



# Shackelfordian Technical Writing Guidelines<sup>1</sup>

*I would have written a shorter letter, but I did not have time.*

- Blaise Pascal, Provincial Letters, Letter XVI, 4 December 1656

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## General

1. Your writing should aim to describe the results in the most simple, direct, clear, and logical way possible. The goal of technical writing is not to be dramatic, but to convey technical information. Good technical writing often is tedious in terms of word usage but is exciting from a technical basis in terms of the data, analysis, results, discussion, and conclusions.
2. Preference in technical writing should be given to correct "grammar" rather than "style," because styles vary from one person to another and from one publisher to another, whereas grammar is "exact," i.e., aside from the differences between American<sup>2</sup> English versus British English (e.g., see Rule 42) Of course, American English is preferred in the USA. Many acceptable writing styles actually violate English grammar.
3. Generate all figures and tables prior to writing, as this approach will increase your efficiency in writing tremendously. That is, you need to think about what you want to describe and explain based on your results, generate the appropriate figures or tables to facilitate the description and explanation, and then write the description and explanation based on the generated figures and/or tables. This approach will greatly improve your efficiency in writing relative to the approach where you generate figures and/or tables as you are writing (but will require a considerable amount of time and effort prior to writing).

<sup>1</sup> By Charles D. Shackelford, Professor, and Joseph Scalia, Associate Professor; last updated July 22, 2022.

<sup>2</sup> Note that the term "American" is derived from the name of the country, United States of America, and not from the name of the continent, North America. I was in a graduate class one time when a student from South America took offense to students from the USA calling themselves Americans, because this student considered all residents of any country in North and South America to be Americans. Of course, this statement is true when referring to continents, but not when referring to countries. Someone from China is both Chinese and Asian, but not everyone from Asia is Chinese. Another American student in the class clarified this distinction to the South American, who then remained quiet thereafter.



4. Figures are always preferred relative to tables because the reader can more easily discern trends or differences in data from figures than from tables. When you create a table, consider how the data/results shown in the table can be presented instead as a figure.
5. Always double check before submitting. A final check should include:
  - a. affiliations,
  - b. spelling,
  - c. figure and table captions,
  - d. plots used for figures,
  - e. table contents,
  - f. equations, including definitions of parameters in equations, equation numbers,
  - g. reference to figure, table, equation numbers in text,
  - h. correlation between reference cited in text and those listed in reference list, and
  - i. consistent reference format.

## Structure

6. Almost every conference or journal paper has the same structure:
  - a. title page,
  - b. abstract,
  - c. keywords
  - d. introduction,
  - e. methods,
  - f. materials or application site,
  - g. results,
  - h. discussion
  - i. conclusions,
  - j. acknowledgments,
  - k. references,
  - l. tables, and
  - m. figures.
7. Avoid writing a paper or report like a story or a sequence of events (first, we did this and then this). Technical papers and reports are logical arguments that support a set of conclusions. Think of your paper or report as a court case rather than a story. Write a series of logical connections and supported assertions (to accomplish this thing, that thing was done; this result implies that effect).
8. Keywords: Capitalize first word and use semi-colons (or common format), and alphabetize the list of keywords (generally not required by publishers, but also not precluded).
9. Introduction: The introduction always has the same structure. Start by stating the general subject area that is being studied and why additional study is needed. Next, discuss what is known about that subject area that helps meet the current needs. Then, identify the key gaps in the understanding and why these matter. Finally, state the objective of the paper (which should be to fill the gaps you've identified).
10. Results: The results section always has the same structure, which repeats (in structure) several times in the section. First, provide the analysis that a figure is describing (which will be easier if you have followed Rule 3), then state the main observations you make from that figure, then discuss/interpret why the observations occur and the significance of the observations. Repeat (and rinse) this procedure for each table or figure.



11. Conclusions: The structure of the conclusions section is always the same. Start with a brief summary of what was done in the study (in case someone did not read the methods and results). Then, often as a bulleted list, describe what you found that is relevant, and what you conclude or recommend. The conclusions should meet the objectives that were stated in the introduction and should be obvious after someone has read through the results. In general, there should be one conclusion for each objective (makes sure the number of conclusions matches the number of objectives). All conclusions must be supported by your results. Always be quantitative by providing specific values.

## Writing

12. **NEVER, NEVER, NEVER** use the word "it" when writing formally. The use of "it" results from the tendency of "lazy writing" and leads to confusion and lack of clarity as to what is meant by "it." Also, starting a sentence with "It...", which often occurs in technical writing, results not only in an unclear meaning (e.g., what is "It"), but also in inefficient writing. For example, "It can be shown that the coefficient of consolidation decreases with increase in effective stress..." can be rearranged easily to read, "The coefficient of consolidation can be shown to decrease with increase in effective stress..."

