

## Civil Engineering Writing Project - Language Unit 4

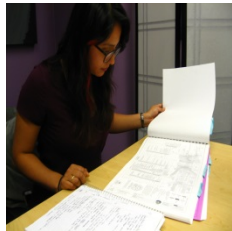
### EFFECTIVE SENTENCE STRUCTURE – CONNECTING IDEAS IN SENTENCES

#### What do you need to know about effective writing in civil engineering practice?

About one-quarter of the sentences written by experienced engineering practitioners use complex sentence structure to connect closely related ideas. This unit describes the kinds of ideas that are typically connected. These connections are important for communicating engineering work, and they reflect values in engineering, such as showing the basis of information. In other words, attending to sentence structure is actually part of thinking and working like an engineer.

This unit also describes how choosing the right sentence structure facilitates your readers' ability to understand your message. The needs of the audience and other aspects of the context like the purpose and content should always shape your writing. The sentence-level features here fit into the wider concerns of engineering genres.

Background note: Complex sentences have two parts - an independent clause that can stand on its own and a dependent clause that cannot stand alone. If these concepts are not familiar to you, use Grammar Lesson 1, Sentence Punctuation, before you use this unit.



#### What experienced engineering practitioners say

*"I have to stop and think about what's important to my client. It's all interesting to me but...I have to think about keeping the important stuff together, which often means removing the unimportant stuff that's keeping it apart. So my audience can understand the connections. It's thinking about what the audience needs."*

#### What do effective sentences by engineering practitioners look like?

**A)** Two ideas can effectively be connected in a single, complex sentence when each idea is relatively simple and the relationship between the ideas is important. The sentence structure is more complex than in a simple sentence, but the sentence must still be concise, precise, and easy to read.

The following are the most common connections expressed in engineering practitioners' complex sentences. The examples are from reports and technical memoranda. Notice the important functions these complex sentences express for engineering.

Effective Connection of Ideas with Complex Sentence Structures	
Example	Function of complex structure
1. The design flood for Scout River and Scout River Overflow Bridges is the 50-year flood event <u>based on Table 1.1 from the Oregon Department of Transportation Manual.</u>	<b>Basis of Information.</b> The source of information or basis for analyses or designs is made explicit, most often with <b>based on</b> and <b>provided by</b> . Telling the basis of information connects observations to interpretations and demonstrates that a firm is following expected standards. If some information is later
2. <u>Based on our visual and hands-on inspection,</u> we conclude that...	
3. We assume a water depth of 10 feet for the	

<p>braced excavation <u>based on recent piezometer readings</u>.</p> <p>4. The study team conducted a review of existing bridge inspection records <u>provided by the railroads and passed to the study team by Western Railway</u>.</p>	<p>questioned, the explicit statement makes its origin clear.</p>
<p>5. A culvert analysis was done <u>using FHWA HY-8 culvert analysis software</u>.</p> <p>6. Each system has been sized <u>using the City of Kimberly's standards for pollution removal</u>.</p> <p>7. All pipe conveyance calculations were done <u>using Manning's equation for open channel flow</u>.</p>	<p><b>Method</b> (usually with <i>using</i>). Writers state the software or approaches used for analyses. They overtly demonstrate that they are following standard practice. These sentences have a similar function to the basis of information.</p>
<p>8. We performed a site reconnaissance on August 12, 2013, <u>to observe surface features</u>.</p> <p>9. An Initial Site Assessment (ISA) was completed <u>to investigate potential hazardous waste issues within the project area</u>.</p>	<p><b>Purpose</b>. The purpose of an activity is added with <b>to+verb</b> (<i>to observe, to investigate</i>). Explicit statements leave no ambiguity about the purpose of an engineer's actions. These sentences often introduce a description of procedures.</p>
<p>10. <u>If these accidents were excluded from this freeway segment</u>, the resulting accident rate would be similar to the average rate.</p> <p>11. This value will be conservative <u>if approach panels are used</u>.</p>	<p><b>Condition</b> (with <i>if</i>). The idea in the main sentence is true only with the condition of the <i>if</i> statement. This condition is therefore crucial for readers to understand.</p>
<p>12. There were 12 crashes on the eastbound I-48 off ramp, <u>including three (3) injury crashes resulting in Type C injuries to three (3) people</u>.</p> <p>13. The width of the proposed structure is 40 feet, <u>including two 12-foot lanes, two 7-foot sidewalks and two bridge rails</u>.</p>	<p><b>Specific detail</b>. Writers add a specific detail with an <i>-ing</i> verb, especially <b>including</b>. The detail often identifies important components of a general description.</p>
<p>14. Repairing the existing bridge was not considered as a feasible option <u>because seismic retrofit, FRP repair, epoxy injection and widening have already been performed on the structure</u>.</p>	<p><b>Reason or cause</b> (usually with <i>because</i>). Complex sentences with <i>because</i> make the decision process explicit.</p>
<p>15. Segment B had an average crash rate of 151.9 crashes per 100 MVM over the study period, <u>which is 39% higher than the statewide average for interstate routes</u>.</p>	<p><b>An evaluative or comparative piece of information</b>. Writers add information with a single <b>relative clause</b> (made of a word like <i>which, that, or where</i> with a subject and verb). The extra detail helps readers know how to evaluate the information.</p>

