolution presented this morning is very timely. We should ask the legislature to transfer all survey records from the auditor's and recorder's offices to the office of the county engineer. The engineer knows that he needs them. If any have not discovered it they

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The resolution presented this morning is very timely. We should ask the legislature to transfer all survey records from the auditor's and recorder's offices to the office of the county engineer. The engineer knows that he needs them. If any have not discovered it they

soon will. I believe that a good set of records, well kept and up-to-date, would make unnecessary a lot of digging.

Then we come to the actual method of making the corners easy to use. Let me read you a few notes from the original government survey. "North between sections 22 and 23, variation 8°-30′. At 2.46 the surveyor found an elm 16 inches in diameter on the line; he hit it with his axe. At 5.00 he touched the creek at a bend. At 19.00 he crossed the river. It was 40 links wide. At 29.30 he hit the river again. At 40.00 he left the bottom. At 66.00 he entered the timber running SE. At 73.00 he left the timber running NE. At 80.00 chains he set a post in a mound, pit 8 links east." A lot of men have the idea that the government surveyed this land according to a set of rules such as appear in the text books today. If they left the bottom and entered a slope, that is a good indication of distance. When we come to the bank of the creek we know that 83 years ago a tree stood there on the line. That is a very good tie, but the creek may have moved like the pavement we heard about yesterday. The old notes show the location of the river in 1847. The land owner in this case did not want to give us any information, but fortunately he had cut the line tree down. We found the axe mark on the tree, but it was so low on the tree that we know that there is an entirely new topography of that section. That is a tie which is usable, but that type of tie is passing.

If any of you are in doubt concerning the rules governing land surveys, I would suggest that you read Johnson and Smith's book on surveying. Judge Cooley, who was Circuit Judge in Michigan, is quoted rather widely in that book, and his opinions have a good deal of weight.

Last night Mr. Harlan told you about the old surveyors and their work. You can perhaps understand and appreciate their work better if you think of the things that were going through the minds of those old surveyors. If the record shows 40 or 80 chains between two corners, the presumption should be in favor of the original survey. But you should not expect to find two 40-chain intervals of exactly the same length.

This talk about finding the stones, implies that all of the original stakes were replaced by stones. In many cases, of course, this was not done. Often we spend time digging for a stone and destroy what evidence there might be of a wooden stake. Probably stakes were used in 95% of the cases. If the land has not been disturbed you may expect to find the stake or some evidence of it. You could not expect to find much in the upper layer of soil, but you may expect to find some part of the point of the stake that pierced the sub-soil. These stakes were split from the best timber at the camp site. They were generally walnut or oak. You will not find stakes of lath or lumber, but stakes that were split out. The point is generally harder, either from burning or from the force of driving it through the ground. You would not expect to find the stake itself if the ground had been plowed while the stake was new.



I would recommend a marker of steel or iron rather than stone. I believe the time will come when we will be able to locate such stakes by radio and thus eliminate a lot of digging. A radio would give static when you approached the corner. This is really Professor Owen's idea rather than mine. I think that a Ford axle is a good thing for a corner. It will last as long as you need a record, and will permanently discolor the ground. Gas pipes 3 feet long make satisfactory markers. That type of corner is superior to a stone for there is no doubt but that it was set there artificially; by hand, and on purpose. When the idea becomes prevalent that we are looking for that kind of a corner, I believe we will have gained a point.

A very sad lack, in my estimation, in connection with surveying records relates to the measurement of angles. A corner may be obliterated though you know the distances, but if you also have the angles or bearings you can re-establish it. A great many surveyors have made surveys without measuring angles. If you have to occupy a a corner you can run a random line, measure the angle and record it.

I believe there is a slight tendency to value the section corners more highly than the quarter-section corners. The section corner is not necessary when you set the center of the section. It governs the area of one square mile or four quarter-sections only. The quarter-section corner is useful in locating four quarters in each of two sections. If you preserve the old quarter-section corners you are preserving more property rights. That is why it is so important to find and preserve the original quarter-corners.

Now I get back to the point of actually tying a corner down and using it. We want the corner so well referenced that we can use it without digging for it. In this county the engineer is finding corners and making definite ties. He is faced with the necessity of finding a method of relocating these points. We know of course that a section corner is not at the intersection of two straight lines, but where four lines come together. After finding the corner and setting hubs for the fence corner you could use those for reference marks. City engineers make use of a little metal button in pavement marking that can be fixed in the top of the reference stake. If we expect any uniformity we must suggest something that can be easily obtained. You could drive the iron pipes for referencing the corners and then put this button on the top. The top of the button could say "Polk County" or just "County" and "R. P." I think it would also be desirable to add "$50 fine for disturbing this mark". You could locate a lot of corners in the winter when other work is slack. The United States government has markers somewhat similar to this, but with a $250 fine and they have very few disturbed. If a person accidentally disturbs one he generally has sense enough to know that if he reports it he will not be prosecuted.

If we have some uniform system of referencing corners we can avoid wasting a lot of time. If we waste our time digging and doing

work that a 40-cent-an-hour man could do, we are worth just $4.00 a day. It will be more profitable to do surveying when the unnecessary detective work has been done away with. The quarter-corners should be referenced in the same way.

The next point I would like to discuss with you is how to mark the center of a section. It should be possible to use a zinc or aluminum plate, 4″ x 6″, with the inscription "Center of Section." If we could set these in the center of the section with the stone, it would be ample. If it has already been fenced and the center post is at the center, tack this on the post in such a way that it could be removed and put on the next replacement post. You would find it helpful to use the center post in many cases.

## DISCUSSION

A VOICE: We have sections that have 3 or 4 center stones. Each land owner claims that his stone is the right stone.

