CHAPTER 27

Technical Communications

27.1 GENERAL

The most important concepts in technical communications are:

1. Be brief
2. Be clear
3. Be right technically
4. Be correct from the communication point of view

"Be brief" is essential, as you may lose your reader or listener if your statement drags on. It is often better to be too short and entice your audience to come back to you for more than to be too long and boring. Of course, in the end you wish to hit exactly the right length. In technical writing, 10-word sentences are about the best length. In oral communications, you have the choice between the 15-second sound bite, the 2-minute exposé, the 10-minute discourse, and the 1-hour lecture. Think about which one is right for the situation.

"Be clear" requires that you put yourself in the shoes of your readers or listeners and aim at the sophistication level that most closely corresponds to their background. If you are unsure, assume a lower level and gradually increase the sophistication of the message. This sophistication level refers to the sophistication of for the vocabulary as well as the sophistication of the technical content and thought process.

"Be right technically" is crucial in our field; it requires that any statement made be based on prior work by others or your own work. If not, it is necessary to acknowledge that your statement is based on your intuition or experience. If you use prior work in your statement, you must quote the source and respect intellectual property.

"Be correct from the communication point of view" requires proper vocabulary, grammar, and diction, including being politically correct. Make sure to proofread your written work. Don't forget that your listener may not speak your language, so be prepared to speak slowly and exercise patience when you get indications that you have lost contact.

27.2 E-MAILS

E-mail has become a huge part of daily communications, because these messages are very convenient and time efficient. They include the distribution lines (To, Cc, Bcc), the title, and the body of the message. In the distribution line, make sure that you copy those who truly need to see your message—and no more. The Bcc can be dangerous, as you are obviously hiding something from someone. Remember this golden rule of communication: It is always best to communicate in such a way that if your message were published on the front page of a major newspaper, you would not be embarrassed.

Sometimes you will receive an unpleasant message. When you do, please follow this other golden rule: It is best not to answer unpleasant messages right away. In fact, it is often best not to answer at all. Answering right away with another unpleasant message may give you a few seconds of pleasure, but days of agony later on. Unpleasant messages are best left to simmer for a few days (and it is often disturbing to the sender when such messages remain unanswered).

An email signature with your complete title and contact information is important and convenient. It allows your reader to know who you are and gives your contact information in case a phone call is more appropriate as a response. However, if you do not wish to be contacted, or if your reader knows you well, these items are not useful and may convey a message of misplaced egocentric pride. When you write your name in your signature, write your first name in lower case and your family name in capital letters; you may be sending an email to someone in a country where it is not obvious which is your first name and which is your last name. Another problem may be that, in that other country, names are so different that your gender is not obvious. One trick is to answer by saying "Dear Dr. Something": that way you do not have to decide. By the way, make sure that you include your country as part of your signature contact information.

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27.3 LETTERS

Letters are no longer very common. They are used for extraordinary and more formal occasions. Letter formats vary, but, generally speaking, you will have the letterhead at the top or bottom of the page (or both) with the text of your message in between. The letterhead has the name of your organization and general contact information. Start by indicating the date of the letter, then follow with the name, title, affiliation, and address of the person you are writing to. The greeting line should be Dear Mr. X, Dear Mrs. X, Dear Ms. X (for women not married or if you are not sure of their marital status), Dear Dr. X, Dear Professor X, and so on. If you have a choice of two titles, it is always best to choose the title indicating higher rank. Note that one uses Mr. President but Madame President, not Mrs. President. The text of your letter follows. This text should be two pages or less; letters that must be longer probably should be reports. Letters rarely have attachments unless they are cover letters.

27.4 GEOTECHNICAL REPORTS

A geotechnical design report communicates the site conditions, design, and construction information to the owner of the project, or to the owner's representative. It is an essential part of the construction process and is used at the design stage, the construction stage, and after construction if there are claims. In any case, it should be clear, concise, and accurate. Although the content of a geotechnical report will vary depending on the type and complexity of the project, a typical report will contain at least the following information:

1. Summary of all site investigation data, including layering, groundwater conditions, and variability based on borings
2. Geologic interpretation
3. In situ test results
4. Laboratory test results
5. Interpretation and analysis of the subsurface data
6. Predictive analyses, design
7. Engineering judgment and recommendations, including solutions for possible problems
8. Recommended special provisions and limiting conditions

The detailed data usually appears in appendices with all figures, including boring logs, soil profiles, and test results. Remember that when you have only a few borings at some distance from each other, it is unwise to infer the layering in between the borings unless confirmed through the geology of the site, geophysical methods, or other evidence. Though it is tempting to draw a continuous layering graph, it is best to use question marks between borings when suggesting a layering profile.

