



PDHonline Course G418 (2 PDH)

Basics on Forensic Engineering - Part I

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Basics on Forensic Engineering

Part I

Ruben A. Gomez, P.E.

1.0 Introduction

This author spent over twenty-five years of his professional career working on cases involving forensic engineering. He covered disaster areas such as Homestead and Greater Miami, Florida in the aftermath of Hurricane Andrew in 1992, the Florida Panhandle, mainly Panama City, Destin, Walton Beach and Pensacola after the destruction created by Hurricane Opal in 1995 and finally, the areas of Punta Gorda, Port Charlotte, North Port, Sebring and Arcadia as they were devastated by Hurricane Charley in the year 2004.

In many occasions during his practice when introduced to clients and members of the lay public, the usual reacted to the concept of *forensic engineer* was as some kind of an odd occupation and they wondered if there was a connection or relationship with the traditional concept of medical forensic sciences where the practitioner dealt with and dissected dead bodies to determine the cause(s) of death, as physicians have had a monopoly on the word forensic for centuries. However, the word *forensic* is not exclusive of the medical sciences though, as it may also apply to any other occupational endeavor. The author's answer to that sort of public perception was more often than not with a touch of triviality and humor with comments such as....."I am pretty much like a forensic doctor, I test and examine sick, moribund or dead buildings....."

Dictionaries are not much help in clarifying the purpose and scope of the activity. The Webster Unabridged International Dictionary defines "forensic" as "belonging to courts of judicature or to public discussion and debate; used in legal proceedings; argumentative; rhetorical". Funk & Wagnalls Standard Desk Dictionary defines the same word as "relating to, characteristic of, or used in courts of justice or public debate". As one may fairly conclude, neither one of those two definitions gives us a decisive description of what forensic is all about.

Some other less authoritative sources make a more plausible effort to define the activity, such as this one pulled out of "WiseGeek" on the Internet: "A forensic engineer is one who applies his/her engineering experience to forensic problems. Forensic engineers typically work with civil cases involving poor performance products, but they can also be involved in criminal cases and other legal issues which require the input of an experienced engineer." That is a lot better and a closer assessment of what it really is. It can be added that a forensic engineer also handles the process of reconstructing or retracing the background of a product, object or event back to its origin or design, so it can be determined the change or damage sustained. Lastly and in a more condensed way, the forensic engineer is the professional who examines, investigates and analyzes the engineering aspects of a legal problem. Therefore and in even fewer words, forensic engineering is the application of the art of engineering to the legal system.

Part of the methodology used in forensic engineering has been borrowed from the principles of the old *reverse engineering* as it was often defined as "the process of discovering the technological principles of a device, object or system through an analysis of its structure, function and operation". Some of the old folks would also call it as "retracing backwards the development process" which is what we need to do in many of the cases involving the practice of forensic engineering.

2.0 Who can call himself a forensic engineer?

In order to call yourself a forensic engineer, first you need to have a full curriculum engineering degree and have solid experience in your area of expertise, for there are as many specialties in forensic engineering as many there are disciplines in general engineering practice. Second, you need to have shown proficiency and be duly licensed as a professional engineer in your state.

Thirdly, you need to have an inquisitive and analytical mind and have a knack for details and last but not least, you must have the proper credentials so your presence in court is properly acknowledged and respected.

3.0 Required skills for success

The forensic engineer is a man (or woman) of many skills, and the reach and degree of those skills may vary to some extent with the applicable discipline, however, they are paramount and absolute prerequisites for a successful practice.

TECHNICAL SKILLS

Forensic engineers must demonstrate advanced skills in their area of chosen disciplines comparable to their education and experience. Beyond doubt, a forensic engineer with adequate professional background and hands-on engineering practice is more likely to be credible and effective when it comes to the point of courtroom testimony.

INVESTIGATIVE SKILLS

His investigative skills must parallel those of a veteran detective. He must be effective in the detection, collection, interpretation and preservation of the field evidence and data, the same way that he must be able to differentiate between relevant, conflictive and irrelevant data. Since time is of the essence and some of the evidence could be time sensitive, he must be able to move fast in the collection and protection of evidence, since damage or alteration of the evidence may have great influence on the outcome of his investigation. Examples of such sensitive cases are the evidence resulting from a fire or building collapse where the destruction of evidence may accidentally be caused during and as result of the rescue and/or clean-up operations.