MR. DODDS: Several different ways of determining the center have been used. One is by running in half way on one line. Another by measuring in a half mile each way and locating the center. Running through from two opposite quarter-section corners and dividing the distance would give a different point than the correct method. The correct method is of course to intersect two straight lines connecting the opposite quarter-corners. But can we do any more than just talk about this problem. If we place these markers on the fence line their preservation is up to the integrity of the individual land owner. Probably not one in a thousand would ever be disturbed. The interests of adverse land owners would tend to preserve the original corners. If the corner is in the fence line and there is no intersecting line, then there might be a marker in the ground below and a plate on the wire. I have been reading a lot of old proceedings of Iowa Engineering conferences, and 25 years ago we were talking about this matter that has come to a head today. In the county engineer's office we have more than 90 percent of good records. That is, the men who are now county engineers are taking this matter into their hands and transcribing their notes on a new basis which will not be cumbersome, and are building up an effective system of finding corners from ties.

MR. THOMPSON: Would it be just as good to have two references straight across at the quarter-section corners.

MR. DODDS: Two references directly across are not good ties. If you have four you can re-locate your point from any two of them.

MR. THOMPSON: If you had two you could measure straight across and take the center.

MR. DODDS: But you might lose one. With four, the loss of one would not be serious.

MR. OWEN: I have had some experience with the use of buttons. I laid out a lot of references in a level circuit for my students. Before that they had been running to the same bench mark. I went out and struck a radius 2½ miles from the engineering building. I had a lot of those buttons made so there were 30 to 40 different circuits to run. The buttons disappeared at a great rate. They made nice souvenirs for the students when out on a hike. They were easy to pry loose. The $50 fine might make some difference. But think how many people are going to see them each year, and many would want to take them.



MR. MAHONE: Unless the weeds are cut along the fences better than they have been, no one is ever going to see them.

A VOICE: In 25 years they would be as hard to find as the corner itself.

A VOICE: I have had occasion to look up some ties that have been in only 2 or 3 years, and it is as hard to find them as it would be to find the corner. One in particular was at the bottom of a hill and it was buried under a foot of silt.

MR. DODDS: What type of reference points were they?

ANSWER: Concrete.

MR. DODDS: The proposed radio method would have done away with that searching.

A VOICE: I think in using references or records you need to know something of the man who made them. If you have enough of his work you can get a pretty good idea about him. We had one man who was formerly a surveyor in our county, who chained distances and picked out his corners regardless of the government survey. Sometimes with the record of his corner he would mention, "government corner 6 feet 6 inches north in error". Now we have two corners. If you can find out for certain that this man surveyed that corner you can throw it out. But he did not always say which were his corners. When we find a stone we have to determine whether it is one of his or one of the original government corners.

# Section Corner Records in Hardin County

BY WALTER A. SCHULTZ
County Engineer's Office, Eldora, Iowa

Most of the townships of Hardin County were subdivided during the year of 1847, eighty-four years ago. A copy of the original field notes and a plat of each township made from the original notes is kept in the office of the county engineer. The county has been fortunate in having, through quite a period of years, two or three competent county surveyors whose writing most people can read and whose notes are reasonably complete. The records consist of three books having recorded in them 653 surveys made between the years of 1856 and 1931. All of the witness corners shown in the surveys have been of temporary nature, such as trees, corner posts and telephone poles.

Time and man have been very efficient in destroying these corners. The clearing of land for agricultural purposes and the construction of roads have played a very important part in their destruction.

Aside from the work of the State Highway Commission along primary roads no attempt has been made to set permanent witness corners. During the last fifteen years our records show that we have located what appeared to be the remains of about six original government stakes used for marking the original corners and have no record of having found an original government witness corner. We have been able to locate but very few of the witness corners set on resurveys made more than ten years ago. Like the original government witness corners they have been of a temporary nature and after a very few years most of them have been destroyed.

Fifty-eight years ago an attempt was made to have permanent markers set at the government corners in order that they might be preserved. On September 4, 1873 the following recommendations were submitted to the Board of Supervisors by the Deputy County Surveyor:

> To the Honorable Board of Supervisors,
> Hardin County, Iowa.
>
> In view of the rapid defacement and destruction now taking place of the Original United States Monuments marking the corners of lands in Hardin County, I would respectfully recommend that your Honorable Body request of all land owners within your jurisdiction to plant permanent corners in accordance with the following Resolution.
>
> Resolved by the Board of Supervisors of Hardin County, Iowa:
>
> That the land owners of this County are hereby requested to assemble on days set by themselves before November 1, 1873, on their respective lands so far as may be and proceed to plant a stone of at least eighteen inches in length to the depth of fourteen inches at each and every Government Corner on their respective sections placing two well burnt brick beneath each stone and replacing all road or other material found at such corners in the ground at the north side of said stone, one of each assemblage of owners should be selected as clerk who shall reduce the facts relative to the planting of each stone to writing, together with the evidence of corner and the names of the persons present and make oath to the same in writing before some Justice of the Peace, or other competent officer of the township in which the land is situated and file the same for reference in the office of the County Auditor, on or before the 10th day of November 1873. As many of the younger members of the neighborhood, competent to understand the matter and testify hereafter if necessary it would be well to have present at the corners. Compliance with this Resolution will probably save much needed surveying and litigation hereafter.
>
> Respectfully,
> Deputy County Surveyor.



The recommendation was examined by the Board, approved and ordered published.

Up to this time we have been unable to find any record of the resolution having been complied with.

In this county, until recent years, the existence of a corner seemed not to have been taken into consideration as much as it should in the location and construction of bridges, culverts and roads. A half-hearted search seems to have been made and if the corner was not located, the existing road fences were split and the road, bridge or culvert constructed.

In carrying out our road programs of recent years, no permanent bridge, culvert or road has been constructed without finding the government corners or relocating them.

During the year 1930 we found the corners or relocated them for 191.5 miles of road. Part of this work was done preliminary to road construction, a part in carrying out our road construction program and a part at the request of the property owners for fence lines along the roads, in order that fences might be constructed on the property lines. At times this necessitated some extensive surveys, involving considerable time. From our experience with the destruction of the temporary witness corners of the past it seems that we should adopt some standard permanent system of marking these corners if we wish the public to receive one hundred percent benefit from the expenditure of the money spent for making these surveys. We expect to adopt by the time the construction season starts, some system of permanent markers for corners and witness corners.

