# Interview of Load Rating Engineers

**Pittsburgh, PA**

**HWY22MH003**

(41 pages)

UNITED STATES OF AMERICA

NATIONAL TRANSPORTATION SAFETY BOARD

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Investigation of: *
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COLLAPSE OF THE FERN HOLLOW BRIDGE *
IN PITTSBURGH, PENNSYLVANIA * Accident No.: HWY22MH003
ON JANUARY 28, 2022 *
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Interview of: DAVID WORST & PATRICK MINNAUGH (Former Employees)
CDM Smith

Thursday,
September 22, 2022

APPEARANCES:

STEVE PROUTY, Senior Highway Engineer
National Transportation Safety Board

DAN WALSH, Senior Structural Engineer
National Transportation Safety Board

JUSTIN OCEL, Senior Structural Engineer
Federal Highway Administration

JON BUCK, Senior Bridge Engineer
Federal Highway Administration

LUBIN GAO, Civil Engineer
Federal Highway Administration

DEREK SODEN, Principal Structural Engineer
Federal Highway Administration

ERIN MARGOLIUS, Attorney
CDM Smith

# I N D E X

I N T E R V I E W

MS. MARGOLIUS: I see that. I mean, it looks like that function might be turned off for the folks who were just invited.

MR. PROUTY: Yeah, probably is. I've got a little handheld recorder here, so we'll just go with that one.

So today is Thursday, September 22nd. We are interviewing David Worst and Patrick -- is it Minnaugh?

MR. MINNAUGH: Yes, Minnaugh.

MR. PROUTY: And the questions today are related mainly to the load rating calculations that were started at the end of 2013.

My name is Steve Prouty, with the NTSB. Last name is spelled P-r-o-u-t-y.

Dan?

MR. WALSH: Dan Walsh, W-a-l-s-h, senior structural engineer with the NTSB.

MR. PROUTY: Justin?

MR. OCEL: Justin Ocel, O-c-e-l, senior structural engineer with the Federal Highway Administration.

MR. PROUTY: Jon?

MR. BUCK: Jon Buck, B-u-c-k, Federal Highway Administration, Pennsylvania Division office.

MR. PROUTY: Lubin?

MR. GAO: Lubin Gao, G-a-o, with Federal Highway.

MR. PROUTY: And Derek?

MR. SODEN: Derek Soden, S-o-d-e-n, principal structural

engineer, Federal Highway Administration.

MR. PROUTY: And Patrick?

MR. MINNAUGH: Patrick Minnaugh, M-i-n-n-a-u-g-h. I'm a structural engineer, and I was with CDM Smith at the time of 2013 load rating.

MR. PROUTY: And David?

MR. WORST: David Worst, W-o-r-s-t, and I am the engineer of record on the load rating that -- worked for CDM Smith at the time of the rating.

MR. PROUTY: And Erin?

MS. MARGOLIUS: Erin Margolius, M-a-r-g-o-l-i-u-s. I work with CDM Smith in the Office of General Counsel.

MR. PROUTY: Great. Thank you.

INTERVIEW OF DAVID WORST AND PATRICK MINNAUGH

MR. PROUTY: David, can you give us just a general description of your duties and responsibilities back in 2013?

MR. WORST: Back in 2013, I was in the bridge inspection group. We did inspections and load ratings.

MR. PROUTY: And have those responsibilities changed since performing the load rating back in 2013, 2014?

MR. WORST: Yeah. I'm no longer with CDM Smith. I work for another company and I do more highway design now than what I did back then. I don't do the load ratings anymore.

MR. PROUTY: Okay. Can you give us a quick, I guess, educational background and work history, at least up until that

point?

MR. WORST: How far back do you want me to go? Like when I graduated, what I worked on, I mean, up to that point?

MR. PROUTY: Yeah. It doesn't have to be super detailed. Just give us an idea of where you were coming from, what your experience was at that point.

MR. WORST: So after I graduated, I worked at -- in the Ohio group for a while and I was doing a lot of highway design, would do some structures. I got my inspection permit -- or my inspection certifications, and then in 2011, I moved to Pittsburgh, started doing primarily inspections and working on the load ratings.

MR. PROUTY: Okay. Did you ever have a chance to complete the Load and Resistance Factor Rating of Highway Bridges course through NHI?

MR. WORST: NHI? No.

MR. BUCK: And have you completed any PennDOT training regarding load ratings developed by PennDOT or other DOTs?

MR. WORST: There was one that I did for -- while I was in Ohio, but I did not complete any PennDOT training for load ratings.

MR. PROUTY: And how many years of experience would you say you had in performing load ratings I guess back at the point in 2013 when this one was done?

MR. WORST: Three, about 3 years.

MR. PROUTY: Okay. And then, and Patrick --

MR. OCEL: Before you move on, Steve, can I --

MR. PROUTY: Yeah, please.

MR. OCEL: If we just could follow up while it's on here.

So with the question with the educational background/work history, do you remember -- you said the inspection certification. Was that the NHI 2-week inspection course?

MR. WORST: So I had the NHI 2-week course, and then I also took the Pennsylvania like 3- -- almost 3-week inspection course as well, and --

MR. OCEL: And do you remember the approximate year that that was?

