PDHonline Course G422 (2 PDH)

Basics on Forensic Engineering - Part V

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Basics on Forensic Engineering
Part V

Ruben A. Gomez, P.E.

1.0 INTRODUCTION

The forensic engineer needs to be an effective communicator, both in his oral and in his written presentations. During and after an investigation, casual contacts with the news media should be viewed as opportunities to restore public confidence and to show professional concern. When you do have such an opportunity, make sure you speak deliberately, carefully and articulately.

Oral communication skills are also a prerequisite to effective testimony in the court room or in public hearings. That is another opportunity to shine performing as an educator, being able to explain complex technical issues in a language that is simple and comprehensible to lay-persons with no technical background. The ability to use simple examples in clear words to illustrate complex phenomena is an essential gift which will improve your credibility as an expert witness.

When a written report is produced as result of a forensic investigation, it becomes the tangible record of your work, and the quality of such report reflects your understanding and competency on the matter at hand.

On the other hand, just because the victim, perpetrator or the lay-witnesses are poor, reluctant or deceptive communicators does not give you an excuse for a poor job, you must uncover the facts as accurately as humanly possible before you venture into your own conclusions.

In this course we will show via examples, how the forensic engineer could use his communication skills, not only at the oral level, but also using every tool, whether it is graphic, mechanical or written to convey his own ideas as well as to extract them from the key players in the investigative process.

2.0 A CLAIMANT WHO FELL FROM A CHAIR

Sometime during the first week of January of the year 1998 we received in the office a phone call from one of those large insurance companies whose commercials appear on TV quite frequently. They were handling a claim on a homeowner's policy. A lady nicknamed Fanny and friend of the lady of the house had come visiting their home. They sat down at the den for an afternoon chat at coffee break. While the lady

homeowner was in the kitchen preparing coffee and toast, allegedly the visitor made the wrong movement and fell backwards landing on her shoulders and head. As result of the accident she sustained injuries which are being described ahead in the text that follows.

As usual, we were sent an assignment sheet with all the pertinent information on the case as it was known to the insurance company at the time, such as: homeowner's policy number, date and time of loss (DOL), address, homeowners' names, claimant's name, assigned adjustor's name, claimant's attorney, brief case's claim description as well as the assignment description.

Since the claimant had ignored all attempts from the adjustor to meet and had instead retained the services of a litigating attorney, the insurance company in turn, was requesting from us for an evaluation of the claim as well as a measure of the potential liability as part of their strategy directed to damage control.

Without delay, the homeowners were contacted by our office as well as the claimant's attorney and a meeting for the six of us (both homeowners, the claimant, her attorney, and two members of our staff) was arranged immediately after at the attorney's office.

At the meeting we were confronted with a bellicose attorney and a reluctant claimant who clearly expressed their intention of meeting as a formality, just that one time. Therefore, we needed to obtain as much information as possible, just in case their threat was brought up to materialization.

We took the claimant's body measurements which are herein reproduced as part of Figure 2.1. She was 5'- 8" tall, weighed 142 pounds and was 47 years of age. When we asked her to describe the accident, she succinctly said that as she was waiting in the den and as the lady homeowner was in the kitchen preparing coffee, she attempted to reposition herself in the chair she was sitting in "near the edge", and "before she knew the chair gave way and she fell backwards on the floor, sustaining a cut across the temporal bone at the back of her head, as well as concussions on her neck and shoulders, with the resulting soft tissue damage." Following the accident she had a decrease in her manual abilities and allegedly had to quit her job with the consequent loss of income.

There were some small inconsistencies in her story that were of our particular concern. After the meeting, our next stop took place at the scene of the accident, once there we realized that the den in question was actually a converted and poorly refurbished garage. There was a 6 in. step that was never addressed, from the platform used as sitting area which was also where the dryer and washing machine were located, down to the original garage floor level.

Once back in the office, we made a fully hinged cardboard mannequin which was used to mock the conditions of the accident. The measured body parts have been depicted to scale on Figure 2.2. By strictly following the description given by the claimant we were able to produce the graphics shown on Figure 2.3, as they were prepared on January 15, 1998 and sent next day to the homeowners for a critique.

The lady homeowner, although she was in the kitchen at the time of the alleged incident, however, she was not only well aware of her own furniture arrangements, but she had also attended the meeting at the attorney's office, and therefore, after the claimant she was the person most familiar with the case. Her version and comments appear handwritten on the same sketch we submitted for their review. In addition, she also provided us with a free-hand sketch of the chair used by the claimant (see Figure 2.4):

a. our version of the type of chair was erroneous at first, the actual chair had a round seat, a round support base and was made out of wicker material, as sketched by the responder herself on the same sheet.

b. the chair had not collapsed as indicated by the claimant, it had instead turned over on its back.

c. the rear of the chair was about 6 inches from the edge of the step rather than the 2 inches as originally suggested by the claimant and thus shown in our first drawing as such.

After securing all that information, the fall scene had consequently to be adjusted to comply with the new found facts and the factual logic that came with it, rather than following the description given by the claimant. Therefore, we redrew the mechanism of the fall as it had been updated and had it revised in Figure 2.5.

When we attended the first round of depositions, we brought with us our mock-up and graphics. On first sight, the claimant's attorney became anxious and restless. In an effort to discredit and minimize the importance of our products, he referred to them as "your lousy cartoons" and assured us that he would strongly oppose to their presentation in court. Nevertheless, he could not manage to hide his disturbance and frustration. From there upon, we made sure to bring an enlarged version of all the paraphernalia to every meeting that followed.

