

Supplemental Material A1. 2011 Interview Summary

1 Researcher: I guess where I would start is does the office use technology?

2 Interviewee: Yes. AutoCAD.

3 R: Is that it?

4 I: We're not using Revit, a couple of different reasons, I don't think its there yet. It's still in its
5 infancy and I look forward to its developing more. I think that it's a great idea, great direction.
6 It's probably better to think of building the way it thinks of it. It's developing a whole model,
7 and then spinning off of that model to do the details. I understand the concept, but I've never,
8 you know,

9 R: the actual practicality of it?

10 I: Never, gotten into the application itself. We also use SketchUp. And we use SketchUp not to
11 do finished renderings. I really believe that the art of drawing is really important, and the
12 softness of it, especially in the initial design concept is really important. I mean if you bring
13 out a computer generated (.) rendering, if you will, it looks cold, it looks final, and quite often
14 we want the ability to just dive into one little area and show a concept and then you can go into
15 lighter on the others and you don't have to finish the whole thing. And with a skilled pencil,
16 you can do that. But,

17 R: With a skilled pencil?

18 I: yes. Well, and quite often, I'm gonna digress here a little bit - I'm asked by students when
19 they come through, sometimes, if they don't ask me I tell them, "what is that we should be
20 doing to better prepare ourselves for practice?" And I always say, draw.

21 R: Yeah.

22 I: Hand draw.

23 R: Yeah.

24 I: Because if you do so, I really firmly believe, you'll understand what you're drawing a lot
25 better. You can take a picture, but if you draw it, you're gonna understand why that texture
26 works really well. Or the balance just is striking. Or, ah, the proportions are wonderful. Or
27 how the details connect. But you're not gonna get that unless you have the ability to dissect it
28 mentally and very few people do.

29 R: I guess, just off of that, and I don't mind if we kind of move around from here to there

30 because everyone has some things that they find important, that just that idea of looking at
31 something and not having that ability, you have to develop that. I've read some research that
32 seems to implies, that a computer model allows to you see things, but

33 I: Well, I think that I would put that in a different context. Ah, I would put it in, and I would
34 agree within this context, that we can model something up in wireframe and we can quickly
35 move it around to find the view that we want. Whereas, in the old method, and I still use the
36 old method, because we know how to mock up a quick perspective using, judging the depth by
37 just sort of playing with it and getting till it feels right. And then projecting it out that out and
38 you get everything in proportion. And that's a quick way to do it. But, I quite often get
39 something set up, I think I know where I want to look at it from, I'll wire, I'll rough sketch it
40 all out, and then I'll look at it and realize that I really want it to move the perspective over.
41 Now, if I have someone who is really (facile) with the 3D program and they can wireframe it
42 out, and I (told) where I thought it was, and I'm in error, we can move it around. And so, you
43 know, one of the younger guys is doing that right now. He's working up a wireframe and I'll
44 manipulate the views, and then I'll overlay it, and do the changes on it, and the combination of
45 those two methods is faster than, ah, one of them by themselves.

46 R: I'd agree with that. I have found it very interesting because I don't' - my background
47 experience in trying to teach ... technology to students is that because they can often look at
48 those things, and understanding that students don't have all of the skills quite yet, and where
49 does technology fit if you're going to teach them basic skills that designers would start with,
50 otherwise they just get tangled in technology and that's really all they want to do, is to play
51 with the thing, and fix it and fix it and fix it, and now you're this close, and when you pull out,
52 everything is, there's not, essentially it's not where it should be because they've not
53 necessarily gone down that pathway. So, I have to look, I often look at that as skeptical, for
54 those reasons.

55 I: And I have other reasons too. I agree with what you've said, but my other reasons are, the
56 majority of the time, the computer operator, computer drafter as you will, is looking at the
57 screen, and its a composition of various colors, lines. They don't vary in width. They don't,
58 when you lose that, you lose the ability to put depth in a two-dimensional drawing. And just
59 the flat screen and coloring, you don't get the feeling of how (.) are really coming together.
60 Whereas, even in 2dimensional quick drawing, if certain lines are heavier than others, you start

61 to feel how this really is pointing up.

62 R: Where's the profile [

63 I: Right.

64 [R: What's the detail, yeah.

65 I: So, in that you're not connecting your mind with the actual building. It's really interesting,
66 I've read several proposals, and I've that I first heard from our other partner, you really don't
67 understand something, unless you've drawn it, from the standpoint - one of our biggest
68 residences, over in[...], had these huge moment frames, and X was standing in a meeting with
69 the structural engineer, and our lead architect on the project, and several other people, and he
70 asked the question, "How many of these moment frames do we have?" We didn't have a full set
71 of documents there, so nobody really knew. He kinda looked around, and we were doing this
72 project totally on CAD, and he said, "you know, if you'd drawn it, you would know." And he
73 was right. But know, they'd plotted it out, replicated it, and there it was.

74 R: Just array that.

75 [I: Yeah.

76 [R: Till the end of the building.

77 I: Now I'm not saying that everything should be drawn completely by hand, I think that

78 [R: I wouldn't think that.

79 [I: there are really strong parts to CAD, especially if you have to change it, or replicate it. If
80 you're doing a high-rise building, and you wanna, just do 22 floors that are virtually the same,
81 it's great.

82 R: Yes, I think that has the level of, what does the technology do for the efficiency.

83 [I: Right.

84 [R: of the office.

85 I: So what we've discovered, is, it's a combination of both. That's sort of been hinting at. And if
86 we know something's gonna take a lot longer we're gonna put in CAD. So, the floor plans, the
87 sections, the elevations, because as they come up through the development of the project,
88 things change. So we're gonna do those in CAD. But the details, that aren't gonna change,
89 we quite possibly, might draw them by hand.

90 R: I like that. With that in mind in terms of the process, um, do you find that most of the early
91 conceptual, they'll start all by hand?

92 I: Yes. Totally.

93 R: And, just out of curiosity, that at least within the office, the preferred method, no one, you're
94 not to start in SketchUp.

95 I: Correct. SketchUp is a wireframe tool for looking at what we can from it. And I have several,
96 the paper B did deals with that too (he indicates the paper that another student has written on
97 sketching)), I really think you lose the connection between ah, your mind and the project, if
98 you slip CAD in between it. He doesn't necessarily agree with me in his paper, because he
99 argued, well, let me step back and say why. It takes a lot of mental capacity to operate CAD.
100 And it takes the left side of the brain.

101 [R: Yes.

102 [I: The right side, is the creative side. So when you switch over to the left side, you're choking
103 down the creative side. You got the left side, going to operate this very complex, ah
104 application, you're not being creative. Ah, so if you design within CAD, I really think you're
105 cutting everything short, of what it could be. Ummm, so we try to keep it by hand.

106 R: I'm only nodding because, well, I, myself, and I'm trying hard not to be biased, I have, I
107 didn't learn on the computer. I took one quarter, one semester of CAD, I think when I went
108 through school, because it was required. Right, it was CAD one, and probably version 9.

109 I: Well, and that was a good thing. R: Yeah, but everything else all of other things, every piece,
110 every project, all done by hand, at the level I could manage it, in school, but none of this, and
111 certainly my first portfolio, it was all done by hand. I made copies, I cut them out, I pasted
112 them on. You know, I did it that way, it was not, move this, move this, try this new layout,
113 okay let's change the color, I used black museum board, cuz I didn't want to use white
114 museum board. I didn't really have any other colors. And I try hard not to be biased, and that
115 something for me, its a different, its changed. It's a different world, but how do we, how do
116 we reconcile that? In a way.

117 [...]

118 I: B kinda touches on that a little bit, when he politely disagreed with me, or brought in a
119 different point, I should say, he didn't disagree. And that was that perhaps, there are people
120 that are so (facile) with CAD, umm, that they can stay on that side of the brain and still be
121 creative. I personally can't see it, haven't seen it, ahh, but that's an interesting thought.

122 R: I would have to imagine, and maybe this is where that kind of thing is headed, is you know, as

123 we develop the connections between the two sides, some things that have to be developed also,
124 like from childhood, so maybe.

125 I: Well, we're also fighting how many thousands of years of evolution, they're trying to do it in
126 what, twenty years?

127 [R: I don't know. I don't have an answer for that, other than that you have those students don't
128 know what an album record, album vinyl, let alone a CD half the time.

129 [I: and we lost the album art.

130 I: if you scan this really closely, there was another objection I had with CAD in general, and that
131 is ummm, it's level of satisfaction for people working on the job. In the old days, if you put
132 together a beautiful set, that represented the project really well and was a great document, you
133 had a lot of art to it. And there was personal satisfaction. If that person was just detailing
134 toilet partitions, you could still make it art on paper. And at the end of the day, you can look
135 back at a nice set of drawings. I don't think that can be achieved with the coldness of a CAD
136 project. And we're all in this for some sort of art aspect.

137 [R: You hope. ((laughter))

138 [I: I hope.

139 R: Yeah. Well I think if you're gonna take the time and put in the effort to become and
140 architect, whatever that means at different levels, at different points in life, or twenty years ago
141 as opposed to now, there's some sense of the aesthetic and the desire to make something, and
142 to make something beautiful. Whether it is a physical object that gets completed, or the set
143 that gets you there. Or the rendering, that, you know. And I think there's some level of
144 satisfaction still, but when I had to do CAD documents, it was always just getting it done that
145 was the satisfaction, not the beauty of the layout necessarily. In that sense, all the bugs are
146 right.