MR. WORST: I took the NHI course, I believe, in 2006 and the PennDOT course was in 2011.

MR. OCEL: Okay. Thank you.

MR. PROUTY: Patrick, we're going to go through some of the same questions to get us kind of caught up to this point, and then it'll be kind of, I guess, whoever from that point.

Can you give us a general description of your duties, responsibilities back in 2013?

MR. MINNAUGH: Right. I was a -- I would call myself a bridge designer at that time, mostly working on design projects for PennDOT or the Turnpike for bridge replacements and sometimes a bridge rehab. I was hired in 2007, I believe, right out of grad school. I had been with Wilbur Smith, who then got bought by CDM,

and I was a -- again, in the bridge design group that whole time.

MR. PROUTY: And then, you know, a brief educational background/work history?

MR. MINNAUGH: Yeah. So if you're talking like college, I went -- I graduated from Pitt in 2005 with a bachelors. Got my masters in 2007, masters in structural engineering, and then that's when I started at Wilbur Smith, January 2007. So that covers that part of education.

You were asking about load rating courses. I took a lot of PennDOT -- like they had STLRFD, but that's more a design course, I would say, more than a load-rating course. I'm not certain I ever took a specific load-rating course using BAR7 or -- there's another one. Again, I don't think I took it. I took more -- when I say I was a designer, like that's -- the LRFD stuff is more of the design courses versus -- load ratings are a little different. I understand it's still analyzing the structure, but most of the course I had taken that were sponsored by PennDOT were those more the LRFD programs.

And in terms of timing, I remember they sent me to those right after I was out of school. Like 2007, 2008 would be the rough time I took whatever courses they were.

MR. PROUTY: Okay. Thanks. And then, so about how many years of experience did you have performing load ratings back in 2013?

MR. MINNAUGH: I don't know how to answer in terms of an

exact time because as a designer it would be more like if the inspection group had a load rating need, then it would come to us and we would help out. So I probably did it all the 7 years I was there. I don't know if I would say like I had 7 years of experience doing it, collectively. You know, I'd get one every now and again, kind of thing. So it was more sporadic. I would get them as needed, as the inspection group needed. Or if they couldn't handle it themselves, you know, it would trickle out of the inspection group and go to the structures group type of thing. So you could say I did all 7 years -- so if I were to --

MR. PROUTY: Just in terms of maybe for both of you, just in terms of about how many bridges would you say you load rated prior to the 2013 rating? I mean not exact number, but even order of magnitude.

MR. WORST: I don't know. We've done -- I've done a lot of little ones that were just using the BAR7. There was probably at least 20 or 30. I can't, I can't remember for sure, you know, how many there were.

MR. PROUTY: And Patrick, if you had to come up with a --

MR. MINNAUGH: Yeah, I would say a couple of years. So if 2007 to 2013 is, what, 6, 7 years or so. So I would say somewhere between 10 to 20. The majority of them would be using BAR7. Most of the ratings I had done were using PennDOT's BAR7 program because it's easy, efficient. A lot of times you have an existing analysis that you use as a base and you just add your section

losses to it. So, yeah, I would say 10 to 20-ish probably at that time.

MR. PROUTY: Okay.

MR. SODEN: So David, you mentioned most of them were fairly small bridges before that. I mean, would this -- would you consider the Fern Hollow to be a little bit more of a complex structure than what you were usually doing or you just meant like you used a lot -- you've done a lot smaller ones (indiscernible)?

MR. WORST: Just a lot of smaller ones that were, you know, just simple girders, you know, or like, you know, smaller structures. We've done a couple bigger ones. But this being a K-frame, that's why Patrick got involved.

MR. PROUTY: Did either of you have a chance to go out and conduct a site visit at the Fern Hollow Bridge prior to doing the load rating? Had you been out there and seen the bridge itself?

MR. WORST: Yes. I was actually part of the inspection prior to the load rating.

MR. PROUTY: Okay.

MR. MINNAUGH: When that was done, I was -- like I said, as a bridge designer I'm always in the office and I don't -- there were times I would go out and look at bridges, but usually it wasn't big, complex ones like that, especially at that time in my career. So I did not see it.

MR. PROUTY: And would you say that doing site visits would be common prior to doing load ratings or not?

MR. WORST: The way we did it is, is that one of the people that were out there doing the inspection was involved in the load rating. So that's --

MR. PROUTY: Okay.

MR. WORST: You know, it wasn't just that the inspection group just handed it off and didn't have any involvement with the rating. It was somebody that saw the bridge.

MR. PROUTY: Okay. Good. Thanks.

Do either of you know what method was used to rate the Fern Hollow Bridge -- ASR, LFR, LRFR -- and then how was that method selected?

MR. WORST: Pat, I'm not, as far as --

MR. MINNAUGH: Yeah, I believe it was -- I would call it LFD. We used AASHTO standard specs. I can't tell you why that method was selected at this point. I just don't remember how that was decided. I know part of that was probably because the stringer and floor beam portion was using BAR7, which is LFD. And then CSiBridge was used for the frame since it was more complex; that's too complex for BAR7 to handle. And then we used AASHTO standard spec equations for the load ratings for the frame.

