William R. Dickson Oral History Project
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Discussion of Microfilming, FERMIT, and MAPMIT

INT: Discussion on FERMIT and MAPMIT. Okay.

WD: Well, first I think we'll talk about neither of the subjects that Sue just mentioned because I've decided to add a third one.

INT: Okay.

WD: And that's microfilming drawings. And since that's the first of these things to have happened, I'm going to start there. But even before I start there, I'm going to mention one thing that we didn't talk about last week on the first. That was -- and I wanted to mention as far as the student unrest, and that was that Howard Johnson and his family lived at the president's house. And there were so many interruptions at the president's house as far as knocks on the door and chanting outside and everything else that he finally moved out of the president's house, and for a couple years lived in Wellesley in a house that I believe MIT bought out there for that purpose. So that was the one and only time that a president and his family really got under siege in their personal residence so much that they decided that it was not good to live on the campus.

All right, having said that, now let's go to the subject for today -- one of them anyway. And I'm going to start with microfilming of MIT drawings. In the early '60s as we started building massively on the campus, we had many occasions to find out information from the drawings in the file, which were all in the drafting room at the time; and I think they were hung, if I'm not mistaken. But particularly, the original buildings were not fifty years old and the drawings, which were massive in scale, really large drawings and fairly detailed because at that time they used to do a lot more detailed work than leave anything to chance or custom as they do now. And they were difficult to use and they were getting brittle. Some of them were originals; some of them were sepias. And some of them in the later buildings were actually copies of the building drawings that were not duplicate[able].

So I think particularly driven by the fact that the older drawings were so large and so brittle and subject to easily getting ripped and stuff, we decided that we would microfilm all the drawings that MIT had in its hands. Microfilm was not new; but it was not used on a regular basis by many people for this purpose at the time. So we actually set up a room. I remember it was in E19; and it was probably where the piece of the Safety Office used to be. And we retained -- after interviewing some vendors, we retained a vendor who would do the actual microfilming. And then we also retained an individual to work on the project. And the project consisted of taking every drawing that we had in our possession, examining it, repairing it in ways that were agreed upon by the individual that was going to microfilm them, and numbering them with a new MIT code system for microfilm so that in the future we could retrieve any of these by going through a catalog, and we would cross-reference what the drawing was versus the new number.

INT: Some of them must have been beautiful, huh? I mean the original ones?

WD: They were pieces of real artwork.

INT: I bet.

WD: And we still have them. I think they hang in the archives now.

INT: Really?

WD: But that's when they used to draw out every single detail --.

INT: Yes, I bet.

WD: On the drawings.

INT: That must have been a great collection.

WD: So these were all Stone and Webster drawings.

INT: How was that?

WD: The original engineers on the job. We also decided that as we proceeded along in building buildings, that on completion we would take every set of drawings and require that we get reproducible[s] for our archives; but we also microfilmed. We didn't request -- require the architects to filming. We just got reproducible copies of the final drawings. And then we numbered them in our MIT system and had them microfilmed. And so I believe that as long as they haven't stopped it, at the current time we probably have all record drawings, not only in reproducible form in the archives but on very useable form on microfilm, which, of course, is very much smaller.

We bought a reader-printer so that we could, in looking for something, we could sort of browse through the microfilm drawings. And when we found what we were looking for, we could press a button and it would give us a microfilm print of a scale larger than the small piece of microfilm. They became very well used, particularly the mechanical people, if I remember right – used copies of the mechanical drawings quite frequently.

INT: I have a question. In the early drawings, how were they reproduced for people? Were they not really reproduced?

WD: Well, the sepias are reproducible. But they were in such terrible shape that we generally didn't reproduce them. We took information off of them that we needed. And that's -- as I said, they were ungainly and getting very brittle. Many of them had been torn previously and needed a lot of repair. In the newer drawings for a new building, we naturally get a set that are in pristine shape; and all we have to do is really renumber them and send them out for microfilming. This proved to be a very popular thing at the Institute, very useful and very popular throughout the country.

I remember I gave a paper on MIT's microfilming of its drawings at the National Association of Physical Plant Administrators in Colorado in one of the late '60s, '66 or '67. And it drew a tremendous amount of interest because, as I said, although microfilm was not new -- it had been used during the war -- very few people had adapted it to use in something like this. At least colleges and universities -- I can't speak for industry; they may well have done a lot of it.

INT: Do you remember the person who did the job?

WD: Well, most of it was done by Phil Greene.

INT: Really?