For a published example, the following text was extracted from Pan et al.<sup>3</sup>:

"Therefore, approximately 6.25 million constant-strain brick elements would need to be used to simulate the wall and replicate the small penetrating holes with a dimension of about 0.04 m in the numerical model. This would require a RAM of approximately 50 GB and 103h to run a simple transient flow analysis on a single core with a central processing unit clock speed of 3.4 GHz. **This makes it extremely difficult to implement RFEM on an ordinary workstation when thousands of Monte Carlo simulations are involved.** In cases where instant onsite evaluation of the cutoff performance is required with existing inclination data, one cannot run a time-consuming finite element analysis to guide the ongoing construction. Hence, **it is of engineering interest to develop an algorithm enabling a fairly accurate and speedy evaluation of the impact of geometric imperfections on the performance of the cutoff walls.**"

In this text, there are two sentences within the same paragraph that contain the word "it," and there's no clarity as to what "it" is referring. The wording in these two sentences can be easily rearranged and/or changed to eliminate the word "it" and improve clarity as follows:

"This makes ~~it extremely difficult to implementing~~ RFEM on an ordinary workstation **extremely difficult** when thousands of Monte Carlo simulations are involved."  
Hence, ~~it is of engineering interest to developing~~ an algorithm **that enables** a fairly accurate and speedy evaluation of the impact of geometric imperfections on the performance of the cutoff walls **is of engineering interest.**"

13. Always write to eliminate unnecessary punctuation, if possible, as doing so makes the writing more efficient and more effective. Punctuation usually can be eliminated simply by rearranging the word structure of the sentence.
14. **ABBREVIATION AND ACRONYM RULES**
  - a. Always define an abbreviation or acronym immediately after first usage, except for common terms, including versus (vs.), for example (e.g.), that is (i.e.). However, these common terms should only be abbreviated when used within parentheses (e.g., x vs. y).
  - b. Once an abbreviation or acronym is defined, the abbreviation or acronym must always be used.

<sup>3</sup> Pan, Y., Hicks, M.A., and Broere, W. (2020). An efficient transient-state algorithm for evaluation of leakage through defective cutoff walls. *International Journal of Numerical and Analytical Methods in Geomechanics*, 45, 108-131.



- c. Never start a sentence with an abbreviation, chemical formula, acronym (Fig., ASTM etc.), numbers, -ing words, or chemical formulas.
  - d. The use of "avg" instead of "ave" as the abbreviation for "average" is preferred, since "ave" can also represent "avenue."
  - e. Unit abbreviations for "days" is "d", for "hours" is "h" and for "seconds" is "s." The abbreviations "sec" and "hr" are word abbreviations for "seconds" and "hours," respectively, and not abbreviations for units. [Note: The use of the word abbreviations for units instead of units abbreviations is more common in older publications e.g., m/sec instead of m/s, although I still today see presentation slides where the presenter has used the word abbreviations].
  - f. For replacing the word "approximately" in the text, use  $\sim$ , whereas in an equation, use  $\approx$ .
  - g. For the symbol for effective stress,  $\sigma'$ , use the inclined accent in the Symbols font for the prime here and all other locations, and **NOT an apostrophe**, i.e., use  $\sigma'$ , not  $\sigma'$  or  $\sigma'$ .
15. Do not animate the inanimate. For example, figures and tables are inanimate (non-living) objects and, therefore, cannot "show", "give", or "present" anything.
- a. Therefore, do not write, "The figure shows...", "The results show...", "The membrane shows...", "This paper illustrates...", "This tables gives...", etc.
  - b. Do write "...as shown in Fig. ??..." or "...as illustrated in Table ??..."
16. COMMAS
- a. Use Oxford commas, i.e., in a list of three or more items, put a comma before the "and" such as, "a, b, and c."
  - b. Commas for emphasis: For example, "This relative difference is expected, as the slurry in the dialysis bag with less bentonite mass would have a higher porosity and, therefore, higher rate of diffusion." There's a reason for this punctuation. The word that is not required here is "therefore." That is, the sentence could easily read as follows: "...would have a higher porosity and higher rate of diffusion." Note that, in this format, there is no comma before "and," and certainly none would be expected. Thus, the commas are added immediately before and after "therefore" to isolate this word, which has been added only for emphasis, from the rest of the sentence.
  - c. If the two parts of a sentence don't both have a subject, then you do not need a comma. "Today was warm and hot." "Today was warm, and today was hot." Both of these examples are correct, but one is better (more concise).
  - d. If the sentence is so complicated such that you don't know the correct use of commas, dashes, etc., then simplify the sentence to avoid the issue. You can also use parentheses to simplify complicated sentences. "Fort Collins is semi-arid (15 in of precipitation)."
17. EQUATIONS
- a. Equations should be referenced only after these have been presented in the text. That is, never refer to an equation number before the equation is presented.
  - b. Equations should appear in the same font as variables in the text.
  - c. Steps to insert an in-line equation:



- i. place the equation in the line (no indentation and no tab marks in the ruler);
  - ii. type the equation number in parentheses on the right side of the equation;
  - iii. right justify the equation; and
  - iv. place the cursor between the equation and the equation number and use either the tab function key or the space bar to locate the equation in the middle of the page.
18. Whenever writing a sentence as a statement of fact, either one or more references must be provided to support the statement, or the sentence must be qualified to remove the connotation of a fact.
19. For a formal name of a type of soil, all the words should be capitalized. For example: Nelson Farm Clay; NATURALGEL® [which is a specific name of a commercially available bentonite (including a registered trademark symbol)].
20. HYPHENS
  - a. Try to avoid the "disease" I refer to as "hyphenventilation," which is the tendency to over hyphenate or hyphenate too much. Note that the term "hyphenventilation" is derived by analogy with the term "hyperventilation," which refers to over breathing typically caused by anxiety or panic. When I see too many hyphens, I start to hyperventilate.
  - b. A series of nouns used collectively as an adjective modifying a subsequent noun must be hyphenated, for example, a 71.1-mm-diameter specimen. Alternatively, the phrase could be written without hyphens as, "...a specimen with a diameter of 71.1 mm..." Two classic examples in geotechnical engineering where this rule has not been followed are "grain size distribution" or "particle size distribution" and "pore water pressure." In both cases, the two words being used collectively as an adjective should be hyphenated, i.e., "grain-size distribution," "particle-size distribution," and "pore-water pressure." Other examples include:
    - i. 24-h period, 4-in diameter, air-entry disk,
    - ii. 20-mm-thick sand layer, and
    - iii. 30-m-long roll.
  - c. When one of two words modifying a subsequent noun is an adjective, then a hyphen is not necessarily needed, e.g., "well graded sand," because "graded" is an adjective and "well" is an adverb that can be used to modify an adjective. This situation is in contrast to the aforementioned references to the terms "grain size distribution" and "particle size distribution," where the modifying words "grain," "size," and "particle" are all nouns such that, from a grammatical perspective, these terms should be hyphenated, i.e., "grain-size distribution" and "particle-size distribution," which almost is (incorrectly) never the case.
  - d. Only hyphenate between a prefix and the word being modified when the prefix ends in a vowel and the main word starts with a vowel, e.g., "de-aired," "de-ionized," "semi-infinite." **Note that some publishers, such as ASCE journals, generally do not hyphenate these words based on their "style," e.g., "deaired," "deionized," and "semiinfinite."**
  - e. There is no need to hyphenate when the prefix ends in a vowel and the main word starts with a consonant, e.g., write "semipermeable," not "semi-permeable," and write "nonideal," not "non-ideal." **Again, some publishers do not follow this rule based on their own style.**
21. Italicize variables/parameters, not mathematical symbols/acronyms/Greek. Journals prefer italicized parameters to distinguish parameters from the simple letters (e.g., *x* vs. *x*, *t* vs. *t*)



- a. Do not italicize Greek symbols in accordance with ASCE policy (although this rule does not seem to be followed consistently).
  - b. Parameters italicized in the equation, should also be italicized in the text/tables/figures.
  - c. Differential symbols ( $d$  or  $\partial$ ) should not be italicized, e.g.,  $dt/dy$
  - d. English letter subscripts should be italicized, e.g.,  $\gamma_d$ .
  - e. pH is the exception, as most journals refuse to italicize pH, even though pH involves only English letters and is a variable/parameter.
  - f. Acronyms versus parameters. The acronyms for some terms also serve as variables/parameters, e.g., CEC = cation exchange capacity, EC = electrical conductivity. Thus, when used as variable/parameters with measured values, these acronyms should be italicized, e.g., "...the *CEC* of montmorillonite ranges from 80 to 150 meq/100 g (cmol<sub>c</sub>/kg)..." Note that, if you italicize these acronyms, many journals will convert them back to the non-italicized form, usually because the text editor does not realize the acronym is being used as a variable/parameter.
22. **Never write a single sentence paragraph.** If the sentence is long (based on personal interpretation), split the sentence into two or more sentences. If the sentence is short, combine the sentence with the previous or subsequent paragraph. All paragraphs should have at least two sentences, and preferably three or more.
23. Always place the value of the parameter as close to the parameter designation as possible to enhance reader comprehension. For example, use: "...significant increase in the *ESP* relative to the *ESP* of 47 % for the untreated bentonite", instead of "...significant increase in the *ESP* relative to the *ESP* of the untreated bentonite was 47 %."
24. LISTINGS
- a. Listing items within a sentence: When listing a series of items within a sentence, the sentence structure and grammar should be maintained even when the list is separated from the main body of the sentence. For example, for the statement, "The assumption in Terzaghi's theory of consolidation are that (1) the soil is homogeneous, (2) the soil is water saturated, (3) the solid particles are incompressible, (4) compression and flow (seepage) are one-dimensional, (5) strains are small, (6) Darcy's law is valid, (7) the hydraulic conductivity and volume compressibility are constant, and (8) there is a unique relationship, independent of time, between the void ratio and effective stress." should be written in list form as follows: "The assumptions in Terzaghi's theory of consolidation are that
    - (1) the soil is homogeneous,
    - (2) the soil is water saturated,
    - (3) the solid particles are incompressible,
    - (4) compression and flow (seepage) are one-dimensional,
    - (5) strains are small,
    - (6) Darcy's law is valid,
    - (7) the hydraulic conductivity and volume compressibility are constant, and
    - (8) there is a unique relationship, independent of time, between the void ratio and effective stress."

