NUCLEAR REGULATORY COMMISSION

ORIGINAL

In the Matter of: :

COMMONWEALTH EDISON COMPANY : DOCKET NOS. 50-373 and 50-374

LaSalle County Nuclear Generating Station, Unit 1 and Unit 2

DATE: March 31, 1982 PAGES: 1 - 77

AT: Bethesda, Maryland

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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COMMONWEALTH EDISON COMPANY	:	Docket Nos. 50-373
LaSalle County Nuclear	:	and
Generating Station, Unit 1	:	50-374
and Unit 2	:	

- -x

Room P-422,
7920 Norfolk Avenue,
Bethesda, Maryland.
Wednesday, March 31, 1982.

The meeting in the above-entitled matter was convened at 1:03 p.m., when were present:

APPEARANCES:

H. Denton
R. Purple
A. Bournia
R. Tedesco
A. Schwencer
C. Norelius
C. Williams
B. Shoemaker
R. Hoefling

APPEARANCES (continued):

P. T. Kuo

S. P. Chan

R. E. Lipinski

J. Boeley

B. Lee

L. Delgeorge

M. Miller

P. Steptoe

D. Shamblin

T. Quaka

K. Kostal

V. Reklactis

C. Schroeder

M. Morris

T. Longlais

J. Goodie

* * *

P R O C E E D I N G S

(1:03 p.m.)

MR. DENTON: Let me thank you for attending this meeting on such short notice and tell you what I would like to do. I want to call your attention to the fact that a transcript is being taken. We will provide a transcript to the various parties. The reason I am taking a transcript is to facilitate our review of this information. So we will assume that whatever we hear from the company today is valid information and we can use it in doing our review of this issue, unless you choose to modify the information you present here today.

I received a petition from the Attorney General of the State of Illinois dated March 24th, requesting that we initiate a show cause proceeding and initiate other relief because of some circumstances alleged at LaSalle. There are two types of problems that the petition is concerned with. One is the boring of holes through important walls in the building or either partially the way through, and the other is with regard to the adequacy of the roof design on the off-gas building.

We have made a cursory examination of what we know about these issues and have talked to the Region regarding their knowledge of these issues. What I would like to do today is to give the company an opportunity to explain its position on the matters of concern.

One reason for not just noticing this for 30 days and going with our normal pace in these matters is the pendancy of the completion of the plant and its readiness for an OL review. We have been meeting with the company quite extensively over the last few months in anticipation that the plant would be finished in the near future. I understand it may be finished in the next week or so.

So the kind of information that we would be interested in hearing about today, if you have it available, relate to the number of holes drilled, the size of the holes including the depth of penetration, your procedures for mapping the holes that get rebars, tendons, liners, on the general layout drawings, describe the condition of the damage that you might have expected to have occurred in each case; namely, with a rebar cut, partially cut, was the concrete cracked.

We will also be interested in the load conditions that exist in these wall panels that are affected by the holes. We would be interested in where the rebar reinforcement is placed in these walls where the holes have been drilled. We will also want to hear about the procedures and acceptance standards that you have issued to the drilling crews and the field engineerings, including the dates for when these procedures were implemented. And most importantly, I want to understand your methodology and techniques for evaluating the safety significance of any such penetrations drilled through walls.

Let's see, Bob, any other points I should cover at the beginning here?

MR. PURPLE: Well, we would want similar information on the design questions relating to the roof of the off-gas building. We are not involved with the drilling of holes, but the questions of the thickness in its design.

MR. DENTON: With that introduction then, let me go around the room and make sure we all know who is attending here. I am Harold Denton from NRR. Why don't we turn to the right?

MS. GOODIE: I am Judith Goodie, Assistant Attorney General of Illinois.

MR. BOURNIA: Anthony Bournia, from NRR.

MR. SCHWENCER: Al Schwencer, from NRR.

MR. NORELIUS: Chuck Norelius, Region 3.

MR. KNIGHT: Jim Knight, NRR.

MR. PURPLE: Bob Purple, NRR.

MR. HOEFLING: Dick Hoefling, counsel for the Staff.

MR. LEE: Byron Lee, Commonwealth Edison.

MR. DELGEORGE: Lou Delgeorge, Commonwealth Edison.

MR. LONGLAIS: Tom Longlais, Sargeant & Lundy.

MR. STEPTOE: Philip Steptoe, Isham, Lincoln & Beale.

MR. MILLER: Mike Miller, Isham, Lincoln & Beale, for Commonwealth Edison.

MR. BIGLEY: Jack Bigley, NRC staff.

MR. SHOEMAKER: Bob Shoemaker, IE.

MR. WILLIAMS: Cordell Williams, Region 3.

MR. KUO: Jim Kuo, NRR.

MR. CHAN: Sy Chan, NRR.

MR. LIPINSKI: Ron Lipinski, NRR.

MR. SHAMBLIN: Dan Shamblin, Commonwealth Edison.

MR. QUAKA: Tom Quaka, Commonwealth Edison.

MR. KOSTAL: Ken Kostal, Sargeant & Lundy.

MR. REKLACTIS: V. Reklactis, Sargeant & Lundy.

MR. SCHROEDER: Chuck Schroeder, Commonwealth Edison.

MR. MORRIS: Mike Morris, Commonwealth Edison.

MR. DENTON: With that introduction, Byron, why don't I turn it over to you to tell us what you know about these issues, and let me point out that we are pleased to have Ms. Goodie here, and I will provide you an opportunity to comment at some periodic intervals but figure that you are mainly here as an observer.

MS. GOODIE: I understand that.

MR. DENTON: And don't feel that we will expect you to contribute directly more than you have done in raising the issues in the petition.

MR. LEE: Thank you. We do, too, also appreciate the holding of this meeting on short notice, but we agree that it is absolutely necessary. I would start by saying that we are deeply concerned about the potential delay of low power licensing of LaSalle Unit 1, especially based on a single construction worker's allegation of some possible concerns. And even reading the affidavit, it is pretty much an indication that there were fairly decent controls in place in marking and so forth.

We are concerned that the Attorney General's office did not come to us with this issue as they have done with several other technical issues in the past, and we have been able to resolve those issues. We continue to believe that our practices and our control of engineering and construction at LaSalle County are excellent. We have had many discussions in the last few months with you on that issue with NRR and with Region 3, and we think that all of that has pretty much indicated that we have had good records. I think that what we will tell you today will just support and substantiate that even further, as we are now into some details.

One of our other major concerns is the diversion of some key people, both ours and yours, from the major effort that we have all been at for the last several months. This does have some significant impacts on our customers and on our stockholders. We do need LaSalle County Unit 1 for capacity. It is not an excess capacity unit that we are building just because we want to complete it.

So it is important to us in that respect. And of course, it is always important to our customers and stockholders to finish. Even our own Illinois Commerce Commission has reached that decision. As a result, we do ask for a quick review and resolution of the problem. And we do appreciate your getting into it so quickly.

In any event, I think that after today we can hopefully give you enough of an indication to show you that there is absolutely no reason for interrupting the issuance of a low power license and the testing process. So with that, I would like to ask Lou Delgeorge, who is our Director of Licensing who has been deeply involved in the LaSalle County project for quite a few years, to kind of narrate and handle our presentation.

MR. DELGEORGE: What I would like to do is review the allegations presented in the petition as we understand them, stating the facts and the information we have which we think will resolve the concerns that have been raised in your mind.

I would like to start with the questions raised relative to the off-gas building because we feel that to be a less complicated issue that can be more easily dispositioned.

First, there is an allegation that the roof thickness is eight inches as opposed to the 12 inch design thickness. I would like to say at the outset that although this building is a non-safety related building containing no safety-related equipment and not requiring the implementation of our quality assurance program, we did in fact apply our quality assurance program to the construction of this building, which has given us greater confidence in the accuracy of the information that we will be providing to you.

As a result of our receipt of the petition we made a survey specific to verifying the thickness of the slab in question. This was done within the last week. We took 15 measurements of that slab thickness and determined that the average thickness of the slab was slightly greater than 12 inches. Of the measured thicknesses, the lowest value was 11 1/4 inches. This measure was taken in what we believe to be an area of a floor drain on the slab roof and can be justified on that basis.

We have no reason to believe that the thicknesses that we have measured and the thickness of that slab is not consistent with the design requirement for the off-gas building roof.

The second allegation that was made --

MR. DENTON: Can we discuss that one just a bit? I have forgotten how big this roof is. We described it as the roof of the off-gas building. Is there a separate building called the off-gas building? Can you characterize the size of the roof that we discussed?

MR. DELGEORGE: I will call on Dan Shamblin from our site construction staff.

MR. SHAMBLIN: My name is Dan Shamblin, I work at the LaSalle Commonwealth station. I guess the simplest way to show you this is with this picture here. This is the roof we are talking about here for this concrete enclosure (indicating). It is roughly dimension-wise, it is roughly 34 feet by 75 feet.

MR. PURPLE: Lou, one part of the allegation I did not hear you address was transformers sitting on the roof and cracks through the --

MR. DELGEORGE: I am just going to get to that.

MR. PURPLE: I see, okay.

MR. DENTON: Do you think there is any confusion in nomenclature that the allegation should not be read narrowly to be the off-gas building? Have you read the whole text? Do you think you have identified the roof they had in mind?

MR. DELGEORGE: I will ask for any comments from our staff if they disagree with what I am about to say, but there is no information contained in the affidavits presented in the petition from which we can conclude that any slab other than the off-gas building roof is the slab in question.

And I am not aware of any additional information that may have come to our attention that would suggest some other slab being involved.

MR. DENTON: Have you had this allegation called to your attention before?

MR. DELGEORGE: Sir, it is my understanding that until the issue was raised through the attorney general's office that we were not aware of this potential deficiency.

MR. DENTON: Let me ask the regional representatives if they would like to ask any questions about the building.

MR. SHAMBLIN: Excuse me. The issue of the roof thickness was presented to us in early March through our legal department.

MR. DELGEORGE: But it was as a result of information developed through the inquiry by the attorney general.

MR. SHAMBLIN: That is correct, yes.

MR. DENTON: Chuck, do you have any questions on this?

MR. NORELIUS: No, I don't think I have any questions on this particular subject.

MR. DENTON: Let me ask you how you measured it. Did you have access to --

MR. DELGEORGE: To address your previous question of whether we could conclude that we have, in fact, covered the area in question, the specifics of other portions of the allegation relative to the placement of a transformer and identified surface cracking, we have in fact identified the transformer in question and were aware of surface cracking in this particular slab identified on our own initiative sometime ago. And taking those facts into account I think we can conclude that we are addressing the slab that was discussed in the affidavit.

MR. DENTON: Why don't you go ahead, then?

MR. DELGEORGE: The next allegation I had intended to address was the placement of the transformer on the roof of the off-gas building. It is, in fact, true that a temporary construction-related transformer was placed on that slab. The transformer has been removed from the slab and it was removed in late 1981 before we became aware of the issue in controversy here. The placement of that transformer did not exceed any of the posted live loads allowable for that slab.

We have surveyed the under surface of the slab and detected no apparent damage in the vicinity of the placement of the transformer. We have no reason to believe that the placement of that transformer caused any structural damage to the off-gas building roof.

MR. DENTON: How big a transformer was this? What was it intended to do?

MR. DELGEORGE: It provided

construction-related loads and weighed, as I understand it, on the order of 6700 pounds.

MR. DENTON: Let me go back to a question I asked earlier about how did you determine the thickness of the roof.

MR. DELGEORGE: We conducted a field survey. Given a reference zero, we were able to determine the height of the under surface of the slab, and from the same reference zero, we determined the height of the top surface of the roof, which included both the concrete slab and surface roofing materials. In order to verify the thickness at the points of survey, we measured the thickness of the roofing material; subtracting those values allowed us to establish the concrete thickness. We have prepared a report which discusses those measurements and we are prepared to leave that report with you.

MR. DENTON: I take it these are measurements made in situ and not taken off of drawings?

MR. DELGEORGE: That is correct.

MR. DENTON: I think we would like to have the report. Perhaps you can give us a copy and we will attach it to the transcript and make sure it is available.

MR. NORELIUS: This may be in the report, Lou, but how did you come to the conclusion that 15 selected points was appropriate to give you a good picture of what the roof thickness was?

MR. SHAMBLIN: The roof is made up of a series of beams, and I essentially told the surveyors to take measurements between the beams. Essentially, the center span of the slab. It worked out to be three measurements per span between the beams, turning out to be 15 measurements.

MR. PURPLE: There is yet another item in that particular allegation. Are you going to get to that?

(Laughter.)

MR. DELGEORGE: I am ready. The last allegation suggested that the concrete associated with this slab had been cracked substantially. Commonwealth Edison discovered surface cracking of the subject slab through its own site quality assurance department in September 1979. As a result of the deficiency identified, an inquiry was made at that time which included an engineering evaluation and which also included the tracing of the crack depth by chipping at the concrete in the vicinity of the cracks.

As a result of that review, it was established that the crack depth did not exceed one quarter inch; that the cracking was, in fact, surface cracking, and as a result, it was patched. We have no reason to believe, based on that investigation, that the cracking alleged is the result of drilling of anchor bolt holes. It is our opinion, based on that evaluation, that the cracks observed are normal shrinkage cracks associated with this type of slab.

MR. DENTON: Now, from the dates you gave, you observed those cracks before the transformer was placed on the top.

MR. DELGEORGE: No, sir, the transformer was placed at the time the observation was made.

MR. DENTON: So the transformer was taken off the date you measured, but it had been on for a considerable period of time?

MR. DELGEORGE: Yes.

MR. SHAMBLIN: That is correct. The transformer was placed sometime in 1976. We do not have the exact date, but we suspect it was in the second half of 1976.

MR. DENTON: And when you repaired the cracks then, or examined for depth, the transformer was still there?

MR. DELGEORGE: Yes, sir.

MR. DENTON: And you did not remove it until--

MR. DELGEORGE: Until late 1981.

MR. SCHWENCER: None of these cracks went through the support points of the transformer?

MR. SHAMBLIN: That is correct.

MR. DELGEORGE: I am not sure I understand your question.

MR. SCHWENCER: The point at which you fastened the transformer to the roof or where it was in contact with the roof, none of the cracks were associated with that contact area?

MR. SHAMBLIN: That is correct, none of the cracks were associated with the contact area of the transformer.

MR. DENTON: Let me ask the project manager what categorization we gave that roof.

MR. BOURNIA: It is a non-safety grade building. I have the reviewer here. We did not consider this as a safety grade building.

MR. DENTON: What is under the roof?

MR. BOURNIA: What is this?

MR. DENTON: What is under it?

MR. DELGEORGE: That is described in our report. The concrete enclosure above-grade as a part of the off-gas roof is a non-safety related structure which houses off-gas building, heating/ventilating/and air conditioning, air handling units, HVAC, water cooled condensing units, HVAC exhaust filter units, HVAC control panels and associated motor control centers and switchgear.

MR. DENTON: Does that mean there is no Category 1 safety-related equipment in that building?

MR. DELGEORGE: Yes, sir.

MR. DENTON: Any questions? We can come back to this, but I thought we would give the company a chance.

MR. PURPLE: There still remains yet one more feature of that particular allegation. Maybe you are going to get to it. It is the part that says there were holes drilled through rebars in the roof. I have not heard an answer that you did not have such holes or if you did, what they meant.

MR. DELGEORGE: We did not address the potential for drilling of bar in that roof, separate from the question presented in the primary allegation which we will address. You will see, based on the evaluation that we have done relative to the overall question of rebar damage, that we have addressed all slabs. Correct me if I am wrong. Is it true that our evaluation would have included that building.

We can verify that for you, but it is our --

MR. RECKLACTIS: It did include this building, also.

MR. PURPLE: Can you say whether or not the roof of this building was in fact drilled and did go through some rebar specifically?

MR. RECKLACTIS: As I understand it, the transformer did not even have any bolts. That is what I was told.

MR. DELGEORGE: I am not sure we are prepared to answer that question completely. We will get back to you, though.

MR. DENTON: What is the design basis for the thickness of that roof? Why did you pick 12? What controls?

MR. LEE: Why 12 inches?

MR. KOSTAL: Why 12 inches? Okay. My name is Ken Kostal from Sargeant & Lundy. The thickness of a number of slabs -- we generally have a minimum thickness of concrete related to structural elements such as slabs and walls. The 12-inch thickness is typically associated with a certain amount of load which would accompany that particular slab. So I would say in general, the 12-inch represented the thickness required to support a live and dead load attributable to that particular area.

MR. KNIGHT: May I ask, by that you mean there was a, let us call it, a design live load that is selected for convenience and utility, if you will?

MR. KOSTAL: Yes.

MR. KNIGHT: Keeping in mind they you are in a heavy industrial area, you provide sufficient capacity for--

MR. KOSTAL: We provide a certain minimum capacity -- meaning we provide a certain minimum live load capacity-- to allow for construction conditions, to allow for initial installation, equipment storage such as the example given by Mr. Delgeorge relative to the transformer, and that generally constitutes our initial criteria in terms of original design load capabilities.

MR. KNIGHT: Did you have a standard live load used throughout the facility?

MR. KOSTAL: A minimum live load for this particular plant is 100 pounds per square foot. That is associated with all concrete slabs.

MR. DENTON: Can you describe the construction of the slab a bit more? Is it reinforced?

MR. KOSTAL: It is a typical concrete reinforced one-way slab with concrete beam elements. I do not know the exact spacing of them, but it is a general one-way beam type slab design, reinforcing top and bottom, top reinforcing across the beams carrying negative moment, bottom carrying positive moment, and temperature reinforcing to account for normal construction and shrinkage cracking that could occur.

MR. DENTON: Any other comments on this part?

(No response.)

MR. DENTON: If not, let me ask Ms. Goodie if you would like to comment on this part before we go ahead.

MS. GOODIE: My only comment here would be that as I understand it, someone at Region 3 has spoken to the informant who provided us with this information, and I understand there is a report in Region 3 about this information. It is my understanding from the person I spoke to at Region 3 that the allegations of the less-than-design thickness of the roof were correct. I have not seen this report.

MR. DENTON: Would you like to comment?

MR. NORELIUS: We received allegations on this some months ago and evaluated it in-office. I do not have those with me. I am not sure that I know they say exactly what she said, and I have not read them carefully. But we were aware of the allegation. It was evaluated within our office and I think, in recognition of our manpower considerations, we chose not to delve deeply into this at the field level because of its

Category 2 nature.

MR. DENTON: I think on this one it might be well to just reiterate that Staff silence does not mean consent with the utility's view on this.

MS. GOODIE: I understand.

MR. DENTON: It is more the fact that we are trying to get the facts from which we would proceed to do a review.

MR. NORELIUS: Could I ask Ms. Goodie, did you speak to someone in our office on that?

MS. GOODIE: Yes.

MR. NORELIUS: Who did you talk to?

MS. GOODIE: I spoke to two different people. I believe this one was from Jim Foster. I can check my notes on that.

MR. NORELIUS: Jim was one of our investigators.

MR. DENTON: All right, let us move to the second issue.

MR. DELGEORGE: The second issue addressed the damage to reinforcing steel by the drilling through reinforced concrete slabs. I attempted to outline the allegations presented by that petition item, and I will address each of them as I understand it.

We have also prepared a report in this area describing the procedural controls that we have had in place. That report identifies the controls, their date of implementation, and attempts to describe why we believe this prevents the type of unrestricted damage that has been suggested by the petition.

The first allegation presented is that thousands of holes are drilled through reinforced concrete slabs as a matter of course. I believe that we can, through the report, demonstrate to you that the process of drilling all reinforced slabs has been a control process, that this program was implemented in late 1976 before the time period at which the contractor employee, whose affidavit is contained in the petition, made his -- discusses the problem that he alleges exists.

And in fact, we have conducted an engineering evaluation of all reported structural -- or reinforcement steel damage and have concluded, based on that evaluation, that the structural integrity of all the walls, of all the concrete reinforced slabs in the plant have not been repaired.

I would point out at this point in time that our review is not yet complete. However, it is substantially complete, and we have no reason to believe at this point that there is any question relative to the structural integrity of the slabs.

The second allegation presented is that there is an unknown number of holes. We are also in a position to discuss with you the numbers of holes that have been either cored or drilled at LaSalle County. A rough estimate of the number of holes, inasmuch as we have not fully tabulated all our records, is on the order of 50,000.

We have developed as a practice, given the program we have implemented, a program of recording the placement of the holes and reporting any rebar reinforcement damage associated with the drilling of a hole.

MR. DENTON: Let me ask you, how does a driller know that he has struck rebar or reinforcing steel?

MR. DELGEORGE: In general, the techniques used for producing the hole would have used drill bits that are not capable of penetrating reinforcement steels. That practice was not 100 percent uniform, however, and I will ask the people from the site to address this also, where he did use a bit capable of penetrating the steel.

MR. KOSTAL: It sounds different.

MR. DELGEORGE: It would be decidedly different. Again, I will ask our site people, our engineering people to discuss that further.

MR. KOSTAL: Do you want to discuss that?

MR. SHAMBLIN: Relative to hardness of steel versus concrete, when you hit it with a soft drill bit, it just will not go through it. It will meet a stiff resistance there, plus the sound that it produces, the different sound when you hit that reinforcing rod.

MR.QUAKA: In some cases you will get a very large squeaking sound when you come in contact with steel. So it is not only you being the driller, but 20 feet around you, you know, everybody knows you have contacted the steel.

MR. DELGEORGE: I think we would agree with your statement in the affidavit that your ability to drill through the concrete once steel has been contacted is significantly diminished.

Mr. Garrison, whose affidavit is attached to the petition, made it clear that he knew when he had contacted steel. And I guess our general feeling is that that would be representative of both people put in that position.

MR. DENTON: Did you make measurements everywhere or only for the steel that was struck?

MR. DELGEORGE: Tom Quaka, from our site assurance department will address that.

MR. QUAKA: As a normal course, work is not done unless there is some engineering document that either specifies that an anchor be installed in a location, or there there has been some request to install one and appropriate approval given to do that. So there is a record that demonstates where the hole is or where the anchor is going to go. And then ther is a separate set of records that identifies situations where the rebar is contacted or cut through.

MR. DENTON: Can you describe normal engineering practice of the architect-engineer in this area? Do you try to locate these holes from the knowledge of the rebar in the wall from the drawing, or is it more of a field installation kind of thing where you take your chances when you drill such a hole?

MR. DELGEORGE: Mr. Denton, we have a full presentation on that engineering evaluation, which will follow my discussion.

MR. DENTON: All right, we will postpone that.

MR. DELGEORGE: A point we would like to make here is the fact that we believe the petition clearly indicates that records were kept of rebar damage. This point is noted in many places both in the petition and in the contractor employee's affidavit. This information, we believe, supports the integrity of our control program, which is described in more detail in the report.

The records involved here are substantial, and we have over the course of the years during which this program has been in place -- and as I say, that began in 1976 -- we have monitored the performance of the contractors under this program.

The next allegation presented is that no information exists which suggests an engineering approval occurred relative to the potential for damaging rebar prior to 1980.

Unfortunately, this conclusion was reached on the basis of a site laborer whom we would not expect to be privy to the fundamental basis for the program we had in place.

However, we have been able to verify that the foreman of the specific laborer whose affidavit is contained in the petition participated in more than one training session in which the overall control program for drilling and coring of holes, which included an engineering evaluation, took place.

In other words, the supervision for the laborer in question participated in four recorded training sessions, whose dates I can provide to you, which we believe is sufficient to assure that the program that we had in place was in fact followed.

We take greater confidence in this in the fact that Mr. Garrison, the laborer involved, attested to the fact that he was required to provide rebar damage reports.

MR. DENTON: Who conducted these training courses you referred to?

MR. DELGEORGE: The programs in question were conducted by site contractors. The site contractors, Foley being the contractor involved here, had received direction fromn our site management personnel associated with Commonwealth Edison's organization, although we do not provide that training ourselves.

As I have said earlier, the procedures in question have existed since 1976. In the case of cored holes, which are identified in the petition as larger holes, prior engineering review of the holes is done to either prevent reinforcement steel damage or to assess the impact of reinforcement steel damage.

For drilled holes that have been characterized in the petition as "smaller holes" used for concrete expansion anchor-bolted supports, our engineering evaluation program included the specification of certain areas in the plant where concrete expansion anchors were to be limited. So that we did an engineering evaluation in advance to limit the areas in which such drilling could take place.

In addition, there was an engineering evaluation made of all reported damage upon receipt by the architect-engineer of the drilling reports, which are recognized in the petition.

We have a more substantial presentation to review for you that engineering evaluation process. It may, in fact, be appropriate to do that now, inasmuch as the last issue of substance that we perceived in the petition dealt with the question of whether or not corrective action, if necessary, was required immediately. We can address that after the discussion by our architect-engineer, the evaluation program, if you would like.

MR. DENTON: Okay, let us go that route.

MR. DELGEORGE: I would like to introduce Tom

Longlais from Sargent & Lundy.

Let me say first that I have copies of the report prepared by Commonwealth Edison which discusses the procedural controls that have been in place at the LaSalle County site.

I will offer those for your review. We also have copies of the materials that Mr. Longlais is going to present now. And I will offer those for your review.

[Slide]

MR. LONGLAIS: I would like to start the presentation with first differentiating the different types of holes that have been drilled at LaSalle.

[Slide]

Exhibit 1 defines basically two types of holes: one which we call a core hole; the other is what we consider to be a drill hole.

There are essentially two types of core holes. The first type of core hole is one in which it is drilled through the concrete, and it passes completely through the concrete element. This hole has been put in the element to allow for the passage of the electrical and mechanical components, such as a pipe or conduit.

The second type of core hole is one in which it is only drilled partially through the depth of the concrete. The purpose of this type of core hole is to allow for the setting and grouting of an anchor bolt for either the support of equipment foundations, or for the support of mechanical piping and baseplate assemblies.

In the first situation for the cored holes which pass completely through concrete, their diameter varies anywhere from 2 inches to 16 inches in diameter.

In the case of holes that are cored partially through the concrete for the installation of an anchor bolt, that diameter is approximately 3 inches. Its depth would vary anywhere from 1 foot to maybe 2 feet, 2-1/2 feet, depending upon the size of the anchor bolt.

The second category of holes we have are what we consider to be drilled holes. Holes are drilled primarily for the installation of concrete expansion anchors. These holes tend to be much smaller in diameter. They vary from 1/4 inch to 1 inch, and the depth of embedment varies anywhere from 1-1/4 inch to 8 inches.

Again, it is important to have an understanding of the types of holes, since the engineering assessment is somewhat different for each type of hole.

[Slide]

Exhibit 2: I will discuss the engineering evaluation for cored holes. These are the holes that pass directly through the concrete or the holes that are partially drilled into the concrete for the setting of an anchor bolt.

For holes that pass directly through concrete elements, these holes are located, in the case of office-audited components -- in other words, when our engineers are auditing the piping and electrical components in the office, and they have got to penetrate a concrete element, they will indicate that penetration on a structural drawing.

Prior to the release of that structural drawing indicating the core hold, it is reviewed by structural engineers. It is at this point in time that our structural engineers make an assessment of the effects of the reinforcement steel that will be cut by this operation.

In most cases, this assessment has consisted primarily of engineering judgment based upon the stress levels in the reinforcing steel in relation to the location of the cored hole.

In the case of cored holes that are requested by a contractor in the field for field audit components, the contractor is required to submit to Commonwealth

Edison Company a field change request requesting permission to drill this hole.

This field change request is approved by the consulting engineers. And again, a similar assessment is made prior to approving this field change request.

We assess the reinforcing steel that is likely to be damaged by the coring of this hole prior to releasing of the FCR for the drilling operation.

MR. PURPLE: Question. Have you ever disapproved a field change request because the engineering evaluation told you that it was not right to put the hole there?

MR. LONGLAIS: Not to my knowledge. The location of the holes that are generated via a field change request likewise get picked up at a later date on the structural drawings. So a complete record of all cored holes does appear on the structural design drawings.

MR. PURPLE: The engineering assessment, is it written?

MR. LONGLAIS: Up to this point in time, all our engineering assessment on cored holes has been based upon engineering judgment.

MR. PURPLE: It is not written down?

MR. LONGLAIS: It is not been written down.

We have not made detailed structural calculations.

Over the last week or two, in response to the petition, we have made some detailed calculations for a sample of cored holes. And we have proved that our engineering judgment was appropriate in these instances and found that the effects of the reinforcing steel did not affect the structural integrity of any of the safety-related structures.

MR. LEE: Tom, "engineering judgment," I gather, is kind of the standard approach for this kind of evaluation?

MR. LONGLAIS: Yes, it is; yes, it is.

MR. KNIGHT: Could I pursue just one step further? What you are saying is the system was in force, the area to be drilled was identified, and an engineer in the office was made aware that the hole was to be drilled. And he said either yes or no based on his judgment?

MR. LONGLAIS: Yes; that is correct.

MR. DELGEORGE: And in the case of field change requests, there would be documentary evidence that the review had been completed, although there might not be analytical evidence of something other than engineering judgment?

MR. KUC: But the judgment was made one by one. Say, for instance, a slab may have more than 10 holes there. Do you make a judgment looking at all the 10 holes or just 1 where it was drilled?

MR. LONGLAIS: We make a judgment on both. We have to make it first individually as each cored hole is submitted and requested. As I mentioned before, all these core holes are eventually indicated on the structural drawings. So when our engineers are adding other cored holes in an area, they have a history of all the other cored holes that have been installed. They would take this into consideration when making the assessment of the effects of this additional cored hole that is being requested.

MR. KUO: So all the holes were considered, in your judgment?

MR. LONGLAIS: That is correct.

MR. KNIGHT: Can you give me a feel, there was a number mentioned earlier, 50,000 holes. I am going to assume that a very large percentage of that 50,000 were anchor bolts.

MR. LONGLAIS: That is correct.

MR. KNIGHT: Can you give me the other side of that number as far as 2 inches larger, this type of thing? Do you have any feeling for how many of those there were?

MR. LONGLAIS: I would venture a guess at something less than 1000 at this point. I believe 1000 could definitely be an upper bound.

MR. DENTON: Can you characterize the issues that you considered in reaching such a judgment about holes? What were the elements that are important in reaching that judgment?

MR. LONGLAIS: The critical decision was looking at the distress level in reiforcing steel where the hole is being put. In some areas, the cored hole is being put in an area where the reinforcing steel is not stressed. This would be totally acceptable to core the hole.

MR. LEE: Which you will get to in a moment.

MR. LONGLAIS: Yes. In other areas, the stress levels in the reinforcing steel have sufficient margin for the final design loads. We make an assessment on this basis that we can accept some reduction in the stress levels since we have sufficient margin currently available for those reinforcing bars.

MR. DENTON: Should I assume that you could put an 8-inch hole in any wall, safety-related wall; or are there some areas in that wall that are already near limits and this would degrade it?

MR. LONGLAIS: There are a number of areas where we have, after our engineering assessment, we have become concerned about additional coring in which if we assume that X number of bars would be cut by putting this cord hole in that we feel it would not be appropriate, would not be acceptable, we have put appropriate notes in our drawings and appropriate controls requiring that the contractor use a metal detector to find the reinforcing steel before he makes the coring.

MR. DELGEORGE: And we have examples of those notes which we can provide and show to you here. I think as a part of this package you will find three examples of notes of that type.

MR. LONGLAIS: There has not just been indiscriminate coring of bars. We have identified the areas, and where we have areas of concern we do require that the metal detector be used.

MR. SCHWENCER: Has that process been in effect since 1976?

MR. LONGLAIS: That process has been in effect once we determined that that particular concrete element could not tolerate many more bars. That could have been '77, '78, '79. There really has not been any for later years that, as the coring operations increased, that we can see as certain areas being defined that we do not want to lose any more strength margin that we put these notes on the drawings.

MR. DENTON: If you take a typical wall -- I am not sure you have a typical wall -- where are the moments the largest on the wall? Where would you least like to see a hole?

MR. LONGLAIS: I would like to get into that in a few minutes when I talk about some of the concrete expansion anchors. I am prepared to discuss that.

MR. DENTON: I was wondering if you could just tell me is it near the top or near the bottom? I do not want to jump too far ahead, but I would like to have a feel for where moments are largest.

MR. MILLER: Exhibit 5.

MR. LONGLAIS: Exhibit 5, for example, for slabs. I do have other flimsies if you want to talk about other ones. This is a typical two-way slab. A typical area in a tewo-way slab. We are talking about the reinforcing steel on the top of the slab.

The critical area would be the exterior core span. That is this area that is shaded. This area would tend to have negative design moments, and the reinforcing steel would tend to be stressed in this area.

In the middle region of the slab, the area that is not shaded in, the reinforcing steel would not be stressed in these cases. The stress is all carried by the bars in the outer periphery.

In the case of the reinforcing steel on the bottom of the slab, it is the bars that are in the middle region of the slab, the middle half span of the bars, that primarily carry the stress. The bars toward the periphery are much less stressed than the bars in the center.

There are also other areas, bars that have been provided around trim steel for major openings or where additional bars have been provided in the slab to carry heavy elements, to carry a concrete wall or to carry a concrete block wall, where we have provided additional reinforcing steel. We have called for not drilling in those areas.

MR. DENTON: Thank you.

[Slide]

MR. LONGLAIS: Cored holes for anchor bolts and pipe support baseplate assemblies are indicated on the mechanical design drawings.

The coring for the mechanical baseplate pipe support assemblies commenced approximately in the summer of 1980. In January of 1980 we issued Drawing M-1100, Sheet 23, which required that all the concrete be notched to expose the reinforcing steel to avoid rebar damage under this operation.

So for any concrete, any coring operation for this particular application, it was controlled by requiring that the reinforcing steel be exposed before the drilling was done.

MR. DELGEORGE: That activity involving mechanical components would not have been observed by the contractor employee whose affidavit is contained in the petition, inasmuch as he worked as a subcontractor to our electrical site contractor, and he was gone at that time anyway.

[Slide]

Exhibit 3 is the continuation of the cored holes for equipment foundation anchor bolts. In this situation what we have done is we have plotted the location of all equipment foundation anchor bolts that require coring in a separate set of drawings called RHS drawings, rebar hit schedule drawings.

From these drawings we assess the amount of reinforcing steel that is likely to be damaged by this coring operation. The assessment which we performed subsequently is engineering judgment on the damage and the effects that this likely damaged reinforcing steel will have on the strength capacities of the concrete elements.

The engineering judgment again is based upon the location of the cored holes and the damaged reinforcing steel in relation to the existing stress levels in the concrete elements.

Exhibit 3A is a set of approximately 90 drawings, which we have marked all the rebar damage, both due to the coring operations and due to the drilling operations at the site.

MR. KOSTAL: There are approximately 90 drawings in there that will document exactly what Mr. Longlais commented on.

MR. DENTON: Are these drawings of different walls and such?

MR. LONGLAIS: This is all the reinforcing steel that has been contacted. "Contacted" means either nicked or cut.

MR. SCHWENCER: So that is 100 percent drawings of those that have been contacted or cut?

MR. LONGLAIS: Yes, that is for Unit 1.

MR. DELGEORGE: Based on those damage reports that have been received from the field at the time the drawing was prepared. And we are still in the process of verifying that all reports have been received and incorporated into the drawings.

MR. DENTON: Maybe we can look at them during a break to see if we need those.

MR. KOSTAL: I think it is relevant that these drawings have been in preparation over the last 6 years. So they are not drawings that we just made within the last few days.

We have been documenting these during the last 6 years as they have occurred and as we have received the data from various contractors.

MR. LONGLAIS: I should clarify that we have -- this item, the plotting of the core holes for the anchor bolts were made recently.

(Slide)

In Exhibit 4 I would like to pursue the engineering review of drill holes for concrete expansion anchors. The engineering control for the drilling of holes for concrete expansion anchors began long before the drilling is initiated.

By that I mean there are a number of engineering controls which are contained in Form LS/CEA which contains all the specification requirements for the drilling of concrete expansion anchors at La Salle. In Exhibit 4A we have here the entire eight revisions to the specification, which were issued between the period September 1976 and May of 1981.

There are a number of engineering controls in this particular document. Probably the most important is the recognition of the fact that there are stressed and nonstressed areas in the structures. LS/CEA defines the stressed and nonstressed areas. The areas which are stressed areas, we require that a metal detector be used to avoid reinforcing steel damage. It requires that the contractor obtain engineering approval prior to cutting a bar and to subsequently report any damage or nicks that may have been made to a bar by the use of a metal detector.

There are areas -- again, I did go through this slide before, but the areas where a metal detector would be required to be used in the case of a two-way slab would be the shaded area in the exterior quarter span, and the top of two-way slabs, in the middle span section, in the bottom of two-way slabs, and in areas adjacent to penetrations, and to areas where we have provided additional reinforcing steel on the slab to carry additional loads.

MR. PURPLE: A general question. All of these control programs, do they apply to all of the buildings for which you have design responsibility, unrelated to whether they are safety-related structures or not?

MR. LONGLAIS: That is correct. That is correct.

MR. DENTON: If you take a wall that is, say 20 by 50, what kind of spacing would you typically find on the reinforcing bars?

MR. LONGLAIS: I believe between 9 to 12 inches on center.

MR. DENTON: So when you are installing anchor bolts, then you would have enough discretion to move around a foot or two?

MR. LONGLAIS: Yes. Well, a foot or two? In the later versions of the concrete expansion anchor program, I believe when you get into Revisions 6, 7, and

8, we have added provisions in the specification which gives the contrator guidelines in relocating expansion anchor plates. If he does contact reinforcing steel, we give him the latitude to move the plate plus or minus 3 inches in either direction so he can avoid drilling through and damaging the bar.

(Slide)

It has consistently been our intention at the beginning of the job to minimize the use of concrete expansion anchors. However, when a field contractor is routing small bore piping or electrical conduit, he has an option of trying to attach to an embedded plate or existing structural steel or use expansion anchors.

We have a requirement in the specification that should he elect to use a concrete expansion anchor baseplate assembly, that he contact us for prior approval before he can use this type of anchor.

We have further defined in the specification areas in which a concrete expansion anchor may not be installed without the specific approval of the consulting engineer. This is irregardless of the stress level.

One example of the situation would be the containment building wall. The last control that we do have, and it was mentioned earlier, is that beginning in

1976 with Revision 0, we required that only a solid carbide-tipped drill bit be used for drilling the hole. Now this type of drill bit is not capable of drilling through reinforcing steel. The most damage this drill bit could do would be to make a very small, well-rounded depression approximately 1/16 of an inch deep in the reinforcing steel.

We have conducted a number a tests. The Commonwealth Edison Company has conducted a number of tests, both laboratory testing and analytical assessment, and we have proved that these type of nicks are not detrimental to the integrity of the reinforcing steel.

MR. DENTON: What size reinforcing steel is typically used in walls and floors?

MR. LONGLAIS: Walls, typically in safety-related structures would probably vary from number 9 to number 11 bars. Slabs would probably vary--

MR. LEE: Which is what size, for us nonstructural --

MR. LONGLAIS: Number 9 bar is about 1-1/8 inch in diameter, and Number 11 bar is approximately 1-3/8 inch in diameter. For slabs, the reinforcing steel would vary from probably a Number 6 bar which is about 3/4 inch in diameter, again to a Number 11 bar which is 1-3/8 inch in diameter.

(Slide)

What I just described is the engineering precautions that have taken place in the specifications and are in force prior to going into operations. During the drilling operations should a contractor contact or drill through a reinforcing bar with our approval, it is required that the contractor submit a rebar damage report.

When these damage reports are submitted, they are reviewed by the structural engineers to determine what I consider to be the immediate local impact of the damaged bar. Again, we look at where the damaged bar occurred, whether it be a cut or a nick, in relation to stress level in the slab to determine if it is acceptable.

Should we not determine it is acceptable, we would have to come back and do some subsequent modifications. However, we have never found this to be the case in any of the holes that have been contacted or drilled at La Salle. This review on the part of the engineer was based primarily on judgment, again with respect to location of the hole, and the existing stress level.

After the engineer has reviewed the effect of this damaged reinforcing steel, the damaged bar, be it hit -- by that I mean nipped or cut through -- is plotted on the BHS drawings, which we have submitted as Exhibit 4-A.

MR. LIPINSKI: Excuse me. Since when did you start this practice?

MR. LONGLAIS: This practice was initiated in September 1976.

MR. DENTON: That includes Steps II-A and II-B?

MR. LONGLAIS: The II-A, the review of the damaged rebars was performed when the first damaged rebar report was submitted to us, which I believe was in early 1977. II-B, the plots were started, I believe, towards the latter part of 1978 or 1977, the early part of 1978. It really was not until this latter part of 1977 that we had substantial enough rebar hit reports to warrant studying of the drawings at that time.

MR. KNIGHT: Along those lines, to work up the numbers like 50,000 holes or 1000 or so poured, which makes a pre-assessment, could you give me a ballpark figure for the number of rebar hit reports or rebar damage reports that have accumulated over the years?

MR. LONGLAIS: We estimate today there are approximately 3000 to 3500 reinforcing steel bars that have been damaged. Of that 3000 to 3500 bars, we believe a number of these bars to be only nicked bars. Between the period 1977-1979, contractors were not required to differentiate between a cut and a nicked bar.

After Commonwealth Edison Company did the laboratory investigation on the effect of nicked bars and concluded that nicked bars were not detrimental, did we eliminate the requirement for reporting of nicked bars.

MR. KUO: In making your engineering judgment, do you have any guideline or criteria as to what percentage of the steel could be damaged or cut?

MR. LONGLAIS: The guideline is that as long as you don't impair the safety or the integrity of the concrete structure, as long as you still have sufficient margin to carry the design loads, whether that be one bar, two bars or ten bars. That has to be determined on a case-by-case basis. That is not a function of a percentage.

MR. KNIGHT: Somewhere in your discussion there is a distinction between a cut and a nick.

MR. LONGLAIS: Yes.

MR. KNIGHT: You show situations where you take about half a bar out sometimes. Do you have any way to differentiate?

MR. LONGLAIS: The nick that I am speaking of is the hick that would be made by a solid carbide-tipped drill bit in which you get this -- .

MR. KNIGHT: Okay. When I am talking about taking a half-bar --

MR. LONGLAIS: That would be a core.

MR. KOSTAL: To clarify, the kind of drills used are like your everyday household drills. Unless you have a tempered steel bit, I think all of us have been aware of the difficulty of trying to drill through anything with a typical carbon steel bit that you buy at Sears Roebuck. That is the kind of drill we are talking about here. It is impossible to go through a rebar with that bit. You will eat up the bit before you will go through the bar.

MR. LIPINSKI: Do you know of any cases or can you quantify perhaps for us when a remedial action or a design change was necessary as a result of --

MR. LONGLAIS: We have never run across a case at LaSalle. In any -- we are positive that of all our drilling operations we have not found one place where the structural integrity of any concrete element has been impaired.

MR. CHAN: Does the driller of the holes know whether the hole is going to be in the tension area or the compression area?

MR. LEE: The driller, you said?

MR. CHAN: Yes, the driller.

MR. LEE: I would say probably not.

MR. SHAMBLIN: He is given the direction to drill a hole in this location.

MR. DELGEORGE: The driller would not be aware whether he was drilling in an area of tension or compression, the driller as opposed to the contractor supervision to whom that man reports. Let me paint what I think is an accurate picture.

The driller is only aware that his job is to drill a hole. The contractor, based on the program we have in place, is aware that with certain restrictions, he is able to drill holes in concrete elements in certain areas of the plant. The engineer, Sargent & Lundy, has through his design specifications and design drawings identified those areas capable of having holes drilled. So there is a different level of understanding of what the impact of an individual hole would have on the reinforcing steel.

We do not believe that it is essential that the individual performing the drilling operation be aware of the entirety of that program or how we reach the point that he drill a specific hole.

MR. LONGLAIS: The final disposition in the review of damaged reinforcing steel in the drilling operations occurs at the time of load check performed just prior to fuel load. In this instance we are looking at the effect of the accumulation of all the damage to the reinforcing steel which is plotted on the RHS drawings.

This review again consists primarily of engineering judgment based upon the final stress levels in the concrete elements with respect to the location of the damaged reinforcing steel. Detailed calculations were not warranted due to the random distribution of the damaged reinforcing steel in the safety-related areas.

By random distribution I mean that the density in any one area is very, very low. We see the bars nicked, scattered here, maybe up in that corner, down in the bottom corner, but they are not concentrated effects. We have subsequently performed some calculations in response to this petition and we have substantiated that this engineering judgment is appropriate.

MR. PURPLE: Question. Independent of the petition, was this review you are discussing, has it been completed?

MR. LONGLAIS: The engineering judgment has been completed.

MR. PURPLE: And documented?

MR. LONGLAIS: Yes -- Well, engineering judgment?

MR. PURPLE: No, I mean but there is a final review?

MR. LONGLAIS: The final load check is completed and documented.

MR. DELGEORGE: To the extent that the architect engineer has received all the reports from the field.

MR. SCHWENCER: That is the tie-in I was -- you mentioned earlier you were not sure that had all the reports in it yet. The only ones you are aware of.

MR. DELGEORGE: We are in the process now of verifying that he is in receipt of all the reports.

MR. SCHWENCER: So Item A is not done yet.

MR. LONGLAIS: Not to the extent that we have received all the reports. But I believe from what we have seen so far we are confident that it is.

MR. LEE: We are confident that it is, but since that question obviously will come up, we felt it necessary to go back and assure ourselves.

MR. KOSTAL: To clarify, we believe we have every report in the house. The documents that were just submitted to us are nothing more than a -- we are going to scrutinize each one of those documents regarding the document we have in house to make sure that we have the same corresponding document.

That is the review that is taking place. The review of the final load check has totally been complete, but it covers a lot of other multitude of ingredients besides this ingredient of the damage to rebar.

MR. LONGLAIS: What we have done is we have taken a look at what we feel to be nine areas in which the concentration of the damaged rebar has been somewhat higher than what you normally would see looking at the entire sets of drawings. We have calculated the design margins in the slabs both before and after the coring operations.

(Slide)

I should first define what we mean by design margin. The design margin, we consider it to be the ratio of the strength of a concrete element as determined by ACI 318 divided by the actual design stresses that have been calculated in accordance with the LaSalle FSAR commitments.

What you are looking for is a design margin equal to or greater than one. You would like to design for a margin exactly equal to one. This represents an economical and optimally designed structure.

Now there are a lot of reasons why design margins do exceed one. There are many cases in safety-related structures, particularly in a nuclear power plant, in which shielding controls a design and structural strength does not control. So we have a lot of concrete elements that are a lot thicker and a lot bigger than required by structural design.

So you will see some margins greater than one. You will see some up here of about three or so. What we would like to see is about one.

MR. LIPINSKI: Before you take this down, I see that in area number 2 there is no number of holes cored, and yet the design margin is different. Why is that?

MR. LONGLAIS: I am sorry?

MR. LIPINSKI: Second line.

MR. MILLER: It says 31 damaged rebar.

MR. SCHWENCER: Drilled to the core.

MR. LONGLAIS: These are the reinforcing steel damaged due to drilling; these are the numbers due to damage due to coring.

MR. LIPINSKI: So the number of bars damaged were due to --

MR. LONGLAIS: Drilling, and this column is coring.

MR. LIPINSKI: Okay.

MR. KUO: Can you explain the last item there, the ratio of margin of holes as against margin without holes? Is that 1.13?

MR. LONGLAIS: Well, this is the percent decrease. The number was put down wrong. This is the percent decrease in margin. For this case the design margin without the holes was 3.55, the design margin with the holes was 1.33. This represented about a 13 percent reduction in design capacity. The ratio was computed wrong here. I must admit that when we prepared these tables, we were pulling them off the typewriter yesterday as we were heading for the plane, but that is a percent you are looking at.

MR. KUO: That is a decreasing margin?

MR. LONGLAIS: Yes; 13 percent is the percent reduction in the design margins. These design margins that you see listed here are very conservative design margins. One item of conservatism is the fact that when we do the final load check, we assume a minimum piping load of about one kip per square foot. In many areas the actual component support load is less than one kip per square foot.

We also have not taken into account any actual material strengths in the field such as the actual poured-in-place concrete strength or the actual strength of the reinforcing steel. This would typically increase your design margin from anywhere from 10 to 15 percent.

MR. DENTON: How did you pick these locations for samples?

MR. LONGLAIS: We looked at the density of the number of bars in a given area, the number of areas that stand out as looking like it has a high concentration of bars.

MR. DENTON: These are average cored and damaged locations or more severely damaged? How would you characterize them?

MR. LONGLAIS: I would characterize these areas as having a greater density of nick bars.

MR. KNIGHT: Take in item number 3, this is probably just one bar. How does that fit into the framework of what you were just saying?

MR. LONGLAIS: This one bar happened to be what we consider to be a critical area. It was in a highly stressed area.

MR. LIPINSKI: So just to pursue this line a little bit further, did you give any consideration to the stress concentration of the given particular area that he selected for this, or just density of the holes?

MR. LONGLAIS: Density was the primary one. In this situation here, stress was the critical one.

MR. LIPINSKI: So both factors were considered?

MR. LONGLAIS: Yes.

MR. LIPINSKI: Density of the holes and stress concentration?

MR. LONGLAIS: Yes.

MR. DENTON: How did you go back and calculate a margin with the damaged bar? Did you assume that the bar did not exist analytically?

MR. LONGLAIS: Yes, we had discounted the entire bar.

MR. DENTON: And the concrete, or does it matter?

MR. LONGLAIS: Concrete has no effect.

MR. NORELIUS: Even on the damage basis you are discounting the entire bar?

MR. LONGLAIS: We assumed in this case the damage to be a cut. As I said, between the period 1977 and 1979, the contractors were not required to differentiate between a cut and a nick, so unless we saw specific notes on the rebar damage report that would lead us to believe the fact that we did have only a nick, we considered these to be cuts.

MR. DENTON: How do you do such a

calculation? You have otherwise uniformly distributed slabs on a bar and one is cut. How do you go about determining the margin?

MR. LONGLAIS: Let's say in the case of a two-way slab you divide that slab up into middle strips and end strips. You calculate a design moment for the middle strip and then subsequently the area of steel required for that design moment. If you knock one bar, or two bars, or three bars out of that middle strip, you subtract that area, recompute a new moment, and compare that with your applied moments.

MR. DENTON: So it is as though the bar was not there at all.

MR. LONGLAIS: That is how we have done that calculation, correct.

MR. LIPINSKI: Perhaps you can explain why you said that the area of concrete removed has no effect. I will agree with you that it is in the zone where there is a tension, but in the case of compression, concrete is the vital element.

MR. LONGLAIS: The concrete area removed would be so small.

MR. LIPINSKI: Depending on the diameter of the holes. If you have a little hole, that is fine, but if you have holes, say, 12 -- we know the diameter of the holes was up to 16 inches, right?

MR. LONGLAIS: Typically in these plants, and structural considerations for the most part do not govern the design. It is shielding requirements. The reinforcement steel ratios that we have used are very low. And subsequently the concrete compressive stresses are very low. So if we drill out a 16-inch core out of a slab, the stresses could redistribute itself to adjacent concrete elements, and there would be really no effect on the slab itself.

The stresses are very low. The compressive stresses do not govern concrete design. You have to get up to very, very high reinforcing steel ratios before compressive stresses govern, and we are not anywhere near those reinforcing steel stresses.

MR. DENTON: Are any of these walls or floors pressure bearing, and by that I mean pressure-retaining walls or floors?

MR. LONGLAIS: Do you recall off-hand?

MR. REKLACTIS: We had some holes in the containment wall, a few holes, but they were not true through holes through the walls. They were for expansion anchors up to 6 inches deep and maybe one inch in diameter.

MR. KNIGHT: How thick was that wall?

MR. REKLACTIS: That wall would be 6-foot thick.

MR. DELGEORGE: And those were all on the outer surface.

MR. REKLACTIS: On the outer surface. They did not compromise the boundary of the containment.

MR. KOSTAL: That is a post-tension element.

MR. LIPINSKI: In the affidavit there was a statement that the drillings were holes made in the reactor building at elevation 710 and 735 in the reactor building wall. Now in this presentation you do not show an area -- these are internal walls. Is that right?

MR. LONGLAIS: These are all the walls and slabs.

MR. DELGEORGE: On a BWR containment you have to be sure to distinguish between the primary containment boundary and the reactor building walls. Those are two different surfaces.

MR. LIPINSKI: If I remember right in the affidavit a statement was made that it was the elevation that I indicated, and in the reactor building and the primary containment. Is that correct?

MR. DELGEORGE: No reference was made to primary containment that I can remember.

MR. DENTON: I had assumed the reference was to so-called secondary containment, not primary containment. That is a good point.

MR. SCHWENCER: On page 4 of the affidavit, the affidavit says reactor building, Unit 1 at elevation below 710.

MR. CHAN: In that table in the last column, do you think the numerator and the denominator ought to be reversed?

MR. LONGLAIS: Yes, that's right, it should be. That is why we are getting a number greater than one. Yes.

MR. DELGEORGE: One point of interest that we might comment on is that there are two specific allegations in the affidavit by Mr. Garrison with respect to his activities in two areas of the plant. We believe, because of the record-keeping process that we have had in place, that we have been able to identify the records associated with those two areas.

In fact, I believe we have one of them here. You will remember from the affidavit an indication that the phalanges of a beam were contacted as the result of drilling through a floor. We have identified what we believe to be the source of that report. There is, in fact, a non-conformance report written and documented evidence of an engineering evaluation of the reported damage.

Now, given the vagaries of the information provided in the affidavit, we cannot be certain that what we found was what was alleged to have existed. However, it appears to us that we can find the damage suggested in the affidavit.

This is true of the other instance as well, but I am reluctant to talk about that one in more detail because we have not confirmed it ourselves, the point of the discussion being that we believe our records are very complete.

MR. NORELIUS: What confidence do you have that these hits and all have been put into the record?

MR. DELGEORGE: As we indicated earlier, that have been both audits and surveillances conducted by site contractor and Commonwealth Edison QA personnel during the course of drilling and coring of the holes initiated in the late seventies through 1981-1982. We have, because of the emphasis placed by this petition, gone back to assure ourselves by requesting each site contractor to identify all damage reports so that we can cross-correlate those records received by the architect engineer versus those records prepared by the site contractors, and we are in the process of verifying that we have in fact reviewed each of the reports developed at the site.

Based on the review that has been conducted to date, we are not ware of any discrepancies in that process.

MR. NORELIUS: You mentioned that the program started in 1976, the control program that you have. How does that relate to the drilling that has been done?

MR. LEE: Dan?

MR. SHAMBLIN: Yes. We went back and took a look at where we stood on electrical and mechanical installation from our progress reports, and in the electrical area from a cost control report for the period ending October 20, 1976, which is a period of approximately when the first revision of LSC came out, the first draft of it. Cable pan installation, we had 11,260 feet of cable pan out of 119,800 feet of cable pan installed. The 119,000 was based on two units. That represents 9.4 percent of the cable tray installed.

Exposed conduit: We had no exposed conduit installed at that point in time. Lighting: We had 2,163 of 9,876 fixtures installed at that point in time. I think we used the shorter anchors on the lighting, quarter-inch anchors. We had no cable pulled, and this again is consistent with if we didn't have any exposed conduit installed we wouldn't have any cable pulling.

In the area of piping installation, for the period ending December 31, 1976, piping supports, we had 1,917 of 17,745 piping supports installed. Piping, 2-1/2 inch and larger, we had 51,657 feet of 310,926 feet installed; and stainless steel piping, we had 3,909 feet of 79,269 feet of stainless steel piping, all sizes, installed. Now these numbers include the whole plant, both safety and nonsafety-related areas.

In reviewing one of the progress reports at that point in time, we did find out that the HVAC contractor was not working in any safety-related areas at that point in time. This was the progress report dated December 10, 1976. He was working in the nonsafety areas only and he had not started work in the safety-related areas.

MR. LEE: Primarily in the service building?

MR. SHAMBLIN: Primarily in the service building, and the lower elevations of the turbine building. The main electrical contractor was installing lighting in reactor number one and number two and in the aux buildings.

He was installing cable pans in the reactor one turbine and aux buildings, and he was installing communications, which is a -- the type of anchors you may use on that is similar to the lighting in the reactor area aux building, service building, and lake screen house.

The piping contractor was installing service water, cycle condensate, clean condensate, closed cooling water piping in the reactor building Unit 1, and he had just started the installation of Section 3 high and low pressure core spray and residual heat removal hangers.

You have to remember that the amount of expansion anchor work that would have been going on at that time would have been very, very minimal, because it was a clear building that the contractors were able to get into and hang from the embedment plates. So we are concluding that the amount of concrete expansion anchor work that went on prior to September 1976 or the fall of 1976, was very, very minimal.

MR. NORELIUS: Thank you.

MR. DENTON: Let me return to the slide that you have shown. The lowest margin appears to be in area number one. That is down to 1.05. Your sample is actually rather small. In view of the large number of potentially damaged bars. How far do you intend to look for remedial action? Are you going to look back, wall by wall? Do you consider this a sample to base a judgment on?

MR. LONGLAIS: We feel satisfied that our initial engineering judgment was adequate. We feel that we have picked out nine critical areas. We have demonstrated that we still have a factor of greater than one. We do not feel it is necessary to go back at this point in time.

MR. DENTON: It is not very much greater than one. Your sample is --

MR. LONGLAIS: All we need is "one."

MR. LEE: We have been accused of overbuilding there, or some of the utilities have recently, that we have not paid enough attention to quantities, and what have you, and that we are overdesigned. So "one" does not mean here that if we go to .99 the building is going to fall down.

MR. DENTON: Well, I was trying to relate to the number that Mr. Knight raised where he said there may be 50,000 holes either drilled or cored. There may be a thousand of those that are greater than 2 inches, or some such number. Of those 1000 holes that may be greater than 2 inches, how many of them are sampled in this table? It looks like --

MR. LONGLAIS: Maybe less than 1 percent.

MR. LEE: There were only 3000 that had any kind of even a nick report, let alone a cut or an actual rebar replacement. So out of the 50,000, only 3000-and-some had any indication of contact with a reinforcing bar.

MR. DENTON: Well in the column labeled "number of damaged rebar locations," do you assume all these are cut?

MR. LONGLAIS: We assume all of these to have been cut, when in fact the number may have only been nicked.

MR. KOSTAL: I would like to clarify one thing. that 1.05 in Tom's earlier comment regarding the margins that exist, if we took the actual concrete strength, that number is actually 1.2. It is not 1.05, because we typically have 10 to 30 percent increase in capacity of the concrete and steel that exists out in that plant compared to the original design. So that is not even taken into account.

So when it says "from an engineering point of view we feel we have adequate safety margins," there are additional margins on top of that 1.05 that are available to us, if any additional assessment was required, which we do not believe is needed.

MR. DENTON: Are you saying then that these calculations of margins with and without holes are using design strength, not --

MR. KOSTAL: That is design strength, not actual material strength; and it is automatically required required that the actual material strengths must be greater than design strengths, and we have-- you know, Edison has documentation to show that the level of that increased capacity range is well above the 15 percent range.

MR. LIPINSKI: But that depends on how we define the margins. If the margin is defined on the basis of ACI 3.18, then we are using the code allowables.

MR. KOSTAL: The margin is defined based upon what is committed to in the FSAR, which was reviewed and agreed to by Staff.

MR. LIPINSKI: Fine. Then we are talking about--

MR. KOSTAL: Which is greater than ACI. Your margins are less than what is allowed for ACI.

MR. LIPINSKI: No, but you bring up another point. You bring up the actual concrete strength.

MR. KOSTAL: I am saying that it is available if it is required to be called upon, which is not taken into account in this assessment.

MR. LIPINSKI: We are aware of that fact, but if we are assessing the margin on the basis of code allowables, then this is one thing. But you bring up another point.

MR. LONGLAIS: The margin is based upon the design strength of the concrete element. That design strength is calculated per the applicable requirements of ACI 3.18. That is divided by the design stresses in the concrete element, which were calculated using the committed-to design requirements in the LaSalle FSAR.

MR. DENTON: I want to get back to statistical confidence just one more time. The number of damaged bars for which you have done this calculation cannot add up to much over 100.

MR. LONGLAIS: That is correct.

MR. DENTON: And you are saying the number of bars actually damaged is what? 3000?

MR. LONGLAIS: Approximately that, yes.

MR. DENTON: And then you tried to select these, picking ones that you thought were more likely to show deterioration than not. But still, what level of confidence do you think this represents where you have identified holes that will actually keep the structure from performing its function?

MR. LONGLAIS: I personally feel we have done a complete job in this assessment. I believe we have been very conservative in our engineering assessments throughout the entire program. And in all the areas we have looked at in selecting highly congested rebar damages, be they nicks or cuts, we have demonstrated that we have a factor of safety greater than one. Again, I think the proof of the pudding is in looking at the drawings and looking at how sparsely most of these reinforcing steel damages do occur.

We have tried to select areas that appear to be congested. One area here where it appeared that we had a stress problem, we did isolate that and showed that we still had sufficient margin.

