

Lecture Notes in addition or in lieu of Textbooks

Abstract

In teaching over nineteen years, the author has become increasingly frustrated with textbooks that do not fulfill the needs of the classes. While strong in some areas, most textbooks contain large sections that are weak or do not pertain to the class. Because of this, the author has started supplementing textbooks with lecture notes that are typed in excel and posted to the instructors website. Student response has been so positive that in some cases, the lecture notes have replaced the textbooks.

This paper will examine the process in which the lecture notes were developed. It will include the progression and timetables from using the notes as a supplement to actually replacing textbooks. Discussion into negative issues such as preparation time and copyright issues will be analyzed. Review of the positive points and the long term advantages will also be discussed.

With the limited amount of time to teach what seems to be an ever increasing amount of material, any advantage that can be found is necessary. The use of lecture notes to supplement or replace textbooks allows the instructor to concentrate in areas that they deem important, while limiting or eliminating non essential areas. Asking students to pay nearly \$200 for textbooks that will only be used for a portion of the material does not make sense. It is the author's opinion that the use of lecture notes, while initially work intensive, have worked well in the long term.

Introduction

Starting off as an Adjunct Faculty member in 1990, using the established course textbooks was the logical thing to do. When teaching structural design courses, working out problems (other than those used as examples in textbooks) in class is often necessary. It is, however, often quite frustrating and slow to work out problems in the classroom. When solving problems in class, typically one or two students actually do the calculations (or are the only ones to call out answers) and the time delay can be enormous. Also, when only a few students call out answers, and no one stops to class to point out that they had gotten a different answer, then at the end of the problem it is quite possible to have a wrong answer. It is because of this that in structural design classes, worked out problems were copied and distributed prior to the start of class. This not only eliminated errors, but also sped the class up allowing for more material to be covered. The students liked it because they could concentrate on the lesson plan without the frenzied writing of notes.

Teaching primarily "Materials" and "Structural" type courses in a Construction Technology program, there was a wealth of textbooks on these subjects. During the course of the next fifteen years however, there arose a situation that changed the way these classes were taught. First, the textbook that was used for the Materials Laboratory was discontinued. An exhaustive search was performed by the full time faculty, but a suitable replacement was never found. The first of the major problems was that teaching in a technology program, the textbooks were either geared to engineering students, or so "dumbed down" as to be almost insulting. The second problem is

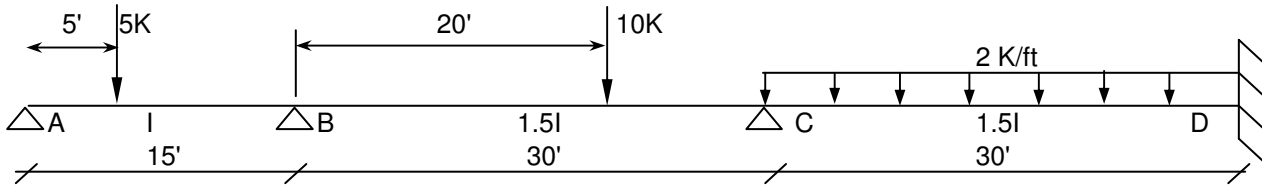
that the textbooks often contained large amounts of material that were irrelevant to the course taught. When teaching the Materials Testing course, the class was comprised of both students from the Construction Technology (CNT) as well from the Mechanical Engineering Technology (MET) programs. Because of this, the class laboratories were split evenly between those laboratory tests that were more relevant for the CNT students, and those tests more relevant to the MET students. While no one textbook was ever found that covered all of the laboratory testing performed in the class, one was found that contained a majority of them. Lecture notes were then provided to the students for the laboratories that were not covered. An unforeseen issue came up when the book used went out of print. At least one dozen other textbooks were reviewed without finding a suitable replacement. At this time, lecture notes were utilized completely and a textbook was no longer required for the class. It was at this point that a requirement for a textbook was eliminated from this course and class notes were used entirely. It was also the first class taught entirely from lecture notes.

Other courses that did not lose their textbooks had a slower transition. Once the decision had been made to attempt the formal lecture notes, the notes were prepared. The first time the notes were used in a class, the textbook was still required, and the notes were used as a “supplement” to the textbook. At the end of the semester the students were asked about their opinion of the lecture notes versus the textbook and the response has been overwhelmingly in favor of the lecture notes. At the end of the most recent Structural Calculations course (Fall of 2008), an informal survey of the students was conducted to determine their opinion of the lecture notes. This course still required the textbook, but the primary teaching instrument was the notes. Out of fifteen students, two had a neutral opinion (3 out of a 5 scale) and the balance of the class rated the notes a 4 or 5. At this point, the textbook was given the “optional” status for the students and the notes became the primary instructional tool. As a final note to the survey, excluding comments regarding the cost savings of not buying the textbook, the most common comment was that the lecture notes were easier to follow and that the students were able to process the lecture and problems easier.