The report is written to help in the design of the project and so must be helpful to the person who will use it. At the same time, you have to be careful not to make statements that may hurt you or your company in the future. Although detailed calculations are not included in a geotechnical report, it is important to keep all your calculations, as you may have to go back to them later on. This is why it is important, when you make calculations, to clearly document the steps you took, why you assumed some values, how you came to a conclusion, and what published references you used. Once the geotechnical report is ready, have it proofread by a senior and experienced engineer.

27.5 THESES AND DISSERTATIONS

A *thesis* is usually required for a master's degree, whereas a *dissertation* is produced by a candidate for a PhD degree. Both have the same typical organization.

1. *Title.* The title should reflect as precisely as possible the content of the work—no more, no less. It is better to have a longer, more descriptive title than a short and misleading or vague title. Overall, titles of about 50 to 75 characters (5 to 10 words) are best.

2. *Cover page*. The cover page should include the title, the author' (or authors') name(s), and the name of the institution. The date should also appear on the cover page.

3. *Dedication*. You may wish to dedicate your work to someone who is important to you.

4. *Acknowledgments*. This is where you thank those who have contributed to the work but are not the author(s). Don't forget the name of the sponsoring organization and anyone in that organization who helped you in some fashion.

5. *Table of contents (TOC)*. This is the first major step in writing a thesis or dissertation. The more time you spend on the table of contents, the less time you will have to spend writing and iterating. Start with major section and subsection titles. As you do so, think about the natural flow of the work. Then, for each subsection, write notes to yourself in bullet form identifying what you will talk about in each paragraph. The more detailed the TOC, the easier the body of the paper will be to write. A skimpy or poorly organized table of contents leads to many rewrites, frustration, and a feeling of not making progress.

6. *Executive summary, abstract, or summary*. Summaries or abstracts are a very important part of a thesis or dissertation, as people often do not take the time to read the details of your work. Describe the problem, summarize the important findings of each section (in order), and briefly state the most important conclusions. Usually there are no figures, tables, or photos in this part.

7. *Introduction*. The purpose of the introduction is to answer the following questions: what, why, how, where, by whom, and for whom. Once these questions are answered, you can present a narrative outline of the thesis or dissertation.

8. *Review of existing knowledge (literature review)*. It is important to collect and study existing information so you

do not repeat work that has already been well established. It is sometimes good to duplicate important experiments done by others, especially if there is some level of controversy regarding the techniques or findings, but overall this is not a great way to progress. Once you have summarized the existing knowledge, take the time to synthesize that knowledge, give your opinion and point out why your work was necessary or how it built on or extended previous work.

9. *Experiments*. A dimensional analysis is always a helpful initial step. If the experiment is a small-scale version of the full-scale prototype, scaling laws must be addressed and extrapolation of the results to full scale explained. Experiments should be reported by first explaining what the purpose of the experiment was, then the design of the experiment, the description of the mechanical and electronic parts, the test procedure, the data acquisition, and the results. If the project included a large number of experiments, a table listing all the experiments should be presented. If there are too many parameters to report for each experiment, a number designation (e.g., T46) should be attributed to each one and the table should give all parameters. If there are too many results or figures to present in the main text, present a few strong examples in the main text and put all the results in an appendix. A summary table should be the first page in the appendix. The analysis of the results can appear here or in a separate section.

10. *Numerical simulations.* The motivation behind running numerical simulations should be outlined. The mesh size should be discussed first, demonstrating the reason for choosing the distance to the boundaries. The boundary conditions should be explained. The selection of the soil model and of the input parameters should be discussed next. A table summarizing the number of simulation cases helps readers understand the extent of the work and identify which parameters were varied. If the number of simulations is not too large, the results can be presented in the main text. If not, put the results in the appendix that starts with a summary table. The analysis of the results can be done here or in a separate section.

11. *Analysis of data.* This section makes use of all data accumulated to formulate a solution to the problem posed. Theory, measurements, engineering judgment, logic, and common sense all contribute to making the outcome and results as simple, sound, and useful as possible. It often takes a lot of effort to reach the optimum threshold of simplicity.

12. *Conclusions*. This is where you demonstrate your contribution to new knowledge in a succinct way. It is often convenient to go chapter by chapter and collect your conclusions from each part, arranging them in a consistent framework that shows progress in geotechnical engineering. I am reminded of two comments I received on my research in the early 1980s, one from my father and one from Geoff Meyerhof. My father, after patiently listening to my research work, looked straight at me and said: "So what?!" Meyerhof, after reading my early work on laterally loaded piles, said: "Too complicated!" So, while you have to deal with great complexity to solve the problem, in the end your goal should be to develop something "useful and simple."