COMMUNICATION SKILLS

Effective communication skills, both oral and written, are important requirements to an effective forensic engineer. Careful and well articulated testimonies are an extremely effective tool, whether they are given to the media, public hearings, in the deposition or court rooms. On the other hand, a well written, relevant and clearly explained report is a valuable tool to the client or as a piece of evidence in court. By the way, the forensic engineer must be very cautious and careful in the preparation of his report or other written communications because he may be called upon to testify on his findings and he will have to stand by them in an effective and convincing way.

FAMILIARITY WITH LEGAL LANGUAGE

Legal language is very particular and specific; therefore, the forensic engineer must become familiar with the terminology used in legal documents and make a special effort to use it in his own documents with propriety and accuracy.

MISCELLANEOUS SKILLS

Familiarity with the basics of sociology and psychology are important skills to have for an effective interaction with clients, interviewers, colleagues, attorneys and opponents. Lastly, the forensic engineer must be a knowledgeable and effective photographer. He needs to know how to take clear, complete, relevant and reproducible photographs and bearing in mind that in many cases the viewer of a photograph may get lost in proportional dimensioning, so it would always help to have a point of reference, such as a familiar object or an extended tape measure included as part of the scene to provide proper dimensioning. In the same manner lighting is important, when in a confined area always use the flash, when outdoors keep in mind the proper position of the Sun. One last hint, it is always better to have more pictures than needed than being short and unable (or perhaps prohibited) from going back to the site.

4.0 Personality Traits

In addition to all above described skills, the forensic engineer must have integrity of character and high ethical standards. He will be expected to stand by his professional principles of honesty and fairness. Always taking into consideration that as an "expert witness" he could be placed in a position to adversely affect others with his testimony. Furthermore, in spite of the pressures of taking emotional or advocacy positions, he should be able to maintain his objectivity and impartiality and so allow the preponderance of the truth to prevail in spite of his own preferences.

A professional forensic engineer must maintain faith in his competence as an *expert witness* and should be prepared to endure the rigors of cross examination in spite of attempts from the opposing attorney to undermine his personal convictions, integrity and competence. Granted, such challenges are foreign to most practicing engineers and may place duress on those poorly prepared for the process of cross examination.

5.0 The Forensic Engineer as an Expert Witness

As indicated above, if you plan to practice as a forensic engineer do yourself a favor and get thoroughly familiar with the legal language and procedures when it comes to legal witness requirements. Most of the material shown on this Section have been extracted or are excerpts from either the Rules of Civil Procedure or the Evidence Code. For easier identification, all verbatim herein reproduced items or paragraphs are being shown in quotes.

First, you must be aware of the fact that there are two (2) types of witnesses:

1. The *layman witness* or *fact witness* who testifies only so as to the findings of fact. This kind of

witness cannot demand payment for his time, yet it can be ordered to appear in court regardless of the value of his time. This kind of witness is questioned by both attorneys and is required to answer to the questions with a *yes* or *no* with no regards or room for qualifications or longer explanations. The following is what the Evidence Code says about this matter:

“If the issue involves a matter of common knowledge about which the ordinary layman would be capable of forming a correct judgment, expert testimony is not admissible.”

2. The *expert witness* which the law defines as “a person duly and regularly engaged in the practice of his profession who holds a professional degree from a university or college and has had special professional training and experience or one possessed of special knowledge or skill about the subject upon which he is called to testify.” This could well be someone or an engineer like you. This type of witness is allowed to have or express an opinion and further “the expert may give a dissertation or an explanation of scientific or other principles relevant to the case.....”

Something important to remember here is that the attorney on your side may ask you to testify in terms of opinion or inferences and without further qualification, but the opposing attorney “upon cross examination may require you to specify the relevant facts or data.” Always keep that in mind.

The forensic engineer must also be aware of “contrived” questioning on part of the opposing attorney and the overuse of the “hypothetical question as misused by the clumsy and abused by the clever which has often led to the obstruction of truth”.

The following are a few pointers which may become very important in the practice of the typical forensic engineer:

GENERAL

Do not try to be a *know-it-all* or a *jack-of-all-trades*, rather keep yourself within the limits of your area of specialization, otherwise you will lose all credibility.