Method of Delivery

When the distribution of class notes first started (in structural design courses), they consisted of handwritten (obviously before the proliferation of word processors/personal computers), worked out problems that were copied and distributed to the students. This worked extremely well, as mentioned previously, for it sped up the class and allowed for more material to be covered. Student feedback was favorable, so the practice continued for many years in several classes. Once the Materials Testing course switched to lecture notes, “Word” was used to type the notes. However, it was discovered that the use of excel was typically of greater use. If notes were comprised simply of text, the word processing is faster and more efficient. Excel, however, allows for easier drawing of free body diagrams and the use of a separate worksheet with formulas allows for changes with little effort. Another benefit of electronic notes is the fact that quite often, during class, a student asks a really good question that requires an explanation or during the lecture, the instructor “goes off on a tangent”). When this happens, it is back and add additional information so that the next class will have it. The following is various excerpts from a single problem from a Structural Applications class which shows how the first tab is used for the problem and

Now let us do a similar problem as from Lesson 8, but change the Moment of Inertia for spans BC and CD. Please note - if actual member sizes were given, then the values from the steel manual would be inserted in lieu of "I".

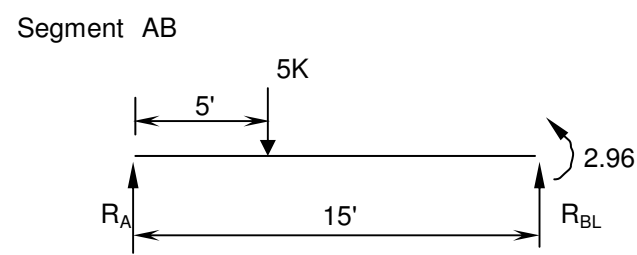


$$\begin{aligned}
 FEM_{AB} = M_{max} &= Pab^2/l^2 = 11.11 \text{ K-Ft} \\
 FEM_{BA} = M_{max} &= Pa^2b/l^2 = -5.56 \text{ K-Ft} \\
 DF_{BA} &= 0.5 & DF_{CB} &= 0.5 \\
 DF_{BC} &= 0.5 & DF_{CD} &= 0.5
 \end{aligned}$$

0	A	1		0.5	B	0.5		0.5	C	0.5		0	D	1
0.00		11.11		-5.56		22.22		-44.44		150.00		-150.00		
		-11.11	→	-5.56						0.00	←	0.00		150.00
				-5.55		-5.55	→	-2.78						
				0.00		-25.70	←	-51.39		-51.39	→	-25.70		
				12.85		12.85	→	6.42		0.00	←	0.00		25.70
				0.00		-1.61	←	-3.21		-3.21	→	-1.61		
				0.80		0.80	→	0.40		0.00	←	0.00		1.61
				0.00		-0.10	←	-0.20		-0.20	→	-0.10		
				0.05		0.05	→	0.03		0.00	←	0.00		0.10
				0.00		-0.01	←	-0.01		-0.01	→	-0.01		
				0.00		0.00	→	0.00		0.00	←	0.00		0.01
0.00		0.00		-2.96		2.96		-95.18		95.18		-177.41		177.41



We will now break each segment down and create a free body diagram. From this, we will then solve for reactions and draw a composite shear diagram.