13. *References.* The purpose of a reference is to acknowledge the work of others and support your statement. Remember that in engineering, when you make a statement, you must have proof (experiment, theory, simulation, reference) or at least a factual basis for that statement; you may need to say that your statement is based on your experience or common sense or engineering judgment. The best way to quote a reference in the text is according to your institution's mandated or preferred system; most use the author-date system, In this system, you use the name of the first author, followed by the name of the second author if there are only two authors, or by "et al." if there are more than two authors, and followed by the year of publication. In the reference list, the full citation information for each source is given, organized in such a way that readers can easily track down and obtain the referenced publication. A typical presentation is

- Last name and initials of all authors, year of publication (in parentheses); title of paper, report, or book chapter; title of periodical, proceedings, or book (usually in italics); volume number and issue number; name of publisher and the publisher's location; inclusive page numbers.

If the reference is a web site address (URL), the reference is organized as follows:

- Author if any is credited, copyright or posting date, title, the address/URL of the web site from which the piece was retrieved, and the date the material was accessed or downloaded.

If the reference is a CD, the reference citation is organized as follows:

- Author(s), copyright date, title, medium, and producer/publisher and publisher's location.

14. *Appendices.* The bulk of your data should appear in an appendix; you may need to use more than one. The front page of each appendix should explain what is in that appendix. This is where a summary table of tests or simulations becomes most useful.

27.6 VISUAL AIDS FOR REPORTS

Visual aids for reports may include figures, tables, and photographs. Figures showing graphs of data should have the two axes labeled with the spelled-out name of the variable, the letter symbol, and the unit in parentheses. The axes should have scales with about 20 tick marks and 4 or 5 numbers on the scale. The data points should be clearly identified. If you have more than one set of data points, use different symbols. Although color graphs are more appealing and easier to read, remember that a color graph created electronically may end up printed in black and white. In this case, if you have used

the same symbols but different colors, the data points will be undistinguishable between sets. If a set of data points leads to a recommended design line, leave the data points with the recommended line; this will help the user gauge the extent of the scatter and select a different value than your recommendation if necessary. If a regression line is drawn, indicate the equation of the line and the value of the coefficient of regression R^2. The size of the letters or numbers in a graph should be such that the graph can be easily read; the minimum size to ensure easy readability is about 1/20 of the size of the graph.

Tables should have the name, symbol, and unit of the parameters at the top of each column or the beginning of each row. The caption of a table precedes the body of the table, whereas the caption of a figure or photo goes below the artwork (don't ask me why!). For best results, photos must be sharp and high resolution. The rules about using visual aids that are not yours, or that are yours but that you have signed over to a publisher by signing a copyright agreement, vary from one source to another. For noncommercial purposes, the general rule is that the source of each visual aid must be acknowledged unless it is your own original work. The acknowledgment may be made simply by placing in the caption the name of the author and date of the publication where the visual aid was found (essentially, giving the reference citation. For commercial purposes, written permission must be obtained from the publisher of the visual aid, and that permission or credit line must be mentioned along with the acknowledgment of the source. Student work is noncommercial, but it is essential to get into the good habit of acknowledging any intellectual property you use that is not your own. People always appreciate when they are recognized and get upset when they are not.

27.7 PHONE CALLS

In all cases, one should prepare for a phone call—if nothing else, to anticipate questions and minimize cost. Know what you wish to achieve and have a plan on how to maneuver if the conversation goes in a different direction than you anticipated.

E-mail or phone call: that is the question! Most of the time, e-mails are very efficient, but there are some situations in which they are very dangerous, misleading, and inefficient. It is amazing to see how many different ways a given e-mail may be interpreted by different people. There is a big difference between the written word and the spoken word. For example, if an interaction might be contentious, it is best to pick up the phone. People tend to understand much better when spoken to than when written to. Reading an e-mail can lead to a serious misunderstanding and an escalating response; it is often much easier to diffuse a misunderstanding on the telephone.

There are also times when you simply have to be courageous enough to call the person rather than hiding behind an impersonal and cold e-mail. Most people appreciate being told unpleasant truths "in person" by a telephone call rather than reading them in e-mail. One might argue that some things must be in writing, and that is true. However, the best approach in those cases is to talk on the telephone and explain that the conversation will be followed by a follow-up e-mail to restate and formally memorialize the points covered in the conversation.