147 I: Well, when I used to do them, when I first started, it's just the way a elevation is put together,
148 and the line weights, and the crispness of the corners, you know. It was a type of art. And
149 everybody that I was working with was the same way.

150 [R: Yeah.

151 [I: They all were striving to put together a really good looking set of drawings. And that care
152 would project to the contractor.

153 [R: Ummhmm, I think so.

154 [I: His level of care, too. If it was a sloppy set, contractor's (gonna say) are my expectations not
155 that high? Because, we haven't projected it? I don't know.

156 R: I'd say yeah. Anytime your work, collaborate, it wears off, every person on the job, typically.

157 [I: Sure. Right.

158 [R: and the client I would suspect.

159 I: The other problem I have with hand drawing versus CAD is CAD can look complete and done,
160 before it is, and hand drawing you can't disguise that.

161 [R: you don't have it if you don't have it.

162 [I: Yeah.

163 [R: I think that was the other part of it, if you don't know how to build it, you can't detail it,
164 because you don't know how to build it.

165 [I: Yeah, you can fake it on the surface, but pretty quickly.

166 I: okay.

167 [R: Okay, past that one. Umm. I think that's really process, technology, incorporation...let's see.
168 Okay, how about this one. This one is interesting. I have a couple of questions, and they vary
169 based on who I'm speaking with, which is umm, do you think technology's important to
170 design. For designing.

171 I: In a way. And I think it enable us to do...(hhhhh) umm, different kinds of design. Umm, the
172 example would be the experience museum. That was not, you could not have done that by
173 hand.

174 [R: Right.

175 [I: The computer was really important. Ummm. I'm not saying I appreciate that particular
176 design, just pointing out, I'm not gonna get into commenting.

177 R: You don't have to. I was just there Monday, experiencing it is always fun.

178 I: Yes. Well there are various aspects that are excellent, especially where the, you know, the
179 tram, goes through it. Those are really nice. Ah. And it also, I think it enables us to um,
180 probably, well, we originally thought it was going to be faster, and it wasn't, totally, not till
181 we went back, and discovered if we partially hand drew some areas, that we could actually get
182 a little more done. But, in the end, I don't think it really has changed. We haven't saved any
183 time or any money in construction documents. But, it has raised the standards.

184 R: Sure.

185 I: The standard of care. As we're judged legally.

186 R: Oh, right.

187 I: Ah, if you get I would be willing to be bet, at some point, we're either there now, or in the
188 future, of a practitioner was hauled off to court, and, accused of not being professional or not
189 putting together an adequate set of construction documents, and they were hand drawn one of
190 the first things that would be said, is, these aren't even done on CAD.

191 R: right, these aren't accurate.

192 R: And that would be easy to sell to a jury, but it's definitely not true. So, anyway, yeah, I think
193 we're given more opportunity to do different things. But, we can argue whether that's good or
194 not. And the example that I used in a lecture three or four years ago was, the introduction of
195 fiberglass into yacht design. Instead of the inability of wood to do certain things, it always
196 dictated a certain shape, and it had to be efficient to go through the eater well. Fiberglass
197 could do just about anything. And then you further add the technology of being able to, ah,
198 counterbalance the boat with ballast tanks, we end up with these ugly blocks ((interview
199 laughs)) that go across the water and they don't have the beauty that the old wood ones used to
200 have.

201 R: and they can't, essentially.

202 [I: no. And, so, is there a parallel there? I don't know.

203 [R: Perhaps, there might be. I think, and you've probably heard that discussion about, you know,
204 these are SketchUp buildings.

205 [I: Yeah.

206 [R: It's forcing, you know, and it also brings up that question, if you only know how to do using
207 technology, does technology start to really influence

208 [I: or driving the design. Yeah.

209 R: I think the only person that can answer that is often the individual who's actually using it.

210 You know. You can't make curves very well in SketchUp, so darned if everything isn't boxy
211 and this and that are pushed and pulled. It's hard to say, in that sense, because that's one of
212 the questions. Does technology actually aid designing, if you use it, when you use it?

213 I: We're very aware and we made the statement multiple times within the firm this is a tool.

214 [R: Yeah.

215 [I: We're not going to let it drive us.

216 [R: No.

217 [I: We're gonna try and use it for what it's best able to do.

218 R: I would have to stay too, though, that what area of concentration and the type of work that the
219 firm does, that makes all the sense in the world. Because you're not doing office buildings, or
220 necessarily trying to create shapes and experiences that (usually) like EMP. I wonder what
221 would happen if we took it turned it, and did this and that, and look at that and you, know, say,
222 let's make that. I read a very interesting article, and I still have trouble with it, because I'm not
223 sure how to approach it. Saying that, parametric design, and using technology to create
224 something interesting, and then using that interesting thing to be the concept and to create the
225 way that architecture, you know, this is really what we should be studying, what are the
226 possibilities, and then wrapping our architecture around that, and using that to create new
227 spaces, is where education should be going. I don't know.

228 I: Our designs always start with the spaces, and what they're supposed to support, and relate to,
229 and then from there, out the rest develops.

230 R: Yeah, I think, the first time I ever went to EMP, I'm assuming you've been inside as well,

231 [I: Yeah.

232 [R: I think that the disconnect between the uses of the space, and the exterior - you look at the
233 exterior and expect it to do something when you walk inside. I'm going to have an amazing
234 sort of experience just walking in and it, none of it, very little of it made sense to me. And I
235 thought where's that - and the sort of inside to outside I had trouble with.

236 I: Yeah. That would have been nice.

237 [R: and I assumed that was something it was going to do, and I think making that assumption
238 was probably what I shouldn't have done. But that's okay. And just experience it for what it
239 is. Which is a structure that houses other things, and don't look at anything else just the things
240 that are inside.

241 I: And it was meant to grab attention, which it does, R: ummhmm, oh boy does it, in every way
242 shape and form, which we know. But, I hadn't been close to it since Monday.

243 [...]

244 I: But the library, when you're inside, and I really believe, and remember when I talked about the
245 way we start with interior spaces and how they relate to each other, and how they work, and
246 they support people that are using them. The library has a really good system of structure,

247 relativity, and the exterior skin is just sort of draped over it, but the main thing is the inside.

248 So from that, when I first saw it, I didn't like it, but when I toured it and understood it's

249 structure, I liked it.

250 R: I had the opportunity to hear the structural engineer speak [...] just listening to that thought
251 process, and how do we work through, how do we make this happen, and preserve that inside
252 feeling.

253 I: Yeah, I went on a tour with, I think was the local architect, and they worked really closely with
254 the main architect, and it was the structure and organization of the spaces, that I was speaking
255 to, and they pointed it out, and went through it very carefully, and it became really apparent to
256 me that that was very well thought out.

257 R: and I think, I don't know, I guess, knowing that it had been well thought out makes me
258 appreciate it significantly more. As opposed to [...]

259 R: I asked about technology, and aiding the design process. Why do you think students should
260 prepare to use technology in design?

261 I: Ah, well, I think it's here to stay. I think it's gonna evolve. Ah, my own personal experience
262 was, I went to XXX in the early seventies, and our university was on the forefront of
263 computers. That's where XXX went to school, and he was probably laying under one of the
264 punch card desks when I was up there in the middle of the night trying to, trying to get my
265 project through, and he was trying to grab an hour's worth of sleep, but anyway those guys
266 were always up there. Ahh, and I, kinda had an inkling that computers were going to be an
267 everyday thing.

268 [R: Yeah.

269 [I: So I took a real pertinent, beginning level computer class. What it did, it just gave me the
270 aptitude to better understand this when it became on everybody's desk. Ahh, so I had leg up, for
271 my age. And not everybody had that. So I think students these days, even though, you know,
272 the CAD that we see now, compared to what we're gonna see in twenty years, is going to be
273 looked at as archaic. Ahhh, and because it is awkward and is difficult, but you still have to get
274 into it and understand it so that you can you can better use the next generation. So, it's a tool,
275 we need to know how to use the tool.

276 R: I agree. Definitely. And it came about because we were going to use these tools and it
277 became more efficient, in many ways, I think. I don't know if the efficiency, where it fits into
278 the process, if it is exactly where everybody thought it would go.

279 I: Well, I think it depends on the firm and its practice. Again, we can go back to the forty story
280 office building, and you've gotta have it, or you're not gonna be in competition with other
281 firms. Our office, well, you can argue you can just do without it.

282 R: And that actually leads me to the question, that is ah, I ask this because I like to hear the
283 different answers to it. How would you approach design without technology?

284 I: But we do approach design without technology. Cause we're not using till we're, with the
285 exception of the wireframes in the 3D programs, we're not using it till we get to construction
286 documents. But, that said, there's still a lot or design refinement once you put it into the box.

287 [R: Of course.

288 [I: So, how would we do it without it? Well, we used to do it without it. Ahh and I don't think
289 our design philosophies have changed in the last thirty years, but I it's not because of the
290 computer. It's because of, just the evolution of our practice. We've tried to become much
291 more modern and a little less sticky northwest contemporary.

292 R: I don't think that's bad. I, actually, that's one question I've been trying to ask consistently
293 because, for you I don't think I would have had to ask it, because I would have guessed that
294 was the answer. But I do know, that I've asked it and had people smile, because they know
295 there are some people that would not be able to answer that.