MR. DELGEORGE: The point that needs to be made is that the engineering evaluation is 100 percent complete for all concrete elements. That is, we have reviewed these drawings and performed an assessment for each of the concrete elements. We have done an additional analytical assessment to verify the evaluation that has been done for all walls, and we have found that there is nothing in this analytical assessment of the nine walls shown to suggest that the 100 percent review that we did was inadequate.

So on that basis statistcally we have looked at 100 percent of the elements involved, and we have done an over-inspection of a limited number of those walls, or concrete elements.

MR. DENTON: I propose that we take a break in a moment to perhaps mull over what we have heard; but before we do, let me ask Mrs. Goodie if she would like to make any comments?

MS. GOODIE: Not at this point, thank you.

MR. PURPLE: One part of the petition speaks to asking us to not allow fuel to be loaded, because if fuel would be loaded you would be unable to have access to areas that needed repair, and so forth and so on. Do you have anything to provide on that?

MR. DELGEORGE: Yes. If you will remember, I asked that we defer that, and now looks like a good time to talk about it. The petition does say that immediate attention is required prior to plant operation. In materials that we have submitted to the Staff, you are aware that our low-power test startup program involves certain hold points.

From the date at which fuel is started to be loaded into the reactor vessel, there is a period of approximately two months before the first criticality is reached. During that period of time, we do not feel that there is any jeopardy to the continuation of an evaluation, and there is no radiation level that needs to be addressed anywhere in the plant.

Beyond that, it is our view, based on the experience in starting up similar reactors at Dresden and Quad Cities, that over the full course of the five percent power license that we have requested, that the radiation levels in those areas of the plant subject to inquiry here would not be such that a continuing review or inspection would be precluded. So it is our feeling that the immediacy suggested in the petition is overstated.

MR. LEE: And I guess I would say that in fact after 12 years of operation on Dresden, it would not, from a radiation standpoint, preclude evaluations and inspections. After all, we do maintain all of that equipment.

MR. DENTON: Any other questions anyone would like to raise before we take a break?

(No response.)

MR. DENTON: Let us break for about 10 minutes and try to get back a few minutes before 3:00.

(Recess.)

MR. PURPLE: Let's get started again.

(Pause.)

Harold was unable to come back. He was called away. He asked me to continue the meeting -- continue, or close the meeting, I suspect. I think Commonwealth Edison has presented all you intended to present today, I trust?

MR. DELGEORGE: I would like to supplement the record with one fact.

MR. PURPLE: All right.

MR. DELGEORGE: Early in the discussion a question was raised relative to whether or not we had performed a reinforcement steel assessment of the off-gas building roof. We have verified by conversations with our consultant, and we have in fact performed a similar evaluation of the off-gas building roof to what has been described here. And is it true that a drawing like this exists for that slab?

MR. REKLACTIS: There are two cuts that were noted, and they were observed, and there are several nicks which are not detrimental.

MR. DELGEORGE: The point being that although only safety related concrete elements are addressed in the package we have provided you today, we have been able to determine that the off-gas building roof, which is a non-safety related structure, was also evaluated in a similar way.

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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In the Matter of	:	
COMMONWEALTH EDISON COMPANY	:	Docket Nos. 50-373
LaSalle County Nuclear	:	and
Generating Station, Unit 1	:	50-374
and Unit 2	:	

- -x

Room P-422,
7920 Norfolk Avenue,
Bethesda, Maryland.
Wednesday, March 31, 1982.

The meeting in the above-entitled matter was convened at 1:03 p.m., when were present:

APPEARANCES:

H. Denton
R. Purple
A. Bournia
R. Tedesco
A. Schwencer
C. Norelius
C. Williams
B. Shoemaker
R. Hoefling

MR. PURPLE: Okay. Well, I bring Harold's thanks for everybody who came on such short notice. The information we have received today will certainly help us kick off our review.

We will accept those 90 drawings and turn them over to the Staff for a subsequent look. We are, and have been I guess from an earlier notification of possible problems with holes at the site, the Regional Office has initiated its own inquiry into the facts, and that is continuing and will continue.

We cannot identify today any specific additional information we need from the utility to help us complete it. It is possible that we may ask for some. If so, we will certainly get the request to you promptly. Recognizing your scheduler needs, we certainly would intend to put what resources we need to finish this up as rapidly as possible.

Harold did ask me to pass on, in follow-on to the question he asked a couple of times, his concern about the last chart we saw with statistics, and whether or not that really gives you and him and us sufficient statistical confidence that you really have found all the places. I think if there had not been one number that came as low as 1.05, he might not have been as concerned; but again, I do not know that we are going to ask that you do any more, but you may want to be thinking about that.

I think you have delivered today all the reports that you mentioned? Do we have all of that information?

MR. DELGEORGE: I believe so. Before we leave we will check with whoever you think has a complete package, and we will --

MR. PURPLE: The Project Manager, I hope.

MR. LEE: I might just say, by responding to that last concern of Harold Denton's, that in fact, I think as Lou has said, that we have looked at we think 100 percent.

MR. PURPLE: Yes; I understand that.

MR. LEE: It is really only a sampling verification, in a sense. So that a look by your experts at these prints hopefully will give the same conclusions. Again, we can only make the plea that we have spent a lot of time on this effort.

We, just on a kind of a back-of-the-envelope estimate, while we were having a quick sandwich before we came over here, estimated that we probably spent more than one man-year worth of effort in five days, and that is not counting all the effort that is indicated here by the people who have come who should be back at the site trying to move that facility along.

If there is a problem, we would be anxious to get into it as quickly as anybody. We are convinced that there is no problem here, and that we ought to move as quickly as we can. And there is certainly no justification for holding up low-power testing.

MR. PURPLE: Mrs. Goodie, are there any comments you wish to make?

MS. GOODIE: We certainly appreciate the prompt response to the NRC to the petition. We recognize that the decision is yours to make. Unfortunately, we were not able to have our consultant here, so there was very little, or nothing that I could say technically, obviously. But he will be looking at all the information as soon as I can get it to his office.

MR. PURPLE: We were very glad to have you here today.

If there is nothing further, the meeting will be closed. Thank you very much.

(Whereupon, at 3:10 p.m., the meeting was adjourned.)

* * *

NUCLEAR REGULATORY COMMISSION

This is to certify that the attached proceedings before the

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in the matter of: Commonwealth Edison Company (LaSalle County Nuclear Generating Station, Unit 1 and Unit 2)

Date of Proceeding: March 31, 1982

Docket Number: 50-373 & 50-374

Place of Proceeding: Bethesda, Maryland

were held as herein appears, and that this is the original transcript thereof for the file of the Commission.

Jane N. Beach

Official Reporter (Typed)

Jane N. Beach

Official Reporter (Signature)

EXHIBIT A

March 30, 1982

OFF-GAS BUILDING ROOF REPORT

PURPOSE

The purpose of the report is to present information regarding the second allegation (Page 6, Request to Institute a Show Cause Proceeding and for other Relief - Tyrone Fahner, Attorney General of the State of Illinois) on the Off-Gas Building roof.

BACKGROUND

The concrete enclosure above grade as part of the Off-Gas Building is a non-safety related structure which houses Off-Gas Building HVAC Air Handling Units, HVAC Water Cooled Condensing Units, HVAC Exhaust Filter Units, HVAC Control Panels and associated motor control centers and switchgear. The specification concrete compressive strength is 4000 psi at 90 days. While detailed quality assurance requirements were not required due to the building being non-safety related, they were applied as part of the overall Commonwealth Edison/Walsh Construction Company quality effort.

FINDINGS

The Off-Gas Building enclosure concrete (walls and roof) was poured on November 7, 1975. Walsh Construction Company (WCC) Q.C. Form QCP-9A (Pour Checkout Card) was signed by the appropriate construction and Q.C. personnel and countersigned by a Commonwealth Edison Company Field Engineer. Additionally, WCC Q.C. Forms QCP-6A(Reinforcing Steel Placement Audit) and QCP-9B(Concrete Placement Control Audit Form) were utilized and signed by WCC Q.C. personnel. Concrete testing during the pour by A&H Engineering Corporation showed the concrete was within specification requirements for slump, air content and placing temperature. The concrete met compressive strength requirements, the lowest cylinder break was 4670 psi at 90 days.

On September 25, 1979, Commonwealth Edison Company Quality Assurance pointed out some surface cracking in the bottom of the Off-Gas Building roof. The area had a high density of concrete expansion anchors. An inspection performed by WCC Q. A. Supervisor, WCC General Superintendant and CECo. Structural Engineer found the cracking to be surface in nature and no futher action was required.

A temporary construction power center transformer and switchgear were set on the roof in 1976. The unit weighed approximately 6700 pounds. The unit was set over a concrete beam in the longitudual direction and one end rested on the east concrete wall. A check was made to insure the roof would take the unit loading prior to installation. The unit was removed in late 1981 as it was no longer required.

Luyin

The slab thickness has been checked on two different occasions. On March 10, 1982 a single point check showed the slab as 1' - 2 1/4" thick including roofing material. Roofing material is approximately 1-3/4" - 2" thick. Additional slab thickness checks were made on March 29, 1982. Fifteen (15) points checks showed the slab plus roofing material varied from 1' - 1-5/8" to 1' - 3-3/4". A check made effectively eliminating the roofing material showed the slab thickness varied from 11-1/4" to 1'- 1-1/4".

A visual survey of the roof underside was made by WCC Q.A. and CECo. on March 27, 1982. The survey showed no abnormal concrete cracking. The area under the former electrical equipment showed no abnormal concrete cracking.

SUMMARY

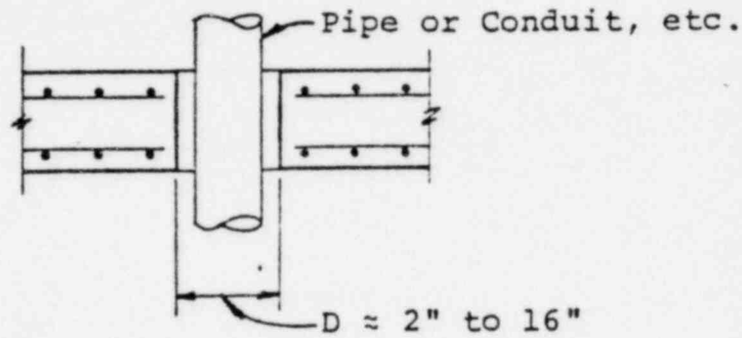
The Off-Gas Building roof concrete is 12 inches thick per specifications. There is no abnormal concrete cracking due to concrete expansion anchors and/or the electrical equipment formerly placed there. The roof will serve its' intended function.

3759N

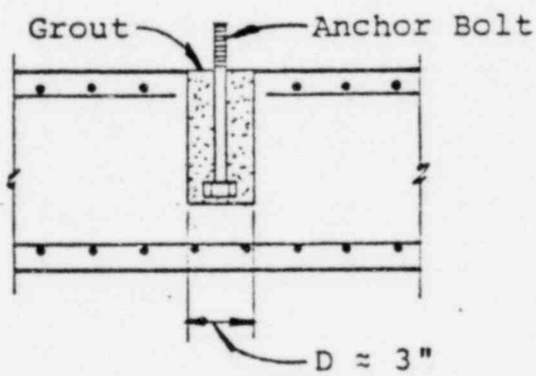
Exhibit 1

TYPES OF CORED HOLES

A. Holes passing through concrete element to allow for passage of an electrical or mechanical component.



B. Holes partially penetrating a concrete element for a grouted anchor bolt.



DRILLED HOLES FOR CONCRETE EXPANSION ANCHORS

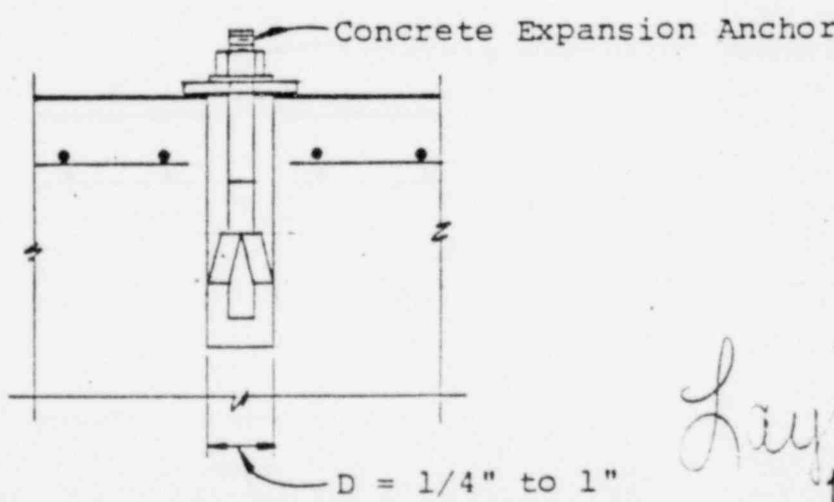


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Exhibit 2

SUMMARY OF ENGINEERING PEVIEW OF CORED HOLES

I THE LOCATION OF ALL CORED HOLES PASSING THRU CONCRETE ELEMENTS FOR OFFICE ROUTED COMPONENTS ARE LOCATED ON STRUCTURAL DRAWINGS. PRIOR TO THE RELEASE OF THE DRAWINGS, AN ENGINEERING ASSESSMENT IS MADE OF THE EFFECTS OF THE REINFORCING STEEL LIKELY TO BE DAMAGED BY THE CORING OPERATION. THIS ASSESSMENT HAS CONSISTED OF ENGINEERING JUDGEMENT BASED UPON THE STRESS LEVELS IN THE CONCRETE ELEMENTS IN RELATION TO THE LOCATION OF THE CORED HOLE.

II CORED HOLES FOR FIELD ROUTED COMPONENTS ARE REQUESTED BY THE CONTRACTOR VIA A FIELD CHANGE REQUEST (FCR). AN ENGINEERING ASSESSMENT, SIMILAR TO THAT PERFORMED FOR OFFICE ROUTED COMPONENTS, IS MADE PRIOR TO THE APPROVAL OF THE FCR. THE LOCATION OF THESE CORED HOLES ARE SUBSEQUENTLY INDICATED ON THE STRUCTURAL DESIGN DRAWINGS.

III SUBSEQUENT DETAILED CALCULATIONS RECENTLY PERFORMED FOR A SAMPLE OF CORED HOLES HAVE SUBSTANTIATED THAT ENGINEERING JUDGEMENT WAS APPROPRIATE.

IV CORED HOLES FOR EQUIPMENT FOUNDATION AND PIPE SUPPORT BASEPLATE ASSEMBLIES ARE INDICATED ON THE MECHANICAL DESIGN DRAWINGS.

A. THE CORING OF HOLES FOR PIPE SUPPORT BASEPLATE ASSEMBLIES, WHICH COMMENCED IN THE SUMMER OF 1980, WAS CONTROLLED BY DRAWING NO. M-1100, SHEET 23, WHICH REQUESTED THAT THE CONCRETE BE NOTCHED TO EXPOSE THE REINFORCING STEEL TO AVOID REBAR DAMAGE. THIS REQUIREMENT PRECLUDED ANY REBAR DAMAGE.

Exhibit 3

B. CORED HOLES FOR EQUIPMENT FOUNDATION ANCHOR BOLTS ARE PLOTTED ON THE RHS DRAWINGS. AN ASSESSMENT BASED UPON ENGINEERING JUDGEMENT HAS BEEN MADE ON THE ASSUMPTION OF THE REINFORCING STEEL LIKELY TO BE DAMAGED BY THE CORING OPERATION IN RELATION TO THE EXISTING STRESS LEVELS IN THE CONCRETE ELEMENTS.

Exhibit 4

Summary of Engineering Review of Drilled Holes for Concrete Expansion Anchors

I Engineering control on reinforcing steel damaged during concrete expansion anchor installation is initially exercised via Form LS-CEA, which:

A. Defines areas in which a metal detector must be used to avoid reinforcing steel damage, and requires the contractor to obtain engineering approval prior to cutting a bar and to subsequently report this occurrence.

B. Prohibits the use of concrete expansion anchors without prior approval from the consulting engineer.

C. Defines areas in which concrete expansion anchors may not be installed without the specific approval of the consulting engineer.

II Initial Engineering Review and Disposition of Damaged Reinforcing Steel Reports Submitted by the Contractor

A. Individual damaged rebar reports which are submitted are reviewed by the consulting engineer to determine the immediate, local impact of the damaged bar. This review, in most instances, consists of engineering judgement based upon the existing stress levels in the concrete element.

B. The rebar damage reports are subsequently logged in, indexed and plotted on a separate set of structural drawings (RHS drawings).

Exhibit 5

SARGENT & LUNDY
ENGINEERS
CHICAGO

September 30, 1976
Rev. 3. 7-20-79

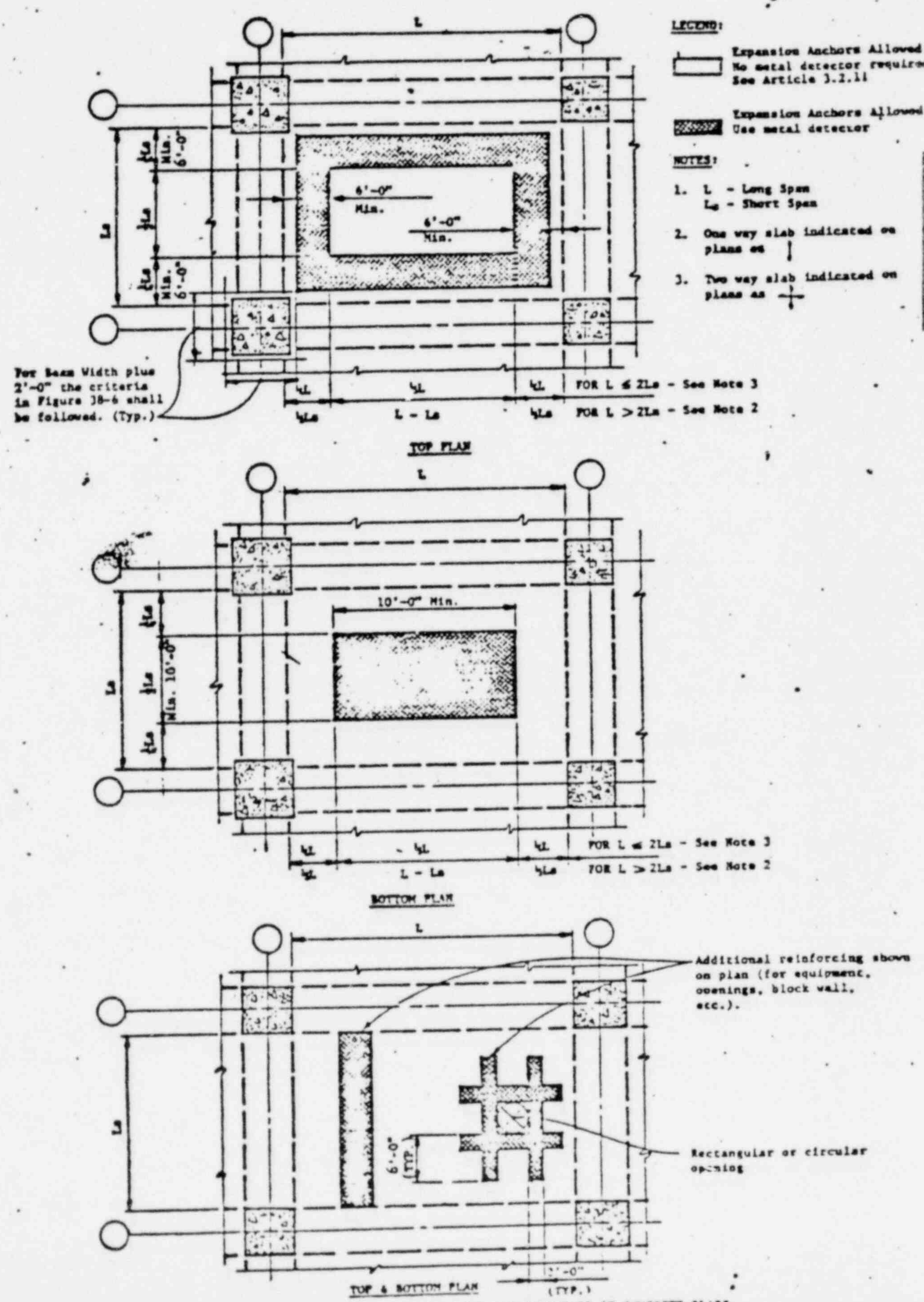

FIGURE 38-7. CRITERIA FOR DRILLING OF HOLES FOR EXPANSION ANCHORS IN CONCRETE SLABS

Exhibit 6

III FINAL ENGINEERING REVIEW AND DISPOSITION OF DAMAGED REINFORCING STEEL

A. THE ASSESSMENT OF THE OVERALL EFFECTS OF THE ACCUMULATION OF DAMAGED REINFORCING STEEL OCCURS DURING THE FINAL LOAD CHECK, JUST PRIOR TO INITIAL FUEL LOAD.

B. THIS REVIEW HAS CONSISTED OF ENGINEERING JUDGEMENT BASED UPON THE FINAL STRESS LEVELS IN THE CONCRETE ELEMENTS WITH RESPECT TO THE LOCATION OF THE DAMAGED REBAR. DETAILED CALCULATIONS WERE NOT WARRANTED DUE TO THE RANDOM DISTRIBUTION OF THE DAMAGED REINFORCING STEEL IN THE SAFETY RELATED AREAS. CALCULATIONS RECENTLY PERFORMED IN RESPONSE TO THE PETITION HAVE SUBSTANTIATED THAT ENGINEERING JUDGEMENT WAS APPROPRIATE.

Exhibit 7

Margins in Sample Areas with Congested Rebar Hits for

LaSalle County, Unit 1

Table 3-1

Area No.	Building	Slab/Wall (Panel Size)	Elevation	Wall Location or Slab Panel No.	No. of Damaged Rebar Locations	No. of Cored Holes	Margin Without Holes	Margin With Holes	Ratio $\frac{\text{Margin With Holes}}{\text{Margin Without Holes}}$
1	Reactor (S-201)	Wall 19.67'x56'	Above 673'-4"	Diagonal Wall at Col. C & 14	5	2	1.25	1.05	1.19
2	Reactor (S-211)	Slab 12.5'x32'	740'-0"	56" Slab between Col. J & H, 11-2 & 12-8	31	0	2.24	1.23	1.82
3	Reactor (S-215)	Beam 3'x24.5'	786'-6"	Beam at Line 14 between Col. D & E	1	0	3.55	3.13	1.13
4	Reactor (S-219)	Slab 10'x26' Each Slab	820'-6"	IRS 719	2	1	1.71	1.36	1.26
				IRS 720	5	0	1.88	1.50	1.25
5	Reactor (S-219)	Wall 14.7'x33'	Above 820'-6"	Between 11 & 13 & Col. J & G	12	1	2.16	1.27	1.70
6	Reactor (S-223)	Wall 21.2'x27'	Between 673'-0" & 694'-6"	Col. Row J between 14 & 15	19	2	4.00	3.00	1.33

7	Reactor (S-237)	Wall ..17'x28'	Between 673'-0" & 694'-6"	Row 15	9	0	2.85	2.53	1.13
8	Reactor (S-274)	Wall 19.17'x27'	Between 673'-4" & 694'-6"	At Line 8 - 9 between Col. J & G	6	0	1.73	1.34	1.29
9	Auxiliary (S-572)	Wall 18'x25'	Above 731'-0"	At Line 11 - 3 running	9	0	1.34	1.22	1.10

*All these bar damages are in top of slab scattered in the entire bay.

Exhibit 8

Table 3-1 (Continued)

RESPONSE TO PETITION MADE BY

THE OFFICE OF THE ATTORNEY GENERAL, STATE OF ILLINOIS,

IN THE MATTER OF REINFORCING STEEL DAMAGED DURING

THE INSTALLATION OF CORED HOLES AND CONCRETE EXPANSION ANCHORS

LASALLE COUNTY, UNITS 1 AND 2

Commonwealth Edison Company

Chicago, Illinois

March 31, 1982

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1.0 Summary of Allegation

The Office of the Attorney General, State of Illinois, has brought forward information alleging, "...that, during the construction of LaSalle County, Units 1 and 2, certain practices related to the drilling of holes in the concrete walls, floors and ceilings of the Units 1 and 2 buildings have created a potentially hazardous condition which, upon the operation of either unit at full power, may be injurious to the public health and safety." The subject petition contends that, as a matter of course, an unknown number of drilled holes, ranging in the order of thousands, were likely to have been cut through the reinforcing steel. The petition, which is based on the affidavit of Ernest Garrison, indicates that records of these situations were made at the time the alleged practices occurred, and that the practice of drilling through reinforcing steel was discontinued or subjected to the case-by-case approval of an engineer some time in late 1979, early 1980. The petition also states that the State of Illinois has no information which suggests that any engineering approval was ever obtained from Commonwealth Edison Company's engineering consultant prior to 1980. A second affidavit by Mr. Dale Bridenbaugh states that, if the reinforcing steel was damaged or severed <u>without</u>

appropriate structural analysis, and if the drilling practice was wide-spread, "...it seems nearly certain that some safety related structures...would have been affected."

2.0 Response to Allegation

2.1 Introduction

Commonwealth Edison Company, throughout the course of the LaSalle County, Units 1 and 2 construction, has controlled the drilling through concrete for either cored holes or the installation of concrete expansion anchors via appropriate quality control procedures and has documented and assessed reinforcing steel reported as having been contacted (hit or cut) during this operation.

A distinction is made between a cored hole and a hole drilled in the concrete for the installation of a concrete expansion anchor. A cored hole is one in which (a) the hole passes completely through the concrete element to allow for the passage of a mechanical or electrical component, such as a pipe or electrical conduit, or (b) the hole penetrates only partially into the concrete element, and in which an anchor bolt is set and grouted. A cored hole is typically 3" in diameter or larger. Holes drilled for the installation of concrete expansion anchors, on the other hand, vary from 1/4" in diameter to 1" in diameter, with the corresponding hole depth varying from 1-1/4" to 8". Holes drilled for concrete expansion anchors do not pass completely through the concrete element.

2.2 Disposition of Cored Holes

2.2.1 Cored Holes Passing thru Concrete Elements

The need for cored holes is determined in either the initial design phase during the routing of mechanical and electrical components, or by the contractor in the case of field routed electrical and mechanical components. In the first situation, the cored holes are located on the structural design drawings, and a conservative structural assessment is made by Sargent & Lundy for Commonwealth Edison Company of the effects of the removal or damage to reinforcing steel due to the installation of the cored hole. This assessment is made prior to the release of the drawings and the coring of the hole. In the second situation, the contractor is required to submit a Field Change Request (FDR), requesting permission to install a cored hole for field routed components prior to the coring operation. Commonwealth Edison Company, on the recommendation of Sargent & Lundy, approves this request only after a structural assessment has been made of the effects of reinforcing steel which may be removed or damaged during this operation. These cored holes are subsequently indicated on the structrual design drawings. It should be emphasized that, in both these situations, engineering approval is obtained prior to cutting the reinforcing steel. Where the engineering assessment has determined that it is not permissible to cut or damage reinforcing steel during installation of cored holes, this requirement has been specified on the appropriate structural design drawing. The following are some examples of this situation:

A. General Note No. 44 on Drawing No. S-199 states that, "For cored holes marked E, less than 8" diameter, use metal detector to locate existing reinforcing prior to core drilling. In case of interferrence with rebar, holes may be cored in alternate location within ±3" radius from location shown on drawing."

B. Drawing No. S-213, concerning the Reactor Building floor framing plan at Elevation 761'-0", Note 11 requires the use of metal detectors to avoid cutting of reinforcing steel in this area.

2.2.2 Cored Holes for Grouted Anchor Bolts

Cored Holes for grouted anchor bolts are indicated on either the mechanical or structural design drawings. Grouted anchor bolts are utilized primarily to anchor equipment foundations or pipe support baseplates to concrete elements. These cored holes are, likewise, reviewed by the consulting engineer. This review consists of an assessment of the effects of the reinforcing steel likely to be damaged due to the installation of the cored hole.

The installation of cored holes for the support of pipe support baseplate assemblies essentially commenced during the summer of 1980. Mechanical Drawing No. M-1100, Sheet 23, issued in January, 1980, controls the coring of holes for these baseplate assemblies, and requires that the concrete be carefully notched to expose the reinforcing steel in both directions prior to coring the hole, to avoid damage to the reinforcing steel.

The location of the cored holes for the installation of grouted equipment anchor bolts are plotted and located on a separate set of structural design drawings for the purpose of assessing the effects of reinforcing steel likely to be damaged in the coring operation. The structural assessment has determined that the structural integrity of the concrete elements has not been impaired by the coring operation for grouted anchor bolts for mechanical equipment foundations.

2.3 Disposition of Drilled Holes for Concrete Expansion Anchors

The drilling of holes for concrete expansion anchors is controlled by Form LS-CEA. This form was initially issued in September, 1976, and contained the following strict provisions for the protection of the reinforcing steel:

A. During the installation of concrete expansion anchors, drilling through concrete reinforcement will not be permitted. For nuclear safety related work, contractor shall use a deep magnetic detector to locate the reinforcement in concrete.

B. For all anchors in a connection, drill holes into the concrete with carbide tipped solid masonry bits. (Carbide tipped solid masonry bits are not capable of drilling through reinforcing steel. These bits can produce only a shallow, 1/16" deep, smooth and well rounded depression in the reinforcing steel).

C. Concrete expansion anchors shall <u>not</u> be used for any other work without prior approval of the Consulting Engineers.

Form LS-CEA, Revision 1, was issued on December 7, 1976. This revision relaxed the requirements for the use of the metal detector in non-critical areas, based upon a structural assessment performed by Sargent & Lundy for

Commonwealth Edison Company. Specific guidelines were given, defining these areas, and required that the consulting engineers be notified of all cases in which a reinforcing bar was cut or nicked where a metal detector was required to be used. Sargent & Lundy has reviewed for Commonwealth Edison Company the damaged reinforcing steel reports submitted by the contractors in accordance with this requirement, and has determined that the structural integrity of the nuclear safety related structures has not been impaired.

Revision 2 to Form LS-CEA was issued on November 29, 1978, However, it did not alter the reinforcing steel control provisions of Revision 1.

Revision 3 to Form LS-CEA was issued on July 20, 1979. This revision incorporated a standard form for reporting cut or nicked reinforcing steel during the installation of concrete expansion anchors. In addition, the contractor was also required to document the location of nicked reinforcing steel in those non-critical areas in which a metal detector was not required. The contractor was also permitted to cut one reinforcing bar in these non-critical areas, the extent of such area being defined by the spacing of the reinforcing steel. Additional requirements were also given to the contractor to permit him flexibility in relocating concrete expansion holes when reinforcing steel was encountered.

Revision 4 to Form LS-CEA was issued on September 7, 1979. This revision differentiated. The documentation of the installation and inspection requirements by the following categories:

(a) Safety related work in safety related areas (complete documentation of installation & testing was required)
(b) Non-safety related work in safety related areas (documentation of inspection was waived).
(c) Non-safety related work in non-safety related areas (most documentation waived, cutting of rebar not permitted.)

Revisions 5, 6, and 7 to Form LS-CEA were issued on December 10, 1979, February 13, 1980, and October 27, respectively. However, these revisions did not alter the reinforcing steel control provisions of Revision 4.

During the period 1978 through 1981, Commonwealth Edison Company conducted extensive investigations to determine the effect on reinforcing steel which is nicked during the installation of concrete expansion anchors. These investigations conclusively demonstrate that reinforcing steel, nicked by a carbide tipped drill bit during the installation of concrete expansion anchors, does not impair the structural integrity of reinforced concrete elements. This conclusion was based upon both laboratory testing and analytical assessment. Form LS-CEA, Revision 8, was subsequently issued on May 13, 1981, deleting the requirements for reporting of nicked reinforcing steel.

3.0 Conclusion

In summary, the drilling operations performed at LaSalle County, Units 1 and 2, has not degraded the safety margins of safety related structures, and has not violated the quality requirements imposed by the U.S. Code of Federal Regulation, 10CFR, Part 50, Appendix A, General Design Criteria for Nuclear Power Plants, and Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants. Commonwealth Edison Company has implemented appropriate procedures to control reinforcing steel damage and exercised sound engineering judgement and due precaution with regard to the drilling of concrete for cored holes and holes for the installation of concrete expansion anchors.

ATTACHMENT 3

SARGENT & LUNDY
ENGINEERS
CHICAGO

September 23, 1976

SPECIFICATION FOR CONCRETE EXPANSION ANCHOR WORK

LASALLE COUNTY STATION - UNITS 1 AND 2

(Form LS-CEA)

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ENGINEERS
CHICAGO

September 23, 197[illegible]

SPECIFICATION FOR CONCRETE EXPANSION ANCHOR WORK

LASALLE COUNTY STATION - UNITS 1 AND 2

(Form LS-CEA)

1. GENERAL

1.1 Scope: Concrete expansion anchor WORK shall conform to the requirements of this Specification Form LS-CEA unless otherwise indicated in the Project Specification or on the design drawings. This WORK shall include furnishing, installing, inspecting and testing of expansion anchors where their use is specifically indicated in the Project Specification and on the design drawings. Concrete expansion anchors shall not be used for any other work without prior approval of the Consulting Engineers.

1.2 Definitions: The following terms, when used in this Specification or in the Project Specification or on the design drawings, shall have the meanings indicated following, unless otherwise specifically stated:

1.2.1 Indicated..........As shown, noted, called for or specified.

1.2.2 Provided...........Furnished and installed.

1.2.3 Self-Drilling Type Expansion Anchor: An externally slit and internally threaded tubular expansion shell, with a single-cone expander, as shown in Figure 1 -1 following:

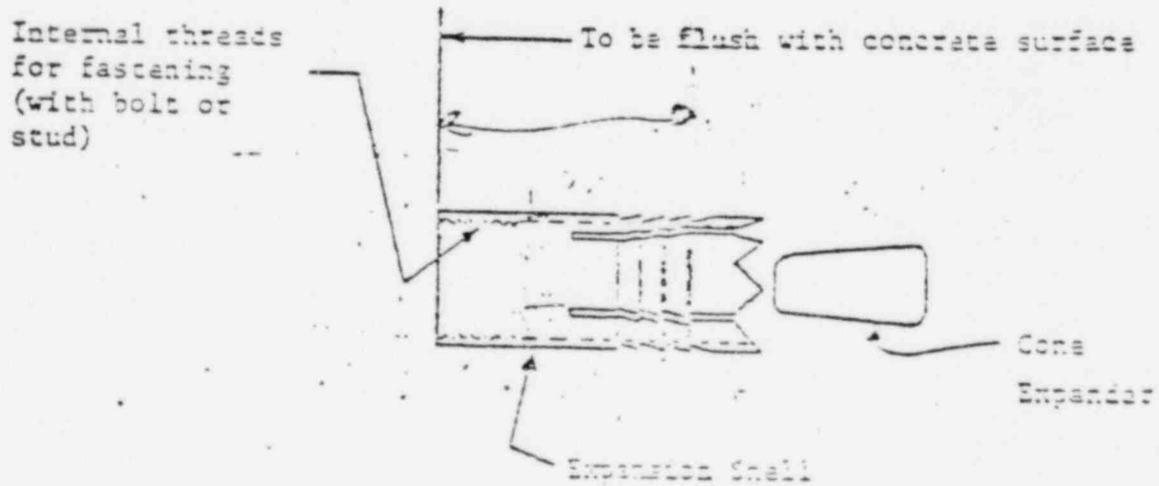

Figure 1-1 Typical Self-Drilling Type Expansion Anchor

1.2.4 Sleeve Type Expansion Anchor: A slit tubular expansion shield, with a threaded stud bolt with integral cone expander, as shown in Figure 1-2 following:

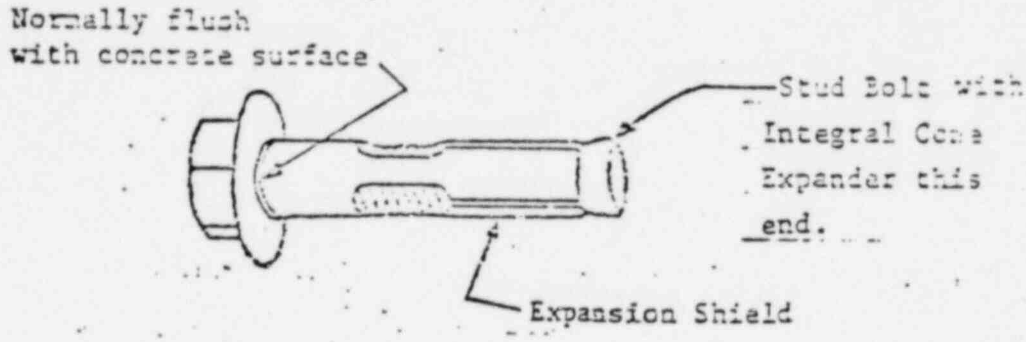

Figure 1-2 Typical Sleeve Type Expansion Anchor

1.2.5 Wedge Type Expansion Anchor: A split expansion ring or a separate expansion wedge pair, with a threaded stud bolt with integral cone expander or taper expander, as shc in Figures 1-3 and 1-4 following:

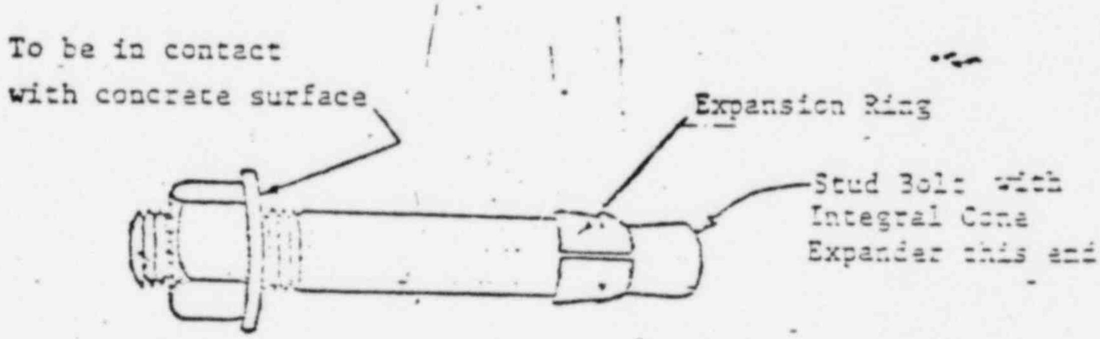

Figure 1-3 Typical Wedge Type Expansion Anchor with Cone Expander

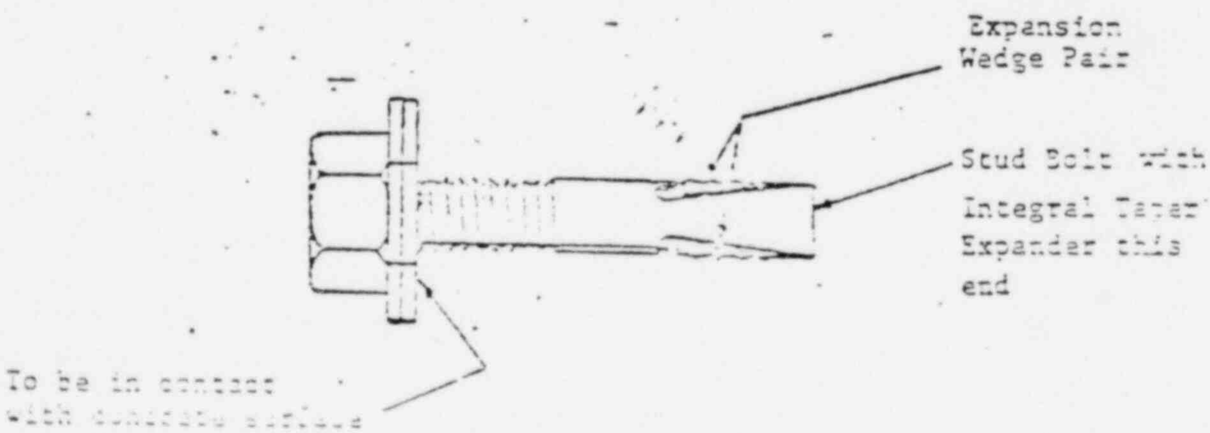

Figure 1-4 Typical Wedge Type Expansion Anchor with Taper Expander

1.3 Reference Publications:

1.3.1 Related Publications of nationally recognized technical sponsoring organizations are specified in this Specification Form by reference. Unless otherwise indicated, all references to these specified Publications, and to any Publications included by reference in the specified Publications, shall be to the latest issue of each, together with all additions, supplements, addenda, amendments or revisions thereto, as of the date of initial issue of design drawings released for ~~construction for the WORK covered by this Form LS-CEA~~ References to the sponsoring organizations will be made in accordance with the following abbreviations:

clarify

a. AISC....American Institute of Steel Construction

b. U.S.....United States Government

1.3.2 In this Form , the following Publications, or portions of these Publications, are referenced; only these referenced Publications or portions are part of this Form:

a.	AISC Standard	Manual of Steel Construction
b.	U.S. Federal Specifications:	
b1.	FF-S-325	Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
b2.	QQ-Z-325B	Requirements for Zinc Coating, Electrodeposited

1.3.3 Where Reference Publications are specified, the requirements of these Publications shall govern unless otherwise specified in this Form or in the Project Specification, or on the design drawings. Where there is a conflict between the requirements of two or more specified Publications, the more stringent requirements, as interpreted by the Consulting Engineers, shall govern unless otherwise indicated.

1.4 Consulting Engineers' Reference Standard Specifications:

1.4.1 Form 1707....Standard Requirements for Specified Products and List of Approved Manufacturers (Written portion only, no Tables)

1.5 Quality Assurance Program: This Program is required for nuclear safety related work only, and shall conform to the requirements of the Quality Assurance Articles of the Project Specification.

1.6 Qualification of Expansion Anchor Installers - For Nuclear Safety Related Work Only:

1.6.1 All installers of concrete expansion anchors for nuclear safety related work shall be qualified by Contractor in accordance with this Paragraph 1.6.

1.6.2 Each installer shall install a test set of the type and size of anchors to be used for each installation position - overhead, horizontal and downward. Each test set shall consist of three anchors. This test installation shall be made at the project site in suitable and approved areas of concrete structures which have a minimum compressive strength of 3,500 psi at 28 days.

1.6.3 Each test set of installed anchors shall be tested with applied pull-out loads. The average actual pull-out load for each test set shall not be less than the ultimate pull-out strength indicated in Table 1-1 for the corresponding size anchor; and the minimum actual pull-out load for any one tested anchor shall not be less than 85% of this pull-out strength.

1.6.4 The qualification of the installer shall be certified by Contractor if his test results meet the requirements of Paragraph 1.6.3. All certifications shall be kept on file at the project site for review and audit.

1.6.5 Any installer shall be re-qualified, with the same procedure indicated in this Paragraph 1.6, if he has not performed this work for six months or more, or if the acceptability of his performance is in doubt.

1.6.6 All costs in connection with the qualification and requalification of all installers shall be borne by Contractor.

2. DETAILS

2.1 Types of Anchors:

2.1.1 For All Work Except Nuclear Safety Related Work:
Any of the following types of expansion anchors may be used:

a. Self-drilling type

b. Sleeve type

c. Wedge type

2.1.2 For Nuclear Safety Related Work:
Only wedge type expansion anchors shall be used.

2.1.3 The three types of expansion anchors shall meet the requirements of the following portions of U.S. Federal Specification FF-S-325:

a. "Group III, Type 1"............for self-drilling anchors

b. "Group II, Type 3, Class 3".....for sleeve anchors

c. "Group II, Type 4, Class 1".....for wedge anchors

2.2 Detailed Requirements:

2.2.1 Embedded Lengths: The minimum embedded length of an expansion anchor shall be 4.5 times the nominal inside diameter or bolt diameter of the anchor.

2.2.2 Ultimate Pull-out strengths: The ultimate pull-out strengths of expansion anchors embedded in concrete shall not be less than as indicated in Table 1-1.

TABLE 1-1

Minimum Ultimate Pull-Out Strengths of Expansion Anchors in Concrete with a Minimum compressive strength of 3500 psi at 28 days

Nominal Inside Diameter or Bolt Diameter of Anchor (in.)	Ultimate Pull-Out Strength (lbs.)
1/4	700
5/16	1,200
3/8	1,900
1/2	3,500
5/8	5,600
3/4	8,400
1	13,[illegible]

2.2.3 Size Limits: The nominal inside diameters or bolt diameters expansion anchors shall be 1/4" through 3/4" for self-drilling type, 1/4" through 5/8" for sleeve type, and 1/4" through 1" for wedge type.

2.2.4 Edge Distance: The minimum distance from the center of an expansion anchor to any edge of concrete shall not be less than six times the nominal diameter of the anchor (outside diameter of sleeve for self-drilling or sleeve type and bolt diameter for wedge type); and shall not be less than 6 inches

refer to tolerance on drill

2.2.5 Locations: Location of or means expansion anchors shall be as indicated on the design drawings. All other areas will not be permitted without prior written approval by the Consulting Engineers. verbal

2.2.6 Special Provisions:

a. For all work except nuclear safety related work, expansion anchors with 1/4", 5/16" and 3/8" bolt diameters may be used in solid masonry walls.

b. For nuclear safety related work, expansion anchors shall not be used in solid masonry walls without prior written approval by the Consulting Engineers.

3. MATERIALS

3.1 Kinds of Materials:

a. Concrete expansion anchors and accessories shall be made of carbon steel with zinc plated coating conforming to U.S. Federal Specification QQ-Z-325B. Stainless steel may be used in place of this zinc coated carbon steel.

Reference ASTM requirement [illegible]

b. Materials for Nuclear Safety Related Work shall have an appropriate ASTM certification. When ASTM certification is not available, the required testing and certification of the material shall be as approved by the Consulting Engineers.

3.2 Strength of Materials: The anchor material shall have a minimum yield strength of 60,000 psi. for self-drilling and wedge type anchors, and 50,000 psi. for sleeve type anchors.

3.3 Cross-Sectional Areas of Anchors: The smallest cross sectional area of an expansion anchor shall not be less than the cross sectional area at the thread root of the same size standard screw, as indicated in the AISC Manual of Steel Construction.

3.4 Makes and Types:

3.4.1 Concrete expansion anchors shall be one of the makes and types as indicated in the following table:

TABLE 1-2

Manufacturers	Types
a. Hilti Fastening Systems, Inc.	a1. Hilti HHS Self Drilling anchors a2. Hilti Universal Hex Nut Sleeve Anchors a3. Hilti Kwik-Bolt Stud Wedge Anchors
b. ITT Phillips Drill Company	b1. Red Head Self-Drilling Anchors b2. Red Head Hex Nut Sleeve Anchors b3. Red Head Wedge Anchors
c. Ramset Fastening Systems	c1. Ram-Drill Self-Drilling Anchors c2. Dynabolt Mark II Hex Nut Sleeve Anchors c3. Trubolt Wedge Anchors
d. The Rawlplug Company, Inc.	d1. Rawl Saber-Tooth Self-Drilling Anchors d2. Rawl Lok/Bolt Hex Nut Sleeve Anchor d3. Rawl-Stud Wedge Anchors
e. USM Corporation, Construction Products Division	e1. Parasleeve Hex Nut Masonry Anchors e2. Parabolt Wedge Anchors
f. Wej-It Corporation of Allied Products Corp.	f1. DE-Bolt Hex Nut Sleeve Anchors f2. Wej-It Double Wedge Anchors

3.4.2 Other concrete expansion anchors not specified in Table 1-2 may also be acceptable, provided they meet the same requirements and are specifically approved by the Consulting Engineers (See Form 1707).

4. INSTALLATION

4.1 General Provisions:

4.1.1 During the installation of concrete expansion anchors, drilling through concrete reinforcement will not be permitted.

allowed to [illegible] guidelines

4.1.2 For Nuclear Safety Related Work, Contractor shall use a deep magnetic detector to locate the reinforcement in concrete. This detector may be one of the following:

a. Product: James "R" Meter C-4952
   Manufacturer: James Electronics, Inc.
   Chicago, Illinois

b. Product: Profometer
Manufacturer: Proceq. SA Riesbachstrasse 57 CH-8034 Zurich 8, Switzerland

c. Product: CT-4949 A Deep Pachometer
Manufacturer: Soiltest, Inc. Evanston, Illinois

4.2 Installing Procedures:

4.2.1 Self-Drilling Type Concrete Expansion Anchors: These anchors shall be installed in strict accordance with the following requirements and with manufacturers' specifications and recommended procedures:

a. Drill hole in concrete with the anchor. The maximum depth of the hole shall not exceed the thickness of the concrete minus 2-1/2 inches.

b. Remove the anchor from the hole, and thoroughly clean hole and anchor.

c. Insert the cone shape expander plug partially into the anchor.

d. Reinsert the anchor into the hole, and expand the anchor by driving it over the expander plug until the anchor is flush with concrete surface.

4.2.2 Sleeve and Wedge Type Concrete Expansion Anchors: These anchors shall be installed in strict accordance with the following requirements:

a. For all anchors in a connection, drill holes into the concrete with carbide tipped solid masonry bits, using a power drill, in accordance with the following:

a1. The diameter of each hole as drilled shall not exceed the nominal diameter of the anchor by more than 3%.

a2. The depth of the hole shall not exceed the thickness of the concrete minus 2-1/2 inches.

a3. Holes shall be thoroughly cleaned before installing the anchors.

b. Assemble washer, nut and bolt such that the top of the bolt is flush with the top of the nut to protect threads from damage.

c. Drive the assembled anchor required for the connection into the hole until the anchor is brought to a hand-tight condition so that all parts of the connection are in good contact with one another.

d. Tighten the anchor in the connection by three full turns of the nut unless otherwise specified in manufacturer's standards and approved by the Consulting Engineers. This tightening shall proceed systematically from the most rigid or inner part of the connection to its free edges. During this operation, there shall be no rotation of the parts except the nut.

5. INSPECTION AND TESTING

1" - check?

5.1 General Provisions:

5.1.1 Installed concrete expansion anchors with nominal bolt diameters 1/2" or larger are subject to inspection and testing, unless otherwise indicated in the Project Specification.

5.1.2 The services of an independant testing laboratory will be provided by Purchaser for inspection to assure that the requirements of this Specification are met.

why 75% - why not -

5.1.3 Installed anchors shall be tested with testing tension equal to 75% of the ultimate pull-out strengths indicated in Table 1-1.

5.1.4 Testing and inspection shall be performed using one of the following method

a. Calibrated Torque Wrench Inspecting (for sleeve and wedge type anchors only)

out b. Direct Tension Testing

5.1.5 Unacceptable installed anchors shall be replaced and then re-tested or re-inspected until all tested installed anchors are acceptable.

5.1.6 The re-use of expansion anchors will not be permitted.

5.2 Project Inspecting Torque:

5.2.1 For Calibrated Torque Wrench Inspecting, the Project Inspecting Torque shall be established as follows:

a. Three anchors of the same grade, size and condition as those to be tested shall be placed individually in a calibration device capable of indicating bolt tension. The contact surfaces under the part to be turned in tightening each bolt shall be similar to those under the corresponding part in the structure.

b. These three anchors shall be tightened in the calibrated device, to full testing tension equal to 75% of the ultimate pull-out strengths indicated in Table 1-1.

c. Wrenches shall be calibrated at least once each working day for each bolt diameter being installed; and shall be re-[illegible] significant changes are noted in the surface condition of the [illegible] nuts or washers.

d. The calibration shall be done by applying a torque wrench and tightening the nut a small amount each time until the testing tension is reached. The average reading of these three anchors shall be taken as the Project Inspecting Torque for the size inspected, but which shall be within the following ranges.

Nominal Bolt Diameter	Torque Range	
	Wedge Type Anchors	Sleeve Type Anchors
1/2"	45-65 ft.-lb.	50-75 ft.-lb.
5/8"	70-90 ft.-lb.	75-100 ft.-lb.
3/4"	100-175 ft.-lb.	
1"	250-300 ft.-lb.	

5.3 Testing Requirements:

5.3.1 For All Work Except Nuclear Safety Related Work:

a. Testing Sequence:

a1. One out of each two hundred expansion anchors installed shall be randomly selected for testing.

a2. If this tested anchor is unacceptable, two other anhcors in the same group of two hundred shall be tested.

a3. If one of these two anchors is unacceptable, ten other anchors of the same group of two hundred shall be tested.

a4. If two or more of these ten anchors are unacceptable, all other anchors in this group of two hundred shall be tested.

a5. Information on all expansion anchors that require replacing shall be sent to the Consulting Engineers for review.

b. Acceptance Standards:

b1. Calibrated Torque Wrench Method:

b1.1 The inspector shall place the wrench on the nut of the selected anchor, and apply torque to the nut until the wrench dial reading reaches the Project Inspecting Torque.

b1.2 If the nut of the inspected anchor does not turn, the anchor shall be accepted. If the nut does turn, the anchor shall be considered unacceptable.

b2. Direct Tension Method: If the anchor under testing showed no sign of slip, pull-out, or failure, the anchor shall be accepted as properly installed. If the anchor under testing slipped, pulled-out or failed, the anchor shall be considered unacceptable.

5.3.2 For Nuclear Safety Related Work:

a. Testing Sequence:

a1. For each two hundred expansion anchors, one group of fifty expansion anchors shall be tested using the Direct Tension Method and the remaining three groups of fifty shall be tested using the Calibrated Torque Wrench Method, as follows, unless otherwise indic[illegible]

a2. One in each group of fifty concrete expansion anchors installed shall be randomly selected for testing.

a3. If this tested anchor is unacceptable, two other anchors in the same group of these fifty anchors shall be tested.

a4. If one of these two anchors tested is unacceptable, all other anchors in this group shall be tested.

b. Acceptance Standards: Same as Paragraph 5.3.1b.

SARGENT & LUNDY
ENGINEERS
CHICAGO

September 30, 1976
Revised December 7, 1976

Rev. 1

SPECIFICATION FOR
CONCRETE EXPANSION ANCHOR WORK
LA SALLE COUNTY STATION - UNITS 1 AND 2

(Form LS-CEA)

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SARGENT & LUNDY
ENGINEERS
CHICAGO

September 30, 1976
Revised December 7, 1976

SPECIFICATION FOR CONCRETE EXPANSION ANCHOR WORK LA SALLE COUNTY STATION - UNITS 1 AND 2

(Form LS-CEA)

1. GENERAL

1.1 Scope: Concrete expansion anchor WORK shall conform to the requirements of this Standard Specification Form LS-CEA unless otherwise indicated in the Project Specification or on the design drawings. This WORK shall include furnishing, installing, inspecting and testing of expansion anchors where their use is specifically indicated in the Project Specification and on the design drawings. Concrete expansion anchors shall not be used for any other work without prior approval of the Consulting Engineers.

1.2 Definitions: The following terms when used in this Standard Specification or in the Project Specification or on the design drawings, shall have the meanings indicated, unless otherwise specifically stated:

1.2.1 Self-Drilling Type Expansion Anchor: An externally slit and internally threaded tubular expansion shell, with a single-cone expander, as shown in Figure 38-1 following:

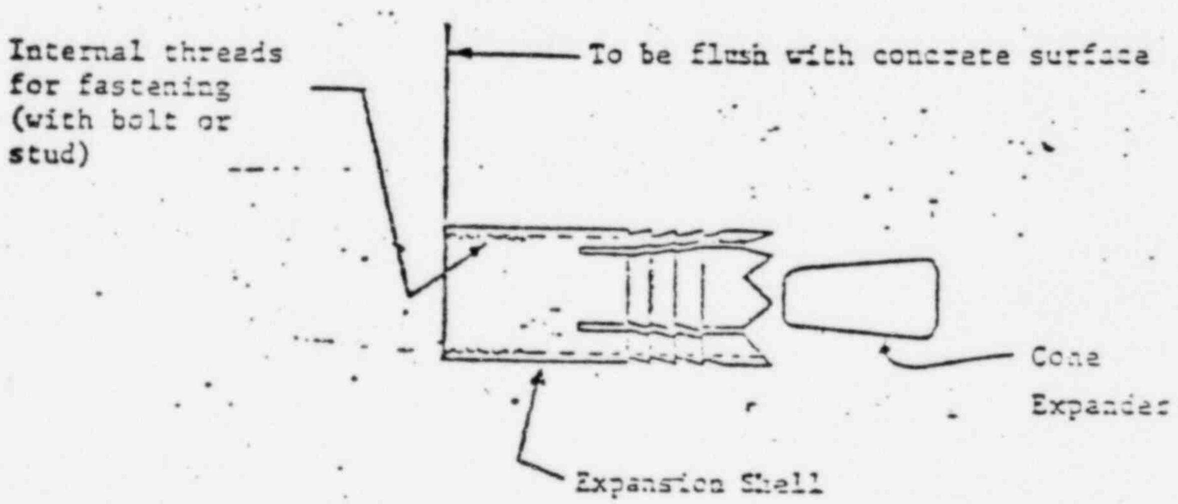

Figure 38-1 Typical Self-Drilling Type Expansion Anchor

1.2.2 Sleeve Type Expansion Anchor: A slit tubular expansion shield, with a threaded stud bolt with integral cone expander, as shown in Figure 38-2 following:

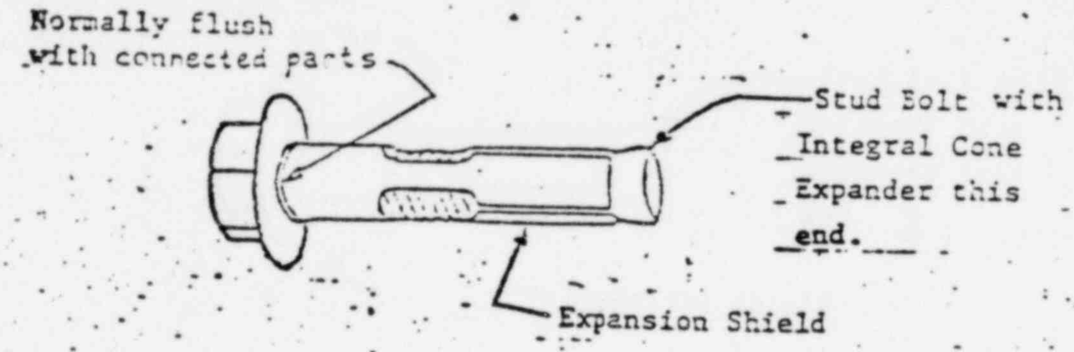

Figure 38-2 Typical Sleeve Type Expansion Anchor

1.2.3 Wedge Type Expansion Anchor: A split expansion ring or a separate expansion wedge pair, with a threaded stud bolt with integral cone expander or taper expander, as shown in Figures 38-3 and 38-4 following:

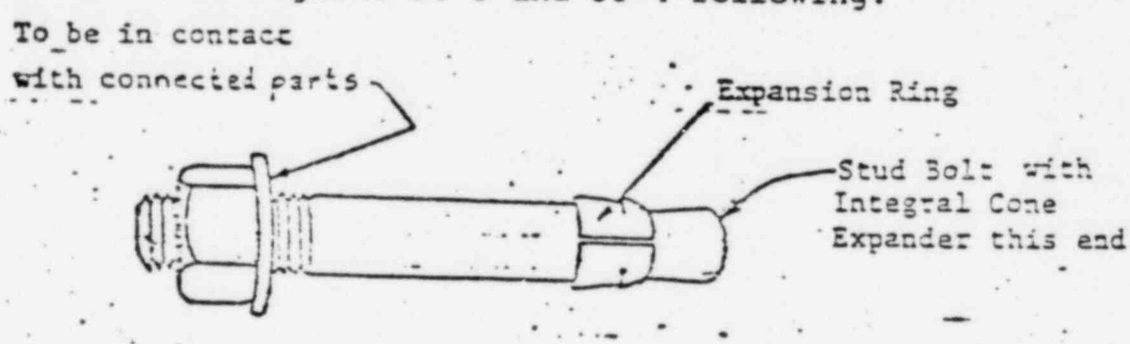

Figure 38-3 Typical Wedge Type Expansion Anchor with Cone Expander

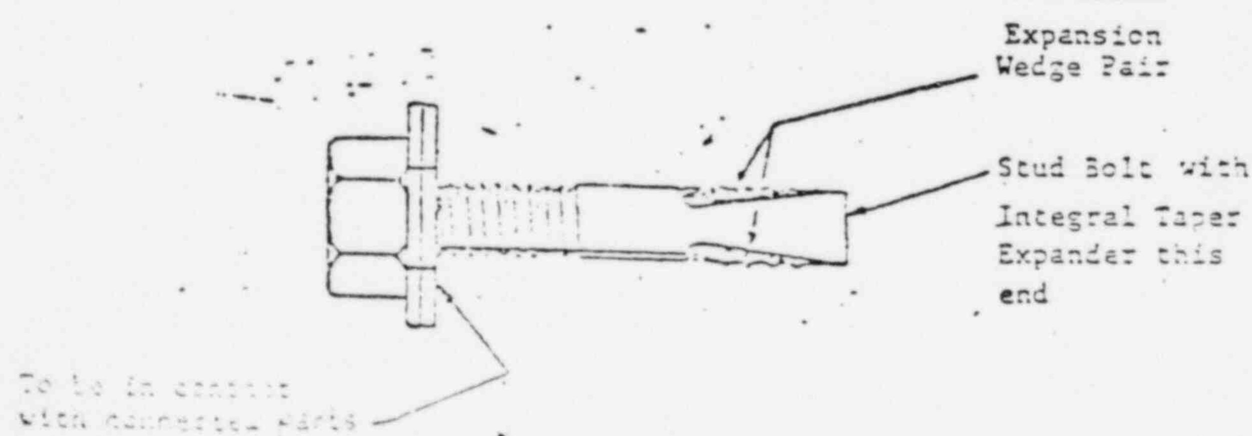

Figure 38-4 Typical Wedge Type Expansion Anchor with Taper Expander

1.3 Reference Publications:

1.3.1 Related Publications of nationally recognized technical sponsoring organizations are specified in this Standard Form LS-CEA by reference. Unless otherwise indicated, all references to these specified Publications, and to any Publications included by reference in the specified Publications, shall be to the latest issue of each, together with all additions, supplements, addenda, amendments or revisions thereto, as of the date of initial Certification of the Project Specification for the WORK covered by this Form LS-CEA.