The point here is that the use of graphics and close communication with the participants were more effective than just random words subjected to misinterpretations. In the end, it took a great deal of time, effort and effective communication to bring about the facts and the truth for the completion of our work. Naturally, that all that time and effort was billable to the client and therefore no complaint is meant here. By the way, we kept the details on file but did not ever prepare a report at the request of the insurer, and they had very good reasons for doing so.

In the final analysis, the case never reached the courts as it once appeared to be heading towards; it was settled by direct and open negotiation between the parties involved, the representatives of the claimant and the insurer.

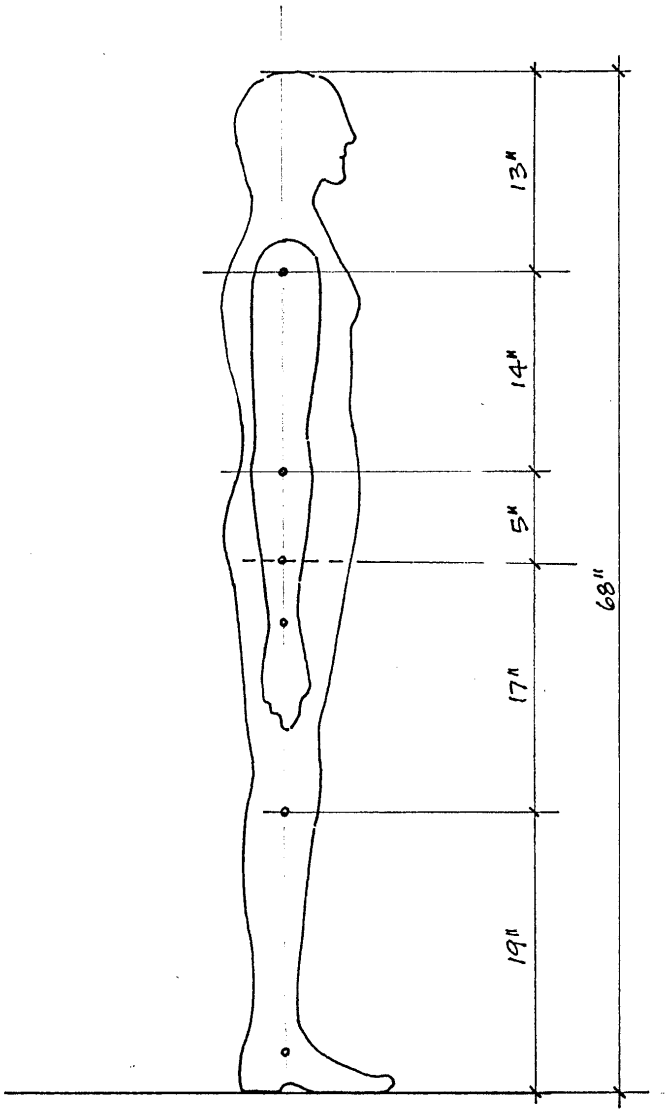


FIGURE 2.1

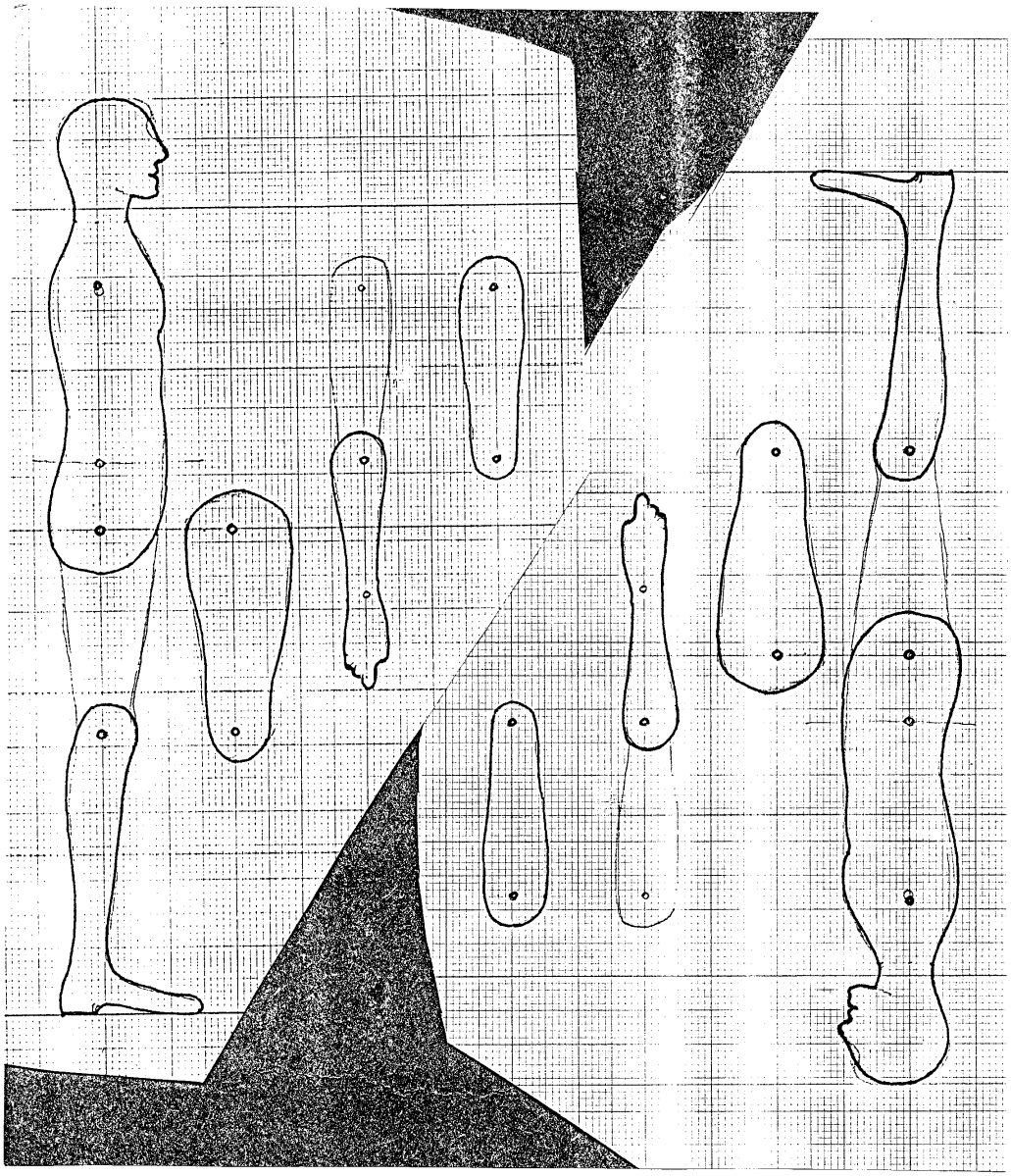


FIGURE 2.2

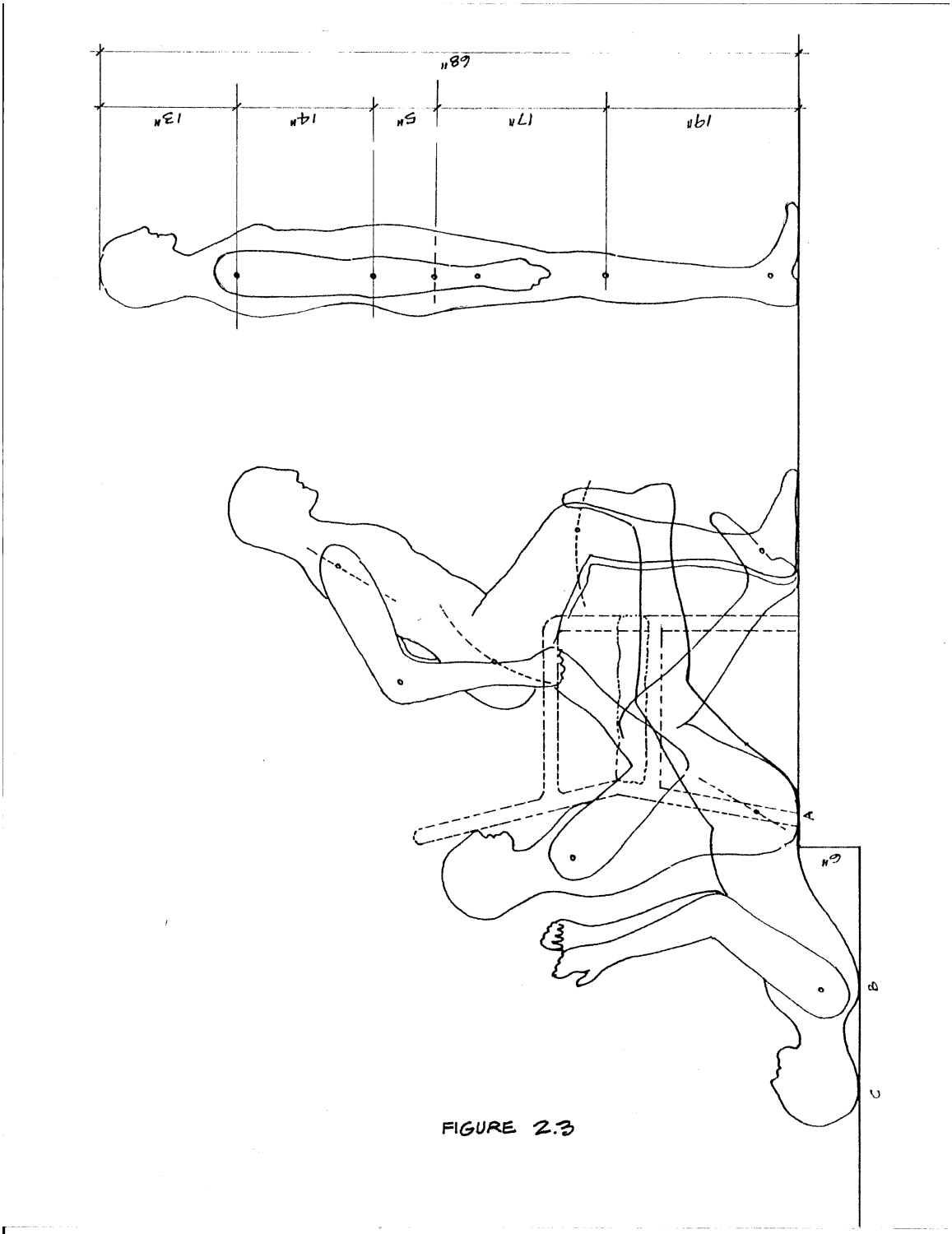
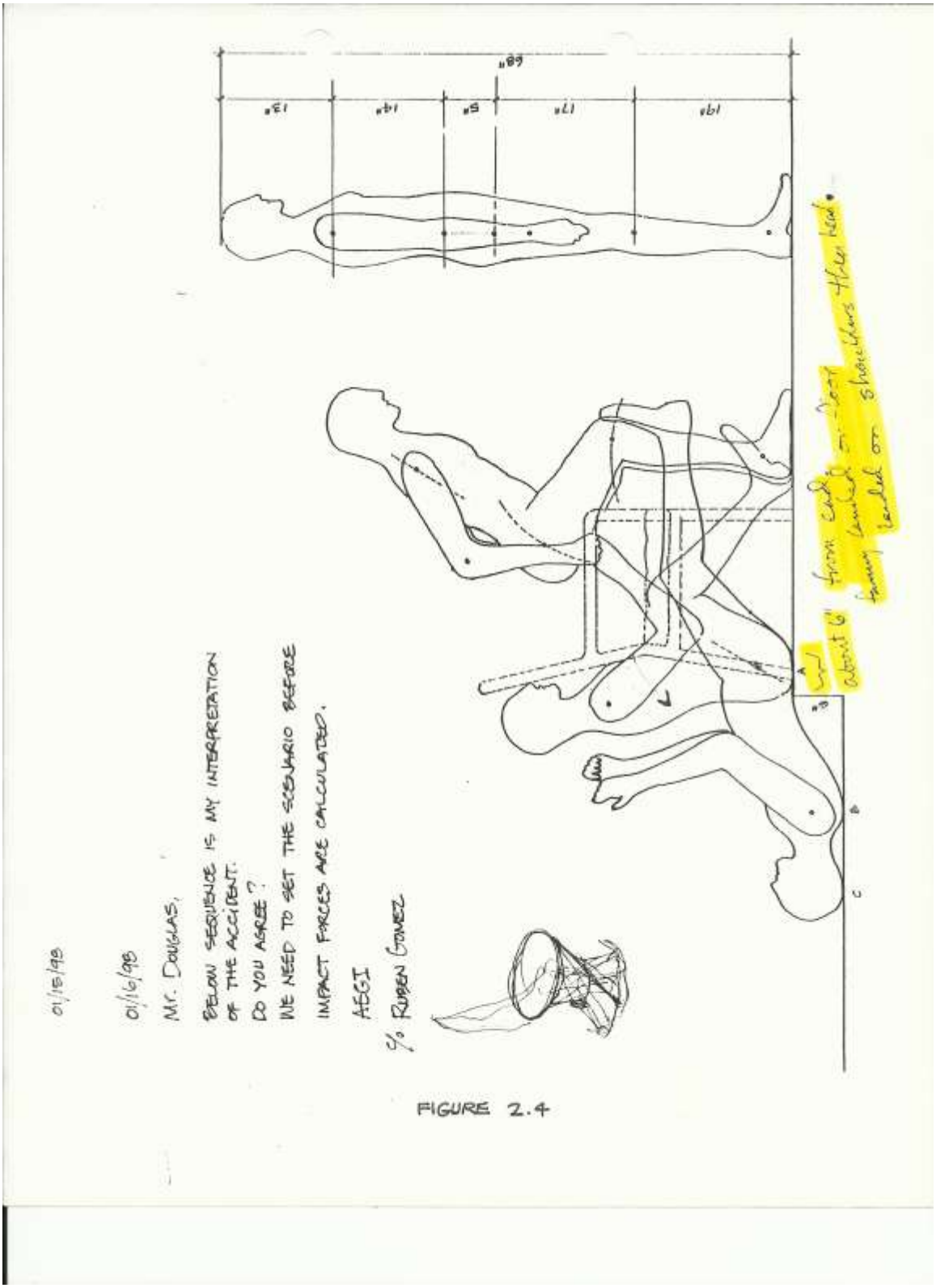