At the present time when a corner is found or set it is tied in to temporary corners and the ties recorded in eight field books, each book containing the ties for two townships. We now have recorded the ties for 1125 government corners. When the permanent markers are set, we expect to make a duplicate record, one for the office and one for field use.

## DISCUSSION

MR. HOFFMAN: In running surveys and locating section corners, I tie in to all temporary corners like fence corners and telephone poles, etc., but I do not make that a permanent record as they are likely to be changed. But if a fence corner is a steel post set in concrete I make it a permanent record. We usually drive iron pipes or iron reinforcing bars at the four corners and make a note of the distances to the monument. If you do this you will have a marker that will stay a long time.

MR. MAHONE: Mr. Schultz you said that in connection with your work you keep eight field books. What is the general arrangement in these books?

MR. SCHULTZ: We have two pages for each section, with the sec-

tion drawn and surveys recorded. All of the records are kept in our office.

MR. MAHONE: There is a point I wish to bring up. In some counties the records are kept in the auditor's office, in some in county engineer's office, and in some in the recorder's office. A man going into a county to work does not know where to look for the records. There should be some uniformity.

MR. HOFFMAN: We have one record in the engineer's office and one in the auditor's office.

MR. MAHONE: Are these essentially duplicate records?

MR. HOFFMAN: Yes they are. A way we have of identifying the stones is to measure them. We measure the longest side, the thickest and widest. We then put this information down in the field book, *stone at this corner measures 18"x10"x6"*. If we find the stone lying loose on the ground we can measure it and see if the measurements correspond, and we can more accurately identify the corner.

MR. MAHONE: You can't always tell just where the stone came from when you find it on the ground, can you?

MR. HOFFMAN: One time I began to dig where the corner should be to find the old stake. The stone was lying on the top of the ground. We dug and found a spot of black earth. The stone had a big crease in it and when we cleared the spot we found that the stone fitted exactly into the place that we had dug out.

MR. MAHONE: In Hamilton county they follow the practice of putting pieces of broken glass and crockery under the stones, and there will generally be a few of these pieces remaining to give an indication of where the stone was placed.

MR. HOFFMAN: In two townships a number of commission surveys were made by order of the court. The commission put in crockery and broken glass under the corner stones. I have found some of them where the stone is gone, and the pottery or glass gives the location. The records of these surveys are kept in the clerk's office. I have made copies of a number of these surveys. Some of the records have been misplaced or lost and the copy I have made is the only record left.

MR. CAPPER: That practice of putting in bricks or tile is very good in stony counties where there are many stones that might be confused with the corner stone.

MR. MAHONE: There is another thing in connection with these stones. Some of the residents of this county have told me that their fathers used to go around with a wagon load of stones and put one at each corner where the old pit was clearly to be seen. This was about the time the roads were moved to the section lines.

MR. CAPPER: I have a method of keeping records but it isn't one that would be useful to county or highway engineers. Mine is a private practice. I make tracings 8½x11, using a scale of 1,000 feet to the inch. I work out a section and on that I show the work I did for



Mr. Jones, putting in rings to show old corners and solid marks to show the new corners established. I then make blueprints, so I have something to give my client and he is satisfied. I file the tracing in my file for my own records. I also take one of these prints and paste it in the book in the auditor's office. This method seems to be very satisfactory in my field.

MR. MAHONE: How long will those blue prints last as permanent records?

MR. CAPPER: The tracing is kept in my own file, but perhaps it would be better to paste that in the auditor's book for it would make a more permanent record.

MR. MAHONE: It seems to be the custom in this county for the surveyors to transcribe their records into the books with good black ink.

MR. HOFFMAN: There is a state law that requires that the county surveyor keep records of his surveys in a book kept in the auditor's office.

MR. CAPPER: The office of county surveyor has been abolished, so that law has no weight.

MR. MAHONE: I have wondered if a loose-leaf book might not be more satisfactory.

MR. CAPPER: I think the county engineer's office is the place where the records should be kept. I have had some trouble in keeping up-to-date information on corners and ties, because the Highway Commission in construction work destroys the old ties, and we do not have complete local records of the new ties they have used. They have those records in their books, but they are not available anywhere in the county. I suppose all their records are kept here in Ames.

MR. SCHOPPE (Highway Commission): We tie in all of the line points and all of the section corners we have found. We are most particular about section and quarter-section corners, and tie those in by referencing those corners to hubs outside of the right-of-way. Sometimes trees and buildings are used for references. As these hubs are outside of the right-of-way they will not be disturbed by the construction work. After the work is finished we go back and mark the line points by crosses on the pavement, and the section corners by lead plugs in the pavement.

MR. HOFFMAN: On number 71, a north and south road through our county, the Highway Commission set concrete markers at the four corners so that intersecting lines will locate the section and quarter-section points.

MR. THOMPSON: I have had difficulty in getting these highway records. Our county was one of the first to start paving. The highway surveyors got the P. I. points but they did not say whether there was a stone or what it was. I am sure we know nothing of what they found. There is nothing left in our county if we want to go back. Should we ask the Commission to leave a record in the county where they work? The records are all sent here to Ames.

A VOICE (From the Highway Commission): A copy of our original notes is filed with the auditor, and a copy of the original plans it filed in the auditor's office.

MR. THOMPSON: But that would not show the stones that were found during construction.

MR. CAPPER: There is no lead plug in the gravel roads. It is just a tie proposition.

MR. HOFFMAN: It would be a good idea to have the stones that are found during construction put in on the original plans after the construction work.

MR. SPANGLER: In my work with the Commission, when I find a corner I note it in my field book, give the original references, date when found, and the ties. That is what should be done, and all this shows on the highway maps.

MR. CAPPER: Isn't that getting back to the proposition of half a dozen sources of information. All that information should be available at one central place.