1.3.2 In this Form LS-CEA, the following Publications, or portions of these Publications, are referenced; only these referenced Publications or portions are part of this Form LS-CEA:

a. U.S. Federal Specifications:

a1.	FF-S-325	Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
a2.	QQ-Z-325B	Requirements for Zinc Coating, Electrodeposited

1.4 Quality Assurance Program: This program is required for nuclear safety related work only, and shall conform to the requirements of the Quality Assurance Articles of the Project Specification.

2\. MATERIALS

2.1 Type and Finish of Materials: Concrete expansion anchors and accessories shall be made of carbon steel with zinc plated finish conforming to U.S. Federal Specification QQ-Z-325B. Stainless steel may be used in place of this zinc coated carbon steel.

For nuclear safety related work, the material supplier shall provide material certification.

2.2 Strength of Materials: The material shall have a minimum yield strength of 60,000 psi for self-drilling and wedge type anchors, and 50,000 psi for sleeve type anchors.

2.3 Cross Sectional Areas: The smallest cross sectional area of the stud bolt of an expansion anchor shall not be less than the cross sectional area at the thread root.

2.4 Size Limits: The bolt (not anchor) size limits for expansion anchors shall be as follows:

2.4.1 Self-Drilling Type: 1/4" through 3/4" inside diameter of internally threaded shell.

2.4.2 Sleeve Type: 1/4" through 5/8" diameter of stud bolt.

2.4.3 Wedge Type: 1/4" through 1" diameter of stud bolt.

2.5 Types and Makes of Anchors: Concrete expansion anchors used for the WORK shall be one of the types and makes indicated in Table 38-1. Other concrete expansion anchors not specified in Table 38-1 may also be acceptable provided they meet the requirements of this specification and are specifically approved by the Consulting Engineers.

Table 38-1

Types, Classifications, Use and Makes of Expansion Anchors

Types of Anchors	Self-Drilling	Sleeve	Wedge
U.S. Federal Specification FF-S-325 Classifications	Group III Type 1	Group II Type 3 Class 3	Group II Type 4 Class 1
Permissble Use	For all Work except Nuclear Safety Related	For all Work	
Manufacturers	Products		
a. Hilti Fastening Systems, Inc.	Hilti HHS Self-Drilling Anchors	Hilti Universal Hex Nut Sleeve Anchors	Hilti Kwik-Bolt Stud Wedge Anchors
b. ITT Phillips Drill Company	Red Head Self-Drilling Anchors	Red Head Hex Nut Sleeve Anchors	Red Head Wedge Anchors
c. Ramset Fastening Systems	Ram-Drill Self-Drilling Anchors	Dynabolt Mark II Hex Nut Sleeve Anchors	Trubolt Wedge Anchors
d. The Rawlplug Company, Inc.	Rawl Saber-Tooth Self-Drilling Anchors	Rawl Lok/Bolt Hex Nut Sleeve Anchors	Rawl-Stud Wedge Anchors
e. USM Corporation Construction Products Division	———	Parasleeve Hex Nut Masonry Anchors	Parabolt Wedge Anchors
f. Wej-It Corporation of Allied Products Corp.	———	DH-Bolt Hex Nut Sleeve Anchors	Wej-It Double Wedge Anchors

3. INSTALLATION

3.1 General Provisions:

3.1.1 For expansion anchors installed in nuclear safety related concrete, drilling of concrete shall conform to the criteria shown in Table 38-2 and Figures 38-5 and 38-6 except for the following:

a. For 1/4" diameter anchors with depth of holes less than the concrete cover, the anchors may be installed without using a metal detector.

b. Expansion anchor shall not be installed in bottom of concrete slabs at the ribs of metal deck.

3.1.2 In locations where metal detector is to be used per Article 3.1.1, the Contractor shall use a deep magnetic detector to locate the reinforcement in concrete. This detector may be one of those indicated in Table 38-3:

Table 38-3

Products and Manufacturers of Magnetic Detectors

Products	Manufacturers
a. James "R" Meter C-4952	James Electronics, Inc. Chicago, Illinois
b. Profometer	Pro ceq. SA Riesbachstrasse 57 CH-8034 Zurich 8, Switzerland
c. CT-4949 A Deep Pachometer	Soiltest, Inc. Evanston, Illinois

3.1.3 Reuse of expansion anchors will not be permitted.

SARGENT & LUNDY
ENGINEERS
CHICAGO

September 30, 1976
Revised December 7, 197

1-T76

Table 38-2

Criteria for Drilling of Safety Related Concrete

ELEMENT	METAL DETECTOR NOT NEEDED (BARS MAY BE CUT)	LOCATIONS WHERE METAL DETECTOR TO BE USED (BARS SHALL NOT BE CUT)	REMARKS
Beam Top	No where	For middle half of clear span	Figure 38-5
Beam Bottom	No where	For end 1/4 of clear span	
Beam Sides	Middle half of clear span	End 1/4 span Anchors not to be drilled in top & bottom 10" of beam	
Columns	No where	Full length	
Slab Bottoms	Other than the following: (a) Middle 1/2 span (b) Where additional reinforcing shown on plan (c) For openings 12" to 48" - For opening dimension + 5'-0" on each side	(a) Middle 1/2 span (b) Where additional reinforcing shown on plan (c) For openings 12" to 48" - For opening dimension + 5'-0" on each side	When the ratio of short (L_S) to long span (L_L) is less than 0.5, the middle 1/2 span in the short direction = $L_L - L_S$ Figure 38-6
Slab Top	(a) Middle 1/2 span (b) Except where (i) Additional reinforcing shown on plan (ii) For openings 12" to 48" - Opening dimension + 5'-0" on each side of opening	Everywhere except (a) Middle 1/2 span (b) Additional reinforcing shown on plan (c) For openings 12" to 48" Opening dimension + 5'-0" on each side of opening	See remark above Figure 38-6
Interior Walls (With a gap at top)	Full height & width between floor & ceiling & columns respectively.	No where	
Subgrade Walls	Ends 1/4 span (vertical)	Middle 1/2 vertical span	
Exterior Walls Above Grade	Ends 1/4 span vertical Anchor group spacing not less than 9' C/C (See note 3)	(a) Middle 1/2 vertical span (b) Other areas when anchor groups are closer than 9' C/C	
Steam Tunnel	No where	Entire Area	
Fuel Pools Slabs & Walls	No where	Entire Area	
All Other Interior Walls	For anchor groups spaced farther than 9' C/C	Anchor group spaced < 9' from another anchor group	
Reactor Building Mat	No where	For Entire Area	
Other Building Mats	Except middle 1/2 span	Middle 1/2 Col C/C and/or sump dimension + 5'-0" on each side	

NOTES: 1. This table is only applicable [illegible] concrete.

2. If a metal detector indicates the presence of a rebar at the [illegible] the Consulting Engineers shall be notified.

3. Bars that are cut or nicked in [illegible]

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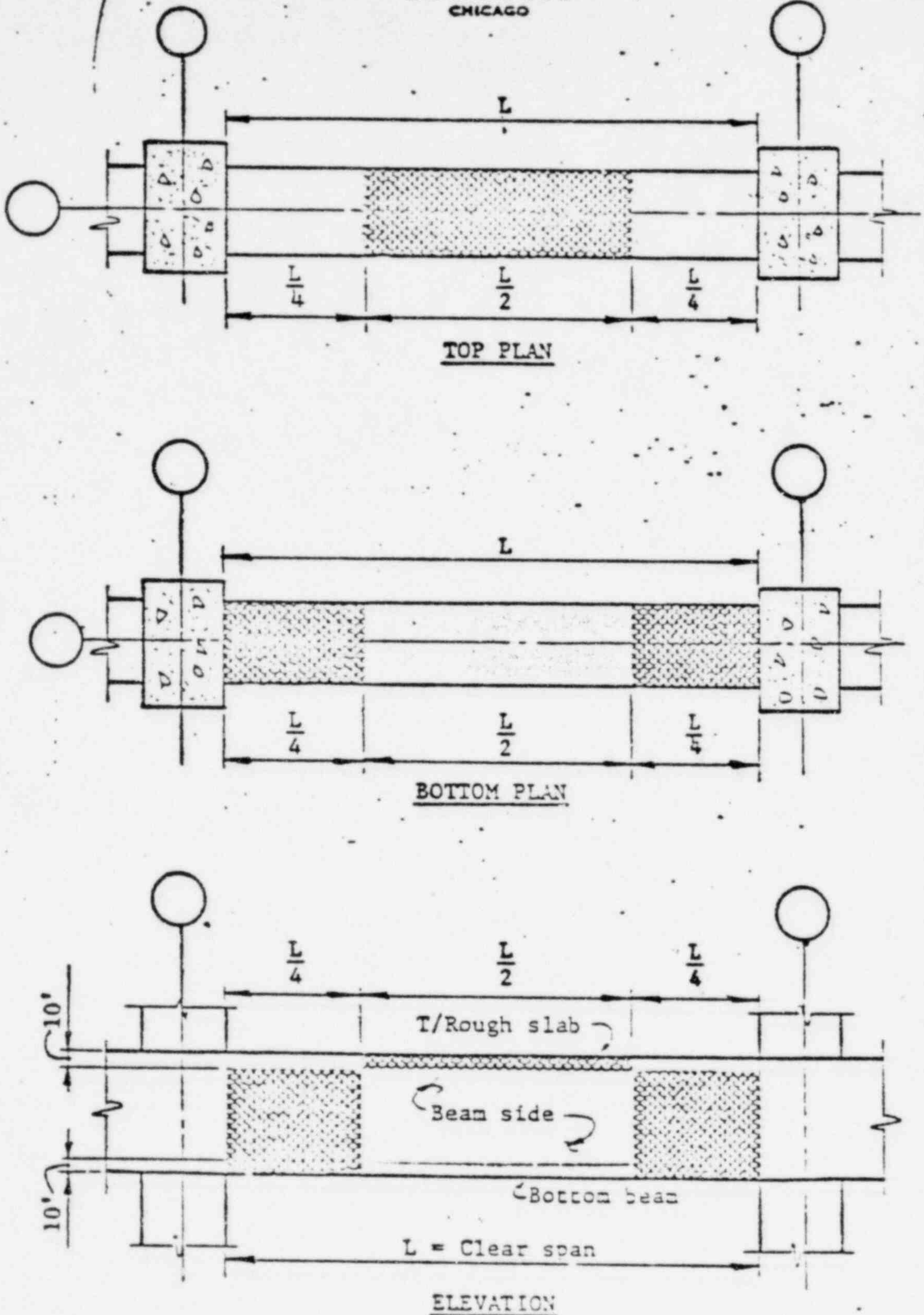

Exp. anchor allowed, no metal detector required.

No exp. anchor allowed.

Exp. anchor allowed, use metal detector.

FIGURE [illegible]-5 [illegible]

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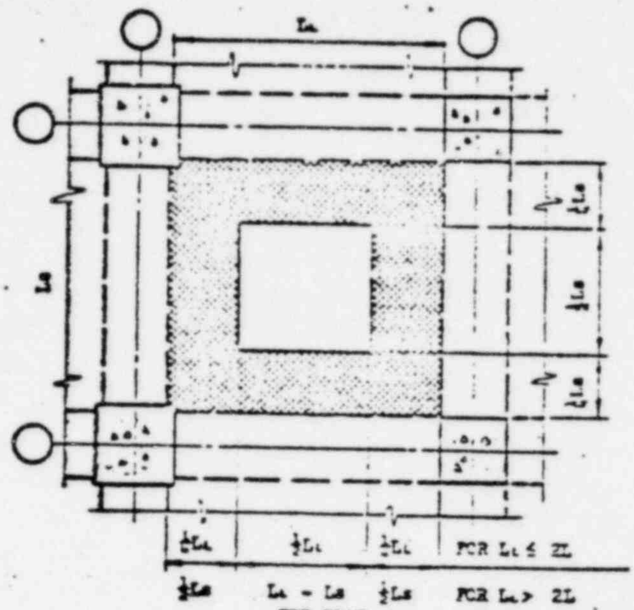
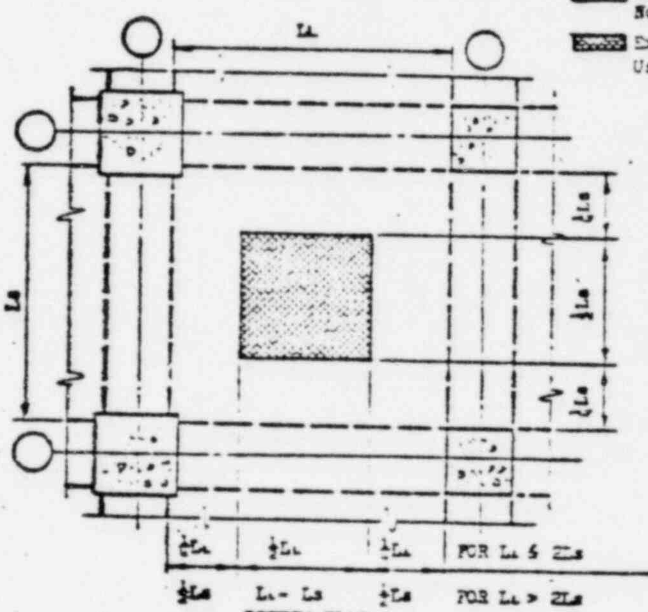


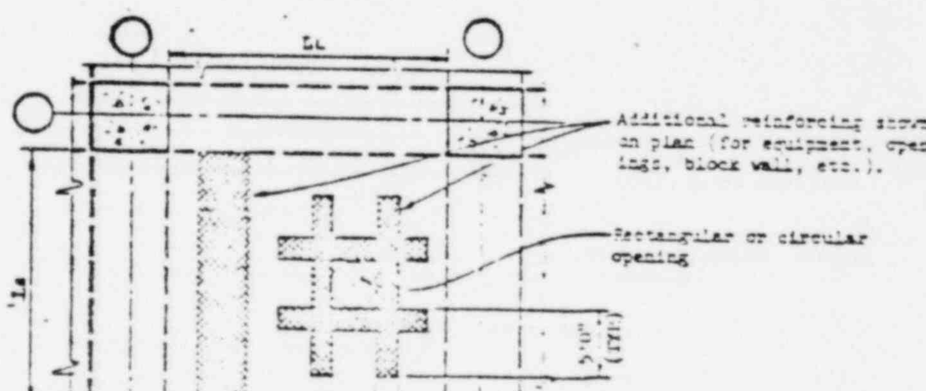
TOP PLAN

Expansion Anchors Allowed
No metal detector required

Expansion Anchors Allowed
Use metal detector



BOTTOM PLAN



3.2 Detailed Requirements: Concrete expansion anchors shall be installed in strict accordance with manufacturers' specifications and recommendations and the following requirements:

3.2.1 Maximum Depth of Holes: Thickness of concrete minus 2-1/2 inches.

3.2.2 Embedded Lengths: The embedded length of an expansion anchor shall be the longest available but shall not be less than 4.5 times the bolt diameter for wedge and sleeve anchors and shall not be less than four times the bolt diameter for self-drilling anchors. For 1/4" diameter anchors, the embedded length may be 4.5 times the nominal bolt diameter in order to satisfy Article 3.1.1a.

3.2.3 Spacing: The minimum spacing of expansion anchors shall be 12 times the nominal diameter of anchors (outside diameter of shell for self-drilling type, of shield for sleeve type, and diameter of stud bolt for wedge type), unless otherwise indicated on the design drawings or approved by the Consulting Engineers.

3.2.4 Edge Distance: The minimum distance from the center of an expansion anchor to any edge of concrete shall be 6 times the nominal diameter of the anchor (outside diameter of shell for self-drilling type, of shield for sleeve type, and diameter of stud bolt for wedge type).

3.2.5 Drilling

a. For all anchors in a connection, drill holes into the concrete with quality carbide tipped solid bits, using a power drill.

b. The precision with which the hole is drilled is the critical factor in maintaining the expansion anchor's pullout value.

3.2.6 Tightening

a. Drive the anchors required for the connection into the holes then bring all anchors to a "hand-tight" condition so that all parts of the connection are in good contact with one another.

b. Tighten the anchor to the torque values given in Table 38-4. This tightening shall proceed systematically from the most rigid or inner part of the connection to its free edges. During this [illegible], there shall be no rotation of the [illegible] the nut.

4. INSPECTION AND TESTING - FOR NUCLEAR SAFETY RELATED WORK ONLY

4.1 General Provisions: Concrete expansion anchors with nominal bolt diameters less than 1/2" are to be used for nonessential loads and do not require testing.

4.1.1 Installed concrete expansion anchors with nominal bolt diameters of 1/2" or larger shall be subject to inspection by Contractor, as specified in this Article 4, and to the extent indicated in Paragraph 4.2.2 unless otherwise indicated in the Project Specification.

4.1.2 The services of a nationally recognized independent testing laboratory shall be furnished and paid for by Purchaser to perform this testing and inspection, unless otherwise indicated.

4.2 Calibrated Torque Wrench Inspection:

4.2.1 Calibration

Torque wrenches shall be certified by testing laboratory as to their accuracy before use. Certification shall be on a monthly basis after initial qualification.

4.2.2 Inspection Sequence and Frequency:

Contractor

a. One out of each two hundred expansion anchors installed but a minimum of one per day shall be randomly selected for testing.

b. If this tested anchor is unacceptable, two other anchors in the same group as defined in article 4.2.2a shall be tested.

c. If one of these two anchors is unacceptable, ten other anchors of the same group as defined in article 4.2.2a shall be tested.

d. If two or more of these ten anchors are unacceptable, all other anchors in this group as defined in article 4.2.2a shall be tested.

e. Information on all expansion anchors that require replacing shall be sent to the Consulting Engineers for review and resolution.

4.2.3 Acceptance Standards: Testing and inspection shall be performed using a calibrated torque wrench.

a. On inspection, the inspector shall place the wrench on the nut of the selected anchor, and apply torque to the nut until the wrench dial reading reaches the testing torque given in Table 38-5.

b. If the nut of the inspected anchor is not turned, the anchor shall be accepted. If the nut is turned, the anchor shall be considered unacceptable.

c. Unacceptable installed anchors shall be retorqued or replaced, and then re-tested and re-inspected.

Table 38-4 Installation Torque, ft.-lb.

Nominal Bolt Diameter	Torque Range	
	Wedge Type Anchors	Sleeve Type Anchors
1/4"	8 - 10	8 - 10
3/8"	25 - 35	35 - 50
1/2"	55 - 65	60 - 75
5/8"	80 - 90	90 - 100
3/4"	150 - 175	
1"	250 - 300	

Table 38-5 Minimum Testing Torque, ft.-lb.

Nominal Bolt Diameter	Torque Range	
	Wedge Type Anchors	Sleeve Type Anchors
1/2"	35	30
5/8"	60	55
3/4"	110	
1"	200	

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ENGINEERS
CHICAGO

September 30, 1976
Revised November 29, 1978

SPECIFICATION FOR
CONCRETE EXPANSION ANCHOR WORK
LA SALLE COUNTY STATION - UNITS 1 AND 2

(Form LS-CEA)

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SARGENT & LUNDY
ENGINEERS
CHICAGO

September 30, 1976
Revised November 29, 1978

SPECIFICATION FOR
CONCRETE EXPANSION ANCHOR WORK
LA SALLE COUNTY STATION - UNITS 1 AND 2

(Form LS-CEA)

1. GENERAL

1.1 Scope: Concrete expansion anchor WORK shall conform to the requirements of this Standard Specification Form LS-CEA unless otherwise indicated in the Project Specification or on the design drawings. This WORK shall include furnishing, installing, inspecting and testing of expansion anchors where their use is specifically indicated in the Project Specification and on the design drawings. Concrete expansion anchors shall not be used for any other work without prior approval of the Consulting Engineers.

1.2 Definitions: The following terms when used in this Standard Specification or in the Project Specification or on the design drawings, shall have the meanings indicated, unless otherwise specifically stated:

1.2.1 Self-Drilling Type Expansion Anchor: An externally slit and internally threaded tubular expansion shell, with a single-cone expander, as shown in Figure 38-1 following:

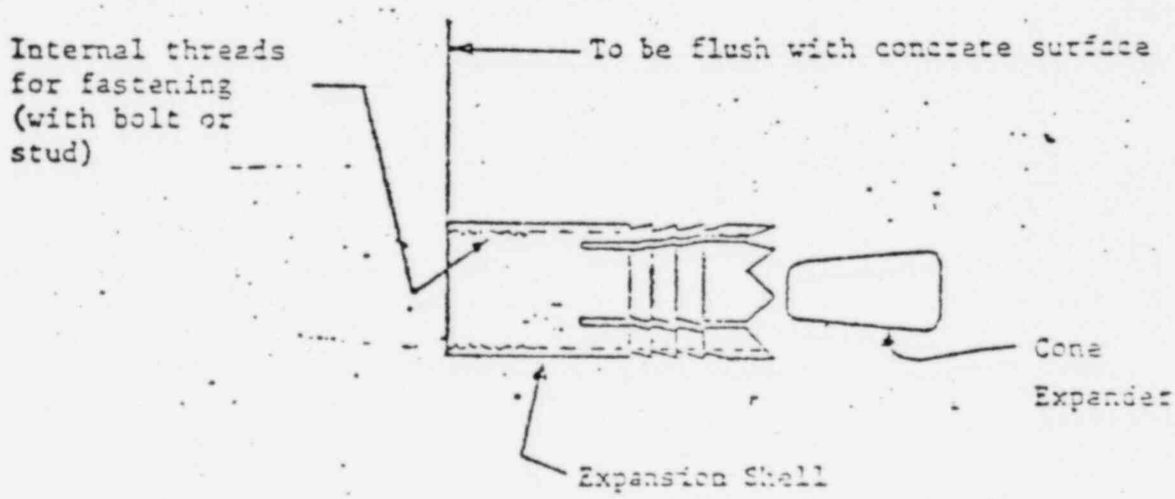


Figure 38-1 Typical Self-Drilling Type Expansion Anchor

1.2.2 Sleeve Type Expansion Anchor: A slit tubular expansion shield, with a threaded stud bolt with integral cone expander, as shown in Figure 38-2 following:

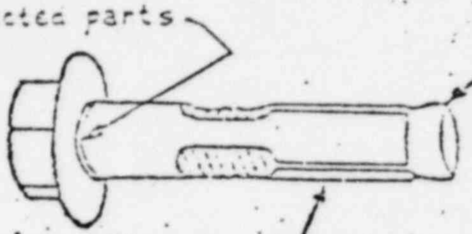


Figure 38-2 Typical Sleeve Type Expansion Anchor

1.2.3 Wedge Type Expansion Anchor: A split expansion ring or a separate expansion wedge pair, with a threaded stud bolt with integral cone expander or taper expander, as shown in Figures 38-3 and 38-4 following:

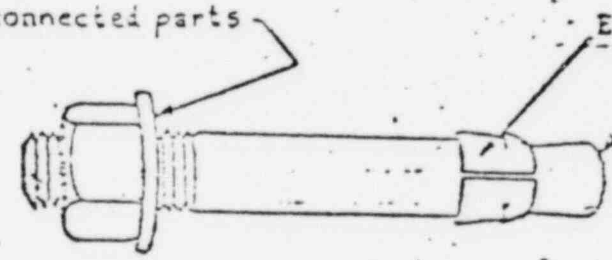
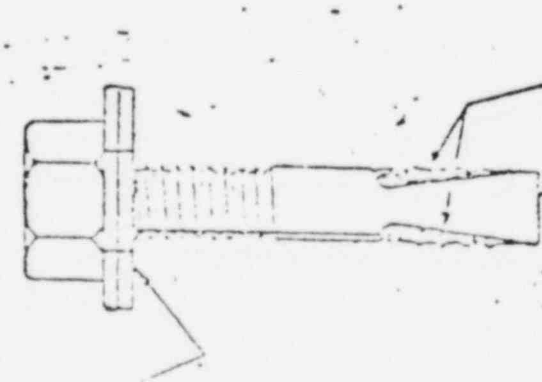


Figure 38-3 Typical Wedge Type Expansion Anchor with Cone Expander



[illegible]

1.3 Reference Publications:

1.3.1 Related Publications of nationally recognized technical sponsoring organizations are specified in this Standard Form LS-CEA by reference. Unless otherwise indicated, all references to these specified Publications, and to any Publications included by reference in the specified Publications, shall be to the latest issue of each, together with all additions, supplements, addenda, amendments or revisions thereto, as of the date of initial Certification of the Project Specification for the WORK covered by this Form LS-CEA.

1.3.2 In this Form LS-CEA, the following Publications, or portions of these Publications, are referenced; only these referenced Publications or portions are part of this Form LS-CEA:

a. U.S. Federal Specifications:

a1.	FF-S-325	Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
a2.	QQ-Z-325B	Requirements for Zinc Coating, Electrodeposited

1.4 Quality Assurance Program: This program is required for nuclear safety related work only, and shall conform to the requirements of the Quality Assurance Articles of the Project Specification.

2. MATERIALS

2.1 Type and Finish of Materials: Concrete expansion anchors and accessories shall be made of carbon steel with zinc plated finish conforming to U.S. Federal Specification QQ-Z-325B. Stainless steel may be used in place of this zinc coated carbon steel.

For nuclear safety related work, the material supplier shall provide material certification.

2.2 Strength of Materials: The material shall have a minimum yield strength of 60,000 psi for self-drilling and wedge type anchors, and 50,000 psi for sleeve type anchors.

2.3 Cross Sectional Areas: The smallest cross sectional area of the stud bolt of an expansion anchor shall not be less than the cross sectional area at the thread root.

2.4 Size Limits: The bolt (not anchor) size limits for expansion anchors shall be as follows:

2.4.1	Self-Drilling Type:	1/4" through 3/4" inside diameter of internally threaded shell.
2.4.2	Sleeve Type:	1/4" through 5/8" diameter of stud bolt.
2.4.3	Wedge Type:	1/4" through 1" diameter of stud bolt.

2.5 Types and Makes of Anchors: Concrete expansion anchors used for the WORK shall be one of the types and makes indicated in Table 38-1. Other concrete expansion anchors not specified in Table 38-1 may also be acceptable provided they meet the requirements of this specification and are specifically approved by the Consulting Engineers.

Table 38-1

Types, Classifications, Use and Makes of Expansion Anchors

Types of Anchors	Self-Drilling	Sleeve	Wedge
U.S. Federal Specification FF-S-325 Classifications	Group III Type 1	Group II Type 3 Class 3	Group II Type 4 Class 1
Permissble Use	For all Work except Nuclear Safety Related	For all Work	

Manufacturers	Products		
a. Hilti Fastening Systems, Inc.	Hilti HHS Self-Drilling Anchors	Hilti Universal Hex Nut Sleeve Anchors	Hilti Kwik-Bolt Stud Wedge Anchors
b. ITT Phillips Drill Company	Red Head Self-Drilling Anchors	Red Head Hex Nut Sleeve Anchors	Red Head Wedge Anchors
c. Ramset Fastening Systems	Ram-Drill Self-Drilling Anchors	Dynabolt Mark II Hex Nut Sleeve Anchors	Trubolt Wedge Anchors
d. The Rawlplug Company, Inc.	Rawl Saber-Tooth Self-Drilling Anchors	Rawl Lok/Bolt Hex Nut Sleeve Anchors	Rawl-Stud Wedge Anchors
e. USM Corporation Construction Products Division	------	Parasleeve Hex Nut Masonry Anchors	Parabolt Wedge Anchors
f. Wej-It Corporation of Allied Products Corp.	------	DH-Bolt Hex Nut Sleeve Anchors	Wej-It Double Wedge Anchors

3. INSTALLATION

3.1 General Provisions:

3.1.1 For expansion anchors installed in nuclear safety related concrete, drilling of concrete shall conform to the criteria shown in Table 38-2 and Figures 38-5 and 38-6 except for the following:

a. For 1/4" diameter anchors with depth of holes less than the concrete cover, the anchors may be installed without using a metal detector.

b. Expansion anchor shall not be installed in bottom of concrete slabs at the ribs of metal deck.

3.1.2 In locations where metal detector is to be used per Article 3.1.1, the Contractor shall use a deep magnetic detector to locate the reinforcement in concrete. This detector may be one of those indicated in Table 38-3:

Table 38-3

Products and Manufacturers of Magnetic Detectors

Products	Manufacturers
a. James "R" Meter C-4952	James Electronics, Inc. Chicago, Illinois
b. Profometer	Pro ceq. SA Riesbachstrasse 57 CH-8034 Zurich 8, Switzerland
c. CT-4949 A Deep Pachometer	Soiltest, Inc. Evanston, Illinois

3.1.3 Reuse of expansion anchors will not be permitted.

Table 38-2

Criteria for Drilling of Safety Related Concrete

ELEMENT	METAL DETECTOR NOT NEEDED (BARS MAY BE CUT)	LOCATIONS WHERE METAL DETECTOR TO BE USED (BARS SHALL NOT BE CUT)	REMARKS
Beam Top	No where	For middle half of clear span	
Beam Bottom	No where	For end 1/4 of clear span	
Beam Sides	Middle half of clear span	End 1/4 span Anchors not to be drilled in top & bottom 12" of beam	Figure 38-5
Columns	No where	Full length	
Slab Bottoms	Other than the following: (a) Middle 1/2 span (b) Where additional reinforcing shown on plan (c) For openings 12" to 48" - For opening dimension + 5'-0" on each side	(a) Middle 1/2 span (b) Where additional reinforcing shown on plan (c) For openings 12" to 48" - For opening dimension + 5'-0" on each side	When the ratio of short (L_S) to long span (L_L) is less than 0.5, the middle 1/2 span in the short direction = $L_L - L_S$ Figure 38-6
Slab Top	(a) Middle 1/2 span (b) Except where (i) Additional reinforcing shown on plan (ii) For openings 12" to 48" - Opening dimension + 5'-0" on each side of opening	Everywhere except (a) Middle 1/2 span (b) Additional reinforcing shown on plan (c) For openings 12" to 48" Opening dimension + 5'-0" on each side of opening	See remark above Figure 38-6
Interior Walls (With a gap at top)	Full height & width between floor & ceiling & columns respectively.	No where	
Subgrade Walls	Ends 1/4 span (vertical)	Middle 1/2 vertical span	
Exterior Walls Above Grade	Ends 1/4 span vertical Anchor group spacing not less than 9' C/C (See note 3)	(a) Middle 1/2 vertical span (b) Other areas when anchor groups are closer than 9' C/C	
Steam Tunnel	No where	Entire Area	
Fuel Pools Slabs & Walls	No where	Entire Area	
All Other Interior Walls	For anchor groups spaced farther than 9' C/C	Anchor group spaced < 9' from another anchor group	
Reactor Building Mat	No where	For Entire Area	
Other Building Mats	Except middle 1/2 span	Middle 1/2 Col C/C and/or sump dimension + 6'-0" on each side	

NOTES: 1. This table is only applicable when [illegible] are in [illegible].

2. [illegible]

3. [illegible]

September 30, 1976
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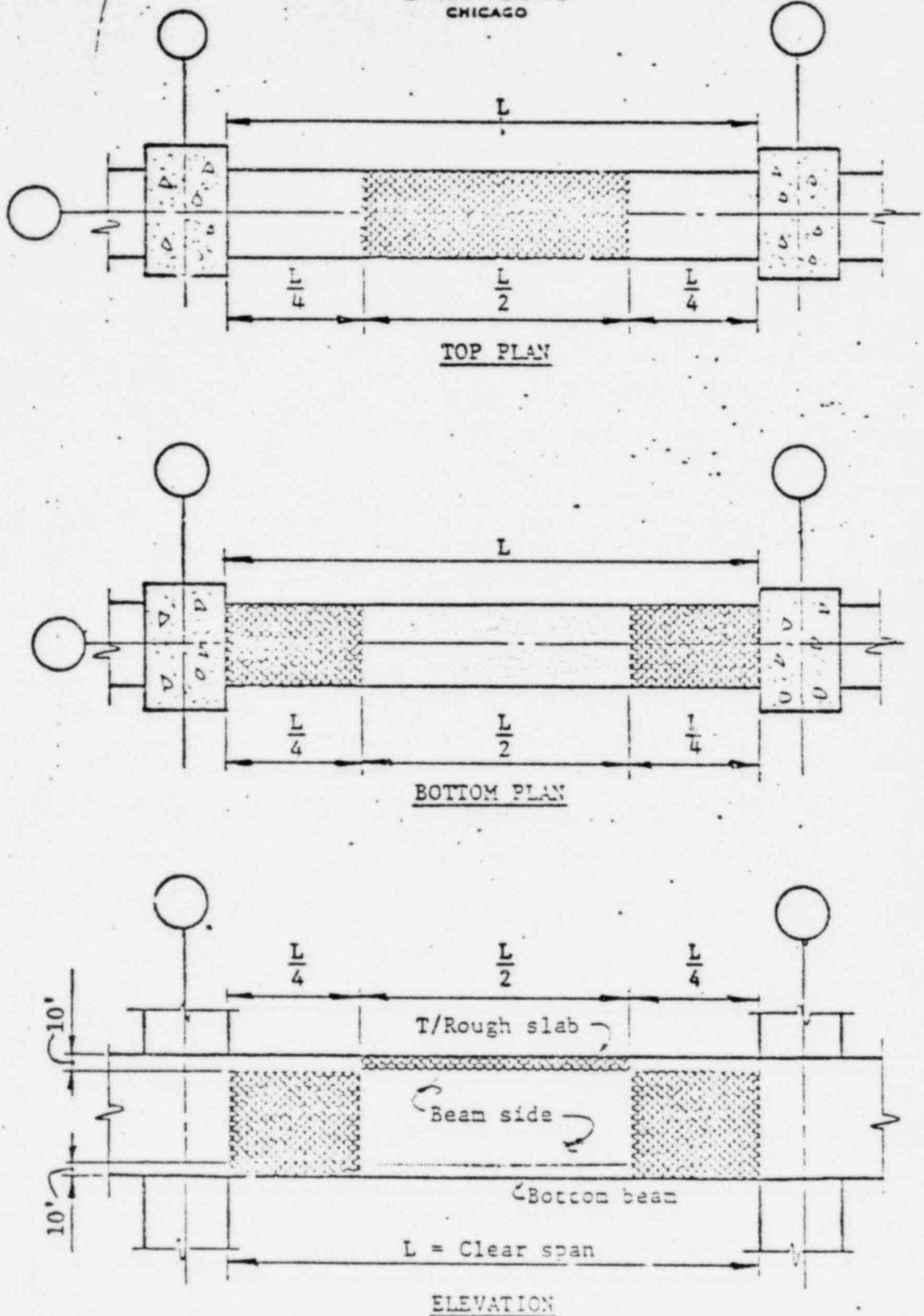
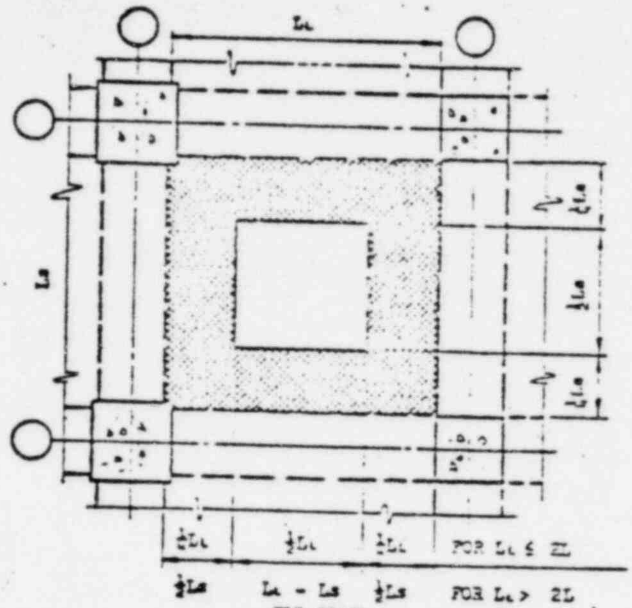


Exp. anchor allowed, no metal detector required.

No exp. anchor allowed.

Exp. anchor allowed [illegible] metal detector.

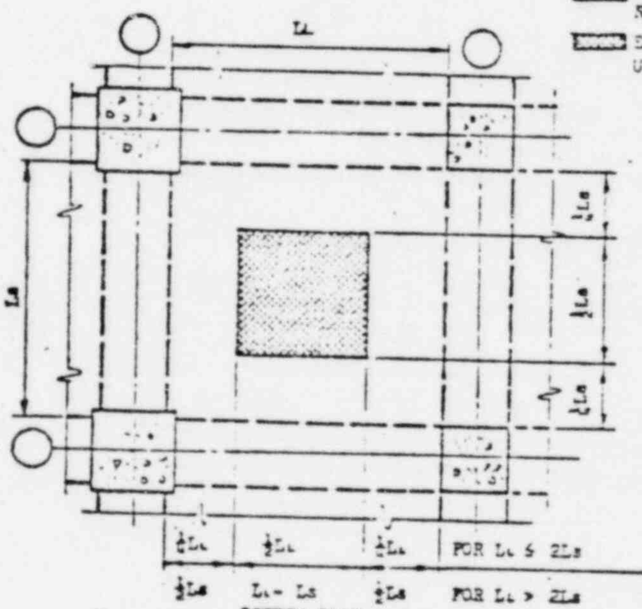
FIGURE 3[illegible]-5 [illegible]



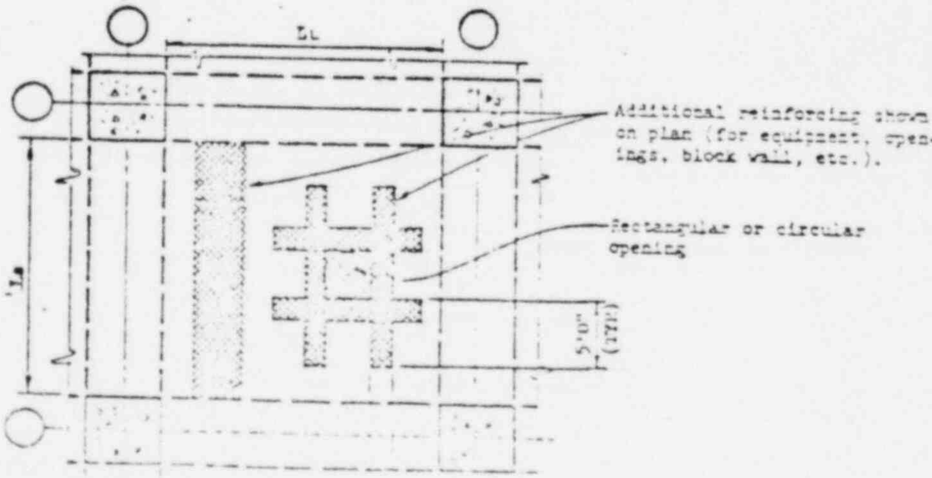
TOP PLAN

Expansion Anchors Allowed
No metal detector required

Expansion Anchors Allowed
Use metal detector



BOTTOM PLAN



3.2 Detailed Requirements: Concrete expansion anchors shall be installed in strict accordance with manufacturers' specifications and recommendations and the following requirements:

3.2.1 Maximum Depth of Holes: Thickness of concrete minus 2-1/2 inches.

3.2.2 Embedded Lengths: The embedded length of an expansion anchor shall be the longest available but shall not be less than 4.5 times the bolt diameter for wedge and sleeve anchors and shall not be less than four times the bolt diameter for self-drilling anchors. For 1/4" diameter anchors, the embedded length may be 4.5 times the nominal bolt diameter in order to satisfy Article 3.1.1a.

3.2.3 Spacing: The minimum spacing of expansion anchors shall be 12 times the nominal diameter of anchors (outside diameter of shell for self-drilling type, of shield for sleeve type, and diameter of stud bolt for wedge type), unless otherwise indicated on the design drawings or approved by the Consulting Engineers.

3.2.4 Edge Distance: The minimum distance from the center of an expansion anchor to any edge of concrete shall be 6 times the nominal diameter of the anchor (outside diameter of shell for self-drilling type, of shield for sleeve type, and diameter of stud bolt for wedge type).

3.2.5 Drilling

a. For all anchors in a connection, drill holes into ~~the~~ concrete with quality carbide tipped solid bits, using a power drill.

b. The precision with which the hole is drilled is the critical factor in maintaining the expansion anchor's pullout value.

3.2.6 Tightening

a. Drive the anchors required for the connection into the holes then bring all anchors to a "hand-tight" condition so that all parts of the connection are in good contact with one another.

b. Tighten the anchor to the torque values given in Table 38-4. This tightening shall proceed systematically from the most rigid or inner part of the connection to its [illegible] edges. During this operation, [illegible]

3.3 Repair of Failures: Failures shall be rectified as follows:

3.3.1 Concrete failure: This shall include all cracking or spalling of the concrete in the vicinity of an installed anchor.

a. The concrete shall be repaired to have a strength at least equivalent to that of the original concrete.

b. After the concrete has been repaired, the anchor hole may be redrilled. The redrilled hole shall be deep enough to allow the replacement anchor to have an embedded length a minimum of 1.5 times the nominal bolt diameter longer than the embedded length provided per Article 3.2.2.

c. All concrete failures shall be reported to the Consulting Engineers for review.

3.3.2 Anchor Failure: This shall include anchor breakage, visible slippage, or loosening to the extent that the anchor cannot be tightened to the installation torque.

a. If the unacceptable anchor can be removed without damaging the surrounding concrete, the hole may be redrilled and the anchor replaced with the next larger size anchor. The embedded length shall conform to the requirements of Article 3.2.2.

b. If the unacceptale anchor cannot be removed without damaging the surrounding concrete, the anchor location shall be moved within the tolerance given for the connection. The minimum distance from the unacceptable anchor to the replacement hole shall be 2.5 times nominal bolt diameter. If this distance exceeds the given tolerance on the placement of the expansion anchors, the Consulting Engineers shall be notified before proceeding.

c. All anchor failures shall be reported to the Consulting Engineers for review.

4. INSPECTION AND TESTING - FOR NUCLEAR SAFETY RELATED WORK ONLY

4.1 General Provisiona: Installed concrete expansion anchors shall be subject to inspection by Contractor, as specified in this Article 4, and to the extent indicated in Paragraph 4.2.2 unless otherwise indicated in the Project Specification.

4.1.1 The services of a nationally recognized independent testing laboratory shall be furnished and paid for by Purchaser to perform this testing and inspection, unless otherwise indicated.

4.2 Calibrated Torque Wrench Inspection:

4.2.1 Calibration

Torque wrenches shall be certified by testing laboratory as to their accuracy before use. Certification shall be on a monthly basis after initial qualification.

4.2.2 Inspection Sequence and Frequency:

a. One out of each two hundred expansion anchors installed but a minimum of one per day shall be randomly selected for testing.

b. If this tested anchor is unacceptable, two other anchors in the same group as defined in article 4.2.2a shall be tested.

c. If one of these two anchors is unacceptable, ten other anchors of the same group as defined in article 4.2.2a shall be tested.

d. If two or more of these ten anchors are unacceptable, all other anchors in this group as defined in article 4.2.2a shall be tested.

e. Information on all expansion anchors that require replacing shall be sent to the Consulting Engineers for review and resolution.

4.2.3 Acceptance Standards: Testing and inspection shall be performed using a calibrated torque wrench.

a. On inspection, the inspector shall place the wrench on the nut of the selected anchor, and apply torque to the nut until the wrench dial reading reaches the testing torque given in Table 38-5.

b. If the nut of the inspected anchor is not turned, the anchor shall be accepted. If the nut is turned, the anchor shall be considered unacceptable.

c. Unacceptable installed anchors shall be retorqued or replaced, and then re-tested and re-inspected.

Table 38-4 Installation Torque, ft.-lb.

Nominal Bolt Diameter	Torque Range			
	Wedge Type Anchors		Sleeve Type Anchors	
1/4"	8	10*	8	10*
3/8"	25	35	35	50
1/2"	55	65	60	75
5/8"	80	90	90	100
3/4"	150	175		
1"	250	300		

*For 1/4" Ø Expansion Anchors installed in 1 1/4" deep hole, a minimum of 5ft-lb torque shall be used.

Table 38-5 Minimum Testing Torque, ft.-lb.

Nominal Bolt Diameter	Torque Range	
	Wedge Type Anchors	Sleeve Type Anchors
1/4"	5	5
3/8"	19	19
1/2"	35	30
5/8"	60	55
3/4"	110	
1"	200	

SARGENT & LUNDY
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CHICAGO

Rev. 3

STANDARD SPECIFICATION FOR

CONCRETE EXPANSION ANCHOR WORK

(FORM LS-CEA)

LASALLE COUNTY STATION

UNITS 1 AND 2

Revision 0	Issued on September 30, 1076
Revision 1	Issued on December 7, 1976
Revision 2	Issued on November 29, 1978
Revision 3	

Prepared By	S. M. Kazmi	Date	7-19-79
Reviewed By	P. Pohl	Date	7-20-79
Approved By	E. R. Weaver	Date	7.20.79

SPECIFICATION FOR CONCRETE EXPANSION ANCHOR WORK LASALLE COUNTY STATION - UNITS 1 AND 2

(Form LS-CEA)

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September 30, 1976
Rev. 3, 7-20-79

SPECIFICATION FOR CONCRETE EXPANSION ANCHOR WORK LA SALLE COUNTY STATION - UNITS 1 AND 2

(Form LS-CEA)

1. GENERAL

1.1 Scope: All Concrete expansion anchor WORK shall conform to all requirements of this Standard Specification Form LS-CEA unless otherwise indicated in the Project Specification or on the design drawings. This WORK shall include furnishing, installing, inspecting and testing of expansion anchors where their use is specifically indicated in the Project Specification and on the design drawings. Concrete expansion anchors shall not be used for any other work without prior approval of the Consulting Engineers.

1.2 Definitions: The following terms when used in this Standard Specification or in the Project Specification or on the design drawings, shall have the meanings indicated, unless otherwise specifically stated:

1.2.1 Self-Drilling Type Expansion Anchor: An externally slit and internally threaded tubular expansion shell, with a single-cone expander, as shown in Figure 38-1 following:

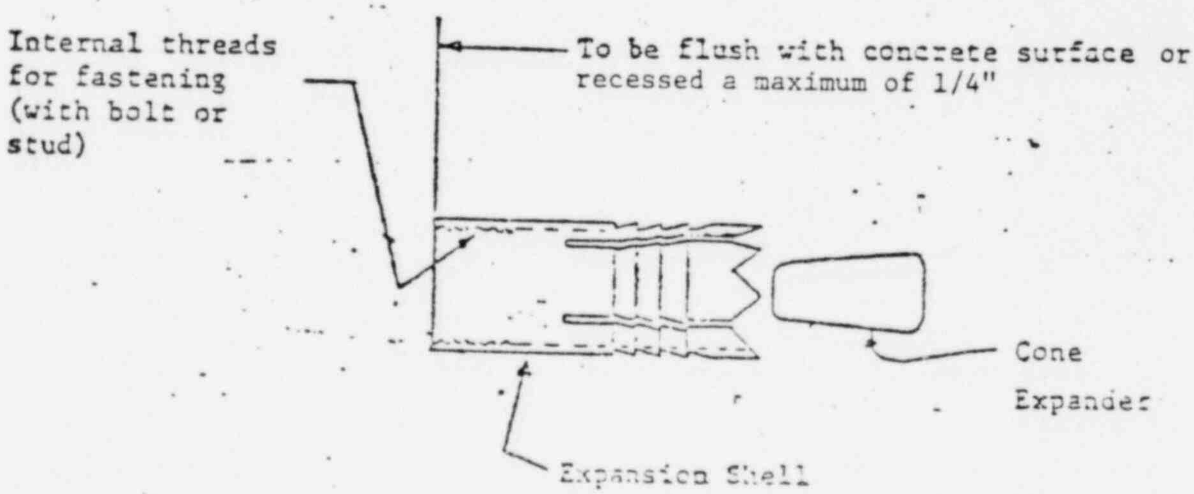

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Figure 38-1 Typical Self-Drilling Type Expansion Anchor

1.2.2 Sleeve Type Expansion Anchor: A slit tubular expansion shield, with a threaded stud bolt with integral cone expander, as shown in Figure 38-2 following:

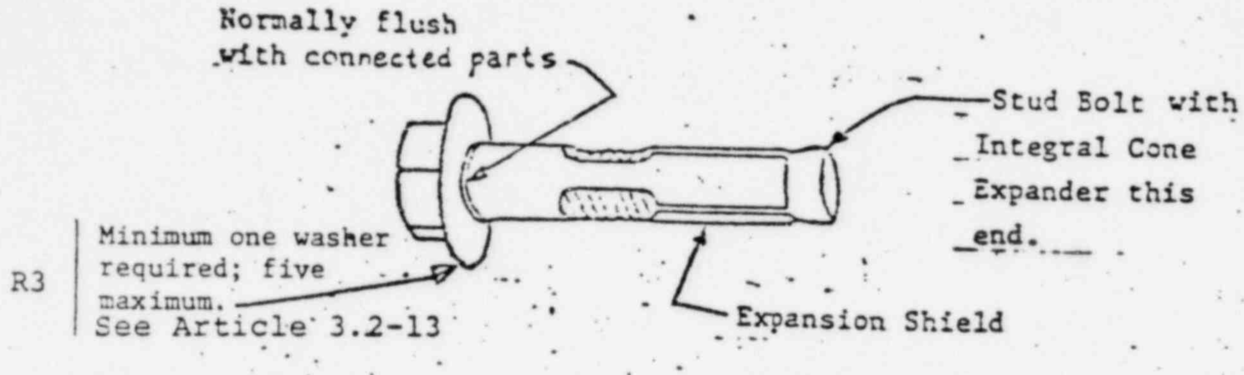


Figure 38-2 Typical Sleeve Type Expansion Anchor

1.2.3 Wedge Type Expansion Anchor: A split expansion ring or a separate expansion wedge pair, with a threaded stud bolt with integral cone expander or taper expander, as shown in Figures 38-3 and 38-4 following:

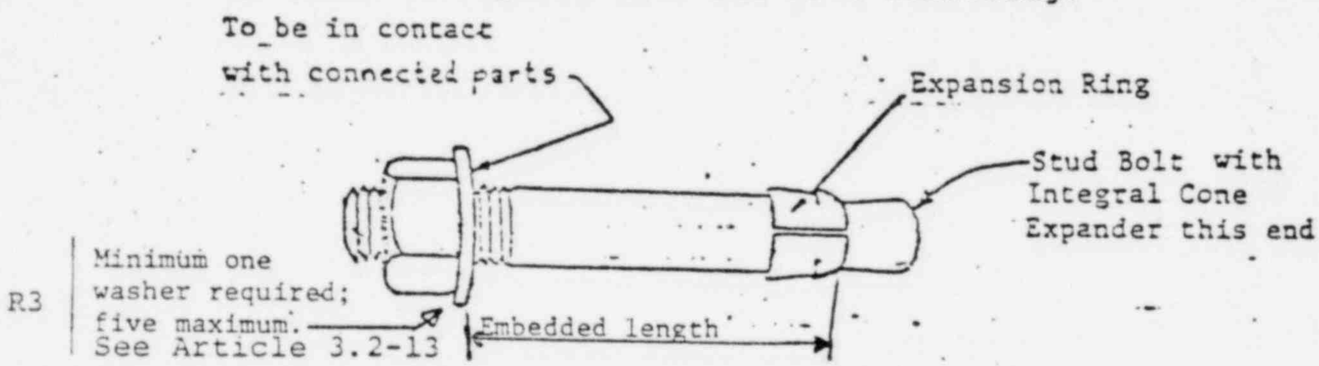


Figure 38-3 Typical Wedge Type Expansion Anchor with Cone Expander

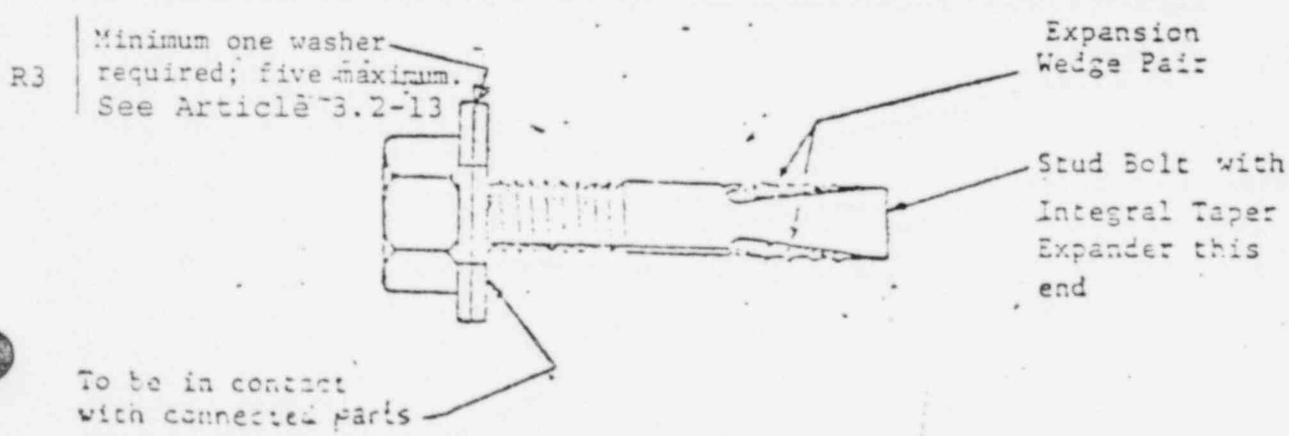


Figure 38-4 Typical Wedge Type Expansion Anchor with Taper Expander

1.3 Reference Publications:

1.3.1 Related Publications of nationally recognized technical sponsoring organizations are specified in this Standard Form LS-CEA by reference. Unless otherwise indicated, all references to these specified Publications, and to any Publications included by reference in the specified Publications, shall be to the latest issue of each, together with all additions, supplements, addenda, amendments or revisions thereto, as of the date of initial Certification of the Project Specification for the WORK covered by this Form LS-CEA.

1.3.2 In this Form LS-CEA, the following Publications, or portions of these Publications, are referenced; only these referenced Publications or portions are part of this Form LS-CEA:

a. U.S. Federal Specifications:

a1.	FF-S-325	Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
a2.	QQ-Z-325B	Requirements for Zinc Coating, Electrodeposited

1.4 Quality Assurance Program: This program is required for nuclear safety related work only, and shall conform to the requirements of the Quality Assurance Articles and of the Project Specification.

1.5 Procedure Documentation

1.5.1 Installation Procedure :

For all expansion anchors, Contractor shall submit a complete installation procedure to the Consulting Engineers for review, prior to any installation, in accordance with Contractor's quality assurance procedure as required. The procedure shall describe the implementation of this Form, and shall include, but not be limited to, the following:

a. Installation process

b. Equipment to be used

c. Tolerances for Equipment

d. Equipment inspection frequency

e. Types of installation devices and calibration frequency

f. Overall anchor length and minimum depth of hole for each anchor diameter

g. Methods to insure and verify proper anchor length (i.e. marking bolt ends for lengths) R3

h. Methods to insure and verify proper hole depth, spacing and edge distance

i. Methods to verify actual embedded length of an installed anchor

j. Methods to determine the angularity of the installed anchor

k. Repair methods for damaged concrete and grouting procedure for patching up trial holes

l. Methods to identify the location of a nicked bar

m. Information to be documented

1.5.2 Quality Assurance Responsibilities of the Contractor

The Contractor shall be responsible for the quality assurance check for the following items in particular, but not limited to:

a) The anchors have been installed to the torquing requirements as specified in the Table 38-8.

b) The minimum embedment depth in accordance with the design drawings has been provided. For drawings released for construction before 7-20-79, if no embedment depth is specified, the minimum embedment depth shall be 4.5d. For the drawings released first time or revised showing anchor size/plate changed, on/after 7-20-79, the minimum embedment depth shall be '8d', if no specific embedment depth is shown on the drawings.

c) If the installed anchor is at an angle and the angularity exceeds the tolerances shown in Section 3-2.3 of this specification, a report shall be submitted to the purchaser. R3

d) If the nut of the anchor is not fully engaged, a report shall be submitted to the purchaser.

e) While drilling holes for anchor installation, if trial drills have been made in the concrete wall or slab, it has to be ensured that the concrete has been repaired by grouting before the final installation of the plate is made.

f) Verification of spacing and edge distances as specified in Table 38-5 and Figure 38-6.

g) Verification that anchor or concrete failure/damaged rebar reports have been reported on Form LS-CEA 1.0.

1.5.3 Inspection Procedure (Safety Related Work Only):

The agency responsible for the inspection and testing specified in Article 4 shall submit a complete inspection procedure to the Purchaser prior to any inspection. The procedure shall describe the implementation of this form and shall include, but not be limited to, the following:

a) Inspection process and frequency R3

b) Equipment to be used

c) Tolerances for Equipment

d) Calibration frequency for inspection devices

e) Information to be documented

2. Materials

2.1 Type and Finish of Materials:

Concrete expansion anchors and accessories shall be made of carbon steel with zinc plated finish conforming to U.S. Federal Specification QQ-Z-325B. Stainless steel may be used in place of this zinc coated carbon steel.

For nuclear safety related work, the material supplier shall provide material certification for each batch of delivery made to the site. R3

2.2 Strength of Materials:

The material shall have a minimum yield strength of 60,000 psi for self-drilling and wedge type anchors, and 50,000 psi for sleeve type anchors. The material shall have a minimum tensile strength of 75,000 psi for all anchors. R3

2.3 Cross Sectional Areas:

The smallest cross sectional area of the stud bolt of an expansion anchor shall not be less than the cross sectional area at the thread root.

2.4 Size Limits:

The bolt (not anchor) size limits for expansion anchors shall be as follows:

2.4.1 Self-Drilling Type: 1/4" through 3/4" inside diameter of internally threaded shell.

2.4.2 Sleeve Type: 1/4" through 5/8" diameter of stud bolt.

2.4.3 Wedge Type: 1/4" throught 1" diameter of stud bolt.

2.5 Types and Makes of Anchors:

Concrete expansion anchors used for the WORK shall be one of the types and makes indicated in Table 38-1. Other concrete expansion anchors not specified in Table 38-1 may also be acceptable provided they meet the requirements of this specification and are specfically approved by the Consulting Engineers.

Table 38-1

Types, Classifications, Use and Makes of Expansion Anchors

Types of Anchors	Self-Drilling	Sleeve	Wedge
U.S. Federal Specification FF-S-325 Classifications	Group III Type 1	Group II Type 3 Class 3	Group II Type 4 Class 1
Permissible Use	For all Work except Nuclear Safety Related & concrete block wall.	For all Work	

Manufacturers	Products		
a. Hilti Fastening Systems, Inc.	--	---	Hilti Kwik-Bolt Stud Wedge Anchors R3
b. ITT Phillips Drill Company	Red Head Self-Drilling Anchors	Red Head Hex Nut Sleeve Anchors	Red Head Wedge Anchors
c. Ramset Fastening Systems	Ram-Drill Self-Drilling Anchors	Dynabolt Mark II Hex Nut Sleeve Anchors	Trubolt Wedge Anchors
d. The Rawlplug Company, Inc.	Problem Rawl Saber-Tooth Self-Drilling Anchors	Rawl Lok/Bolt Hex Nut Sleeve Anchors	Rawl-Stud Wedge Anchors
e. USM Corporation Construction Products Division	------	Parasleeve Hex Nut Masonry Anchors	Parabolt Wedge Anchors
f. Wej-It Corporation of Allied Products Corp.	------	----	Wej-It Double Wedge Anchors

3. Installation:

(For all expansion anchors except as noted)

3.1 General Provisions:

3.1.1 Concrete expansion anchors shall be installed in accordance with the manufacturer's specifications and recommendations and the requirements of this Form LS-CEA. In case of conflict, the requirements of this form shall govern.

3.1.2 The minimum embedded lengths, spacing and edge distance for expansion anchors shall conform to Table 38-5 and Figure 38-6 unless otherwise indicated in Article 3.1.10.