FIGURE 2.3


01/15/98
01/16/98
Mr. Douglas,
BELOW SEQUENCE IS MY INTERPRETATION
OF THE ACCIDENT.
DO YOU AGREE?
WE NEED TO SET THE SCENARIO BEFORE
IMPACT FORCES ARE CALCULATED.
AEGI
c/o RUBEN GOMEZ
FIGURE 2.4

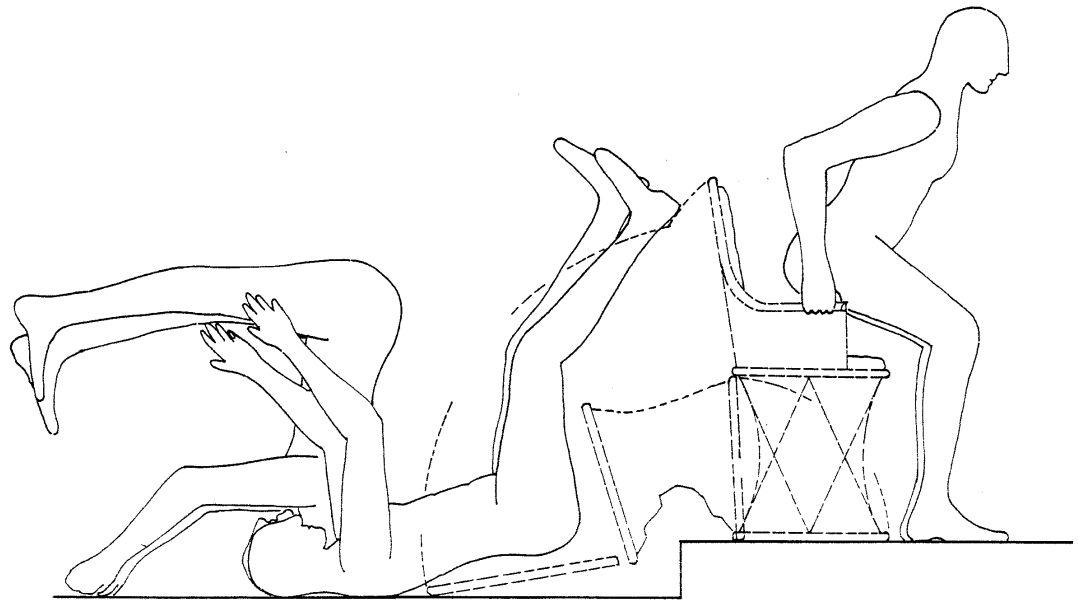


FIGURE 2.5

3.0 CASE OF SLIP & FALL IN A PAVILION

This time the insurer had at hand a case of liability triggered by a claim of "slip & fall" against their insured. Before getting in contact with us, they had retained the services of another forensic engineering firm from whom they had already secured a first opinion. Therefore, our assignment was indeed to render a second evaluation of the case. We had the infrequent opportunity not only to read their report but also to discuss some of the details with the authors, whom in our perception, had done an excellent job in their assessment of the case. Consequently, we felt that given the circumstances we needed to "sharpen our pencils" further than usual and try to get into the finer and minute details that the other firm may have overlooked or had escaped to their consideration.

We have herein transcribed the highlights of our report. The readers should bear in mind that some of the less relevant but sensitive details have been either edited or omitted to protect the client's confidentiality.

Here is the edited transcription of our original report:

TABLE OF CONTENTS

1.0 ASSIGNMENT

The subject project was known as the Victoria Woods Housing Development, a private community located at 5750 Summit Boulevard in the City of West Palm Beach, Florida.

As part of the community facilities there was a designated recreational area with a swimming pool, volleyball, basketball, handball and tennis courts. In the middle of those facilities there was a picnic pavilion (please see Exhibit A at the end of this report) which was the object of the requested examination.

Our assignment had been directed to examine the site conditions, construction materials, design characteristics and relevant code requirements as they were applicable to the pavilion at the time of construction.

All findings and preliminary report(s) were to be documented and maintained on file until otherwise requested by the client.

2.0 SCOPE OF SERVICES

Visit the alleged slip & fall site and determine if the subject recreation pavilion was built according to applicable building code(s) and following good construction practices as prevailing at the time.

Determine the possibilities of *subrogation* against other direct or indirect parties.

Findings, including recommendations, are to be conveyed verbally to the client and follow further instructions afterwards, if any.

3.0 PARTICIPATING PERSONNEL

(Section deleted)

4.0 OBSERVATIONS

Our examination of the site conditions was conducted during the early morning hours of Friday October 25, 1991. Prevailing weather conditions during our examination were: slightly cloudy skies, 82% humidity and 76°F air temperature. Clear evidence of an overnight rain storm was observed at our arrival.

The subject pavilion was part of the recreational facilities pertaining to the housing community. A structural wood structure of approximately 20 x 36 ft. and carried by six (6) steel columns, with no wall enclosure.

The floor slab was dead-leveled, however with some slight depressions formed by the raking of the fresh concrete around the central area. Although slight, said depressions were deep enough to allow transient water ponding. Because of the lack of slope, rain water did not drain away and in some spots water remained long and often enough to promote algae growth with the resulting potential for a slippery surface. A similar condition was also observed at the handball courts.

In spite of the prevailing conditions, no "slippery when wet" signs were posted anywhere within view.

Simplified *slip resistance tests* were performed by our technicians using leather and rubber shoe soles on dry concrete surfaces. While dry concrete surfaces were found to be at the level of "satisfactory" in terms of their friction factors, the wet surface tests were found to be in the "marginal" to "dangerous" categories.

The *friction factor* (or friction coefficient) hereby referred to is determined as a fraction of dividing the unit horizontal force component that triggers slippage **H**, by the unitary vertical force **V** that represents the object's weight. In other words:

$$\mathbf{F_c = k(H / V)}$$

In that formula, the **k** multiplier provides for weather variables, surface conditions and presence of contaminants, if any.

Practical friction coefficients applicable to dry materials commonly found in slip & fall cases are shown below for **k** = 1.0:

Common Materials	**Friction Coefficient (F_c)**
Vinyl to Concrete	0.50
Leather to Concrete	0.70
Rubber to Concrete	0.95

The terms "satisfactory", "marginal" and "dangerous" used above have been borrowed from the British Standard known as BS 6677, which defines the slippery characteristics of a mineral floor in terms of its friction coefficient.

We hereby acknowledge having had the opportunity to review a complaint letter dated March 14, 1991 submitted by MJSGM&D, claimant's attorneys, as well as a report submitted by a certain local Industrial Safety Consultant.

We also had the opportunity to review the permit drawings dated August 17, 1980. Those drawings were very vague and generic, making no mention of slope or surface

finish concerning the floor of the subject pavilion, therefore leaving it up to the builder to use his own judgment.

We have found in our own experience that a "dead" level is a most unrewarding solution for a roof or an exposed floor surface, such as the one described in this report. Normal raking as well as hand or machine toweling will always produce slight low points and valleys that are prone to allow rain water ponding. In other words, no positive and effective drainage can be achieved on a flat leveled surface and drainage is left to just hydraulic gradient to dispose of the unwanted rain water. Therefore, an adequate minimum slope must be provided to not only ensure proper run-off, but also to counteract the real possibility of water ponding due to unevenness induced during the trowelling process.