**B)** If a single complex sentence would be difficult to understand, writers divide the ideas into individual sentences. The relationship between ideas is made explicit with a precise connecting word.

Effective Connection of Ideas between Individual Sentences	
<p>1. Soils under the bridge railings do not contain concentrations of lead in excess of EPA Region 9 Residential PRGs. It is also unlikely these soils would be considered hazardous waste under federal regulations (40 CFR Part 261). <u>Therefore</u>, no remedial activities should be necessary for shallow soils under the bridge railings. <i>(Report)</i></p> <p>[1B. <i>Compare ineffective complicated sentence structure:</i> Because soils under the bridge railings do not contain concentrations of lead in excess of EPA Region 9 Residential PRGs and it is also unlikely these soils would be considered hazardous waste under federal regulations (40 CFR Part 261), no remedial activities should be necessary for shallow soils under the bridge railings.]</p>	<p>The information in example 1 has many parts (concerning the levels of lead relative to screening standards, the character of the soils relative to hazardous waste classifications, and the conclusion about no remedial action). The writer wisely chose to make separate sentences and connect the conclusion with <i>therefore</i>. The separate sentences allow readers to process each bit of information sequentially.</p> <p>If the information is combined into one sentence (1B), there are too many different ideas for readers to hold in their minds at once. In addition, too many words occur before the main verb, which always makes reading more difficult. Also, the levels of lead and classification of the soils are presented as minor ideas (in the dependent <i>because</i> clause) when they are actually distinct, important ideas.</p>
<p>2. For this alternative, the computer modeling shows that the hydraulic grade line in the first three manholes would be above the manhole rim elevations. <u>Thus</u>, the sewer system would have water flowing onto the highway at these manhole locations. This condition is not acceptable.</p> <p><i>(Report)</i></p> <p>[2B. <i>Compare ineffective complicated sentence structure:</i> Based on the computer output, the sewer system would have water being pushed out and onto the highway at the first three manhole locations because the hydraulic grade line would be above the manhole rim elevations, which is an unacceptable condition.]</p>	<p>The information in example 2 has three major parts: (1) the output of the computer model, (2) an interpretation of that output (water onto the highway), and (3) the conclusion that the condition is unacceptable. The writer wisely states the basis of information in a separate sentence (<i>The computer modeling shows...</i>) and connects cause-effect sentences with <i>thus</i>. The evaluative statement (<i>an unacceptable condition</i>) is in its own sentence so that it is not lost amidst the other information.</p> <p>The alternative complicated sentence (2B) presents too many different ideas for readers to hold in their minds at once. Readers will not be able to identify the main idea. The important conclusion (the unacceptable condition) is presented as a minor idea in a dependent clause (<i>which is....</i>).</p>


## Techniques for Improving Your Writing

Complex sentences are problematic when they are too complicated for readers to easily follow. Readers need to be able to hold the information from a single sentence in their minds all at once. Any sentence that presents multiple independent ideas or has multiple long clauses is probably too complicated to be effective.