3.1.3 The overall anchor length and the hole depth required shall be determined by Contractor such that the specified minimum embedment length 'Le" (as shown in Fig. 38-6) and bolt projection can be obtained. R3

3.1.4 As a minimum, anchor threads shall engage the complete nut, however, a 1/4" thread projection above the nut after installation is recommended. If projection exceeds 1/4", projection shall not be removed without the consent of the Consulting Engineer. A record of embedment depth and any length of removed projection shall be kept for all anchors.

3.1.5 Holes for the anchors may be drilled through hardened grout, but the embedded length shall be determined from the surface of the rough concrete. Holes for the anchors may be drilled through surface repaired concrete, but the embedded length anchor spacing and edge distance shall be determined in accordance with Article 3.1.9. Holes shall not be drilled through grout or repaired concrete that has not completely hardened nor shall grout or concrete be placed around anchors without the approval of the Consulting Engineers.

3.1.6 Reuse of expansion anchors shall not be permitted.

3.1.7 1/4" Ø expansion anchors are allowed in all locations provided the required hole depth is less than the effective depth of the concrete covering the main reinforcement. 1/4" Ø expansion anchors shall not be used in solid block walls for support of nuclear safety-related items.

3.1.8 Welding on expansion anchors is not permitted without approval of the Consulting Engineers. R3

3.1.9 For anchors installed in holes drilled through surface repaired concrete, the dimension (Le) given in Table 38-5 shall be increased by a dimension X as shown in Figure 38-5.

where X = thickness of concrete cover plus nominal diameter of outside bar.

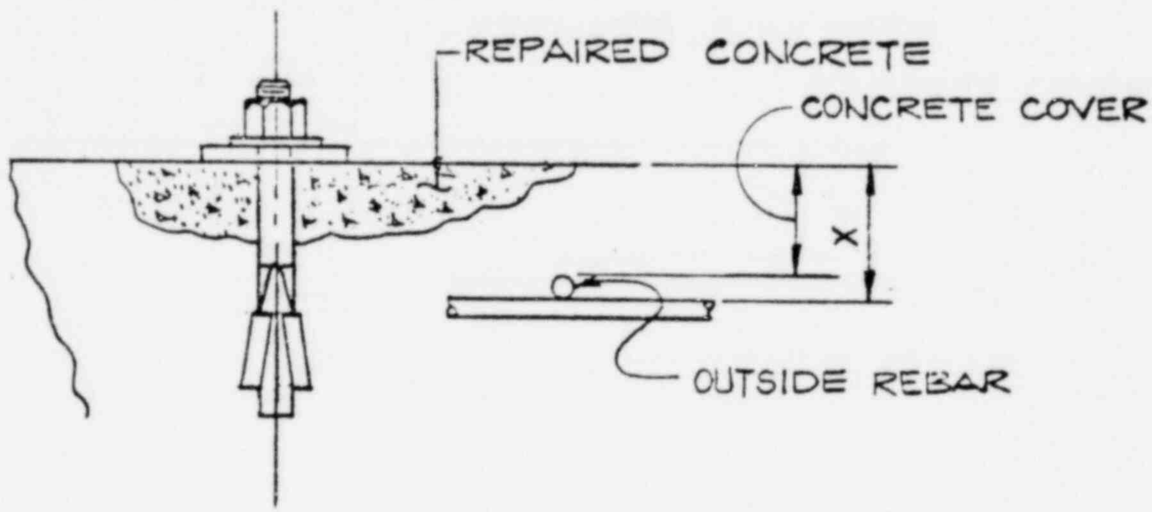


Figure 38-5

Anchors Installed in Repaired Concrete

3.1.10 Refer to Table 38-5 and Figure 38-6.

a. When two anchors of different diameters are installed adjacent to each other, "S" shall be the average of the two "S" dimensions.

b. If dimensions ED, ES and S cannot be maintained between two anchor assemblies, allowable erection tolerance indicated on the design drawings should be used to resolve the problem. If the problem involves anchors installed by two different contractors, their erection tolerances should be used or the Consulting Engineers should be notified for a resolution.

c. If Le cannot be met, the Consulting Engineers should be notified before work proceeds. R3

d. For anchors installed near an embedded steel plate, the minimum distance between the anchor and the edge of the steel plate shall be equal to the S dimension.

3.1.11 Where the concrete surface is uneven, shimming is required under the plate in the area of the expansion anchor, or it is required to improve the concrete surface.

Table 38-5

Minimum Embedded Length, Spacing And Edge Distance
For Expansion Anchors

Nominal Bolt Diameter (inch)	Minimum Embedded Length (inches) Le		Minimum Spacing (inches) (S)	Minimum Edge Distance (inches)			
				Ed		Es	
	4.5d	8d		4.5d'	8d'	4.5d'	8d'
1/4	1.25"	1.25"	2.5	1.5	2.0	1	1.0
3/8	1.75"	3.0	4.5	2.5	5.0	1.25	2.5
1/2	2.25	4.0	6.0	3	7.0	1.5	3.5
5/8	2.8	5.0	7.5	4	8.0	2	4.0
3/4	3.4	6.0	9.0	5	10.0	2.5	5.0
1	4.5	8.0	12.0	6	12.5	3	6.0

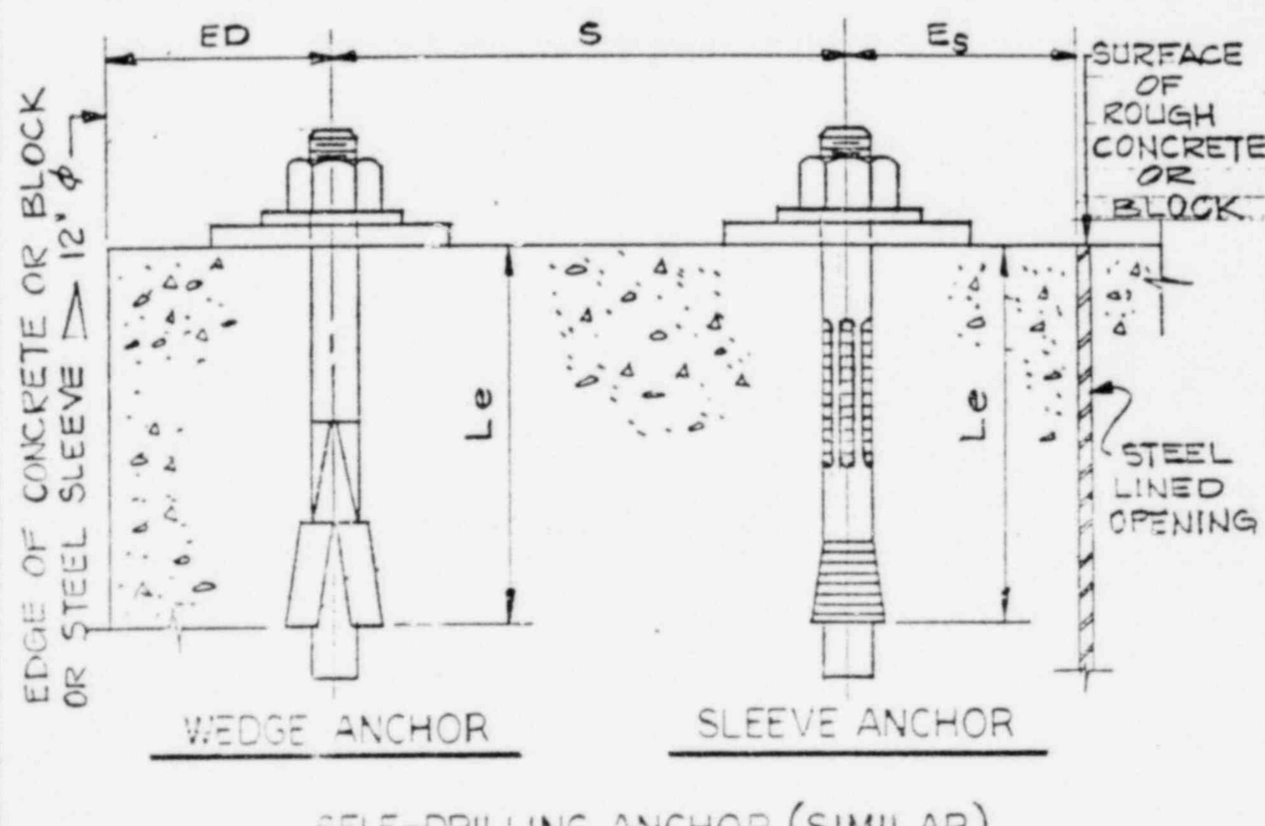


FIGURE 38-6

R3

3.2 Drilling of Holes

3.2.1 For all expansion anchors, except self-drilling type, holes in concrete shall be drilled with quality carbide tipped solid bits, using a rotary/percussion type power drill.

3.2.2 Each hole shall be drilled precisely in order to maintain the expansion anchor's pullout value. The tolerances on the bit shall be within the tolerances specified by the anchor manufacturer for each anchor size.

3.2.3 The anchor shall be no more than 5° out of plumb for '4.5d' embedment and 10° for '8d' embedded length after installation. Angular deviation shall be measured from the top of concrete to the exposed end of installed anchor. For angular deviation greater than 3°, square or rectangular bevelled washers shall be placed between the attachment and the nut to maintain full bearing of the nut.

3.2.4 The maximum depth of the hole shall not be greater than the thickness of the concrete minus 2-1/2 inches. Hole depth as determined from the requirements in Article 3.1.10c shall have no negative tolerance. In addition, no positive tolerance is allowed for 1/4" diameter anchors. R3

3.2.5 Holes for the concrete expansion anchors shall not be drilled until the concrete has been cured for a minimum of 28 days.

3.2.6 If drilled holes are not used, they shall be filled with dry-pack grout.

3.2.7 The criteria for drilling holes in concrete shall be as indicated in Table 38-7 and Figures 38-7 through 38-9.

3.2.8 At locations where a metal detector is required, a deep magnetic detector shall be used to locate the reinforcement in the concrete and to assure that the reinforcement will not be cut or nicked. Reinforcing placement drawings may be used as reference in conjunction with the use of the detector. This detector may be one of those indicated in Table 38-6.

Table 38-6

Products and Manufacturers of Magnetic Detectors

Products	Manufacturers
James "R" Meter C-4952	James Electronics, Inc. Chicago, Illinois
Profometer	Pro ceq. SA Riesbachstrasse 57 CH-8034 Zurich 8, Switzerland
CT-4949 A Deep Pachometer	Soiltest, Inc. Evanston, Illinois

3.2.9 In areas where metal detection is not required and a reinforced bar is nicked, the following procedure shall be followed:

a. The location where the reinforcing bar is nicked shall be suitably identified on the beam, slab, wall, column, etc., where this bar is located so that all contractors can identify the damaged rebar location.

b. The damaged rebar shall be documented on Form LS-CEA 1.0 or equivalent and sent to the Consulting Engineer for review within two weeks from the occurrence. For non-safety related areas, such documentation is not required.

c. Further drilling of holes shall be performed by using a metal detector within the following areas:

c1. A 18'-0" x 18'-0" square with its center at the point where the reinforcing bar was damaged when the reinforcing bars are spaced 12 inches or more on centers.

c2. A 9'-0" x 9'-0" square with its center at the point where the reinforcing bar was damaged when the reinforcing bars are spaced less than 12 inches on centers.

d. It is permissible to cut one reinforcing bar per anchor plate within the areas given in Article 3.2.9c above. For example, consider an anchor plate detail installed with four expansion anchors, one expansion anchor may be installed through reinforcing steel provided the remaining three anchors do not hit reinforcing steel and no other damaged reinforcing bars are identified within the areas given in Article 3.2.9c above. R3

3.2.10 In area where metal detection is required, the following procedure should be followed:

a. Using a metal detector, the location of all holes to be drilled and reinforcing bar pattern shall be laid out on the structural element.

b. If metal detection indicates the presence of a reinforcing bar at the anchor design location, the anchor plate assembly should be moved within the support location tolerance (as specified in drawings) to clear the reinforcing bar.

c. If the anchor plate tolerance does not allow sufficient movement to clear reinforcing, the Consulting Engineer shall be notified so that the problem can be resolved before proceeding.

d. If per chance the reinforcing bar is still nicked, the procedures given in Article 3.2.9 shall be followed.

3.2.11 Where Table 38-7 or Figure 38-7 or Figure 38-9 refers to this article, drilling of holes is allowed without the use of the metal detector if no reinforcing bar has been identified as damaged within the areas given in Article 3.2.9c. If a reinforcing bar has been cut or nicked, the procedures in Article 3.2.9 shall be followed.

3.2.12 The use of a metal detector is not required for 1/4 inch diameter anchors.

3.2.13 The maximum number of washers shall be limited to five. For longer anchor projections, structural plate or thicker washers shall be used.

3.2.14 The location of an individual anchor can be changed to facilitate installation provided the following tolerances are met.

a) Bolt with '4.5d' embedment:
Maximum spacing tolerance ±1d as long as the minimum edge distance between the anchor and the plate edge meets the AISC specification and meets the requirements of E_s, Ed, per Table 38-5. R3

b) Bolts with '8d' embedment:
The tolerance shall be the same as in Article 3.2.14.a, except that no negative tolerance on minimum spacing is allowed without the approval of the Consulting Engineer.

3.2.15 Where oversize and slotted holes are provided in the field to facilitate installation, hardened washer or structural plate washers as per section 1.23.4 of AISC. Spec. 1978 shall be used. Such washer shall cover the entire hole area in the plate. Holes can be enlarged by flame cutting up to 1/8" less than the required size, and then reamed to the size required.

Table 38-7

Criteria for Drilling Holes for Expansion Anchors in Concrete

Element	Area No.	Description
Concrete Slabs*	1	See Figure 38-7
Concrete Beams	2	See Figure 38-8
Concrete Columns	3	Drilling is allowed with the use of the metal detector.
Concrete Walls — Interior	4	See Article 3.2.11
Concrete Walls — Exterior — Above grade	5	For nuclear safety related wall and walls monolithic to nuclear safety related walls, see criteria for walls below grade. For other walls, see Article 3.2.11.
Concrete Walls — Exterior — Below grade	6	Drilling holes is allowed. For the use of metal detector, see Figure 38-9.
Primary Containment Exterior Wall & Drywell Floor	7	No drilling is allowed, unless approved by consulting engineer.
Concrete Slabs on Metal Deck	8	For the top of the slab, see Article 3.2.11. For the bottom of the slab, drilling is not allowed. R3
Concrete Finish	9	Drilling holes is allowed without the use of metal detector provided the hole is completely within the concrete finish. However Nuclear Safety Related anchors shall not be placed in the finish.
Foundation Mat — Containment [illegible]	10	No drilling is allowed.
Foundation Mat — Others	11	Drilling of holes is allowed. For application where the metal detector is to be used, see Figure 38-7. For mats, "L" is the distance between adjacent column centerlines.
Concrete for Steam Tunnels	12	Drilling of holes is allowed with the use of metal detector.
Concrete for Fuel Pools	13	Drilling of holes is allowed with the use of metal detector.
Masonry Block Walls	14	No drilling is allowed unless shown on the design drawings or approved by the Consulting Engineers.
Turbine Foundation	15	No drilling is allowed unless approved by the Consulting Engineer.

*NOTE: No expansion anchors allowed in magnetite concrete.

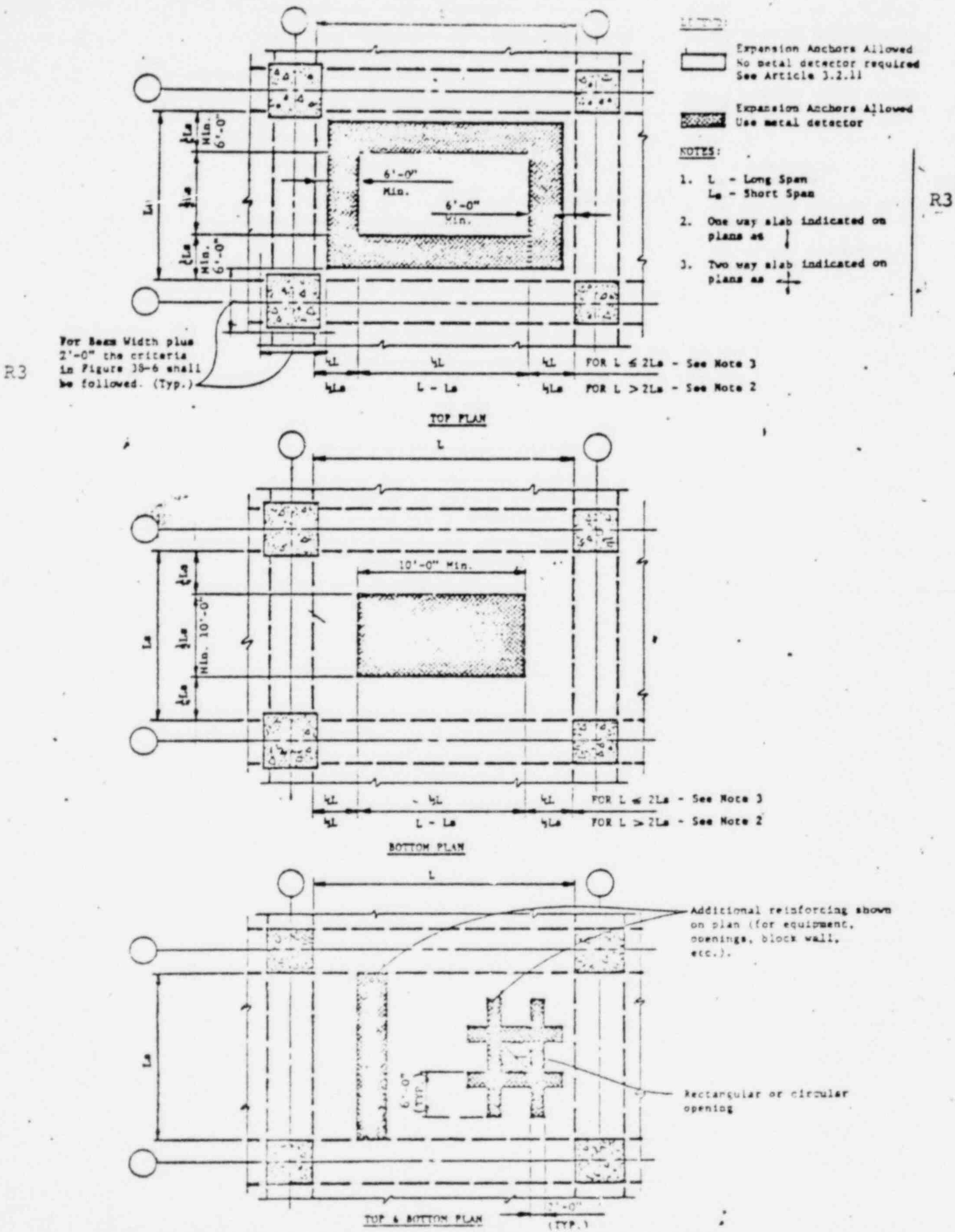


FIGURE 3B-7 CRITERIA FOR DRILLING OF HOLES FOR EXPANSION ANCHORS IN CONCRETE SLABS

SARGENT & LUNDY

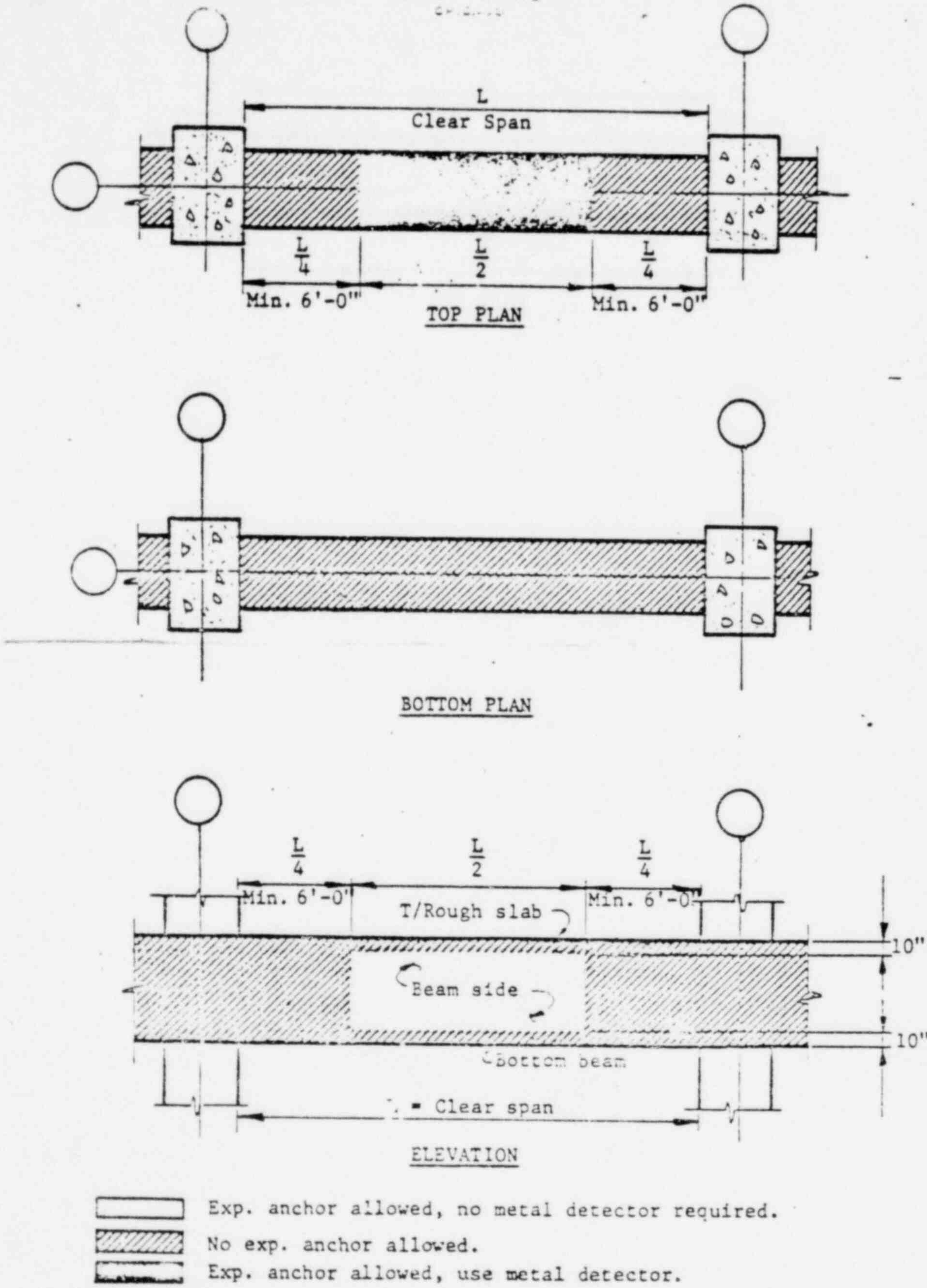
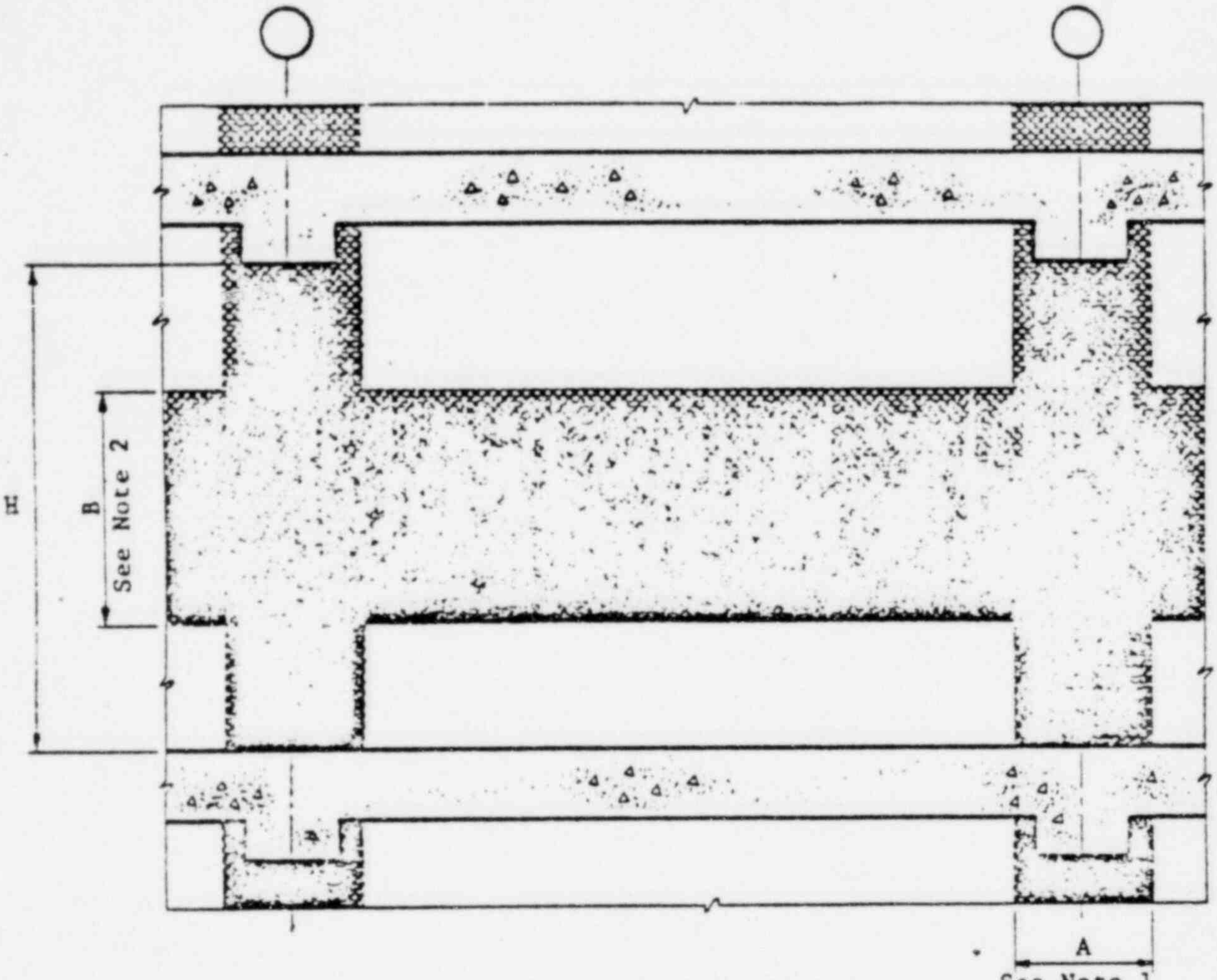
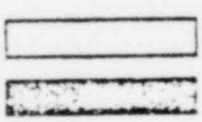


FIGURE 38-8 CRITERIA FOR DRILLING OF HOLES FOR EXPANSION ANCHORS IN CONCRETE BEAMS



INSIDE FACE ELEVATION

R3



Expansion Anchors Allowed
No metal detector required
See Article 3.2.11

Expansion Anchors Allowed
Use metal detector

Noted: 1. Dimension "A" shall be as follows:

a. If a wall column is present, "A" shall be the width of the wall column plus two feet.
b. If otherwise, "A" shall be the width of the beam above plus two feet.

2. Dimension "B" shall be the middle one half of "H" but a minimum of 16 feet.

Figure 38-9 CRITERIA FOR DRILLING OF HOLES FOR EXPANSION ANCHOR IN ALL EXTERIOR CONCRETE WALLS BELOW GRADE AND NUCLEAR SAFETY RELATED EXTERIOR CONCRETE WALLS ABOVE GRADE

3.3 Tightening of Expansion Anchors:

3.3.1 After the anchors for a connection are driven into the holes, they shall be brought to a "hand-tight" condition so that all parts of the connection are in contact with one another.

3.3.2 For wedge and sleeve type anchors, the anchors shall be tightened to the torque values given in the applicable Table 38-8 or Table 38-9. This tightening shall proceed systematically from the most rigid or inner part of the connection to its free edges. During this operation, there shall be no rotating of the parts except the nuts.

3.3.3 A calibrated torque wrench shall be used for tightening expansion anchors. Verification of calibration and recalibration shall be performed per the Contractor's approved procedure. The following frequency is acceptable.

a. For a direct reading torque wrench, on a monthly basis.

b. For snap-type torque wrench, on a weekly basis.

c. For an air driven wrench, on a daily basis.

Table 38-8 Installation Torque, ft-lb.
For Anchors Installed in 3500 PSI Concrete

Nominal Bolt Diameter	Torque Range		
	Wedge Type Anchors		Sleeve Type Anchors
	4.5'd' Emb.	8'd'Emb.	
1/4"	8 - 10*	8-10*	8 - 10*
3/8"	25 - 35	27-35	35 - 50
1/2"	55 - 65	65-75	60 - 75
5/8"	80 - 90	130-150	90 - 100
3/4"	150 - 175	230-270	
1"	250 - 300	280-320	

R3

* For 1/4" Ø Expansion Anchors installed in 1 1/4" deep hole, a minimum of 5ft-lb. torque shall be used.

For 1/4" Ø, 3/8" Ø Anchors
The Contractor shall exercise caution not to over torque the bolt to cause damage to concrete or bolt.

Table 38-9

Installation Torque for Anchors
Installed in Solid Block Walls

Nominal Bolt Diameter (in)	Torque Range (ft-lb)	
	Wedge Type	Sleeve Type
3/8	16 ± 1	16 ± 1
1/2	50 ± 2	50 ± 2
5/8	70 ± 2	70 ± 2
3/4	135 ± 5	--

R3

3.3.5 For self-drilling type anchors, tightening shall be performed in accordance with manufacturer's recommendations.

3.4 Repair of Failures: Failures shall be rectified as follows:

3.4.1 Concrete Failure: This shall include all cracking or spalling of the concrete in the vicinity of an installed anchor.

a. The concrete shall be repaired in accordance with the project concrete repairing procedure.

b. After the concrete has been repaired, the anchor hole may be drilled in accordance with Article 3.1.5.

c. All concrete failures shall be reported on Form LS-CEA 1.0/or equivalent and sent to the Consulting Engineers for review within one week from the occurance.

3.4.2 Anchor Failure: This shall include anchor breakage, slippage equal to or greater than one anchor diameter, or loosening to the extent that the anchor cannot be tightened to the installation torque.

a. If the unacceptable anchor can be removed without damaging the surrounding concrete, the hole may be redrilled and the anchor replaced with the next larger size anchor. The embedded length shall conform to the requirements of Table 38-5 and Figure 38-6.

b. If the unacceptable anchor cannot be removed without damaging the surrounding concrete, the anchor location shall be moved within the tolerance given for the anchor plate detail. The minimum center to center distance from the unacceptable anchor to the replacement hole shall be 2 times the nominal bolt diameter. If this distance exceeds the given tolerance on the placement of the anchor plate detail, the Consulting Engineers shall be notified before proceeding.

c. Unacceptable anchors that cannot be removed without damaging the surrounding concrete shall have their projecting end cut off. A saw-cut or flame-cut method is acceptable for removing this projection.

d. All anchor failures and relocation shall be reported on Form LS/CEA 1.0 or equivalent and sent to the Consulting Engineers for review within two weeks from the occurrence. R3

4.0 Inspection and Testing

4.1 Non-Safety Related Work: Contractor shall be responsible for all inspection and testing work as required or as needed, unless otherwise indicated. Purchaser and the Consulting Engineers may, during the course of the WORK, inspect the various phases of the WORK at the Project Site, for full compliance with all requirements of this Standard Specification, the Project Specification and the design drawings. Any work failing to meet the specified requirements shall be rectified or replaced by Contractor at his expense with no cost to Purchaser.

4.2 Safety Related Work

4.2.1 General Provisions:

a. Installed concrete expansion anchors shall be subject to inspection and testing as specified in this Article 4.2.

b. Inspection and testing shall be performed using a calibrated torque wrench. The torque test shall be performed after a minimum elapsed time of 6 hours and before an elapsed time of 14 days after installation of the bolt.

c. The agency responsible for this inspection and testing shall be independent of the Contractor and shall be as designated by the Purchaser.

d. The inspected anchors shall be suitably marked.

e. The inspection results shall be documented in a suitable test report which should include information such as the following: R3

e1. Compliance with the minimum testing torque requirements of Table 38-10 for concrete and 38-11 for solid block.

e2. Location of inspected anchors.

e3. Location of all anchors represented by the inspected anchor.

e4. Signature of inspector and date of inspection.

f. The inspection report should be submitted to the Consulting Engineers for review.

4.2.2 Calibrated Torque Wrench Inspection:

a. Calibration: Torque wrenches to be used for inspection shall be of the dial indicating type and shall be calibrated before use to verify that they are accurate in the testing torque range. The tolerance on these torque wrenches shall be within ± 3 percent. Calibration of these torque wrenches after initial qualification shall be on a monthly basis.

b. Frequency and Sequence:

b1. One out of each ten expansion anchors installed, or fraction thereof, but a minimum of one per day per crew per contractor shall be randomly selected for testing. This frequency shall be applied to anchors of each diameter installed.

b2. If the tested anchor is unacceptable, two other anchors in the same group as defined in b1, above, shall be tested.

b3. If one of these two anchors is unacceptable, ten other anchors in the same group shall be tested.

b4. If two or more of these ten anchors are unacceptable, all other anchors in this group shall be tested.

c. Inspection and Acceptance:

c1. On inspection, the inspector shall place the wrench on the nut of the selected anchor and apply torque to the nut until the torque reaches the applicable testing torque given in Table 38-10 or 38-11.

Table 38-10

Minimum Testing Torque for Anchors Installed in 3500 PSI Concrete

Nominal Bolt Diameter (in)	Minimum Testing Torque (ft-lb)		
	Wedge Type		Sleeve Type
	4.5d	8d	
1/4	5	5	5
3/8	15	15	15
1/2	35	45	45
5/8	60	90	90
3/4	110	160	--
1	200	200	--

R3

Table 3B-11

Minimum Testing Torque for Anchors
Installed in 1500 psi Solid Concrete Block

Nominal Bolt Diameter (in)	Minimum Testing Torque (ft-lb)	
	Wedge Type	Sleeve Type
3/8	10	10
1/2	25	25
5/8	35	35
3/4	70	--

c2. If the nut of the inspected anchor is not turned, the anchor shall be accepted. If the nut is turned, the anchor shall be considered unacceptable.

c3. Unacceptable anchors shall be reported to the responsible Contractor for re-torquing to installation torque and re-inspection. If the anchor is again unacceptable, it shall be replaced in accordance with Article 3.4. R3

c4. A record of the following items shall be maintained for each anchor tested or replaced.

1. Location of tested anchor
2. Expansion anchor length marking
3. Measurement of threaded bolt projection from the top of the concrete
4. Verification of spacing and edge distances
5. Degree from plumb
6. Check for full engagement of nut
7. Check for quantity of washer
8. Check for washers covering oversized holes, and for deformed washers

CONCRETE EXPANSION ANCHOR INSTALLATION

CONCRETE OR ANCHOR FAILURE/DAMAGED REBAR REPORT

Commonwealth Edison Company

Report No. ____

Date ________

Page 1 of ____

1. LaSalle County Station Project No. Unit -1 LaSalle County Station Project No. Unit -2

2. Building ________________ Floor Elevation ________

3. S&L Dwg. No.______________ Detail No. ____________

4. Structural Element Affected"

   slab (top side)
   slab (bottom side)
   beam (top)
   beam (side)
   wall (exterior)
   wall (interior)
   column

5. Reason for Relocation of Anchor: R3

   Rebar nicked
   Rebar cut
   Anchor failure
   Concrete Failure

6. The depth of damaged rebar ______inches.

7. Location: Attached is a sketch indicating actual location of the expansion anchor detail with respect to the nearest column lines and elevation and anchor(s) which failed or damaged rebar. Sketch shall be identified by report number and proper page number(s).

8. Prepared: (Installed Contractor) ______________ (NAME)   Reviewed: (Client Q.A.) ______________ (NAME)

   ______________ (ORGANIZATION)   ______________ (ORGANIZATION)

   ______________ (DATE)   ______________ (DATE)

FORM LS-CEA 1.0

SARGENT & LUNDY
ENGINEERS

Rev. 4

STANDARD SPECIFICATION FOR

CONCRETE EXPANSION ANCHOR WORK

(FORM LS-CEA)

LASALLE COUNTY STATION

UNITS 1 AND 2

PROJECT NO. 4266, 4267

Revision 0 Issued on September 30, 1976

Revision 1 Issued on December 7, 1976

Revision 2 Issued on November 29, 1978

Revision 3:

Prepared By S. M. Kazmi Date 7-19-79

Reviewed By [signature] Date 7-20-79

Approved By E. R. Weaver Date 7-20-79

Revision 4:

Prepared By S. M. Kazmi Date 9-7-79

Reviewed By [signature] Date 9-7-79

Approved By E. R. Weaver Date 9-7-79

SPECIFICATION FOR CONCRETE EXPANSION ANCHOR WORK LASALLE COUNTY STATION - UNITS 1 AND 2

(Form LS-CEA)

Table of Contents

[illegible]
CONC[illegible] WORK
LA SALLE COUNTY STATION - UNITS 1 AND 2

(Form LS-CEA)

1. GENERAL

1.1 Scope: All concrete expansion anchor WORK shall conform to the requirements of this Standard Specification Form LS-CEA unless otherwise indicated in the Project Specification or on the design drawings. This WORK shall include furnishing, installing, inspecting and testing of expansion anchors as indicated in the Project Specification or on the design drawings. The requirements of this Standard Specification shall also apply for attaching hangers for field routed piping and conduits.

1.1.1 For purposes of establishing basic requirements for different applications of concrete expansion anchors, the WORK shall be divided into three categories as follows:

a. Safety Related Work in a Safety Related Structure:

a1. Requires complete documentation of installation and inspection/testing as given in Articles 1.4 and 4.0

b. Non-Safety Related Wrok in a Safety Related structure:

b1. Requires complete documentation of installation as given in Article 1.4. Inspection/testing documentation is waived.

c. Non-Safety Related Work in a Non-Safety Related Structure: R4

c1. Installation, inspection/testing and the use of metal detection is waived. Cutting of reinforcing steel is not allowed.

1.1.2 Classification of Structures & Components

For classification of Safety Related and Non-Safety Related Structures and Components, refer to the corresponding design drawings. "Class-I Structure," marked on structural drawings shall be considered as Safety Related. In case no classification has been shown on the drawings, it shall be construed to be Non-Safety Related Structure/Component.

1.2 Definitions (For All Expansion Anchors): The following terms, when used in this Standard Specification or in the Project Specification or on the design drawings, shall have the meanings:

1.2.1 Self-Drilling Type Expansion Anchor: An externally slit and internally threaded tubular expansion shell, with a single-cone expander, as shown in Figure 38-1:

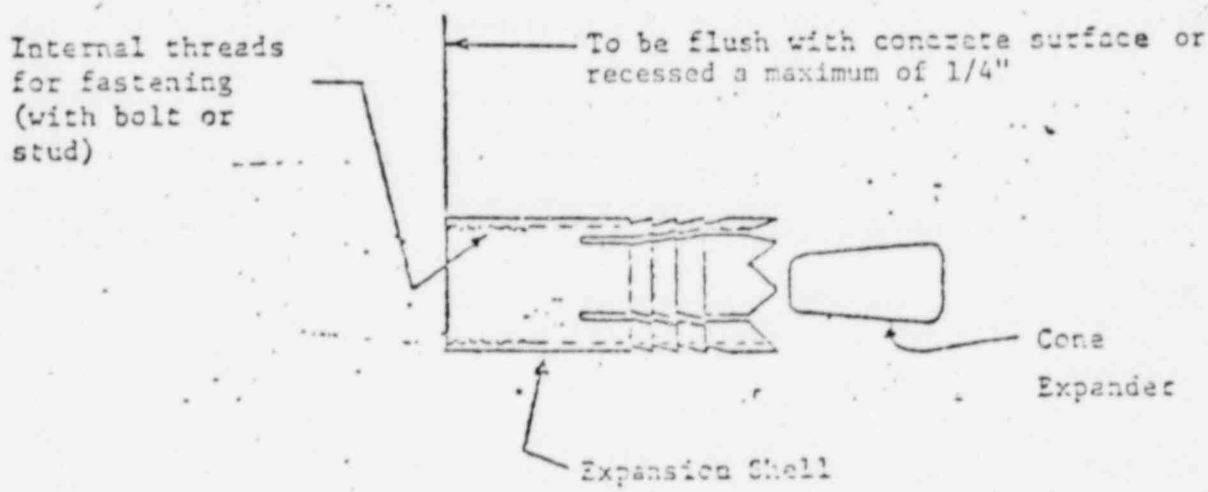


Figure 38-1

Typical Self-Drilling Type Expansion Anchor

1.2.2 Sleeve Type Expansion Anchor: A split tubular expansion shield, and a threaded stud bolt with integral cone expander, as shown in Figure 38-2 following:

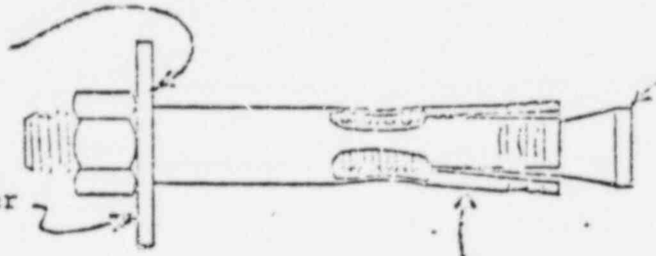


Figure 38-2 Typical Sleeve Type Expansion Anchor

1.2.3 Wedge Type Expansion Anchor: A split expansion ring and (or a separate expansion wedge pair), a threaded stud bolt with integral cone expander (or taper expander), as shown in Figures 38-3 and 38-4 following:

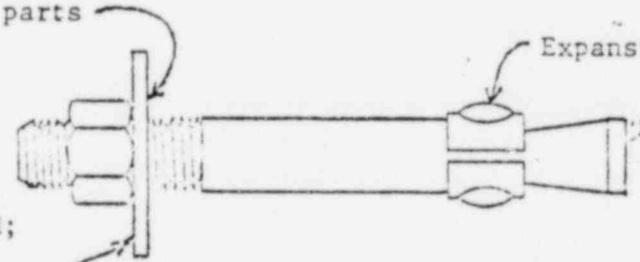


Figure 38-3 Typical Wedge Type Expansion Anchor with Expansion Ring and Cone Expander R4

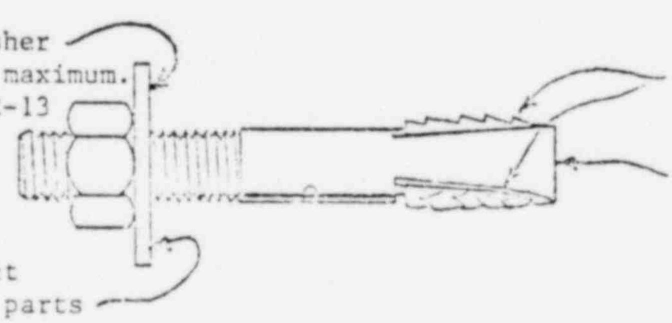


Figure 38-4 Typical Wedge Type Expansion Anchor with Expansion Wedge Pair and Taper Expander

[illegible] Quality
Assurance Articles of the Project Specification.

1.4 Installation and Inspection Documentation

1.4.1. Installation Procedure:

Contractor shall submit a complete installation procedure to the Consulting Engineers for review, prior to any installation, in accordance with Contractor's quality assurance procedure. The procedure shall describe the implementation of this Form, LS-CEA, and shall include but not be limited to, the following:

a. Installation process

b. Equipment to be used

c. Tolerances for Equipment

d. Equipment inspection frequency

e. Types of installation devices and calibration frequency

f. Overall anchor length and minimum depth of hole for each anchor diameter.

g. Methods to insure and verify proper anchor length (i.e., marking bolt ends for lengths).

h. Methods to insure and verify proper hole depth, spacing and edge distance from anchor to edge of concrete or steel lined openings. R4

i. Methods to verify actual embedded length of an installed anchor with no marking for bolt length.

j. Methods to determine the angularity of the installed anchor.

k. Repair methods for damaged concrete and grouting procedure for patching up abandoned holes R4

l. Methods to identify the location of a nicked bar.

m. Information to be documented.

[illegible] Quality Assurance Responsibilities of the Contractor

The Contractor shall be responsible for the quality assurance check for the following items in particular, but not limited to:

a. Ensure use of an approved installation procedure. R4

b. The anchors have been installed to the torquing requirements as specified in the Table 38-8.

c. The minimum embedment depth in accordance with the design drawings has been provided. For drawings released for construction before 7-20-79, if no embedment depth is specified, the minimum embedment depth shall be 4.5d. For the drawings released first time or revised showing anchor size/plate changed, on/after 7-20-79, the minimum embedment depth shall be '8d', if no specific embedment depth is shown on the drawings.

d. If the installed anchor is at an angle and the angularity exceeds the tolerances shown in Section 3-2.3 of this specification, a report shall be submitted to the purchaser.

e. If the nut of the anchor is not fully engaged, a report shall be submitted to the purchaser.

f. While drilling holes for anchor installation, if trial drills have been made in the concrete wall or slab, it has to be ensured that the concrete has been repaired by grouting before the final installation of the plate is made.

g. Verification of spacing and edge distances as specified in Table 38-5 and Figure 38-6.

h. Verification that anchor or concrete failure/damaged rebar reports have been reported on Form LS-CEA 1.0.

[illegible] Procedure ([illegible] Related Work Only):

The agency responsible for the inspection and testing specified in Article 4 shall submit a complete inspection procedure to the Purchaser for review prior to any inspection The procedure shall describe the implementation of this form and shall include but not be limited to, the following:

a. Inspection process and frequency

b. Equipment to be used

c. Tolerances for equipment

d. Calibration frequency for inspection devices

e. Information to be documented

2. [illegible]

2.1 Type and Finish of Materials:

Concrete expansion anchors and accessories shall be made of carbon steel with zinc plated finish conforming to U.S. Federal Specification QQ-Z-325B. Stainless steel may be used in place of this zinc coated carbon steel. R4

2.2 Strength of Materials:

The material shall have a minimum yield strength of 60,000 psi for self-drilling and wedge type anchors, and 50,000 psi for sleeve type anchors. The material shall have a minimum tensile strength of 75,000 psi for all anchors.

2.3 Cross-Sectional Areas:

The smallest cross-sectional area of the stud bolt of an expansion anchor shall not be less than the cross-sectional area at the thread root.

2.4 Size Limits:

The bolt size limits for expansion anchors shall be as follows: (all sizes shown on design drawings are bolt sizes for sleeve and wedge type anchors). R4

2.4.1 Self Drilling Type: 1/4" through 3/4" inside diameter of internally threaded shell.

2.4.2 Sleeve Type: 1/4" through 5/8" diameter of stud bolt.

2.4.3 Wedge Type: 1/4" through 1" diameter of stud bolt.

2.5 Types and Makes of Anchors:

Concrete expansion anchors used for the WORK shall be one of the types and makes indicated in Table 38-1. Other concrete expansion anchors not specified in Table 38-1 may also be acceptable provided they meet the requirements of this specification and are specifically approved by the Consulting Engineers.

2.6 Certificate of Conformance

For nuclear safety related work, the material supplier shall provide certificate of conformance for each shipment made to the site. R4

Table [illegible]-1

Types, Classifications, Use and Makes of Expansion Anchors

Types of Anchors	Self-Drilling	Sleeve	Wedge	
U.S. Federal Specification FF-S-325 Classifications	Group III Type 1	Group II Type 3 Class 3	Group II Type 4 Class 1	
Permissible Use	For all Work in Non-Safety Related Structures except Block Walls	For All Work		R4

Manufacturers	Products		
a. Hilti Fastening Systems, Inc.	--	---	Hilti Kwik-Bolt Stud Wedge Anchors
b. ITT Phillips Drill Company	Red Head Self-Drilling Anchors	Red Head Hex Nut Sleeve Anchors	Red Head Wedge Anchors
c. Ramset Fastening Systems	Ram-Drill Self-Drilling Anchors	Dynabolt Mark II Hex Nut Sleeve Anchors	Trubolt Wedge Anchors
d. The Rawlplug Company, Inc.	Rawl Saber-Tooth Self-Drilling Anchors	Rawl Lok/Bolt Hex Nut Sleeve Anchors	Rawl-Stud Wedge Anchors
e. USM Corporation Construction Products Division	------	Parasleeve Hex Nut Masonry Anchors	Parabolt Wedge Anchors
f. Wej-It Corporation of Allied Products Corp.	------	----	Wej-It Double Wedge Anchors

3. [illegible]

(For all expansion anchors except as noted)

3.1 <u>General Provisions:</u>

3.1.1 Concrete expansion anchors shall be installed in accordance with the manufacturer's specifications and recommendations and the requirements of this Form LS-CEA. In case of conflict, the requirements of this form shall govern.

3.1.2 The minimum embedded lengths, spacing and edge distance for expansion anchors shall conform to Table 38-2 and Figure 38-6 unless otherwise indicated in Article 3.1.10.

3.1.3 The overall anchor length and the hole depth required shall be determined by Contractor such that the specified minimum embedment length and bolt projection can be obtained.

3.1.4 As a minimum anchor threads shall engage the complete nut, however, a 1/4" thread projection above the nut after installation is recommended. If projection exceeds 1/4", projection shall not be removed without the consent of the Consulting Engineer. If consent is given, a record of embedment depth shall be made for all anchor with removed projections. R4

3.1.5 Holes for the anchors may be drilled through hardened grout, but the embedded length shall be determined from the surface of the rough concrete. Holes for the anchors may be drilled through surface repaired concrete, but the embedded length shall be determined in accordance with Article 3.1.9. Holes shall not be drilled through grout or repaired concrete that has not completely hardened nor shall grout or concrete be placed around anchors without the approval of the Consulting Engineers.

3.1.6 Reuse of expansion anchors shall not be permitted.

3.1.7 1/4"Ø expansion anchors are allowed in all locations of reinforced concrete, provided the required hole depth is less than the effective depth of the concrete covering the main reinforcement. 1/4"Ø expansion anchors shall not be used in solid block walls.

3.1.8 Welding on expansion anchors is not permitted without approval of the Consulting Engineers.

3.1.9 For anchors installed in holes drilled through surface repaired concrete extending beyond the rebar cover, the dimension (Le) given in Table 38-2 shall be increased by a dimension X as shown in Figure 38-5. In addition, 1/4"Ø expansion anchors are not allowed to be installed through surface repaired concrete. R4

where X = thickness of concrete cover plus nominal diameter of outside bar.

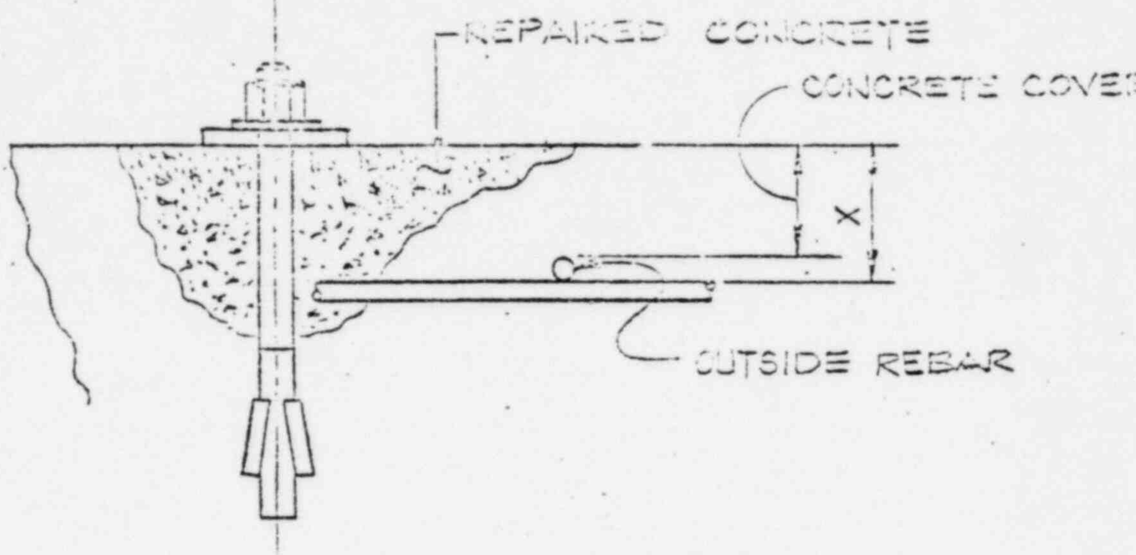


Figure 38-5

Anchors Installed in Repaired Concrete

3.1.10 Refer to Table 38-2 and Figure 38-6, where in:

S = Center to Center distance between anchors in adjacent assemblies
E_D = Edge distance, measured from center of the anchor to the nearest concrete edge
E_S = Edge distance, measured from center of the anchor to the nearest surface of a steel lined opening (sleeve, etc.)

a. When two anchors of different diameters are installed adjacent to each other, "S" shall be the average of the two "S" dimensions.

b. If dimensions ED, ES and S cannot be maintained between two anchor assemblies, allowable erection tolerance indicated on the design drawings should be used to resolve the problem. If the problem involves anchors installed by two different contractors, their erection tolerances should be used or the Consulting Engineers should be notified for a resolution.

c. For anchors installed to a minimum of '8d' embedded length, Le shall be to the untorqued position of the expansion ring. For anchors installed to the 4.5d embedment length requirement, Le shall be to the bottom of the anchor before torquing. For such anchors (4.5d), a minimum depth of '3.5d' after torquing shall be acceptable. R4

d. If [illegible] cannot be met, the Consulting Engineers should be notified before work proceeds.

e. Edge distance to the side of embedded steel plates shall be the 'S' dimension.

3.1.11 Where the concrete surface is uneven, the following shall be the acceptance criteria for uneven surface between the plate and the mounting surface:

a. Gaps up to 1/8" maximum are allowed in the following cases:

   1. Width of the gap does not exceed 1" along the full length of the plate.
   2. Gap extension into the plate beyond 1" is limited to 20% or less of the plate length (i.e., at least 80% contact length is available beyond 1".

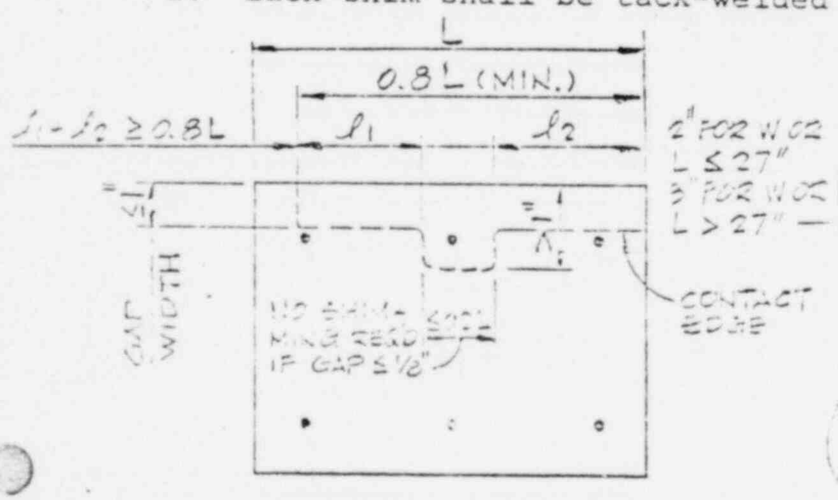
b. Gaps larger than 1/8" are not allowed, and shall require concrete surface improvement or shimming as required in paragraph (d) through (f).

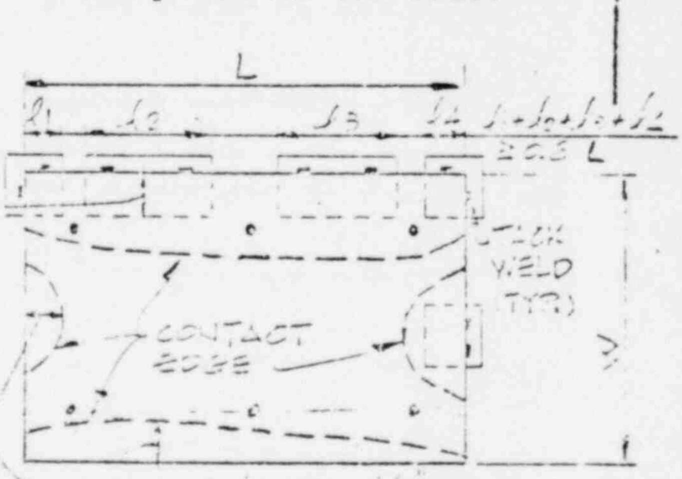
c. Mounting surface and the plate shall be assumed to be in contact when 1/32 inch thick plate inserted between them makes contact with both the surfaces, and for such cases no shim is required.

d. For gaps not meeting the requirements of (a) and (b) above, the concrete surface shall be improved by grinding or bush hammering. Alternatively, the gap may be filled by inserting shims between the plate and the mounting surface to ensure that 80% length along the edge is available.

e. The shims shall be flat or tapered, of the thickness as required and may be made discontinuous between adjacent anchors. The material for shims shall be ASTM A-36.

f. Each shim shall be tack-welded to the plate at two ends. R4





CONTACT DETAIL
(TYPICAL EACH SIDE)
FIG. 3B-?

SHIMMING DETAIL
FIG. 3B-11 R4

Table [illegible]-2

Minimum Embedded Length, [illegible] and Edge Distance
For Expansion Anchors

Nominal Bolt Diameter (inch)	Minimum Embedded Length (inches) Le		Minimum Spacing (inches) (S)	Minimum Edge Distance (inches)				
				Ed		Es		
	4.5d	8d		4.5d'	8d'	4.5d'	8d'	
1/4	1.25"	1.25"	2.5	1.5	3.25	1	1.75	R4
3/8	1.75"	3.0	4.5	2.5	5.0	1.25	2.5	
1/2	2.25	4.0	6.0	3	7.0	1.5	3.5	
5/8	2.8	5.0	7.5	4	8.5	2	4.25	R4
3/4	3.4	6.0	9.0	5	10.0	2.5	5.0	
1	4.5	8.0	12.0	6	13.0	3	6.5	R4

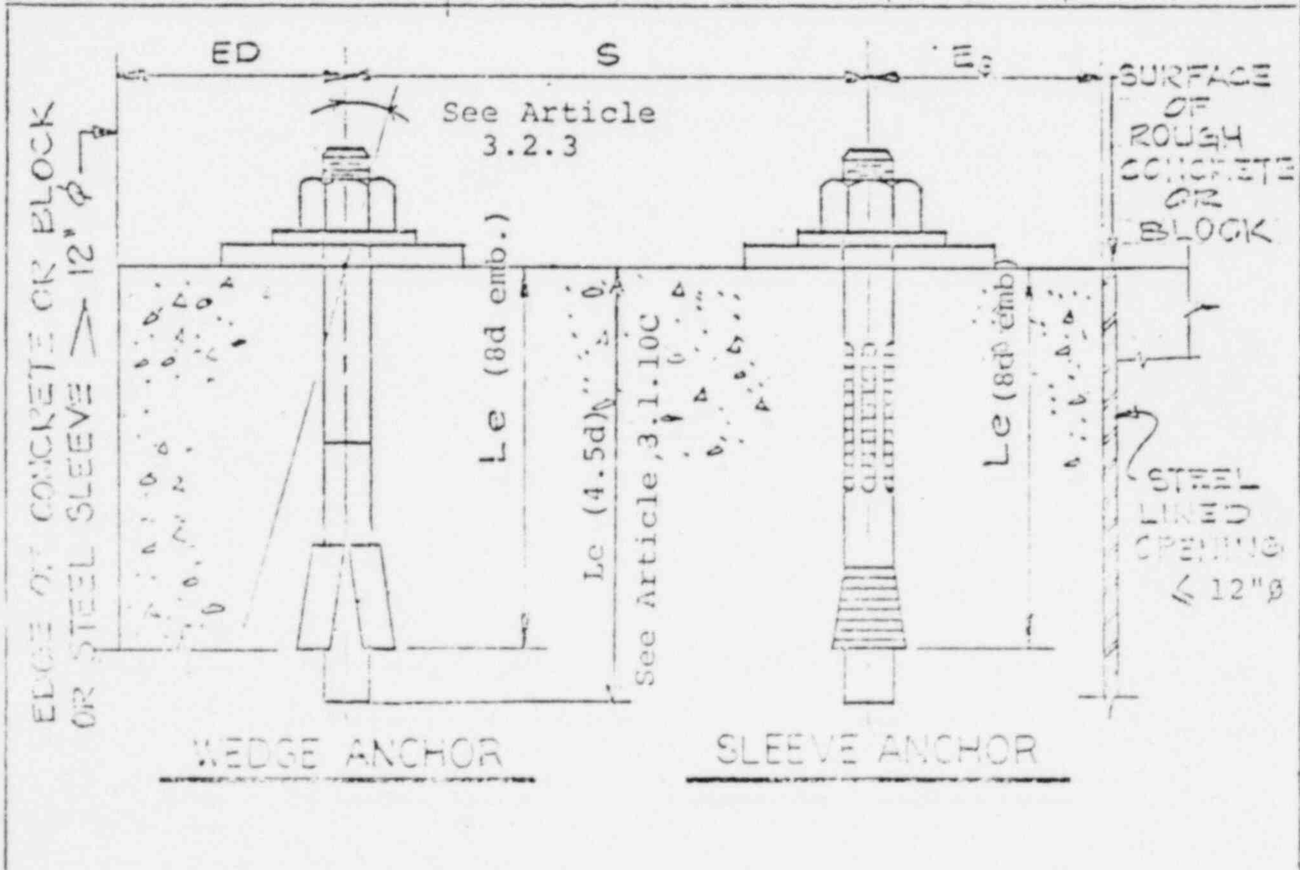


FIGURE 3B-6

3.2 Drilling of Holes

3.2.1 For all expansion anchors, except self-drilling type, holes in concrete shall be drilled with quality carbide tipped solid bits, using a rotary/percussion type power drill.