**Note that the punctuation in the sentence format is maintained in the list format.** This is an important distinction in that many styles, such as Strunk & White's *The Elements of Style* and journal publishing styles, consider the following format as preferred:

"The assumptions in Terzaghi's theory of consolidation are that:



- (1) The soil is homogeneous.
- (2) The soil is water saturated.
- (3) The solid particles are incompressible.
- (4) Compression and flow (seepage) are one-dimensional.
- (5) Strains are small.
- (6) Darcy's law is valid.
- (7) The hydraulic conductivity and volume compressibility are constant.
- (8) There is a unique relationship, independent of time, between the void ratio and effective stress."

Clearly, this acceptable *style* violates English grammar in at least two ways. First, the style converts what was a single sentence with one period into multiple sentences that all start with a capital letter and end with a period. Second, the introductory sentence ends in a colon (:), not a period. This example is a classic example of how a writing or publishing style violates English grammar.

- b. When making a list in a sentence, the items need to be equivalent in grammatical structure and equivalent in their meanings. So, the following examples are incorrect. "Key properties of the object include size, shape, texture, and greenness..." since greenness is more specific than the other items in the list. The last word should be "color" to be conceptually equivalent to the others in the list. Also, "Key properties of the object include size, shape, and the nature of the color of the object..." because the last item is not grammatically equivalent to the previous items in the list.

## 25. LOCATION

- a. Location of activity (e.g., at Massachusetts Institute of Technology, Cambridge, Massachusetts, United States of America, Earth) usually is not necessary in the case of laboratory testing. Of course, in the case of field testing, location is imperative.
- b. Location of manufacturer or distributor of a material or piece of equipment typically is necessary. As an example for a journal published in the USA, "The CMCHV is produced by MP Biomedical (Irvine, CA), and the CMCLV is produced by Calbiochem® (Millipore Sigma, Burlington, MA). As an example for a journal published internationally, i.e., a journal published outside the USA, "... the SPME fiber was vibrated at constant and controlled frequencies of 10, 250, 420, and 800 Hz via the signal generator (Hewlett-Packard Co. Palo Alto, California, USA) for specific periods." Note that, in the case of the journal published in the USA, the two-letter abbreviation for the state (MA) is allowable and the country designation (USA) is not required, whereas these allowance are not typically permitted for internationally published journals.

## 26. NUMBERS OR VALUES

- a. In general, spell out numbers when less than two digits, *i.e.*, one, two, three, ..., nine, 10, 11, 12... In technical writing, an exception occurs when describing a range of values that transitions from single digits to more than single digits (e.g., "from 5 to 20" instead of "from five to 20").
- b. When presenting a range of values, always use the "from" - "to" sequence, e.g., "...ranging from 25 to 55."

## 27. PERCENTAGE

- a. Distinguish between the words "percent" and "percentage." "Percent" is associated with a specific number and the % symbol may be used as a replacement for the word,



e.g., 20 percent or 20 %. "Percentage" is general term that is qualitative, i.e., not number specific. For example: "A significant percentage of the students passed the course."

- b. "Percent" versus %: Use "%" for actual data, and use "percent" for conceptual illustration. For example, "...this interpretation is 100 percent correct..."
- c. Atterberg limits: Tradition is that the % sign is not used when reporting Atterberg limits, e.g., plastic limit (PL), liquid limit (LL), plasticity index (PI), even though the values are all measured gravimetric water contents that typically are reported in %. For example, "...the plasticity index decreased from 35.3 to 33.6..." However, since these values are water contents, I personally prefer to show the % symbol, e.g., "...the plasticity index decreased from 35.3 % to 33.6 %..."

## 28. UNIT RULES

- a. Spacing before units: always place a space between the number and units.
    - i. If you were to write this sequence out in words, you would write "two millimeters". Since there is a space between the word "two" and the word "millimeters", there also should be a space between the number "2" and the units "mm", i.e., "2 mm" not "2mm."
    - ii. Note that the % symbol is almost always placed directly adjacent to the number, e.g., 20%, although this format violates this rule. Similarly, temperature is almost always abbreviated without a space; i.e., either "20°C" versus "20 °C."
  - b. Units in quotient format: The units for some parameters, particularly those based on a time-dependent rate are in a quotient format. For example, the units for both the coefficient of consolidation,  $c_v$ , and the diffusion coefficient,  $D$ , are length squared per unit time (e.g.,  $m^2/s$ ). In cases where there are two units in the denominator, a commonly used format is to separate all the units with the mathematical divisor symbol, /. For example, the units for area normalized mass flux are mass per unit area per unit time, which commonly is depicted as mass/area/time (e.g., grams per square meter per second, or  $g/m^2/s$ ). However, this format could be interpreted mathematically to be represent  $g \cdot s/m^2$ , since  $2^{3/4} = 2 \cdot 4/3 = 8/3$ , which obviously is incorrect. Thus, the correct way to format the units for these parameters is to use either a dot (·) or a dash (-) to separate the units in the denominator, e.g.,  $g/m^2 \cdot s$  or  $g/m^2-s$ .
  - c. When using the / for units, do not place a space between the / and the number or units being represented (which seems to be occurring more often these days). For example, write 30 mL/2 g, not 30 mL/ 2 g, 30 mL /2g, or 30 mL / 2 g.
29. Do not animate the inanimate. For example, figures and tables are inanimate (non-living) objects and, therefore, cannot "show", "give", or "present" anything. Therefore, do not write, "The figure shows...", "The results show...", "The membrane shows...", "This paper illustrates...", "This tables gives...", etc. Do write, "... as shown in Fig. ??...", or "...as illustrated in Table ??..."
30. Avoid sentences that are complicated (i.e. have asides, subclauses, etc.). Instead, put those items in separate sentences. This approach improves clarity and logical flow.
31. Avoid sequencing several adjectives modifying a single noun. For example, instead of writing, "one-dimensional, large-strain consolidation tests," write "tests for one-dimensional large-strain consolidation." [Not the best example, so I will find a better one from a published paper.]
32. Be specific with time. Resist statements such as, "...over the past couple of decades..." because the time frame is relative to that of the published paper, not the present.