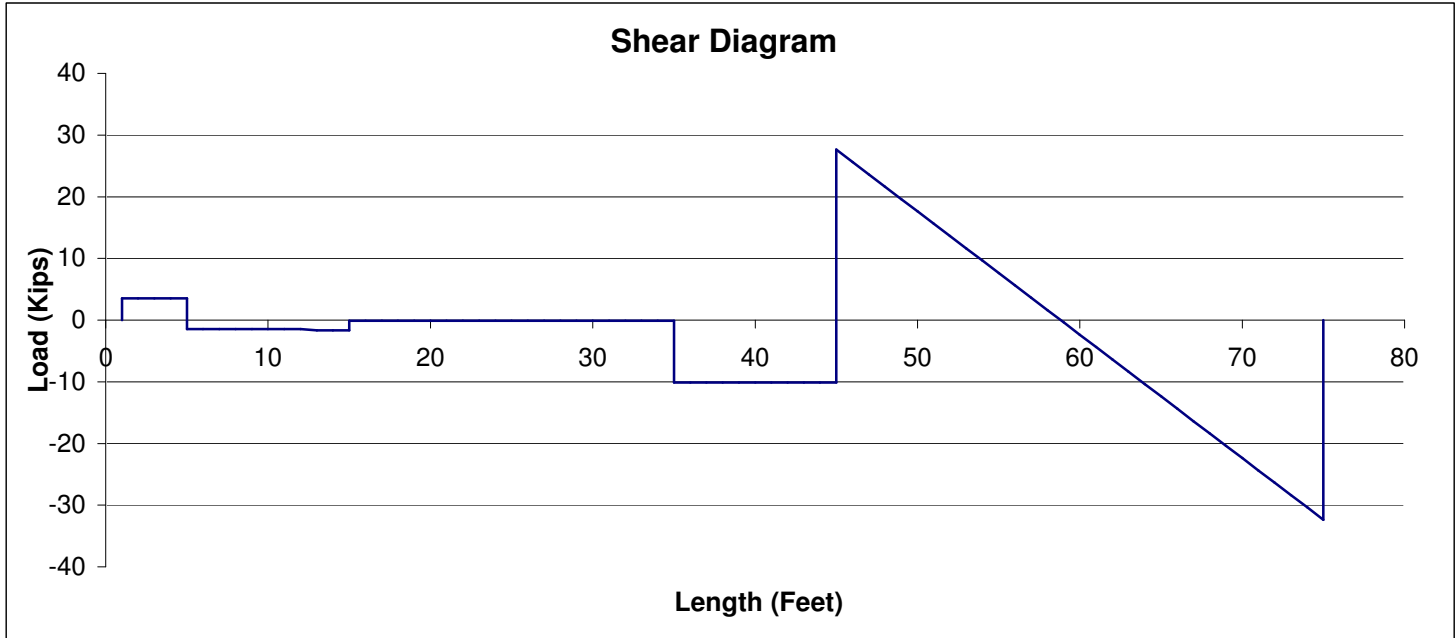
$$\begin{aligned}
 +\sum M_A = 0 & \quad -2.96 \text{ K-ft} + 5K(5') - R_{BL}(15') = 0 \\
 & \quad R_{BL} = 1.47 \text{ Kips}
 \end{aligned}$$

$$\begin{aligned}
 +\sum M_B = 0 & \quad R_A(15') - 5K(10') - 2.96K\text{-ft} = 0 \\
 & \quad R_A = 3.53 \text{ Kips}
 \end{aligned}$$

$$\text{Check: } +\sum F_y = 0 \quad R_A + R_{BL} - 5K = 0 \quad \text{☺}$$

Now let us look at the shear diagram. The first step is to write the shear equations. Remember - we write equations wherever there is a change in a loading condition. Therefore, we will need equations for $0 \leq x < 5'$, $5' \leq x < 15'$, $15' \leq x < 35'$, $35' \leq x < 45'$, and $45' \leq x < 75'$.