3.2.2 Each hole shall be drilled precisely in order to maintain the expansion anchor's pullout value. The tolerance on the bit shall be within the tolerances specified by the anchor manufacturer for each anchor size. The drill bits as recommended by the anchor manufacturer for each anchor size shall be used. R4

3.2.3 The anchor shall be no more than 5° out of plumb for '4.5d' embedment and 10° for '8d' embedded length after installation. Angular deviation shall be measured from the top of concrete or plate surface to the exposed end of installed anchor. For angular deviation greater than 3°, square or rectangular bevelled washers shall be placed between the attachment and the nut to maintain full bearing of the nut. R4

3.2.4 The maximum depth of the hole shall not be greater than the thickness of the concrete minus 2-1/2 inches. In addition, for 1/4" diameter anchors, the maximum hole depth is 1 inch.

3.2.5 Holes for the concrete expansion anchors shall not be drilled until the concrete has been cured for a minimum of 28 days.

3.2.6 If drilled holes are not used, they shall be filled with dry-pack grout. The grout is to have a minimum compressive strength of 3500 psi. R4

3.2.7 The criteria for drilling holes in concrete shall be as indicated in Table 38-5 and Figure 38-7 through 38-9.

3.2.8 At locations where a metal detector is required, a deep magnetic detector shall be used to locate the reinforcement in the concrete and to assure that the reinforcement will not be cut or nicked. Reinforcing placement drawings may be used as reference in conjunction with the use of the detector. This detector may be one of those indicated in Table 38-3

Table 38-3

Products and Manufacturers of Magnetic Detectors

Products	Manufacturers
James "R" Meter C-4952	James Electronics, Inc. Chicago, Illinois
Profometer	Pro ceq. SA Riesbachstrasse 57 CH-8034 Zurich 8, Switzerland
CT-4949 A Deep Pachometer	Soiltest, Inc. Evanston, Illinois

3.2.9 In areas where metal detection is not [illegible] reinforcing bar is nicked, the following procedure shall be followed:

a. The location where the reinforcing bar is nicked shall be suitably identified on the anchor plate where this bar is located so that all contractors can identify the damaged rebar location. R4

b. The damaged rebar shall be documented on Form LS-CEA 1.0 or equivalent and sent to the Consulting Engineer for review within two weeks from the occurrence. R4

c. Further drilling of holes shall be performed by using a metal detector within the following areas:

c1. A 18'-0" x 18'-0" square with its center at the point where the reinforcing bar was damaged when the reinforcing bars are spaced 12 inches or more on centers.

c2. A 9'-0" x 9'-0" square with its center at the point where the reinforcing bar was damaged when the reinforcing bars are spaced less than 12 inches on centers.

d. It is permissible to cut one reinforcing bar per anchor plate within the areas given in Article 3.2.9c above. For example, consider an anchor plate detail installed with four expansion anchors, one expansion anchor may be installed through reinforcing steel provided the remaining three anchors do not hit reinforcing steel and no other damaged reinforcing bars are identified within the areas given in Article 3.2.9c above.

e. When it is permissible to cut reinforcing steel, it shall be cut using a quality diamond carbide tipped bit. R4

3.2.10 In area where metal detection is required, the following procedure should be followed:

a. Using a metal detector, the location of all holes to be drilled and reinforcing bar pattern shall be laid out on the structural element.

b. If metal detection indicates the presence of a reinforcing bar at the anchor design location, the anchor plate assembly should be moved within the allowable erection tolerance indicated on the design drawings to clear the reinforcing bar.

If the anchor plate tolerance does not allow sufficient movement to clear reinforcing, the Consulting Engineer shall be notified so that the problem can be resolved before proceeding.

d. If per chance the reinforcing bar is still nicked, the procedures given in Article 3.2.9 shall be followed.

3.2.11 Where Table 38-5 or Figure 38-7 to Figure 38-9 refers to this article, drilling of holes is allowed without the use of the metal detector if no reinforcing bar has been identified as damaged within the areas given in Article 3.2.9c. If a reinforcing bar has been cut or nicked, the procedures in Article 3.2.9 shall be followed.

3.2.12 The use of a metal detector is not required for 1/4 inch diameter anchors.

3.2.13 The maximum number of washers shall be limited to five. If more than five washers are required, the consent of the Consulting Engineers shall be obtained. R4

3.2.14 The location of an individual anchor can be changed to facilitate installation provided the following tolerances are met:

a. Bolt with '4.5d' embedment:
Maximum spacing tolerance ±1d as long as the minimum edge distance between the anchor and the plate edge meets the requirements as shown in Table 38-4, and meets the requirements of E_s. Ed, per Table 38-2. R4

b. Bolts with '8d' embedment:
The tolerance shall be the same as in Article 3.2.14.a, except that no negative tolerance on minimum spacing is allowed without the approval of the Consulting Engineer.

Table 38-4

Anchor Size	Minimum Edge Distance for Punched, Reamed or Drilled Holes (inches)	
	At Sheared Edges	At Rolled Edges of Plates or Gas Cut Edges
1/4"	1/2"	3/8"
3/8"	3/4"	1/2"
1/2"	7/8"	3/4"
5/8"	1-1/8"	7/8"
3/4"	1-1/4"	1"
1"	1-3/4"	1-1/4"

R4

3.2.15 Where oversize and slotted holes are provided in the field to facilitate installation, hardened washer or square structural plate washers as shown in the Table 38-4A & 38-4B shall be used. Such washer shall cover the entire hole area in the plate. Holes can be enlarged by flame cutting up to 1/8" less than the required size, and then reamed or rotary filed to the size required. R4

PLATE WASHER SIZE FOR SLOTTED HOLES

ANCHOR SIZE (d) (INCHES)	SHORT SLOT: MAX. SLOT SIZE (INCHES) $(d+1/16) \times (d+1/2)$	SHORT SLOT: MINIMUM WASHER SIZE	LONG SLOT: MAX. SLOT SIZE (INCHES) $(d+1/16) \times 2\,1/2\,d$	LONG SLOT: MINIMUM PL WASHER SIZE (INCHES)	LONG SLOT: WELD SIZE
1/4	5/16 × 1/2	USE MINIMUM OF 2-STANDARD HARDENED WASHERS.	5/16 × 9/16	2 × 2 × 1/4	SEE NOTE BELOW
3/8	7/16 × 5/8		7/16 × 7/8	2 × 2 × 5/16	
1/2	9/16 × 3/4		9/16 × 1 1/8	2 1/2 × 2 1/2 × 5/16	
5/8	11/16 × 7/8		11/16 × 1 3/8	2 1/2 × 2 1/2 × 5/16	
3/4	13/16 × 1		13/16 × 1 3/4	3 × 3 × 5/16	
1	1 1/16 × 1 1/4		1 1/16 × 2 1/8	3 1/2 × 3 1/2 × 3/8	

TABLE 38-4B

PLATE WASHER SIZE - FOR OVERSIZE HOLES

NOMINAL BOLT DIAMETER (INCHES)	PLATE WASHER HOLE (INCHES)	WELD SIZE	HOLE SIZE IN PLATE (INCHES)	MINIMUM WASHER SIZE (INCHES)	HOLE SIZE IN PLATE (INCHES)	MINIMUM WASHER SIZE (INCHES)
1/4	5/16	SEE NOTE BELOW	1/2	1 1/2 × 1 1/2 × 3/16	9/16 TO 3/4	2 × 2 × 1/4
3/8	7/16		5/8	1 5/8 × 1 5/8 × 3/16	11/16 TO 7/8	2 1/8 × 2 1/8 × 5/16
1/2	9/16		3/4	1 3/4 × 1 3/4 × 3/16	13/16 TO 1	2 1/4 × 2 1/4 × 5/16
5/8	11/16		7/8	2 × 2 × 3/16	15/16 TO 1 1/8	2 1/2 × 2 1/2 × 5/16
3/4	13/16		1	2 1/8 × 2 1/8 × 3/16	1 1/16 TO 1 1/4	2 5/8 × 2 5/8 × 5/16
1	1 1/16		1 1/4	2 3/4 × 2 3/4 × 1/4	1 5/16 TO 1 1/2	3 1/2 × 3 1/2 × 3/8

NOTE: PLATE WASHERS SHOWN IN TABLES ABOVE SHALL BE TACK WELDED TO THE BASE PLATE WITH A MINIMUM OF ONE TACK EACH SIDE OF THE WASHER.

TABLE NO. 5

Criteria for Drilling Holes for Expansion Anchors in Concrete

Element	Area No.	Description
Concrete Slabs*	1	See Figure 38-7
Concrete Beams	2	See Figure 38-8
Concrete Columns	3	Drilling is allowed with the use of the metal detector.
Concrete Walls — Interior	4	See Article 3.2.11
Concrete Walls — Exterior — Above grade	5	For nuclear safety related wall and walls monolithic to nuclear safety related walls, see criteria for walls below grade. For other walls, see Article 3.2.11.
Concrete Walls — Exterior — Below grade	6	Drilling holes is allowed. For the use of metal detector, see Figure 38-9.
Primary Containment Exterior Wall & Drywell Floor	7	No drilling is allowed, unless approved by consulting engineer.
Concrete Slabs on Metal Deck	8	For the top of the slab, see Article 3.2.11. For the bottom of the slab, drilling is not allowed.
Concrete Finish	9	Drilling holes is allowed provided the hole is completely within the concrete finish. Metal detection is not required. However, anchors installed in Safety Related structures shall not be placed in the finish unless shown on the design drawings or approved by Consulting Engrs. R4
Foundation Mat — Containment	10	No drilling is allowed.
Foundation Mat — Others	11	Drilling of holes is allowed. For application where the metal detector is to be used, see Figure 38-7. For mats, "L" is the distance between adjacent column centerlines.
Concrete for Steam Tunnels	12	Drilling of holes is allowed with the use of metal detector.
Concrete for Fuel Pools	13	Drilling of holes is allowed with the use of metal detector.
Masonry Block Walls	14	No drilling is allowed unless shown on the design drawings or approved by the Consulting Engineers.
Turbine Foundation	15	No drilling is allowed unless approved by the Consulting Engineer.

*NOTE: No expansion anchors allowed in magnetite concrete.

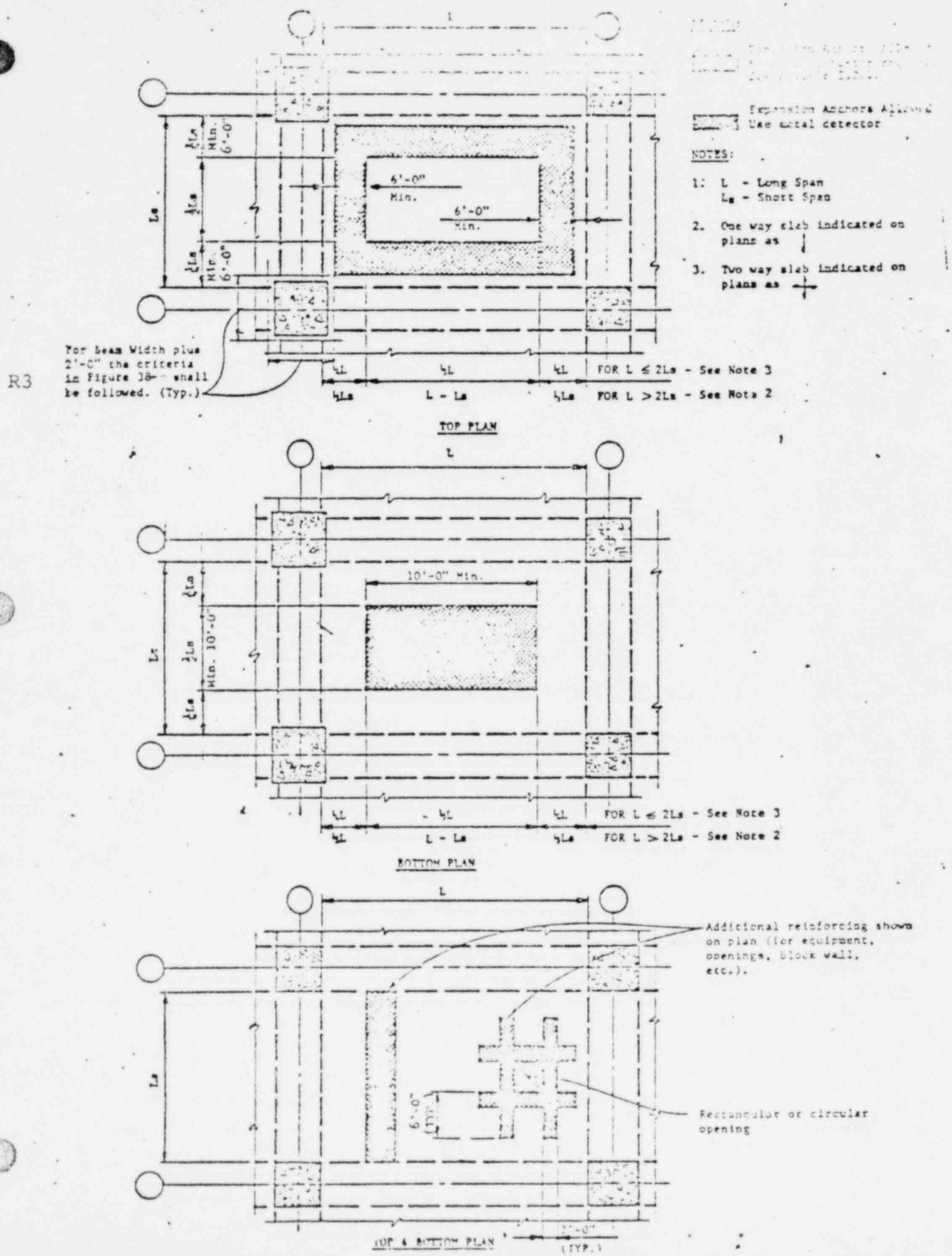
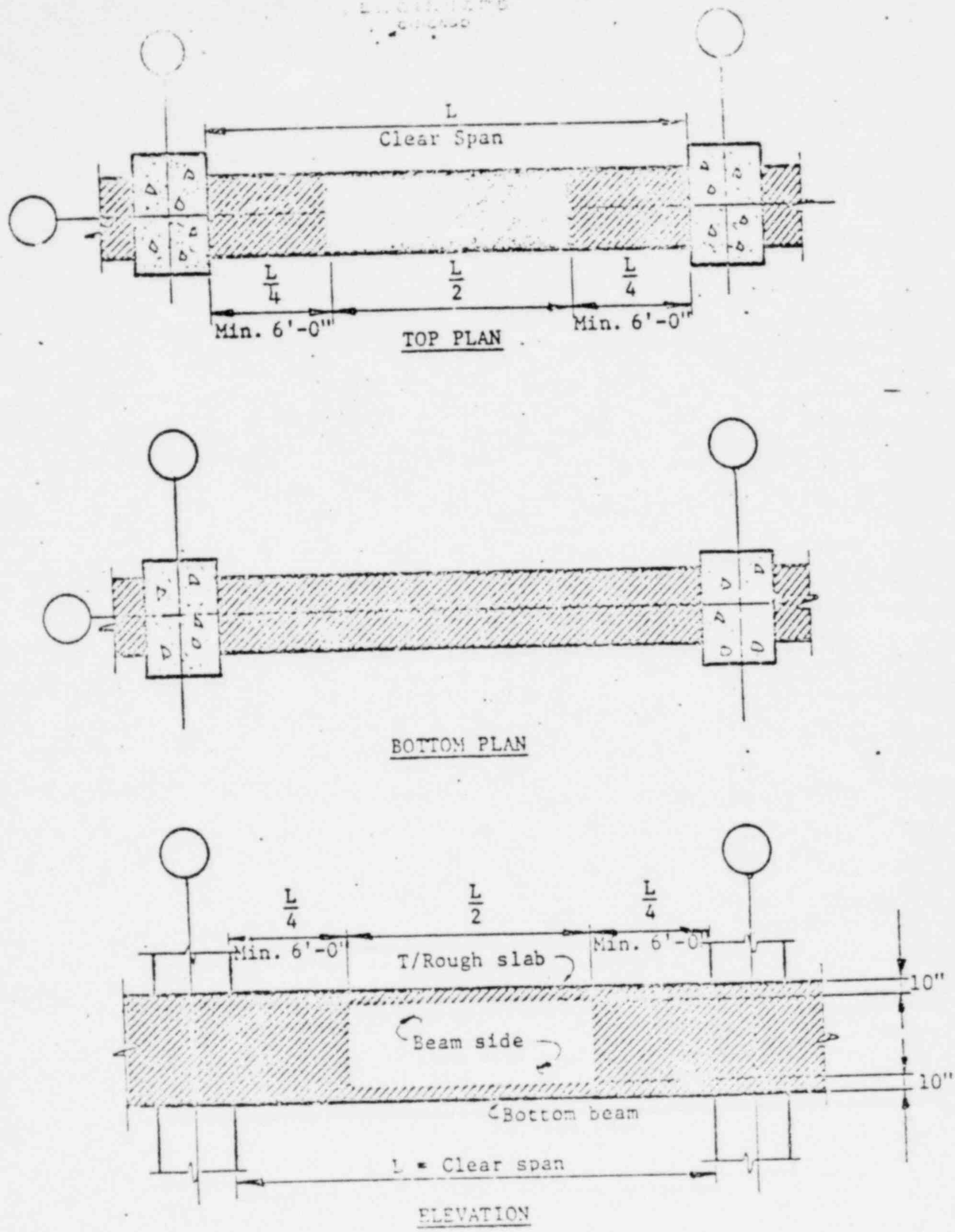


FIGURE 38-7 CRITERIA FOR DRILLING OF HOLES FOR EXPANSION ANCHORS IN CONCRETE SLABS



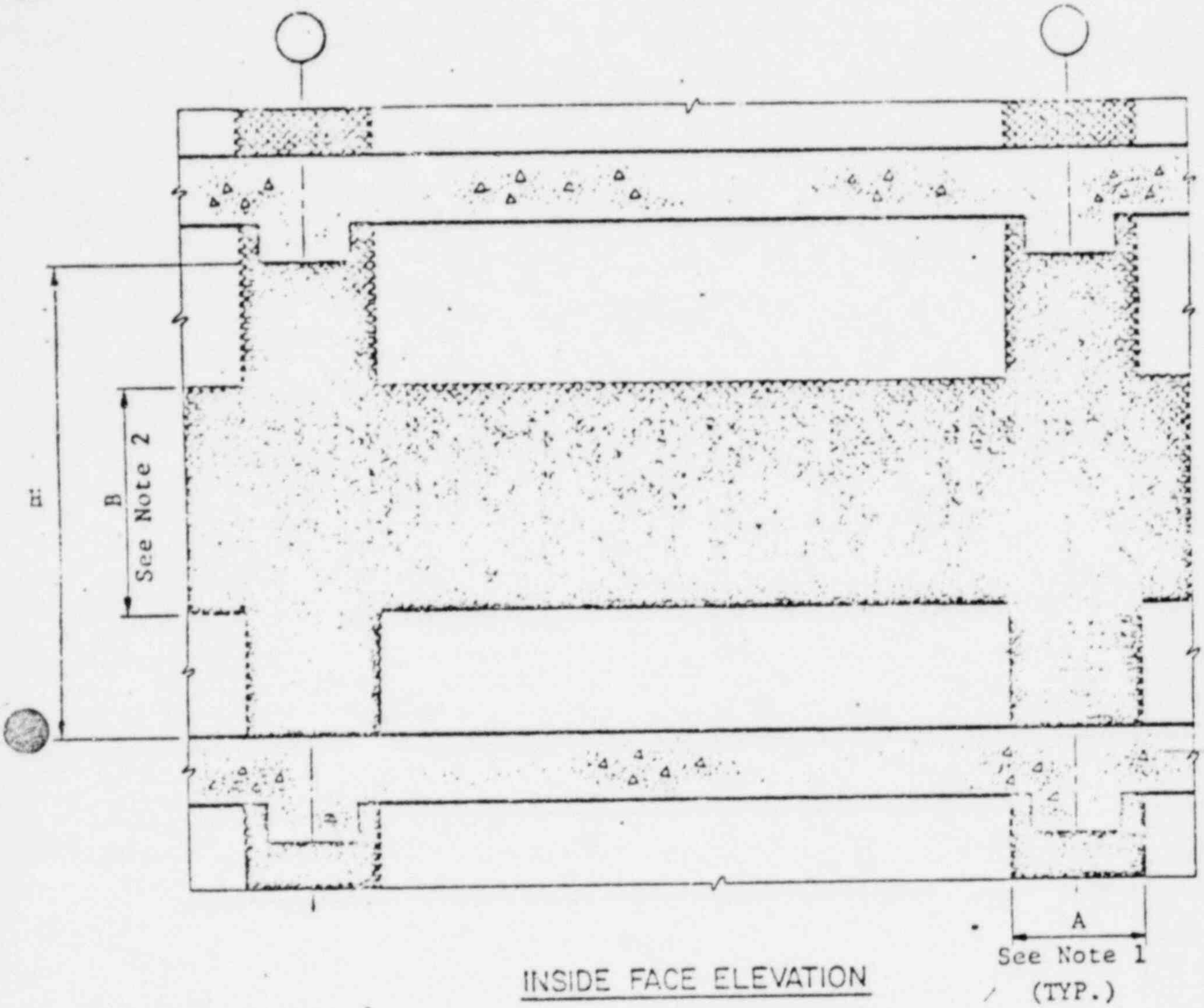
Exp. anchor allowed, no metal detector required.

No exp. anchor allowed.

Exp. anchor allowed, use metal detector.

FIGURE 38-8 CRITERIA FOR DRILLING OF HOLES FOR EXPANSION ANCHORS IN CONCRETE BEAMS

SARGENT & LUNDY
ENGINEERS
CHICAGO



INSIDE FACE ELEVATION

Expansion Anchors Allowed
No metal detector required
See Article 3.2.11

Expansion Anchors Allowed
Use metal detector

Noted: 1. Dimension "A" shall be as follows:

a. If a wall column is present, "A" shall be the width of the wall column plus two feet.
b. If otherwise, "A" shall be the width of the beam above plus two feet.

2. Dimension "B" shall be the middle one half of "H" but a minimum of 16 feet.

Figure 38-9 CRITERIA FOR DRILLING OF HOLES FOR EXPANSION ANCHOR IN ALL EXTERIOR CONCRETE WALLS BELOW GRADE AND NUCLEAR SAFETY RELATED EXTERIOR CONCRETE WALLS ABOVE GRADE

3.3 [illegible] of [illegible]:

3.3.1 After the [illegible] of a connection are [illegible] the holes, they shall be brought to a "hand-tight" condition so that all parts of the connection are in contact with one another.

3.3.2 For wedge and sleeve type anchors, the anchors shall be tightened to the torque values given in the applicable Table 38-6 or Table 38-7. This tightening shall proceed systematically from the most rigid or inner part of the connection to its free edges. During this operation, there shall be no rotating of the parts except the nuts.

3.3.3 A calibrated torque wrench shall be used for tightening expansion anchors. Verification of calibration and recalibration shall be performed per the Contractor's approved procedure. The following frequency is acceptable.

a. For a direct reading torque wrench, on a monthly basis.

b. For snap-type torque wrench, on a weekly basis.

Table 38-6 Installation Torque, ft-lb.
For Anchors Installed in Minimum 3500 PSI Concrete

Nominal Bolt Diameter	Torque Range		
	Wedge Type Anchors		Sleeve Type Anchors
	4.5'd' Emb.	8'd'Emb.	
1/4"	5 - 8	5-8	5 - 8
3/8"	25 - 35	27-35	35 - 50
1/2"	55 - 65	65-75	60 - 75
5/8"	80 - 90	130-150	90 - 100
3/4"	150 - 175	230-270	
1"	250 - 300	280-320	

The Contractor shall exercise caution not to over torque the bolt to cause damage to concrete or bolt.

Table 38-7

Installation Torque for Anchors
Installed in Solid Block Walls

Nominal Bolt Diameter (in)	Torque Range (ft-lb)	
	Wedge Type	Sleeve Type
3/8	16 ± 1	16 ± 1
1/2	50 ± 2	50 ± 2
5/8	70 ± 2	70 ± 2
3/4	135 ± 5	--

3.3.5 For self-drilling type anchors, tightening shall be performed in accordance with manufacturer's recommendations.

3.4 Repair of Failures: Failures shall be rectified as follows:

3.4.1 Concrete Failure: This shall include all cracking or spalling of the concrete in the vicinity of an installed anchor.

a. The concrete shall be repaired in accordance with the project concrete repairing procedure.

b. After the concrete has been repaired, the anchor hole may be drilled in accordance with Article 3.1.5.

c. All concrete failures shall be reported on Form LS-CEA 1.0/or equivalent and sent to the Consulting Engineers for review within two weeks from the occurrence. R4

3.4.2 Anchor Failure: This shall include anchor breakage, slippage equal to or greater than one anchor diameter, or loosening to the extent that the anchor cannot be tightened to the installation torque.

a. If the unacceptable anchor can be removed without damaging the surrounding concrete, the hole may be redrilled and the anchor replaced with the next larger size anchor. The embedded length shall conform to the requirements of Table 38-2 and Figure 38-6.

b. If the unacceptable anchor cannot be removed without damaging the surrounding concrete, the anchor location shall be moved within the tolerance given for the anchor plate detail. The minimum center to center distance from the unacceptable anchor to the replacement hole shall be 2 times the nominal bolt diameter. If this distance exceeds the given tolerance on the placement of the anchor plate detail, the Consulting Engineers shall be notified before proceeding.

c. Unacceptable anchors that cannot be removed without damaging the surrounding concrete shall have their projecting end cut off. A saw-cut or flame-cut method is acceptable for removing this projection.

d. All anchor failures and relocation shall be reported on Form LS/CEA 1.0 or equivalent and sent to the Consulting Engineers for review within two weeks from the occurrence.

4.0 Inspection and Testing

4.1 Non-Safety Related Work: Contractor shall be responsible for all inspection and testing work as required or as needed, unless otherwise indicated. Purhcaser and the Consulting Engineers may, during the course of the WORK, inspect the various phases of the WORK at the Project Site for full compliance with all requirements of this Standard Specification, the Project Specification and the design drawings. Any work failing to meet the specified requirements shall be rectified or replaced by Contractor at his expense with no cost to the Purchaser.

4.2 Safety Related Work

4.2.1 General Provisions:

a. Installed concrete expansion anchors shall be subject to inspection and testing as specified in this Article 4.2.

b. Inspection and testing shall be performed using a calibrated torque wrench. The torque test shall be performed after a minimum elapsed time of 6 hours and before an elapsed time of 14 days.

c. The agency responsible for this inspection and testing shall be independent of the Contractor and shall be as designated by the Purchaser.

d. The inspected anchors shall be suitably marked.

e. The inspection results shall be documented in a suitable test report which should include information such as the following:

e1. Compliance with the minimum testing torque requirements of Table 38-8 for concrete and 38-9 for solid block.

e2. Compliance with requirements of minimum embedded lengths, spacing, edge distances, bolt projection beyond nut and plumbness, as indicated in Table 38-2, Articles 3.1.4 and 3.2.3. R4

Location of inspected anchors.

e4. Location of all anchors represented by the inspected anchor.

e5. Signature of inspector and date of inspection.

f. The inspection report should be submitted to the Purchaser for review. R4

4.2.2 Calibrated Torque Wrench Inspection:

a. Calibration: Torque wrenches to be used for inspection shall be of the dial indicating type and shall be calibrated before use to verify that they are accurate in the testing torque range. The tolerance on these torque wrenches shall be within ±4 percent. Calibration of these torque wrenches after initial qualification shall be on a monthly basis. R4

b. Frequency and Sequence:

b1. Maximum one anchor per assembly, but a minimum of one out of each ten expansion anchor installed in that assembly, shall be selected for testing. R4

b2. If the tested anchor is unacceptable, all the other anchors in the assembly as defined in b1, above, shall be tested.

c. Inspection and Acceptance

c1. On inspection, the inspector shall place the wrench on the nut of the selected anchor and apply torque to the nut until the torque reaches the applicable testing torque given in Table 38-8 or 38-9.

Table 38-8

Minimum Testing Torque for Anchors Installed in a Minimum 3500 PSI Concrete R4

Nominal Bolt Diameter (in)	Minimum Testing Torque (ft-lb)		
	Wedge Type		Sleeve Type
	4.5d	8d	
1/4	5	5	5
3/8	15	15	15
1/2	35	45	45
5/8	60	90	90
3/4	110	160	--
1	200	200	--

Table 3B-9

Minimum Testing Torque for Anchors
Installed in 1500 psi Solid Concrete Block

Nominal Bolt Diameter (in)	Minimum Testing Torque (ft-lb)	
	Wedge Type	Sleeve Type
3/8	10	10
1/2	25	25
5/8	35	35
3/4	70	--

c2. If the nut of the inspected anchor is not turned, the anchor shall be accepted. If the nut is turned, the anchor shall be considered unacceptable.

c3. Unacceptable anchors shall be reported to the responsible Contractor for re-torquing to installation torque and re-inspection. If the anchor is again unacceptable, it shall be replaced in accordance with Article 3.4.

c4. A record of the following items shall be maintained for each anchor tested or replaced.

1. Location of tested anchor

2. Embedded depth, determined by one of the following methods:

   a. Anchor length marking and measuring projection

   b. UT - Conforming to ASTM E-114 R4

3. Verification of spacing and edge distances as defined in Article 3.1.10.

4. Degree from plumb

5. Check for full engagement of nut

6. Check for quantity of washer

7. Check for washers covering oversized holes, and for deformed washers.

CONCRETE EXPANSION ANCHOR INSTALLATION

CONCRETE OR ANCHOR FAILURE/DAMAGED REBAR REPORT

Commonwealth Edison Company

Report No. _____

Date ___________

Page 1 of _____

1. ☐ LaSalle County Station Project No. Unit -1 ☐ LaSalle County Station Project No. Unit -2

2. ☐ Building ____________________ Floor Elevation __________

3. S&L Dwg. No. ________________ Detail No. ______________

4. Structural Element Affected"

   ☐ slab (top side)
   ☐ slab (bottom side)
   ☐ beam (top)
   ☐ beam (side)
   ☐ wall (exterior)
   ☐ wall (interior)
   ☐ column

5. Reason for Relocation of Anchor:

   ☐ Rebar nicked
   ☐ Rebar cut
   ☐ Anchor failure
   ☐ Concrete Failure

6. The depth of damaged rebar _______ inches.

7. Location: Attached is a sketch indicating actual location of the expansion anchor detail with respect to the nearest column lines and elevation and anchor(s) which failed or damaged rebar. Sketch shall be identified by report number and proper page number(s).

8. Prepared: (Installed Contractor) ____________________ (NAME)

   Reviewed: (Client Q.A.) ____________________ (NAME)

   ____________________ (ORGANIZATION)

   ____________________ (ORGANIZATION)

   ____________________ (DATE)

   ____________________ (DATE)

FORM LS-CEA 1.0

September 30, 1976
Rev. 5, 12-10-79

SARGENT & LUNDY
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CHICAGO

Rev. 5

STANDARD SPECIFICATION FOR

CONCRETE EXPANSION ANCHOR WORK

(FORM LS-CEA)

LASALLE COUNTY STATION

UNITS 1 AND 2

PROJECT NO. 4266, 4267

Revision 0	Issued on September 30, 1976
Revision 1	Issued on December 7, 1976
Revision 2	Issued on November 29, 1978

Revision 3:

Prepared By	S. M. Kazmi	Date	7-19-79
Reviewed By	[illegible]	Date	7-20-79
Approved By	E. R. Weaver	Date	7-20-79

Revision 4:

Prepared By	S. M. Kazmi	Date	9-7-79
Reviewed By	[illegible]	Date	9-7-79
Approved By	E. R. Weaver	Date	9-7-79

Revision 5:

Prepared By	S. M. Kazmi	Date	12-10-79
Reviewed By	[illegible]	Date	12-10-79
Approved By	E. R. Weaver	Date	12-10-79

SARGENT & LUNDY
ENGINEERS
CHICAGO

September 30, 1976
Rev. 5, 12-10-79

SPECIFICATION FOR CONCRETE EXPANSION ANCHOR WORK LASALLE COUNTY STATION - UNITS 1 AND 2

(Form LS-CEA)

Table of Contents

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ENGINEERS
CHICAGO

September 30, 1976
Rev. 5 12-10-79

SPECIFICATION FOR
CONCRETE EXPANSION ANCHOR WORK
LA SALLE COUNTY STATION - UNITS 1 AND 2

(Form LS-CEA)

1. GENERAL

1.1 Scope: All concrete expansion anchor WORK shall conform to the requirements of this Standard Specification Form LS-CEA unless otherwise indicated in the Project Specification or on the design drawings. This WORK shall include furnishing, installing, inspecting and testing of expansion anchors as indicated in the Project Specification or on the design drawings. The requirements of this Standard Specification shall also apply for attaching hangers for field routed piping and conduits.

1.1.1 For purposes of establishing basic requirements for different applications of concrete expansion anchors, the WORK shall be divided into three categories as follows:

a. Safety Related Work in a Safety Related Structure:

a1. Requires complete documentation of installation and inspection/testing as given in Articles 1.4 and 4.0

b. Non-Safety Related Work in a Safety Related structure:

b1. Requires complete documentation of installation as given in Article 1.4. Inspection/testing documentation is waived.

c. Non-Safety Related Work in a Non-Safety Related Structure:

c1. Installation, inspection/testing and the use of metal detection is waived. Cutting of reinforcing steel is not allowed, except as permitted in Article 3.2.9.d. R5

1.1.2 Classification of Structures & Components

For classification of Safety Related and Non-Safety Related Structures and Components, refer to the corresponding design drawings. "Class-I Structure," marked on structural drawings shall be considered as Safety Related. In case no classification has been shown on the drawings, it shall be construed to be Non-Safety Related Structure/Component.

1.2 Definitions (For All Expansion Anchors): The following terms, when used in this Standard Specification or in the Project Specification or on the design drawings, shall have the meanings:

R5

1.2.1 Sleeve Type Expansion Anchor: A slit tubular expansion shield, and a threaded stud bolt with integral cone expander, as shown in Figure 38-2 following:

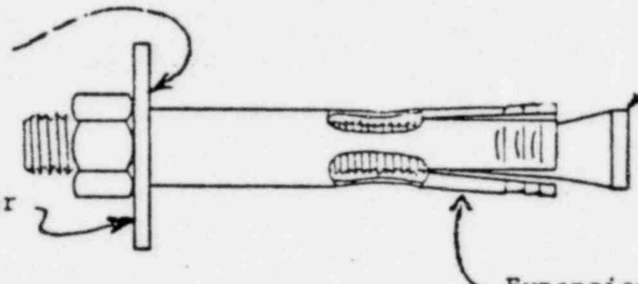

Figure 38-2 Typical Sleeve Type Expansion Anchor

1.2.2 Wedge Type Expansion Anchor: A split expansion ring and (or a separate expansion wedge pair), a threaded stud bolt with integral cone expander (or taper expander), as shown in Figures 38-3 and 38-4 following:

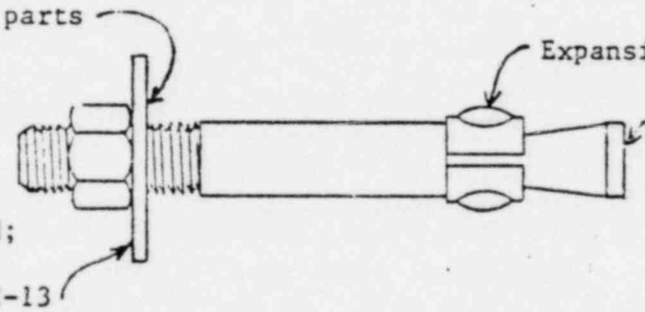

Figure 38-3 Typical Wedge Type Expansion Anchor with Expansion Ring and Cone Expander

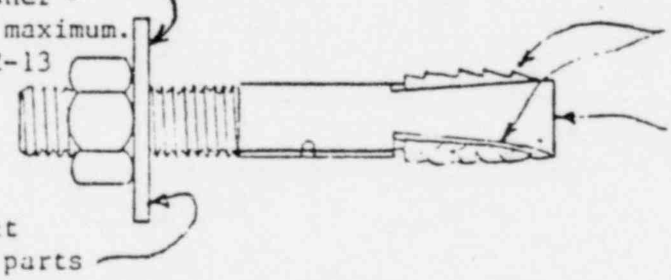

Figure 38-4 Typical Wedge Type Expansion Anchor with Expansion Wedge Pair and Taper Expander

Quality Assurance Program (For Nuclear Safety Realted Work Only): Shall conform to the requirements of the Quality Assurance Articles of the Project Specification.

1.4 Installation and Inspection Documentation

1.4.1 Installation Procedure:

Contractor shall submit a complete installation procedure to the Consulting Engineers for review, prior to any installation, in accordance with Contractor's quality assurance procedure. The procedure shall describe the implementation of this Form, LS-CEA, and shall include but not be limited to, the following:

a. Installation process

b. Equipment to be used

c. Tolerances for Equipment

d. Equipment inspecti quency

e. Types of installation devices and calibration frequency

f. Overall anchor length and minimum depth of hole for each anchor diameter.

g. Methods to insure and verify proper anchor length (i.e., marking bolt ends for lengths).

h. Methods to insure and verify proper hole depth, spacing and edge distance from anchor to edge of concrete or steel lined openings.

i. Methods to verify actual embedded length of an installed anchor with no marking for bolt length.

j. Methods to determine the angularity of the installed anchor.

k. Repair methods for damaged concrete and grouting procedure for patching up abandoned holes

l. Methods to identify the location of a nicked bar.

m. Information to be documented.

1.4.2 <u>Quality Assurance Responsibilities of the Contractor</u>

The Contractor shall be responsible for the quality assurance check for the following items in particular, but not limited to:

a. Ensure use of an approved installation procedure.

b. The anchors have been installed to the torquing requirements as specified in the Table 38-8.

c. The minimum embedment depth in accordance with the design drawings has been provided. For drawings released for construction before 7-20-79, if no embedment depth is specified, the minimum embedment depth shall be 4.5d. For the drawings released first time or revised showing anchor size/plate changed, on/after 7-20-79, the minimum embedment depth shall be '<u>8d</u>', if no specific embedment depth is shown on the drawings.

d. If the installed anchor is at an angle and the angularity exceeds the tolerances shown in Section 3-2.3 of this specification, a report shall be submitted to the purchaser.

e. If the nut of the anchor is not fully engaged, a report shall be submitted to the purchaser.

f. While drilling holes for anchor installation, if trial drills have been made in the concrete wall or slab, it has to be ensured that the concrete has been repaired by grouting before the final installation of the plate is made.

g. Verification of spacing and edge distances as specified in Table 38-5 and Figure 38-6.

h. Verification that anchor or concrete failure/damaged rebar reports have been reported on Form LS-CEA 1.0.

i. Check quality of weld for welded plate washers shown in Tables 38-4A and 38-4B, as per the approved welding procedure. R5 [illegible].3 Inspection Procedure (Safety Related Work Only):

The agency responsible for the inspection and testing specified in Article 4 shall submit a complete inspection procedure to the Purchaser for review prior to any inspection. The procedure shall describe the implementation of this form and shall include but not be limited to, the following:

a. Inspection process and frequency

b. Equipment to be used

c. Tolerances for equipment

d. Calibration frequency for inspection devices

e. Information to be documented

2. Materials

2.1 Type and Finish of Materials:

Concrete expansion anchors and accessories shall be made of carbon steel with zinc plated finish conforming to U.S. Federal Specification QQ-Z-325B. Stainless steel may be used in place of this zinc coated carbon steel.

2.2 Strength of Materials:

The material shall have a minimum yield strength of 60,000 psi for self-drilling and wedge type anchors, and 50,000 psi for sleeve type anchors. The material shall have a minimum tensile strength of 75,000 psi for all anchors.

2.3 Cross-Sectional Areas:

The smallest cross-sectional area of the stud bolt of an expansion anchor shall not be less than the cross-sectional area at the thread root.

2.4 Size Limits:

The bolt size limits for expansion anchors shall be as follows: (all sizes shown on design drawings are bolt sizes for sleeve and wedge type anchors). R5

2.4.1 Sleeve Type: 1/4" through 5/8" diameter of stud bolt.

2.4.2 Wedge Type: 1/4" through 1" diameter of stud bolt.

2.5 Types and Makes of Anchors:

Concrete expansion anchors used for the WORK shall be one of the types and makes indicated in Table 38-1. Other concrete expansion anchors not specified in Table 38-1 may also be acceptable provided they meet the requirements of this specification and are specifically approved by the Consulting Engineers.

2.6 Certificate of Conformance

For nuclear safety related work, the material supplier shall provide certificate of conformance for each shipment made to the site.

TABLE 38-1

Types, Classifications, Use and Makes of Expansion Anchors

Types of Anchors	Sleeve	Wedge
U.S. Federal Specification FF-S-325 Classifications	Group II Type 3 Class 3	Group II Type 4 Class 1
Permissible Use	For Block Walls Only	For All Work

Manufacturers	Products	
a. Hilti Fastening Systems, Inc.	--	Hilti Kwik-Bolt Stud Wedge Anchors
b. ITT Phillips Drill Company	Red Head Hex Nut Sleeve Anchors	Red Head Wedge Anchors
c. Ramset Fastening Systems	Dynabolt Mark II Hex Nut Sleeve Anchors	Trubolt Wedge Anchors
d. The Rawlplug Company, Inc.	Rawl Lok/Bolt Hex Nut Sleeve Anchors	Rawl-Stud Wedge Anchors
e. USM Corporation Construction Products Division	Parasleeve Hex Nut Masonry Anchors	Parabolt Wedge Anchors
f. Wej-It Corporation of Allied Products Corp.	--	Wej-It Double Wedge Anchors

R5

Installation

(For all expansion anchors except as noted)

3.1 General Provisions:

3.1.1 Concrete expansion anchors shall be installed in accordance with the manufacturer's specifications and recommendations and the requirements of this Form LS-CEA. In case of conflict, the requirements of this form shall govern.

3.1.2 The minimum embedded lengths, spacing and edge distance for expansion anchors shall conform to Table 38-2 and Figure 38-6 unless otherwise indicated in Article 3.1.10.

3.1.3 The overall anchor length and the hole depth required shall be determined by Contractor such that the specified minimum embedment length and bolt projection can be obtained.

3.1.4 As a minimum, nut shall be flush with the end of an anchor, however, a 1/4" thread projection above the nut after installation is recommended. If projection exceeds 1/4", projection shall not be removed without the consent of the Consulting Engineer. If consent is given, a record of embedment depth shall be made for all anchor with removed projections.

3.1.5 Holes for the anchors may be drilled through hardened grout, but the embedded length shall be determined from the surface of the rough concrete. Holes for the anchors may be drilled through surface repaired concrete, but the embedded length shall be determined in accordance with Article 3.1.9. Holes shall not be drilled through grout or repaired concrete that has not completely hardened nor shall grout or concrete be placed around anchors without the approval of the Consulting Engineers.

3.1.6 Reuse of expansion anchors shall not be permitted.

3.1.7 1/4"Ø expansion anchors are allowed in all locations of reinforced concrete, except where prohibited in Table 38-5, provided the required hole depth is less than the effective depth of the concrete covering the main reinforcement. 1/4"Ø expansion anchors shall not be used in solid block walls. R5

3.1.8 Welding on expansion anchors is not permitted without approval of the Consulting Engineers.

3.1.9 For anchors installed in holes drilled through surface repaired concrete extending beyond the rebar cover, the dimension (Le) given in Table 38-2 shall be increased by a dimension X as shown in Figure 38-5. In addition, 1/4"Ø expansion anchors are not allowed to be installed through surface repaired concrete.

where X = thickness of concrete cover plus nominal diameter of outside bar.

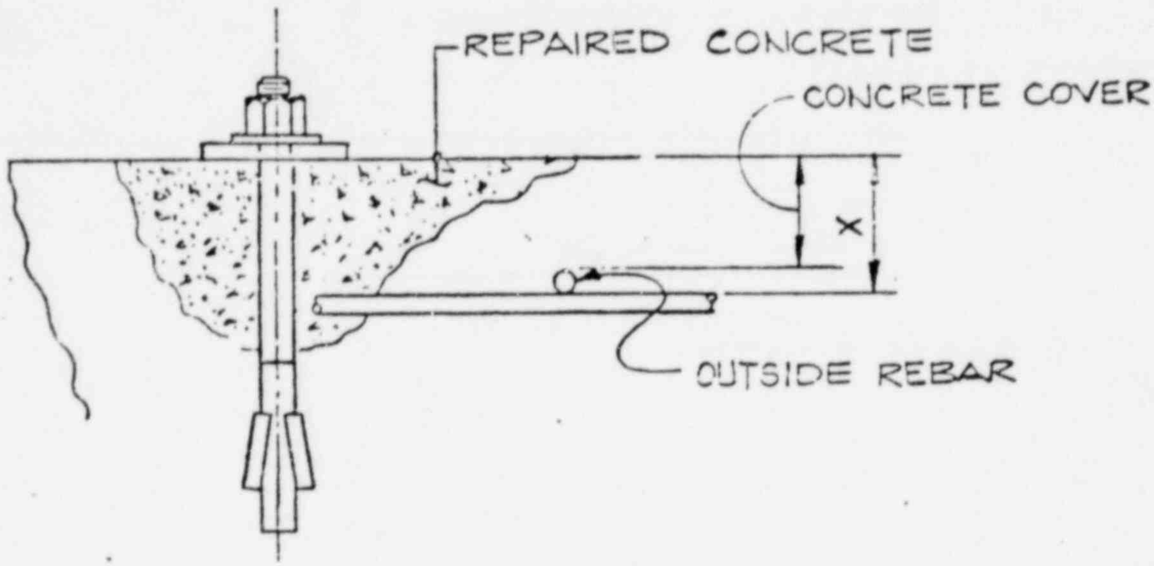

Figure 38-5

Anchors Installed in Repaired Concrete

3.1.10 Refer to Table 38-2 and Figure 38-6, where in:

S = Center to Center distance between anchors in adjacent assemblies
E_D = Edge distance, measured from center of the anchor to the nearest concrete edge
E_S = Edge distance, measured from center of the anchor to the nearest surface of a steel lined opening (sleeve, etc.)

a. When two anchors of different diameters are installed adjacent to each other, "S" shall be the average of the two "S" dimensions.

b. If dimensions ED, ES and S cannot be maintained between two anchor assemblies, allowable erection tolerance indicated on the design drawings should be used to resolve the problem. If the problem involves anchors installed by two different contractors, their erection tolerances should be used or the Consulting Engineers should be notified for a resolution.

c. For anchors installed to a minimum of '8d' embedded length, Le shall be to the untorqued position of the expansion ring. For anchors installed to the 4.5d embedment length requirement, Le shall be to the bottom of the anchor before torquing. For such anchors (4.5d), a minimum depth of '3.5d' after torquing shall be acceptable.

d. If Le cannot be met, the Consulting Engineers should be notified before work proceeds.

e. Edge distances to the side of embedded steel plates shall be the 'S' dimension.

3.1.11 Where the concrete surface is uneven, the following shall be the acceptance criteria for uneven surface between the plate and the mounting surface. This criteria need not be met for attachments with rod type hangers.

a. Gaps between the mounting surface and the plate are acceptable if:

1. Width of the gap 'a' along the length or width of the plate does not exceed dimension, as shown in Figure 38-10.

2. Length of gap 'b' extending into the plate beyond width 'a' is limited to 20% or less of the plate length (i.e., at least 80% contact length is available beyond dimension 'a'.

This acceptance criteria shall be applied after welding of all attachments to the plate has been completed.

Mounting surface and the plate shall be assumed to be in contact when a 1/32 inch feeler gauge inserted between them makes contact with both the surfaces. The plate shall be checked for contact along the entire perimeter. R5

b. For gaps not meeting the requirements of (a) above, the concrete surface shall be improved by grinding or bush hammering. Alternatively, the gap may be filled by inserting shims between the plate and the mounting surface to ensure that at least 60% length along the plate edge is shimmed or is in contact. The shims shall be placed evenly along the plate edge, with a shim provided at each corner where a gap exists. When the shims are made discontinuous to clear anchors, the spacing between the shim pieces shall not exceed dimension 'd' as shown in Figure 38-11.

c. The shims shall be flat or tapered and of the thickness as required to fill the gap. The shims shall extend into the gap as required but need not exceed dimension 'c' as shown in Figure 38-11. The material for shims shall be ASTM A-36 or equivalent.

d. Each shim shall be tack-welded to the plate at two ends.

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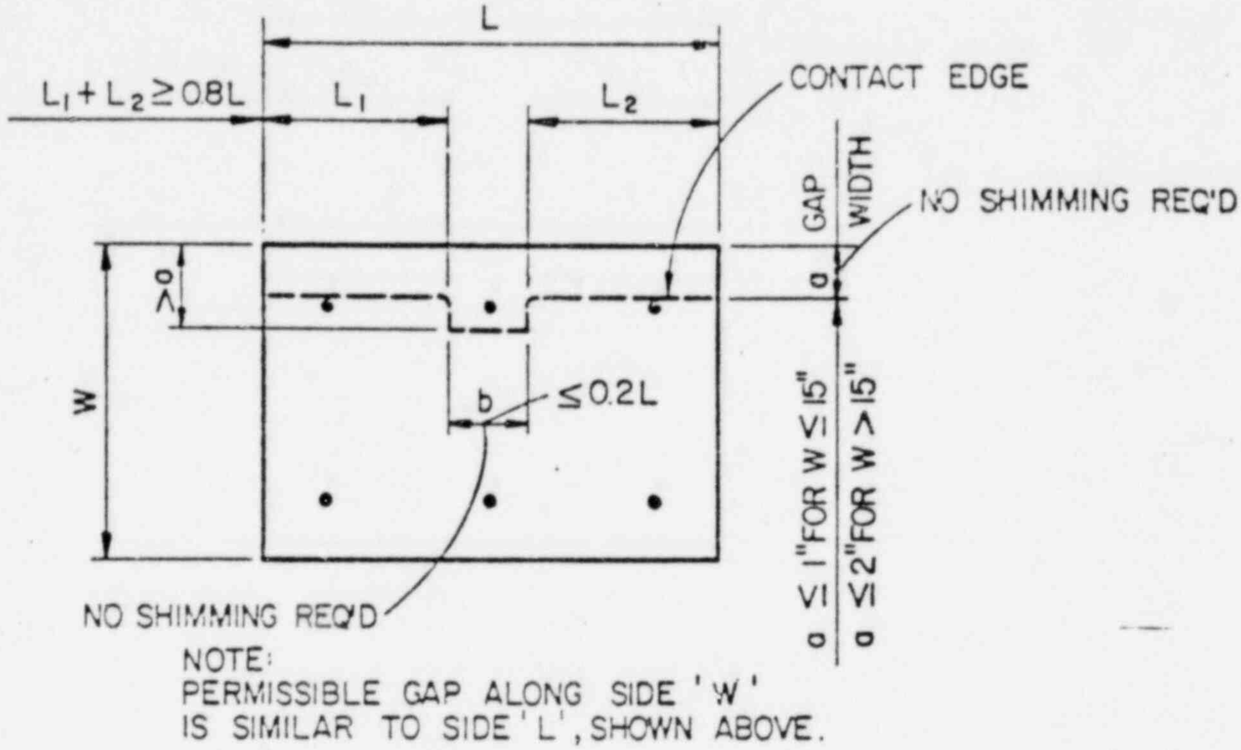
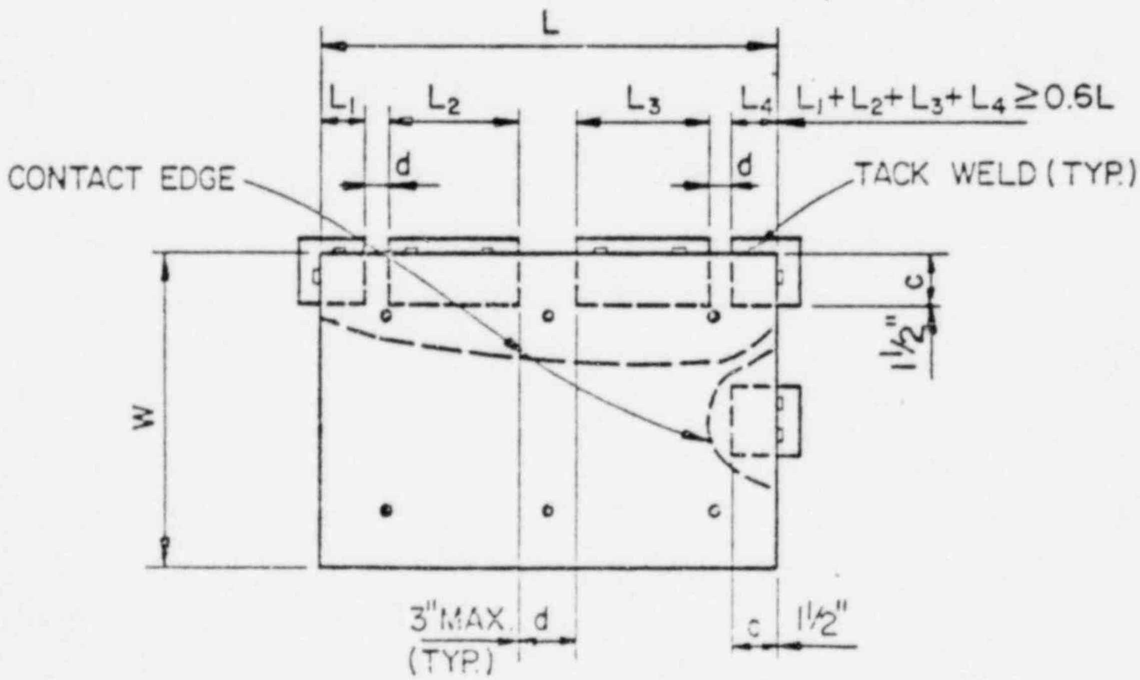


CONTACT DETAIL

FIG. 38-10



SHIMMING DETAIL

FIG. 38-11

Table 38-2

Minimum Embedded Length, Spacing And Edge Distance
For Expansion Anchors

Nominal Bolt Diameter (inch)	Minimum Embedded Length (inches) Le		Minimum Spacing (inches) (S)	Minimum Edge Distance (inches)			
				Ed		Es	
	4.5d	8d		4.5d'	8d'	4.5d'	8d'
1/4	-	0.875"	2.5	1.5	3.25	1	1.75
3/8	1.75"	3.0	4.5	2.5	5.0	1.25	2.5
1/2	2.25	4.0	6.0	3	7.0	1.5	3.5
5/8	2.8	5.0	7.5	4	8.5	2	4.25
3/4	3.4	6.0	9.0	5	10.0	2.5	5.0
1	4.5	8.0	12.0	6	13.0	3	6.5

R5

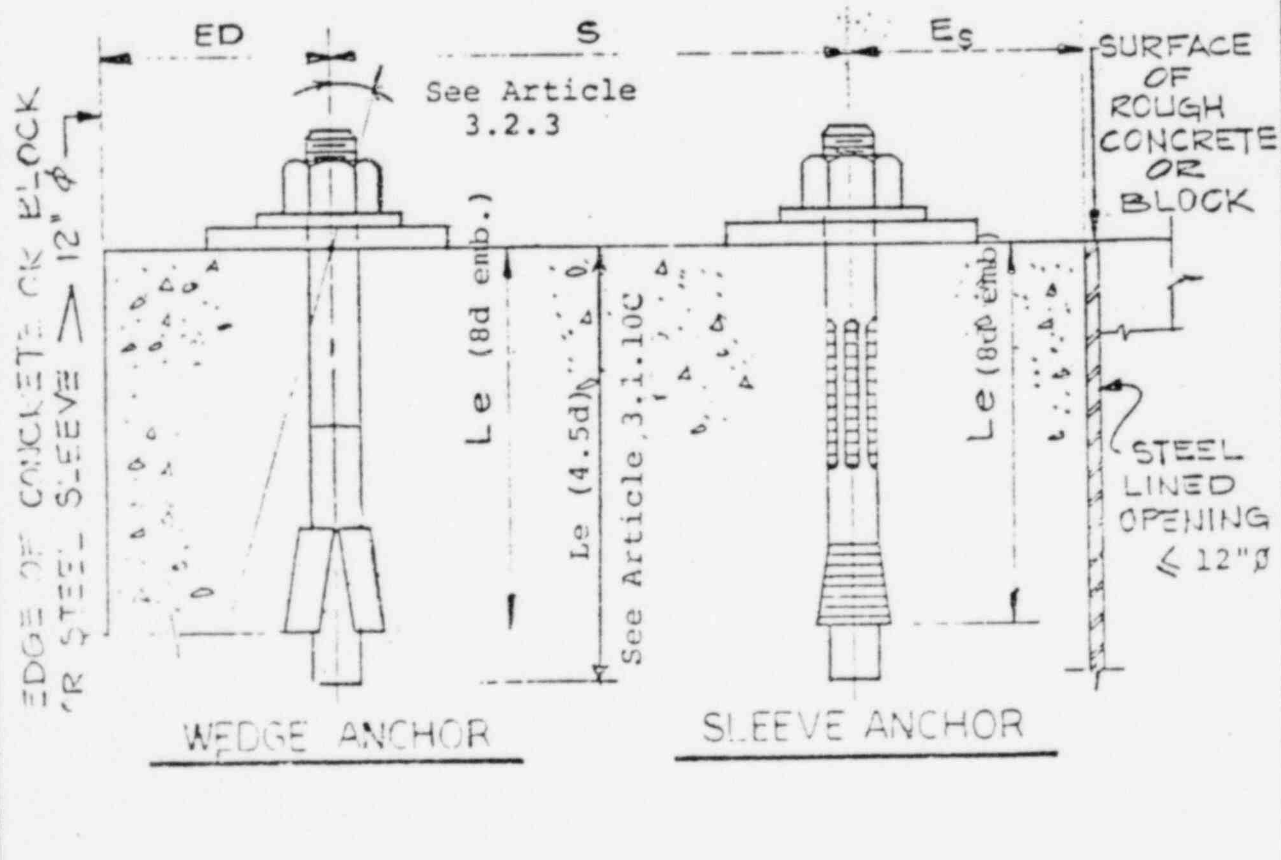


FIGURE 38-6

3.2 Drilling of Holes

3.2.1 For all expansion anchors, except self-drilling type, holes in concrete shall be drilled with quality carbide tipped solid bits, using a rotary/percussion type power drill.

3.2.2 Each hole shall be drilled precisely in order to maintain the expansion anchor's pullout value. The tolerance on the bit shall be within the tolerances specified in American National Standard Institute B94.12 Standards or closer for each anchor size. The nominal drill size for each size anchor shall be as recommended by anchor manufacturer. R5

3.2.3 The anchor shall be no more than 5° out of plumb for '4.5d' embedment and 10° for '8d' embedded length after installation. Angular deviation shall be measured from the top of concrete or plate surface to the exposed end of installed anchor. For angular deviation greater than 3°, square or rectangular bevelled washers shall be placed between the attachment and the nut to maintain bearing of the nut within 3° tolerance. R5

3.2.4 The maximum depth of the hole shall not be greater than the thickness of the concrete minus 2-1/2 inches. In addition, for 1/4" diameter anchors, the maximum hole depth is 1-1/4 inch. R5

3.2.5 Holes for the concrete expansion anchors shall not be drilled until the concrete has been cured for a minimum of 28 days.

3.2.6 If drilled holes are not used, they shall be filled with dry-pack grout. The grout is to have a minimum compressive strength of 3500 psi.

3.2.7 The criteria for drilling holes in concrete shall be as indicated in Table 38-5 and Figure 38-7 through 38-9.

3.2.8 At locations where a metal detector is required, a deep magnetic detector shall be used to locate the reinforcement in the concrete and to assure that the reinforcement will not be cut or nicked. Reinforcing placement drawings may be used as reference in conjunction with the use of the detector. This detector may be one of those indicated in Table 38-3.