33. In English, words that are borrowed directly from another language should be italicized.
- For example, *in lieu* and *in situ* are taken directly from Latin.
  - Also, strictly speaking, "i.e." for "that is," "e.g." for "for example," and "viz." for "namely" also should be italicized (*i.e.*, *e.g.*, *viz.*), as these abbreviations are taken directly from Latin. However, this rule generally is not followed.
34. PREPOSITIONAL PHRASES
- By using introductory words or clauses, such as "However, ...", "As a result, ...", "Consequently,", "Nonetheless,...", and "Accordingly,...", concepts or points made in consecutive sentences are tied together better. However, do not overuse introductory words or clauses, and check to make sure that you don't start consecutive sentences with the same introductory word or clause. For an example of this latter point, see the quoted text in Rule 12.
  - Do not begin a new paragraph with a sentence that starts with a prepositional phrase.
35. QUOTATION MARKS
- Double quotation marks are often used around titles, indicating that a word is special in some way, or when you are writing a sentence and you want to emphasize or draw attention to the use of a word (see "split infinitive" in Rule 39).
  - Single quotation is commonly used when you are quoting someone who is quoting someone else. You enclose the primary speaker's comments in double quotation marks, and then you enclose the thing they are quoting in single quotation marks. And when there's a quote in a headline\*\*, and using them to highlight words with special meaning in certain disciplines such as philosophy, theology, and linguistics.
  - Periods and commas typically are placed inside double/single quotation marks, e.g.:
    - The sign changed from "Walk," to "Don't Walk," to "Walk" again.
    - She said, "Hurry up."
    - She said, "He said, 'Hurry up.'"
  - Colons (:) and semicolons (;) should stay outside quotation marks.
  - A short quotation can be merged with your sentence. Use quotation marks to indicate that the phrase is not your own writing. At the end of the quotation, cite the name of the author. Use parenthesis (round brackets) to provide information about the quotation. This could include the name of the author, the source of the quotation, the page number of the extract and the like. Reproduce all the punctuations used by the author of the quotation. Don't modify the original structure of the quotation. If the quotation is more than three lines long, indent the quotation about half an inch from the left margin. If you indent your quotation, do not use quotation marks.
  - If you skip parts of the quotation, indicate the missing part by using ellipses (...).
  - If hyphens (-), question marks (?), or exclamation marks (!) are a part of the original quotation, use them inside the quotation marks. If they are your own, use them outside the quotation marks. If a question is in quotation marks, the question mark should be placed inside the quotation marks, e.g.:
    - She asked, "Will you still be my friend?"
    - Do you agree with the saying, "All's fair in love and war"? Here the question is outside the quote. Note that only one ending punctuation mark is used with quotation marks. Also, the stronger punctuation mark wins. Therefore, a period is not used after war.



- h. When you have a question outside quoted material AND inside quoted material, use only one question mark and place this inside the quotation mark, e.g.:
  - i. Did she say, "May I go?"
- i. Use single quotation marks for quotes within quotes. Note that the period is placed inside all quotation marks, e.g.:
  - i. He said, "Danea said, 'Do not treat me that way.'"
- j. When you are quoting something that has a spelling or grammar mistake or presents material in a confusing way, insert the term sic in italics and enclosed in brackets. Sic means, "This is the way the original material was written."