Keep accurate records and drop in the proper file all leads and hints that led you to your findings and conclusions. They will become handy if the case ever lands in court.

For your sampling and testing always use widely accepted procedures, such as those of ASTM. It does not matter how smart and logical an unorthodox method may sound, they will invariably be torpedoed without mercy by the opposing attorneys.

WITNESS COURT Demeanor

As a sign of respect for the Court, you should dress properly with jacket (gray/black/blue) and matching necktie. Remain at your assigned seat, keep your nerves under control, and above all be calmed and collected.

When called upon, testify with firm and clear voice, articulate your thoughts as well as you can. Don't interrupt your inquisitor, wait until the question is complete before you answer and never be in a rush. During direct and re-direct questioning, keep eye contact with your own attorney, be precise in your answers.

Never hesitate to admit you have had meeting(s) with your (side) attorney, it is an allowable

practice. Opposing attorneys ask that question as a way to intimidate you by giving the impression that such meetings were either illegal or manipulatory.....they are neither. During cross-examination look at the opposing attorney as little as possible, in fact, show a little contempt for him. Rather, keep your eyes on the Jury. If you find yourself under duress or the target of a restless attack, there are certain methods of *derailment* you may and should use. Here are some of the techniques that have worked well for us in the past:

- a. ask for a moment to check your notes (if applicable),
- b. slow down yourself, force a slower pace in the questioning by slowing your own answers,
- c. ask the opposing attorney to either repeat or rephrase the question, that will throw him off, and yet the most devastating trick on the book,
- d. ask the judge for a short recess due to your *unavoidable* need to go to the bathroom.

The psychology behind those techniques is based on the concept that the interrogator needs to maintain a particular and frail pace of questioning, otherwise he will lose his grip on the cadence, as result, he will get confused, frustrated and possibly in a desisting mood.

PAYMENT FOR YOUR TIME

When it comes to payment for your fees you should charge your normal hourly fee for all field investigative work, site visits, preparation of report(s), testing, research, phone calls, meetings and depositions, however, when it comes to court testimony you should double your hourly fee. The reason for that is by you not being the star of the show, you will have to wait for hours on end in the witness room, you will also likely have to spend hours reading reports and depositions as well as rehearsing your part, for which time you will never be paid for.

CAUSES OF FAILURE

In closing this section, something important must be said here with all due emphasis, one of the most common reasons for failure on part of the expert witness is the *lack of preparation*. Therefore, the opposite is also correct, the key to success is preparation, preparation and preparation. In fact you can't ever be too well prepared.

In addition of being unprepared, there are other reasons for failure, or at least for an embarrassing and frustrating event for the expert witness and they are:

- b. not being qualified in the particular specialty at hand,
- c. basing his testimony on the expertise or investigating effort of others,
- d. showing hostility against the members of the opposing team,
- e. producing last minute papers, letters, reports or any other document that his attorney had not previously seen,
- f. having a financial interest on the outcome of the case, and last,
- g. by using mannerisms, sayings of poor taste or clichés in the course of his testimony and/or answers.

6.0 Professional Responsibility

A professional engineer acting as a forensic engineer has an unavoidable ethical and professional responsibility in the discharge of his duties, much the same as in any other area of practice.

When the engineer issues a report regarding his observations, findings and conclusions, he must ascertain of the correctness and accuracy of his statements, otherwise he could be found in violation or negligence in the practice of engineering in his home state. False or untruthful statements in a signed and sealed/stamped report are serious offenses. Therefore, this author urges the practitioner to become familiar and aware of those requirements to avoid disciplinary action on part of his Professional Engineering Board.

7.0 Insurances

The customary client of the forensic engineer is very likely, prior to the release of any work assignment, to request submittal of the proper proof of insurance(s), such as, errors and omissions, public liability, as well as professional responsibility. Therefore, it is an upfront expense that must be considered as part of the routine business operating expenses.

8.0 Case History

As a matter of illustrative example, the following report is presented as a classic case of a claim firstly referred as a *defective product* case that had an unexpected turn of events for the claimant.