MR. PROUTY: Okay. In rating the Fern Hollow Bridge, did you -- or how did you identify or verify wearing surface thicknesses for the load calculations?

MR. WORST: The first thing was what was in the reports, that there was 3 inches of wearing surface in the bridge file in the

I-forms in the record. And it was the curb kind of matched up to their standard drawing, you know, the record drawings, and there was no covering or anything over the -- you know, there was no -- the deck joints on either side were still exposed. So we had no record of -- that's how we went with it, what was there. The record plans also show the 3 inches.

MR. WALSH: Steve, if I could follow up on that line of questioning?

MR. PROUTY: Yeah.

MR. WALSH: Did either of you know, David and Patrick, the actual wearing surface thickness was double what was assumed in the design of the bridge?

MR. WORST: Double? So it's 6 inches?

MR. WALSH: Yes.

MR. WORST: No, sir.

MR. WALSH: Patrick?

MR. MINNAUGH: No. Did not know.

MR. WALSH: In your mind -- this is a question for both of you -- what would initiate a new load rating for a wearing surface thickness that exceeded those assumed in the design of the bridge?

MR. MINNAUGH: I would say any increase needs a new rating.

MR. WORST: Yeah, that's --

MR. WALSH: Do you think it is your responsibility to determine the actual wearing surface thickness on a bridge?

MR. WORST: You mean like every time you rate it you go out

and core it or something? I mean --

MR. WALSH: Or whatever method that you think is appropriate, do you think it's your responsibility to determine the actual wearing surface thickness?

MR. WORST: We thought we had reason to believe that that was -- we had accurate information. If there was something that would've indicated that it wasn't, I'm sure we would have said something, but --

MR. WALSH: What other methods are there to determine the actual wearing thickness besides coring that you're aware of?

MR. WORST: I don't -- I'm not aware of any.

MR. WALSH: Patrick?

MR. MINNAUGH: I don't, I don't know how to answer that. I don't do a lot of inspections. I guess you could rely on if the deck, if it gets resurfaced, rely on an inspector at that time giving measurements. And then that's something that needs communicated to the appropriate people who are inspecting the bridge later. I don't know how you get those two to connect. But other than measuring as it's resurfaced, I can't think of a good way.

MR. WALSH: Thank you very much.

MR. OCEL: Steve, may I ask -- since Dan started this vein, I think I have one other question.

MR. PROUTY: Yeah. Absolutely, Justin.

MR. OCEL: This is for David, since you were actually an

inspector. I guess I presume you were inspecting in Ohio and Pennsylvania mostly. Is it routine to assess the wearing surface thickness?

MR. WORST: Well, it -- when we would do the inspection, we'd look to see if there was any new wearing surface added to it, and if there was -- or if there was any new wearing surface that was there, then we would document it. I always check the -- like if there's curb reveals and stuff, we always verify the reveal, and if it's -- you know, that's kind of how we used to verify and make sure that someone didn't sneak in additional asphalt on top of it. But you would count on a lot of the records being there so that way you could verify with those dimensions.

MR. OCEL: Thank you.

MR. PROUTY: In rating the bridge, how did you calculate the dead load of the frame?

MR. MINNAUGH: We use CSiBridge, which is SAP. So you build a model and I believe, I believe that self-weight of the steel was -- as you would set up each segment you would define it with section properties and that would give you your self-weight there. I believe in the calculation package I figured out a lot of other tributary dead loads that would get applied to certain members, whether it would be deck -- I think the deck may have already been included in the model, because CSiBridge will model the deck, from my recollection. But anything additional, whether it be stiffeners -- I think I did a dead load for asphalt. I can't

think of what other additional ones were at the time, maybe the railing load or something. Sidewalk, I think we had to add the sidewalk load. So those were input into the -- into SAP as a linear distributed load, and hit "Go" and get your results.

Again, my recollection is just checking it against the contract plans -- or not -- the existing plans for the original bridge. It had, I believe it had moments and reactions and things, and it all seemed to line up close to what was in the original plans. So it was a good indication that the model was working the way I would have expected it to.

So that's the way it was done, was mostly -- for members that you could define and give section, again, areas and things to, areas and densities, it would auto calculate that dead load. And then, and then anything extra we would have to put in the model and make sure it was modeled on each appropriate member.

MR. SODEN: Actually, I think maybe I'd like to take a step back.

So Patrick, you mentioned that you kind of came on because of the additional modeling for the complexity of the frame. Could you, I guess, both speak to what on this -- you know, what your specific role was on the load rating? Was one like the main rater and the checker, or were you kind of working together to kind of come together on a rating? What was your role on this specific rating?

MR. MINNAUGH: My recollection was just that since it was

complex we needed to use something more, more advanced than BAR7. And I had had a little bit of experience using SAP. I use it for building frames. Again, I did mostly bridges, but every now and then you get the oddball project. So I had experience modeling in SAP.