Table 38-3

Products and Manufacturers of Magnetic Detectors

Products	Manufacturers
James "R" Meter C-4952	James Electronics, Inc. Chicago, Illinois
Profometer	Pro ceq. SA Riesbachstrasse 57 CH-8034 Zurich 8, Switzerland
CT-4949 A Deep Pachometer	Soiltest, Inc. Evanston, Illinois

3.2.9 In areas where metal detection is not required and a reinforced bar is nicked, the following procedure shall be followed:

a. The location where the reinforcing bar is nicked shall be suitably identified on the anchor plate where this bar is located so that all contractors can identify the damaged rebar location.

b. The damaged rebar shall be documented on Form LS-CEA 1.0 or equivalent and sent to the Consulting Engineer for review within two weeks from the occurrence.

c. Further drilling of holes shall be performed by using a metal detector within the following areas:

c1. A 18'-0" x 18'-0" square with its center at the point where the reinforcing bar was damaged when the reinforcing bars are spaced 12 inches or more on centers.

c2. A 9'-0" x 9'-0" square with its center at the point where the reinforcing bar was damaged when the reinforcing bars are spaced less than 12 inches on centers.

d. It is permissible to cut one reinforcing bar per anchor plate within the areas given in Article 3.2.9c above. For example, consider an anchor plate detail installed with four expansion anchors, one expansion anchor may be installed through reinforcing steel provided the remaining three anchors do not hit reinforcing steel and no other damaged reinforcing bars are identified within the areas given in Article 3.2.9c above.

e. When it is permissible to cut reinforcing steel, it shall be cut using a quality diamond carbide tipped bit.

3.2.10 In area where metal detection is required, the following procedure should be followed:

a. Using a metal detector, the location of all holes to be drilled and reinforcing bar pattern shall be laid out on the structural element.

b. If metal detection indicates the presence of a reinforcing bar at the anchor design location, the anchor plate assembly should be moved within the allowable erection tolerance indicated on the design drawings to clear the reinforcing bar.

c. If the anchor plate tolerance does not allow sufficient movement to clear reinforcing, the Consulting Engineer shall be notified so that the problem can be resolved before proceeding.

d. If per chance the reinforcing bar is still nicked, the procedures given in Article 3.2.9 shall be followed.

3.2.11 Where Table 38-5 or Figure 38-7 to Figure 38-9 refers to this article, drilling or holes is allowed without the use of the metal detector if no reinforcing bar has been identified as damaged within the areas given in Article 3.2.9c. If a reinforcing bar has been cut or nicked, the procedures in Article 3.2.9 shall be followed.

3.2.12 The use of a metal detector is not required for 1/4 inch diameter anchors.

3.2.13 The maximum number of standard washers or combination of standard washersand A-36 plate washers shall be limited to five.

3.2.14 The location of an individual anchor can be changed to facilitate installation provided the following tolerances are met:

a. <u>Relocation of One or Two Bolts Per Assembly (Fig. 38-12)</u>

For bolts with '4.5d' or '8d' embedment, a relocation within a circle of '2d' radius shall be permissible, if the following requirements are met: R5

1. The minimum edge distance between the anchor and the plate edge meets the requirements as shown in Table 38-4.

2. Requirements of E_s, E_d, L_e per Table 38-2.

3. If the angularity of the relocated anchor is $\leq$ 4°, use of the same size anchor is allowed.

4. If the angularity of the relocated anchor is $>$ 4°, and $<$ 10°, next larger size shall be used for the relocated anchor. For example, use 5/8"Ø anchor in place of 1/2"Ø, 1"Ø in place of 3/4"Ø. For existing 1"Ø anchor, the relocated anchor shall be of the same diameter and the angularity limitation of 4°, per paragraph 3.2.14.a.3 shall be maintained.

b. <u>Relocation of More Than Two Bolts Per Assembly</u>

Such cases shall be reported to the Consulting Engineers for resolution on a case by case basis.

c. Relocation of Bolts Outside the Existing Plate Assemblies

1. The maximum permissible relocation shall be in an arc of radius 3" as shown in Figure 38-13 and Figure 38-14.

2. Requirements of E_s, E_d, L_e per Table 38-2 and minimum edge distance requirements per Table 38-4 shall be met.

3. In case only one bolt in an assembly is relocated outside the existing assembly, a new rectangular plate of the same thickness as the existing assembly plate, of size WxL' or W'xL', based on the minimum edge distance requirement, shall be used.

4. In case two or more anchors are relocated, a new rectangular plate, of thickness 1/4" more than the existing assembly plate, of size WxL' or W'xL', based on the minimum edge distance requirement, shall be used.

5. The anchor size shall remain the same as in the existing plate assembly, except where more than half of the total number of anchors are being moved. For such cases, the Consulting Engineer shall be contacted for resolution.

R5

Table 38-4

Anchor Size	Minimum Edge Distance for Punched, Reamed or Drilled Holes (inches)	
	At Sheared Edges	At Rolled Edges of Plates or Gas Cut Edges
1/4"	1/2"	3/8"
3/8"	3/4"	1/2"
1/2"	7/8"	3/4"
5/8"	1-1/8"	7/8"
3/4"	1-1/4"	1"
1"	1-3/4"	1-1/4"

3.2.15 Where oversize and slotted holes are provided in the field to facilitate installation, hardened washer or square structural plate washers of A-36 material, as shown in the Table 38-4A & 38-4B, shall be used. Such washer shall cover the entire hole area in the plate. Holes can be enlarged by flame cutting up to 1/8" less than the required size, and then reamed or rotary filed to the size required.

3.2.16 If an installed plate is to be replaced by a new larger plate, the minimum center to center distance from the existing anchor to the new anchor shall be 2 times the nominal bolt diameter. The projecting end of the existing anchor shall be cut off per Section 3.4.2.c.

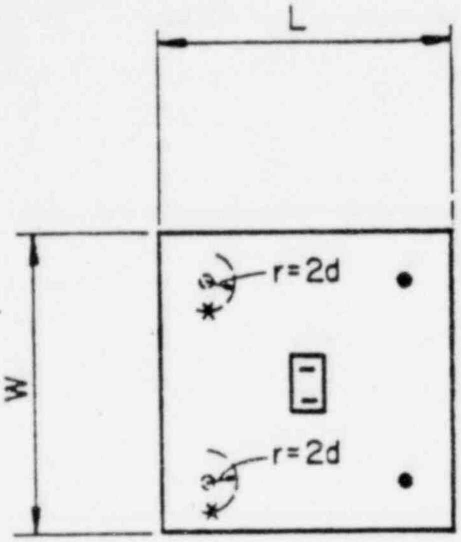


FIGURE 38-12

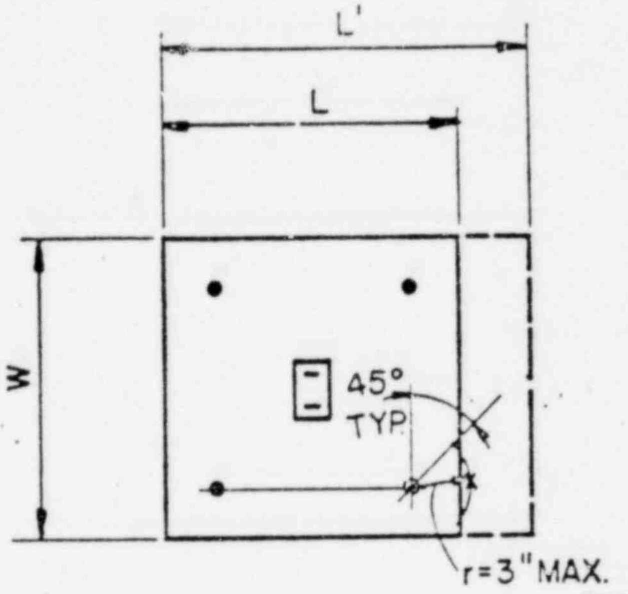


FIGURE 38-13

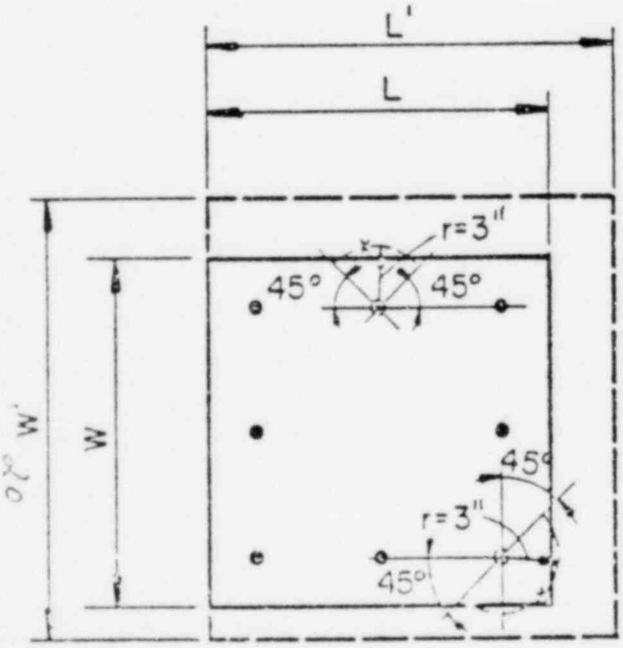


FIGURE 38-14

• – ANCHORS INSTALLED WITHOUT INTERFERENCE
○ – REBAR INTERFERENCE
X – RELOCATED ANCHOR

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TABLE 38-4A

Plate Washer Size - For Slotted Holes

SHORT SLOT			LONG SLOT		
ANCHOR SIZE (d) (inches)	MAX. SLOT SIZE (inches) (d+1/16)(d+1/4)	MINIMUM WASHER SIZE	MAX. SLOT SIZE (inches) (d+1/16)(2-1/8d)	MINIMUM PLATE WASHER SIZE (inches)	WELD SIZE
1/4	5/16 x 1/2	Use	5/16 x 9/16	2 x 2 x 1/4	
3/8	7/16 x 5/8	Minimum	7/16 x 7/8	2 x 2 x 1/4	See
1/2	9/16 x 3/4	of 2	9/16 x 1-1/8	2-1/2 x 2-1/2 x 1/4	Note
5/8	11/16 x 7/8	Standard	11/16 x 1-3/8	2-1/2 x 2-1/2 x 3/8	Below
3/4	13/16 x 1	Hardened	13/16 x 1-3/4	3 x 3 x 3/8	
1	1-1/16 x 1-1/4	Washers	1-1/16 x 2-1/8	3-1/2 x 3-1/2 x 3/8	

NOTE: Plate washers shown in table above shall be welded to the base plate on two opposite sides of the plate washer with a 1-1/2" long fillet weld. For 3/16" thick plate washers, use 3/16" weld, and for 1/4" and 3/8" thick plate washers, use 1/4" fillet weld.

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TABLE 38-4B

Plate Washer Size - For Oversize Holes

NOMINAL BOLT DIAMETER (inches)	PLATE WASHER HOLE (inches)	WELD SIZE	HOLE SIZE IN PLATE (inches)	MINIMUM WASHER SIZE (inches)	HOLE SIZE IN PLATE (inches)	MINIMUM WASHER SIZE (inches)
1/4	5/16		1/2	1-1/2 x 1-1/2 x 3/16	9/16 to 3/4	2 x 2 x 1/4
3/8	7/16	See	5/8	1-5/8 x 1-5/8 x 3/16	11/16 to 7/8	2-1/8 x 2-1/8 x 1/4
1/2	9/16	Note	3/4	1-3/4 x 1-3/4 x 3/16	13/16 to 1	2-1/4 x 2-1/4 x 1/4
5/8	11/16	Below	7/8	2 x 2 x 3/16	15/16 to 1-1/8	2-1/2 x 2-1/2 x 1/4
3/4	13/16		1	2-1/8 x 2-1/8 x 3/16	1-1/16 to 1-1/4	2-5/8 x 2-5/8 x 1/4
1	1-1/16		1-1/4	2-1/2 x 2-1/2 x 3/16	1-5/16 to 1-3/4	3 x 3 x 3/8

NOTE: Plate washers shown in table above shall be welded to the base plate on two opposite sides of the plate washer with a 1-1/2" long fillet weld. For 3/16" thick plate washers, use 3/16" weld and for 1/4" and 3/8" washer plates, use 1/4" fillet welds.

Table 38-5

Criteria for Drilling Holes for Expansion Anchors in Concrete

Element			Area No.	Description
Concrete Slabs*			1	See Figure 33-7
Concrete Beams			2	See Figure 38-3
Concrete Columns			3	Drilling is allowed with tne use of the metal detector.
Concrete Walls	Interior		4	See Article 3.2.11
Concrete Walls	Exterior	Above grade	5	For nuclear safety related wall and walls monolithic to nuclear safety related walls, see criteria for walls below grade. For other walls, see Article 3.2.11.
Concrete Walls	Exterior	Below grade	6	Drilling holes is allowed. For the use of metal detector, see Figure 38-9.
Primary Containment Exterior Wall & Drywell Floor			7	No drilling is allowed, unless approved by consulting engineer.
Concrete Slabs on Metal Deck			8	For the top of the slab, see Article 3.2.11. For the bottom of the slab, drilling is not allowed.
Concrete Finish			9	Drilling holes is allowed provided the hole is completely within the concrete finish. Metal detection is not required. However, anchors installed in Safety Related structures shall not be placed in the finish unless shown on the design drawings or approved by Consulting Engrs.
Foundation Mat	Containment		10	No drilling is allowed.
Foundation Mat	Others		11	Drilling of holes is allowed. For application where the metal detector is to be used, see Figure 38-7. For mats, "L" is the distance between adjacent column centerlines.
Concrete for Steam Tunnels			12	Drilling of holes is allowed with the use of metal detector.
Concrete for Fuel Pools			13	Drilling of holes is allowed with the use of metal detector.
Masonry Block Walls			14	No drilling is allowed unless shown on the design drawings or approved by the Consulting Engineers.
Turbine Foundation			15	No drilling is allowed unless approved by the Consulting Engineer.

*NOTE: No expansion anchors allowed in magnetite concrete.

R3

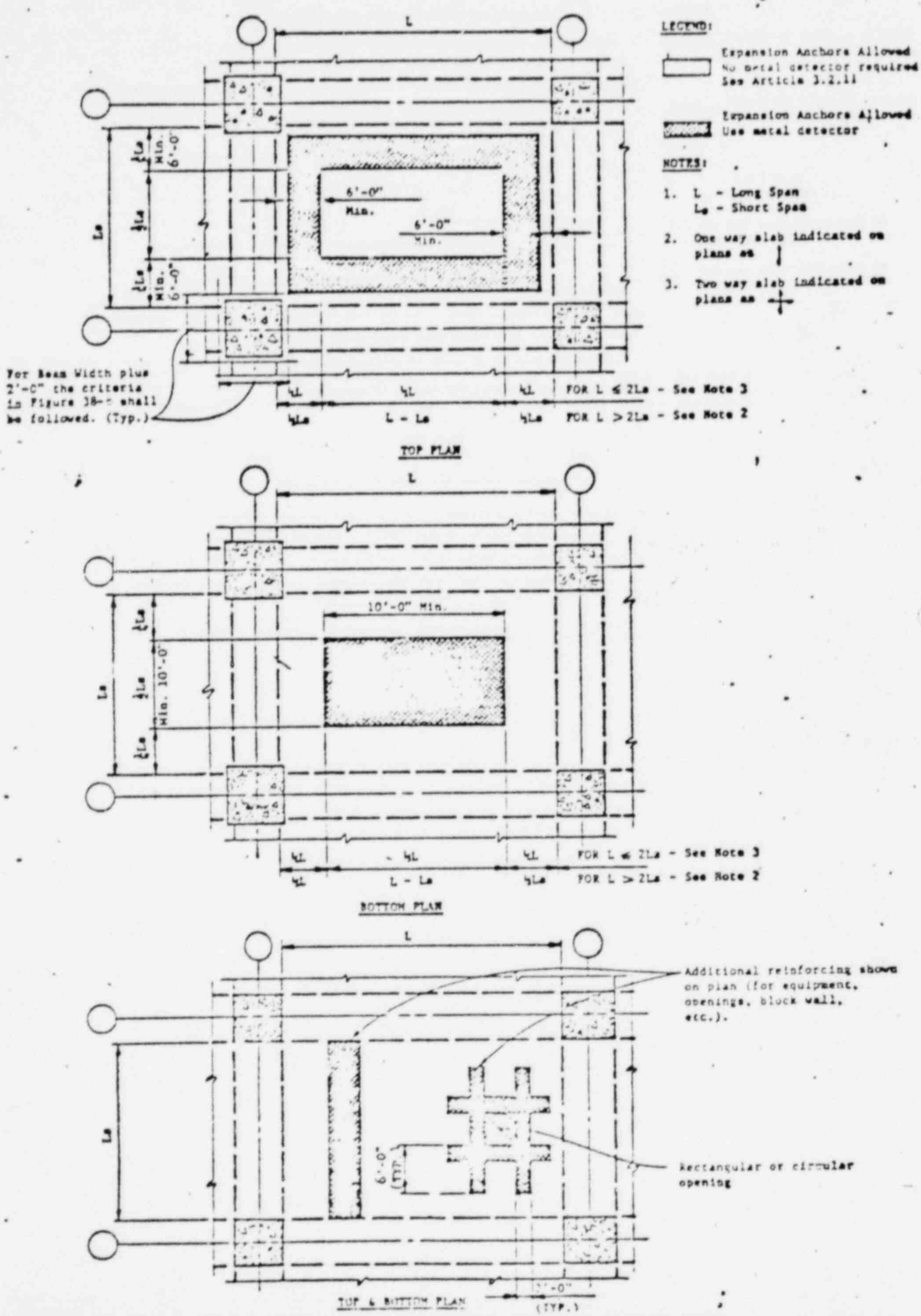

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FIGURE 38-7 CRITERIA FOR DRILLING OF HOLES FOR EXPANSION ANCHORS IN CONCRETE SLABS

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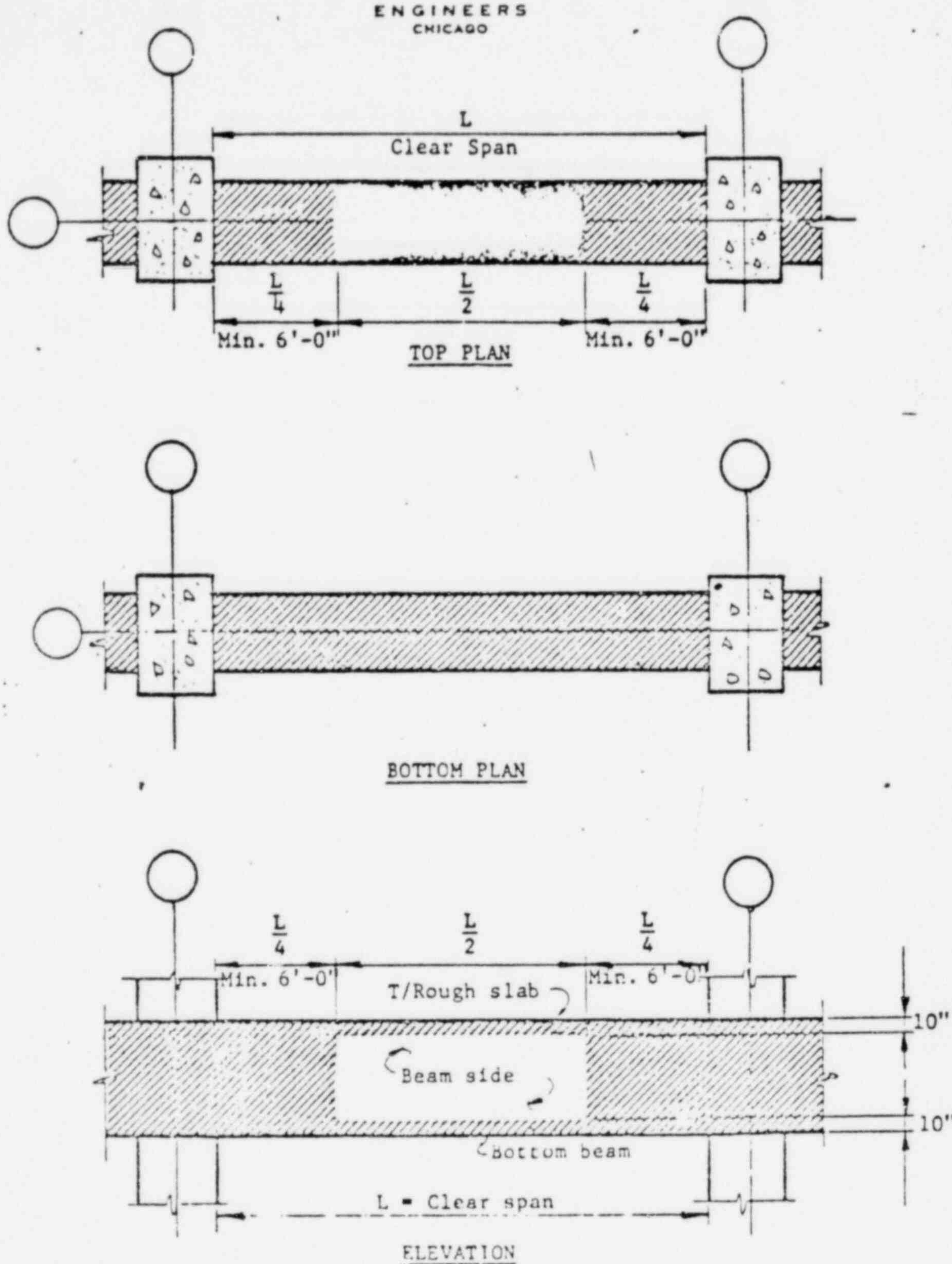

Exp. anchor allowed, no metal detector required.

No exp. anchor allowed, except 1/4" diameter anchor

Exp. anchor allowed, use metal detector.

R5

FIGURE 38-8 CRITERIA FOR DRILLING OF HOLES FOR EXPANSION ANCHORS IN CONCRETE BEAMS

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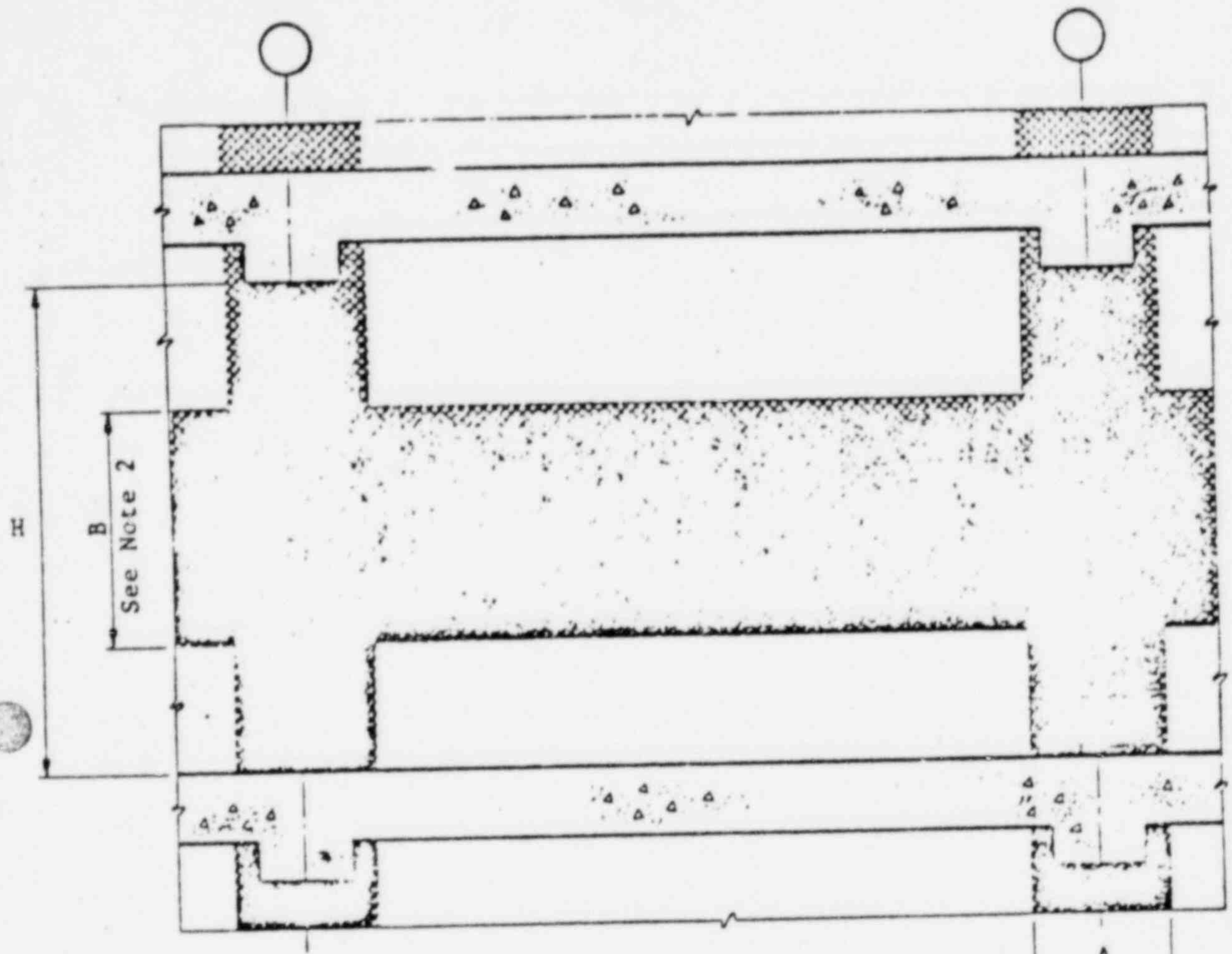

INSIDE FACE ELEVATION

(blank box)	Expansion Anchors Allowed No metal detector required See Article 3.2.11
(shaded box)	Expansion Anchors Allowed Use metal detector

Noted: 1. Dimension "A" shall be as follows:

a. If a wall column is present, "A" shall be the width of the wall column plus two feet.
b. If otherwise, "A" shall be the width of the beam above plus two feet.

2. Dimension "B" shall be the middle one half of "H" but a minimum of 16 feet.

Figure 3B-9 CRITERIA FOR DRILLING OF HOLES FOR EXPANSION ANCHOR IN ALL EXTERIOR CONCRETE WALLS BELOW GRADE AND NUCLEAR SAFETY RELATED EXTERIOR CONCRETE WALLS ABOVE GRADE

3.3 Tightening of Expansion Anchors:

3.3.1 After the anchors for a connection are driven into the holes, they shall be brought to a "hand-tight" condition so that all parts of the connection are in contact with one another.

3.3.2 For wedge and sleeve type anchors, the anchors shall be tightened to the torque values given in the applicable Table 38-6 or Table 38-7. This tightening shall proceed systematically from the most rigid or inner part of the connection to its free edges. During this operation, there shall be no rotating of the parts except the nuts.

3.3.3 A calibrated torque wrench shall be used for tightening expansion anchors. Verification of calibration and recalibration shall be performed per the Contractor's approved procedure. The following frequency is acceptable.

a. For a direct reading torque wrench, on a monthly basis.

b. For snap-type torque wrench, on a weekly basis, by using an upright or horizontal bench tester. This tester shall be verified for calibration or recalibrated at a frequency prescribed by the manufacturer. R5

Table 38-6 Installation Torque, ft-lb.
For Anchors Installed in Minimum 3500 PSI Concrete

Nominal Bolt Diameter	Torque Range Wedge Type Anchors	
	4.5'd' Emb.	8'd' Emb.
1/4"	5 - 8	6 - 8
3/8"	25 - 35	27 - 35
1/2"	55 - 65	65 - 75
5/8"	80 - 90	130 - 150
3/4"	150 - 175	230 - 270
1"	250 - 300	280 - 320

The Contractor shall exercise caution not to over torque the bolt to cause damage to concrete or bolt.

R5

Table 38-7

Installation Torque for Anchors
Installed in Solid Block Walls

Nominal Bolt Diameter (in)	Torque Range (ft-lb)	
	Wedge Type	Sleeve Type
3/8	16 ± 1	16 ± 1
1/2	50 ± 2	50 ± 2
5/8	70 ± 2	70 ± 2
3/4	135 ± 5	--

R5

3.4 Repair of Failures: Failures shall be rectified as follows:

3.4.1 Concrete Failure: This shall include all cracking or spalling of the concrete in the vicinity of an installed anchor.

a. The concrete shall be repaired in accordance with the project concrete repairing procedure.

b. After the concrete has been repaired, the anchor hole may be drilled in accordance with Article 3.1.5.

c. All concrete failures shall be reported on Form LS-CEA 1.0/or equivalent and sent to the Consulting Engineers for review within two weeks from the occurrence.

3.4.2 Anchor Failure: This shall include anchor breakage, slippage equal to or greater than one anchor diameter, or loosening to the extent that the anchor cannot be tightened to the installation torque.

a. If the unacceptable anchor can be removed without damaging the surrounding concrete, the hole may be redrilled and the anchor replaced with the next larger size anchor. The embedded length shall conform to the requirements of Table 38-2 and Figure 38-6.

b. If the unacceptable anchor cannot be removed without damaging the surrounding concrete, the anchor location shall be moved within the tolerance given for the anchor plate detail. The minimum center to center distance from the unacceptable anchor to the replacement hole shall be 2 times the nominal bolt diameter. If this distance exceeds the given tolerance on the placement of the anchor plate detail, the Consulting Engineers shall be notified before proceeding.

c. Unacceptable anchors that cannot be removed without damaging the surrounding concrete shall have their projecting end cut off. A saw-cut or flame-cut method is acceptable for removing this projection.

d. All anchor failures and relocation shall be reported on Form LS/CEA 1.0 or equivalent and sent to the Consulting Engineers for review within two weeks from the occurrence.

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4.0 Inspection and Testing

4.1 Non-Safety Related Work: Contractor shall be responsible for all inspection and testing work as required or as needed, unless otherwise indicated. Purhcaser and the Consulting Engineers may, during the course of the WORK, inspect the various phases of the WORK at the Project Site for full compliance with all requirements of this Standard Specification, the Project Specification and the design drawings. Any work failing to meet the specified requirements shall be rectified or replaced by Contractor at his expense with no cost to the Purchaser.

4.2 Safety Related Work

4.2.1 General Provisions:

a. Installed concrete expansion anchors shall be subject to inspection and testing as specified in this Article 4.2.

b. Inspection and testing shall be performed using a calibrated torque wrench. The torque test shall be performed after a minimum elapsed time of 6 hours and before an elapsed time of 14 days.

c. The agency responsible for this inspection and testing shall be independent of the Contractor and shall be as designated by the Purchaser.

d. The inspected anchors shall be suitably marked.

e. The inspection results shall be documented in a suitable test report which should include information such as the following:

e1. Compliance with the minimum testing torque requirements of Table 38-8 for concrete and 38-9 for solid block.

e2. Compliance with requirements of minimum embedded lengths, spacing, edge distances, bolt projection beyond nut and plumbness, as indicated in Table 38-2, Articles 3.1.4 and 3.2.3.

Location of inspected anchors.

e4. Location of all anchors represented by the inspected anchor.

e5. Signature of inspector and date of inspection.

f. The inspection report should be submitted to the Purchaser for review.

4.2.2 Calibrated Torque Wrench Inspection:

a. Calibration: Torque wrenches to be used for inspection shall be of the dial indicating type and shall be calibrated before use to verify that they are accurate in the testing torque range. The tolerance on these torque wrenches shall be within ±4 percent. Calibration of these torque wrenches after initial qualification shall be on a monthly basis.

b. Frequency and Sequence:

b1. Maximum one anchor per assembly, but a minimum of one out of each ten expansion anchor installed in that assembly, shall be selected for testing.

b2. If the tested anchor is unacceptable, all the other anchors in the assembly as defined in b1, above, shall be tested.

c. Inspection and Acceptance

c1. On inspection, the inspector shall place the wrench on the nut of the selected anchor and apply torque to the nut until the torque reaches the applicable testing torque given in Table 38-8 or 38-9.

Table 38-8

Minimum Testing Torque for Anchors Installed in a Minimum 3500 PSI Concrete

Nominal Bolt Diameter (in)	Minimum Testing Torque (ft-lb) Wedge 4.5d	Type 8d
1/4	5	5
3/8	15	15
1/2	35	45
5/8	60	90
3/4	110	160
1	200	200

R5

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Table 38-9

Minimum Testing Torque for Anchors
Installed in 1500 psi Solid Concrete Block

Nominal Bolt Diameter (in)	Minimum Testing Torque (ft-lb)	
	Wedge Type	Sleeve Type
3/8	10	10
1/2	25	25
5/8	35	35
3/4	70	--

c2. If the nut of the inspected anchor is not turned, the anchor shall be accepted. If the nut is turned, the anchor shall be considered unacceptable.

c3. Unacceptable anchors shall be reported to the responsible Contractor for re-torquing to installation torque and re-inspection. If the anchor is again unacceptable, it shall be replaced in accordance with Article 3.4.

c4. A record of the following items shall be maintained for each anchor tested or replaced.

1. Location of tested anchor
2. Embedded depth, determined by one of the following methods:
   a. Anchor length marking and measuring projection
   b. UT - Conforming to ASTM E-114
3. Verification of spacing and edge distances as defined in Article 3.1.10.
4. Degree from plumb
5. Check for nut being flush with the bolt as a minimum.
6. Check for number of washers to be within the specified limit.
7. Visual check for washers covering oversized holes, and for deformed washers. R5
8. Torque test.

CONCRETE EXPANSION ANCHOR INSTALLATION

CONCRETE OR ANCHOR FAILURE/DAMAGED REBAR REPORT

Commonwealth Edison Company

Report No. _____

Date __________

Page 1 of _____

1. ☐ LaSalle County Station Project No. Unit -1 ☐ LaSalle County Station Project No. Unit -2

2. ☐ Building ________________ Floor Elevation __________

3. S&L Dwg. No. ______________ Detail No. ______________

4. Structural Element Affected"

   ☐ slab (top side) ☐ wall (exterior)
   ☐ slab (bottom side) ☐ wall (interior)
   ☐ beam (top) ☐ column
   ☐ beam (side)

5. Reason for Relocation of Anchor:

   ☐ Rebar nicked ☐ Rebar cut

   ☐ Anchor failure ☐ Concrete Failure

6. The depth of damaged rebar _______ inches.

7. Location: Attached is a sketch indicating actual location of the expansion anchor detail with respect to the nearest column lines and elevation and anchor(s) which failed or damaged rebar. Sketch shall be identified by report number and proper page number(s).

8. Prepared: (Installed Contractor) ______________ (NAME) Reviewed: (Client Q.A.) ______________ (NAME)

   ______________ (ORGANIZATION) ______________ (ORGANIZATION)

   ______________ (DATE) ______________ (DATE)

FORM LS-CEA 1.0

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SARGENT & LUNDY
ENGINEERS
CHICAGO

Rev. 6

Revision 6 (Pages 4, 5, 23):

Prepared By S.M. Kazmi Date 2-13-80

Reviewed By [illegible] Date 2-13-80

Approved By E.C. Weaver Date 2-13-80

SD
ECN #1044
Page 3 of 6
Job 4266/4267

1.3 Quality Assurance Program (For Nuclear Safety Realted Work Only): Shall conform to the requirements of the Quality Assurance Articles of the Project Specification.

1.4 Installation and Inspection Documentation

1.4.1 Installation Procedure:

Contractor shall submit a complete installation procedure to the Consulting Engineers for review, prior to any installation, in accordance with Contractor's quality assurance procedure. The procedure shall describe the implementation of this Form, LS-CEA, and shall include but not be limited to, the following:

a. Installation process

b. Equipment to be used

c. Tolerances for Equipment

d. Equipment inspection frequency

e. Types of installation devices and calibration frequency

f. Overall anchor length and minimum depth of hole for each anchor diameter.

g. Methods to verify proper anchor length (i.e., marking bolt ends for lengths).

h. Methods to verify proper hole depth, spacing and edge distance from anchor to edge of concrete or steel lined openings. R6

i. Methods to verify actual embedded length of an installed anchor with no marking for bolt length.

j. Methods to determine the angularity of the installed anchor.

k. Repair methods for damaged concrete and grouting procedure for patching up abandoned holes

l. Methods to identify the location of a nicked bar.

m. Information to be documented.

1.4.2 Quality Assurance Responsibilities of the Contractor

The Contractor shall be responsible for the quality assurance check for the following items in particular, but not limited to:

a. Ensure use of an approved installation procedure.

b. The anchors have been installed to the torquing requirements as specified in the Table 38-8.

c. The minimum embedment depth in accordance with the design drawings has been provided. For drawings released for construction before 7-20-79, if no embedment depth is specified, the minimum embedment depth shall be 4.5d. For the drawings released first time or revised showing anchor size/plate changed, on/after 7-20-79, the minimum embedment depth shall be '8d', if no specific embedment depth is shown on the drawings.

d. If the installed anchor is at an angle and the angularity exceeds the tolerances shown in Section 3-2.3 of this specification, a report shall be submitted to the purchaser.

e. If the nut of the anchor is not fully engaged, a report shall be submitted to the purchaser.

f. While drilling holes for anchor installation, if trial drills have been made in the concrete wall or slab, it has to be ensured that the concrete has been repaired by grouting before the final installation of the plate is made.

g. Verification of spacing and edge distances as specified in Table 38-2 and Figure 38-6. R

h. Verification that anchor or concrete failure/damaged rebar reports have been reported on Form LS-CEA 1.0.

i. Check quality of weld for welded plate washers shown in Tables 38-4A and 38-4B, as per the approved welding procedure. R

Table 38-7

Installation Torque for Anchors
Installed in Solid Block Walls

Nominal Bolt Diameter (in)	Torque Range (ft-lb)	
	Wedge Type	Sleeve Type
3/8	16 ± 1	16 ± 1
1/2	50 ± 2	50 ± 2
5/8	70 ± 2	70 ± 2
3/4	135 + 5	---

3.4 Repair of Failures: Failures shall be rectified as follows:

3.4.1 Concrete Failure: This shall include all cracking or spalling of the concrete in the vicinity of an installed anchor.

a. The concrete shall be repaired in accordance with the project concrete repairing procedure.

b. After the concrete has been repaired, the anchor hole may be drilled in accordance with Article 3.1.5.

c. All concrete failures shall be reported on Form LS-CEA 1.0/ or equivalent and sent to the Consulting Engineers for review within two weeks from the occurrence.

3.4.2 Anchor Failure: This shall include anchor breakage, slippage equal to or greater than one anchor diameter, or loosening to the extent that the anchor cannot be tightened to the installation torque.

a. If the unacceptable anchor can be removed without damaging the surrounding concrete, the hole may be redrilled and the anchor replaced with the next larger size anchor. The embedded length shall conform to the requirements of Table 38-2 and Figure 38-6. For such cases, 1"Ø anchors may be replaced by 1-1/4"Ø anchors having minimum embedded length (Le) of 8", installation torque of 400 ± 30 ft-lbs and testing torque of 250 ft-lbs minimum. R6

b. If the unacceptable anchor cannot be removed without damaging the surrounding concrete, the anchor location shall be moved within the tolerance given for the anchor plate detail. The minimum center to center distance from the unacceptable anchor to the replacement hole shall be 2 times the nominal bolt diameter. If this distance exceeds the given tolerance on the placement of the anchor plate detail, the Consulting Engineers shall be notified before proceeding.

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Form LS-CEA
Rev. 7, 10-27-80

Rev. 7

STANDARD SPECIFICATION FOR

CONCRETE EXPANSION ANCHOR WORK

(FORM LS-CEA)

LASALLE COUNTY STATION

UNITS 1 AND 2

PROJECT NO. 4266, 4267

Revision 0	Issued on September 30, 1976
Revision 1	Issued on December 7, 1976
Revision 2	Issued on November 29, 1978

Revision 3:

Prepared By	S.M. Kazmi	Date	7-19-79
Reviewed By	[illegible]	Date	7-20-79
Approved By	E.R. Weaver	Date	7.20.79

Revision 4:

Prepared By	S.M. Kazmi	Date	9-7-79
Reviewed By	[illegible]	Date	9-7-79
Approved By	E.R. Weaver	Date	9-7-79

Revision 5:

Prepared By	S.M. Kazmi	Date	12-10-79
Reviewed By	[illegible]	Date	12-10-79
Approved By	E.R. Weaver	Date	12-10-79

SARGENT & LUNDY
ENGINEERS
CHICAGO

Form LS-CEA
Rev. 7, 10-27-80

Revision 6:

Prepared By	S.M. Kazmi	Date	2-13-80
Reviewed By	V. Pehlat	Date	2-13-80
Approved By	E.R. Weaver	Date	2-13-80

Revision 7:

Prepared By	S. M. Kazmi	Date	10-27-80
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SPECIFICATION FOR
CONCRETE EXPANSION ANCHOR WORK
LASALLE COUNTY STATION - UNITS 1 AND 2

(Form LS-CEA)

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SPECIFICATION FOR CONCRETE EXPANSION ANCHOR WORK LA SALLE COUNTY STATION - UNITS 1 AND 2

(Form LS-CEA)

1. GENERAL

1.1 Scope: All concrete expansion anchor WORK shall conform to the requirements of this Standard Specification Form LS-CEA unless otherwise indicated in the Project Specification or on the design drawings. This WORK shall include furnishing, installing, inspecting and testing of expansion anchors as indicated in the Project Specification or on the design drawings. The requirements of this Standard Specification shall also apply for attaching hangers for field routed piping and conduits.

1.1.1 For purposes of establishing basic requirements for different applications of concrete expansion anchors, the WORK shall be divided into three categories as follows:

a. Safety Related Work in a Safety Related Structure:

a1. Requires complete documentation of installation and inspection/testing as given in Articles 1.4 and 4.0

b. Non-Safety Related Work in a Safety Related structure:

b1. Requires complete documentation of installation as given in Article 1.4. Inspection/testing documentation is waived.

c. Non-Safety Related Work in a Non-Safety Related Structure:

c1. Installation, inspection/testing and the use of metal detection is waived. Cutting of reinforcing steel is not allowed, except as permitted in Article 3.2.9.d.

1.1.2 Classification of Structures & Components

For classification of Safety Related and Non-Safety Related Structures and Components, refer to the corresponding design drawings. "Class-I Structure," marked on structural drawings shall be considered as Safety Related. In case no classification has been shown on the drawings, it shall be construed to be Non-Safety Related Structure/Component.

1.2 Definitions (For All Expansion Anchors): The following terms, when used in this Standard Specification or in the Project Specification or on the design drawings, shall have the meanings:

1.2.1 Sleeve Type Expansion Anchor: A slit tubular expansion shield, and a threaded stud bolt with integral cone expander, as shown in Figure 38-2 following:

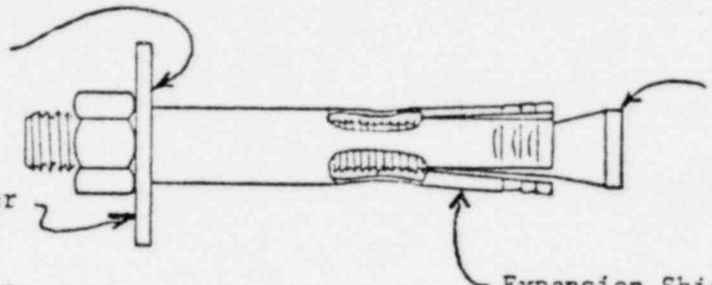


Figure 38-2 Typical Sleeve Type Expansion Anchor

1.2.2 Wedge Type Expansion Anchor: A split expansion ring and (or a separate expansion wedge pair), a threaded stud bolt with integral cone expander (or taper expander), as shown in Figures 38-3 and 38-4 following:

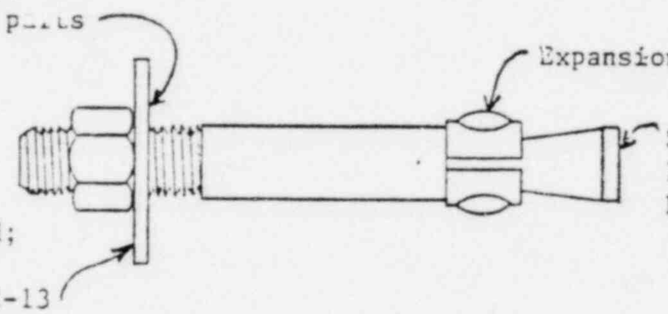


Figure 38-3 Typical Wedge Type Expansion Anchor with Expansion Ring and Cone Expander

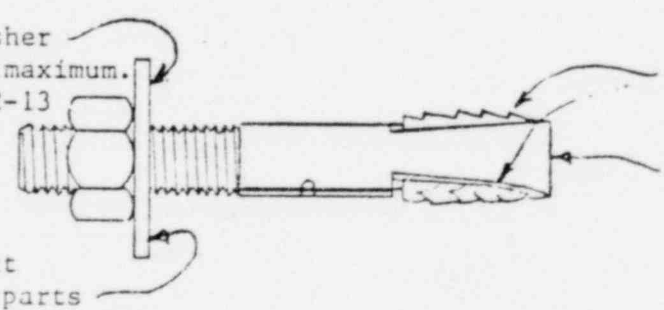


Figure 38-4 Typical Wedge Type Expansion Anchor with Expansion Wedge Pair and Taper Expander

1.4.2 Quality Assurance Responsibilities of the Contractor

The Contractor shall be responsible for the quality assurance check for the following items in particular, but not limited to:

a. Ensure use of an approved installation procedure.

b. The anchors have been installed to the torquing requirements as specified in the Table 38-8.

c. The minimum embedment depth in accordance with the design drawings has been provided. For drawings released for construction before 7-20-79, if no embedment depth is specified, the minimum embedment depth shall be 4.5d. For the drawings released first time or revised showing anchor size/plate changed, on/ after 7-20-79, the minimum embedment depth shall be '8d', if no specific embedment depth is shown on the drawings.

d. If the installed anchor is at an angle and the angularity exceeds the tolerances shown in Section 3-2.3 of this specification, a report shall be submitted to the purchaser.

e. If the nut of the anchor is not fully engaged, a report shall be submitted to the purchaser.

f. While drilling holes for anchor installation, if trial drills have been made in the concrete wall or slab, it has to be ensured that the concrete has been repaired by grouting before the final installation of the plate is made.

g. Verification of spacing and edge distances as specified in Table 38-2 and Figure 38-6.

h. Verification that anchor or concrete failure/damaged rebar reports have been reported on Form LS-CEA 1.0.

i. Check quality of weld for welded plate washers shown in Tables 38-4A and 38-4B, as per the approved welding procedure.

1.3 Quality Assurance Program (For Nuclear Safety Realted Work Only): Shall conform to the requirements of the Quality Assurance Articles of the Project Specification.

1.4 Installation and Inspection Documentation

1.4.1 Installation Procedure:

Contractor shall submit a complete installation procedure to the Consulting Engineers for review, prior to any installation, in accordance with Contractor's quality assurance procedure. The procedure shall describe the implementation of this Form, LS-CEA, and shall include but not be limited to, the following:

a. Installation process

b. Equipment to be used

c. Tolerances for Equipment

d. Equipment inspection frequency

e. Types of installation devices and calibration frequency

f. Overall anchor length and minimum depth of hole for each anchor diameter.

g. Methods to verify proper anchor length (i.e., marking bolt ends for lengths).

h. Methods to verify proper hole depth, spacing and edge distance from anchor to edge of concrete or steel lined openings.

i. Methods to verify actual embedded length of an installed anchor with no marking for bolt length.

j. Methods to determine the angularity of the installed anchor.

k. Repair methods for damaged concrete and grouting procedure for patching up abandoned holes

l. Methods to identify the location of a nicked bar.

m. Information to be documented.

.4.3 Inspection Procedure (Safety Related Work Only):

The agency responsible for the inspection and testing specified in Article 4 shall submit a complete inspection procedure to the Purchaser for review prior to any inspection. The procedure shall describe the implementation of this form and shall include but not be limited to, the following:

a. Inspection process and frequency

b. Equipment to be used

c. Tolerances for equipment

d. Calibration frequency for inspection devices

e. Information to be documented

2. Materials

2.1 Type and Finish of Materials:

Concrete expansion anchors and accessories shall be made of carbon steel with zinc plated finish conforming to U.S. Federal Specification QQ-Z-325B. Stainless steel may be used in place of this zinc coated carbon steel.

2.2 Strength of Materials:

The material shall have a minimum yield strength of 60,000 psi for self-drilling and wedge type anchors, and 50,000 psi for sleeve type anchors. The material shall have a minimum tensile strength of 75,000 psi for all anchors.

2.3 Cross-Sectional Areas:

The smallest cross-sectional area of the stud bolt of an expansion anchor shall not be less than the cross-sectional area at the thread root.

2.4 Size Limits:

The bolt size limits for expansion anchors shall be as follows: (all sizes shown on design drawings are bolt sizes for sleeve and wedge type anchors).

2.4.1 Sleeve Type: 1/4" through 5/8" diameter of stud bolt.

2.4.2 Wedge Type: 1/4" through 1" diameter of stud bolt.

2.5 Types and Makes of Anchors:

Concrete expansion anchors used for the WORK shall be one of the types and makes indicated in Table 38-1. Other concrete expansion anchors not specified in Table 38-1 may also be acceptable provided they meet the requirements of this specification and are specifically approved by the Consulting Engineers.

2.6 Certificate of Conformance

[illegible]

TABLE 38-1

Types, Classifications, Use and Makes of Expansion Anchors

Types of Anchors	Sleeve	Wedge
U.S. Federal Specification FF-S-325 Classifications	Group II Type 3 Class 3	Group II Type 4 Class 1
Permissible Use	For Block Walls Only	For All Work

Manufacturers	Products	
a. Hilti Fastening Systems, Inc.	--	Hilti Kwik-Bolt Stud Wedge Anchors
b. ITT Phillips Drill Company	Red Head Hex Nut Sleeve Anchors	Red Head Wedge Anchors
c. Ramset Fastening Systems	Dynabolt Mark II Hex Nut Sleeve Anchors	Trubolt Wedge Anchors
d. The Rawlplug Company, Inc.	Rawl Lok/Bolt Hex Nut Sleeve Anchors	Rawl-Stud Wedge Anchors
e. USM Corporation Construction Products Division	Parasleeve Hex Nut Masonry Anchors	Parabolt Wedge Anchors
f. Wej-It Corporation of Allied Products Corp.	--	Wej-It Double Wedge Anchors

3. Installation

(For all expansion anchors except as noted)

3.1 General Provisions:

3.1.1 Concrete expansion anchors shall be installed in accordance with the manufacturer's specifications and recommendations and the requirements of this Form LS-CEA. In case of conflict, the requirements of this form shall govern.

3.1.2 The minimum embedded lengths, spacing and edge distance for expansion anchors shall conform to Table 38-2 and Figure 38-6 unless otherwise indicated in Article 3.1.10.

3.1.3 The overall anchor length and the hole depth required shall be determined by Contractor such that the specified minimum embedment length and bolt projection can be obtained.

3.1.4 As a minimum, nut shall be flush with the end of an anchor, however, a 1/4" thread projection above the nut after installation is recommended. If projection exceeds 1/4", projection shall not be removed without the consent of the Consulting Engineer. If consent is given, a record of embedment depth shall be made for all anchor with removed projections.

3.1.5 Holes for the anchors may be drilled through hardened grout, but the embedded length shall be determined from the surface of the rough concrete. Holes for the anchors may be drilled through surface repaired concrete, but the embedded length shall be determined in accordance with Article 3.1.9. Holes shall not be drilled through grout or repaired concrete that has not completely hardened nor shall grout or concrete be placed around anchors without the approval of the Consulting Engineers.

3.1.6 Reuse of expansion anchors shall not be permitted.

3.1.7 1/4"Ø expansion anchors are allowed in all locations of reinforced concrete, except where prohibited in Table 38-5, provided the required hole depth is less than the effective depth of the concrete covering the main reinforcement. 1/4"Ø expansion anchors shall not be used in solid block walls.

3.1.8 Welding on expansion anchors is not permitted without approval of the Consulting Engineers.

3.1.9 For anchors installed in holes drilled through surface repaired concrete extending beyond the rebar cover, the dimension [illegible] [illegible] Table 38-2 shall [illegible] increased by a [illegible] [illegible] [illegible] [illegible]

where X = [illegible] of concrete cover plus nominal diameter of outside bar.

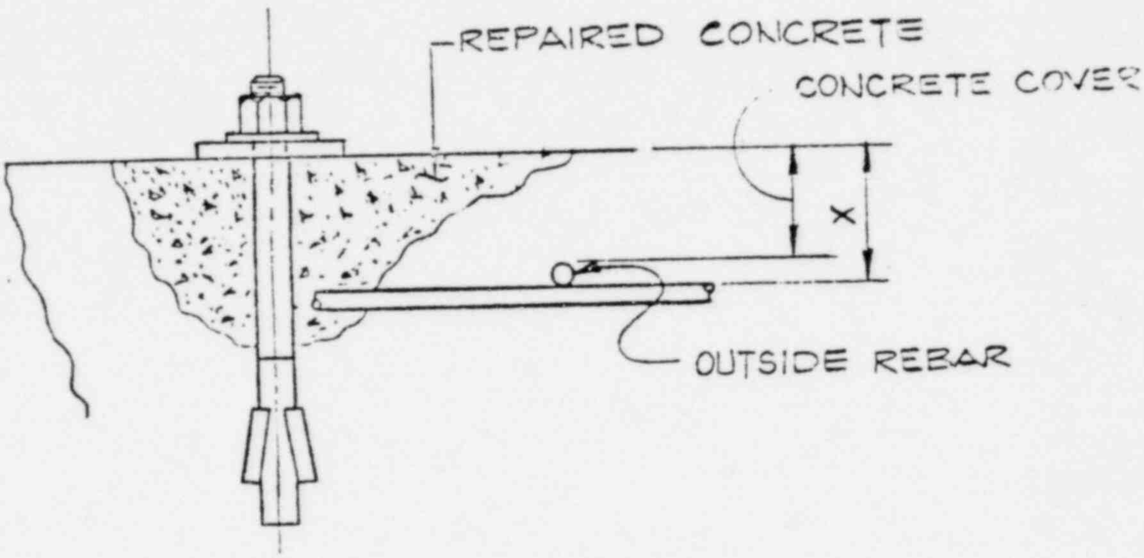


Figure 38-5

Anchors Installed in Repaired Concrete

3.1.10 Refer to Table 38-2 and Figure 38-6, where in:

S = Center to Center distance between anchors in adjacent assemblies
E_D = Edge distance, measured from center of the anchor to the nearest concrete edge
E_S = Edge distance, measured from center of the anchor to the nearest surface of a steel lined opening (sleeve, etc.)

a. When two anchors of different diameters are installed adjacent to each other, "S" shall be the average of the two "S" dimensions.

b. If dimensions ED, ES and S cannot be maintained between two anchor assemblies, allowable erection tolerance indicated on the design drawings should be used to resolve the problem. If the problem involves anchors installed by two different contractors, their erection tolerances should be used or the Consulting Engineers should be notified for a resolution.

c. For anchors installed to a minimum of '8d' embedded [illegible]

d. If Le cannot be met, the Consulting Engineers should be notified before work proceeds.

e. Edge distances to the side of embedded steel plates shall be the 'S' dimension.

3.1.11 Where the concrete surface is uneven, the following shall be the acceptance criteria for uneven surface between the plate and the mounting surface. This criteria need not be met for attachments with rod type hangers, and for those attachment details for which specific requirements are given on the design drawings. 7

a. Gaps between the mounting surface and the plate are acceptable if:

1. Width of the gap 'a' along the length or width of the plate does not exceed dimension, as shown in Figure 38-10.

2. Length of gap 'b' extending into the plate beyond width 'a' is limited to 50% or less of the plate length (i.e., at least 50% contact length is available beyond dimension 'a'. 7

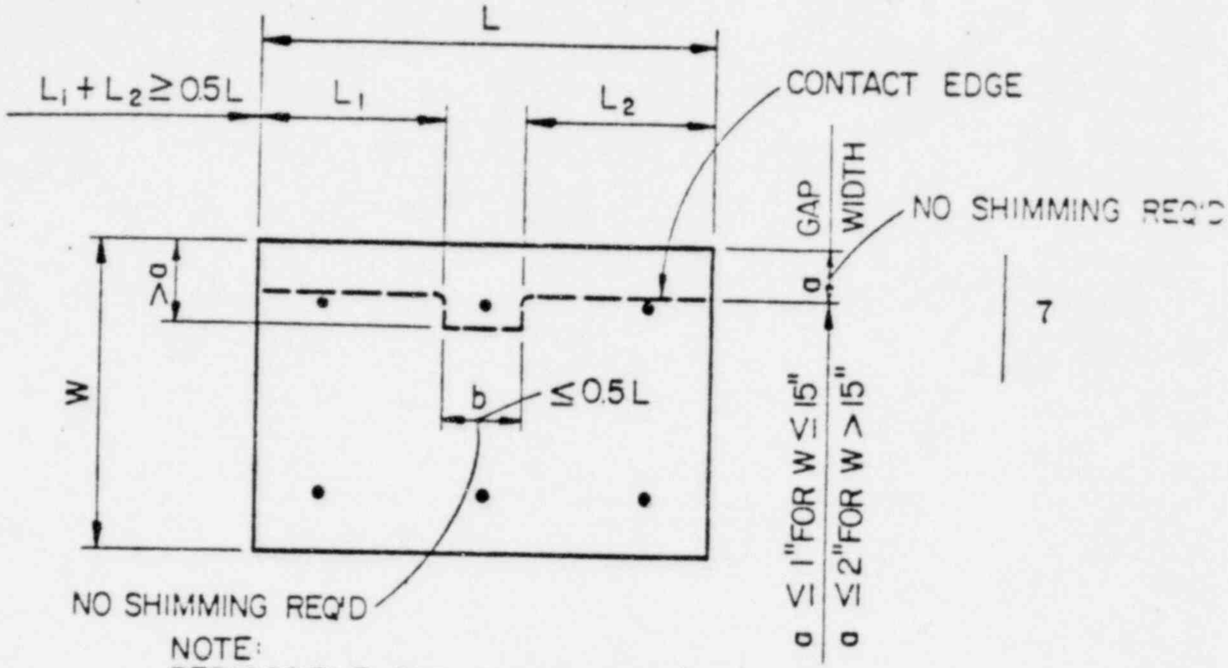
This acceptance criteria shall be applied after welding of all attachments to the plate has been completed.

Mounting surface and the plate shall be assumed to be in contact when a 1/32 inch feeler gauge inserted between them makes contact with both the surfaces. The plate shall be checked for contact along the entire perimeter.

b. For gaps not meeting the requirements of (a) above, the concrete surface shall be improved by grinding or bush hammering. Alternatively, the gap may be filled by inserting shims or grouting as per Section 5.0, between the plate and the mounting surface to ensure that at least 50% length along the plate edge is shimmed or is in contact. 7 The shims shall be placed evenly along the plate edge, with a shim provided at each corner where a gap exists. When the shims are made discontinuous to clear anchors, the spacing between the shim pieces shall not exceed dimension 'd' as shown in Figure 38-11.

c. The shims shall be flat or tapered and of the thickness as required to fill the gap. The shims shall extend into the gap as required but need not exceed dimension 'c' as shown in Figure 38-11. The material for shims shall be [illegible] A-36 or equivalent.

[illegible] welded to the [illegible]



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NOTE:
PERMISSIBLE GAP ALONG SIDE 'W'
IS SIMILAR TO SIDE 'L', SHOWN ABOVE.