MR. MAHONE: I think that is just the point. There is no uniformity throughout the counties. Records should be kept so that any surveyor would know that a particular office could give him all of the available information. The most logical place for this information is in the engineer's office.

MR. MAYNE: I can see how the matter of keeping these records together in some available place is rather discouraging. In one county they may be carefully filed in the auditor's office, and in the adjoining county they may be rolled up and piled in the basement. I have found that records are best preserved in the recorder's office.

A VOICE: In many cases the auditor does not know anything about the records or their value. It seems that there should be some way of keeping the records together in some one office. The Highway Commission would be glad of some definite recommendation. I find it is more the fault of the local officers where the records are not well kept. In some counties it is almost impossible to find the records after they are filed. The engineer is probably the man who should have them all.

MR. MAHONE: I would like to ask if there is such an officer in Iowa as County Surveyor?

MR. CAPPER: There could not be legally, the office has been abolished.

MR. MAHONE: The thing I am getting at is this. The law states that the records shall be kept by the County Surveyor and filed with the auditor. The law should be amended and brought up to date.

MR. HOLMES: I was County Surveyor for some years. The law states that the County Surveyor shall keep records in a record book. The record books cost about $20.00 and I tried to get our Board of Supervisors to buy one and they told me if I wanted a book to buy it myself. The law provided that the records should be kept, but made



no provisions how to get the place to keep them. The law was never rigidly enforced.

MR. MAHONE: As many of you possibly know we still have a law that provides for a County Surveyor. I do not know whether this is the place for such a proposal, but we might ask that the Iowa Engineering Society make a study of the laws and prepare a recommendation for the legislature.

MR. DODDS: I think a committee should be appointed consisting of a Highway Commission engineer, a county engineer and one in private practice, to study the provisions of the present code and make a definite recommendation that the surveying records be kept in the county engineer's office. I believe that the time is now ripe for that step. The county engineer is going to have to know where every section corner is in every square mile of his county. The county engineer should have the records and should be provided with funds for keeping them up to date. I think this meeting is sufficiently important and representative to make this recommendation. There is no use in waiting longer.

MR. MAHONE: I would like to hear from some county engineers.

MR. THOMPSON: I wish to add something about this matter of the Highway Commission and the corner stones. This man has told us what he does when he finds the stones. But how long do they look to find them? A preliminary survey was made some years ago in the winter time, and I was on the construction work the following year. A complete set of plans were made with practically all P. I.'s. The next year we found a great number of stones that were just P. I.'s in the plans. If that is the practice in making winter surveys, and they can not make sufficient search for those stones, we never get a record of them. I think they go into it more thoroughly now, but the records in the counties are not complete.

MR. R. ZACK: I have read our instructions a good many times, and have asked several other men just how much and what they require. The intent of the Commission is that all the information be complete. When we find a corner stone, a complete record is made of the stone with references and that information eventually finds its way to the auditor's office. However, a good many stones are found on construction. The preliminary survey party is supposed to make a real effort to find the stones. The men who follow up on construction are more interested in finding the stones than those in the preliminary survey. This information gets on the highway maps. I am not sure whether we are to file these with the county officers. I think the auditor gets one. The engineer could have a copy upon requesting it. When we go into a county to make a survey, we go first to the engineer's office for we find that his records are usually well kept. At the present time there is a duplication of records in the engineer's and auditor's offices. The auditor's office is the official repository, but the engineer has more use for the records.

MR. BUTTERFIELD: The public service corporations have been putting in some high lines in Black Hawk County. Last summer a couple of the boys came in and wanted us to go out with them and help locate a corner that they could not find. When they finished the survey they came back and left us a copy of the notes they had made on the survey. Thus we have information that will help us a lot in the future. The boys told us that they are very glad to cooperate with the county engineers when the engineers are willing to reciprocate.

MR. MAHONE: I believe the Highway Commission requires that a diligent search be made for the stones. But the interpretation of the word "diligent" is varied. I am still wondering if any county engineer would object to keeping the records?

MR. GREENWOOD: In our district we try to have a conference at least twice a year. That matter has been brought up in three different meetings, and all of the men have been in sympathy with some kind of a provision so we could keep these records on file in the engineer's office. I feel that I can speak for that group and say that they would all be willing.

MR. MAHONE: I would like to hear just a word from Mr. Robertson as to the form of records in Cerro Gordo County.

MR. ROBERTSON: We have nothing that we are particularly proud of, but it is something we thought of ourselves. We keep all corner stone ties on a card index. We also have a copy tucked away in a fire-proof vault. For field work these references are kept in a loose-leaf binder, with a page or more to the references on each section. I would like to add that I think all such records should be kept in the engineer's office. Everyone comes there for information. It could easily be made the duty of the county engineer to keep these records. Absolute uniformity might not be possible, but we could approximate it a great deal closer than is now the case.

MR. R. ZACK: Mr. Chairman, the Iowa Engineering Society is to meet in a short while, and I believe we could have them make this recommendation to the legislature, as that would give it more standing.

MR. MAHONE: I think that is a very fine suggestion.

MR. R. ZACK: I will offer as a motion that this assembly request the Iowa Engineering Society officers to appoint a committee to make a study of the present methods of keeping survey records, looking forward to a simplification of the system, and transferring all records to the county engineer's office. This committee should consist of one private engineer, one from the Highway Commission and one county engineer.

(Motion was seconded and unanimously carried).

MR. MAHONE: Such a resolution will be sent to the Iowa Engineering Society.



# The Preservation of Government Corners in Cities

BY C. C. MCCARTHY
Assistant City Engineer, Ames, Iowa

The United States government land surveys were made in this locality more than three-quarters of a century ago. At this time the corners established were marked by small granite boulders or in some cases by limestone rocks of suitable size and shape set in the ground at varying depths. During the intervening years all subsequent surveys and resurveys were based on the government survey and were dependent on these original corners. With this fact in mind, the importance of preserving such of these corner stones, as we are fortunate enough to have left to us, can readily be seen.