We used the CSiBridge -- I don't know if module is the right word. I don't know how -- what the right phrase is. But CSiBridge, which uses SAP, can model a bridge quickly for you. Now this was unique since it was K-frame. So that standard bridge that you can put in as a quick template needs a lot of manipulation to get the fact that the two K-frames or different girders and the stringers, input the floor beams and all the cross-members, get the columns in, because CSiBridge won't model a column, so put those in; get all the different assumptions for releases at the end of the members. I guess that was my job to do at the time because I'm not sure who else they would've had to do it. I -- just because it was a complex thing. And we didn't have -- when we had to rerate the floor beams and stringers, we had a, again, a previous analysis. I don't believe we had a previous analysis to go by to rate the actual frame, so we had to use that.

That was the program that was decided to use. I'm not sure why it was picked. It was just that's what I was told to use, so that's what I used to model the thing.

MR. OCEL: Well, okay, to follow up on Derek's question. I

mean, who quality controls it then? Is there an independent structural analysis? It's just whatever CSiBridge dumps out must be the truth? I mean, how do you --

MR. MINNAUGH: No. We sent it to some people in -- I remember we sent it to the South Carolina office because they had -- I think they had more experience with K-frames. I remember someone looked at it just to make sure that things were flowing the right way. I know we checked it against the reactions in the stresses that were in the plans from whatever, 1950, 1970, whatever it was. So that was another check on it. I don't know if there's -- I can't recall if there was some back-of-the-envelope check. What you're saying is like verified a different way.

I didn't use any other program, I'll tell you that. I only used SAP and CSiBridge and verified against this.

MR. OCEL: And then I guess part of it, David, since you were then the one that stamped it then, what part of -- to Derek's question, what was your role then? He made -- Patrick made the model, gave you, I guess, loads. Well, I don't know if he gave the rating factors. But where do you come in on this?

MR. WORST: I -- being that I was the one that actually looked at, you know, was out there on the bridge, I made sure that all of the assumptions with the losses and -- you know, were taken into account, and that the hand calculations -- I went through, redid all -- you know, made sure all the hand calculations were

actually correct and that, you know, the assumptions were, that were -- all the assumptions that we knew we were going with were used, like, you know, the -- well, not assumptions, but like all the section loss. This one had those cables connecting them, you know, so I was looking at -- to make sure we had what's out there incorporated into this.

MR. OCEL: And then, whether you, your group, or the company, was there some sort of like in design, like a redline process? Like do you have it looked over before you stamp it by somebody else, have them run independent calcs? I mean, how did -- how was it handled?

MR. WORST: I'm not -- I guess I'm not sure of the question. I checked it, all of the hand calculations before I stamped it, for sure. And anything that was -- all of our internal checks were done prior to stamping. We also provide the information, you know, correspond a little bit with the district, you know, saying here's what we found. And then when we have it all wrapped up, then that's when we, you know, put the final report together, stamp it, and upload it to the bridge file that's stored on BMS2.

MR. OCEL: Let me ask this another way. You said you verified the equations, load rating or capacity equations. Okay. If you did it, did anybody check your work or was it you were the final -- I guess you were the checker in a way then. I guess that's my question is, was there independent verification or any kind of quality control on these load rating calculations to

determine the final load posting and the rating?

MR. WORST: I mean, that was the whole reason for me checking it.

MR. MINNAUGH: Yeah, I did the model and I did the load -- like I took the loads and I plugged them in the equations. I did the rating. I got the rating factors.

MR. OCEL: Okay. So Patrick did all that, and then -- all right. So David was the checker before it was stamped.

MR. MINNAUGH: Yeah. Yeah. I thought you (indiscernible) --

MR. OCEL: Okay. That's what I was trying to get to, is who did the calcs and then who checked it.

MR. MINNAUGH: Yeah. Right, right. I think I was picking up on it, Dave wasn't. I think I --

MR. OCEL: Okay.

MR. MINNAUGH: -- see where you were going, but -- yeah, I did -- I got the model, and from the results from the model, I went through the rating equations and Dave checked all of it.

MR. OCEL: Okay. Thank you.

MR. MINNAUGH: Yep.

MR. OCEL: Derek, did that answer all of your questions?

MR. SODEN: Yes, it did. Thank you.

MR. OCEL: All right.

MR. PROUTY: All right. How did you account for the weight of miscellaneous steel components that weren't part of the steel cross-section?

MR. MINNAUGH: I believe I included it by -- when I looked at the calculation there that's on BMS, I figured out how much pounds per foot there would be and added it to the model as a linear load by going off existing plans. I can't remember if there was some other way I did it. I can't remember if I added an additional, because sometimes -- in SAP there's a -- you can, say, use 1.0 for the load or 1.05, whatever. I just don't remember what I did. I don't have access to the model to know if I did that or not with any other way to do it. I do know that I tried to account for as much as possible a certain way by adding up a linear load to certain elements to account for, like you're saying, the additional steel that's not part of the cross-section.

MR. PROUTY: Okay. In calculating the load effects on the frame, did you find any portion of the frame legs that went into tension?

MR. MINNAUGH: I don't remember. I don't believe so, but I just can't -- I don't recall it. I don't think -- I think there was so -- my recollection, there was so much load on the thing that that didn't happen, but --

MR. OCEL: Do you recall if anybody ever asked if that should be a question?

MR. MINNAUGH: No.

MR. PROUTY: And in rating the frame legs, can you explain how you determined that the effective length factor K should be equal to .75?