296 [I: ummhhmmm.

297 [R: And in straight forward a manner as you can. Well of course, I do this, this, and this, and if I
298 didn't have a computer, I'd just start drawing, by hand.

299 I: Yeah, but, I have to put the caveat in there, we, most employees nowadays, have more training
300 in cad than they do in hand drafting. Ahh, and that's exhibited just by the quality of simple
301 things like lettering. You know, you did not get out of architecture school in the seventies
302 unless you knew how to letter perfectly.

303 [R: You pretty much wrote books.

304 [I: Yeah

305 [R: practicing

306 [I: Yeah!

307 I: Not so much nowadays.

308 [R: Yeah, and I think some of the difficulty certainly, to go to any school that has design in
309 general, there are rarely drafting boards and everything has been replaced with a computer or a
310 space for your laptop and a place it, and it I don't want to say it's heartbreaking, but it in a way
311 it kind of is.

312 I: Well, when I went over to XXX and that computer thing first started hitting and XXX donated
313 a whole bunch of money in the architecture department went all over to CAD and computers.

314 And drafting desks were gone. But, they're back now. [

315 [R: That's nice to hear.

316 [I: They have both. They've evolved also.

317 R: I don't think I'm going to find any answer, you know, truly that is we need to do it like this.

318 I: Well, it will be interesting when you go into a lot of offices, I don't tour a lot of offices, we're
319 so busy right here, we don't get out all that much, are there offices that don't have drafting
320 boards?

321 [R: Umm hmm.

322 [I: Yeah, I'm sure there is.

323 [R: And that's why I'm asking all different kinds of firms that do all kinds of different things,
324 because maybe that's the consistency really, is that certain types of practice just need, if that's
325 just what you would like to do, as a beginning architect, that these are the kind so skills that
326 you should be developing and maybe that means education has to start thinking about, what
327 kinds of - you end up on some kind of track that allows you to develop the kinds of skills that
328 your particular interest is going to value more. Because it is a shame for someone who
329 believes that they want to go into one, to not have enough to get into that without actually
330 having to work first a fair amount. But I don't know, I don't have an answer for that. I'm
331 really curious, though, and I've been talking to people who have said, you don't want to talk to
332 me, I have a lot of opinions. And, my answer is I actually want hear those opinions, because,
333 id rather in my point of view. My advisor calls is the XXX hypothesis. You know,
334 something's missing. Something's definitely missing, and what's missing. I'm trying to
335 figure out, can we actually pinpoint what's missing, or is it something that, we don't, there's
336 no way to tell. Not that the graduates, aren't smart, they're bright, they're well trained, they're
337 this, they're that, but there's something that's not quite the same.

338 I: Yeah. R: I don't know what it is.

339 I: I think learning how to sketch, is what's missing.

340 [R: Probably.

341 [I: But, you know, technology is a great tool, and the kids know how to use it.

342 [R: Do you think it's that's its stated to force them to see differently too, though?

343 I: Yeah, I don't think they see as well.

344 [R: Do you think they see, long and skinny now?

345 [I: Remember when we first started talking, unless you draw it, you don't really understand it.

346 Ahh, you're not understanding it when you draw it in the box. Ahhh, you're manipulating

347 colored lines. And also going back to when kids come though and tour the office, well talk

348 about sketching. I really try to encourage them, don't take a picture, sit there and sketch it.

349 Ummm, when I was a freshman, there was, oh I don't know, 900 to 1200 kids trying to get in

350 to a 65-person program. And the way they took care of that in early studios is, is just handed

351 out an unbelievable amount of sketching requirements in the first week, three quarters of the

352 people would drop, and the rest of us would benefit because we learned to sketch.

353 R: I know I run into students that say, I can't sketch that well. It's because you're not sketching,

354 enough.

355 [I: Right!

356 [R: People who sketch beautifully, do it while they're standing in line at [the coffee shop], do it

357 when they're in a meeting. Essentially, if you were to aggregate the hours that they spent

358 sketching, there's a reason.

359 I: It's like anything, it's practice. Some people are better than others, they just start quicker.

360 But in the end, if you put in the hours, there isn't gonna be that much difference.

361 R: It's a skill. And, like you said, you have to practice it, cause you will lose it.

362 [I: yeah.

363 [R: I have told my students, that I got to a place in my career where it wasn't really necessary,

364 and you stop doing it because you're churning out whatever needs to be done, and you go an

365 try to sketch something, you find that it's not, this isn't easy anymore. That didn't' come out

366 right, and I'm hoping to add that into this, its' the physical skill of doing that, it's a learned

367 muscle skill, to be able to draw a straight line

368 [I: muscle memory.

369 [R: That's why you do it, so you understand, this is how it should feel when you're doing it
370 properly.

371 [I: Right.

372 [R: You know, when you learn to play the piano, it's the same thing, anything almost, but right
373 now this is the muscle memory, right here, and whit this thing.

374 R: Ummm. I don't want to keep you for too long. How about, do you use technology, in this
375 case it would be AutoCAD or SketchUp, which is what you currently use in this office,
376 collaboratively? In the office, outside with consultants, does it serve a purpose in that sense,
377 do you have to use it because other people want to be able to use it also?

378 I: Well, our consultants really appreciate a background, if they're going to be doing the
379 documents. Yeah, that serves a purpose. But, and this is maybe a different subject, but it
380 lends itself to the same concept, we, we're reticent, to let, let's say a structural engineer, draw
381 our structure. You can check a drawing till you're blue in the face, you might miss something.
382 But if you've drawn it, you're gonna get it. So, what we, our structural engineer went to
383 school two years behind me in architecture, got out of school, and things were really
384 depressed, he went to work for structural engineer, and where we went to school, we took
385 structures from the engineering department. We're only a few credits short of getting an
386 engineering degree ourselves. But, he's really good, and he sketches everything out by hand,
387 gives it to us, we draw it up in construction documents, and he checks it. That way, we can
388 make sure it is coordinated with the architecture. Whereas, in a more traditional method, you
389 may miss how a beam or purlin interacts with the spaces that we're trying to create. So, most
390 of the time we do it that way. Sometimes it gets really tricky, and we have them draw it up,
391 then we have to take the extra time to make sure the integration is working perfectly.

392 R: I think that at all levels, but not every office will see the time as valuable, you 're responsible
393 for yours, we're responsible for ours, let's figure it out on site if it becomes an issue.

394 I: Well, you know it's tough, because sometimes the building department wants their stamp on
395 the structural, where legally our stamp is supposed to suffice. Typically, we're able to get by
396 with the engineer stamping his calculations and we're able to submit them.

397 R: Good. Umm, that sort of collaborative thing, I know certain places, you are probably not
398 experiencing this, do you run into the issue of we took your thing, and we did this to it, how
399 does this mesh together. Our insurance companies and lawyers when this first started

400 happening we saying, don't share electronic files, they become corrupted, you can't lock them
401 all that successfully, and so you don't know who's manipulated what, and when you get it
402 back, something might be changed. But some people insist that you do it. So we have this
403 little legal statement that paste on it when we send our electronic files, that say they're
404 responsible and we're not. It's kind of sad, but in the end, I guess it does save time. To have
405 the backgrounds. In the old days, what I would do is burn a sepia, and I would draw over the
406 top of the background. If you changed a sepia, you could really see it. [...] So our preference
407 is to send them a pdf and let them go from there, but they always want the blocks.

408 [R: Well, yeah, essentially they're gonna have to put in the time, and redraw it, and they don't
409 know if it's correct.

410 [I: Right.

411 R: I'll make this essentially the last question because it's something else that I wanted to ask,
412 mostly because in general I've started to see a change, Does the level of technological ability
413 for any individual, actually determine what roles they can play in terms of the design process.

414 I: No. I think it's design ability that is that. Our associate is a very talented artist. Ahhh, he
415 draws really well, is an accomplished sculptor. And he is the best person here, and its because
416 he has that ability, and it's not, you don't know Revit, you can't take these roles. A few of the
417 younger people have played with Revit, but everybody that is here is here because they are
418 interested in the art of design. And they know about us and they want to be involved, and
419 that's why they come here.

420 R: The assumption for me would be, because of the way that you approach the design process as
421 the office, umm, you wouldn't put someone in the position of, well here's this, draw this, not
422 just draw, but put this into CAD, they'd also have to have the design ability, before they did
423 just that. Not just drafters.

424 I: Because if they understand it, and understand what we're trying to do, and they understand the
425 philosophy, it's going to become enhanced, when they're working with us.

Supplemental Material A2. 2222 Interview Transcript

1 R: Essentially, today, just talking with you, I really just want to get your feedback. I have three
2 or four questions

3 [I: okay. I

4 [R: if we get stuck, [I have] some more I can ask you. But umm, yeah, just based on that
5 premise, that's really all, I'm trying to find out where, where everything is going, where you
6 think it might be going, how we could possibly better educate. So, knowing that you've seen
7 the history, or seen different levels, is helpful.