These techniques will help you revise ineffective complicated sentences in your own writing. They address the most common problems in civil engineering students' papers. As with all engineering, however, you cannot apply the techniques thoughtlessly; you always need to exercise judgment to revise effectively for your specific content, purpose, and audience.

**Instructions:** Read each technique and its examples. Then apply the technique to revise the practice sentences. If necessary, invent details to make the information precise (but only for this practice – never for real content!). You may need to revise words as you restructure sentences.

Technique 1: Check that the connection you express is accurate. Revise as needed.	
Original	Revision
<p>Figure 6 displays the average wait times for pedestrians using the crosswalk. The longest average wait time was in the hour from 10 AM to 11 AM; the wait time was almost 45 seconds. <u>The wait time was driven by cars not stopping to wait for the pedestrians to start.</u> This data was also <u>surprising because in a couple hours 30 or more cars did not stop for pedestrians as shown in Figure 7.</u> <i>(Student report)</i></p>	<p>Figure 6 displays the average wait times for pedestrians using the crosswalk. The longest average wait time occurred between 10 AM and 11 AM; the wait time was almost 45 seconds. The wait time <b>was caused by cars not stopping for the pedestrians. In the peak traffic hours of 10 AM to 11 AM and 4 PM to 5 PM,</b> 30 or more cars per hour did not stop for pedestrians <b>(Figure 7).</b></p>
<p><b>Explanation.</b> In the original, the writers are likely trying to say they were surprised by both the length of the wait time and the number of cars that did not stop for pedestrians. However, the meaning expressed by their sentences is wrong: They say the data about the average wait time (“this data”) was surprising because of the number of cars. The revision reports the data without confusing connections. It also makes information more precise (<i>caused by</i> rather than <i>driven by</i>, exact hours) and wording more concise (e.g. eliminating <i>in the hour, to start, as shown in</i>). It also deletes the writers’ evaluation that the data are “surprising” because this paragraph is reporting the data.</p>	
Original	Revision
<p>MR Credit 6 (Rapidly Renewable Materials) will not be obtained. ... <u>It may not be feasible based on the large cost of materials to be used on this project dedicated to structural, site, and specialty equipment.</u> <i>(Student report, section describing LEED credits)</i></p>	<p>MR Credit 6 (Rapidly Renewable Materials) will not be obtained. ... It is not feasible <b>because the structures require construction materials that cannot be made with rapidly renewable content.</b></p>
<p><b>Explanation.</b> The original provides a confusing, wordy description that makes a false connection between the cost of materials and the feasibility of renewable materials. The revision clearly states the writer’s analysis (<i>it is not feasible</i>) and its reason (<i>because...</i>).</p>	

Original Needing Revision	Revision
<p>Scour is the removal of material from banks and beds by the actions of flowing water. <u>Even though scour processes are affected by the presence of structures and obstacles in the flow path of a river or any open channel, scour is a natural process caused by the flow of water over an erodible surface.</u> <i>(Student report)</i></p>	<p>Scour is the removal of material from banks and beds by the actions of flowing water. <b>It is a natural process caused by the flow of water over an erodible surface. Scour processes are affected by the presence of structures and obstacles in the flow path of a river or any open channel.</b></p>
<p><b>Explanation.</b> In the original, the writer expresses a concessive connection between the idea that scour is a natural process and the idea that structures and obstacles affect it (using <i>even though</i>). Concessive relationships have to do with contrast. But the idea that structures and obstacles affect scour processes is not in contrast to the idea that scour is a natural process. These are two separate ideas. The revision states the separate ideas in their own sentences.</p> <p> Be careful of <b><i>although</i></b> and <b><i>even though</i></b>! Many students connect ideas with <i>although</i> or <i>even though</i> inaccurately. Use them only when the dependent idea might be expected to preclude the main idea, but it does not. Make sure there is a contrast involved, for example:  <i>Although scour processes are affected by obstacles, most natural debris is too small to have an effect.</i>  <i>Even though it is not always obvious, scour occurs whenever water flows over an erodible surface.</i></p>	