This case is of a common occurrence, a person buys a product that comes disassembled in a box and neglects to read and follow the instructions which come with the product. Unfortunately for the Claimant in this case, his failure to read those instructions cost him a great deal of pain, grief and inconvenience and on top of that, he did not get any compensation to pay for his medical costs because the incident was entirely caused by his own neglect and carelessness. Hopefully the Claimant learned his lesson, on the other hand, this author also learned his for after this experience he became more observant about assembly instructions.

It must be acknowledged that the manufacturer is the party who has the most extensive experience in the design, research, testing, development, assembling, packing, transporting and further, is constantly receiving feedback from distributors and retailers about the performance of his product(s). Based on all that accumulated information is that assembly instructions are written and updated, therefore, they should be deemed as the most valuable source of information conveyed to the consumers and it would be very foolish for them not follow those instructions to the letter.

**PRELIMINARY REPORT ON
AN ALLEGED PRODUCT FAILURE**

**Mr. (*Name withheld*)
CLAIMANT**

FOR

**Ms. (*Name Withheld*), Claim Rep.
(*Name Withheld*) INSURANCE COMPANY
3230 West Commercial Boulevard
Fort Lauderdale, Florida 33309**

Claim #LC0552150

PREPARED BY

**RUBEN A. GOMEZ, P.E.
1216 Oakfield Drive
Brandon, Florida 33511**

CASE #7902

DATE OF LOSS: 01/19/93

DATE OF INSPECTION: 07/15/93

DATE OF REPORT: 07/27/93

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*Note from the Author

On a typical report the conclusions are placed at the end of the narrative where they belong, however, in this particular case the Client (an insurance company) particularly requested that the conclusions were shown at the beginning of the report, for whatever reasons they may have had.

I. Assignment (*as directed by the Client*).

I.1 An alleged product failure took place while the Claimant was using an undetermined model of (*Name Withheld*) weight bench, as locally sold and distributed by (*Name Withheld*).

I.2 Determine what caused the weight bench to collapse, whether it was a design flaw, manufacturing defect or poor maintenance of the unit in question.

II. Scope of Services

II.1 Contact the Client and arrange a meeting at the Claimant's attorney office where the subject bench is located.

II.2 Examine product in detail, photograph and document all relevant findings.

II.3 Prepare and submit a standard written report accordingly.

III. Participating Individuals

III.1 Mr. (*Name Withheld*), Esq.
1815 Griffin Road, Dania, Florida 33004

III.2 Mr. (*Name Withheld*), Claimant

III.3 Ms. (*Name Withheld*), Claim Representative
3230 West Commercial Blvd., Ft. Lauderdale, Florida 33309

III.4 Mr. Ruben A. Gomez, P.E.
1216 Oakfield Drive, Brandon, Florida 33511

IV. Conclusions (*as requested by the Client*).

IV.1 In spite of the fact that as of the date of this report no photographs have been produced as promised by the Claimant, however, after examination of all items, facts, statements, options, notes and correspondence, they gave us a clear and conclusive indication so as to the cause of this failure.

IV.2 Collapse of the backrest unit took place due to improper assembly and willful neglect of the accompanying instructions. Failure of the "wafer board" core occurred as result of being subject to a loading beyond its ability to handle it without the design intended steel angle reinforcement.

V. Observations

V.1 A meeting took place at the conference room of the Claimant's attorney office promptly at 10:00 AM on Thursday July 15th with full attendance of all participating individuals as listed herein.

V.2 Instead of the fully assembled unit as expected, only the backrest component was made available for examination. The backrest unit as displayed consisted of a rectangular panel with a "wafer board" core, upholstered with a padded red vinyl cover showing the manufacturer's name printed on the upper end. Two steel angles were fastened to the reverse and lower face of the panel as depicted on Pictures #1 and #2.

V.3 According to the Claimant's own statements, he stood six feet two inches (6'-2") tall, weighed 175 pounds, was 53 years old (DOB 05/14/40), married, correctional officer (sergeant) as occupation. His medical record included a mild case of diabetes.

V.4 The subject weight bench was purchased unassembled in a box by the Claimant from (*Name Withheld*) store at the Cutler Ridge Mall in South Miami, sometime during period of April-May 1992. No purchase receipt or delivery ticket(s) were kept by the Claimant. Bench model, series, type designation or model name were unknown to him.