8 I: Well, umm, you know, just basic to start with, you know that anybody coming out of school
9 today better know how to operate a computer. Now, you know if you'd ask people...go way
10 back fifteen - no - computers started in the industry, heavy, in the early, not heavy, but in the
11 early eighties is probably when you first had computer to do something. And then it was, ahh,
12 again when we bought, I bought a system, in nineteen, let me think for a minute, 1984. Yeah, I
13 was at XXXX. And we were faced with, and, and, there was no CAD. Everyone was doing
14 things by hand. And, nobody was trained in computers. And so, what we did, was, you know, I
15 got this crazy-ass idea that, you know, we ought to go in, this was out there, you know, and the
16 firm was interested. So, we went and looked at a system, ended up buying a system. It cost us
17 \$450,000. For basically, four stations

18 [R: My goodness.

19 [I: And, ah, we bought a flatbed plotter, or, a flatbed digitizer and a plotter.

20 [R: With a pen I'm assuming.

21 [I: With a pen plot, oh yes. And ah, um, we, we bough this to use...everyone said, don't do
22 anything hard, don't do anything big, don't do anything that has a fast schedule, okay, all those
23 warnings. I said, well, that doesn't work, it doesn't put anybody where it has to solve the
24 problem. ((R: laughs)) So we bought this to do an eight hundred thousand square foot
25 office...that has a tight schedule.

26 R: nothing like a good challenge to start with.

27 I: And, to this day, I don't really know how we ever did it. But, it basically, and talk about the
28 education opportunities, with when you're in the middle of a crisis, you solve things better,
29 than if you have too much time.

30 [R: You'll fill the time otherwise.

31 [I: And, what we did, initially was take an entire team, in shifts, during a review period. We had
32 started the project during a review period. We were at basic, you know, schematic design,
33 where you know, it was a navy project, and it went from forty, sixty, and hundred percent
34 design, it was different. We were at basically, conceptual schematic level by hand. We had a
35 month review, and at the end of that review, we took the entire document set, and put it in the
36 computer. It ahhh, didn't fit.

37 R: Not enough memory.

38 I: Well you gotta realize what we bought was, think about the date, technology, we bought a
39 system that was, each station, stand alone station, had a disk drive that would hold forty
40 megabytes.

41 [R: I learned to use a commodore 64 was the first time I ever used a computer - in high school

42 [I: Yes, yes. It was in that age. So, basically, we went, we probably ended putting, close to half
43 of the document, mainly floor plans, ceiling plans,
44 that kind of stuff, on the computer. But then you have the problem of the output. The pen
45 plotters, for every three plots you did, you had one you had to throw away. 'Cause the pens
46 would clog. We ended up...running that project as a three shift project. We had people
47 working twenty-four hours a day.

48 [R: Swing and graveyard.

49 [I: Yeah. Because we could not, we didn't have enough machines to do all the input. And when
50 we went to plot, there was no way we could plot it all...in a timely manner. That was...the
51 first wave. Then, as that evolved, umm, you know, you started buying the desktop units. And
52 these were big, these units were big. It was amazing. We started, and they were all black and
53 white - or green and black. Green and black, except we had one color one, it was awful, but, it
54 was supposedly colored. And we evolved through, that. It was, ahh, a system that was not
55 very well used throughout the country, and at some point in time, we decided we should
56 switch our operation to AutoCAD, because AutoCAD had the largest...you know, it was
57 getting, his was probably ten, twelve years later.

58 R: It was gaining ground fastest, certainly.

59 I: The other thing that happened there that I think was significant in the evolution of
60 technology...is we had, um, every, every, you got to the point, this was in the early nineties,

61 about ten, twelve years later, where we started having computers on everybody's desk, you
62 had AutoCAD on them, and you had, you started to build infrastructure of people that took
63 care of these things for you. And there was absolutely very, there was very little knowledge of
64 the individual architects of this machine, they learned how to do this, that, and the other thing
65 on it, but they didn't know how the machine worked. They didn't know how it was hooked
66 up, they didn't know anything about it. And so, in the firm you kept adding (fat) to help people
67 deal with these machines. And then it got bureaucratic, and if you wanted you actually had to
68 go through the system. And you stymied the creativity of what you could do with, you know,
69 technology. You basically, you can do it if you can, you know, get it budgeted for next year.
70 And so, what you had was this cycle that was, you know, somebody wanted to go try, you
71 know, there was things coming out, you know, umm, you know, modeling things, there
72 weren't quite that, but there were softwares, you now that were coming out that people wanted
73 to try because it sounded interesting. But you couldn't go buy it because it wasn't it wasn't it
74 the budget.

75 [R: Right.

76 [I: You know, and so. Ahhh, I got really irritated, and went to the system, I was a principal, and
77 so the system was kinda like ourselves, and said, umm, we, we were in studios, we're gonna
78 unplug.

79 [R: Wow.

80 [I: And, and ah what unplugged meant was, we don't want any of your computers firm. We're
81 gonna buy all new computers, and we're going to charge, you know, everything was charged,
82 job charged. It would cost them, I forget the numbers but it was probably five bucks per billed
83 hour that we were paying for computers. And it seemed really high. And so, although when we
84 did the first job we were charging thirty five dollars per hour, we almost paid for the 400,000
85 dollars in the job, and we made a good profit. All this has a good story. But other big move
86 was to unplug. What we did, and this was all a part of how do people learn how to use the
87 machine. You buy a computer, you go to the computer store, something goes screwy, you
88 gotta figure out how to fix it. And you start to learn how these things work. We had people that
89 didn't know sh[...] about how they worked. So, what we did, we took all the old computers,
90 gave them back. I mean this is virtually what we did. I remember it so vividly, then we had, I
91 mean we were twenty-eight people maybe, we bought twenty eight new boxes. And we had

92 them all delivered, and the first thing everybody had to do was go down to the semi that pulled
93 up at the door, and take their computer and take it to their desk. And then they had to hook it
94 up. Nobody was gonna do it for them. And the camaraderie between someone who knew a
95 little bit, somebody that could everybody to learn, how to hook it up

96 [R: Right, exactly, that community doing it together.

97 [I: the community do it together. Loading the software. And then we had a couple of guys who
98 were really interested that put the network together.

99 [R: That's wonderful, now the knowledge belongs to these people.

100 [I: the knowledge belongs to the people. Then what we caused to happen is we had to have some
101 wire that went between us and the system, we developed it. But we, then monitored the cost,
102 we got what was bought, and if somebody wanted software, they'd just come over to my desk
103 and I'd like to try this, and I' said, okay. You know, and we spent three hundred dollars, and
104 five hundred dollars, a thousand dollars, whatever it was, we'd try it, sometimes it worked.
105 You know, people invented something new with it, sometimes it failed, and you wasted a
106 thousand dollars.

107 [R: at least you know. ((laughter))

108 [I: But we didn't waste, you know, five thousand dollars in time talking about it. You know, and
109 that's what's so ridiculous, so I'm taking you, I'll get you to today

110 [R: no that's wonderful because it's a different thought process from other offices that don't
111 work that way.

112 I: You know, the problem is...umm, the nature of what we're doing is changing. I still found,
113 you know, people (grousing) about, well, my computer went bad, well, fix it. You know, ah,
114 and they, and fixing it was taking it apart, and it took their time. Somebody didn't, just come
115 to help them. And you know, it never goes away. You got some people it's no problem, they
116 just take care of it, there are other people that, you know, oh sh[..], but you eventually develop
117 a higher level of knowledge across the people working on these machines than you had before.
118 Are you gonna have everybody that's a computer expert? No. You know. But you're gonna
119 have everybody with a little higher knowledge, and that was the goal. Ummm, today here, we
120 have an IT department in our [portion] that takes care of everything, and its somewhat back to
121 the same kinda, you know, we just had a real problem with our network, we're all connected to
122 Portland, and there was all this grousing about, can't they do what their job is, and why don't

123 you fix it? And the problem is we're in a technology where, absolutely, you're not gonna learn
124 everything there is about running a computer system. But you better know enough to ask the
125 questions of what I need to do. So, today's knowledge, it's not just the software. It's the
126 software and the hardware. I don't think any education system teaches anything about the
127 hardware.

128 R: No. Probably not.

129 I: Now, where is this going? You know, I, ah, I have believed that ever since computers first
130 came out, that it's only going to go to where you're actually are driving all of the, umm,
131 industries that build things, you know, that you're not going to be doing a set of drawings that
132 somebody takes the quantities off of and goes to that. You're going to, and you're going to
133 have extreme flexibility as to what you can do in the construction industry. You don't have to
134 stick to standard sizes, you won't have to stick to standard shapes. Ummm, if you can draw it,
135 you can probably find somebody that can manufacture it. And, you know, with tools, like, you
136 know, like Revit, that's probably the one that's used the most, it keeps track of quantities.
137 Umm, it creates a 3d model that you, with the proper interface to machining, if you put a
138 window in a certain size you can probably have someone deliver it, and it'll cut the schedule
139 time down. The ability to visualize and walk through, umm, is here today, it will be quicker
140 and easier. We're building the model in the computer today, we're not drawing much of
141 anything. But there's still people that will visualize things with hands. And, with everything I
142 said, everything I've been, then I'll let you ask some questions, the quickest computer is your
143 brain to your hand. And so, you know, not your brain to a keyboard or a mouse, but your brain
144 to your hand and a piece of paper. You're not, well I'll never say not, because, you may have
145 technology that puts your brain to that may allow you to, and that may come, I don't discount
146 that. Ahhh, but, you're still able to be, the art of creating an idea, the quickest way is a pen to
147 piece of paper. But today, there isn't a firm that is going to bring in somebody new, that they
148 say well, I only do pen to paper, no I don't know AutoCAD, or I don't know Revit, SketchUp,
149 what's rhino. What we're looking for What we're looking for people that have done all that,
150 have you ever played with x,y,z every who interviews here they do something a little bit
151 different. And that's the kind of person you want, who can push the limit, who can match
152 different softwares to create images. But clients today, are looking for, they just don't want a

153 nice idea, they want to see it, they want to walk through it, they want to fly through it, and they
154 want it tomorrow. They don't want it - oh, well, we could.