MR. MINNAUGH: The -- if I'm recalling correctly, if it's unable to sway, if it's been pinned -- it's right -- in AASHTO LRFD there's a section where it's either .75 or .875, but it has to -- it's not able to sway. I wasn't a big fan of those cables, but those cables were put in to make sure that it didn't sway. So that's why we used .75, from my recollection. I do remember saying we got make sure those cables were -- I didn't want, I didn't want any slack in them. Because that was a point I had at the time. I know that to use the .75, it shouldn't be able to sway.

MR. SODEN: Besides sway, was there any -- what did you consider about the end conditions that led you to the .75?

MR. MINNAUGH: I -- only recollect is that I looked into that section of AASHTO where it said if the -- if I recall -- I don't have it open right now, but something about if it's bolted, you use WAN (ph.) or welded or -- there's certain things to use. And it gave the guidance to use .75 or .875, and we went with .75. I can't remember exactly why we went that way; it's been too long, but --

MR. OCEL: You -- well, you just said LRFD. So let's just verify, is it .75 --

MR. MINNAUGH: LFD.

MR. OCEL: Okay.

MR. MINNAUGH: LFD.

MR. OCEL: So you were working the standard spec?

MR. MINNAUGH: Yeah, the standard -- AASHTO standard specs, yes.

MR. OCEL: All right.

Minnaugh

MR. ~~WORST~~: If I said LR, I apologize.

MR. SODEN: I guess I don't want to go too much in -- would this have been the same case -- do you think you would have arrived at the same -- so, you know, effective length is sort of specification neutral, right, it's in both of them. Do you think you would have arrived at the same effective length factor using LRFD?

MR. MINNAUGH: I don't know how to answer that. I haven't investigated LRFD to know.

MR. SODEN: Okay.

MR. MINNAUGH: So I don't know the answer to that.

MR. PROUTY: So in rating the legs, just to kind of to clarify here, what considerations did you make for the contributions that the cable retrofits had made? Just in the length factor or effective length factor, or was there anything else that you took into account with those?

MR. MINNAUGH: All I took into account was that it was bracing it at the top. And again, I wasn't thrilled with it because a cable is only good in tension. So again, it wasn't my decision to make or whatever, being told that the cables are there and that's that. But all I took them into account for was that it was there to brace the thing because the original ones were

crumbling and falling down. So the cables were there to take their places, was my understanding.

MR. OCEL: If the cables were loose, what do you think the K factor would have been? You would have -- in a load rating scenario that you would have used?

MR. MINNAUGH: Two (indiscernible), because at point it's swaying. I mean, that's the point. Maybe there's some stiffness from the girder, but again, in general, I didn't like them -- I didn't want them loose.

MR. OCEL: Thank you.

MR. PROUTY: In rating the frame legs, how did you -- how did your calculations account for the section loss in the transverse web stiffeners?

MR. MINNAUGH: Say that again.

MR. PROUTY: In rating the frame legs, how did the calculations account for the section loss in the transverse web stiffeners?

MR. MINNAUGH: I don't, I don't remember. I remember doing -- I remember section loss in the web and there was some flange section loss. I don't remember if we accounted for any stiffener loss or not.

MR. GAO: Let me ask a question to this a little bit going off of the previous question about the K factor. You assumed it's a footed bridge, no sway. Is that assumption documented in your calculation and all -- you have passed that method to the

inspector and the others will look at that assumption?

MR. WORST: I think if you're asking how did we document that the cables needed to be tight so it wasn't going to be sway is right at the top right under the assumptions on the load rating, the first page, we had documentation that the cables must be tight or that load rating assumes the tight cables. So that way anytime somebody were to look at that first page of that load rating, they'd see those assumptions.

MR. GAO: Um-hum. So you believe that assumption is documentation on the first page of your calculation; is that right?

MR. WORST: Yeah, in the load rating summary form.

MR. GAO: Um-hum.

MR. WORST: Where, you know, that -- that's probably one of the first things that when somebody's looking at the bridges, that they're going to look at that form to see where -- what controls the rating. You know, it's a PennDOT form that they use so that way it's very consistent between each bridge. And then you can see what, you know, what -- whether it was like shear or moment that's controlling, what member it is, and any special notes that you're -- you know, any comments that are relative to the rating. So that way you're not relying on somebody going through 300 pages of -- or however long it was, 100-and-some pages of analysis to pick up one statement saying that.

MR. GAO: Thanks.

MR. PROUTY: When accounting for the localized section loss in the frame legs by distributing that loss along the length of the leg, what guidance was being followed with that?

MR. MINNAUGH: I'm not sure I understand the -- there was a hole in the leg, if I recall, right? And always the way I had done -- at least the way I was taught, was if there's a hole, you take the original area, subtract out the hole area, divide it by the depth, and that's what you would input in the BAR7 typically as your new thickness.

And I believe I took the shallowest part of the bottom of the girder that was -- because it was a varying depth, so I took the shallowest part to use that as the most section loss and just assumed that section loss was consistent all the way up to a certain point, wherever the documentation said that there were deterioration to. It was like the bottom certain part of the frame leg. Again, that was just -- I don't know if rule of thumb's the right word or just what I was taught, but that's how I would handle that.

