DESIGN CALCULATIONS, REPORTING AND DOCUMENTATION

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1 TECHNICAL WRITING

Good technical writing:

- **Conveys information clearly**
- **Serves as a means of thinking**

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GUIDELINES

Do	Don't
• Use strong verbs & nouns *crack vs separation*	• Don't use pompous words *utilize → use*
• Use present tense *The calculations are in Appendix.*	• Don't use empty words *in as much as* *with regard to*
• Vary sentence construction	
• Be specific, concrete and informative *the water is cold* *→ the water is 10 ℃*	• Don't be redundant *end result* *basic fundamentals*

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GUIDELINES

Do	Don't
• Adapt writing to the audience and purpose	• Don't use humor
• Express negatives in a positive form *he is not on time very often* *→ he is usually late*	• Don't add –ly as a suffix to numbers *secondly → second* *firstly → first*
• Omit needless words *that is a subject that* *→ this subject*	• Don't forget that bad engineering writing may endanger lives

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FORMAT

- **Title, Author's Name, and Date**
  - ***Title should mean something***
- **Introduction**
- **Description of Procedures**
  - ***Including Investigation, Experiment, Analysis, Drawings, Schematics, Photographs***
- **Results and Discussion**
  - ***Insert Data Tables, Graphs, Data Processing***
- **Conclusions**
- **References**
- **Appendices**

main body

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Include figures, photos, tables, and graphs in the main body of the text

Example

Carbon fiber composite stay cables generally have a high initial cost compared to conventional steel cables (Figure 1). However, the use of carbon composite stay cables has the potential of good efficiency for life-cycle cost relative to steel stay cables. The high fatigue life and excellent chemical resistance of the CFRP stay cables provide bridge components that feasibly require less maintenance over their life span.

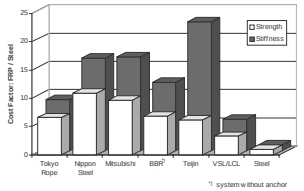

Figure 1 Cost comparison based on strength and stiffness of a 50 m long tendon system

A two phase experimental test program on commercially available FRP cable stay systems in direct support of the I-5/Gilman Advanced Technology Bridge was conducted.

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Example

Using Equation 3 and the natural response frequencies of the stay cables calculated using LARSA, the wind speeds that would cause vortices to form at the same natural frequencies of the stay cables can be determined. **The calculated wind speeds for the first two modes of vibration for the steel and the CFRP stay cables are shown in Table 1.**

Table 1 Wind speeds corresponding to vortical formation with the same frequency as response frequency of the stay cables

Cable #	Steel Cables				CFRP Cables			
	ω_1 (Hz)	V_1 (mph)	ω_2 (Hz)	V_2 (mph)	ω_1 (Hz)	V_1 (mph)	ω_2 (Hz)	V_2 (mph)
1	8.7897	13.75	17.3599	27.16	18.7466	29.33	37.0314	57.95
12	11.0616	17.3	21.8481	34.19	21.5222	33.68	42.5142	66.53
20	15.0244	23.51	29.6789	46.44	32.0329	50.12	63.2771	99.01
32	6.2584	9.79	12.3475	19.32	13.8238	21.63	27.3063	42.73

The ranges of wind speeds that would cause vortices to form with the same natural frequencies of the stay cables are well within the expected wind conditions for the location of the I-5/Gilman Bridge.

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2 TABLES and GRAPHS

Tables and Graphs in a report should:

- **Be self-explanatory, with complete title and other information**
- **Be able to stand alone, without the benefit of the text.**
- **Provide informative, complete, and memorable displays of quantitative information**

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GUIDELINES

Do

- Give a title to a graph or table
- Use a format that provides greatest impact and is easiest to decipher
- Cite tables and graphs in text **IN SEQUENCE!**

Don't

- Don't put too much information on each graph or table
- Don't present graph or table to reader before referring to it in the text

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Organization of informative tables

Table 7.1

W18x35, A=10.3; W16x36, A=10.6; W14x34, A=10;
W12x35, A=10.3; W10x33, A=9.71; W8x35, A=10.3.