### 36. WORD USAGE

- a. The word "data" is plural, e.g., "The data are scattered" is correct, whereas "The data is scattered" is incorrect.
- b. The terms "small" and "large" refer to size, whereas the terms "low" and "high" refer to magnitude. For example, you wouldn't write, "...the temperature gauge in my car ranges from "S" to "L" for "small" to "large" temperature, but rather ranges from "L" to "H" for "low" to "high" temperature. Similarly, the meteorologist doesn't describe a "small" or "large" pressure zone, but rather describes a "low" or "high" pressure zone. In contrast, you wouldn't say, "my foot is low" or "my car is high," but rather would say, "my foot is small" and "my car is large." Accordingly, "hydraulic conductivity" should not be referred to as "large" or "small" as is commonly done, but rather as "high" or "low."
- c. Engineers are quantitative. Always quantify what is meant by "low" or "high" because what is "low" or "high" to one person may not be considered "low" or "high" to another person. For example, don't write, "...the stress level was low...", but rather write, "...the stress level was low (< 35 kPa)..." In some cases, the need to define absolute quantities can be avoided if desired by simply using the relative terms, such as "lower," "higher," "lesser," "greater," "smaller," and "larger," although these terms must provide the frame of reference, e.g., "lower than what?"
- d. Never use any subjective terms like "successful" or "good." These words can never be supported by evidence in a court case. "Better" and "worse" are okay if these words are supported by evidence and are defined with respect to the comparison, i.e., "better than what," and "worse than what."
- e. We do not "run" tests (experiments); instead, we "perform" or "conduct" tests. Also, "performed" or "conducted" is preferable to "carried out."
- f. "Methodology" and "utilize" are pretentions; instead use "method" and "use" for the same meaning with fewer letters.
- g. The whole comprises the parts, instead of "comprised of" or "composed of," write "comprises," "comprised," or "comprising" as appropriate.
- h. Do not use "thus" and "therefore" in the same sentence.
- i. "While" is temporal (meaning at the same time); if the meaning is not temporal, use "whereas" (i.e., meaning "...in contrast to...").
- j. Sample versus Specimen: In accordance with ASTM Geotechnical Testing Journal protocol, "samples" are recovered from the field, whereas "specimens" of "samples" are tested in the laboratory. So, you test specimens, but you recover samples.
- k. Regression versus Fitting: Regression is a statistical term as opposed to a mathematical concept, whereas fitting is a mathematical concept that is based on fundamental equations such as a theoretically derived mathematical model or an equation such as the consolidation equation. Another difference is that fitting is applied



- to determine the parameter values governing a model, whereas regression is applied to discern a goodness of fit. (As an example that no one is too old to learn, I was just informed of this difference about two years ago by one of my former Ph.D. students, as I had been using regression when I should have been using fitting.)
- l. Do not write "enough;" instead, write "sufficient." For example, "...the duration of the test wasn't sufficient..."
  - m. When saying "not only," the words "but also" must always follow. For example, "...not only lower but also more conservative than..."
  - n. The word "below" is a reference to an absolute, physical location. Always use "follows" or "subsequently," as these terms are relative, *i.e.*, independent of the absolute location of the text (*i.e.*, the text that follows can be above the text where this is stated, *e.g.*, at the top of the following page).
  - o. When starting a sentence with the word, "This...", always immediately follow with a word or two describing "what," *i.e.*, "This {what}..." Following this rule greatly enhances the clarity for the reader. As an example, consider the published text previously used as an example for Rule 12 pertaining to "it," wherein there are two consecutive sentences that start with "This," as follows:

"Therefore, approximately 6.25 million constant-strain brick elements would need to be used to simulate the wall and replicate the small penetrating holes with a dimension of about 0.04 m in the numerical model. **This** would require a RAM of approximately 50 GB and 103h to run a simple transient flow analysis on a single core with a central processing unit clock speed of 3.4 GHz. **This** makes it extremely difficult to implement RFEM on an ordinary workstation when thousands of Monte Carlo simulations are involved."

The clarity as to what "This" refers can be improved as follows:

"This **large number of small elements** would require a RAM of approximately 50 GB and 103h to run a simple transient flow analysis on a single core with a central processing unit clock speed of 3.4 GHz."

"This **required computational capacity** makes it extremely difficult to implement RFEM on an ordinary workstation when thousands of Monte Carlo simulations are involved."

Of course, the "it" in the last sentence is still problematic (see Rule 12). Note that this rule also pertains to the words "these" and "those."

- p. Do not write "break-through;" instead write "breakthrough."
- q. "Groundwater" is now spelled as one word when used as both a noun and an adjective (as per the American Geophysical Union). (Note that this spelling is not my personal preference, because this rule is inconsistent with "surface water," which is always spelled as two words. My preference is "ground water" when used as a noun and "groundwater" when used as an adjective, *e.g.*, "groundwater hydrology.")
- r. The word "permeant" is an adjective, not a noun. Therefore, do not write, "...the permeant was water...", but rather write, "...the permeant liquid was water..." Another possibility is "permeant solution" when referring to a chemical solution as the permeant liquid.
- s. Because "area" is a geometric quantity, do not use this word if "region", "site", or "catchment" can be used instead.
- t. Use "site" or "location" to refer to a point in space, but "catchment", "region", or "field" to refer to a location with some spatial extent.
- u. "Dataset" is one word.
- v. "Semiarid" is one word, but should be hyphenated as "semi-arid" (see Rule 20.d).
- w. "Cannot" is one word.
- x. Rather than "model's performance" or "models' performance," just write "model performance."
- y. Never use "since" where "because" can be used instead.



- z. The word "thing" or similar non-descriptive words should never appear in a technical paper or report.
- aa. Do not use "may" anywhere "can" or "might" can be used. The word "may" implies something is allowed rather than possible. Might and can are clearer.
- bb. Do not confuse "that" and "which". The word "which" is always preceded by a comma, for example: "the dataset is large, which reduces uncertainty. " If a comma seems incorrect, you probably should use "that" instead of "which". For example, "The four points that comprise the dataset are consistent. "
- cc. "Mortar" is a general term, not a specific noun, and should not be capitalized in the text (excluding table column headings).