Located, as they usually are in the highways, the problem of their maintenance is a hard one. In cities and towns the preservation of such corners as fall within their boundaries becomes increasingly difficult. Many stones have already failed to survive the onslaught of public improvements. That damage we cannot now entirely repair but we can take steps to save those that remain.

It is true that in survey work within cities and towns these government corners are not always used. The sections have been subdivided into small acreages and they in turn into blocks and lots together with the necessary streets. The block and lot corners are often well marked and sometimes it is not necessary to go outside a particular subdivision in making a small survey. Due to this fact the real value of the government corners is sometimes lost sight of. It is only when the need arises to check back further and we need something to back up against that the true worth of these old marks is appreciated or their loss realized. If they have been carefully preserved we will always have something on which to base our surveys.

Unfortunately most section corners are located within the boundaries of streets and alleys, usually in the center, and often in the center of an intersection. Then how to go about it to save them from the grading gang, the sewer ditchers, or the paving crew, and in the meantime from all the other construction and maintenance men whose chief aim seems to be to destroy everything except the specific object upon which they are working?

During the grading work on new streets the stones which are apt to be disturbed can either be lowered beyond the depth of the grading work or can be removed and referenced to some points outside the grading operation and reset after the work is done. A hole about three feet deep made with a post auger and filled with concrete with a small iron or brass rod set in the middle makes a good substitute for a stone in this case. This is something that is hard to plow out and is noticeable if it is disturbed.

In Ames and many other cities, the sanitary sewer is usually located in the center of the street with manholes in the center of the intersection just where they will cause the destruction of the corner stone. Or if it isn't the sanitary sewer ditch it is the water main or some other ditch. In most cases these ditches could be moved a few feet to one side or the other of the center so as not to disturb the corners. If this is not possible, the corners can at least be referenced before they are removed. Permanent reference points may be set at each of the four intersecting street lines so as to mark the block corners at this point. If proper records are kept of this work it serves very well as a substitute for the real corner.

The best method we have used to preserve corners in paved streets in Ames is, at the time a street is paved, to place a lamp hole cover over the stone it is desired to preserve. I believe some foundries manufacture monument covers especially for this work. These covers consist simply of a cast iron ring about 12″ in diameter and 8″ in height with a flanged base. The cover fits down onto the ring and sets flush with the surface of the pavement. There is a small hole to insert a hook to remove the cover. These castings cost only five or six dollars apiece and last indefinitely. Much more than this amount can be spent in paying a survey party for a few hours time spent in relocating the corner. A stone protected in this way is always available for use and is not lost when a street is repaved or resurfaced. Then, too, the original stone itself is preserved.

There are two difficulties with this method. One is to keep the stone in place until it can be covered and the other to get someone to see that the cover is installed at the proper time and and in the proper place. It is very easy to forget such things in the press of a paving job but when it has once been accomplished the stone is safe for many years to come.

Another method which has been used is to drill a hole about one inch in diameter in the pavement after it has been laid and fill this hole with lead. The hole is located by intersection or measurement from reference points set before the construction work is begun and carefully preserved during the progress of the work. This method is followed by the State Highway Commission in their work. It preserves the corner at least as long as the pavement lasts.

Obviously the time to do work of this kind is before street improvements have begun. It is a worth while job to reference all important corners in or near a town before there is any further chance of their being obliterated. Work of this nature can nicely be worked in while other work is slack; in which event the expense will be insignificant.

The importance of an adequate set of records cannot be overemphasized. A careful record in the field note book of the man doing the work should include a sketch showing the location of the stone and surrounding features together with the location and description of the marks used in referencing and the measurements between them and the stone. The notes should record also the land description of which the corner is a part, a full description of the stone or monument itself and the reference points used, the depth below the surface or preferably the elevation of the top of the stone, the names of the men doing the work, the date and any other information which would aid the users of the notes in relocating the point in question.



The best set of records is of little value if the particular thing you want cannot be readily found. To make this possible we must resort to a good index system. A card system is good or a plat of the town may be used with the different corners shown in their proper location with the number and page of the note book in which the reference to them may be found.

It has been our experience in Ames that errors have crept into our work which would not have been made had someone in previous years taken time to preserve the government corners. An error once established is a difficult thing to rectify. Certainly the time to locate things in their right place is when they are constructed. The cost is so small that it may be used up many times over in correcting errors or in relocating lost corners. If this work is carefully and systematically done and proper records kept it will seldom need to be done again, and the value of the work will some day be appreciated, if not by yourself, at least by those who will follow you.

## DISCUSSION

Mr. Dodds: This subject is of interest to the highway men. Sometimes they find good records in a town and other times they are not so good. Lamp hole covers are good for corner identification. I think the corners have been very well preserved in Ames by their use. The center of the street is no longer the place for reference lines. Very soon all of the corners should be referenced to good lines out of the way of traffic, so that surveying parties can actually use the monuments. The older men remember that we formerly could set up our instruments in the middle of the road and go away and leave them, but that is no longer the case. I have been preparing some horses, with the words, "Men at Work" on them for the use of the students, but even that does not insure safety.

Mr. McCarthy: The only thing that will stop some people is a man in uniform, and some won't even stop for that.

Mr. Dodds: The point that I want to make is that the corners should be refereneed out to new lines so that they can be used. In one city that I have in mind they use a line in the sidewalk on one street and in the cross walk on the other. The reference points have an iron cover marked with "M".

Mr. McCarthy: We have used iron covers over the monuments in the middle of the street. There was one street paved with wood

blocks and a few years after it was put in we had occasion to look for the monument. We found the cover but could not find the stone, and then we discovered that the pavement had moved about a foot and a half and taken the iron cover with it.

A VOICE: In our county we use two-inch tile in referencing corners. We put down two and in some cases three tiles. If the top tile is disturbed the lower tile is still in the correct position.

MR. DODDS: Do you fill the tile with anything?

ANSWER: No, we just put in the tile.