Table 7.2

Area vs W-Section	
Area	Section
10.6	W16x36
10.3	W18x35
10.3	W12x35
10.3	W8x35
10	W14x34
9.71	W10x33

Table 7.3

W-Section Areas	
Section	Area
W18x35	10.3
W16x36	10.6
W14x34	10
W12x35	10.3
W10x33	9.71
W8x35	10.3

Table 7.4

W-Section Areas	
W-Section	Area (in.^{2})
W10x33	9.71
W14x34	10
W12x35	10.3
W18x35	10.3
W8x35	10.3
W16x36	10.6

Example

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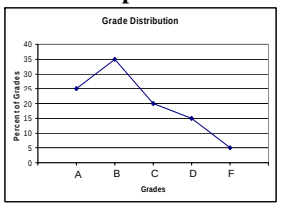
Graphical representation of numerical lists

Table 7.1

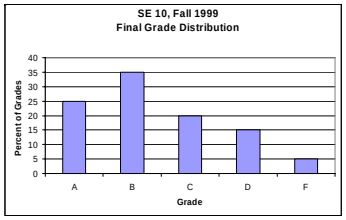
Grade	% of Grades
A	25
B	35
C	20
D	15
F	5

Graph 7.1



Incorrect use of a line graph

Graph 7.2



Histograms (bar graphs) are useful for illustrating numerical lists

Example

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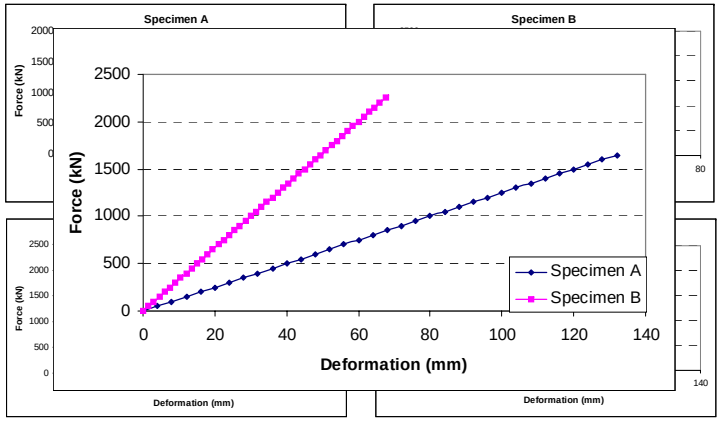
Graphical comparisons of data



Example

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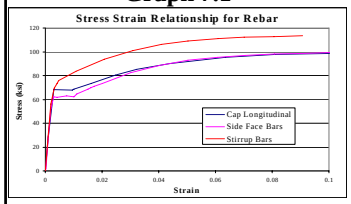
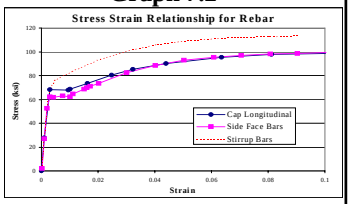
Presentation of graphs with more than one curve

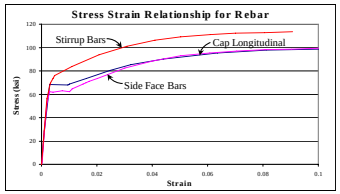
Graph 7.1



Graph 7.2



Graph 7.3



Example

3 FIGURES, PICTURES and EQUATIONS

- **Figures and Pictures are the most common way to clearly show test setups and hardware that are under discussion.**
- **In photographs, it is good practice to include a scale to show size**
- **Number equations so that they are easy to cite in the text.**
- **Place only important equations in the text and all other equations in the appendix.**

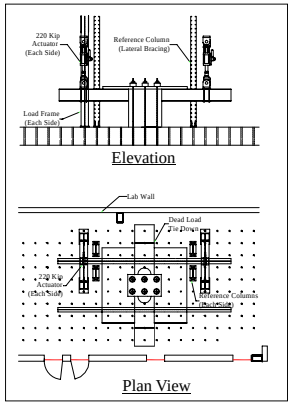


Figure 1 - Test Setup

Example

Indication of size in photos

Figure 1 - Test 1

Figure 1 - Test 1

Example

we have six failure scenarios that need to be defined. The two equations below illustrate the six levels and their implications.

Solve for deflection at midspan

Obtain slope equation:

For $0 \le x \le L/2 \longrightarrow$ $\frac{dy}{dx} = \int \Phi(x)dx = \int \frac{2\varepsilon_{max}(x)}{h}dx = \frac{2}{h}\int \frac{M(x)\cdot\frac{h}{2}}{EI}dx$

$= \frac{1}{EI}\int M(x)dx = \frac{1}{EI}\int P/2\,(x)dx = \frac{P}{2EI}\int x dx$

$= \frac{P}{2EI}\left[\frac{x^2}{2} + C_1\right]$ ……..7.1

Obtain deflection equation:

$y = \int \frac{dy}{dx} = \int \frac{P}{2EI}\left[\frac{x^2}{2} + C_1\right]dx = \frac{P}{2EI}\int \left[\frac{x^2}{2} + C_1\right]dx$

$= \frac{P}{2EI}\left[\frac{x^3}{6} + C_1 x + C_2\right]$ ……..7.2

we have six failure scenarios that need to be defined. The two equations below illustrate the six levels and their implications.