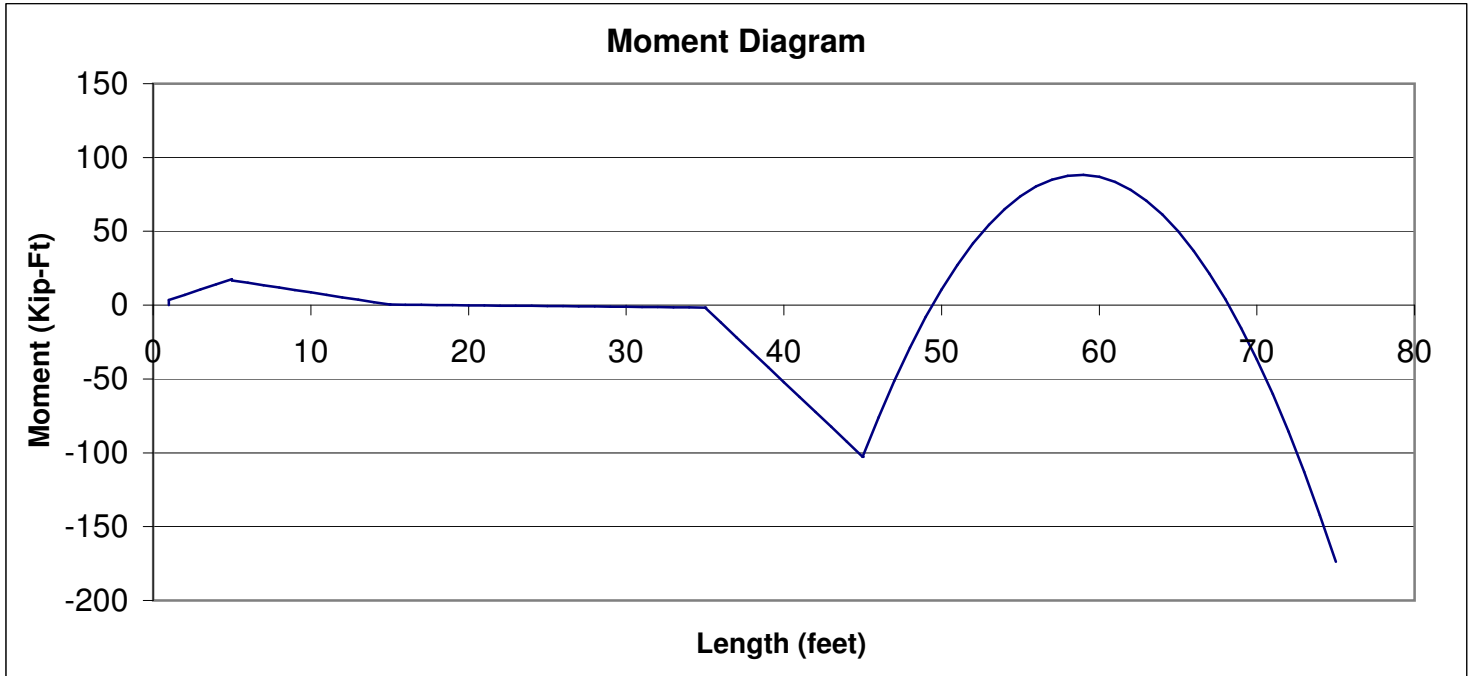
$$0 \leq x < 5' \quad R_A - V + 0$$



The inflection points occur at three locations. The first is at 5'. The second is at 45'. The third is at $(45' + (37.63\text{K}/2\text{K}/\text{ft})) = 58.8'$.

Now we can do the Moment equations and diagram. Remember that the moment equations simply add moment arms to the shear equations.

$$0 \leq x < 5' \quad R_A(x) - M + 0$$



The second tab of the spreadsheet, it then used for calculations and graphs.

R_A	R_B	R_C	R_D	L1	L2	L3	X
3.53	1.54	37.73	32.37	5	10	2	
X1	X2	X3	X4	X5	X6	X7	
0	15	45	75	5	35	45	

X	Shear		X	Moment	
1	0		1	0	
1	3.53	$R_a - V + 0$	1	3.53	$R_a(x) - M + 0$
2	3.53	$R_a - V + 0$	2	7.06	$R_a(x) - M + 0$
3	3.53	$R_a - V + 0$	3	10.59	$R_a(x) - M + 0$
4	3.53	$R_a - V + 0$	4	14.12	$R_a(x) - M + 0$
5	3.53	$R_a - V + 0$	5	17.65	$R_a(x) - M + 0$
5	-1.47	$R_a - L1 - V + 0$	5	16.8	$R_a(x) - L1((x - X1') - M + 0$
6	-1.47	$R_a - L1 - V + 0$	6	15.16	$R_a(x) - L1((x - X1') - M + 0$
7	-1.47	$R_a - L1 - V + 0$	7	13.52	$R_a(x) - L1((x - X1') - M + 0$
8	-1.47	$R_a - L1 - V + 0$	8	11.88	$R_a(x) - L1((x - X1') - M + 0$
9	-1.47	$R_a - L1 - V + 0$	9	10.24	$R_a(x) - L1((x - X1') - M + 0$
10	-1.47	$R_a - L1 - V + 0$	10	8.6	$R_a(x) - L1((x - X1') - M + 0$
11	-1.47	$R_a - L1 - V + 0$	11	6.96	$R_a(x) - L1((x - X1') - M + 0$
12	-1.47	$R_a - L1 - V + 0$	12	5.32	$R_a(x) - L1((x - X1') - M + 0$

Once the notes are ready, they are scanned and then distributed in a “pdf” format. Distribution can be handled in many ways. While copies can be run and distributed, electronic distribution has worked out the best. In actuality, Purdue North Central has three potential methods of “electronically” of delivering notes to its students.

1. Email the notes through the class list
2. Post to the instructors I:/ drive (or whatever shared directory on the university network).
3. Post on Blackboard (or a password controlled web site).