5.0 CONCLUSIONS

Based on our site observations and detailed examination of the evidence and our own test results, it is our conclusive opinion that the architect's plans failed to show and the builder failed to provide adequate drainage slope on the floor of the subject pavilion. A minimum slope should have sufficed to create adequate outwards drainage from the center of the floor slab towards the perimeter. This omission by itself has the potential for subrogation against both parties.

The lack of such slope, which in our opinion is the sole culprit in this case, promoting persistent humidity which in turn sponsored algae and mildew proliferation and consequently undesirable slippery conditions on the floor.

To argue that the alleged slip & fall was the result, as it has been claimed by others, of poor housekeeping is an exaggeration and a diversionary statement, since a properly sloped concrete surface would have been virtually maintenance free, with the exception of occasional sweeping and mopping.

6.0 RECOMMENDATIONS

To preclude the possibility of recurrence of the same incident in either location, the picnic pavilion or the handball courts, one of the following two methods should be implemented:

#1- Pour a concrete topping on the existing slab providing adequate texture and slope,

or

#2- Etch existing slab clean and treat the surface with a proven and guaranteed non-slip coating.

Proposed solutions should be sought in the same order of priority as given above.

7.0 APPENDICES

Enclosed Appendix A shows a site plan with the location of the featured subject.

Appendix B is a copy of our original field questionnaire used to gather information from field personnel, claimants and witnesses.

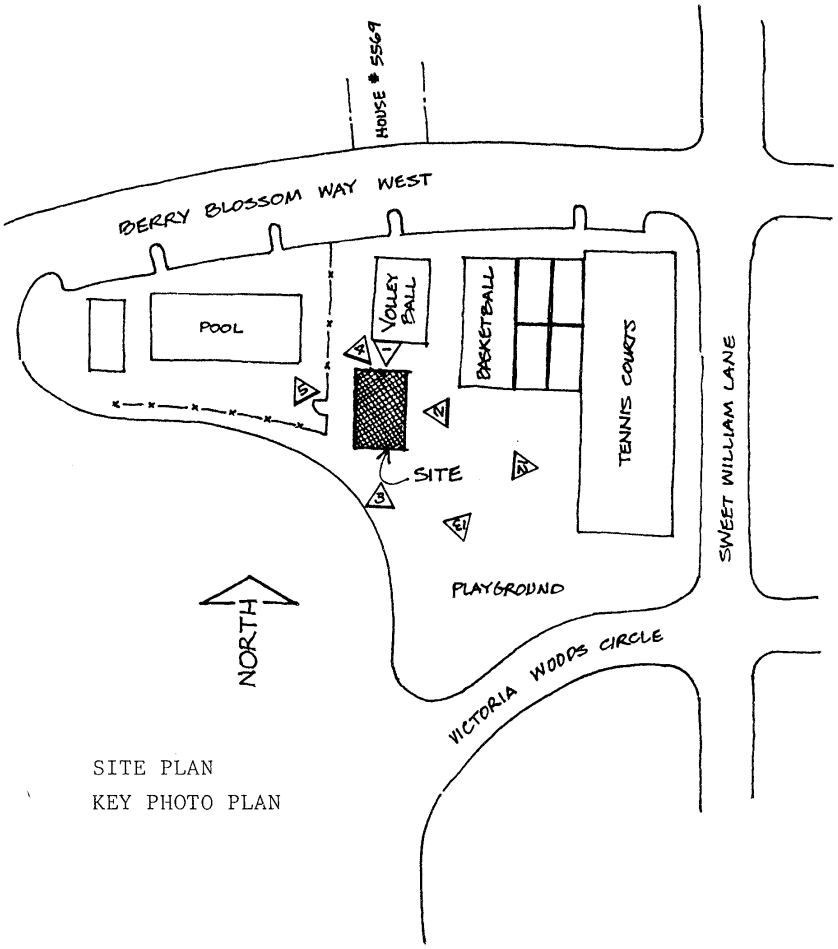
Respectfully submitted on this 18th day of November of the year 1991.

On behalf of AEGI,

Ruben A. Gomez, P.E.

END OF REPORT

At that point the insurer knew that they were at the losing end, therefore they needed to handle the case in a cool manner all the way to its breaking point, if necessary. After a great deal of letters, supplemental reports, clarifications, depositions, meetings and negotiated subordinations, the claim was finally settled and closed up a year later.



SITE PLAN
KEY PHOTO PLAN

APPENDIX "A"

Q U E S T I O N N A I R E

Re: Victoria Woods
5750 Summit Blvd.
West Palm Beach, FL

#1- Name & title of person interviewed: PENNY (407) 471-1771 (RELUCTANT WITNESS)
Date interviewed: 10/25/91 By: R. GOMEZ

#2- Date & time of accident: JULY 4, 1990 (TIME UNKNOWN).

#3- Location of accident: RECREATION PAVILION.

#4- Name of witness(es): NONE GIVEN

#5- Year structure was built: 1986

#6- Description of claimant & details of accident: UNKNOWN TO INTERVIEWEE.

F I E L D S U R V E Y

#7- Description of structure: ASPHALT SHINGLES, FIBERCEMENT DECK, WOOD TRUSSES @ 2 FT. OC, WOOD BEAMS, SQ. STEEL COLUMNS, R/C FLOOR SLAB.

#8- Describe substrate: R/C SLAB ON GROUND.

#9- Floor finishing material: TROWELLED CEMENT FINISH.

#10- General condition of floor: GOOD/WATER STAINS, ALGAE GROWTH.

#11- Floor slope (if any): NONE, DEAD LEVEL

#12- Non-slip treatment?: NONE.