CONTACT DETAIL

FIG. 38-10

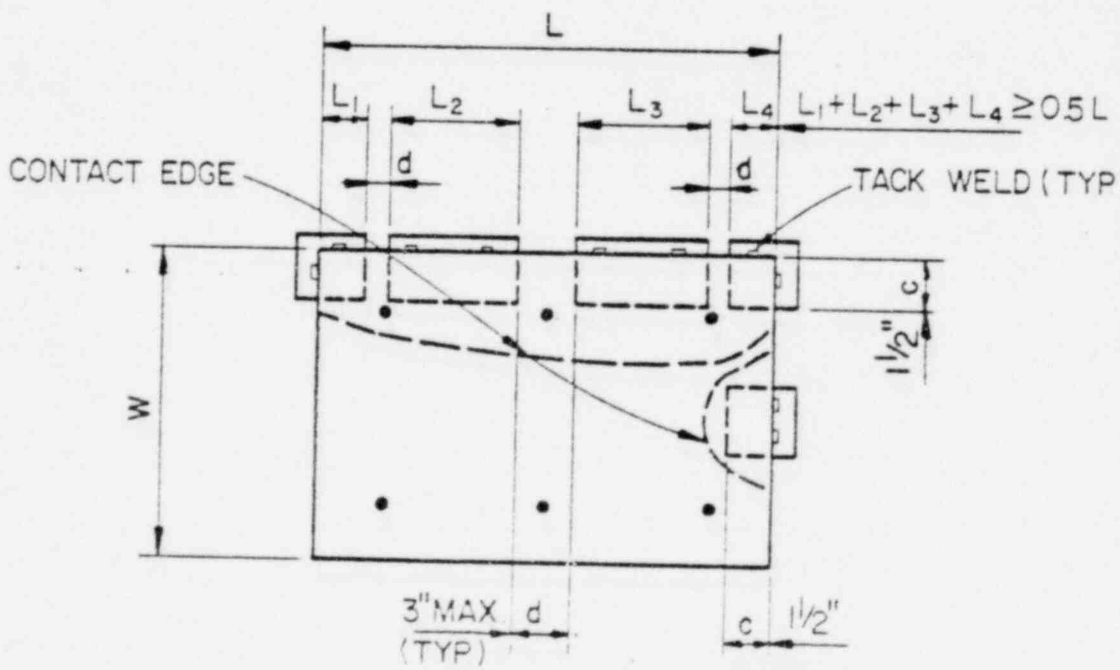

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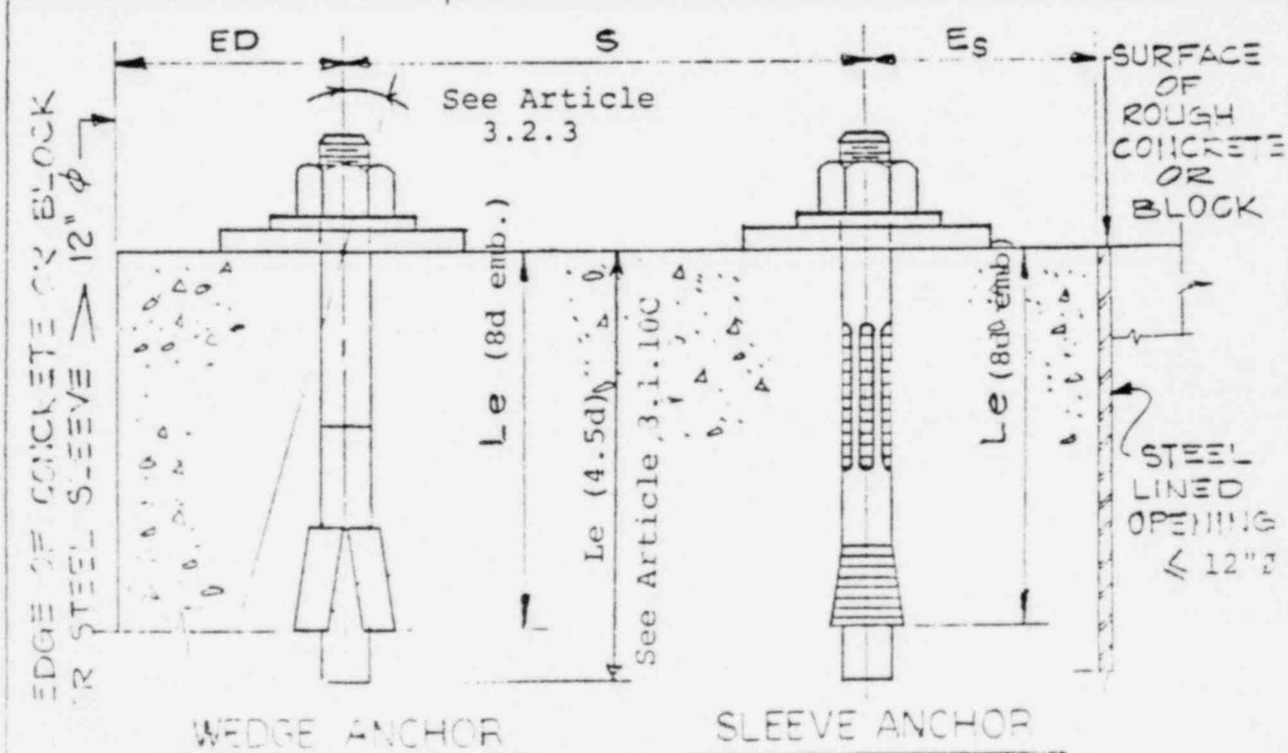
Table 38-2

Minimum Embedded Length, Spacing And Edge Distance
For Expansion Anchors

Nominal Bolt Diameter (inch)	Minimum Embedded Length (inches) Le		Minimum Spacing (inches) (S)	Minimum Edge Distance (inches)			
				Ed		Es	
	4.5d	8d		4.5d'	8d'	4.5d'	8d'
1/4	-	0.875"	2.5	1.5	3.25	1	1.75
3/8	1.75"	3.0	4.5	2.5	5.0	1.25	2.5
1/2	2.25	4.0	6.0	3	7.0	1.5	3.5
5/8	2.8	5.0	7.5	4	8.5	2	4.25
3/4	3.4	6.0	9.0	5	10.0	2.5	5.0
1	4.5	8.0	12.0	6	13.0	3	6.5



3.2 Drilling of Holes

3.2.1 For all expansion anchors, except self-drilling type, holes in concrete shall be drilled with quality carbide tipped solid bits, using a rotary/percussion type power drill.

3.2.2 Each hole shall be drilled precisely in order to maintain the expansion anchor's pullout value. The tolerance on the bit shall be within the tolerances specified in American National Standard Institute B94.12 Standards or closer for each anchor size. The nominal drill size for each size anchor shall be as recommended by anchor manufacturer.

3.2.3 The anchor shall be no more than 5° out of plumb for '4.5d' embedment and 10° for '8d' embedded length after installation. Angular deviation shall be measured from the top of concrete or plate surface to the exposed end of installed anchor. For angular deviation greater than 3°, square or rectangular bevelled washers shall be placed between the attachment and the nut to maintain bearing of the nut within 3° tolerance.

3.2.4 The maximum depth of the hole shall not be greater than the thickness of the concrete minus 2-1/2 inches. In addition, for 1/4" diameter anchors, the maximum hole depth is 1-1/4 inch.

3.2.5 Holes for the concrete expansion anchors shall not be drilled until the concrete has been cured for a minimum of 28 days.

3.2.6 If drilled holes are not used, they shall be filled with dry-pack grout. The grout is to have a minimum compressive strength of 3500 psi.

3.2.7 The criteria for drilling holes in concrete shall be as indicated in Table 38-5 and Figure 38-7 through 38-9.

3.2.8 At locations where a metal detector is required, a deep magnetic detector shall be used to locate the reinforcement in the concrete and to assure that the reinforcement will not be cut or nicked. Reinforcing placement drawings may be used as reference in conjunction with the use of the detector. This detector may be one of those indicated in Table 38-3.

Table 38-3

Products and Manufacturers of Magnetic Detectors

Products	Manufacturers
James "R" Meter C-4952	James Electronics, Inc. Chicago, Illinois
Profometer	Pro ceq. SA Riesbachstrasse [illegible]
[illegible]	Soiltest, Inc. [illegible], Illinois

3.2.9 In areas where metal detection is not required and a reinforced bar is nicked, the following procedure shall be followed:

a. The location where the reinforcing bar is nicked shall be suitably identified on the anchor plate where this bar is located so that all contractors can identify the damaged rebar location.

b. The damaged rebar shall be documented on Form LS-CEA 1.0 or equivalent and sent to the Consulting Engineer for review within two weeks from the occurrence.

c. Further drilling of holes shall be performed by using a metal detector within the following areas:

c1. A 18'-0" x 18'-0" square with its center at the point where the reinforcing bar was damaged when the reinforcing bars are spaced 12 inches or more on centers.

c2. A 9'-0" x 9'-0" square with its center at the point where the reinforcing bar was damaged when the reinforcing bars are spaced less than 12 inches on centers.

d. It is permissible to cut one reinforcing bar per anchor plate within the areas given in Article 3.2.9c above. For example, consider an anchor plate detail installed with four expansion anchors, one expansion anchor may be installed through reinforcing steel provided the remaining three anchors do not hit reinforcing steel and no other damaged reinforcing bars are identified within the areas given in Article 3.2.9c above.

e. When it is permissible to cut reinforcing steel, it shall be cut using a quality diamond carbide tipped bit.

3.2.10 In area where metal detection is required, the following procedure should be followed:

a. Using a metal detector, the location of all holes to be drilled and reinforcing bar pattern shall be laid out on the structural element.

b. If metal detection indicates the presence of a reinforcing bar at the anchor design location, the anchor plate assembly should be moved within the allowable erection tolerance indicated on the design drawings to clear the reinforcing bar.

c. If the anchor plate tolerance does not allow sufficient movement to clear reinforcing, the Consulting Engineer shall be notified so that the problem can be resolved before proceeding.

d. If per chance the reinforcing bar is still nicked, the procedures given in Article 3.2.9 shall be followed.

3.2.11 Where Table 38-5 or Figure 38-7 to Figure 38-9 refers to this article, drilling of holes is allowed without the use of the metal detector if no reinforcing bar has been identified as damaged within the areas given in Article 3.2.9c. If a reinforcing bar has been cut or nicked, the procedures in Article 3.2.9 shall be followed.

3.2.12 The use of a metal detector is not required for 1/4 inch diameter anchors.

3.2.13 The maximum number of standard washers or combination of standard washersand A-36 plate washers shall be limited to five.

3.2.14 The location of an individual anchor can be changed to facilitate installation provided the following tolerances are met:

a. Relocation of One or Two Bolts Per Assembly (Fig. 38-12)

For bolts with '4.5d' or '8d' embedment, a relocation within a circle of '2d' radius shall be permissible, if the following requirements are met:

1. The minimum edge distance between the anchor and the plate edge meets the requirements as shown in Table 38-4.

2. Requirements of E_s, E_d, L_e per Table 38-2.

3. If the angularity of the relocated anchor is $\leq$ 4°, use of the same size anchor is allowed.

4. If the angularity of the relocated anchor is $>$ 4°, and $\leq$ 10°, next larger size shall be used for the relocated anchor. For example, use 5/8"Ø anchor in place of 1/2"Ø, 1"Ø in place of 3/4"Ø. For existing 1"Ø anchor, the relocated anchor shall be of the same diameter and the angularity limitation of 4°, per paragraph 3.2.14.a.3 shall be maintained.

b. Relocation of More Than Two Bolts Per Assembly

[illegible] shall be reported to the Consulting [illegible]

c. Relocation of Bolts Outside the Existing Plate Assemblies

1. The maximum permissible relocation shall be in an arc of radius 3" as shown in Figure 38-13 and Figure 38-14.

2. Requirements of E_s, E_d, Le per Table 38-2 and minimum edge distance requirements per Table 38-4 shall be met.

3. In case only one bolt in an assembly is relocated outside the existing assembly, a new rectangular plate of the same thickness as the existing assembly plate, of size WxL' or W'xL', based on the minimum edge distance requirement, shall be used.

4. In case two or more anchors are relocated, a new rectangular plate, of thickness 1/4" more than the existing assembly plate, of size WxL' or W'xL', based on the minimum edge distance requirement, shall be used.

5. The anchor size shall remain the same as in the existing plate assembly, except where more than half of the total number of anchors are being moved. For such cases, the Consulting Engineer shall be contacted for resolution.

Table 38-4

Anchor Size	Minimum Edge Distance for Punched, Reamed or Drilled Holes (inches)	
	At Sheared Edges	At Rolled Edges of Plates or Gas Cut Edges
1/4"	1/2"	3/8"
3/8"	3/4"	1/2"
1/2"	7/8"	3/4"
5/8"	1-1/8"	7/8"
3/4"	1-1/4"	1"
1"	1-3/4"	1-1/4"

3.2.15 Where oversize and slotted holes are provided in the field to facilitate installation, hardened washer or square structural plate washers of A-36 material, as shown in the Table 38-4A & 38-4B, shall be used. Such washer shall cover the entire hole area in the plate. Holes can be enlarged by flame cutting up to 1/8" less than the required size, and then reamed or rotary filed to the size required.

3.2.16 If an installed plate is to be replaced by a new larger plate, the minimum center to center distance from the existing anchor [illegible]

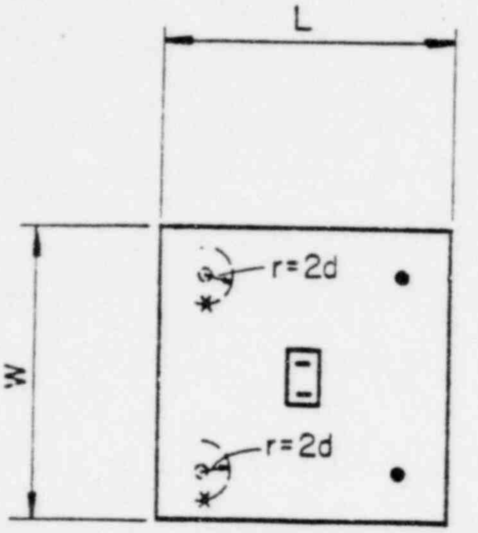


FIGURE 38-12

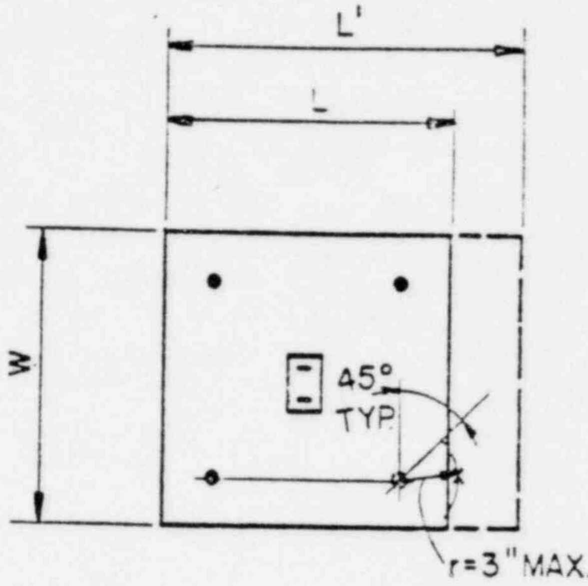
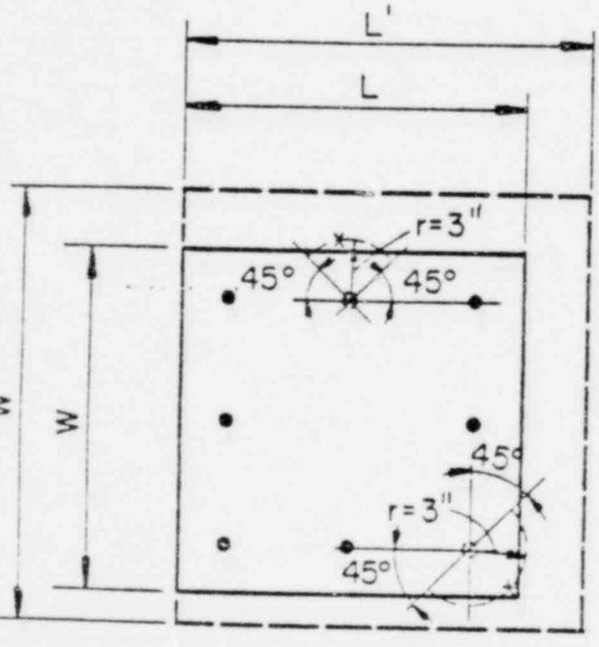


FIGURE 38-13



• – ANCHORS INSTALLED WITHOUT INTERFERENCE

○ – REBAR INTERFERENCE

X – RELOCATED ANCHOR

TABLE 38-4A

Plate Washer Size - For Slotted Holes

[illegible]	SHORT SLOT		LONG SLOT		
[illegible]	MAX. SLOT SIZE (inches) (d+1/16)(d+1/4)	MINIMUM WASHER SIZE	MAX. SLOT SIZE (inches) (d+1/16)(2-1/8d)	MINIMUM PLATE WASHER SIZE (inches)	WELD SIZE
[illegible]	5/16 x 1/2	Use	5/16 x 9/16	2 x 2 x 1/4	
[illegible]	7/16 x 5/8	Minimum	7/16 x 7/8	2 x 2 x 1/4	See
[illegible]	9/16 x 3/4	of 2	9/16 x 1-1/8	2-1/2 x 2-1/2 x 1/4	Note
[illegible]	11/16 x 7/8	Standard	11/16 x 1-3/8	2-1/2 x 2-1/2 x 3/8	Below
[illegible]	13/16 x 1	Hardened	13/16 x 1-3/4	3 x 3 x 3/8	
1	1-1/16 x 1-1/4	Washers	1-1/16 x 2-1/8	3-1/2 x 3-1/2 x 3/8	

[illegible]: Plate washers shown in table above shall be welded to the base plate on two opposite sides of the plate washer with a 1-1/2" long fillet weld. For 3/16" thick plate washers, use 3/16" weld, and for 1/4" and 3/8" thick plate washers, use 1/4" fillet weld.

TABLE 38-4B

Plate Washer Size - For Oversize Holes

PLATE WASHER HOLE (inches)	WELD SIZE	HOLE SIZE IN PLATE (inches)	MINIMUM WASHER SIZE (inches)	HOLE SIZE IN PLATE (inches)	MINIMUM WASHER SIZE (inches)
5/16		1/2	1-1/2 x 1-1/2 x 3/16	9/16 to 3/4	2 x 2 x 1/4
7/16	See	5/8	1-5/8 x 1-5/8 x 3/16	11/16 to 7/8	2-1/8 x 2-1/8 x 1/4
9/16	Note	3/4	1-3/4 x 1-3/4 x 3/16	13/16 to 1	2-1/4 x 2-1/4 x 1/4
11/16	Below	7/8	2 x 2 x 3/16	15/16 to 1-1/8	2-1/2 x 2-1/2 x 1/4
13/16		1	2-1/8 x 2-1/8 x 3/16	1-1/16 to 1-1/4	2-5/8 x 2-5/8 x 1/4
1-1/16		1-1/4	2-1/2 x 2-1/2 x 3/16	1-5/16 to 1-3/4	3 x 3 x 3/8

NOTE. Plate washers shown in table above shall be welded to the base plate on two opposite sides of the plate washer with a 1-1/2" long fillet weld. For 3/16" thick plate washers, use 3/16" weld and for 1/4" and 3/8" washer plates, use 1/4" fillet welds.

SARGENT & LUNDY
ENGINEERS
CHICAGO

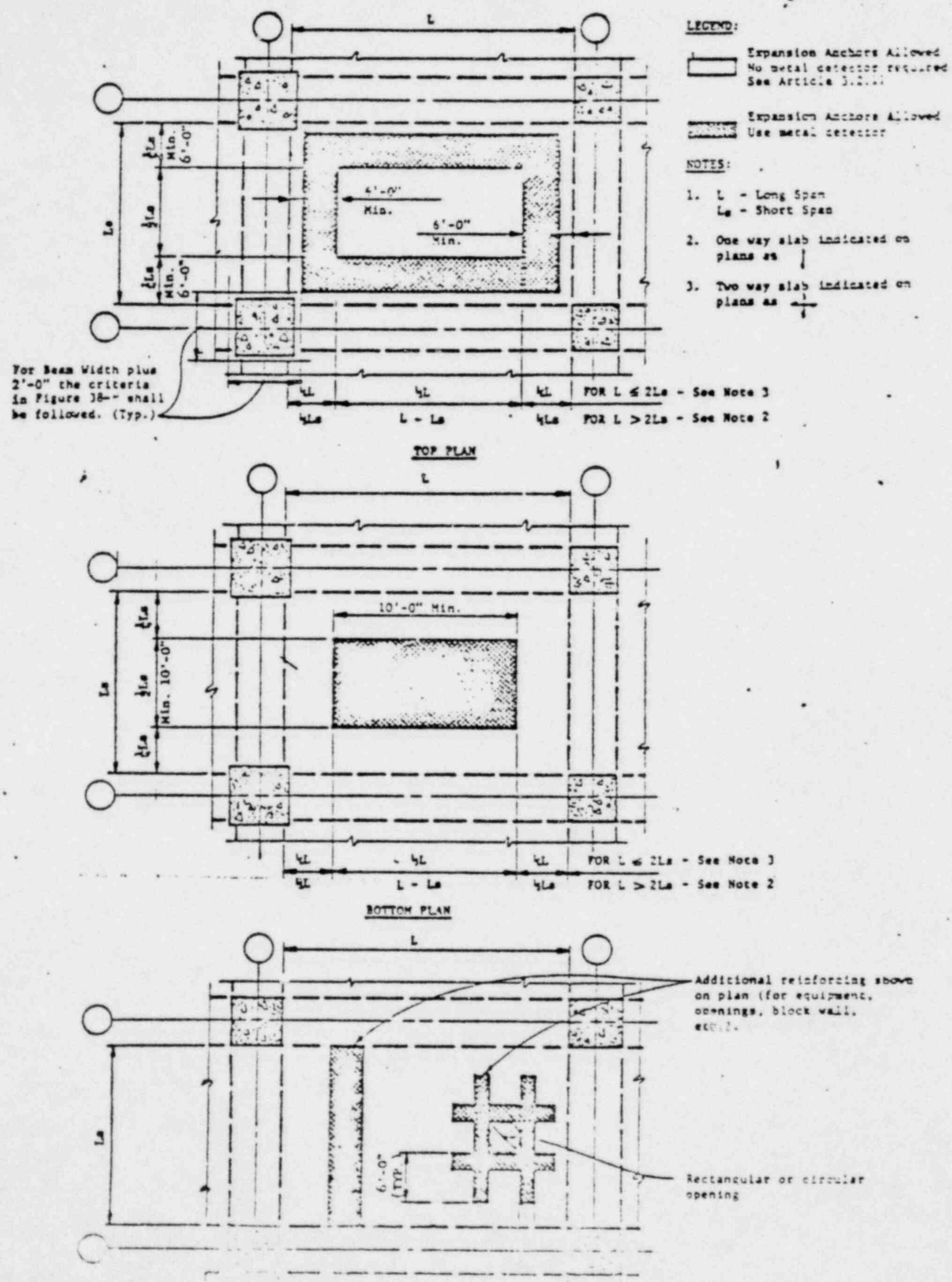
Form LS-CEA
Rev. 7 10-27-80

Table 38-5

Criteria for Drilling Holes for Expansion Anchors in Concrete

Element			Area No.	Description
Concrete Slabs*			1	See Figure 38-7
Concrete Beams			2	See Figure 38-8
Concrete Columns			3	Drilling is allowed with the use of the metal detector.
Concrete Walls	Interior		4	See Article 3.2.11
	Exterior	Above grade	5	For nuclear safety related wall and walls monolithic to nuclear safety related walls, see criteria for walls below grade. For other walls, see Article 3.2.11.
		Below grade	6	Drilling holes is allowed. For the use of metal detector, see Figure 38-9.
Primary Containment Exterior Wall & Drywell Floor			7	No drilling is allowed, unless approved by consulting engineer.
Concrete Slabs on Metal Deck			8	For the top of the slab, see Article 3.2.11. For the bottom of the slab, drilling is not allowed.
Concrete Finish			9	Drilling holes is allowed provided the hole is completely within the concrete finish. Metal detection is not required. However, anchors installed in Safety Related structures shall not be placed in the finish unless shown on the design drawings or approved by Consulting Engrs.
Foundation Mat	Containment		10	No drilling is allowed.
	Others		11	Drilling of holes is allowed. For application where the metal detector is to be used, see Figure 38-7. For mats, "L" is the distance between adjacent column centerlines.
Concrete for Steam Tunnels			12	Drilling of holes is allowed with the use of metal detector.
Concrete for Fuel Pools			13	
Masonry Block Walls			14	No drilling is allowed unless shown on the design drawings or approved by the Consulting Engrs.
[illegible]			[illegible]	[illegible] the Consulting Engineer.

*NOTE: No expansion anchors allowed in magnetite concrete.


L
LEGEND:
Expansion Anchors Allowed
No metal detector required
See Article 3.2.1
Expansion Anchors Allowed
Use metal detector
NOTES:
1. L - Long Span
Ls - Short Span
2. One way slab indicated on plans as
3. Two way slab indicated on plans as
Min. 6'-0"
¼Ls
½Ls
Ls
6'-0" Min.
For Beam Width plus 2'-0" the criteria in Figure 38-- shall be followed. (Typ.)
¼L
½L
¼L
FOR L ≤ 2Ls - See Note 3
¼Ls
L - Ls
¼Ls
FOR L > 2Ls - See Note 2
TOP PLAN
10'-0" Min.
Min. 10'-0"
BOTTOM PLAN
Additional reinforcing shown on plan (for equipment, openings, block wall, etc.).
6'-0" (TYP.)
Rectangular or circular opening

R3

[illegible]

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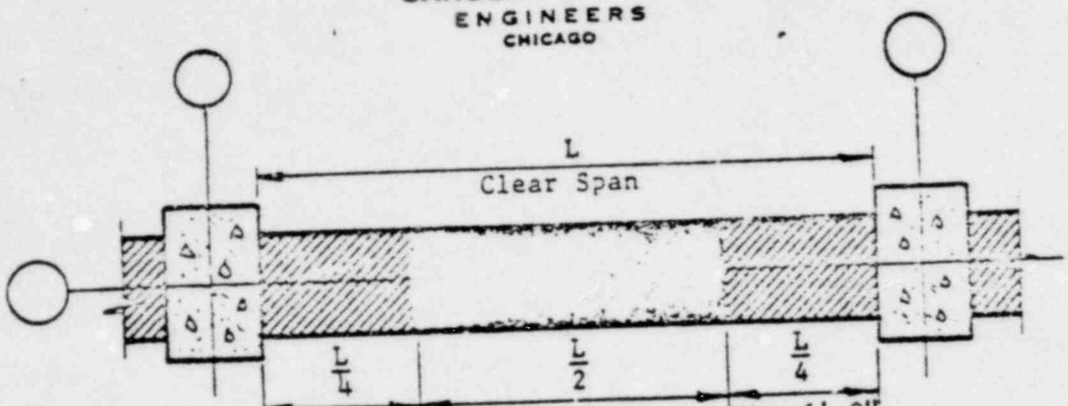
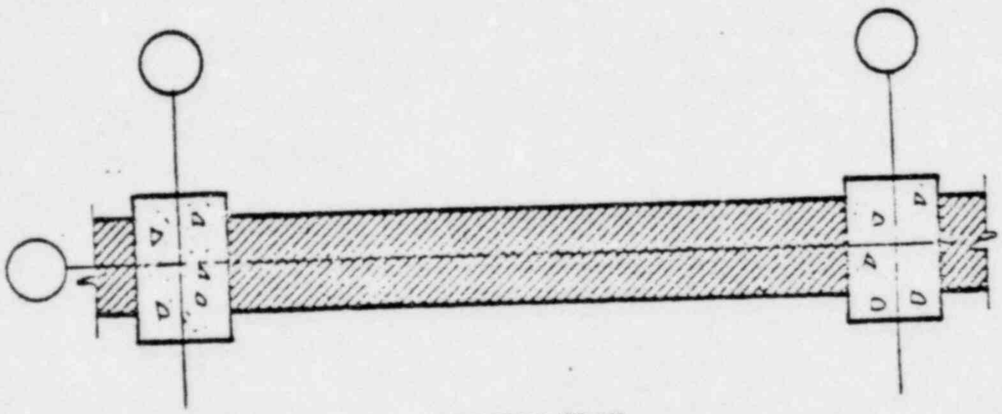
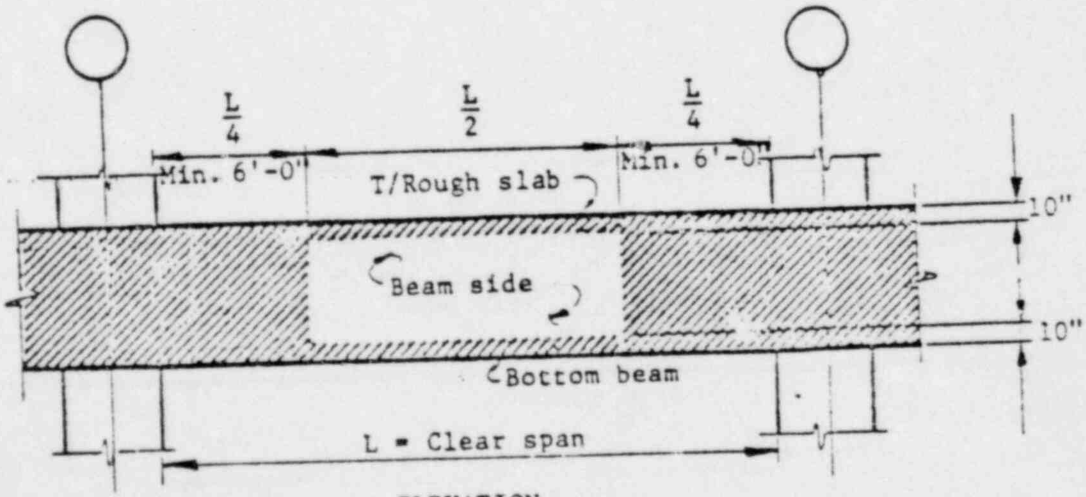


TOP PLAN



BOTTOM PLAN



ELEVATION

Exp. anchor allowed, no metal detector required.

[illegible] except 1/4" diameter anchor [illegible] use metal detector.

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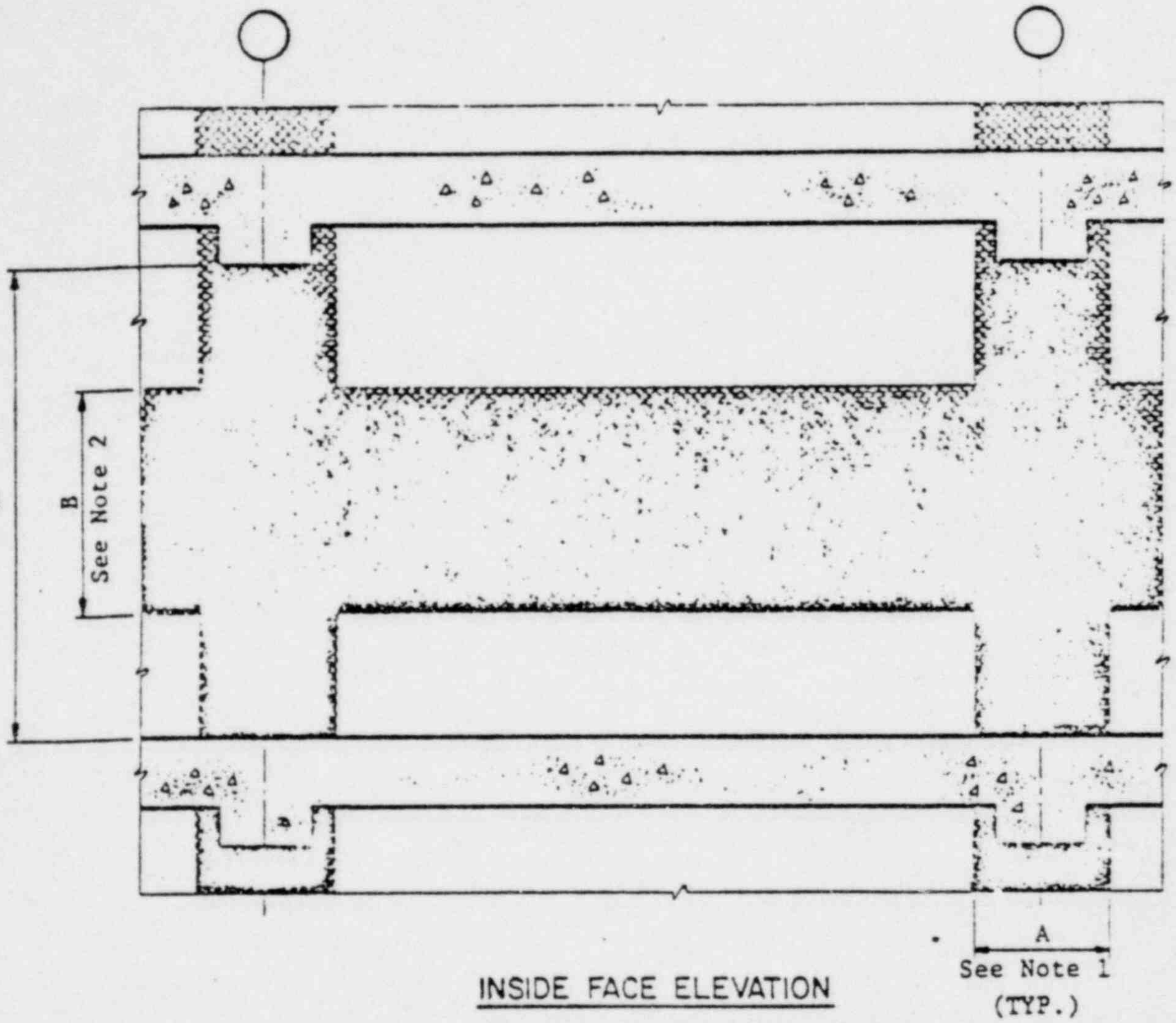
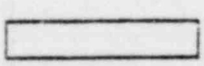
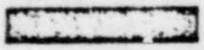


INSIDE FACE ELEVATION



Expansion Anchors Allowed
No metal detector required
See Article 3.2.11



Expansion Anchors Allowed
Use metal detector

Noted: 1. Dimension "A" shall be as follows:

a. If a wall column is present, "A" shall be the width of the wall column plus two feet.

b. If otherwise, "A" shall be the width of the beam above plus two feet.

2. Dimension "B" shall be the middle one half of "H"

3.3 Tightening of Expansion Anchors:

3.3.1 After the anchors for a connection are driven into the holes, they shall be brought to a "hand-tight" condition so that all parts of the connection are in contact with one another.

3.3.2 For wedge and sleeve type anchors, the anchors shall be tightened to the torque values given in the applicable Table 38-6 or Table 38-7. This tightening shall proceed systematically from the most rigid or inner part of the connection to its free edges. During this operation, there shall be no rotating of the parts except the nuts.

3.3.3 A calibrated torque wrench shall be used for tightening expansion anchors. Verification of calibration and recalibration shall be performed per the Contractor's approved procedure. The following frequency is acceptable.

a. For a direct reading torque wrench, on a monthly basis.

b. For snap-type torque wrench, on a weekly basis, by using an upright or horizontal bench tester. This tester shall be verified for calibration or recalibrated at a frequency prescribed by the manufacturer.

Table 38-6 Installation Torque, ft-lb.
For Anchors Installed in Minimum 3500 PSI Concrete

Nominal Bolt Diameter	Torque Range	
	Wedge Type Anchors	
	4.5'd' Emb.	8'd' Emb.
1/4"	5 - 8	6 - 8
3/8"	25 - 35	27 - 35
1/2"	55 - 65	65 - 75
5/8"	80 - 90	130 - 150
3/4"	150 - 175	230 - 270
1"	250 - 300	280 - 320

The Contractor shall exercise caution not to over torque the bolt to cause damage to concrete or bolt.

Table 38-7

Installation Torque for Anchors
Installed in Solid Block Walls

Nominal Bolt Diameter (in)	Torque Range (ft-lb)	
	Wedge Type	Sleeve Type
3/8	16 ± 1	16 ± 1
1/2	50 ± 2	50 ± 2
5/8	70 ± 2	70 ± 2
3/4	135 + 5	---

3.4 Repair of Failures: Failures shall be rectified as follows:

3.4.1 Concrete Failure: This shall include all cracking or spalling of the concrete in the vicinity of an installed anchor.

a. The concrete shall be repaired in accordance with the project concrete repairing procedure.

b. After the concrete has been repaired, the anchor hole may be drilled in accordance with Article 3.1.5.

c. All concrete failures shall be reported on Form LS-CEA 1.0/ or equivalent and sent to the Consulting Engineers for review within two weeks from the occurrence.

3.4.2 Anchor Failure: This shall include anchor breakage, slippage equal to or greater than one anchor diameter, or loosening to the extent that the anchor cannot be tightened to the installation torque.

a. If the unacceptable anchor can be removed without damaging the surrounding concrete, the hole may be redrilled and the anchor replaced with the next larger size anchor. The embedded length shall conform to the requirements of Table 38-2 and Figure 38-6. For such cases, 1"Ø anchors may be replaced by 1-1/4"Ø anchors having minimum embedded length (Le) of 8", installation torque of 400 ± 30 ft-lbs and testing torque of 250 ft-lbs minimum.

b. If the unacceptable anchor cannot be removed without damaging the surrounding concrete, the anchor location shall be moved within the tolerance given for the anchor plate detail. The minimum center to center distance from the unacceptable anchor to the replacement hole shall be 2 times the nominal bolt diameter. If this distance exceeds the given tolerance on the placement of the anchor plate detail, the Consulting Engineers shall be notified before proceeding.

c. Unacceptable anchors that cannot be removed without damaging the surrounding concrete shall have their projecting end cut off. A saw-cut or flame-cut method is acceptable for removing this projection.

d. All anchor failures and relocation shall be reported on Form LS/CEA 1.0 or equivalent and sent to the Consulting Engineers for review within two weeks from the occurrence.

4.0 Inspection and Testing

4.1 Non-Safety Related Work: Contractor shall be responsible for all inspection and testing work as required or as needed, unless otherwise indicated. Purhcaser and the Consulting Engineers may, during the course of the WORK, inspect the various phases of the WORK at the Project Site for full compliance with all requirements of this Standard Specification, the Project Specification and the design drawings. Any work failing to meet the specified requirements shall be rectified or replaced by Contractor at his expense with no cost to the Purchaser.

4.2 Safety Related Work

4.2.1 General Provisions:

a. Installed concrete expansion anchors shall be subject to inspection and testing as specified in this Article 4.2.

b. Inspection and testing shall be performed using a calibrated torque wrench. The torque test shall be performed after a minimum elapsed time of 6 hours and before an elapsed time of 14 days.

c. The agency responsible for this inspection and testing shall be independent of the Contractor and shall be as designated by the Purchaser.

d. The inspected anchors shall be suitably marked.

e. The inspection results shall be documented in a suitable test report which should include information such as the following:

e1. Compliance with the minimum testing torque requirements of Table 38-8 for concrete and 38-9 for solid block.

e2. Compliance with requirements of minimum embedded lengths, spacing, edge distances, bolt projection beyond nut and plumbness, as indicated in Table 38-2, Articles 3.1.4 and 3.2.3.

Location of inspected anchors.

e4. Location of all anchors represented by the inspected anchor.

e5. Signature of inspector and date of inspection.

f. The inspection report should be submitted [illegible] for review.

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4.2.2 <u>Calibrated Torque Wrench Inspection:</u>

a. <u>Calibration:</u> Torque wrenches to be used for inspection shall be of the dial indicating type and shall be calibrated before use to verify that they are accurate in the testing torque range. The tolerance on these torque wrenches shall be within ± 4 percent. Calibration of these torque wrenches after initial qualification shall be on a monthly basis.

b. <u>Frequency and Sequence:</u>

b1. Maximum one anchor per assembly, but a minimum of one out of each ten expansion anchor installed in that assembly, shall be selected for testing.

b2. If the tested anchor is unacceptable, all the other anchors in the assembly as defined in b1, above, shall be tested.

c. <u>Inspection and Acceptance</u>

c1. On inspection, the inspector shall place the wrench on the nut of the selected anchor and apply torque to the nut until the torque reaches the applicable testing torque given in Table 38-8 or 38-9.

<u>Table 38-8</u>

<u>Minimum Testing Torque for Anchors</u>
<u>Installed in a Minimum 3500 PSI Concrete</u>

Nominal Bolt Diameter (in)	Minimum Testing Torque (ft-lb) Wedge 4.5d	Minimum Testing Torque (ft-lb) Type 8d
1/4	5	5
3/8	15	15
1/2	35	45
5/8	60	90
3/4	110	160
1	200	200

Table 38-9

Minimum Testing Torque for Anchors
Installed in 1500 psi Solid Concrete Block

Nominal Bolt Diameter (in)	Minimum Testing Torque (ft-lb)	
	Wedge Type	Sleeve Type
3/8	10	10
1/2	25	25
5/8	35	35
3/4	70	--

c2. If the nut of the inspected anchor is not turned, the anchor shall be accepted. If the nut is turned, the anchor shall be considered unacceptable.

c3. Unacceptable anchors shall be reported to the responsible Contractor for re-torquing to installation torque and re-inspection. If the anchor is again unacceptable, it shall be replaced in accordance with Article 3.4.

c4. A record of the following items shall be maintained for each anchor tested or replaced.

1. Location of tested anchor

2. Embedded depth, determined by one of the following methods:

   a. Anchor length marking and measuring projection

   b. UT - Conforming to ASTM E-114

3. Verification of spacing and edge distances as defined in Article 3.1.10.

4. Degree from plumb

5. Check for nut being flush with the bolt as a minimum.

6. Check for number of washers to be within the specified limit.

7. Visual check for washers covering oversized holes, and for deformed washers.

8. [illegible]

CONCRETE EXPANSION ANCHOR INSTALLATION

CONCRETE OR ANCHOR FAILURE/DAMAGED REBAR REPORT

Commonwealth Edison Company

Report No. ____

Date __________

Page 1 of _____

1. ☐ LaSalle County Station Project No. Unit -1 ☐ LaSalle County Station Project No. Unit -2

2. ☐ Building ________________ Floor Elevation __________

3. S&L Dwg. No. ______________ Detail No. ______________

4. Structural Element Affected"

   ☐ slab (top side) ☐ wall (exterior)
   ☐ slab (bottom side) ☐ wall (interior)
   ☐ beam (top) ☐ column
   ☐ beam (side)

5. Reason for Relocation of Anchor:

   ☐ Rebar nicked ☐ Rebar cut

   ☐ Anchor failure ☐ Concrete Failure

6. The depth of damaged rebar _______ inches.

7. Location: Attached is a sketch indicating actual location of the expansion anchor detail with respect to the nearest column lines and elevation and anchor(s) which failed or damaged rebar. Sketch shall be identified by report number and proper page number(s).

8. Prepared: ________________ Reviewed: ________________
   (Installed Contractor) (NAME) (Client Q.A.) (NAME)

   ________________ ________________
   (ORGANIZATION) (ORGANIZATION)

   ________________ ________________
   (DATE) (DATE)

FORM LS-CEA 1.0

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5.0 GROUTING OF EXPANSION ANCHORED PLATES

5.1 General

The purpose of this procedure is to provide an alternate to the use of metal shims, as specified in Section 3.1.11, behind expansion anchored plate assemblies.

5.2 Materials

5.2.1 Grout for filling voids behind expansion anchored plate shall be premixed grout, Embeco 636, Masterflow 713, or Masterflow 814 or 813 cable grout, manufactured by Master-Builders, or other approved grout meeting the requirements of this specification.

5.2.2 Premixed grout shall develop an ultimate strength of 5500 psi at 28 days.

5.2.3 The grout shall show no signs of bleeding.

5.3 Preparation and Mixing

5.3.1 Surface Preparation

a. All surfaces to be in contact with grout shall be thoroughly cleaned. All laitance, oil grease, loosened particles of aggregate, damaged concrete, loose rust, loose mill scale or any loose particles or coating that may interfere with complete bearing and bond or may react with grout materials shall be removed prior to placing grout.

b. The concrete surface to be in contact with cement grout shall be dampened but not saturated for a minimum of 24 hours prior to placing grout. Free surface moisture shall be removed just prior to grout placement.

c. In addition to the above, for premixed grout, follow manufacturer's recommendations.

d. Concrete and steel surfaces to be in contact with grout during placement shall not be colder than 40°F or hotter than 85°F.

5.3.2 Forms

a. Forms shall not leak or deform during grouting operations.

b. Adequate space shall be provided for between the forms and the base plate to allow rapid and continuous placement of grout.

c. Wall plates shall have rigid grout retainer forms placed on the bottom and sides of the assembly plate. The grout retainers shall be sealed at the wall and the assembly plate.

5.3.3 Mixing

a. Premixed Grout shall be mixed per the manufacturer's recommendations.

b. The Premixed Grout shall be flowable having flow cone consistency (per CRD-C79) of 20-30 seconds at 70°F.

c. Grout shall be agitated between mixing and placing, however, retempering will not be permitted.

d. All grout shall be placed within 1-1/2 hours after the addition of mixing water to cement if the grout temperature does not exceed 65°F or within one hour if the grout temperature is between 65°F and 75°F.

e. In case the entire content of the premixed grout bag is not used, the remainder may be used within a maximum period of one month, if stored in an airtight container.

5.4 <u>Placing and Curing</u>

5.4.1 General Placing Requirements

a. Grouting of a plate shall be a continuous operation until the whole plate is completely grouted. Grout shall be injected behind the plate with a portable hand pump with an injection hose and flattened reducer nozzle.

b. Inject grout from bottom of wall plates, pump grout up behind plate until the gap between plate and existing concrete is filled.

c. Vibration from nearby equipment must be prevented until after the grout takes its final set.

5.4.2 Cold Weather Placing of Grout

a. No grout shall be placed if surrounding temperature is below 45°F. Grout minimum temperature during placing shall be 55°F.

b. The use of calcium chloride or other accelerating admixtures to the grout to prevent freezing and/or develop strength of grout in a shorter period of time are not permitted.

5.4.3 Hot Weather or High Temperature Environment Placing of Grout

a. Grout temperature at time of placing shall not exceed 75°F.

b. Retarder admixtures are not permitted.

5.4.4 Curing of Grout

a. Exposed surfaces of grout shall be cured immediately after completion of grout finishing and/or form removal by applying curing compound.

b. Curing compound shall conform to ASTM C309 and it shall be applied in accordance with manufacturer's recommendations after any water sheen which may develop after finishing has disappeared from the grout surface.

c. Exposed surfaces of grout and the place in contact with it shall be protected from temperatures exceeding 85°F for at least 3 days after placement.

d. Exposure of the grout to freezing temperature after placement shall be prevented until it has been cured for at least 3 days at 70°F, or 4 days at 55°F.

No load shall be applied on the grout until it has been cured for at least 7 days.

5.5 Testing

5.5.1 General

a. Owner shall be responsible for all testing work required by this specification unless otherwise specified.

b. Purchaser may, during the course of the WORK, inspect the various phases of the WORK for full compliance with all requirements of this specification and the design drawings.

5.5.2 Testing Requirements

a. All grout for the work shall be tested in accordance with the requirements of Table 1. Reports of the test results shall be submitted to the Consulting Engineers for review.

b. Initial tests shall be performed prior to the use of the grout. All grout components, including the water, to be used for the initial test shall be those approved for use.

c. Sampling of grout for control tests shall be at the time of placement, except for time of efflux which shall be measured just after initial mixing.

d. The following exceptions apply to ASTM C232 for grout:

Use Method A, "Sample Consolidated by Tamping".

5.6 <u>Acceptance Criteria</u>

5.6.1 At each side of the plate, the grout shall provide contact between plate and concrete for at least 50% of the length. Included in this length shall be widths of gaps less than 1/32".

<u>TABLE 39</u>

<u>TESTING FREQUENCIES FOR BOTH PREMIXED GROUT</u>

<table>
<tr><th colspan="2" rowspan="2">Test</th><th rowspan="2">Test Method</th><th colspan="2">Frequency</th></tr>
<tr><th>Category I Grout</th><th>Category II Grout</th></tr>
<tr><td rowspan="4">INITIAL TESTS</td><td>Temperature</td><td>---</td><td colspan="2" rowspan="4">One set of tests on samples from each of the grout mixes proposed.</td></tr>
<tr><td>Bleeding</td><td>ASTM C232</td></tr>
<tr><td>Compressive strength at 7 & 28 days
(See Note 2)</td><td>ASTM C109</td></tr>
<tr><td>Time of Efflux</td><td>CRD C79</td></tr>
<tr><td rowspan="3">CONTROL TESTS</td><td>Temperature</td><td>---</td><td>Twice daily including the first batch (See Note 1)</td><td>Once daily (See Note 1)</td></tr>
<tr><td>Compressive strength at 7 & 28 days
(See Note 2)</td><td>ASTM C109</td><td>Once daily during production.</td><td>Once daily</td></tr>
<tr><td>Time of Efflux</td><td>CRD C79</td><td>Twice daily including the first batch (See Note 1)</td><td>Once daily (See Note 1)</td></tr>
</table>

NOTES:

1) One additional sample shall be tested if grout temperature exceeds 70°F.

2) For premixed grout, ASTM C109 shall be modified as per the manufacturer's recommendations.

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Form LS-CEA
Rev. 8, 5-13-81

Rev - 8

STANDARD SPECIFICATION FOR

CONCRETE EXPANSION ANCHOR WORK

(FORM LS-CEA)

LASALLE COUNTY STATION

UNITS 1 AND 2

PROJECT NO. 4266, 4267

Revision 0 Issued on September 30, 1976

Revision 1 Issued on December 7, 1976

Revision 2 Issued on November 29, 1978

Revision 3:

Prepared By S. M. Kazmi Date 7-19-79

Reviewed By [signature] Date 7-20-79

Approved By E. R. Weaver Date [illegible]

Revision 4:

Prepared By S. M. Kazmi Date 9-7-79

Reviewed By [signature] Date 9-7-79

Approved By E. R. Weaver Date 9-7-79

Revision 5:

Prepared By S. M. Kazmi Date 12-10-79

Reviewed By [signature] Date 12-10-79

Approved By E. R. Weaver Date [illegible]

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Form LS-CEA
Rev. 8, 5-13-81

Revision 6:

Prepared By S.M. Kazmi Date 2-13-80

Reviewed By V. Pehlivan Date 2-13-80

Approved By E.R. Weaver Date 2-13-80

Revision 7:

Prepared By S.M. Kazmi Date 10-27-80

Reviewed By V. Pehlivan Date 10-27-80

Approved By E.R. Weaver Date 10-27-80

Revision 8:

Prepared By S.M. Kazmi Date 5-13-81

Reviewed By V. Pehlivan Date 5-13-81

Approved By E.R. Weaver Date 5-13-81

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Form LS-CEA
Rev. 8, 5-13-81

SPECIFICATION FOR CONCRETE EXPANSION ANCHOR WORK LASALLE COUNTY STATION - UNITS 1 AND 2

(Form LS-CEA)

TABLE OF CONTENTS

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Form LS-CEA
Rev. 8, 5-13-81

SPECIFICATION FOR
CONCRETE EXPANSION ANCHOR WORK
LA SALLE COUNTY STATION - UNITS 1 AND 2

(Form LS-CEA)

1. GENERAL

1.1 Scope: All concrete expansion anchor WORK shall conform to the requirements of this Standard Specification Form LS-CEA unless otherwise indicated in the Project Specification or on the design drawings. This WORK shall include furnishing, installing, inspecting and testing of expansion anchors as indicated in the Project Specification or on the design drawings. The requirements of this Standard Specification shall also apply for attaching hangers for field routed piping and conduits.

1.1.1 For purposes of establishing basic requirements for different applications of concrete expansion anchors, the WORK shall be divided into three categories as follows:

a. Safety Related Work in a Safety Related Structure:

a1. Require complete documentation of installation and inspection/testing as given in Articles 1.4 and 4.0.

b. Non-Safety Related Work in a Safety Related Structure:

b1. Requires complete documentation of installation as given in Article 1.4. Inspection/testing documentation is waived.

c. Non-Safety Related Work in a Non-Safety Related Structure:

c1. Installation, inspection/testing and the use of metal detection is waived. Cutting of reinforcing steel is not allowed, except as permitted in Article 3.2.9.d.

1.1.2 Classification of Structures & Components

For classification of Safety Related and Non-Safety Related Structures and Components, refer to the corresponding design drawings. "Class-I Structure," marked on structural drawings shall be considered as Safety Related. In case no classification has been shown on the drawings, it shall be construed to be Non-Safety Related Structure/Component.

1.2 Definitions: (For all Expansion Anchors): The following terms, when used in this Standard Specification or in the Project Specification or on the design drawings, shall have the meanings:

1.2.1 Sleeve Type Expansion Anchor: A slit tubular expansion shield, and a threaded stud bolt with integral cone expander, as shown in Figure 38-2 following:

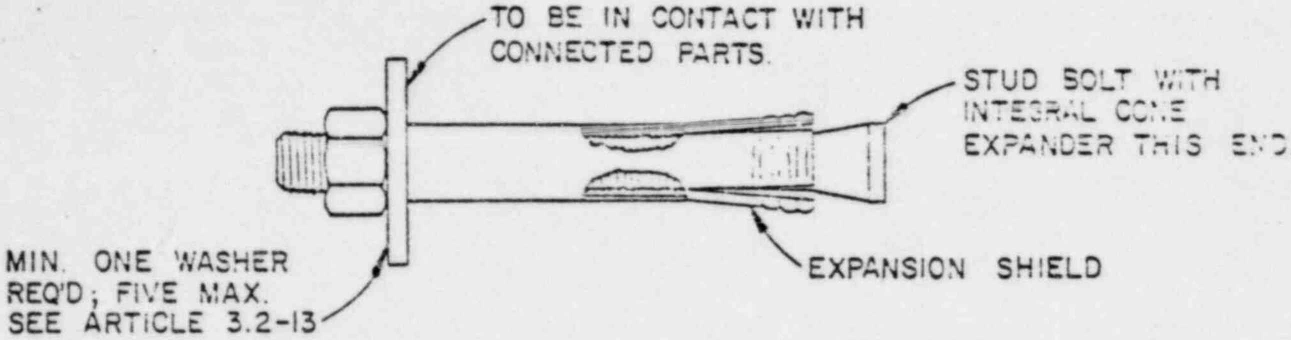


Figure 38-2 Typical Sleeve Type Expansion Anchor

1.2.2 Wedge Type Expansion Anchor: A split expansion ring and (or a separate expansion wedge pair), a threaded stud bolt with integral cone expander (or taper expander), as shown in Figures 38-3 and 38-4 following:

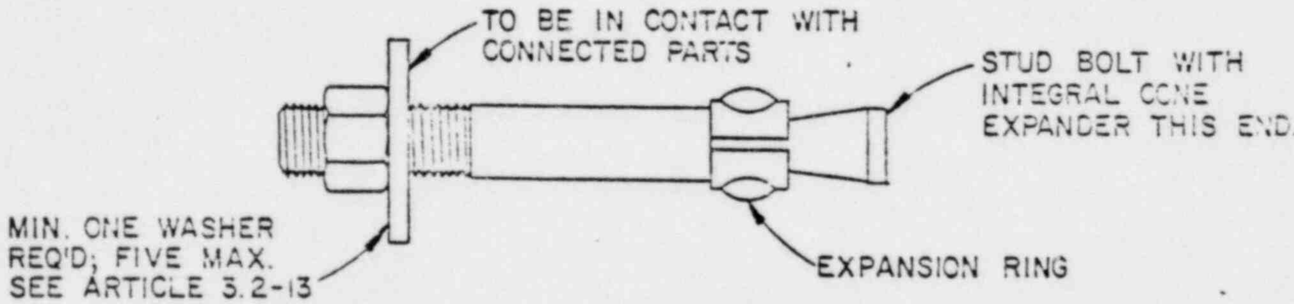


Figure 38-3 Typical Wedge Type Expansion Anchor with Expansion Ring and Cone Expander

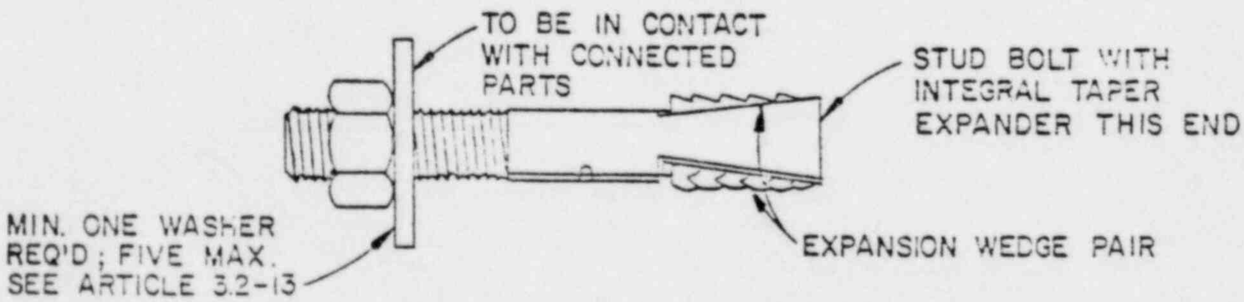


Figure 38-4 Typical Wedge Type Expansion Anchor with Expansion Wedge Pair and Taper Expander

1.3 Quality Assurance Program (For Nuclear Safety Related Work Only): Shall conform to the requirements of the Quality Assurance Articles of the Project Specification.

1.4 Installation and Inspection Documentation

1.4.1 Installation Procedure:

Contractor shall submit a complete installation procedure to the Consulting Engineers for review, prior to any installation, in accordance with Contractor's quality assurance procedure. The procedure shall describe the implementation of this Form, LS-CEA, and shall include but not be limited to, the following:

a. Installation process

b. Equipment to be used

c. Tolerances for Equipment

d. Equipment inspection frequency

e. Types of installation devices and calibration frequency

f. Overall anchor length and minimum depth of hole for each anchor diameter.

g. Methods to verify proper anchor length (i.e., marking bolt ends for lengths).

h. Methods to verify proper hole depth, spacing and edge distance from anchor to edge of concrete or steel lined openings.

i. Methods to verify actual embedded length of an installed anchor with no marking for bolt length.

j. Methods to determine the angularity of the installed anchor.

k. Repair methods for damaged concrete and grouting procedure for patching up abandoned holes.

l. Methods to identify the location of a nicked bar.

m. Information to be documented.

1.4.2 Quality Assurance Responsibilities of the Contractor

The Contractor shall be responsible for the quality assurance check for the following items in particular, but not limited to:

a. Ensure use of an approved installation procedure.

b. [illegible]

c. The minimum embedment depth in accordance with the design drawings has been provided. For drawings released for construction before 7-20-79, if no embedment depth is specified, the minimum embedment depth shall be 4.5d. For the drawings released first time or revised showing anchor size/plate changed, on/after 7-20-79, the minimum embedment depth shall be '8d', if no specific embedment depth is shown on the drawings.

d. If the installed anchor is at an angle and the angularity exceeds the tolerances shown in Section 3-2.3 of this specification, a report shall be submitted to the purchaser.

e. If the nut of the anchor is not fully engaged, a report shall be submitted to the purchaser.

f. While drilling holes for anchor installation, if trial drills have been made in the concrete wall or slab, it has to be ensured that the concrete has been repaired by grouting before the final installation of the plate is made.

g. Verification of spacing and edge distances as specified in Table 38-2 and Figure 38-6.

h. Verification that anchor or concrete failure/damaged rebar reports have been reported on Form LS-CEA 1.0.

i. Check quality of weld for welded plate washers shown in Tables 38-4A and 38-4B, as per the approved welding procedure.

1.4.3 Inspection Procedure (Safety Related Work Only):

The agency responsible for the inspection and testing specified in Article 4 shall submit a complete inspection procedure to the Purchaser for review prior to any inspection. The procedure shall describe the implementation of this form and shall include but not be limited to, the following:

a. Inspection process and frequency

b. Equipment to be used

c. Tolerances for equipment

d. Calibration frequency for inspection devices

e. Information to be documented

2. MATERIALS

2.1 Type and Finish of Materials:

Concrete expansion anchors and accessories shall be made of carbon steel with zinc plated finish conforming to U. S. Federal Specification QQ-Z-325B. Stainless steel may be used in place of this zinc coated carbon steel.

2.2 Strength of Materials:

The material shall have a minimum yield strength of 60,000 psi for self-drilling and wedge type anchors, and 50,000 psi for sleeve type anchors. The material shall have a minimum tensile strength of 75,000 psi for all anchors.

2.3 Cross-Sectional Areas:

The smallest cross-sectional area of the stud bolt of an expansion anchor shall not be less than the cross-sectional area at the thread root.

2.4 Size Limits:

The bolt size limits for expansion anchors shall be as follows: (all sizes shown on design drawings are bolt sizes for sleeve and wedge type anchors).

2.4.1 Sleeve Type: 1/4" through 5/8" diameter of stud bolt.

2.4.2 Wedge Type: 1/4" through 1" diameter of stud bolt.

2.5 Types and Makes of Anchors:

Concrete expansion anchors used for the WORK shall be one of the types and makes indicated in Table 38-1. Other concrete expansion anchors not specified in Table 38-1 may also be acceptable provided they meet the requirements of this specification and are specifically approved by the Consulting Engineers.

2.6 Certificate of Conformance:

For nuclear safety related work, the material supplier shall provide certificate of conformance for each shipment made to the site.

Table 38-1

Types, Classifications, Use and Makes of Expansion Anchors

Types of Anchors	Sleeve	Wedge
U.S. Federal Specification FF-S-325 Classifications:	Group II Type 3 Class 3	Group II Type 4 Class 1
Permissible Use:	For Block Walls Only	For All Work

Manufacturers:	Products:	
a. Hilti Fastening Systems, Inc.	----------	Hilti Kwik-Bolt Stud Wedge Anchors
b. ITT Phillips Drill Company	Red Head Hex Nut Sleeve Anchors	Red Head Wedge Anchors
c. Ramset Fastening Systems	Dynabolt Mark II Hex Nut Sleeve Anchors	Trubolt Wedge Anchors
d. The Rawlplug Company, Inc.	Rawl Lok/Bolt Hex Nut Sleeve Anchors	Rawl-Stud Wedge Anchors
e. USM Corporation Construction Products Division	Parasleeve Hex Nut Masonry Anchors	Parabolt Wedge Anchors
f. Wej-It Corporation of Allied Products Corp.	----------	Wej-It Double Wedge Anchors

3. INSTALLATION

(For all expansion anchors except as noted)

3.1 General Provisions:

3.1.1 Concrete expansion anchors shall be installed in accordance with the manufacturer's specifications and recommendations and the requirements of this Form LS-CEA. In case of conflict, the requirements of this form shall govern.