27.8 MEETINGS

Three of the most important rules for efficient meetings are:

1. Do not interrupt anyone
2. Be brief
3. Be professional in your attitude toward your colleagues

Interrupting people when they speak is rude, but they have to respect your right to contribute as well by being brief. From time to time, someone may get under your skin, but it is important to remain calm under fire and concentrate on facts, data, logic, analysis, and reasoning to win your arguments rather than shouting or attacking someone personally. Accept that sometimes your point of view is not the view of the majority and that you are only a member of the team. In many situations, it is important to have the courage to change the things you can change, accept those that you cannot change, and have the wisdom to know the difference.

If you are a participant in a meeting, speak up only when you really have something important to say—something that will advance the process. If you are presiding at the meeting, keep in mind the time allotted for each item on the agenda, have a plan if a discussion drags on for good reasons, cut off any unnecessary chat, and help the group stay focused on the topic by repeating during the discussion the original problem to be solved or question to be answered. Also, as the leader of the meeting, start by establishing some initial rules about cell phone use, side chats, and texting or answering e-mails during the meeting. All are distracting (and discourteous) and should not be allowed during meeting.

Motions and votes are very valuable because the decision becomes extremely clear. It takes place by

1. A motion is proposed by someone.
2. The motion is seconded by a second person. If not seconded, the motion dies.
3. Once the motion is seconded, a discussion period takes place during which you try to convince your colleagues that they should vote in a particular way.
4. The person presiding calls for the vote when the discussion is over and then the votes are recorded. This can be done by show of hands, voice call, or written ballots. The choices are yes, no, or abstain. For delicate matters, the vote may be secret, depending on the rules of the organization.

Although motions may seem cumbersome at times, they are very useful in case of arguments after the fact. Remember

that after any motion passes, there is usually a need for an action item: who will do what to implement the decision. Any action items or assignments should be included in the recorded minutes of the meeting. For further help in running meetings efficiently, consult *Roberts' Rules of Order*.

27.9 PRESENTATIONS AND POWERPOINT SLIDES

If you are going to give an important lecture in front of many people, make sure that nothing is left to chance. The best presentations can be ruined if something fails to work. Here is a helpful checklist for presentation success:

1. Hook up your laptop to the local projector and check that it works properly. If you have to use someone else's laptop, make sure you know how to use the basic functions on that laptop.
2. Check all your slides to make sure that they are exactly what you expect (equations are not changed, movies are working, and so on).
3. Bring a pointer or find out if one is available to borrow.
4. Know who will advance the slides. If you are not doing this yourself, what will be the signal to advance the slides? Constant use of a "next slide" request is not elegant; a sign of some sort between you and the projectionist is best, including when to start any movies or animations.
5. Keep an eye on time and pace yourself. It is best to practice the full presentation ahead of time and under "field" conditions to measure the time required.
6. The average time per slide is one minute; however, slides with only photos will go faster and slides with sample calculations will go slower.
7. Have a back-up plan if something fails to work. Can you project your voice without the microphone? Can you complete the presentation without slides, for example? Develop the talent of not requiring slides to guide your thoughts.
8. Have a special title slide and final slide that set your desired tone and reflect your personality.
9. Keep an eye on your audience to see if you are getting blank stares or interested looks. Adjust accordingly.
10. If there is no podium to lean on, you may find yourself on an open stage not knowing what to do with your hands and being self-conscious. A good trick in this situation is to grab a pen or a pointer. Both hands will naturally join to hold it, and you will not think about that any more.

PowerPoint presentations are subject to a fair amount of personal taste with regard to color, background, animations, and so on. However, there are some fundamental rules:

1. Do not put too much information on the slide. Four bullets, or one graph (possibly two graphs) with explanation, or a couple of photos is a maximum.
2. Graphs speak well to an engineering audience. These graphs follow the same rules as the figures of a report, thesis, or dissertation (see section 27.6). With PowerPoint, the lettering should be even larger than for figures in a printed report.
3. An audience cannot absorb tables with more than 10 numbers in them at the normal rate of presentation. Generally speaking, tables are not a good way to convey an idea or a result in PowerPoint.
4. Equations may be necessary, but should be limited in length and complexity unless the audience is well versed in that aspect of the work.
5. The use of movies is entertaining and holds the audience's attention. If you intend to use movies, make sure that they work and double-check them right before your presentation.