V.5 Further statements from the Claimant indicated that after the purchase and his completion of the assembly, he used the bench an average of three times a week, then on January 19, 1993 while he was bench pressing a weight of 96 pounds (plus the bar weight), the back rest unit (as seen on the lower figure of Exhibit "C") failed at the fastening line.

V.6 As result of the backrest collapse, the Claimant alleged having sustained serious neck and low back injuries for which he needed extensive medical treatment, hospitalization and rehabilitation.

V.7 When asked if he had used or inserted any screws through the pre-punched holes marked "I" on the enclosed Exhibit "A", he answered on the negative. Then he voluntarily added that "the backrest was directly supported by a cross bar on a somewhat higher location...." He was referring here to a point marked as "point of support" on the lower figure as part of Exhibit "C".

V.8 Despite our request and since the Claimant was reluctant to bring the entire bench for our examination, we settled for a set of color photographs of the assembled product, taken in enough detail to allow us to ascertain as of model, condition and assembly condition. He evasively accepted such request.

V.9 After the meeting was adjourned we went to the store where the product was displayed fully assembled and took pictures as necessary to complete our work. *Those pictures were made part of the original report but are not included herein.*

VI. Recommendations

Spared.

VII. Appendices

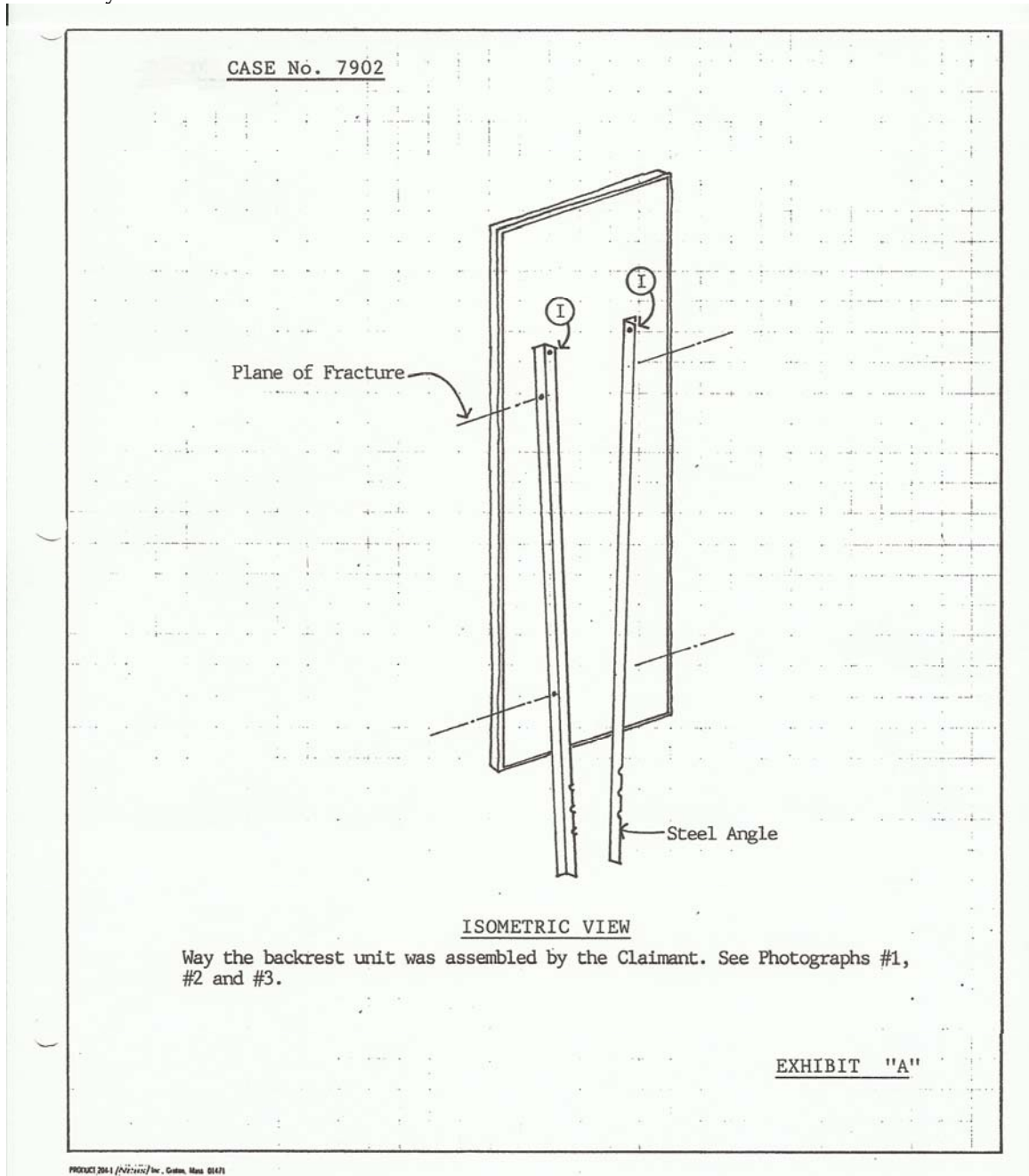
VII.1 This section consists of three (3) exhibits described as follows:

1. Exhibit "A" depicts an isometric view of the backrest which drawing was prepared based on our field notes taken during our examination of such component at the office of the Claimant's attorney.

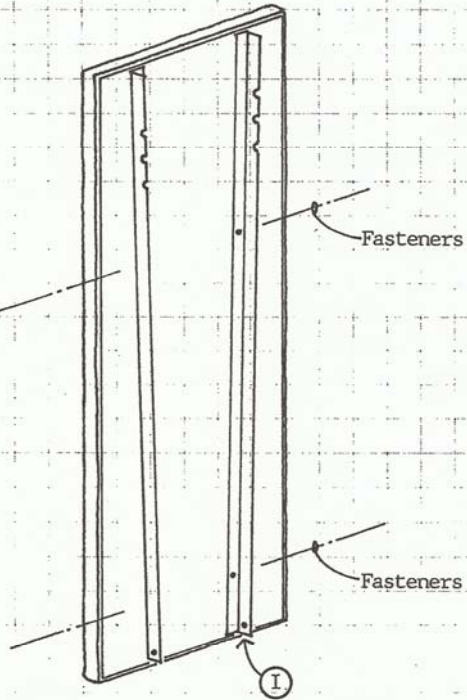
2. Exhibit "B" is also an isometric view of the backrest part now showing the steel angles fastened in place as intended by the manufacturer.

3. Exhibit "C" depicts the right and wrong ways to assemble the backrest unit, and how it was intended to fit as part of the entire weight bench

assembly.