155 [R: six months from now.

156 [I: Six months from now, and education of people to do that is extremely important. So, now, I'll
157 shut up.

158 R: No, it's quite delightful to listen to the, the history of it. The background, essentially, and I'
159 m in the design computing side, the theoretical side of things at the XXX, and for me, sort of
160 looking at it, I've had in my past the opportunity to teach technology to beginning designers.
161 And that thought process of what's the best way to do that. You know, we use technology in
162 practice, very differently, I believe, than what we actually teach our students. Because of
163 course they don't know anything, and as the years continue, they know more and more about
164 using a computer and they already have a predetermined thought of how they should be using
165 a computer. But then, depending on the program, umm, they'll come in, and they'll either
166 learn, and this is where education is sort of maybe struggling with the thought, do you just slot
167 technology into the studio and show them how it would be used, like it is in an actual office, or
168 do you teach them that separately from what they're learning as the foundation of leaning how
169 to do design. Structures. There are people who argue that we should learn to do it by hand first,
170 rather than with a calculator or computer. Count these up, add these in, and then show them
171 the process that you just put these things in, so you know how you got there. So, it's, and that's
172 the struggle, as I was saying earlier, you have only so much time, to be able to try to prepare
173 every student, okay, here you go, out you go, to give them what an office thinks that they're
174 going to need from them. So, that's where I'm at, is trying to say, is the way that we learn,
175 you mentioning how you learned together, and with other people, and your level of knowledge
176 increases because everyone in the room is doing something. And back when, and back when
177 the studio consisted of a lot of people, and you have lots it trace, and drafting boards, and
178 pieces of things getting piled all over, someone else could come along and say, wait! This is
179 one's a really good idea, or you could go back, and now, if they're learning, and it's all in the
180 computer, and we can't see the evolution of they got there, it's a different thought process.

181 I: You just hit something there.

182 R: Okay.

183 I: Make sure I show you before your leave, the way our office is designed. Our offices are, you
184 probably saw the open space. Well, on the other side, of the gallery, are a series of cubicles,
185 that are like little conference rooms open to the studio. But that's where we assign a project
186 and we put everything up, because the computer does not allow other people to see things. We
187 have crits in those spaces, we bring, and it stays up. The problem, in an office space if this is a
188 room, where if somebody comes in to meet with you, you put stuff up, for that meeting. In
189 those, the stuff is always up, so that people within the studio can see what other projects are
190 doing. Because we used to have stuff laying around

191 [R: All the time.

192 [I: on the desks, that was interesting things that showed you what people were thinking. Now you
193 don't. And yet, so when we did the office, we searched for a way to do that. It takes more
194 space. It takes a lot more space, actually, but it, it does solve that problem somewhat. That
195 paired with opened plan, you know, open plan is all about, everyone has a collaborate effort as
196 opposed to the old architectural office, where partners. The engineering world still does that.
197 If you find an one of those offices, stay away from it. They all work. Anything can work. It's
198 just, umm, you know.

199 R: you want to be able to, I think, facilitate, continuing.

200 I: Now back to your question. Ahhh, which I think, I'll try to repeat it if I can, is the education
201 one of having people understand. There are several ways you can educate. Understand by
202 doing everything the old fashioned way, so they understand, you know, everything I know
203 from having done the same thing, or do you start them somewhere in between, and just, you
204 know, they don't need to know because it calculates it for you. You don't need to know that
205 one and one equals two. You go to your calculator, put in one plus one and it comes out with
206 two. You don't need to know that six hundred and forty eight times three thousand and sixty
207 two equals, you don't need to be able to do the hand math to get there. You have a calculator.
208 I don't think today, you need to know how to do the hand math. You know when I was in
209 school, I learned all the things the old fashioned way. I don't use any of that anymore, I still
210 could do it. So now you were talking about how you envision a building. You know, the old
211 fashioned way is you know, by hand, drawing, you still have a large proportion of people that
212 came, anyone that graduated from college before 1980, ahh, you know, isn't there yet. A lot
213 of them never will get there.

214 [R: and that's okay.

215 [I: And that's okay. That's not the future.

216 [R: Right.

217 [I: The future is, ahh, people who grew up, using a computer. And so, I believe, and you can, you
218 probably at the U have, it would be interesting to take a survey of the educators there of how
219 many graduated from college, I'm picking 1980 because I know that's when it started, and
220 how many graduated after 1980. And ahh, you know, I would guess there are more that were
221 before 1980. That's the problem. Just wait, it'll take care, but, is that gonna help, you know, I
222 shouldn't give you a bias. I don't think university education gives you very much of what you
223 need to do and know out in the real world. It never can. You know I've told students, I've told
224 people for years, don't let your classes interfere with your education. Because, college is about
225 learning to live in society, and to think, and to learn, but I also believe you want people to
226 come out of school with skills that they can, you know, put them in a place where they can be
227 productive. We never hire anybody and put them in a [desk] and say just spend your time
228 thinking. ((Interviewer laughs.)) But, back to the 1980's, I have a daughter, she was born in
229 83, you gotta understand, she grew up, there was always a computer in the house. And, you
230 know, when she was tiny she was playing on the computer. And when she was about ten, one
231 of my partners at XXX called me to ask me about a computer question. And she answered the
232 phone. And he said, I have this problem with my computer, could you have [your dad] call me.
233 And she said, She said, [...] maybe I can help you. What's your problem? And he told her
234 what the problem was, and she said, you should do this. And it fixed it. And it basically,
235 showed you, vividly, the difference between the next generation, and our generation. Ten or
236 twelve.

237 R: But she, cognitively, she was already thinking like that.

238 I: She was thinking like that all the time. So, you really have to understand that that's changing.
239 The big disadvantage at the university, with all those people that graduated before 1980, never
240 will get there. They never will. I mean, I think I'm somewhat of an oddity, but I'm not there.
241 You know, if I had my druthers, I'd just retire and learn how to use Revit. I know how to use
242 Revit. You won't find any senior principals in architectural firms that know how to use Revit.
243 I know how to use SketchUp. I know how to use AutoCAD. Am I proficient in them? No. I
244 don't claim to be.

245 [R: But you don't necessarily need to be.

246 [I: I don't need to be, but I'm fascinated with them. Revit is actually. AutoCAD tried to do 3D
247 stuff, you know, at one point in time, never developed, but Revit is starting to get you there. I
248 mean. And you, know, early on programs, I actually know how to use Rhino. XX had this
249 class, that they taught for professionals, of a interface, and I took the first quarter, and learned
250 how all these different programs interface with machines. Fabrication, yes, we played with the
251 plasma cutter that you've got, we played with the, that's probably where you live, the laser
252 cutter, the plasma cutter.

253 R: Typically, in the design computing, that's usually what most students are interested in doing,
254 is going that next direction. People will come in with an architecture and will say, oh I'll
255 learn how to this. I came in because this is where things are going, and how do we educate
256 towards that, now, because, where is that happy medium, is there one, or do we need to keep
257 evolving education also. Along with.

258 I: Unfortunately, you're going to have to keep evolving, because, the architectural profession is
259 just gonna evolve, basically, with who graduated when and what was there. It takes a long
260 time. I wish it didn't, but it does. I mean ,how many people in our office, have any passion for
261 learning, not many. They have, they get out of school, they rent an apartment, then they get
262 married and have kids, and they don't break out - they all want to, but they don't have time to.
263 And the profession, even though we have all these educational programs, people come into the
264 office, they don't know how to use Revit, we sent them to Revit class.

265 R: The office makes sure they are trained.

266 I: You have to. I mean, you can't.

267 R: They don't have to learn it on the job. Sometimes a smaller firm will say,

268 I: Well, if someone comes in and says I'm not proficient at Revit, but I know it, they'll probably
269 learn it on the job. There's a lot of people. You know, it's a collaborative, the person next to
270 you probably knows how to do everything you need to now how to do. And ahh. So, it just
271 takes, plugging away at it. The best thing I got out of going to that class is I had could buy
272 student rate software.

273 [R: ((Laughter.)) That is always a really good plus.

274 I: You know, we spend six thousand dollars or something like that for a copy of Revit. I could
275 buy a combination Revit/AutoCAD for a hundred and fifty bucks. It just put's this black

276 education thing on the front. So that's what I play with at home, and I got a couple of other
277 pieces of software, Rhino, you know, it was like

278 [R: it can't be more than like, a hundred

279 [I: Yeah, and it was a full version.

280 R: If you can get five, which is the new one that's out, apparently fantastic

281 [I: Really?

282 [R: It's the next new version, cause it has it's own renderer, within it also.

283 [I: it does.

284 [R: A better one, I guess, than the one that was.

285 [I: We had a these little seminars, for the connection of grasshopper.

286 [R: Yes, that's its' own, area.