**Practice 1.** Revise these sentences to make the connection between ideas more accurate. Your revisions should also change any meaning that is inaccurate or misleading. Apply your engineering judgment to improve the content.

- a. Although solar energy is a new way of generating energy, solar heads take up a lot of space and also in the state of Oregon where the sun is only out a few months of the year, it is not the best option for generating energy. *(Student Field Observation Memo)*

[Hint: This writer is probably referring only to western Oregon; eastern Oregon has many sunny days all year. Be sure to improve that content in addition to other problems.]

- b. Ethics are not about money, ethics are about commitment to doing what is right. Because money is not ethical, costs and savings should not overshadow decisions in any development. *(Student essay about the civil engineering profession)*

[Hint: Among other problems, this writer is oversimplifying ideas. Wasting clients' money is not ethical. Cost is always a factor that has to be included in engineering. Be sure to improve on the content as you improve the sentence structure.]

- c. Based on Portland Cement Association (PCA) recommendations slab design was based on a worst case scenario. *(Student report)*

[Hint: The writer probably means that the PCA recommendations were followed. A true "worst case scenario" was probably not used because it would be such an extreme, unlikely event.]

**Technique 2: Look for a series of ideas joined into a single sentence. Delete ideas that are not relevant. Create new independent sentences if ideas are not closely related or comprehension is difficult.**

Original Sentence Needing Revision	Revision
<p>Arrival data displayed localized peaks at fifteen minutes before each hour that classes began. <u>Departures tended to have less pronounced localized peaks than arrivals, suggesting that departures are slightly less dependent on class time, as well as may account for the varying duration of class times (see Appendix Graphs A1 and A2).</u></p> <p style="text-align: right;"><i>(Student report)</i></p>	<p>Arrival data displayed localized peaks at fifteen minutes before each hour that classes began. Departures tended to have less pronounced localized peaks than arrivals, <b>suggesting that departures are less dependent on class time (Figure 2).</b></p>

**Explanation.** The original has several problems:

- The writers string so many ideas together that they say the opposite of what they mean (the varying class durations may account for the less pronounced peaks for departures, not vice versa).
- The most important idea – that departures have less localized peaks – is lost by the time readers get to the end of the sentence.
- Information about whether or not class duration varies is irrelevant and redundant. The idea that departures are less dependent on class time has already been stated.

The revision makes the important ideas clear by having only one connecting idea (with **suggesting**).



Use *as well as* very cautiously or not at all. Writers often undermine their meaning or grammatical accuracy when they use it. Readers often stumble over it. Instead, connect ideas with *and* or use a separate sentence for a new idea.

Not: The transit center design expands capacity to seven bus loading bays, accommodates all routes currently serving the campus, **as well as provides** options for future expansion.


Instead: The transit center design expands capacity to seven bus loading bays, accommodates all routes currently serving the campus, **and provides** options for future expansion.

Original Sentence Needing Revision	Revision
<p>Another key point in constructing this bridge was the look of the bridge. <u>Since the bridge will be in the center of Portland, many people want the bridge to look very nice, which was one of the biggest reasons why they chose a cable-stay bridge, which many people feel is beautiful.</u></p> <p style="text-align: right;"><i>(Student field observation memo)</i></p>	<p>Another key <b>consideration for the design of this bridge was aesthetics. Public comments focused on having an attractive bridge because the bridge will be in the center of Portland. The cable-stayed design had the greatest appeal among the public.</b></p>

**Explanation.** The original has too many different ideas in one sentence. Particularly ineffective is the series of relative clauses (*which was...which many people...*). The revision has one complex sentence (with *because*). The other ideas are stated in simple sentences. Imprecise vocabulary has been replaced with more precise and concise terms (*design, aesthetics, public comments, greatest appeal among the public*).