#13- Any signs of water ponding?: YES, SEE PHOTOS #

#14- Results of slip test: SATISFACTORY WHEN DRY/SLIPPERY AT WET SPOTS.

#15- Remarks: THE LADY NAMED PENNY (ABOVE) IS AN EMPLOYEE OF ROBERT C. MALT & CO., BUILDER/DEVELOPER.

'91rg.

APPENDIX "B"

4.0 MAXIMIZING VERBAL COMMUNICATIONS

As we have indicated before, the role of the forensic engineer as an expert witness in court proceedings is another opportunity to show his expertise and verbal abilities in front of the judge, jury members, attorneys, witnesses and the attending public.

Unlike the lay witness who only can testify as to the facts, the expert witness is given wide latitude to explain in detail his thought process and the scientific details that drove him to his conclusions. He also has the opportunity to explain and assist the jury in understanding the content and substance of complex technical matters. Therefore, as an expert witnesses you should use the opportunity to maximize your exposure and thus develop an enduring reputation for the years to come.

5.0 THE FALL SIDE

Again, during your testimony talk in terms that the jury can understand, keep it simple, tell the truth and be confident. However, a word of caution is in order to avoid "injury while walking through the mine fields": do not burn your bridges, do not be a bluff or a speculator.

Here are a few more pieces of good advice:

a. Do not argue with the opposing attorney or anyone else.

b. Do not ramble or offer information that is irrelevant or has not been asked for.

c. Do not allow the opposing attorney, or even your own for that matter, to put words in your mouth; say only what you know and what you believe in.

d. Do not try to perform the functions of the lawyer. That is not your role.

e. Do not lose your cool; remain poised, courteous and objective.

f. Do not be hesitant; respond to the questions with a sharp yes or no answer, when applicable.

6.0 RECOMMENDED READING MATERIALS ON FRICTION

While it is very important for an engineer to know his engineering and physics basics well, it is also important for him to have a general knowledge of all areas, and when some of that knowledge eludes his memory, to have a complete and well indexed library and the recollection of where to find what he needed at a moment's notice.

The following is the additional reading material we recommend:

The American Society for Testing and Materials (ASTM)

C1028-89
Test method for determining the static coefficient of friction of ceramic tiles and other like surfaces under wet and dry conditions by using the horizontal dynamometer pull method.

D2047-93
Test method for static coefficients of friction of polish-coated surfaces as measured by the James Machine.

F462
The Bathing Facility Standards.

D5859
Standard test method for determining traction of footwear on painted surfaces by using the variable incidence tester, also known as The English XL tester.

F609-89
Test method for static slip resistance of footwear, sole, heel, or related materials by using the horizontal pull slip meter.

F1637-95
Practice for Safe Walking Surfaces. A standard addressing many walking surface defects as well as the appropriate design considerations, including where slip resistant surfaces are required.

Z3403Z
Test method for determining the static coefficient of friction and slip resistance of ceramic tiles and other like surfaces by using the Mark II slip meter.

Z5428Z-95
Test method for using a variable incidence tribometer type English XL.

National Fire Protection Association

NFPA 101

Life Safety Code

Underwriters Laboratories

UL 410
Standard For Slip Resistance Of Floor Surface Materials.

Federal Standards and Regulations

Uniform Federal Accessibility Standards.

Note:

It is likely that you have noticed two strange terms up above: *tribometer* and *tribometry*. Tribometer is an instrument to measure slip resistance; a slip meter by another name. In the same manner, Tribometry is the art of measuring slip resistance. The slip resistance factor is the same as the coefficient of friction.

There are a few slip resistant testers in the market which have attained ASTM's acceptance and endorsement. Amongst them are:

The English XL Slip-Resistance Tester

The James Machine

TRRL Skid Tester

Mark II Slip Meter

The reader may just peruse and/or download the desired information on those above instruments directly from their on-line websites.

7.0 CLOSING STATEMENT

One of our readers has asked us to clarify on the following topic: *whether any engineer may become a forensic engineer in his own field of expertise, and which actually the difference between the two is.*

We need to realize that a good design engineer would not necessarily and automatically become a good forensic engineer. While it would help to have a solid engineering background and knowledge, he (or she) must learn the ability to "change hats" as the

need arises. In a more clear language, he needs to be able to switch his design skills into his detective skills as it becomes necessary.

A design engineer is customarily well aware of code requirements and performance specifications and able to design a product to perform to the level of those requirements and to the limit of those specifications and constraints without failure, and perhaps even with a remaining capacity before the safety factor is fully exhausted. Should the product fail; he wants to make sure that it performed to the limits of his design predictions.

A forensic engineer on the other hand, should take the same failed product and investigate said failure from the perspective of physical causation and determine if the failure was due to inadequate design, or perhaps because the product was exposed to operate under extreme conditions and beyond its design limits.

Thanks for the question and the opportunity to revisit this most basic principle.

Now, in closing, this is the last part of the forensic engineering series as originally intended, we hope to have conveyed the material in a direct, precise and concise manner in such a way that the reader would be able to put it to work for his/her maximum advantage and benefit. Good luck!

END

SUPPLEMENTAL NOTE

The practice of forensic engineering is not without controversy, dissent or strife and the practitioner must always be prepared to confront them as they come.

As we were getting ready to close and submit the material of this Part V, an e-mail came up to our attention. It has to do with the course quiz corresponding to Part II of this series. A reader, whom from here on we will call Mr. Crawford, dissented with our questions/statements and their answers on items #13, 16 and 20.

Although we have no intention of using this media as a grievance forum, the case is brought up for the benefit of the readers, as a typical example of the criticism that the forensic engineer has to endure during and after the performance of his job.