MR. NORMAN: I work with the Highway Commission, and we use concrete posts with iron bars through the center of them. We set these in line and take distances so any two can re-establish the corner.

MR. DODDS: Mr. Beisner, will you tell us how you take care of monuments in Cedar Falls?

MR. BEISNER: The corner stones we use are just the regular stone, six inches square, with a hole in the center. At the lot corners we just have the iron pipes. The corners that are in the street we reference to the sidewalks.

MR. DODDS: Some of the older gentlemen smile when they hear us say that the original government corner stones were nice square lime stones. Of course, the original corners put in in 1847 were stakes, and very few rocks were used for corners, but the original stakes were often replaced by square lime stones to make a more permanent corner.

MR. CAPPER: I am not entirely satisfied with our practice. The stones were originally placed at the intersections, but when improvements come along the stones are apt to be disturbed. We have set 1 to 1¼-inch iron rods, three feet back at each block corner. That made the monument fairly safe. This was in one of the smaller towns and we had to find a way that was cheap as well as practical, and the monuments have been fairly well preserved.

MR. DODDS: That is the important thing. We must reference the corners in such a way that we can use them when we need them, and so that they will be permanently preserved.

MR. CAPPER: We find that this works very well in the residence districts, but it is not so good in the business districts.

MR. BURNET: I have done a good deal of work in St. Louis and there we referenced the corners to the road line. We used the original markers, but later put in iron monuments that will probably last fifteen or twenty years. We found that the best corner references were the buildings. Nearly every block has a number of brick buildings. In this work we made a good deal of use of the angle mirror for measuring right angles and getting the shortest measurement. I haven't seen an angle mirror in some time, but they are a great convenience in this sort of work.



# City Surveys and Re-Surveys

BY RAY S. OWEN
Madison, Wisconsin

One of the problems which a surveyor has to solve is that of finding the most probable location of the original stakes in an old plat. As is often the case, the stakes themselves have long since disappeared and the more or less discordant evidence of the occupied property lines must be used to deduce the probable positions of the original stakes.

Given a set of accepted boundaries between property on which surveyors can all agree, there is a scientific method which will justly and impartially give the most probable location of all lot stakes in the frontage concerned.

A convenient and simple application of the method of least squares will accomplish this result. A demonstration follows.

A block was platted consisting of eight 60x120 foot lots numbered from 1 to 8. We are asked to stake out the front corners of the lots. All original stakes and authentic stakes set in their places have disappeared, and the only evidences of division between property is a line fence, (A) supposed to be on line between lots 1 and 2, a mark in walk (B) supposed to be on line between lots 2 and 3, the center of a common driveway (C) supposed to be a line between lots 6 and 7, and the corner of a building (D), supposed to be at the far corner of lot 8. These are all equally respected as property line markers and appear of equal weight and authority, although they do not entirely agree with each other. After finding this evidence we start our measurements. From the first point A we measure back any distance—60 feet in this case—and drive a temporary stake 0 + 00 for a starting point. Any chance position of this starting stake will have no effect on the final conclusions.

From 0 + 00 we survey along the street line taking the following pluses:

| | |
|---|---|
| A | 0+60.00 |
| B | 1+20.36 |
| C | 3+61.39 |
| D | 4+81.61 |

The problem is to deduce from these pluses the most probable plus of the original stake at each lot corner on this line. According to the theory of least squares that solution will be the most satisfactory which causes the sum of the residuals between deduced and observed pluses to be zero and the sum of the squares of the residuals to be a minimum.

The first step is to determine the most probable surplus per lot of the lots in the block.

The following table shows the computation of the most probable surplus per lot. Original plat width of lots 60 feet.

| From plus | To plus | No. of lots | Total surplus | Lots times surplus | Square of no. of lots |
|---|---|---|---|---|---|
| 0 +60.00 | 1 +20.36 | 1 | .36 | .36 | 1 |
| 0 +60.00 | 3 +61.39 | 5 | 1.39 | 6.95 | 25 |
| 0 +60.00 | 4 +81.61 | 7 | 1.61 | 11.27 | 49 |
| 1 +20.36 | 3 +61.39 | 4 | 1.03 | 4.12 | 16 |
| 1 +20.36 | 4 +81.61 | 6 | 1.25 | 7.50 | 36 |
| 3 +61.39 | 4 +81.61 | 2 | .22 | .44 | 4 |
| | | | Totals | 30.64 | 131 |

$$\frac{30.64}{131} = .234 \text{ surplus per lot}$$

With the probable surplus of .234 feet per lot from the above computation, the next step is to find just where to start our pluses; in other words, to find the most probable location of the block corner near which our stake 0 + 00 was driven. We start from stake 0 + 00 above and compute the plus for every lot corner, assigning to each lot a frontage of 60.234 feet.

The following table shows in the second column the actual pluses of points A, B, C, and D, and in the third column the pluses of corresponding lot corners as computed from stake 0 + 00 with a frontage of 60.234 per lot.

Pluses

| Points | Field | Computed |
|---|---|---|
| A | 0 +60.00 | 0 +60.234 |
| B | 1 +20.36 | 1 +20.468 |
| C | 3 +61.39 | 3 +61.404 |
| D | 4 +81.61 | 4 +81.872 |
| Totals | 10 +23.36 | 10 +23.976<br>10 +23.36<br>4 \| .616<br>.154 |

The difference between the sums of the two columns divided by the number of points (4), shows that the pluses in the third column average .154 feet larger than those in the second column. This indicates that we should start .154 foot back of stake 0 + 00 to stake out our lots.