I think there was some section losses to the flange, but it was only half the flange, and just put it across the whole flange for the whole length of the deteriorated zone, which I felt to be conservative.

MR. SODEN: At some point would you think that that assumption will no longer be valid? Like how big does the hole have to get before it'd be like BAR7 ain't going to work?

MR. MINNAUGH: Yeah, I don't know how big that hole would need to get. But, right, I agree, if a hole gets a certain size, you can't really use that anymore.

MR. PROUTY: But I guess just to clarify, this wasn't a written guidance somewhere; it's perhaps just a --

MR. MINNAUGH: Yeah, right. I couldn't tell you -- I couldn't point you to -- if there is written guidance, I don't know if I can point to it.

MR. PROUTY: How do your load rating calculations account for the local effects that might arise from the holes in the frame leg webs noted in the inspection report?

MR. MINNAUGH: I don't know that we -- I don't know the answer to that.

MR. PROUTY: How were the rating calculations checked for any methodology errors or anything like that?

MR. MINNAUGH: That'd be back to whenever we had the other office look at it, go over the -- you know, perhaps I -- unless you're asking about the equations themselves that we used for the rating?

MR. PROUTY: I guess was there anyone that checked -- you know, you used a certain set of methods. Was there anyone else that checked to make sure that, you know, the methods that you chose were appropriate?

MR. WORST: So when we did these -- do these load ratings, we work as a team. Two of the members on the team are on the

document -- that's Patrick and I -- but there's other people, you know, senior level bridge engineers that we bounce this stuff off of before going down the road of full analysis. So as far as the overall methodology, there was other people that were involved. So it's not just Patrick and I talking about it. It was the team there. Is that what you're asking? I --

MR. PROUTY: Yeah, I think so, unless anyone has a follow-up on that?

MR. OCEL: Well, sort of related, not the same. Do you know, were these things having to be done under like a firm fixed price? Was there pressure to get them out the door? Were you -- do you feel like you had adequate time to do these? This is specific to the load rating or I guess the construction of the model that was used for the load rating. Or is it PennDOT said once we load rate it, we pay you this set fee?

MR. WORST: I don't remember a set fee being an issue for this particular one. I don't remember time being an issue to make sure we got it out the door at a certain dollar value or anything like that.

MR. OCEL: I guess, Patrick, do you have any -- Patrick, is that your recollection, too?

MR. MINNAUGH: There's always pressure to get it out. You know, you always got someone barking at you. But I don't remember anything specific for this project entirely. I can be certain it was definitely under a budget, that it wasn't -- there was a prior

agreed-to cost ahead of time type of thing.

UNIDENTIFIED SPEAKER: When you recommend a load rating, then, and PennDOT agrees that a load rating is necessary, they'll create a -- I assume they create a task order for you to perform that load rating?

MR. WORST: Correct. And then, you know --

UNIDENTIFIED SPEAKER: And you give them hours and costs associated with that?

MR. WORST: Yes.

UNIDENTIFIED SPEAKER: Okay.

MR. WORST: Most of the time they, you know, when we're -- you know, we haven't had too many issues with them saying, no, you have to do it for a lot less than that. You know, we usually agree on the, on the cost.

MR. PROUTY: And do either of you recall if you were ever contacted to reevaluate your load rating to account for additional section loss in the frame or changes in asphalt thickness or, you know, any other changes to the bridge?

MR. WORST: For this bridge, no. I was never contacted.

MR. MINNAUGH: Neither was I, that I --

MR. WORST: I also wasn't employed by that company anymore. They would have done it internally themselves.

UNIDENTIFIED SPEAKER: So you didn't go on any additional inspections for this bridge after '13?

MR. WORST: No.

UNIDENTIFIED SPEAKER: Okay.

MR. WORST: I don't believe I'm on any of the other inspections. I'd have to look, but -- I've been with this company that I'm with 8 years now. So, yeah, it'd be pretty close to be the last one I had done with them.

MR. PROUTY: Erin, would it be possible to find out if the company had ever been contacted about modifying the -- or, you know, looking at the load rating again after that?

MS. MARGOLIUS: Sure. Yeah.

MR. PROUTY: We don't have any records of that but we just want to make sure, you know, that something wasn't requested at some point.

MS. MARGOLIUS: Okay.

MR. OCEL: Can we -- Steve, I assume that you're done?

MR. PROUTY: I am. I was just going to ask if there's any other questions that anyone has?

MR. OCEL: Going back to the cable retrofits. So this is -- Patrick and David, any idea what they were for? Did you assume what they were for or was there any sort of you could tell what they were for?

MR. WORST: There was correspondence that indicated they were for the fact that the section loss on the cross-members going down the leg were to the point where they didn't feel that they were effective anymore and those cable retrofits were to mitigate their loss, I guess, right way to say it.

MR. OCEL: Okay.

Anything different, Patrick?

MR. MINNAUGH: That's my recollection. Again, I didn't have a lot of say in why they were there or whether they should be there or what, just --

MR. OCEL: All right. And then --

MR. MINNAUGH: -- that's what (indiscernible).