287 I: I'm not quite there yet. Where you set a formula up that drives all the components and
288 whatever you're drawing, and then if you want to make the column longer, you just change
289 this number's input value.

290 R: It's quite something, and we, there's a lot of people who find that, you know, really
291 fascinating.

292 I: Oh, I think it's really fascinating, but, the problem, this is one of those global problems. Is the
293 size, and capacity, and the speed of your brain. You know, what can a single individual,
294 know. You know, you start to say, well, first of all an architect, really needs to know
295 everything there is about structural engineering, mechanical engineering, electrical
296 engineering, civil engineering, landscape. If they knew all that, they wouldn't have to hire a
297 civil engineer, a mechanical engineer, but why can't they? Why can't they, because if you
298 could learn all that you could be more cost effective. But they can't. It doesn't work. Your
299 brain's not big enough. Or your capacity to feed in, is not big enough. Now perhaps, education
300 will find a way to feed that all into your brain, and you won't have to spend time in classes that
301 do an experience, and you'll get there. Maybe that's the solution. Maybe it's a robot that has it
302 all fed in the brain and you tell the robot what you want. But that's the limitation. Take that, to
303 your training an architect to understand what they need to know to deal with spatial
304 relationships, how a building works, what the needs of a client are, how to interface with a
305 client. The contracts they need, the codes they have to deal with, and now you're telling that
306 same person they have to learn some complex software that has all kinds of rules, that you

307 have to learn how to use. Is that asking them to do too much? And, you know, would you be
308 better off just training them real well how to draw by hand. And then have a whole nother set
309 of people you train to take that input and have it drawn up. I.E., our industry came from, where
310 the architect was the master of what needed to be done, and you had tradespeople that drew it
311 up. You know, the drafting room. Umm, I've been in firms like that. And, you know, I pushed
312 away from that throughout my career because I think there's more capacity in the brain. I also
313 think, not unlike, this is a linkage that you want to make, what we're dealing with today is not
314 unlike what we dealt with forty years ago, where the architect never learned how to draw.
315 Documents. Never learned how to do that piece. So they had the drafting room that did it. I
316 throughout my career have said, from a cost-effective standpoint, if you teach this person how
317 to draw, you don't need these people to (assist you draw). And if they learn how to draw, not
318 just draw, but how the details go together,

319 ((the light in the room goes out.)) I: We may have to move. The lights go off if you don't.

320 R: Where's the sensor?

321 I: I don't know. Somewhere. This room is funny too, [...] ((Return to seats.))

322 I: That you have to detail, you have to learn how to put the funny little sketch so you can build
323 it. That's, you know, there's architects that don't go that far. Because their capacity of brain
324 doesn't take care of it, or their interest doesn't take care of it. But, so what they used to do is
325 they had a drafting crew. Today, I think we pretty much got everybody that goes on a team can
326 draw. They have to draw how it goes together, they can seamlessly go from. [R: they, they
327 know, how to draw. I: They know what to draw and how to draw it. What they don't know
328 today is how to have Revit draw it, or AutoCAD draw it. So we're in the same transition, that
329 you had when you used to have the drafting room. So, you know, now, these people, they can
330 draw, but it's not worth anything anymore. What are we gonna do with this hand drawing. We
331 need in Revit. And so we're facing, that transition. You look at the industry, we made that
332 transition, we don't have drafting rooms, so to speak, anymore. We actually have in, the
333 SketchUp room, you have a lot of the same thing, it's a similar kind of thing.

334 R: You have the people that are the modelers because they do that -

335 I: Well, you know, we have people who are very skilled in it that end up doing too much of it.

336 We work real hard at not getting somebody pigeonholed. And it's hard.

337 R: In terms of the actual, in terms of hiring staff, you don't hire someone who can just 3D model,
338 and is not also capable of knowing what to draw.

339 [I: We want them both.

340 [R: They have to have both.

341 I: We're, you know, we're in the process of trying to find two or three new people, not
342 specifically because we're extremely busy, we have a, we see this workload coming along,
343 we're going to be extremely busy, so our goal in finding, we would like to find the three, best
344 brightest, most capable people in the world, that are graduating from college right now. That's
345 our job description. Doesn't matter, but we do want smart people that can take things and just
346 do it. And the reason we want those people, we've got a couple of those, and you know what,
347 somebody at twenty-four can do a lot if they're smart. And somebody at twenty-four that
348 isn't, can't do. Or somebody at fifty-four, who isn't, can't do much. And we don't want to
349 have people when they're fifty-four, that we hired because we were too busy, and we had to
350 take what was there, sit there and say okay, maybe we can find something from them to do. I'm
351 just being realistic about our firm. So, if you have bright, intelligent people, it doesn't matter
352 what comes along, they'll learn it. They'll learn it. If they don't get too heavily involved with
353 life. But, again, from the education standpoint, you need, it's probably a combination of your
354 descriptions of you know, giving everybody a little bit, but also being able to give them a lot.
355 But your biggest detriment, is professors.

356 R: No, that's fine to hear.

357 [I: And don't, it's not that they're bad. [

358 R: They do know what they're doing.

359 [I: They do know what they're doing, and some of them may be very interested in it
360 [technology], but they don't know how to do it.

361 [R: because they don't have the experience.

362 [I: We have people that say, you know, I want this 3D model walkthrough, and I say, sit down
363 and do it. I don't know how to do it, I shouldn't have to know how to do it. Well, okay, the
364 person that is doing it today, for you. Fifteen years from now, when they're in your position,
365 they won't need to have that done.

366 R: And that's the transition.

367 I: They will create the original idea that you're trying to feed to that person to put into a
368 SketchUp model, straight out of the SketchUp model. So now, you're not wasting that time,
369 and you know, and you always get back, well it's not worth my time to learn how to do it.
370 Well maybe not. So that's the issue. And it's a transition. And you're not there yet. But, you
371 need people that can think, that can learn, and you know, if we had people. The ideal person
372 out of school, from a technology point of view, if they're extremely proficient in Revit,
373 extremely proficient in Rhino, or in SketchUp, one of those early stage things, extremely
374 proficient in 3d max, so you can render things after you've created where they are. And know
375 the entire Microsoft suite and the entire Adobe suite, inside and out, that could do all of that,
376 you know, if you had somebody that was extremely proficient and knew a little bit about
377 architecture, and had a passion for architecture, they would be better than somebody that knew
378 everything there is about architecture but knew nothing about those things. Because you don't
379 learn anything in school, about architecture. I mean, you maybe learn five percent of what you
380 need to know.

381 [R: Everything is gonna be learned through experience

382 [I: and learn way more experience on architecture, in doing the business of architecture. Very
383 little about what we do, as the business of architecture, teaches you how to use Revit, other
384 than you have to use it. So, if you're gonna use it, and use it better, but, going out and meeting
385 with a client, to discuss what their needs are [will] teach you about architecture. So much of
386 what happens in the academic world, there's no cost associated with it, there's no codes
387 associated with it, oftentimes there's no client associated with it, although they're getting
388 better at that. Does that address the first question you kind of –

389 [R: Well it does, kind of. And that's the thing is, I don't know that there is, necessarily a specific
390 answer, to any of the questions that I have.

391 [I: No, there isn't.

392 [R: I'm hoping to, by talking to a number of different people, finding one or two trends that seem
393 to be, that seem to be what the practice is looking for now. And only by looking at the practice
394 from, everybody has a different concentration, they do things differently, the design process,
395 essentially doesn't change.

396 [I: Yes.

397 [R: But how we slot technology in, and where we use it, and when we use it

398 [I: yes.

399 [R: whether it's at the initial stages, where you're preliminary, or it's all the way at the end
400 where it's usefulness is at the document stage, or collaboratively with the rest of the other
401 consultants. That has changed significantly from what it used to be.

402 I: Well, the trend, in manufacturing is going towards less a [...] and more you can have whatever
403 you want. [

404 R: Far more specialized because it can be done now.

405 [I: Because it's all in how they put the numbers in the computer. If you want a window that's
406 twenty-four and two eighths inches wide, as opposed to making a twenty-four inch one work
407 you could get it. The manufacturers are going through this trend also. They say that it's not
408 true in every manufacturing industry, but they're probably ahead of us.

409 [R: I think architecture tends to lag behind in terms of technology.

410 [I: But that's the mentality that you have to slowly learn how to deal with.

411 [R: Right, we don't have to work in twos and fours and eights and this and that.

412 I: And the nature of what the shapes and forms that you can use, and build effectively are
413 changing. A curve something used to always cost more. They curve something probably still
414 does, but I'm not sure that's going to continue. And there's some things that to curve
415 something is a little bit more but not a lot. And so, you know, as it evolves, you'll find that it
416 doesn't have necessarily have to be as rectilinear.

417 R: Do you think that, just based on that, do you think that the ability of technology or technology
418 in the way that it can be I guess manipulated now, as opposed to just hand drawing, does it
419 allow people to think- to design differently now, than they used to?

420 I: Absolutely. But how many of the people are at the point where they're leading design, and
421 they are in fact choosing that technology. That's an interesting question. Are the originators of
422 design offices, the principals that guide them, using technology to start that process or not. My
423 guess is that, this is the older offices, not the young offices, older offices, it's probably ninety-
424 five percent don't use the technology.