The following table shows the final computation. The third column shows the corrected plus for each lot corner, the first plus being negative. The fourth column contains the values of the residuals between field and corrected plus. These add up to zero, and the sum of the squares is .0406 and it can be found out by experiment that any other set of frontages and pluses will produce a larger summation of the squares of the residuals.

| Point | Field plus | Corrected plus | R | $R^2$ |
|---|---|---|---|---|
| Start | 0 +00.00 | 0 −00.154 | | |
| A | 0 +60.00 | 0 +60.080 | +.08 | .0064 |
| B | 1 +20.36 | 1 +20.314 | −.05 | .0025 |
| | | 1 +80.548 | | |
| | | 2 +40.782 | | |
| | | 3 +01.016 | | |
| C | 3 +61.39 | 3 +61.250 | −.14 | .0196 |
| | | 4 +21.484 | | |
| D | 4 +81.61 | 4 +81.718 | +.11 | .0121 |
| | | Sum | .00 | .0406 |

The above treatment gives the most probable location of the original positions of the lot stakes from the evidence of the plat and the four points that the surveyor was able to find. The point chosen as a starting point for the survey has no influence on the final location of the probable position, and two or more surveyors using this method will agree as to corner locations if they can agree on the evidence of the property lines A, B, C, and D.

## DISCUSSION

MR. NORMAN: At the beginning you said that there were four things to consider, with monuments first and distance next, and here you are considering just distance.

MR. OWEN: We are locating these stakes in departure only.

MR. NORMAN: Suppose you had two original stakes at the end of the line, one at either end, and the intermediate points were supposed to be on the line, how would you determine them then.

MR. OWEN: In that case we would not use this method at all.

MR. DODDS: I think Mr. Norman wants to know whether you would use a straight line through the two points.

MR. OWEN: I would use a straight line both in latitude and departure.

MR. NORMAN: Suppose you had another point in between those two established points and everyone had a little different over-run, would you use all of them.

MR. OWEN: You would work it out in the same manner, except you would have more points to work with. If two original corners were found I would not use this method, but would divide the distance between the two corners into equal parts.

QUESTION: Suppose there was a wide variation in over-run in some of the points you used, would the result still be satisfactory.

MR. OWEN: We start out by saying that we have found four reliable points. If there are other points that disagree vitally, that is by a difference of three or four feet, with the other points chosen, I would not use them. If a point disagrees with the other points in the district I would not use it. I would use only those points that I considered reliable, and the choice of which I could explain to a judge and jury. A point that the civil engineer must keep in mind is that his survey may result in a law suit and he may be called upon to testify in court. You should be able to explain every step you take, and every monument you use or do not use.

MR. DODDS: I once had a judge ask me how I knew a stone was a corner stone.

MR. OWEN: You had qualified as an expert witness and so could offer an opinion.

MR. DODDS: I told him it had all the "ear marks" of a corner stone and I knew it was a corner stone.

MR. OWEN: You gain a lot by making positive assertions in court. A lawyer once told me that I should get away from the teaching attitude and make statements as positive facts.

MR. CAPPER: Suppose you were making a check up on two blocks, one a short block and the next a long block, and there were sidewalks to indicate that it was one short and one long block, could you still use this method? And again the lots might not be of uniform width.

MR. OWEN: If the lots are irregular you may have to use a foot as the unit of measurement rather than the lot.

MR. CAPPER: Would you survey each block separately, or the two as a unit?

MR. OWEN: I believe that in such a case I would survey the whole thing as a unit. In the ones I have done I have found no great disparagement between different parts of the plat. I had occasion once to make a survey on an old town plat on the Wisconsin river. The original plat had been laid out before the Civil War. The town became so small that the plat was vacated and the stakes disappeared. Somewhere near the center was a furniture factory. Mr. A and Mr. B were not friends, and Mr. A decided that Mr. B's furniture factory was on his land, and he asked me to make a survey. I found a stone that had a good reputation, and nothing from there west but oat stubble. There was a well-defined fence along the line, which is the Fourth principal meridian. There were lots and pluses to where the original plat came to the section corner. I drove a stake and took the pluses of all the marks down to the monument. When I got them I



worked with this system and arrived at the position where the original corner must have been. We restored the corner and ran a straight line and found that the furniture factory was about twenty feet over the line. The lawyer for B looked over the evidence and decided to advise his client to settle with A.

MR. CAPPER: Suppose you had these two blocks, one short and the other long, and there was something to indicate that they were left that way originally, then would you survey them together or separately?

MR. OWEN: I would have to decide whether I would accept the street as established. If the street, curb and sidewalk were well established, I would work each block separately. But if I should decide that the street had probably been misplaced by some engineer who was not paying enough attention to the things he should, I would work up the two blocks together. You need to remember that the street gets its required width in any case.

MR. LANGDON: Isn't it the theory that the platted street gets its width regardless of the lot corners and stakes.

MR. OWEN: If you could prove that the stakes were the original corners the street would not get it.

QUESTION: How much of an error would you allow before throwing out a point?

MR. OWEN: In this case I have four points with .15 the greatest variation. If I should find another point one foot in error I think I would throw it out.

QUESTION: Suppose you should find a difference of two feet there at the driveway, and the error is much less than two feet between there and the last point?

MR. OWEN: I think I would go back and look around some more. With a discrepancy of two feet all of a sudden it would look as if the trouble might be with the corner. You will have to exercise your own judgment in selecting the four points you will use. After you have decided on the points it becomes a matter of calculation. The residuals I got in this case were .08, .05, .14 and .11. They are all of about the same magnitude. In a case where all of the points disagree about like that I would use them all. This problem illustrates a simple case. Ordinarily you would need to take into consideration more than just one block. In this system one point has just as much influence in the final location of the stake as another point, and your result reflects the influence of all the information you have found.

MR. DODDS: The important thing to remember in this connection is that you are not dealing with original corners, and you are trying to give weight to corners that are not original corners, but which seem to be consistent and are good corners in indicating the probable boundaries. If you could find the original stakes you would not have this problem at all. This is to be used when you do not have original stakes.

## Question Box

QUESTION: Is the direction of a correction line determined by corners governing the land to the north, or those governing the land to the south, or some of each?

MR. DODDS: The corners belonging to the land on the north govern. The closing corner which was set when the land on the south was surveyed does not influence the land on the north. Such a corner is a monument for direction only. You cannot take land away from one man and give it to another along a correction line. You cannot pull the corner out of line so when you set a correction corner it must be on the original correction line.