Here is an unedited transcription of Mr. Crawford's message:

I disagree with the "answers" to questions 13 [(b) is not a "scenario", it is only a question]; 16 ["yes" is only conjecture. Is there a non-slip linoleum? Prove your claim that all linoleum becomes slippery when wet!] and 20 [I am an engineer, and should not act like I know the business of my insurance company employer. Legal opinions are not, and SHOULD not, be my business. I should deal in engineering FACTS, not legal OPINIONS.] I believe this "answers" do a disservice to the goals of engineering professionalism.

While Mr. Crawford is entitled to his opinion and we will make no effort to try to change his convictions, however, here are a few items for the reader to consider:

DEFINITIONS

Funk & Wagnalls Standard Desk Dictionary

Engineer
1. One versed in or practicing any branch of engineering. 2. One who operates an engine. 3. A member of a corps of men engaged in constructing forts and bridges, clearing and building roads, etc. 4. To put through or managed by contrivance.

Engineering
1. The art and science of designing, constructing and operating roads, bridges, buildings, etc. 2. Clever planning or maneuvering.

Professional
1. Connected with, preparing for, engaged in, appropriate to, or conforming to a profession. 2. Of or pertaining to an occupation for gain. 3. One skilled in a profession, craft or art. *Professionalism* (noun).

Webster's International Dictionary

Engineer
1. One who designs or contrives; an inventor, a plotter. 2. A designer or constructor of engines. 3. One versed in or who follows as a calling or profession, any branch of engineering.

Engineering
1. Originally the art of managing engines; in its modern and extended sense, the art and science by which the properties of matter and the sources of power in nature are made useful to man in structures, machines and manufactured goods. 2. The occupation and work of a professional engineer.

Professional
1. Of or pertaining to a profession, especially a learned or skilled profession. 2. A paid professional worker as opposed to an amateur.

KNOWN DISCIPLINES AND BRANCHES OF ENGINEERING

1. Administrative; 2. Aeronautical; 3. Agricultural; 4. Architectural; 5. Chemical; 6. Civil; 7. Construction; 8. Electrical; 9. Electronics; 10. Environmental; 11. Geological; 12. Highway; 13. Hydraulic; 14. Industrial; 15. Marine; 16. Mechanical; 17. Metallurgical; 18. Military; 19. Mining; 20. Municipal; 21. Naval; 22. Petroleum; 23. Sanitary; 24. Structural; 25. Textile; 26. Topographical; 27. Traffic and 28. Transportation.

WHERE DOES THE WORD ENGINEER COME FROM?

"Engineer" actually comes from "engine" and was traditionally applied to a machine operator, such as the locomotive operator who was (and still is) the engineer of the old times. It is just fair to assert here that in some other languages, such as Portuguese and Spanish, the equivalent word for engineer is "ingeniero" which comes from their word "ingeniosidad" (ingenuity), so those linguists were a bit more creative and imaginative.

As far as "engineering" goes, it is likely the widest and most extended profession in existence with more than 28 disciplines. Very few professions have the reach, content and diversity that engineering comprises. Further, considering that forensic engineers may emerge from all and every one of those disciplines, and although they may have different ideas and use different approaches and techniques, they all have something in common: the application of "the art and science by which the properties of matter and the sources of power in nature are made useful to man" as above defined by the Webster's International Dictionary.

From that perspective, just saying "I am an engineer" does not mean much if it does not get properly and fully qualified.

AWARENESS OF LEGAL PROCEDURES

Along with technical competency, the forensic engineer must unavoidably have a working knowledge of legal procedures and their related terms and vocabulary. Since the terminology used in litigation is quite specific, the forensic engineer who is not familiar with that language and practice can do irreparable damage to an otherwise sound presentation. You cannot be successful in this business with your engineering and scientific knowledge alone. YOU MUST INCLUDE LEGAL SAVVY.

Perhaps that is why the message's sender cannot claim his being a forensic engineer, for he has yet a lot to learn.

CHARACTER TRAITS

As we have continually emphasized before, another important quality of the forensic engineer is to have high ethical standards. In fact, ethical and professional principles are put to the test more often than in any other engineering endeavor, since the work of the forensic engineer may adversely influence the professional and personal reputations of all involved parties in a claim and therefore, his position of influence must not be taken lightly. That is where and when real *professionalism* counts.

It is fair to say that some practicing professional engineers have experienced during their practice the misfortune of making errors of judgment, or even without doing so, just by entering the aim of opportunists looking for unearned rewards by instituting legal action against their easy victims. In order to achieve their dubious goals, however, those opportunists must concoct their legal schemes with the help of engineers to act as expert witnesses.

Those "expert witnesses" who lend themselves to play such roles, do so at the expense of diminishing the image of the forensic engineers in general. That is one of the reasons we feel compelled to persist on the need for our engineers to observe a conduct of high moral and ethical standards on all of their private and public acts.

In summarizing, the minimum prerequisites to become a forensic engineer should be:

a. Demonstrated competency in his/her chosen engineering field,

b. Awareness and familiarity with legal procedures and terminology,

c. Having good analytical and investigating abilities,

d. Proven communication skills, and

e. Behaving with the highest code of moral and ethical standards.

Lastly, we have the following answer to Mr. Crawford's challenge on question #16: Unless chemically treated, all flooring materials (including linoleum) when wet, will experience a decrease in slip resistance. As a proof we refer you to the commonly available tables of static friction coefficients compiled by Harold Minshall. The rest of the answers to his inquiry can be found within the text of this supplemental note.