Emailing is typically done as a last resort. By posting the lecture notes where the students have to retrieve them puts the onus on the student and eliminates the “did not get the email” excuse.

Advantages

Among the many advantages of using class notes is being able to tailor the notes to the exact sequence and message that the instructor wants. Quite often, textbooks force the instructor to “jump around” in order to follow the flow of the class that they want. Also, quite often textbooks use their own language, while the instructors’ style can be quite different. Because most people write as they speak, there is a continuity of style between the notes and the lesson. This makes it easier for the students to pick up the message conveyed to them instead of them trying to figure out the message delivered from two different styles.

Another great advantage to using excel based notes is the ease in altering the lesson. While time can be saved in only writing the lesson and answers as opposed to setting up a worksheet (as one would do for a lecture only class), the versatility gained by creating the worksheet is outstanding. Say the instructor want to alter a problem and a worksheet was originally created. Once the drawing is altered, by simply going to the worksheet and imputing the new values it then recalculates the new answers and a new set of lecture notes is created with minimal effort. Revisions (including correcting typographical errors) are also easily done with a new “original” produced. As a note, exams can also be done in this manner. Once a set of problems is created (say ten problems), a rotation of these problems can be used (four or five per exam, labeling the semester and year in which they were used) and by altering the problems and inputs, new “original” exams can be virtually created indefinitely. Conversely, this same technique can also apply to homework assignments. Finally, excel based solutions to mathematical errors. Once the first incarnation of the notes is produced (and manually checked), it is safe to assume that the formulas are correct. Therefore, any changing of inputs can be done with the confidence that the outputs are correct.

Students being able to more easily follow work done on the board without trying to frantically write all of it down has also been advantagous. When working problems on the board, the students often struggle just to keep up and do not fully pay attention to their work (or cannot even read it at a later time). With the notes in front of them, and an exact replication being worked on the board, they can simply add notes as needed for clarification and maintain clean copies of the notes. Also, by posting them a week in advance, the students have an opportunity to review the notes prior to class, just as they would with a reading assignment.

A final advantage for students has been when they miss classes. Because the notes act as an outline for the lecture, most of the pertinent information is contained in them. This allows the student to get another student's notes and add only whatever additional explanations and/or topics were covered in class and not on the notes.

Disadvantages

The first obvious disadvantage is the time in which it takes to prepare the notes. The excerpts previously shown come from an eight page lecture that took approximately eight hours to prepare for a lecture that takes less than ninety minutes. Obviously, notes that do not use free body diagrams or calculations can be written significantly faster. Instructors from larger departments who teach a select amount of classes yearly would have an advantage in that there would be significantly fewer notes to prepare. Instructors from smaller departments, who could potentially teach six to eight classes per year must be more selective and phase notes in over several years. Past experience dictates that for a sixteen week semester (two classes per week), that approximately 25 lessons must be prepared (allowing for exams, weather, conferences, etc.). Obviously, to try to tackle more than one class in a semester would involve a tremendous effort.

One other disadvantage is the possibility of a copyright infringement. Those who have taught for several years have probably used/reviewed/read several textbooks over the years. Quite often, an example/homework problem can “nest” itself to reappear when producing these notes. Due diligence must be taken when preparing notes so as not to infringe on another author's material. Typically, a quick check of one's own references, along with (possibly) a library or the internet, can greatly reduce any potential problems. It is important to remember that if educators place a high standard of ethical conduct on their students, that the same standard must apply to ourselves. If students are required to cite their sources, faculty likewise should do the same.

Of a similar fashion is when the use of reference tables are required. Permission from publishers may be needed to reproduce such tables. However, with the proliferation of the internet, it is often quite possible to find the needed tables and charts, free of charge, on websites. When this is the case, citing the source of the table, or simply giving the web page address suffices to get the student the necessary information.

One final disadvantage is the students who fail to take adequate supplemental notes. In construction, there is a saying that “complacency breeds contempt” that could also apply here. During lectures, the notes seem very clear and make sense. As this happens, students tend to stop taking supplemental notes that clarify the lecture. Invariably, during an exam the student cannot remember how a certain function was performed and does not have any notes to back them up.

When not to replace textbooks

There are times when the removal of a textbook may not be in the best interest of the student. In many courses there are numerous textbooks that are very good and their replacement with lecture notes does not significantly add to the quality of the course. In some cases, reference books cannot be replaced. As mentioned above, some books have large amount of tables or graphs that losing would not negatively affect the class. However, some reference books (such as the American Institute of Steel Construction's Manual of Steel Design) simply cannot be replaced