MR. OCEL: I guess back to you, Patrick, because I think you were the one that -- well, calculations, you were the genesis. So is it -- does the load rating assume that -- there were two X braces in the original fabrication going up the height of the leg. One fell off at some point. Did you assume that the original two X braces were gone and all that's there are the cables?

MR. MINNAUGH: I believe so, yes.

MR. OCEL: And that was, I guess, an act of conservatism to make life easier?

MR. MINNAUGH: Right.

MR. OCEL: Okay.

MR. MINNAUGH: Yeah. Right. And my recollection was they were -- the deterioration at the ends of those things was so bad it's like they weren't even there to do anything. Again, this is a long -- 10 years ago, trying to remember. But that's what I remember, was that they were essentially -- assume they weren't there and that the cables are the only thing.

MR. OCEL: I guess prior to this interview, did you have a

chance to see these calculations or are you working strictly from memory here?

MR. MINNAUGH: I was able to see to the calculations a little bit, but I hadn't seen them in -- I probably saw them for the first time when you guys started reaching out.

MR. OCEL: All right.

MR. MINNAUGH: So --

MS. MARGOLIUS: I have a question about the process just so I'm clear. So, Patrick, you built a model using CSi or some particular program. The folks in South Carolina checked the model for, you know, for being appropriate, and also you checked it against what the design -- the original design moments and other things showed. And then from the model, you generate the hand calculations for the two load --

MR. MINNAUGH: Yeah. I believe, I believe I took the resulting forces -- there's dead load forces, live load forces, impact forces and --

MS. MARGOLIUS: From the model?

MR. MINNAUGH: Yes. And then --

MS. MARGOLIUS: Okay.

MR. MINNAUGH: -- capacities, capacities was -- we -- Dave's using the word hand calc; it was more using Excel. But, you know, the idea is we weren't relying on CSiBridge to the rating. So CSiBridge wasn't analyzing it also, that --

MS. MARGOLIUS: Okay.

MR. MINNAUGH: -- all calculations for axial, moment, shear, whatever, were hand calc that were then put into the various rating factor checks.

MS. MARGOLIUS: Okay. That was more for my understanding than anything else, so thank you.

UNIDENTIFIED SPEAKER: And Patrick, with regards to the section loss measurements, did you rely on what was in the report or did you have to get supplemental information about section loss in the legs?

MR. MINNAUGH: I would have relied on whatever -- again, the report plus when Dave coming in and having sketches or whatever to tell me I had to rely on whatever was given.

UNIDENTIFIED SPEAKER: Okay.

MR. SODEN: So David, I'm looking at the calculations and there's one page that refers to a phone conversation with Will Lines? Line? Who is Will, who is Will Lin?

MR. WORST: He was with PennDOT, District 11, at the time. I think he's retired now, but at the time he was the point of contact for our contract with the district.

MR. SODEN: And so in that conversation -- there's a couple notes underneath there. Were both of those notes, about the H-20 truck operating rating and then the posting load, is that -- both of those based on that conversation, the ultimate posting --

MR. WORST: Yeah.

MR. SODEN: -- load that was determined?

MR. WORST: Yeah. That'd be why I put it in the -- in there, just to memorialize the conversation so it wasn't --

MR. SODEN: So ultimately the posting load that was chosen, which was 26 tons, was that purely from the calculations, was it a combination of the calculations and the conversation you had with Will? Do you recall?

MR. WORST: So it would have been purely off of the calculations. I think that conversation was the lane load, the land load of the S, the H-20 versus the -- you know, posting it off the lane loading of the H-20 or posting it off the lane load of HS-20. And because of -- I can't even remember why, but it was deemed that we post it off the HS-20 lane load. Again, that's why I documented it in there, so that way I'd have a chance of knowing why the H-20 lane load wasn't then used.

MR. SODEN: If you were called 8 years later by NTSB you'd --

MR. WORST: Yeah. Well, you never know. I mean, things happen and -- we try to document as much as we could in there for this purpose. Not this particular purpose, but, you know, when somebody asks you 10 years later or so what you did. Not (indiscernible).

MR. GAO: Yeah, I thought of a question. I know it's a long time ago, but do you recall if there was any disagreement between you -- you, your team, about the methodology or assumptions used in the calculation at that time? Typically when we have different engineer working on one project, we may not agree with each other

during the QA/QC process; we typically find something. Now we need to reconsult, note these (indiscernible), right? Do you recall you have anything happen like that on this particular project?

MR. WORST: I can't recall. I'm sure there was discussions about different things and -- but nothing sticks out in my mind saying that, you know, that anybody thought anything was wrong with what we did.

MR. OCEL: I have another question different from Derek and Lubin. I don't think we recorded this earlier. Were either of you or both of you at CDM Smith in -- let's call it mid-2015 to early 2016, or had you departed by that point?

MR. WORST: I was not there by that point.

MR. MINNAUGH: I was there.

MR. OCEL: Oh. Okay. Patrick, then since you were the one that made the fancy model, do you recall a Tim Pintar coming and asking to see results of it? And being used for developing of the fracture control procedures -- or, excuse me, the -- what is it called -- the fatigue and fracture bridge inspection plan?