425 R: Maybe to open it and look at it, but that would be it.

426 I: If I was a betting person, if you did a survey of principals, in architectural programs, and how
427 many of them are proficient in Revit, ah, proficient in Revit ((emphasis)), you - well it'd be
428 interesting if you found any. How many know Revit? Not very many. How many know the

429 word? Probably seventy-five percent, probably ninety-five percent. Now go back to something
430 like AutoCAD, the percentage will go up. Take new 3d Studio max. How many people, that's
431 one I've haven't ever used, how many people have used that.
432 R: It's got an intimidating interface.

Supplemental Material A3. 2261 Interview Summary

- 1 I: 32 years in practice - 34? Graduated in '79.
- 2 R: How many familiar are you with technology:
- 3 I: Definition of technology? Used to use Leroy pen on vellum. Didn't learn in school. Have to
4 know how to learn on the job. Have to understand how to learn technology - can't learn all at
5 school. Traditional definition of tech - computers used in design phases.
- 6 R: Whether production or development.
- 7 I: Production - has been at XXX 16, previous [company] 19. Started basically with first version
8 of AutoCAD. Didn't learn in school. Company wide charged to be on top of that. Took a few
9 classes, then let's go. It was really just floor plans at that point. Elevations and designs were
10 all the old fashioned way. Even perspectives were on the drawing board with pins. Any of
11 that design never got into that company. That was through 97. We went from floor plans to
12 elevations. Pretty soon after we started. Then it got to - we never got to detailing. Mostly
13 plan related things and elevations. AutoCAD is sort of dumb, there is not a connection. It
14 [AutoCAD] helped more in production than design.
- 15 R: Office here - what types of design software do you currently use?
- 16 I: Revit, previously on AutoCAD, still part of some projects. Consultants are usually more
17 AutoCAD. Just finished job that was in Revit. Engineering add-ons for Revit aren't as far
18 along as architecture. They can't do the same thing as the company can. They develop new
19 routines and shortcuts to make models work together.
- 20 Company is in [three metro locations]. For the first 30-40 years, all design was in [a major
21 California city], satellite offices were production. They've used the latest 3d since early 90s.
22 Form z, 3dstudio, all iterations of that come out of that. When I first came, we'd get an update
23 before it comes out [to the public]. We're on the bleeding edge of that. I think there's other
24 3d software that we use that is not Revit.
- 25 R: No SketchUp no rhino?
- 26 I: We do rhino, we do SketchUp.. SketchUp is a little but of an add-on, we're trying to switch the
27 work we do in SketchUp to Revit and rhino.
- 28 R: assuming based on level of images, you also do illustrator, Photoshop, etc.
- 29 I: Right, yup.

30 R: You said, no formal training in school, does the company do formal training?

31 I: We will, Revit was a big change, 3-4 years ago, we didn't have anyone that had learned it in
32 school, at the leading edge, we wanted to get on top of it. We had a strategy of sending people
33 to workshops to learn that.

34 R: Typically, when someone comes in, whether they were experienced or not, would you send
35 them?

36 I: Kind of depends on our needs, and the type of person. Doesn't necessary raise a flag to train.
37 Lets' see what he can do. Some people can learn on the job. There are some who don't like
38 that, they feel you need to start Revit with a class. It's been both ways. I want to make sure
39 they're good enough for us to invest in a 3 day class, we test them a little but, to be sure that it
40 makes sense. Other side of that is we're on deadline we can't take you out to learn Revit.

41 R: Trial by fire. Do you yourself use Revit/AutoCAD?

42 I: I did AutoCAD, then gradually moved into management role. You do less, and less of that, at
43 least I did.

44 R: So you use it for review?

45 I: Yes. I'm on the point of I'm not ever going to learn this. I might have 10 years left in the
46 industry.

47 R: Sure there are other things they want to utilize you for. But someone new, assume they would
48 go straight into using technology for their job.

49 I: Right. That's true. We basically say, if you don't know Revit, and have no background in
50 AutoCAD, you're kind of (...) there could be a few exceptions - we have needs over the years
51 for just CM [Construction Management]. But even with that you have to get back to the
52 model to make changes.

53 R: It's difficult to fathom anyone who would be doing that. Does the office use revit now, to do
54 conceptual work? Besides DD [Design Development], or is it traditional?

55 I: More, we use, the 3D stuff in concepts and schematics, but that is matter of personnel
56 familiarity. What someone is comfortable with.

57 R: Would you allow - the way that the team wants to start is fine.

58 I: We make sure we understand that we will want to be here, but if it takes some other sketch or
59 model to get the point across, that's fine. But eventually we're gonna translate that.

60 R: [Always] budget and deadlines. Over the years, has technology changed the way the

61 company does practice?

62 I: No, I don't really think so, we have foibles on how we're not necessarily good at delivering
63 our product, but we generally have, in particular in healthcare, we have planner, designer,
64 project manger. Those 3 leaders are involved in the beginning. However they get to the
65 technology to present ideas in design is still kind of the same. SketchUp, Revit, same steps in
66 the process are still there. We haven't silo-ed people, but we have designers, planners,
67 managers, that are aware of what their world is and how they have to work together.
68 Technology hasn't really changed those relationships, from the beginning, probably changed a
69 little more in the end, but DD, CD, CA , still have a product at the end. It still is some
70 documentation of what we've done to build this building.

71 R: Has the amount of time in CD preparing the CD has changed?

72 I: Trying to convince clients that we're spending more time upfront to develop, but they haven't
73 really bough that we need to expand SD and DD phases. And the total is about the same. They
74 like the idea of shorter CDs. ((Laughter))

75 R: Of course, shorter everything.

76 I: So that has shifted a little bit. Minor shift in us and how we deal with that, how we get
77 approval in the DD phase. That still is in flux, in terms of how we manage that internally.
78 We're finding this, we should document what we know. Still people in our group that are not
79 on board with that yet. They don't understand the specifics of that and how that changes the
80 project roles of people.

81 R: Would you say that the roles and responsibilities have shifted a little?

82 I: Yeah, I would say that's fair. We re expecting somebody who knows Revit to do a little more
83 than someone who is a junior level person 20 years ago.

84 R: It's not just production.

85 I: They are in the same model that is the final project, as opposed to just doing a detail. There is
86 nervousness that we have about having junior people open up the model and do this redline.

87 R: It could impact far more than just this section of this drawing.

88 I: Right. I think that is where upper management has said, we need to make sure that we have
89 good people that now what they're doing with the Revit model, if they're just good people,
90 that don't have that training, lets train them. Investing in that.

91 R: But would go back to having the right foundation built in education, design, creativity,

92 I: Yeah, right.

93 R: Not leaning heavily to need to have Revit, need to have CAD,

94 I: Right, yeah. I guess that leads a little into my bias.

95 R: Biases are good. There's many of them out there.

96 I: I think that - it makes sense to me - I think that there other people that share this sentiment,
97 when I see a resume, just out of school or have been out a bit, I take a look at their skill sets,
98 that's not what on the table for me. It's this ((gestures between R and I.)). What you say, how
99 you say it, the non-technology part.

100 R: You can't teach it.

101 I: I can't teach it. I expect the technology part, you gotta have it, but if you have it and you're a
102 jerk, I don't care, I don't want you on my team. This might be coming from some who isn't
103 a Revit guy, I just think that just confuses the issue for me. I wanna look at what value do you
104 bring. I want that [technology] but I want something else. A lot of it is basic, good people
105 skills, good life experience. And then if you have that, I'm gonna spend all the money I can to
106 get you up to where we think you need to be if you're not there already. Its interesting the
107 parallels of the general subject, with work and personal life. I'm intrigued by how it impacts
108 people lives. I cant live without technology, but its not what I look for. I want to have a
109 human experience with people.

110 R: You might be able to live without technology for a bit.

111 I: Yeah.

112 R: Essentially I know that education as a whole is looking at technology and saying how do we
113 manage this interface, this technology. You have no idea what students are doing, if they're
114 engaged. One of my questions - we use so much technology now, in practice, but we don't
115 necessarily, bring in the computer into the studio space, and train how those go together and
116 how do we use them. As an overall whole, students are left to decide that.

117 I: Right, yeah. Right.

118 R: That's my question. I don't know that we know. It changes everyday, how we use it. There
119 are some people that do their jobs without them. I would say there a balance we're searching
120 for. I'm hoping to find that.

121 I: That's a tricky balance. When I was graduating, we looked at ourselves, some had summer
122 jobs, just drafting. They came back, and said, we don't know what we're doing. We don't

123 even know what a door detail looks like. We went to the professors, and said you guys aren't
124 teaching us what we need to know, we're going to be blindsided. He said, well the philosophy
125 is, you're gonna learn that out there. And what you can learn here, you're not gonna learn that
126 out there. You're gonna learn design, you're gonna learn the stuff that is fundamental, that is
127 important to architecture. The technology, you can learn that. And that we expect you to learn
128 that when you get out there. We're not gonna teach you all those things. That made me feel
129 better. Let me get what I can from here. I might be designing these big projects that I might
130 not do when I get out.

131 R: Don't worry so much about the things that you think you might need to have, if you don't
132 really know that you need to have those yet.