**Practice 2.** Revise these sentences to break up the series of ideas currently in each one.

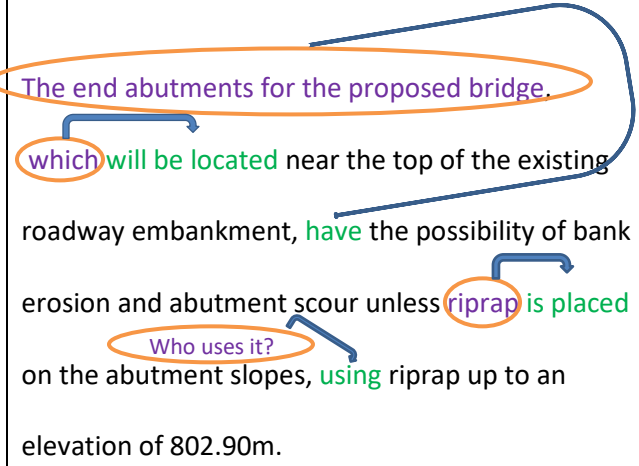
- a. This bridge was constructed for utilitarian purposes only, financed under a strict budget with little or no room for creativity, which also extends to the cyclone fence cage keeping pedestrians and bicyclists safe from falling off the bridge. *(Student bridge description)*
- b. The construction cost increases starting with prefabricated carbon steel storage tanks with construction costs including just the cost of the footing and installation, then to the bolt-together which would require footing construction as well as unskilled labor to put the plates together, and finally to the weld-together which would require footing construction and skilled labor to weld the metal plates together. *(Student report)*

Technique 3: Avoid multiple layers of nested ideas.	
Original Sentence Needing Revision	Revision
<p>This particular modeling detail does not seem to greatly affect the output of the simulation <b>because <u>although it appears unrealistic, it does not affect the flow of traffic greatly and only seems to occur on occasion.</u></b></p> <p style="text-align: right;"><i>(Student report)</i></p>	<p>The lane conflict detail did not affect the output of the simulation because it had a minimal, intermittent effect on traffic flow.</p>
<p><b>Explanation.</b> The original has a concessive idea (<i>although...</i>) nested inside a reason (<i>because...</i>) in addition to the main idea of the sentence. This is too much for any reader to follow! The revision eliminates the nesting and applies precise word choice so the main idea and its reason are easy to understand.</p> <p>Two connectors in immediate succession (e.g. <i>because although</i>) are almost always difficult for readers. Even if connectors are farther apart, two layers of nesting is often too much for readers.</p> <p> When you revise, make sure you write complete sentences. You cannot revise just by putting a period before <i>because</i>. This is <u>not</u> a complete sentence: <i>*Because, although it appears unrealistic, it does not affect the flow of traffic greatly.</i></p>	

**Practice 3.** Revise these sentences from student reports so layers of nested ideas are expressed more effectively.

- a. At sea, tsunamis occur regularly, although they are not as noticeable as at the shoreline because they have large wavelengths and their amplitudes, because of the ocean depth, appear small.
- b. Before oriented strand board, which is a type of wafer board that has a strength axis and not only covers a building's surface but helps to reinforce the structure and is made from fast growing trees so that old growth timber can be left because of its benefits to the environment, the construction industry used a simple wafer board or plywood that added strength to a structure although it was fairly random and had no real axis of higher resistance.