## Grammar

- 37. Voice: Historically, journal articles and reports were written in the passive voice versus active voice (e.g., "Data were collected," not "We collected data"). However, you likely will see either voice used in the published literature, and individuals can disagree as to which voice is correct or preferred. One issue I have seen frequently with the active voice is that the plural, "We," often is used when the publication is authored by a single person, which makes no sense. My personal preference is to use passive voice.
- 38. Tense: Writing needs to be consistent with respect to tense. Use present tense for anything that is still true. Use past tense for activities or events that were only true in the past. Mixing tenses is confusing, so construct sentences to avoid using both present and past tense in the same sentence. Correct past tense example: "...datasets were collected and processed to calculate..." Present tense example: "...the soil moisture values are related to topography. The results show that ..."
- 39. A classic grammar error is the "split infinitive," which is when an adverb is placed between the word "to" and a verb; e.g., "...to barely make...", where "barely" is the adverb and "make" is the verb. In original English, split infinitives represented grammar errors, but my understanding (from English majors) is that this rule is no longer practiced in general. Nonetheless, beware of the split infinitive.
- 40. Parallelism is a grammar rule that requires the verb forms before and after "and" to be of the same tense. For example, "...sampling the soil, transporting the sample, and storing the sample..." and "...assembled, tested, and disassembled the specimen..."
- 41. The preference is to place the helping verb (adverb) immediately adjacent to the verb being modified to emphasize the action being undertaken.
  - a. Example: "The cell then was sealed and a KCl solution was circulated through the top piston whereas PTW was circulated through the base pedestal." Most individuals would write the underlined text as, "...was then sealed ..."
  - b. Example: "I also will need..." instead of "...I will also need...", and "...also was monitored..." instead of "...was also monitored."
- 42. American English (AE) versus British English (BE): There are numerous, well-known differences between AE and BE in terms of spelling (e.g., <http://www.tysto.com/uk-us-spelling-list.html>), word usage (e.g., see: <http://www.boredpanda.com/british-american-english-differences-language/>), and grammar, such as the replacing of "s" in British English with "z" in American English (e.g., mobilise vs. mobilize), or the use of -re in BE versus -er in AE (e.g., centre vs. center). Also, "french fries" in AE is "chips" in BE, "cookies" in AE is "biscuits" in BE, "shoes" in AE are "boots" in BE, and the "soccer field" in AE is the "football pitch" in BE. Many of these differences have been attributed to Noah Webster (1758 – 1843)



of Webster's dictionary fame, whose contribution to the American Revolution was to change BE into AE, although I've read recently that this commonly held belief actually is not true.

One interesting grammar rule difference is the AE rule of the "collective singular case," which does not exist in BE. The collective singular rule states that nouns representing a group of several to numerous entities is treated as the singular case requiring a singular verb. For example, Americans would say that, "Manchester United is winning 2 to 0," whereas the British would say, "Manchester United are winning 2 to nil." Similarly, Americans would say that "United Airlines is offering reduced ticket prices," whereas the British would say that "United Airlines are offering reduced ticket prices." Of course, the singular verb makes more sense in these cases because there's only one soccer (football) team named Manchester United, and there's only one airline company known as United Airlines.

There are numerous other interesting differences that are primarily cultural. For example, when someone has a great idea, the British often say "brilliant," whereas when something goes wrong, the British often say "tragic." To most Americans, the words "brilliant" and "tragic" are reserved for only the most extreme cases (e.g., Einstein was brilliant, and the death toll from the tsunami was tragic). More recently, with the onset of the COVID pandemic, I've noticed (reading the BBC) that the British refer to "vaccinations" as "jabs," whereas Americans refer to vaccinations as "shots."

In *The Canterville Ghost* (1987), Oscar Wilde wrote, "We have really everything in common with America nowadays except, of course, language."

During an interview in 1942, the Irish playwright and commentator George Bernard Shaw has been reported as saying, "England and America are two countries separated by the same language," which most often is reported as, ""England and America are two countries separated by a common language."

## References

43. Regardless of the format chosen, always be consistent in format! For example, don't list journal paper titles inconsistently, such as capitalizing only the first word of some titles but capitalizing all the words in the title for others, or including quotations around the titles of some but not all titles. Other issues including italicizing and/or bold-face typing some journal titles but not all, using inconsistent punctuation, using "pp" for "pages" in some cases but not others, and spelling and listing co-authors in an inconsistent manner.
44. References generally must be placed after the Conclusions and Acknowledgements but before tables and figures.
45. In text references:
  - a. List all references first chronologically (oldest to most recent), and then alphabetically when the references occur in the same year. The reason to do this is that we want to acknowledge the development in the sequence presented. That is, the person who first showed this result should be cited first, and so on. Note that, in the non-technical literature, the common practice is instead to list a series of published references alphabetically regardless of chronology.