3.1.2 The minimum embedded lengths, spacing and edge distance for expansion anchors shall conform to Table 38-2 and Figure 38-6 unless otherwise indicated in Article 3.1.10.

3.1.3 The overall anchor length and the hole depth required shall be determined by Contractor such that the specified minimum embedment length and bolt projection can be obtained.

3.1.4 As a minimum, nut shall be flush with the end of an anchor, however, a 1/4" thread projection above the nut after installation is recommended. If projection exceeds 1/4", projection shall not be removed without the consent of the Consulting Engineer. If consent is given, a record of embedment depth shall be made for all anchor with removed projections.

3.1.5 Holes for the anchors may be drilled through hardened grout, but the embedded length shall be determined from the surface of the rough concrete. Holes for the anchors may be drilled through surface repaired concrete, but the embedded length shall be determined in accordance with Article 3.1.9. Holes shall not be drilled through grout or repaired concrete that has not competely hardened nor shall grout or concrete be placed around anchors without the approval of the Consulting Engineers.

3.1.6 Reuse of expansion anchors shall not be permitted.

3.1.7 1/4"Ø expansion anchors are allowed in all locations of reinforced concrete, except where prohibited in Table 38-5, provided the required hole depth is less than the effective depth of the concrete covering the main reinforcement. 1/4"Ø expansion anchors shall not be used in solid block walls.

3.1.8 Welding on expansion anchors is not permitted without approval of the Consulting Engineers.

3.1.9 For anchors installed in holes drilled through surface repaired concrete extending beyond the rebar cover, the dimension (Le) given in Table 38-2 shall be increased by a dimension X as shown in Figure 38-5. In addition, 1/4"Ø expansion anchors are not allowed to be installed through surface repaired concrete.

Where X = [illegible]

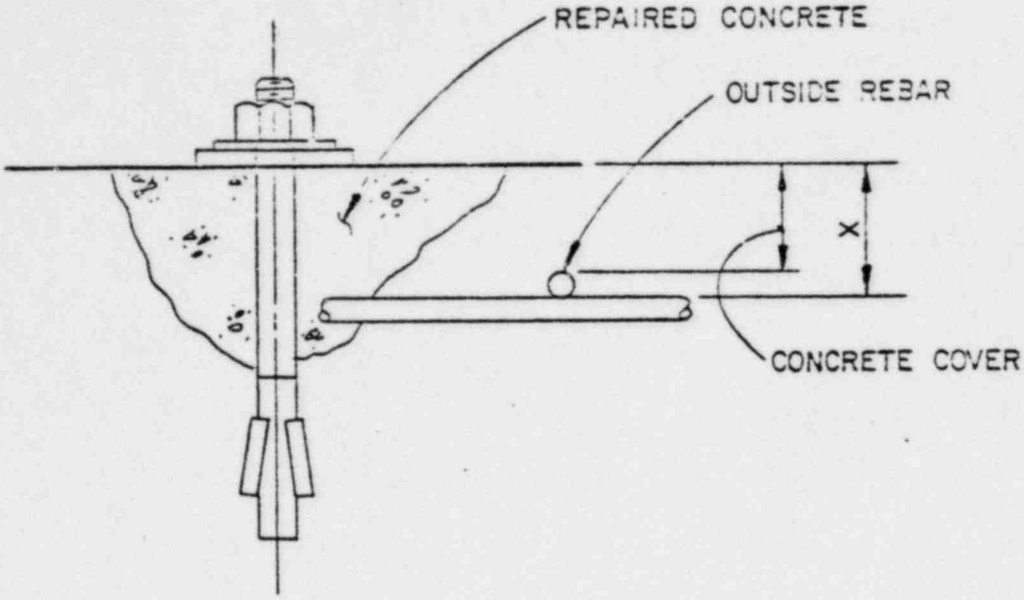


Figure 38-5

Anchors Installed in Repaired Concrete

3.1.10 Refer to Table 38-2 and Figure 38-6, where in:

S = Center to Center distance between anchors in adjacent assemblies

E_D = Edge distance, measured from center of the anchor to the nearest concrete edge

E_S = Edge distance, measured from center of the anchor to the nearest surface of a steel lined opening (sleeve, etc.)

a. When two anchors of different diameters are installed adjacent to each other, "S" shall be the average of the two "S" dimensions.

b. If dimensions E_D, E_S and S cannot be maintained between two anchor assemblies, allowable erection tolerance indicated on the design drawings should be used to resolve the problem. If the problem involves anchors installed by two different contractors, their erection tolerances should be used or the Consulting Engineers should be notified for a resolution.

c. For anchors installed to a minimum of '8d' embedded length, Le shall be to the untorqued position of the expansion ring. For [illegible]

d. If Le cannot be met, the Consulting Engineers should be notified before work proceeds.

e. Edge distances to the side of embedded steel plates shall be the 'S' dimension.

3.1.11 Where the concrete surface is uneven, the following shall be the acceptance criteria for uneven surface between the plate and the mounting surface. This criteria need not be met for attachments with rod type hangers, and for those attachment details for which specific requirements are given on the design drawings.

a. Gaps between the mounting surface and the plate are acceptable if:

1. Width of the gap 'a' along the length or width of the plate does not exceed dimension, as shown in Figure 38-10.

2. Length of gap 'b' extending into the plate beyond width 'a' is limited to 50% or less of the plate length (i.e., at least 50% contact length is available beyond dimension 'a').

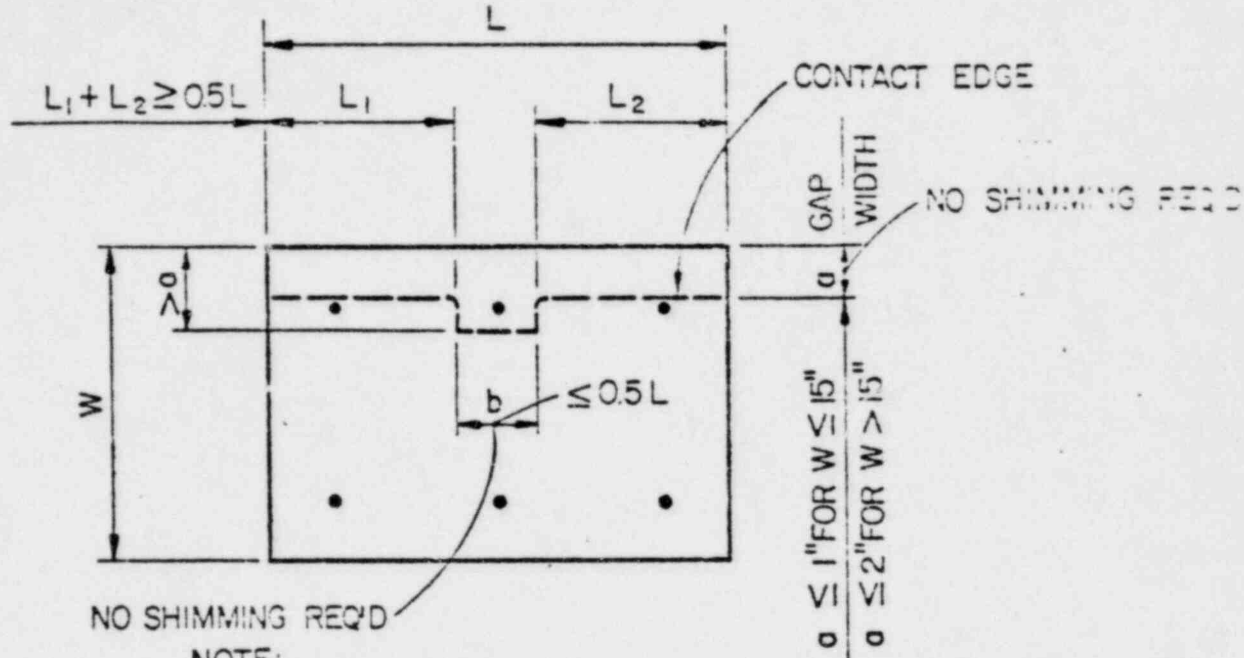
This acceptance criteria shall be applied after welding of all attachments to the plate has been completed.

Mounting surface and the plate shall be assumed to be in contact when a 1/32 inch feeler gauge inserted between them makes contact with both the surfaces. The plate shall be checked for contact along the entire perimeter.

b. For gaps not meeting the requirements of (a) above, the concrete surface shall be improved by grinding or bush hammering. Alternatively, the gap may be filled by inserting shims or grouting as per Section 5.0, between the plate and the mounting surface to ensure that at least 50% length along the plate edge is shimmed or is in contact. The shims shall be placed evenly along the plate edge, with a shim provided at each corner where a gap exists. When the shims are made discontinuous to clear anchors, the spacing between the shim pieces shall not exceed dimension 'd' as shown in Figure 38-11.

c. The shims shall be flat or tapered and of the thickness as required to fill the gap. The shims shall extend into the gap as required but need not exceed dimension 'c' as shown in Figure 38-11. The material for shims shall be ASTM A-36 or equivalent.

d. Each shim shall be tack-welded to the plate at two ends.



NOTE:
PERMISSIBLE GAP ALONG SIDE 'W'
IS SIMILAR TO SIDE 'L', SHOWN ABOVE.

CONTACT DETAIL

FIG. 38-10

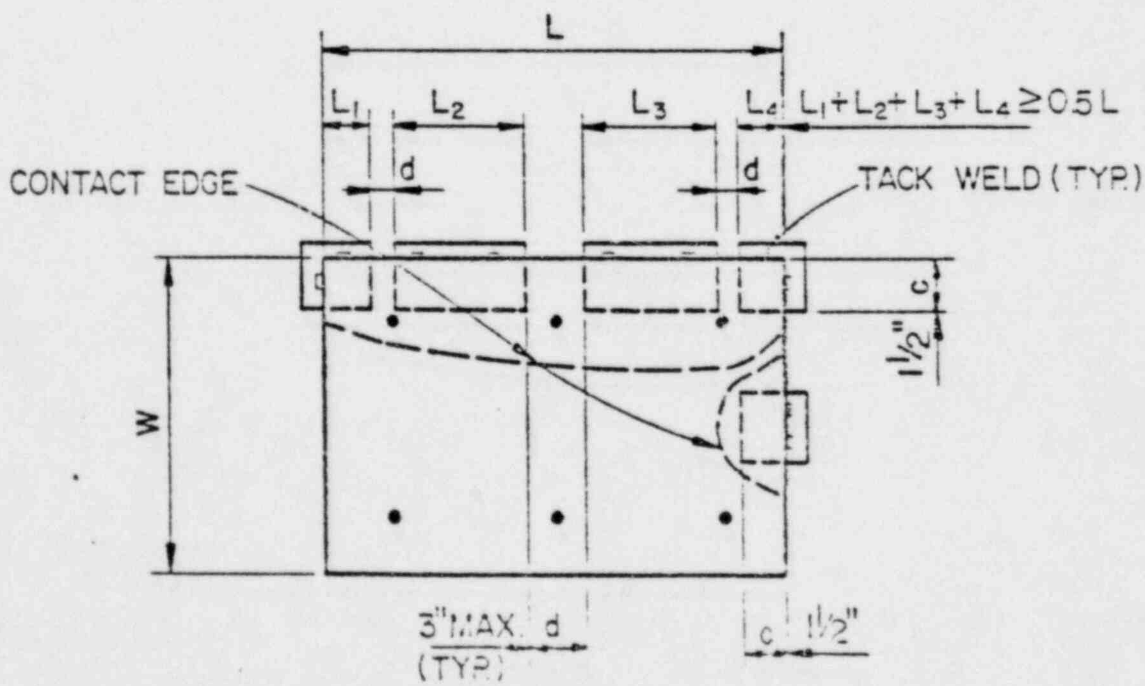


Table 38-2

Minimum Embedded Length, Spacing and Edge Distance For Expansion Anchors

Nominal Bolt Diameter (inch)	Minimum Embedded Length (inches) Le		Minimum Spacing (inches) (S)	Minimum Edge Distance (inches)			
				Ed		Es	
	4.5d	8d		4.5d'	8d'	4.5d'	8d'
1/4	1.25"	1.25"	2.5	1.5	3.25	1	1.75
3/8	1.75"	3.0	4.5	2.5	5.0	1.25	2.5
1/2	2.25	4.0	6.0	3	7.0	1.5	3.5
5/8	2.8	5.0	7.5	4	9.5	2	4.25
3/4	3.4	6.0	9.0	5	10.0	2.5	5.0
1	4.5	8.0	12.0	6	13.0	3	6.5

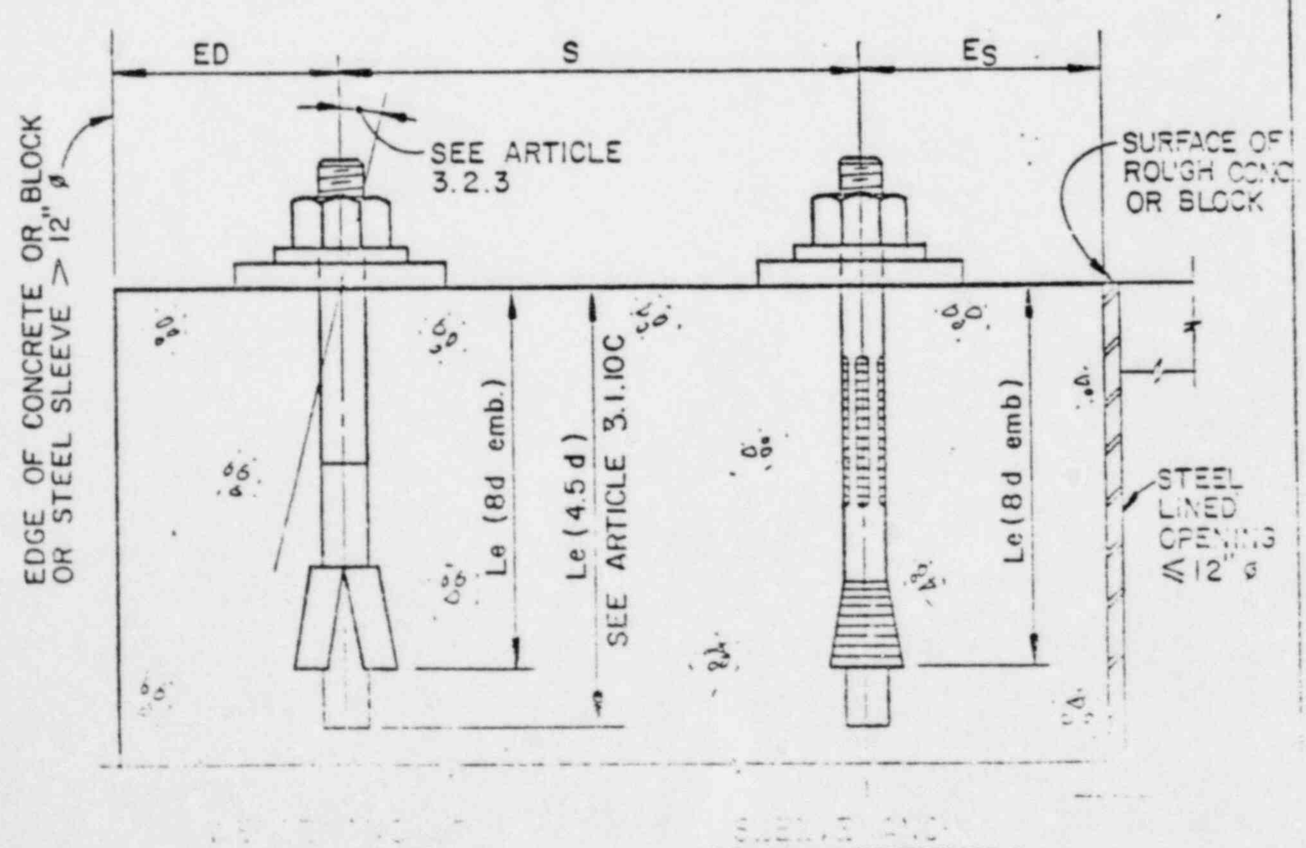


FIGURE 38-3

3.2 Drilling of Holes

3.2.1 For all expansion anchors, except self-drilling type, holes in concrete shall be drilled with quality carbide tipped solid bits, using a rotary/percussion type power drill.

3.2.2 Each hole shall be drilled precisely in order to maintain the expansion anchor's pullout value. The tolerance on the bit shall be within the tolerances specified in American National Standard Institute B94.12 Standards or closer for each anchor size. The nominal drill size for each size anchor shall be as recommended by anchor manufacturer.

3.2.3 The anchor shall be no more than 5^{o} out of plumb for '4.5d' embedment and 10^{o} for '8d' embedded length after installation. Angular deviation shall be measured from the top of concrete or plate surface to the exposed end of installed anchor. For angular deviation greater than 3^{o}, square or rectangular bevelled washers shall be placed between the attachment and the nut to maintain bearing of the nut within 3^{o} tolerance.

3.2.4 The maximum depth of the hole shall not be greater than the thickness of the concrete minus 2-1/2 inches except for slabs on metal decking. For slabs on metal decking, hole depth shall not exceed beyond the location of bottom reinforcing steel. In addition, for 1/4" diameter anchors, the maximum hole depth is 1-1/4 inch. R8

3.2.5 Holes for the concrete expansion anchors shall not be drilled until the concrete has been cured for a minimum of 28 days.

3.2.6 If drilled holes are not used, they shall be filled with drypack grout. The grout is to have a minimum compressive strength of 3500 psi.

3.2.7 The criteria for drilling holes in concrete shall be as indicated in Table 38-5 and Figure 38-7 through 38-9.

3.2.8 At locations where a metal detector is required, a deep magnetic detector shall be used to locate the reinforcement in the concrete and to assure that the reinforcement will not be cut and to avoid nicking. Reinforcing placement drawings may be used as reference in conjunction with the use of the detector. This detector may be one of those indicated in Table 38-3. R8

Table 38-3

Products and Manufacturers of Magnetic Detectors

Products	Manufacturers
James "R" Meter C-[illegible]	James Electronics, Inc. [illegible], Illinois
[illegible]	[illegible]
CT-[illegible] [illegible]	[illegible], Inc. Evanston, Illinois

3.2.9 It is permissible to cut one reinforcing bar per area as given in Article 3.2.9a except for the elements given in Table 38-5.

a1. A 18'-0" x 18'-0" square with its center at the point where the reinforcing bar was damaged when the reinforcing bars are spaced 12 inches or more on centers.

a2. A 9'-0" x 9'-0" square with its center at the point where the reinforcing bar was damaged when the reinforcing bars are spaced less than 12 inches on centers.

b. The location where the reinforcing bar is cut shall be suitably identified on the anchor plate where this bar is located so that all contractors can identify the damaged rebar location. R8

c. The damaged rebar shall be documented on Form LS-CEA 1.0 or equivalent and sent to the Consulting Engineer for review within two weeks from the occurrence.

d. Cutting more than one reinforcing bar within the areas given in article 3.2.9 a1, a2 is not allowed without the consent of the Consulting Engineer.

e. When it is permissible to cut reinforcing steel, it shall be cut using a quality diamond carbide tipped bit.

3.2.10 The following procedure should be followed for metal detection:

a. Using a metal detector, the location of all holes to be drilled and reinforcing bar pattern shall be laid out on the structural element.

b. If metal detection indicates the presence of a reinforcing bar at the anchor design location, the anchor plate assembly should be moved within the allowable erection tolerance indicated on the design drawings to clear the reinforcing bar.

c. If the anchor plate tolerance does not allow sufficient movement to clear reinforcing, the Consulting Engineer shall be notified so that the problem can be resolved before proceeding.

d. If per chance the reinforcing bar is still cut, the procedures given in Article 3.2.9 shall be followed. R8

3.2.11 Where Table 38-5 or Figure 38-7 to Figure 38-9 refers to this article, drilling of holes is allowed without the use of the metal detector if no reinforcing bar has been identified as damaged within the areas given in Article 3.2.9.a. If a reinforcing bar has been cut, the procedures in Article 3.2.9 shall be followed. R8

3.2.12 The use of a metal detector is not required for 1/4 inch diameter anchors.

3.2.13 The maximum number of standard washers or combination of standard washersand A-36 plate washers shall be limited to five.

3.2.14 The location of an individual anchor can be changed to facilitate installation provided the following tolerances are met:

a. Relocation of One or Two Bolts Per Assembly (Fig. 38-12)

For bolts with '4.5d' or '8d' embedment, a relocation within a circle of '2d' radius shall be permissible, if the following requirements are met:

1. The minimum edge distance between the anchor and the plate edge meets the requirements as shown in Table 38-4.

2. Requirements of E_s, E_d, L_e per Table 38-2.

3. If the angularity of the relocated anchor is $< 4^{\circ}$, use of the same size anchor is allowed.

4. If the angularity of the relocated anchor is $> 4^{\circ}$, and $< 10^{\circ}$, next larger size shall be used for the relocated anchor. For example, use 5/8"Ø anchor in place of 1/2"Ø, 1"Ø in place of 3/4"Ø. For existing 1"Ø anchor, the relocated anchor shall be of the same diameter and the angularity limitation of 4°, per paragraph 3.2.14.a.3 shall be maintained.

b. Relocation of More Than Two Bolts Per Assembly (Fig. 38-15)

Any number of anchors in a plate assembly can be relocated as long as the installed spacing between the anchors is within plus or minus two bolt diameter of the original anchor location and the requirements given in Section 3.2.14.a are met. For other cases the Consulting Engineers shall be notified for resolution. R8

c. Relocation of Bolts Outside the Existing Plate Assemblies

1. The maximum permissible relocation shall be in an arc of radius 3" as shown in Figure 38-13 and Figure 38-14.

2. Requirements of E_s, E_d, L_e per Table 38-2 and minimum edge distance requirements per Table 38-4 shall be met.

3. In case only one bolt in an assembly is relocated outside the existing assembly, a new rectangular plate of the same thickness as the existing assembly plate, of size WxL' or W'xL', based on the minimum edge distance requirement, shall be used.

4. In case two or more anchors are relocated, a new rectang- [illegible]

5. The anchor size shall remain the same as in the existing plate assembly, except where more than half of the total number of anchors are being moved. For such cases, the Consulting Engineer shall be contacted for resolution.

TABLE 38-4

Anchor Size	Minimum Edge Distance for Punched, Reamed or Drilled Holes (inches)	
	At Sheared Edges	At Rolled Edges of Plates or Gas Cut Edges
1/4"	1/2"	3/8"
3/8"	3/4"	1/2"
1/2"	7/8"	3/4"
5/8"	1-1/8"	7/8"
3/4"	1-1/4"	1"
1"	1-3/4"	1-1/4"

3.2.15 Where oversize and slotted holes are provided in the field to facilitate installation, hardened washer or square structural plate washers of A-36 material, as shown in the Table 38-4A & 38-4B, shall be used. Such washer shall cover the entire hole area in the plate. Holes can be enlarged by flame cutting up to 1/8" less than the required size, and then reamed or rotary filed to the size required.

3.2.16 If an installed plate is to be replaced by a new larger plate, the minimum center to center distance from the existing anchor to the new anchor shall be 2 times the nominal bolt diameter. The projecting end of the existing anchor shall be cut off per Section 3.4.2.c.

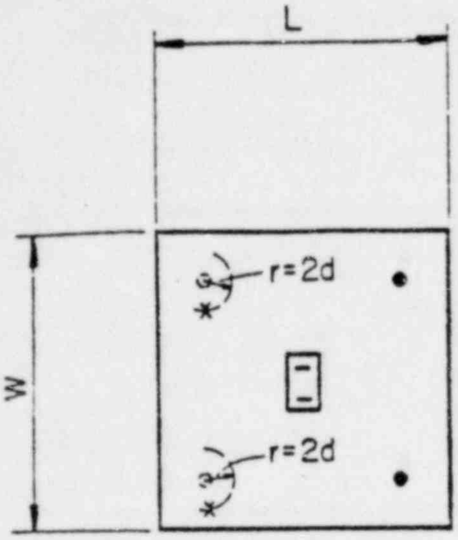


FIGURE 38-12

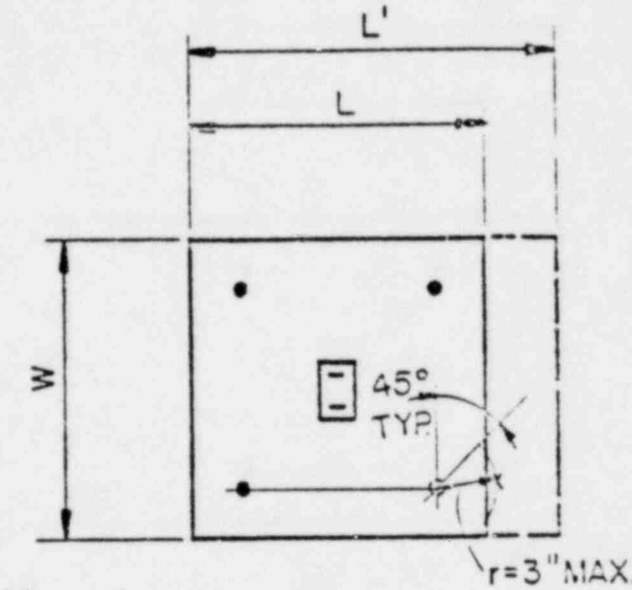


FIGURE 38-13

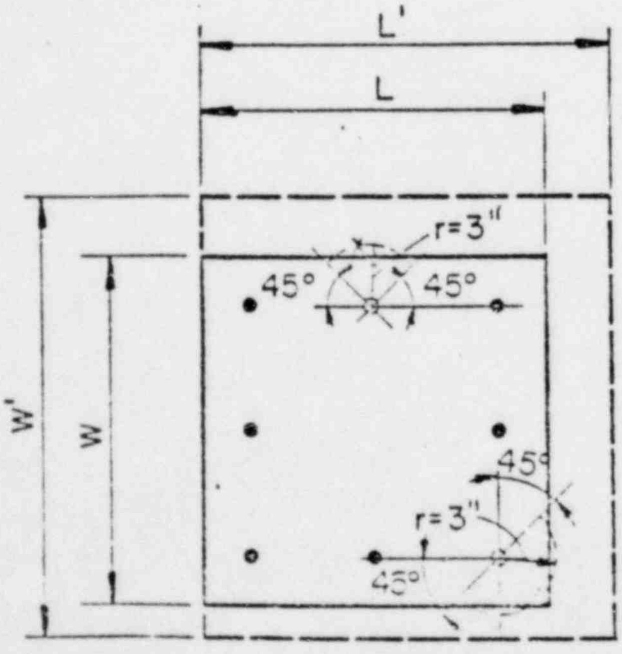


FIGURE 38-14

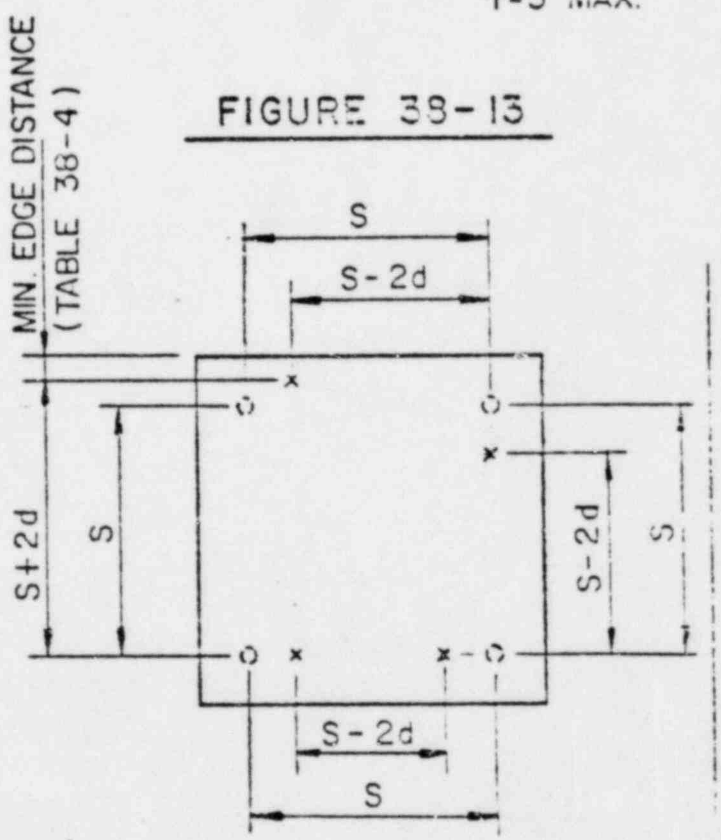


FIGURE 38-15

• - ANCHORS INSTALLED WITHOUT INTERFERENCE

○ - [illegible]

× - [illegible]

TABLE 38-4A

Plate Washer Size - For Slotted Holes

[illegible]	SHORT SLOT		LONG SLOT		
[illegible]	MAX. SLOT SIZE (d+1/16)(d+1/4)	MINIMUM WASHER SIZE	MAX. SLOT SIZE (inches) (d+1/16)(2 1/8d)	MINIMUM PLATE WASHER SIZE (inches)	WELD SIZE
[illegible]	5/16 x 1/2	Use	5/16 x 9/16	2 x 2 x 1/4	
[illegible]	7/16 x 5/8	Minimum	7/16 x 7/8	2 x 2 x 5/16	See
[illegible]	9/16 x 3/4	of 2	9/16 x 1-1/8	2-1/2 x 2-1/2 x 5/16	Note
[illegible]	11/16 x 7/8	Standard	11/16 x 1-3/8	2-1/2 x 2-1/2 x 5/16	Below
[illegible]	13/16 x 1	Hardened	13/16 x 1-3/4	3 x 3 x 5/16	
1	1-1/16 x 1-1/4	Washers	1-1/16 x 2-1/8	3-1/2 x 3-1/2 x 3/8	

[illegible] [illegible]te washers shown in table above shall be welded to the base plate on two opposite sides of the [illegible]te washer with a 1-1/2" long fillet weld. For 3/16" thick plate washers, use 3/16" weld, and [illegible] 1/4" and 3/8" thick plate washers, use 1/4" fillet weld.

TABLE 38-4B

Plate Washer Size - For Oversize Holes

[illegible]	PLATE WASHER HOLE (inches)	WELD SIZE	HOLE SIZE IN PLATE (inches)	MINIMUM WASHER SIZE (inches)	HOLE SIZE IN PLATE (inches)	MINIMUM WASHER SIZE (inches)
1/[illegible]	5/16	See Note Below	1/2	1-1/2 x 1-1/2 x 3/16	9/16 to 3/4	2 x 2 x 1/4
[illegible]/[illegible]	7/16		5/8	1-5/8 x 1-5/8 x 3/16	11/16 to 7/8	2-1/8 x 2-1/8 x 1/4
1/2	9/16		3/4	1-3/4 x 1-3/4 x 3/16	13/16 to 1	2-1/4 x 2-1/4 x 1/4
5/[illegible]	11/16		7/8	2 x 2 x 3/16	15/16 to 1-1/8	2-1/2 x 2-1/2 x 1/4
3/[illegible]	13/16		1	2-1/8 x 2-1/8 x 3/16	1-1/16 to 1-1/4	2-5/8 x 2-5/8 x 1/4
1	1-1/16		1-1/4	2-1/2 x 2-1/2 x 1/4	1-5/16 to 1-3/4	3 x 3 x 3/8

NOTE: Plate washers shown in table above shall be welded to the base plate on two opposite sides of the plate washer with a 1-1/2" long fillet weld. For 3/16" thick plate washers, use 3/16" weld and for 1/4" and 3/8" washer plates, use 1/4" fillet welds.

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Table 38-5

Criteria for Drilling Holes for Expansion Anchors in Concrete

Element			Area No.	Description
Concrete Slabs*			1	See Figure 38-7.
Concrete Beams			2	See Figure 38-8.
Concrete Columns			3	Drilling is allowed with the use of the metal detector.
CONCRETE WALLS	Interior		4	See Article 3.2.11
CONCRETE WALLS	EXTERIOR	Above grade	5	For nuclear safety related wall and walls monolithic to nuclear safety related walls, see criteria for walls below grade. For other walls, see Article 3.2.11.
CONCRETE WALLS	EXTERIOR	Below grade	6	Drilling holes is allowed. For the use of metal detector, see Figure 38-9.
Primary Containment Exterior Wall & Drywell Floor			7	No drilling is allowed, unless approved by the Consulting Engineer.
Concrete Slabs on Metal Deck			8	For the top of the slab, see Article 3.2.11. For the bottom of the slab, drilling is not allowed.
Concrete Finish			9	Drilling holes is allowed provided the hole is completely within the concrete finish. Metal detection is not required. However, anchors installed in safety-related structures shall not be placed in finish unless shown on the structural design drawings or approved by the Consulting Engineers.
FOUNDATION MAT	Containment		10	No drilling is allowed.
FOUNDATION MAT	Others		11	Drilling of holes is allowed. For application where the metal detector is to be used, see Figure 38-7. For mats, "L" is the distance between adjacent column centerlines.
Concrete for Steam Tunnels			12	Drilling of holes is allowed with the use of metal detector.
Concrete for Fuel Pools			13	Drilling of holes is allowed with the use of metal detector.
Masonry Block Walls			14	No drilling is allowed unless shown on the design drawings or approved by the [illegible]
[illegible]			15	[illegible] allowed with [illegible]

*NOTE: No expansion anchors allowed in magnetite concrete.

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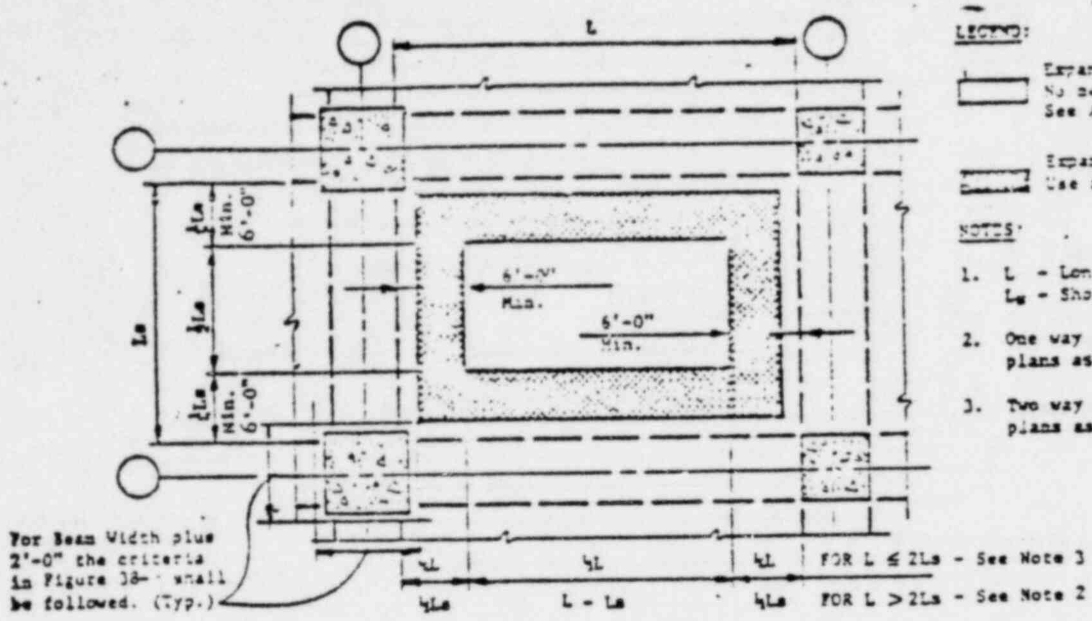


R3

LEGEND:

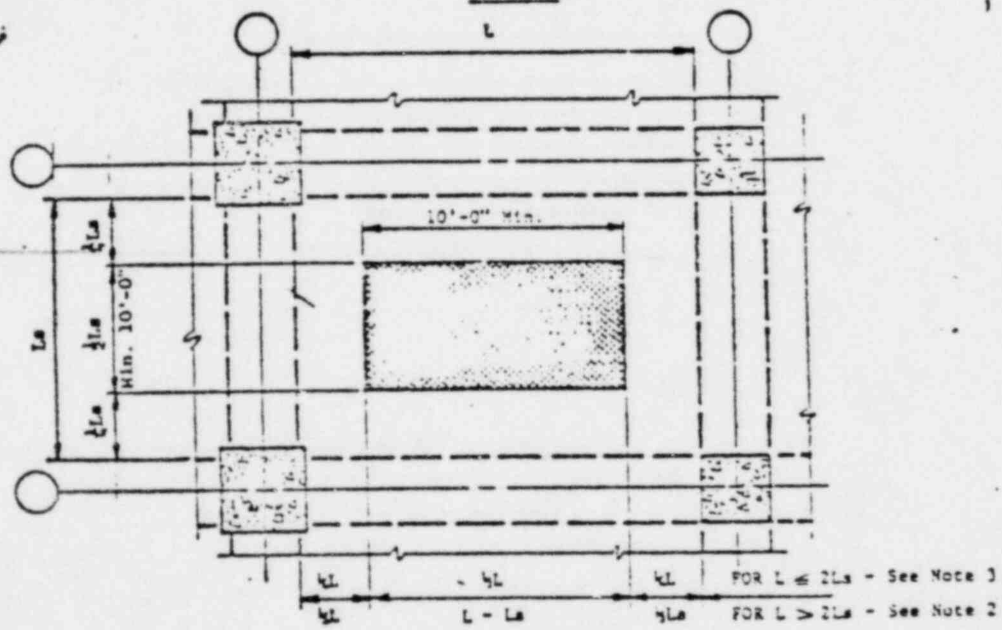
Expansion Anchors Allowed
No metal detector required
See Article 3.2.11

Expansion Anchors Allowed
Use metal detector

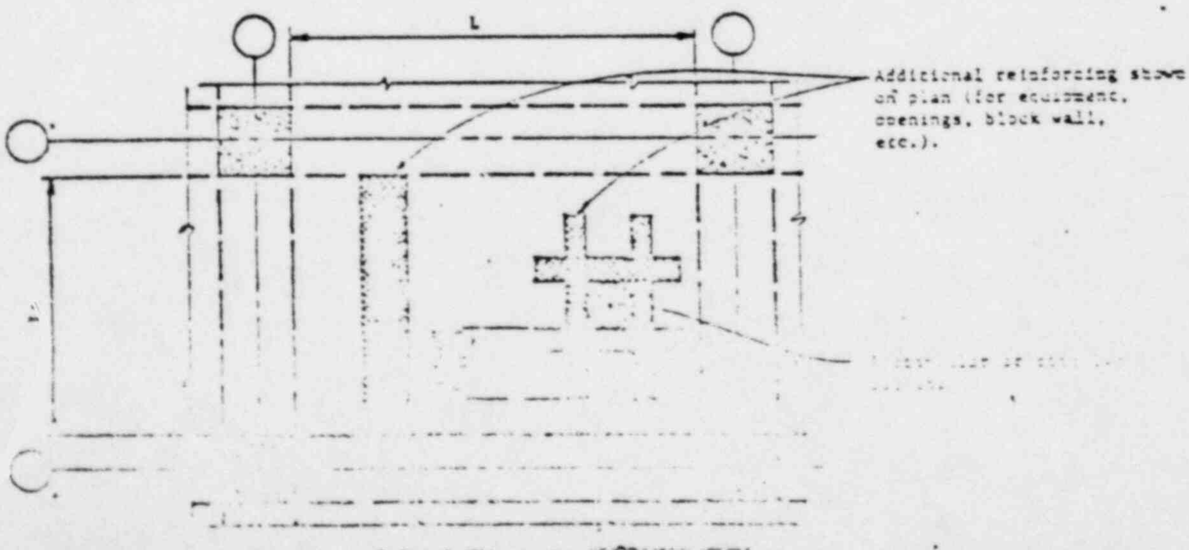
NOTES:

1. L - Long Span
   L_s - Short Span
2. One way slab indicated on plans as
3. Two way slab indicated on plans as

TOP PLAN



BOTTOM PLAN



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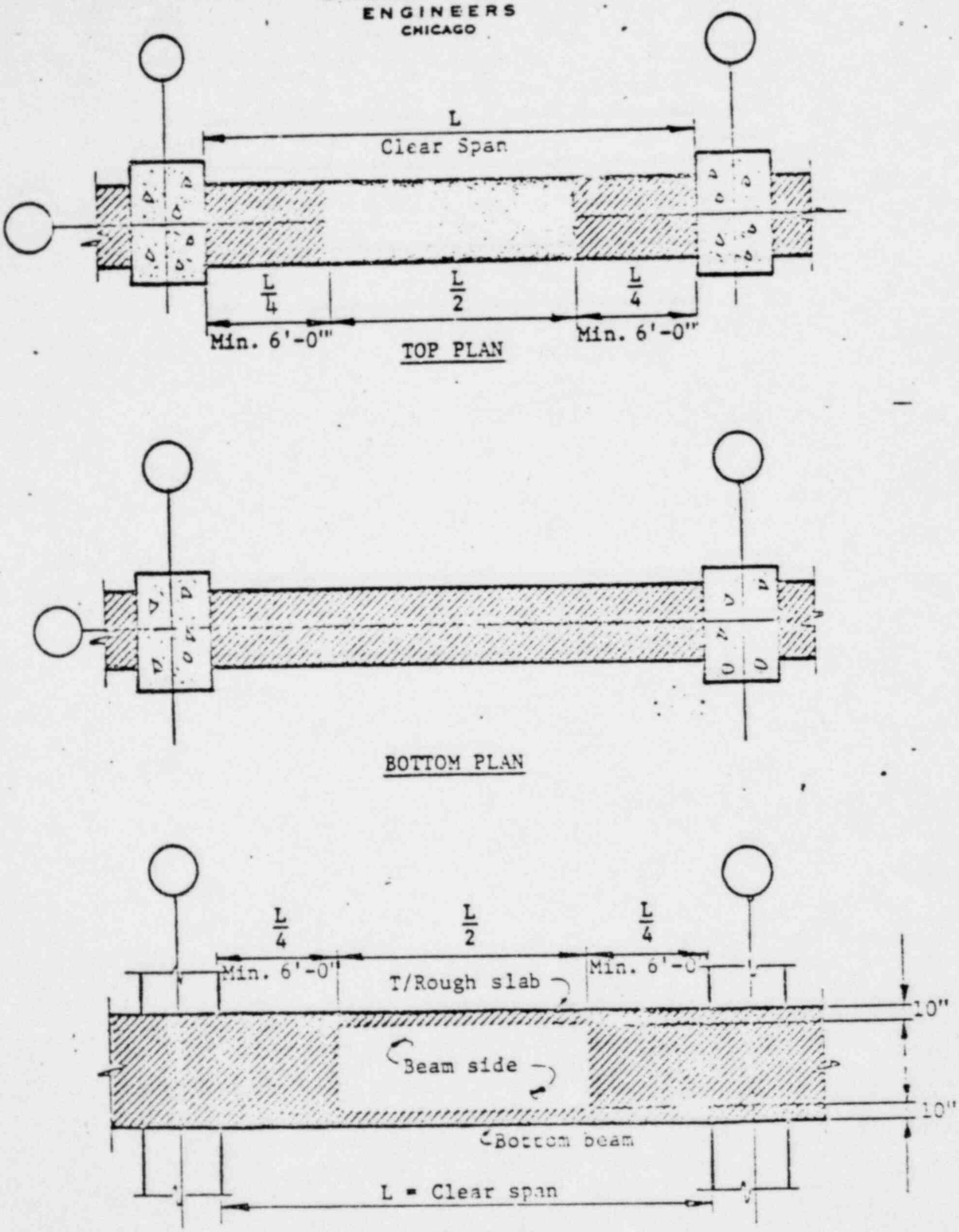

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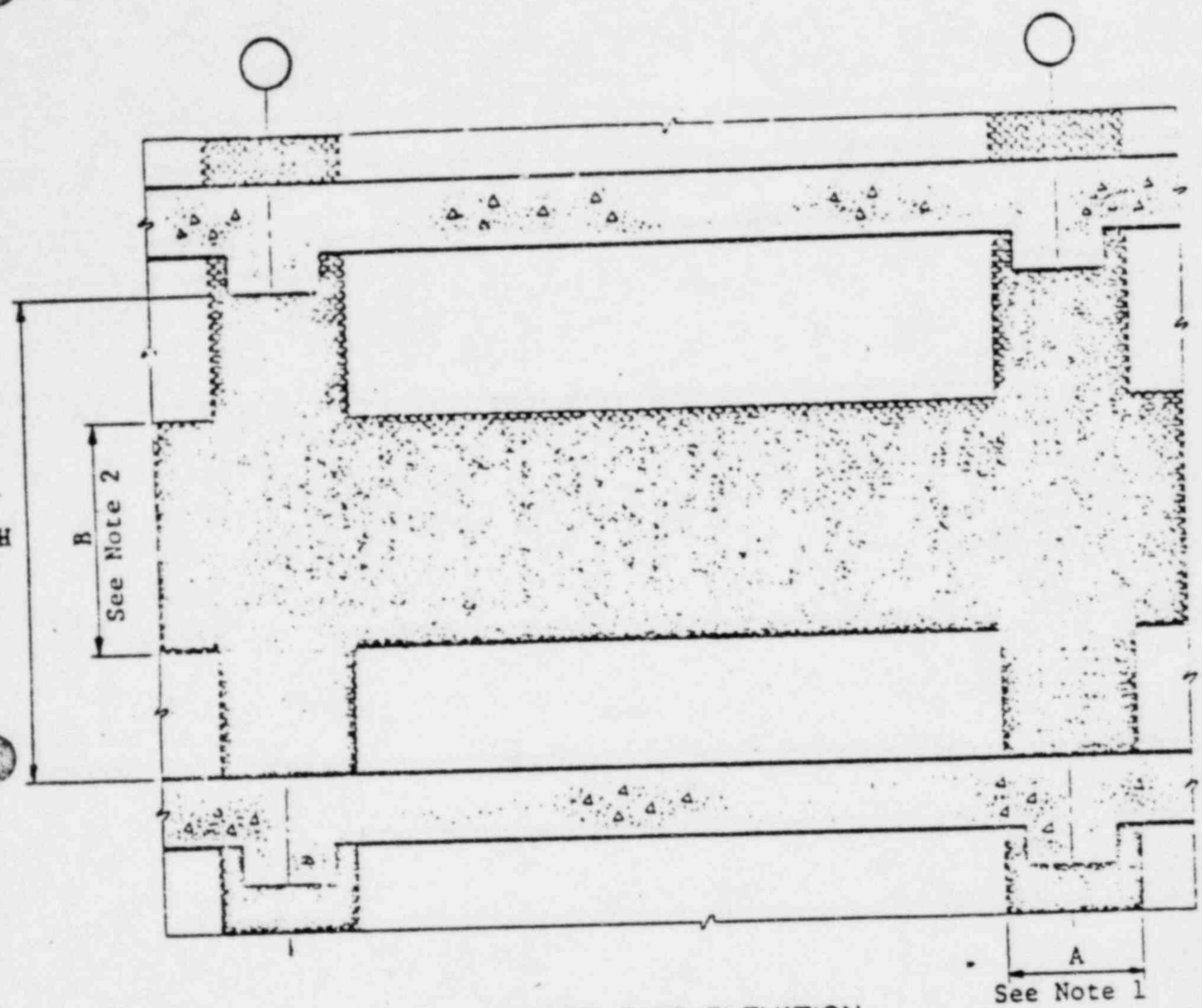

INSIDE FACE ELEVATION

Expansion Anchors Allowed
No metal detector required
See Article 3.2.11

Expansion Anchors Allowed
Use metal detector

Noted: 1. Dimension "A" shall be as follows:

a. If a wall column is present, "A" shall be the width of the wall column plus two feet.
b. If otherwise, "A" shall be the width of the [illegible]

2. [illegible]

[illegible]

3.3 Tightening of Expansion Anchors:

3.3.1 After the anchors for a connection are driven into the holes, they shall be brought to a "hand-tight" condition so that all parts of the connection are in contact with one another.

3.3.2 For wedge and sleeve type anchors, the anchors shall be tightened to the torque values given in the applicable Table 38-6 or Table 38-7. This tightening shall proceed systematically from the most rigid or inner part of the connection to its free edges. During this operation, there shall be no rotating of the parts except the nuts.

3.3.3 A calibrated torque wrench shall be used for tightening expansion anchors. Verification of calibration and recalibration shall be performed per the Contractor's approved procedure. The following frequency is acceptable.

a. For a direct reading torque wrench, on a monthly basis.

b. For snap-type torque wrench, on a weekly basis, by using an upright or horizontal bench tester. This tester shall be verified for calibration or recalibrated at a frequency prescribed by the manufacturer.

Table 38-6 Installation Torque, ft-lb.
For Anchors Installed in Minimum 3500 PSI Concrete

Nominal Bolt Diameter	Torque Range Wedge Type Anchors	
	4.5'd' Emb.	8'd' Emb.
1/4"	5 - 8	6 - 8
3/8"	25 - 35	27 - 35
1/2"	55 - 65	65 - 75
5/8"	80 - 90	130 - 150
3/4"	150 - 175	230 - 270
1"	250 - 300	280 - 320
The Contractor shall exercise caution not to over torque the bolt to cause damage to concrete or bolt.		

Table 38-7

Installation Torque for Anchors
Installed in Solid Block Walls

Nominal Bolt Diameter (in)	Torque Range (ft-lb)	
	Wedge Type	Sleeve Type
3/8	16±1	16±1
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	--

3.4 Repair of Failures: Failures shall be rectified as follows:

3.4.1 Concrete Failure: This shall include all cracking or spalling of the concrete in the vicinity of an installed anchor.

a. The concrete shall be repaired in accordance with the project concrete repairing procedure.

b. After the concrete has been repaired, the anchor hole may be drilled in accordance with Article 3.1.5.

c. All concrete failures shall be reported on Form LS-CEA 1.0/or equivalent and sent to the Consulting Engineers for review within two weeks from the occurrence.

3.4.2 Anchor Failure: This shall include anchor breakage, slippage equal to or greater than one anchor diameter, or loosening to the extent that the anchor cannot be tightened to the installation torque.

a. If the unacceptable anchor can be removed without damaging the surrounding concrete, the hole may be redrilled and the anchor replaced with the next larger size anchor. The embedded length shall conform to the requirements of Table 38-2 and Figure 38-6. For such cases, 1"Ø anchors may be replaced by 1-1/4"Ø anchors having minimum embedded length (Le) of 8", installation torque of 400 ± 30 ft-lbs and testing torque of 250 ft-lbs minimum.

b. If the unacceptable anchor cannot be removed without damaging the surrounding concrete, the anchor location shall be moved within the tolerance given for the anchor plate detail. The minimum center to center distance from the unacceptable anchor to the replacement hole shall be 2 times the nominal bolt diameter. If this distance exceeds the given tolerance on the placement of the anchor plate detail, the Consulting Engineers shall be notified before proceeding.

c. Unacceptable anchors that cannot be removed without damaging the surrounding concrete shall have their projecting end cut off. A saw-cut or flame-cut method is acceptable for removing this projection.

d. All anchor failures and relocation shall be reported on Form LS/CEA 1.0 or equivalent and sent to the Consulting Engineers for review within two weeks from the occurrence.

INSPECTION AND TESTING

4.1 Non-Safety Related Work: Contractor shall be responsible for all inspection and testing work as required or as needed, unless otherwise indicated. Purchaser and the Consulting Engineers may, during the course of the WORK, inspect the various phases of the WORK at the Project Site for full compliance with all requirements of this Standard Specification, the Project Specification and the design drawings. Any work failing to meet the specified requirements shall be rectified or replaced by Contractor at his expense with no cost to the Purchaser.

4.2 Safety Related Work

4.2.1 General Provisions:

a. Installed concrete expansion anchors shall be subject to inspection and testing as specified in Article 4.2.

b. Inspection and testing shall be performed using a calibrated torque wrench. The torque test shall be performed after a minimum elapsed time of 6 hours and before an elapsed time of 14 days.

c. The agency responsible for this inspection and testing shall be independent of the Contractor and shall be as designated by the Purchaser.

d. The inspected anchors shall be suitably marked.

e. The inspection results shall be documented in a suitable test report which should include information such as the following:

e1. Compliance with the minimum testing torque requirements of Table 38-8 for concrete and 38-9 for solid block.

e2. Compliance with requirements of minimum embedded lengths, spacing, edge distances, bolt projection beyond nut and plumbness, as indicated in Table 38-2, Articles 3.1.4 and 3.2.3.

e3. Location of inspected anchors.

e4. Location of all anchors represented by the inspected anchor.

e5. Signature of inspector and date of inspection.

f. The inspection report should be submitted to the Purchaser for review.

4.2.2 [illegible]

a. [illegible]

use to verify that they are accurate in the testing torque range. The tolerance on these torque wrenches shall be within ±4 percent. Calibration of these torque wrenches after initial qualification shall be on a monthly basis.

b. Frequency and Sequence:

b1. Maximum one anchor per assembly, but a minimum of one out of each ten expansion anchor installed in that assembly, shall be selected for testing.

b2. If the tested anchor is unacceptable, all the other anchors in the assembly as defined in b1, above shall be tested.

c. Inspection and Acceptance

c1. On inspection, the inspector shall place the wrench on the nut of the selected anchor and apply torque to the nut until the torque reaches the applicable testing torque given in Table 38-8 or 38-9.

Table 38-8

Minimum Testing Torque for Anchors
Installed in a Minimum 3500 PSI Concrete

Nominal Bolt Diameter (in)	Minimum Testing Torque (ft-lb)	
	Wedge	Type
	4.5d	8d
1/4	5	5
3/8	15	15
1/2	35	45
5/8	60	90
3/4	110	160
1	200	200

Table 38-9

Minimum Testing Torque for Anchors
Installed in [illegible] psi Solid Concrete Block

Nominal Bolt Diameter (in)	Minimum Testing Torque (ft-lb)	
	Wedge Type	Sleeve Type
3/8	10	10
1/2	25	25
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	--

c2. If the nut of the inspected anchor is not turned, the anchor shall be accepted. If the nut is turned, the anchor shall be considered unacceptable.

c3. Unacceptable anchors shall be reported to the responsible Contractor for re-torquing to installation torque and re-inspection. If the anchor is again unacceptable, it shall be replaced in accordance with Article 3.4.

c4. A record of the following items shall be maintained for each anchor tested or replaced.

1. Location of tested anchor

2. Embedded depth, determined by one of the following methods:

   a. Anchor length marking and measuring projection

   b. UT - Conforming to ASTM E-114

3. Verification of spacing and edge distances as defined in Article 3.1.10.

4. Degree from plumb

5. Check for nut being flush with the bolt as a minimum.

6. Check for number of washers to be within the specified limit.

7. Visual check for washers covering oversized holes, and for deformed washers.

8. Torque test.

CONCRETE EXPANSION ANCHOR INSTALLATION

CONCRETE OR ANCHOR FAILURE/DAMAGED REBAR REPORT

Commonwealth Edison Company

Report No. ______

Date ____________

Page 1 of _______

1. ☐ LaSalle County Station Project No. Unit -1 ☐ LaSalle County Station Project No. Unit -2

2. ☐ Building ______________ Floor Elevation ___________

3. S&L Dwg. No. ____________ Detail No. ________________

4. Structural Element Affected

☐ slab (top side) ☐ wall (exterior)
☐ slab (bottom side) ☐ wall (interior)
☐ beam (top) ☐ column
☐ beam (side)

5. Reason for Relocation of Anchor:

☐ Anchor failure ☐ Concrete Failure

☐ Rebar cut

R8

6. The depth of damaged rebar _________ inches.

7. Location: Attached is a sketch indicating actual location of the expansion anchor detail with respect to the nearest column lines and elevation and anchor(s) which failed or damaged rebar. Sketch shall be identified by report number and proper page number(s).

8. Prepared: (Installed Contractor) ______________ (NAME) Reviewed: (Client Q.A.) ________________ (NAME)

______________ (SIGNATURE) ________________ (SIGNATURE)

______________ (DATE) ________________ (DATE)

FORM LS-CEA 1.0

5. GROUTING ~~OF~~ EXPANSION ANCHORED PLATES

5.1 General

The purpose of this procedure is to provide an alternate to the use of metal shims, as specified in Section 3.1.11, behind expansion anchored plate assemblies.

5.2 Materials

5.2.1 Grout for filling voids behind expansion anchored plate shall be premixed grout, Embeco 636, Masterflow 713, or Masterflow 814 cable grout, manufactured by Master-Builders, or other approved grout meeting the requirements of this specification. R8

5.2.2 Premixed grout shall develop an ultimate strength of 5500 psi at 28 days.

5.2.3 The grout shall show no signs of bleeding.

5.3 Preparation and Mixing

5.3.1 Surface Preparation

a. All surfaces to be in contact with grout shall be thoroughly cleaned. All laitance, oil grease, loosened particles of aggregate, damaged concrete, loose rust, loose mill scale or any loose particles or coating that may interfere with complete bearing and bond or may react with grout materials shall be removed prior to placing grout. For plates which are already installed, cleaning behind the plate is not required except that any visible grease and oil must be removed before grouting. R8

b. The concrete surface to be in contact with cement grout shall be dampened but not saturated for a minimum of one hour prior to placing grout. Free surface moisture shall be removed just prior to grout placement. R8

c. Concrete and steel surfaces to be in contact with grout during placement shall not be colder than 40°F or hotter than 85°F. R8

5.3.2 Forms

a. Forms shall not leak or deform during grouting operations.

b. Adequate space shall be provided for between the forms and the base plate to allow rapid and continuous placement of grout.

c. Wall plates shall have rigid grout retainer forms placed on the bottom and sides of the assembly plate. The grout retainers shall be sealed at the wall and the assembly plate.

d. Caulking in lieu of forming shall be acceptable. Reduction in bearing area around the plate periphery due to caulking being under the plate shall be acceptable as long as the caulking width does not exceed 1/2" under the plate. R8

e. Caulking may be left in place permanently. Ten percent of the plates shall be inspected to verify that the grout has been placed and the caulking width requirements are met. R8

5.3.3 Mixing

a. Premixed Grout shall be mixed per the manufacturer's recommendations.

b. The Premixed Grout shall be flowable having flow cone consistency (per CRD-C79) of 20-30 seconds.

c. Grout shall be agitated between mixing and placing, however, retempering will not be permitted.

d. All grout shall be placed within 1-1/2 hours after the addition of mixing water to cement if the grout temperature does not exceed 65°F or within one hour if the grout temperature is between 65°F and 75°F.

e. In case the entire content of the premixed grout bag is not used, the remainder may be used within a maximum period of one month, if stored in an airtight container.

5.4 <u>Placing and Curing</u>

5.4.1 General Placing Requirements

a. Grouting of a plate shall be a continuous operation until the whole plate is completely grouted. Grout shall be injected behind the plate with a portable hand pump with an injection hose and flattened reducer nozzle.

b. Inject grout from bottom of wall plates, pump grout up behind plate until the gap between plate and existing concrete is filled. R8

5.4.2 Cold Weather Placing of Grout

a. No grout shall be placed if surrounding temperature is below 45°F. Grout minimum temperature during placing shall be 55°F.

b. The use of calcium chloride or other accelerating admixtures to the grout to prevent freezing and/or develop strength of grout in a shorter period of time are not permitted.

5.4.3 Hot Weather or High Temperature Environment Placing of Grout

a. Grout temperature at time of placing shall not exceed 75°F.

b. Retarder admixtures are not permitted.

5.4.4 Curing of Grout

a. Exposed surfaces of grout shall be cured immediately after completion of grout finishing and/or form removal be applying curing compound.

b. Curing compound shall conform to ASTM C309 and it shall be applied in accordance with manufacturer's recommendations after any water sheen which may develop after finishing has disappeared from the grout surface.

c. Exposed surfaces of grout and the place in contact with it shall be protected from temperatures exceeding 25°F for at least 3 days after placement. In high temperature areas the grout may be kept wet by spraying water, or by retaining the grout's moisture by keeping the form or caulking in place for 3 days. R8

d. Exposure of the grout to freezing temperature after placement shall be prevented until it has heen cured for at least 3 days at 70°F, or 4 dys at 55°F. R8

5.5 Testing

5.5.1 General

a. Owner shall be responsible for all testing work required by this specification unless otherwise specified.

b. Purchaser may, during the course of the WORK, inspect the various phases of the WORK for full compliance with all requirements of this specification and the design drawings.

5.5.2 Testing Requirements

a. All grout for the work shall be tested in accordance with the requirements of Table 39. Reports of the test results shall be submitted to the Consulting Engineers for review.

b. Initial tests shall be performed prior to the use of the grout. All grout components, including the water, to be used for the initial test shall be those approved for use.

c. Sampling of grout for control tests shall be at the time of placement, except for time of efflux which shall be measured just after initial mixing.

d. The following exceptions apply to ASTM C232 for grout:

Use Method A, "Sample Consolidated by Tamping".