**Technique 4. For complicated ideas and sentences, mark the relationships with lines or arrows. Then, analyze your writing and thinking. Revise as needed.**

Writing and Thinking	Explanation
<p>Original sentence:            The end abutments for the proposed bridge, which will be located near the top of the existing roadway embankment, have the possibility of bank erosion and abutment scour unless riprap is placed on the abutment slopes, using riprap up to an elevation of 802.90m.</p> 	<p>This technique uses a series of actions. It is appropriate for complicated sentences that are not easy to revise, such as this original. Every writer ends up in a tangled sentence at some point, and deliberately analyzing it may be the only way to revise successfully.</p> <p>1) Connect the subjects to their verbs. Make the connections visual. Use the visuals to see how confusing your sentence is and how many ideas you have in it. Look at these features:</p> <ul style="list-style-type: none"> <li>• How many different connections are there? More than two or three will likely confuse readers. Even two might be too many if the information is dense.</li> <li>• How many words come between each subject and its verb? Reading is easier if subject and verb are close.</li> <li>• How many verbs have no stated subject? Do they need one? Some verbs do not need a stated subject (e.g. <b>Place riprap on the slope</b>). But look carefully. Here, wondering “Who is the subject for <i>using</i>?” will help the writer see this is a recommendation that is stated unclearly.</li> </ul>
<p><u>Writer’s analysis</u>            This sentence has 4 ideas:            A) The location of the abutments is near the top of the existing embankment.            B) Erosion could be a problem.            C) Erosion can be reduced with riprap.            D) Someone needs to place the riprap to a certain height.</p> <p>I want to convey two main ideas. One has to do with the location of the abutments. The other concerns how to reduce erosion.</p>	<p>2) Ask: How many ideas are in the sentence? Does this reflect what I want to say?</p>



<p>First revision:  <u>The end abutments for the proposed bridge will be located near the top of the existing roadway embankment.</u> The abutments have the possibility of bank erosion and abutment scour unless riprap is placed on the abutment slopes, using riprap up to an elevation of 802.90 m.</p>	<p>3) Make new independent sentences for main ideas.</p> <p>The first sentence now has one clear idea.</p> <p>The second sentence still has complicated structure and a jumble of ideas. It appears to combine a conclusion (that bank erosion and abutment scour are possible) and recommendation of what to do.</p>
<p><u>Writer thinks...</u>          What's my point for the second sentence? I want to say that the contractor needs to use riprap to help protect the bank and abutment. It is a recommendation and its purpose, not a conclusion from analysis. The recommendation needs to be explicit.</p>	<p>4) Rethink any ideas that you cannot easily make into independent sentences.</p>
<p>Second revision:          The end abutments for the proposed bridge will be located near the top of the existing roadway embankment. <u>To help protect from bank erosion and abutment scour, place riprap on the abutment slopes to an elevation of 802.90 m.</u></p>	<p>5) Rewrite sentences with simpler structure. Combine two ideas into one sentence only if they are closely related and easy to understand.</p> <p>The writer shows the purpose with a to+verb structure</p>

The writer uses a command form for the recommendation. The subject for any command is "you," so the subject is now clear.

## More Practice

**Instructions:** Revise the following using the techniques above and others so that the engineering content is more effective and reading comprehension is easier. If necessary, invent details (but only for this practice – never for real content!).

1. With the country beginning to realize that it needs to pay more attention to sustainable material usage, construction materials have changed rapidly in recent years, including with significant changes in recycling habits of demolition waste materials like concrete, timber, and steel, which means that being able to reuse these materials has a great effect, because not only does it save money on the project but it also drastically reduces the need for new material for construction.  
*(Student essay about the civil engineering profession)*

2. See the attached hand calculations included in the appendices which indicate that for these soil properties and applied loads the factor of safety for bearing capacity is in excess of 42 clearly indicating that the ultimate strength limit state will not be a controlling issue.

*(Student report)*

3. In order to produce a conceptual design of the proposed project that harmonizes with the university's overall vision of their current and future facilities, EQC Engineering reviewed both the approved current Campus Master Plan, which was published in July 2000, and the unapproved Campus Master Plan, which was started in 2007 but was placed on hold during the 2011-2012 academic year. The current university Campus Master Plan was approved by the Campus Planning Committee and published in July 2000.

*(Student report)*

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