- b. List several references for each decade to show you have a broad understanding of the topic and knowledge of the current studies.
  - c. Do not use commas between authors and year, but rather use commas to separate more than one reference. Note that a common format used by some journals is to use a comma between the authors and year of a publication, and then use a semicolon to separate publications, but using this format needlessly increases the number of punctuation marks (see Rule 13).
46. Do not cite references that are not published and, similarly, do not refer to "personal communication" as a reference.
47. Only the first word in the title starts with a capital letter, and the title ends with a period.
48. Spell out the full name of each journal (because the proper format for the abbreviated journal title is sometimes not known).
49. Format: Last name, First name initial. Middle name initial. (year). Title. *Journal full name*, Name of institute, Location of institute, Vol. # (Iss. #), page-page.
50. Provide the volume and issue nos. for journal publications, no need for the month and year twice. The comma (or period) at the end of the paper title should be placed inside the quotes, not outside.
- a. Guido, V. A. and Ludewig, N. M. (1986). "A comparative laboratory evaluation of band-shaped prefabricated drains," *Consolidation of Soils: Testing and Evaluation, ASTM STP 892*, R. N. Yong and F. C. Townsend, Eds., American Society for Testing and Materials, Philadelphia, 1986, 642-662.
  - b. Wissa, A., Christian, J., Davis, E., and Heiberg, S. (1971). "Consolidation at constant rate of strain," *Journal of the Soil Mechanics and Foundations Division*, Vol. 97, No. SM10, 1393-1414. (Note that there are other acceptable formats for the volume number, issue number, and page numbers, such as: 97(SM10), 1393-1414, or 97(SM10): 1393-1414.)
51. ASTM standards are referenced in papers the same as other citations. (Note that no space typically is included between letter "D" and the number "422," although there are exceptions to this format.)
- a. ASTM D422, 2010, "Standard Test Method for Particle-Size Analysis of Soils." Annual Book of ASTM Standards, Vol.04.08, ASTM International, West Conshohocken, PA, pp. 10-17.
  - b. Referencing ASTM standards in the text as, "...was performed in accordance with ASTM..."

## Tables and Figures

52. Present results/tables/figures/plots in the order in which these are to be discussed. If Fig. 1 is referred to first, then Fig. 1 should appear first. NEVER refer a higher numbered figure or table before a lower numbered table. References to both tables and figures should be sequential.
53. All parts of tables and figures should appear on the same page. NEVER split tables or figures onto more than one page.
54. NEVER split a table into parts with the same table number, e.g., Table 6a and Table 6b. Either combine the information in the tables into one table, or label the tables with separate numbers, e.g., Table 6 and Table 7.
55. Fig. 7a: A ( ) around "a" or a space between "7" and "a" is not required (although some journals will format this way).



56. Correct: Figs. 1 – 6.
57. Table column headings. There are two correct formats for table column headings. For example, a column in a table listing hydraulic conductivity values of  $1.2 \times 10^{-9}$  m/s,  $3.4 \times 10^{-9}$  m/s,  $5.6 \times 10^{-9}$  m/s, and  $7.8 \times 10^{-9}$  m/s can be formatted in either of the following ways:

	$k (\times 10^{-9} \text{ m/s})$	
	1.2	
	3.4	
	5.6	
	7.8	

or as

	$k \times 10^9 (\text{m/s})$	
	1.2	
	3.4	
	5.6	
	7.8	

Note that, for the second format,  $k \times 10^9$  equals the value given in the cell. For example,  $k \times 10^9 = 1.2$ , such that  $k = 1.2 \times 10^{-9}$  m/s. The second format has appeared in older books, whereas the first format is used almost exclusively nowadays. However, make sure you understand the magnitudes of values being reported in a table when extracting the values from older books, as significant errors (e.g., orders of magnitude) can occur if the format is not understood.

58. Inefficient rows or columns in a table. Never include a row or a column in a table in which all cells contain the same value, e.g., Column Heading 2 and Row Heading 2 should be eliminated in the following examples

Column Heading 1	Column Heading 2	Column Heading 3
1	3	6
2	3	5
3	3	4
4	3	3
5	3	2
6	3	1

or

Row Heading 1	1	2	3	4	5	6
Row Heading 2	3	3	3	3	3	3
Row Heading 3	6	5	4	3	2	1

In these two examples, Column 2 and Row 2 are unnecessary and should be eliminated based on the value entered in each cell being the same, i.e., "3." The fact that the value for the parameter identified in the column or row heading is "3" can be explained more efficiently in the text, the caption for the table, or as a footnote to the table.

59. Figure and table captions should be detailed sufficiently so that the figure or table can be interpreted without reading the main text of the paper. The main text should only describe the general construction of a figure (not the details, which should be in the caption) to avoid being redundant with the captions as much as possible.



## Format

60. Format should follow specific journal format requirements as applicable.
- 61. Preference is for one space after a period before the start of the next sentence.**
62. Place one space after a semicolon or colon, and the following word should start with a lowercase letter.
63. Publishers generally require double line spacing (line spacing = 2.0) everywhere (including the references) for submitted journal manuscripts.
64. If not instructed otherwise, margins should be one inch (25.4 mm) all around.

## Additional Resources

<http://www.grammarbook.com>

<http://grammar.quickanddirtytips.com>