WD: And I'm not sure whether he was the first one or not. I think he might have been. And then he stayed with it, of course, for many, many years. Another kingpin in this whole thing was a fellow that worked with me named Dick Collins. And Dick did a lot of work on the project also, really leading Phil Greene, not sitting there and repairing drawings, etc. So it turned out to be quite a nice thing. And of course, in the meantime, the reader-printers are much better than they used to be when we started. And I'm sure they're must easier to use. Sue, do you happen to know whether there's a reader-printer in the Plant somewhere?

INT: I don't know, except I think there is one that Maryla uses.

WD: Maryla -- yes.

INT: But Maryla Walters has sort of jurisdiction over it and people can come through her, arrange to view things.

WD: Yes.

INT: Yes, I'm pretty sure.

WD: So it's still very useful.

INT: Yes.

WD: And it doesn't --.

INT: I know a lot of students do it now for classes.

WD: Oh, yes?

INT: Yes.

WD: It does allow us to store thousands of drawings in basically a card catalog, which the same drawings require lots and lots of space when they're hanging in the flesh.

INT: Right.

WD: So that was one very successful thing that I think is still in vogue today. The next thing we're going to talk about is FERMIT. It's F E R M I T. And I believe it stands for Foundation Evaluation Research at MIT. And as I've said previously in some of these tapes, one of the difficult things about building at MIT is the soil conditions which lead to the need to examine foundations very carefully.

And then after the foundation is put in and the building is built, you really want to know how it performs, particularly from the standpoint of settlement and differential settlement because there are varying -- there is a sand layer that you basically have to get to for anything that sometimes is only ten or twelve feet below grade and sometimes may be twenty feet. And it varies in thickness considerably until it eventually reaches the so-called Boston blue clay. Now Boston blue clay also -- and its depths vary from probably fifty feet to a couple hundred feet depending on what area on the campus you're in. It's shallower at the east end and very deep at the west end. And sort of in the main group area is sort of maybe a hundred feet deep.

And so there are several types of foundations you can use on a tall building with heavy column loads or a not so tall building but with large spans, and so, therefore, heavy column loads. You have to use piles. And there are many kinds of piles, but the most common ones we've used on the campus were thin-shelled steel piles, then piles after you drive them with concrete. And that was under the Green Building and the Bush Building in particular.

The Bush Building is only five stories; but it's very heavy loads. There are also -- today, they were then, but H piles, in other words steel egg sections we used for piles. We used the others in some of our buildings because of the cost at the time it was more expensive to use the H piles. There's also now in recent years -- I say recent -- over the last couple of decades, there are pre-stressed concrete piles which are probably the most commonly used piles now. I'm not sure of that but I believe that's right. And so, basically, a building on piles, the piles are driven to either rock or, in our case, mostly glacial till, which is a very dense material, and it is glacially deposited and has a very high blow count per inch when you try to test it with a boring machine.

INT: What does that mean?

WD: It means when you're taking test borings you have a hammer of a certain weight that drops on a rod and peat -- it might sink down to a foot or two when you drop it. In the clay, it might sink -- depending on the consistency of the clay, it might be several inches to go a foot. When you get to the till, you can probably have many, many blows, like fifty or so, to go an inch. So that it's a good material to found buildings on since for the most part we don't even know where the bedrock is. So the only question is, then, how much does the building settle in the future after it's built?

Now we have other buildings that are lighter loads that are put on drilled caissons, and that's a big drilled tube usually belled on the bottom, which means it flairs out at forty-five degrees. And these buildings are generally founded on the sand layer where the sand layer is appropriately thick and within a reasonable difference at the surface. And I'll give you an example. The Hermann Building was put on belled caissons. And the problem with that is you have to go down and inspect the bells -- actually go down in the tube and be hoisted down and inspect the bells; because the bells are dug by machine. And the machine isn't smart enough to figure out whether the material it's digging in is the material you really wanted or expected. Now I can't remember a case that we didn't go down and find that the bell was in the right material. But I'm sure it's happened somewhere.

Another way -- another system is to use footings -- pressure-injected footings -- Frankie piles, we call them because that was the first company around here that used them. And that's where the east garage is -- on Frankie piles. And they drill a tube down to the sand layer, and then they inject concrete in the tube relatively dry. And they form a bell underneath the tube just by pure weight. They use a 140,000-foot-pound hammer; and it expands the concrete into whatever medium -- in that case, into the sand layer. And so instead of having the weight of the thing just on the column, it expands onto the weight of the bulb.