CASE No. 7902

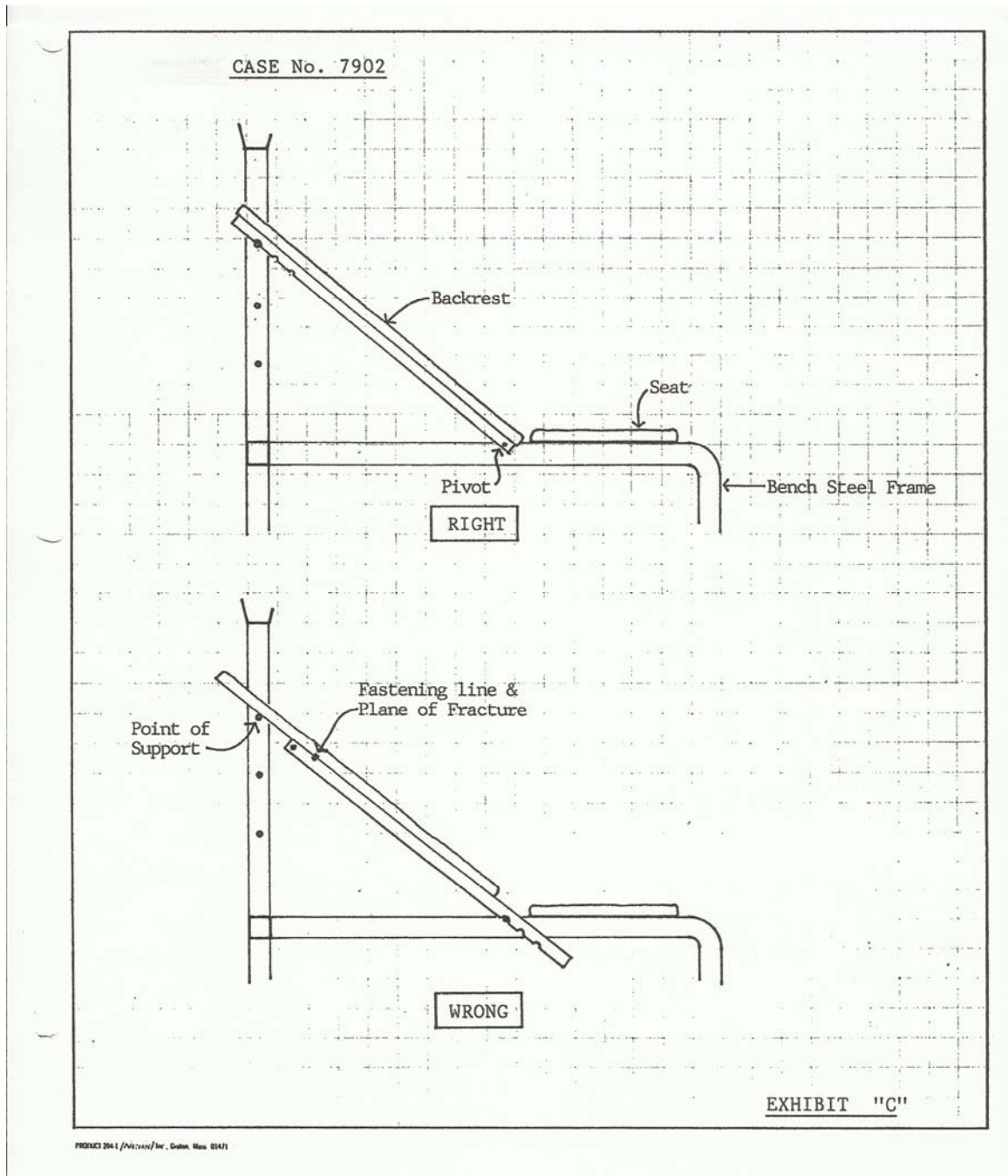


ISOMETRIC VIEW

Way the backrest unit should have been assembled. See Photographs #6, #7 and #8.

EXHIBIT "B"

PROJECT 2041 / PDHonline, Inc., Grafton, Mass. 01421



VIII. Photographs (*omitted*)

August 14, 1993

Case #7902

Insurer:

Insured:

Claimant:

Claim No.: LCO-552150-B2

Nature of Claim: Product Failure

Date of Loss: 01/19/1993

STATEMENT

Further to our preliminary report dated 07/27/1993, and upon receipt of five (5) instant color photographs of the subject weight bench as furnished by the Claimant. The pictures showed the backrest unit installed as part of the assembly as it was used at the time of the alleged collapse.