27.10 MEDIA INTERACTION

The media has essentially three forms: the written press, the audio press, and the video press. In all cases, the most likely interaction will be an interview, although a written communication may be involved as well. This written part may be a press release or a letter to the editor sent to newspapers. In this case, you will have time to prepare and proofread your statements. Interviews for the written press are conducted in an informal setting, often by telephone, and are less stressful than audio and video interviews. For the written press, note that saying "off the record" is best avoided, as you have no insurance that your request will be honored. Always only say what you do not mind seeing printed.

For the video press, you can have either a taped interview (that may be edited) or a live interview. While the possibility of having your statements edited may give you some level of confidence against mistakes, you should not behave differently. Remember also that you most likely will not have an opportunity to edit your statements. Video editing is very time consuming and not as easy as text editing.

In preparing for the interview, take the time to review your notes and check your appearance in a mirror. Before the interview begins, ask the reporter about the line of questioning, including typical questions, and make sure the reporter knows how to pronounce your name and affiliation correctly. Find a way to be comfortable in front of the camera; the best way to do that is to ignore it completely. Just talk to the reporter as if you were chatting with him or her at the kitchen table. Overall, speak your mind, but do not say anything that you are not very sure of. Live TV interviews are an exercise in fast thinking and right thinking. Remember that the 15-second sound bite dominates the TV market. If you are uncomfortable with a question, find a way to answer by talking about what you really wish to talk about. To minimize errors in your answer and give yourself time to think, take a second before answering to look in the distance or at the

ceiling; then start with the obvious while formulating the rest of your answer in your mind.

27.11 ETHICAL BEHAVIOR

In the end, you have to answer to yourself and the dictates of your conscience. In any decision process, you are always free to choose what is right for you. Regardless of your decision, you will also have to face the consequences of that decision. You may get by with a few lucky ones, but you may also find yourself implicated in undeserved conflicts. There are close to 9 billion people on our planet and each one thinks differently—yet everyone thinks that they are right. It often makes it smooth interaction very difficult. Nevertheless, there are reasonable guidelines governing ethical behavior.

As an engineer making a decision, remember the following:

- As engineers, we must uphold, as the highest priority, the safety of the general public within reasonable economic constraints.
- If you are unsure about something, get advice from people whom you respect and who have a proven track record.
- If at all possible, do not rush the decision.
- In the process of deciding, reverse the roles; put yourself in the other person's shoes and treat people the way you would like to be treated.

Whatever you decide after reasonable thought, remember that you have done your best and you should not feel badly about it. If the outcome is unpleasant, do not quit: Keep fighting for what you think is right until it becomes right or you run out of energy. In any case, worrying and stressing are useless (and actually harmful to your health)—but that does not mean that you should take everything lightly. So, don't stress and don't worry; just prepare, plan, and concentrate. Easy to say but hard to do!

27.12 PROFESSIONAL SOCIETIES

In your life, you have two families: your blood family and your professional family. It is important to support your professional family by belonging to your professional organization. In the United States, it is the Geo-Institute (http://www.asce.org/geo/). For the world scene it is the International Society for Soil Mechanics and Geotechnical Engineering (http://www.issmge.org/). By belonging to and being active in your professional society, you will participate in the work of technical committees, contribute to national decisions, and more generally strengthen and advance the practice of geotechnical engineering. In your work as a volunteer, you will be interacting and socializing with your peers; you will learn from them and you will teach them. You will also improve your technical communication skills, as you will naturally find yourself engaging in various types of communication. Being a member of your professional society ranks at the level of a family obligation; you should ask how you can help your professional society rather than ask what it can do for you.

27.13 RULES FOR A SUCCESSFUL CAREER

A successful career is built on a series of demonstrated successes by an individual, either alone or as part of a team. In the performance of your job, remember when you make a decision of any sort that it will take ten successes to erase one mistake from the minds of your peers. This is why it is always important to concentrate and plan. Also, before a challenging moment, remember that you may have been through similar tough moments before and done well; this recollection will give you added confidence and lower the stress.

The following "Top Ten" are some thoughts on what is important in a career. They have been inspired by discussion with many engineers over time, including Clyde Baker, and personal experiences as well:

10. Choose the relentless pursuit of excellence as a way of life.
9. Be curious. The discovery process is a fountain of youth.
8. Work hard but balance your interests (fun, family, sport, art, world news).
7. Make lots of friends. Nurture your public relations.
6. Look for solutions and not who is to blame. Leave that to the judge.
5. Be firm in your decisions, but always be fair and polite.
4. Treat others as you wish to be treated, and you will lead by example.
3. Communication is the best way to solve problems. Convince through logic and data.
2. Surround yourself with smart people and positive role models.
1. Pursue your dreams with vision and perseverance.