Then there are simply in the best cases spread footings, where you dig a hole and place concrete footings and start building from there. In our case, these footings would, again, be at the sand layer. And we don't have very many buildings built on spread footings because the sand layer is down deep enough and is not always thick enough to transfer the load through the sand and into clay to avoid large-scale settlements. That's the issue here is how much a building will settle. And it depends to a large degree on how much load is transported to the clay because the clay is where it enables the settlement. And it will take place over a prolonged period of time, not just when the load is first put on it.

Then, of course, the main group was built on wood piles, thousands of wood piles. They were driven -- some of them into the sand and some of them through the sand so that you get a combination of point bearing piles and friction piles. Pile driven in the clay can only pick up its load by friction on the clay.

And then, lastly, you can float a building where you excavate enough material deep enough so that when you put the building on and get it up, the clay underneath or the clay that the foundation is buried upon doesn't realize anything has happened. And so it doesn't settle. In other words, it stays basically as it was. And we have several of those on the campus. The Chemistry Building, our Chemical Engineering Building, the Westgate, the Main Tower, the Student Center, although that's a hybrid. But nevertheless, it is floating. The Chemistry Building, the Life Sciences Building -- those are all floating slabs and there may be others.

So FERMIT was a joint project between the Plant, which really meant me in this case, and the Soil Engineering Department, which was part of Civil Engineering. And their principal representative was Bill Lamb, Professor Lamb. And we also had some young technical instructors that worked on the project on a day-to-day basis. And we did certain things. One of them was to -- in the evaluation part of it, we decided that we ought to measure the settlement of the building or the columns after we built the building and for a fair piece of time. The original buildings, believe it or not, had settlement pins in them, but you used to have to go around and hand survey from pin to column to column the whole basement.

INT: No kidding.

WD: Could be done, but it was very time-consuming.

INT: Yes, I bet.

WD: So we designed a pin that was somewhat like those in the main group, and we used to put them in our new buildings on the columns in the basements. And then we designed and built at water level. And the water level, as you know, water seeks its own level. So if you put it on one pin and then you put the other in -- and it was quite a bit of length -- you put it on a pin on the next column, the water would move up or down depending on whether there was any difference. If there was uniform settlement, you wouldn't measure it this way because there wouldn't be any difference in elevation at the two ends of the level. But it was very accurate and could measure, you know, down to eighths of an inch I believe of settlement. And then where you started with those, you had a traverse that you would go from sort of pin to pin. And where you started, you had to, every once in a while, bring in a level from a benchmark to make sure that your starting point hadn't settled so that all your readings were off. And we got pretty good at this.

The elevation benchmarks at MIT, just for everyone's information, outside of Building 1 between here and Memorial Drive there's a benchmark that was put in when the Institute was originally built. And it's in what looks like a small manhole, and it was driven to a till of bedrock and it has an elevation. And if you take off the cover you can get a quick elevation by reaching down and putting a rod on top of a nut. And if you want a more exact thing, you put a wrench specially designed on the nut and take that cap off. And then there's another device which allows you to see what the elevation is. Now that remains there today.

INT: I wonder if there was ever even anyone who knows about that as being in existence.

WD: There's a drawing on it somewhere, but I'm not sure anyone uses it anymore. We used to use it frequently. Then there was a benchmark on the Cambridge end of the Harvard Bridge on the abutment on the westerly side. And that was a [coastal] geodetic benchmark, not sure whether it's still there since they rebuilt the bridge.

And there was another [coastal] geodetic benchmark on a round knob on the top of the granite, sort of step near the entrance of what we used to call the armory. I guess it's what -- the [?] now. Now when we surveyed, surveyors often use those two benchmarks. On the other hand, you couldn't swear that neither one of them hadn't settled over time so that it was better to correlate that with the MIT benchmark, which we know basically hadn't settled. And we used to do that occasionally too. So checking the levels to see how the foundations performed was one thing.

We branched out, too, and we did a lot of work on the analysis clay under the buildings to see how it varied in consistency. And all that testing was done up at the Soil Engineering Lab, probably most of it by Professor Ladd, Charles Ladd, who happened to be in some of my classes when I was in school. I think he was a year ahead of me, but he stayed at MIT and got his doctorate degree and really became a guru in soil engineering. Some of the other things we did, we used to -- well, we had sheet piling. I think we maybe were the first user of something called an inclinometer, which probably was -- I would guess it might have been an invention of Bill Land and the soil engineering people. But if it wasn't, it was the first time I ever heard of it. And it would measure after you drove sheet piling and braced it -- it would measure how much the sheet piling moved either in or out of the soil. And it became a very valuable tool because in the designing of sheeted holds because if it moved in much, it would prove you either had bracing that wasn't adequate enough or that the bracing was spaced apart too far, and the sheet piling would move between the bracing points. We did many other things, but those were the principal kinds of things that we did and we gained a lot of information.