MR. MINNAUGH: I don't recall. I would have been there at the time. I know Tim. Like Tim was sitting just down the way from me. (Indiscernible) I don't recall. I'm not saying I didn't help him put with it, just I don't remember doing so.

MR. OCEL: Okay.

MR. PROUTY: Any other questions that we have for them?

(No response)

MR. PROUTY: Okay. Then I'm going to stop the recording.

(Whereupon, the interview was concluded.)

CERTIFICATE

This is to certify that the attached proceeding before the

NATIONAL TRANSPORTATION SAFETY BOARD

| | |
|---|---|
| IN THE MATTER OF: | COLLAPSE OF THE FERN HOLLOW BRIDGE IN PITTSBURGH, PENNSYLVANIA ON JANUARY 28, 2022 Interview of David Worst & Patrick Minnaugh |
| ACCIDENT NO.: | HWY22MH003 |
| DATE: | September 22, 2022 |

was held according to the record, and that this is the original, complete, true and accurate transcript which has been transcribed to the best of my skill and ability.

Kay Maurer
Transcriber

## Collins Dennis

**From:** Margolius, Erin [redacted]
**Sent:** Monday, October 24, 2022 8:13 AM
**To:** Collins Dennis
**Subject:** RE: Transcript of Interview - Worst & Minnaugh
**Attachments:** HWY22MH003_Worst & Minnaugh.09-22-22_PLM_Markup.pdf



Hello Dennis;

A couple of minor corrections from Patrick Minnaugh.

Regards,
Erin

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**From:** Collins Dennis [redacted]
**Sent:** Thursday, October 13, 2022 8:14 AM
**To:** Margolius, Erin [redacted]
**Subject:** Transcript of Interview - Worst & Minnaugh

Erin –

Attached is the transcript of the interview with Worst and Minnaugh for review. Again, would a two-week turn-around work?

Thanks,
Dennis

exact time because as a designer it would be more like if the inspection group had a load rating need, then it would come to us and we would help out. So I probably did it all the 7 years I was there. I don't know if I would say like I had 7 years of experience doing it, collectively. You know, I'd get one every now and again, kind of thing. So it was more sporadic. I would get them as needed, as the inspection group needed. Or if they couldn't handle it themselves, you know, it would trickle out of the inspection group and go to the structures group type of thing. So you could say I did all 7 years -- so if I were to --

MR. PROUTY: Just in terms of maybe for both of you, just in terms of about how many bridges would you say you load rated prior to the 2013 rating? I mean not exact number, but even order of magnitude.

MR. WORST: I don't know. We've done -- I've done a lot of little ones that were just using the BAR7. There was probably at least 20 or 30. I can't, I can't remember for sure, you know, how many there were.

MR. PROUTY: And Patrick, if you had to come up with a --

MR. MINNAUGH: Yeah, I would say a couple of years. So if 2007 to 2013 is, what, 6, 7 years or so. So I would say somewhere between 10 to 20. The majority of them would be using BAR7. Most of the ratings I had done were using PennDOT's BAR7 program because it's easy, efficient. A lot of times you have an existing analysis that you use as a base and you just add your section

complex we needed to use something more, more advanced than BAR7. And I had had a little bit of experience using SAP. I use it for building frames. Again, I did mostly bridges, but every now and then you get the oddball project. So I had experience modeling in SAP.

We used the CSiBridge -- I don't know if module is the right word. I don't know how -- what the right phrase is. But CSiBridge, which uses SAP, can model a bridge quickly for you. Now this was unique since it was K-frame. So that standard bridge that you can put in as a quick template needs a lot of manipulation to get the fact that the two K-frames or different girders and the stringers, input the floor beams and all the cross-members, get the columns in, because CSiBridge won't model a column, so put those in; get all the different assumptions for releases at the end of the members. I guess that was my job to do at the time because I'm not sure who else they would've had to do it. I -- just because it was a complex thing. And we didn't have -- when we had to rerate the floor beams and stringers, we had a, again, a previous analysis. I don't believe we had a previous analysis to go by to rate the actual frame, so we had to use that.

That was the program that was decided to use. I'm not sure why it was picked. It was just that's what I was told to use, so that's what I used to model the thing.

MR. OCEL: Well, okay, to follow up on Derek's question. I

## Collins Dennis

**From:** Margolius, Erin [redacted]
**Sent:** Monday, October 24, 2022 10:40 AM
**To:** Collins Dennis
**Subject:** RE: Transcript of Interview - Worst & Minnaugh



Hello Dennis;

Here are comments from David Worst:

> There was one correction that I would like to make. On sheet 22 line 4 that response should be from Mr. Minnaugh. That was not me, as I was not talking at that time. I did not see any other information that needs corrected as it related to me. There were a couple spots that they could not figure out what was being said but for my statements I do not think that it would add anything. And for me to know what was said, I would need to have a copy of the tape to have a shot at figuring it out anyway.

If you would like to send us the recording we could probably decipher the text, if needed.

Regards,
Erin

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**From:** Collins Dennis [redacted]
**Sent:** Thursday, October 13, 2022 8:14 AM
**To:** Margolius, Erin [redacted]
**Subject:** Transcript of Interview - Worst & Minnaugh

Erin –

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Thanks,
Dennis