Example

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4 ORAL PRESENTATIONS

Do	Don't
• PREPARE and PRACTICE!	• Don't talk to yourself
• Introduce yourself and your topic	• Don't apologize
• Stand tall and speak loud	• Don't fidget with your belongings
• Finish your sentences	• Don't use too much humor
• Have a good beginning and ending	
• Be conscious of the allotted time	

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VISUAL AIDS

- **About 35% of all the information we retain is visual.**
- **Make the writing or graphics on your visuals "too big"**
- **Be careful about using visuals made from printed material**

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5 TRUTHFULNESS IN ENGINEERING COMMUNICATION

- **In engineering writing, readers begin with the assumption that the material is**
  - ***a) true***
  - ***b) written by the person identified as the author***
- **Illustrations can also transmit lies and deceit**
  - ***Most misleading illustrations are deceptions rather than lies***
- **How to use outside material? ⟶ REFERENCE!!**
- **We must judge engineering illustrations not only on the value of their information and on their appearance, but also on their integrity.**

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Misleading illustrations can give an incorrect interpretation of relative difference between two quantities

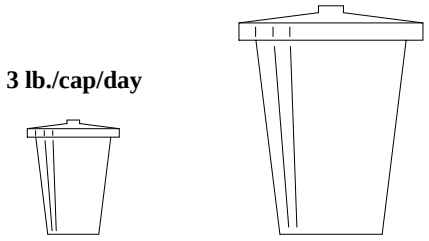

Figure 7.1
Solid Waste Production

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Appropriate scale must also be used for line graphs

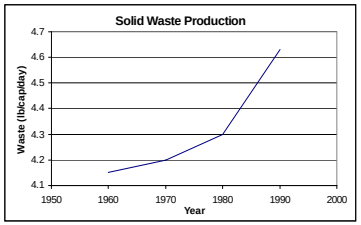

Figure 7.1

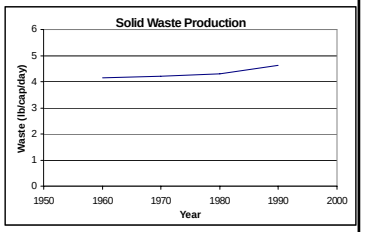

Figure 7.1

Example

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6 REFERENCING OUTSIDE MATERIAL

- **Only use outside material *if*:**
  - → **the material is needed to make your term paper clear**
  - → **the material will help you not repeat already established methods, information, etc.**

DON'T LIST A REFERENCE IF IT IS NOT CITED IN THE TEXT OF YOUR TERM PAPER!!!

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<u>Citation Order System</u>: a system of citing the references (by number) in the order that they appear in the paper

Example

The authors claim that their model is appropriate for general application to metals and can model a material with both a yield plateau and a strain-hardening range. **To verify its accuracy, the theory of the Petersson-Popov model was implemented in a finite element computer program [2].** The authors found satisfactory agreement between their material model and experimental results.

Two-Surface Plasticity Models

After the introduction of multi-surface plasticity models, many two-surface plasticity models developed. **Tseng and Lee [3] proposed one of the first widely accepted two-surface plasticity models.**

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REFERENCES

Journal article (author(s); article title; journal title; publication year; volume (issue):pages)

[1] Chang K.C. and Lee GC. Constitutive Relations of Structural Steel under Nonproportional Loading. Journal of Engineering Mechanics 1986; **112** (8):806-20.

Book (author(s); title; edition; city of publication: publisher; publication year)

[2] Mendelson A. Plasticity: Theory and Application. 1st ed. Malabar: Robert E. Krieger Publishing Co, 1968.

Website (title of site; URL; accessed date)

[3] Library of Congress Home Page. http://lcweb.loc.gov (accessed Dec 1996).

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Journal article

[#] Author(s). Article Title. Journal Title year; **Volume number** (Issue number):pages.

Book

[#] Author(s). Title. Edition number. City of publication: Publisher, year.

Website

[#] Author (if any). Title of Site. URL (accessed date), other identifying information.

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