There were booklets published. I remember the first one was sort of a reddish color book with big white letters on it saying FERMIT, and I'm sure they're available in the Plant or copies from Maryla. Another thing we did, we always took a lot of borings, test borings, before we built on a site. And we always had the soil engineering group examine the borings. The borings would sort of tell you what kind of load you could put on each strata of soil. And, for instance, if you looked at the thickness of the sand layer and you were going to put caissons on top of it, it would give a good indication of how far that load had to spread out before it got to the clay so that you wouldn't get a lot of settlement. To my knowledge, we have not had much differential settlement on any building that was built since 1960. Of course, the original buildings, we had as much as eight to ten inches of differential settlement, although it's very hard to see that.

[Pause]

INT: From June 8th.

WD: I think I probably said about as much as I'm going to say on FERMIT. But it was an extremely valuable project. And, of course, those pins are still embedded in the columns should anyone ever want to use them.

INT: I have to say, listening to all of these different things, wouldn't you say Physical Plant was pretty progressive for its time?

WD: At the time it was, yes.

INT: Yes. I think that's what it sounds like to me that they did an awful lot of things that were kind of a little bit ahead of their time.

WD: Well, they were up with the time anyway.

INT: Yes.

WD: The last topic of the day is MAPMIT. Now in some respects, we've set the stage for this because what MAPMIT was -- dividing the entire MIT campus into a manageable sized grid work so that we could put I believe twenty scaled [?] on prints on pieces of paper that were easy to handle. I don't mean eight-and-a-half by eleven, but I mean something like three feet by two feet or something like that. And the reason we started this was that as we had every building done, we'd have a survey. Our surveyor was William S. Crocker and his successor, Aspenwall & Lincoln I believe was either the surveyor of the original MIT campus. But in any case, every time we'd build a building, we'd have him come on campus and make a topographic survey.

Now we weren't so much interested in the topography of the ground because MIT was pretty flat. Nevertheless, we did have to know what it was, but we also were interested in all the -- anything like manholes and fire hydrants and buildings and roadways and walkways -- anything that was on the ground that could be surveyed. And so we gradually collected a set of drawings. I bet some of them were ten feet long and unmanageable. And we had a big table that we could put them out; but you just don't fool around with drawings that are that big.

So we decided to build a grid and to do two things with the grid -- to transfer recent information to the grid sections and to have any new surveying done and produced on the grid sections. Also it enabled us eventually to have a grid for topographic reasons and then a grid for utilities and I think maybe even a grid eventually for telephones. And so you could use one grid and have several different items on it without just writing all over the original drawing of what was there. Now this should be an on-going project. I don't know -- frankly, I left the Plant while it was still in progress. And other than knowing what the grid looked like and stuff, I don't know how far we eventually got.

I know that eventually we had Dick Raskin do a lot of surveying. He set up his own company and he was formerly with William S. Crocker and did a lot of the surveying or was in charge of it on the MIT campus on these original drawings, original big drawings, so that he was well aware of the campus. The boss of the firm at the time was a guy named Nelson Gaye, who I think has long since deceased. So I assume that we're still using the MAPMIT grid and have expanded it for further uses. But this was an interesting project, and it was done really in conjunction with the Planning Office. I have to give them some credit here because they were interested in this kind of a thing also.

INT: So where does that reside in the --?

WD: Well, I assume it resides in the Plant. I mean I would guess --

INT: Rather than Maryla?

WD: I would guess that you ought to ask Maryla.

INT: Yes, archives.

WD: If she has a copy of the MIT grid and whether we're using the MAPMIT project where we get surveying done. So those are three little things that we did that had the potential for being significant. And I know that FERMIT was significant because I was around during most of its lifetime. We eventually did -- thought we had enough information that we did abandon it. And I doubt whether we're putting settlement pins in new buildings or anything anymore. But I think we've learned enough to know we're not going to get much differential settlement. So I think that's probably what I want to talk about today. Have we gone through one side of the tape?

INT: Almost.

WD: Well, we'd better stop here.

[End of interview]