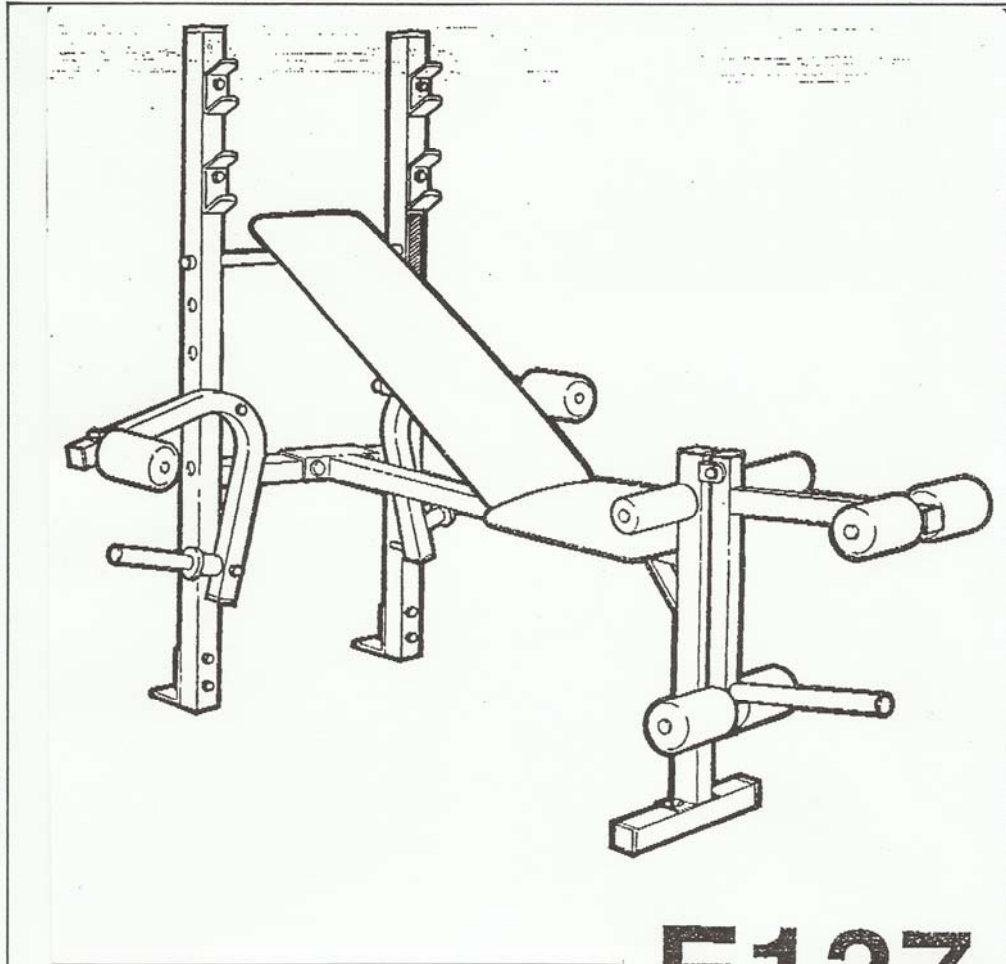
While we were waiting for above pictures, contact was made via telephone and facsimile with the manufacturer. A request was made for the manufacturer to identify the model and to provide us with a copy of the actual assembly instructions as normally furnished as part of the contents in the retail carton.

The manufacturer determined through one of its authorized customer service representatives of the model in question as being designated as **E137**. We were provided with a copy of the assembly instructions (the same that the Claimant should have obtained when he purchased the product). Those instructions show a "Step 2" titled "Backrest Assembly" with a pictorial view of how to properly position and fasten the reinforcing angles to the rear of the backrest unit. Please also see the Exhibit "B" of our report.

This confirms our conclusion as stated on Par. IV.2 which affirms the fact that "Collapse of the backrest unit took place due to improper assembly in willful neglect of the accompanying instructions", conversely, if assembly would have been done as per manufacturer's instructions, such failure would have never occurred.

Ruben A. Gomez, P.E.

Enclosure: Bench Model E137



E137

9.0 CONCLUSION

Shortly after the letter statement dated August 14, 1993 was submitted, the Claimant and his attorney desisted and withdrew the case from further consideration.

10.0 Closing Statement

Cases as the one shown herein were abundant at the time of the described incident, since some 9.5% of the consumer products in the marketplace were defective. Now that percentage is likely to be even higher due to the emergence and proliferation of foreign made consumer products which may have been manufactured with poorer labor and materials, as well as under a lower standard of quality control.

Forensic engineering has a particular niche in the market which has proven to be very effective and necessary. Let us take for example a bridge failure as we have seen quite many in the last 20 years. In such an event the state government may decide to call upon a forensic engineer to decide why or what were the causes of the bridge failure, whether it was a design flaw, a construction defect or an "act of God". Further than that, the state may also want to find out exactly who was responsible for the failure, so to establish the proper and fair liability. At the same time, the insurers may also want to do their own investigation and hire their own forensic engineer. If those two engineers do not agree on their findings and conclusions, then they would have a dispute in their hands which may ultimately land in court for its resolution and disposition.

Scores of buildings collapse every year for different reasons and those findings need to be determined by forensic engineers. As seen on the case history illustrated above, lawyers use those services to decide on product liability cases and other situations where the failure of an engineered product may have caused injury to the user or may have had any other undesirable outcome.

As result of the damage caused by fire, hurricanes, tornadoes, earthquakes and other "acts of God", the involvement of the forensic engineer is necessary to establish origin, causes and responsibilities. Furthermore, the forensic engineer is very useful to the insurers so as to determine a clear separation between the damage sustained as result of the latest incident from all other pre-existing conditions for which the insurer would not be responsible to compensate.

END