QUESTION: Under the Iowa law is there anything wrong with a man registered as a professional engineer after examination in the highway branch, practicing sanitary, mechanical or other engineering?

MR. DODDS: You are licensed as a professional engineer. You are free to practice in any field in which you are not incompetent. If you try to practice in some line in which you are incompetent you could have your license taken away. The only violation of that phase of the registration law is that which relates to the men who are registered under the "grandfather" clause, and who are obviously not qualified. One or more of these cases will be brought to trial before long. These are men who were registered on their own statement that they were qualified. It will be possible under a proposed revision of the rules of the Iowa Board of Engineering Examiners to find out in advance by a special examination whether a man is qualified. The proposal is to examine over college subjects such as mathematics, physics, chemistry and other subjects which we consider are necessary for an engineer. If he wants to qualify in some special branch, the last day of the four day examination will be devoted to that.

QUESTION: If a lot owner makes a survey of his own ground for the purpose of subdividing it into lots, and files the plat, is he within his rights?

MR. ROBERTSON: He is within his rights in doing that, but the board may require that the land be surveyed by a land surveyor.

MR. DODDS: I know that in Iowa a man who is not a registered land surveyor may make surveys but he cannot file the plat.

MR. WINFREY: Such a plat would not be accepted in Des Moines.

MR. MAYNE: He has no right to sell lots other than by metes and bounds. If the lots are numbered then the land must be surveyed by a land surveyor.

MR. MAHONE: The loophole in the law is that though a man cannot sell lots in a plat that has not been surveyed by a land surveyor he may sell property described by metes and bounds. The descriptions often become so involved that the county auditor will order a survey made in order to clarify his records. A man often sells property described by metes and bounds entirely regardless of street widths and size of the lots in comparison to other lots in the region.



MR. ROBERTSON: You have been talking about this case when within incorporated cities and towns. Is there anything that governs the county board or auditor in accepting plats outside of incorporated towns? I have in mind sections around Clear Lake. There are streets and alleys 20 feet, 16 feet and 10 feet wide coming in at right angles. Does the county board or auditor have any right to refuse to accept such plats?

MR. DODDS: I believe the Board would have a right to refuse to accept such plat.

A VOICE: A lot of these plats are not what they should be. I would like to know if a street becomes a public street when the plat is filed? After the county accepts it as a public highway, do they have to maintain it?

ANSWER: If the county accepts it as a public highway they have to maintain it.

MR. WINFREY: Many of these plats were made and accepted before there were any town planning commissions, and are made without any relation to each other. This has been particularly true in Des Moines, and we are now trying to lock the barn by drawing up regulations.

MR. OWEN: Concerning this question of plats on lakes, in Wisconsin the State Board of Health has jurisdiction over all plats on lakes.

MR. THOMPSON: I would like to go back to this morning's discussion of corner stones located by the Highway Commission. I would like to see this session make some recommendation to the Highway Commission that we feel there should be a more diligent search made for the corner stones than is being made at the present time. The survey parties out in the field are being pounded on the back to get the surveys made. I would like to hear some discussion so we can form some resolution to recommend to the Highway Commission that they create a new division to go out and really find the stones. They certainly should make as good a record as the rest of us do. These corners mean a lot to us, and we all know of cases where they are being overlooked. A party went through recently taking a P.I. from one hill top and shooting across to the next. Maybe they looked for the stone, but they did not use it so it was nothing to them whether they found it or not. If there isn't any discussion on this I would like to formulate a resolution to present to the Highway Commission.

MR. ROBERTSON: I can't feel that this practice is general. It is not true in our neighborhood. They have found and referenced the corners. The highway surveyors often come to my office for information and I think they make every effort to find the corners.

MR. DODDS: As we have with us representatives of the Highway Commission I think a resolution might not be necessary. In the early surveys there may have been cause for camplaint, but I think at the present time they are finding the corners pretty well.

MR. BEARD: In our preliminary surveys we do not pay much attention to the section line, but before we can buy the right-of-way we have to have a description of the land we want to buy. Most of the highways are being widened to 100 feet, and in order to buy the land we must have the corners. I don't think many corners get away.

MR. MAYNE: In our county they are finding the corners, and are making as much of an effort as anyone could make. The work has been very carefully done.

MR. DODDS: There has been a feeling that the primary road program was destroying evidence of the location of the corners, and not putting in new evidence that could be used. I believe the highway engineers have the same regard for those corners that we have. Mr. Young, I wonder if you want to say anything at this time?

MR. YOUNG: I do not believe that I can add much to what has been said, except that I know of a number of specific instances where we have spent a good deal of time and labor in getting the line absolutely established, in spite of the fact that the preliminary survey had not found the corner stone. We can't possibly get away without locating a stone, or finding the place where it should be. We can't buy right-of-way without describing it. Some may describe the land loosely, but I don't know how it gets by down here. I know we can't get away with anything like that. Since the Commission began to buy right-of-way they have changed their field practice some.

MR. THOMPSON: This buying of right-of-way has probably had something to do with it. Probably Black Hawk County pays the penalty for having the first paving in 1917. Some 60 miles were put in at that time and our trouble has been mostly along that strip.

MR. DODDS: I think the importance of these corners is well recognized. The Commission surveyors and the county engineers can help each other a good deal in this matter.

MR. YOUNG: There is one thing that I have thought should be done. The law used to require that the County Surveyor file his records with the auditor, but the law has abolished the office of County Surveyor, and since that time many of the records have not been filed. In many counties there is a very slipshod method of keeping the records. I wonder if this body could not recommend some change in the law which would require the compulsory filing of records. We need to have these records available in order to save time in making re-surveys.

MR. DODDS: We agreed this morning, Mr. Young, that these records should be kept in the county engineer's office. We are going to appoint a committee to make a recommendation to the Iowa Engineering Society along that line, and ask them to make the recommendation to the legislature.



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