133 I: Right. Yeah.

134 R: The practice will determine what other skills you'll have to include.

135 I: Right.

136 R: Learn the basics. We're all on the same page.

137 I: I think that's kind of what I got out of that. And I might have put this into his words in my time
138 since then, but I think to me, we had some group projects, and situations where we had to deal
139 with people, there was some focused attention on people skills, and human stuff. That I
140 didn't really realize at the time, but I took that way, and that's kind of what I've focused on
141 more as I've gone through.

142 R: Well, the business of architecture is very collaborative. You need to learn how to work with
143 other people. Do you - have you hired anyone recently - would you say there is a good
144 balance at the moment?

145 I: we were actually on the threshold of adding folks last year, I brought in a lot of people to talk,
146 I guess I placed an add, had a lot of response. Mid-level person - 5-10 years or that. I got a lot
147 of people from 30 years, and graduates. Some of them there was something compelling. Of
148 the people I talked to, I would say there was, half went away pretty quickly. Not too much
149 about technology, we don't have a rigid formal testing.

150 We might get other folks in the discussion. It's about trying to get a feel for who they are. See
151 how they follow along with you or not. I try to get personal reactions. Of the people that
152 didn't seem to be appropriate, everybody seemed to have a comfortable level of basic
153 requirements. Skills set was all there.

154 Actually one guy, I hired him six years ago, he's still here. I noticed that he said eagle scout, that
155 he was a French horn player in the college band. I've been through architecture school, and I
156 know what that involves. And I said, wait a minute, you were in the marching band, and you
157 did architecture? And so those totally unrelated, but not really, sort of made us have a
158 different conversation. We came back to the basics of what he learned I school and his
159 AutoCAD experience, but that really wasn't what sold me.

160 R: It's the other things that are outside - that are really interesting. I think that makes for the
161 most interesting thing in general office relationships.

162 I: A whole culture of an office is the underlying with not only the technology, but how effective
163 you can be, how happy you are, that's a tricky one.

164 R: What you do involves the people that you have to work with every single day. Education is
165 about creating the environment. With that in mind, its good to know that you feel people have
166 what they need, would you say that technology - it can technology assist in design, or improve
167 design? Is it part of it now? Many years ago it was a tool for production, we've changed its
168 role over the years.

169 I: I would say in the early phases of a project I think it's still a tool. It's not it will help you
170 communicate, envision stuff, look at different situations, and it might instigate certain lines of
171 thinking. Umm, but I guess I think that it's still a tool. I'm looking at the board over here, for
172 some project. Whatever was the difference, we had option A,B,C. I forget what it was, what
173 we used for that, but we imported the existing buildings. We had these three different
174 schemes, but somebody has to have the idea first. You can't really, you have to think about
175 the relation of the street, the relation of the exiting...after that comes, then the technology can
176 say okay, well, here's what that looks like. But sort of the early parts of getting to that, is sort
177 of fundamental design training and what you experience in what you've done before, (35:38)
178 what you've worked on before, hat you've even seen, just when you walk around the place is
179 really cool or whatever.

180 R: So, in this office environment, that would not necessarily a manipulation of shapes to see
181 what would happen, without that design process. Let's try this, move this here, move that over
182 there.

183 I: The moving of those things out there - depending on the person, it might be on flimsy. It
184 might be SketchUp. I'm not sure I said that, the first 30 years of this office, we didn't do that,

185 but now anyone can be sitting here or in XXX.

186 R: You did mention that there are people who would prefer to visualize in 3d dimensions, I'm
187 sorry, 3 dimensions as a virtual model, rather than 3d dimensions as a flat 2d model. Even a
188 model is still 2 dimensions in a flat plane, but you're able to manipulate it around.

189 I: Right, right.

190 R: Do you think that's something that has increased over the years?

191 I: The visualization in the 3d?

192 R: Preferring the 3d?

193 I: Yeah, I would say so. It may just be people that are grounded in stuff before that, may not
194 have the preference to not do that, or this is how my brain works when I'm in that situation.

195 R: But it doesn't change that actual process

196 I: True. It still would think about this option, or that, however you get there is whoever you are.

197 R: Everybody is different. Sometimes it just takes the way that you see something, or someone
198 sees it slightly different that train of thought.

199 I: Right, and again, that's sort of to my point. Was, that collaboration, that these two people that
200 work together, a guy that does sketches and a guy that does the virtual, if they sort of don't
201 allow each other the voice to do whatever is brewing inside of them, then the whole sort of
202 party goes to pot there. ((Laughter)). You're not gonna get anything going. If I can draw this
203 and say, I like the idea of moving this, and then Joe over here, yeah, let me try that, and that
204 sort of dynamic that happens between those people, that's as important as however they're
205 each doing their part.

206 R: Do you find that that has increased some over the time also? Someone who is more senior,
207 someone more junior, they both understand what they're talking about, not someone in
208 production, and that there's a let's try this, or this point of view.

209 I: yeah, I would say that ahhh, I think that's grown in general , probably the number of the junior
210 3d people is growing, I hope that it doesn't overtake the other people, but I don't think it will,
211 I don't think it will, the other people that are senior and don't have the skills and don't have
212 the technology, I think they have developed the fundamental stuff that these people don't have.
213 And I think that still needs to get folded in to everyone's experience. And I think that might
214 even be, not an explosion, but some sort of intentional addressing of that fundamental thing.
215 Because there are plenty of cases that I've seen, that these people that have all the technology

216 will try to use the technology to hide their inexperience of fundamental stuff. These other
217 people can see through that pretty quickly. They might be sort of thrown off a little by the
218 snazziness of the stuff, but it comes down to really hard things that won't get built right if that
219 fundamental experience that we look for isn't there.

220 R: That's always the struggle, if you're going to include teaching technology, where is the right
221 place to put it so it doesn't become the most important thing, the be all, end all, and students
222 are still trying to balance how that works out, but not allowing the technology to get in your
223 way, with the design creativity and freedom we need. I don't think we know that yet. You've
224 probably heard that comment, that's a SketchUp building.

225 I'm looking at it from that point of view, we don't want to get in the way of those foundation
226 skills.

227 I: I would agree with that.

228 R: I don't think accreditation would allow us to anyway.

229 I: True. But, I mean, I guess the challenge is identifying the foundational skills, and how do you
230 get there.

231 R: Are they the same or have they changed? I don't know that we know that answer yet.

232 R; I guess I'd just err on they're still the same things. We've been building buildings for
233 thousands of years, and there's some parts that have changed, but you still need basic stuff.
234 And umm, you know, I thought a lot about when you go to Europe, and you look at the old
235 buildings, or the colonial buildings around here, and you read about the stories about how
236 buildings are built, if you're building it this way, then it's this. Then I look at a lot of things,
237 and I think, they could use a few rules. But that's the nature of change. You have something,
238 you go somewhere, and this looks all good. You can't necessarily go back there, but you can
239 apply few of things that were here on these prescriptions back there, and then straighten this
240 out. You're never going to go back to the old rules of colonial architecture, but you can look
241 at them and reinvent them.

242 [...]

243

244 R: Do you have anything you'd like to add? I have many different thoughts - but essentially, - I
245 don't know if you have a suggestion, that seems to work better.

246 I: I think mostly, start from the beginning, there's so many other things. To have an office that

247 does architecture, and then we complicate by having multiple offices good and bad, and then
248 the interactions with clients, and contractors, the whole process of a project, the collaboration
249 that's needed, it just seems like that whole ball of wax is really complicated. It's hard to parse
250 it out and say, here's something clear that we have to do. And technology is woven in there.
251 It's hard to figure things out. I guess I have wondered, from what I have learned in my career,
252 what can I offer, what do I think architectural education should look like? I got nothing.

253 R: I thought you had a magic answer for me.

254 I: It's life 101 is what it is. It's sort of a cop out, because we're gonna give the degree in
255 architecture, what do we have to teach to do that. What those components, are, what the need
256 to be to be accredited, what the industry is expecting out of school teaching folks.

257 R: We're still going to ask. In case things are changing. But I sort of believe that the discipline,
258 it's still sort of the same thing. When you're a kid and you say I'm gonna be an architect, it
259 still means the same thing. You won't spend hours on the drafting board, maybe a conference
260 call, but it's still going to be the same tasks.

261 I: You know, that's a good point, when you're a 10, 15-year old kid. Being an architect sort of
262 means you design buildings. And it was that way a hundred years ago. And it's probably
263 going to be that way a hundred years from now. We're always going to have buildings.

264 R: The change is what's current and where do you fit into that world.

265 I: It's gonna be something different.

266 I: If you say ask and listen, it's what do I do with what I heard, what sense can I make of these
267 good things that people have said.

Supplemental Material A4. 3011 Interview Transcript

1 I: I hope I can help. You said more of the management level was fine.

2 R: Oh that's absolutely fine. I have talked to a number of different people. I'm trying to sort of
3 get a good of, um, range of different people who have finished or who have been in practice in
4 different levels, different years, because of the way that each person uses technology these
5 days is very different, in many cases.

6 I: Right.

7 R: But, as a sort of an intro, my background is in design, and in teaching, and I ended up at the
8 university asking lots of questions about how do we, I've had to teach technology classes
9 before and had to teach CAD, and teach, um, sketch up, or illustrator, and because of doing
10 those things, my question was, do we have a way that we like to do this? Because design is a
11 difficult thing, alone, let alone, putting, in, including trying to learn technology, or master
12 software, or learn how to use it properly. And there isn't really that much out there. Education
13 in general, I think, is really struggling with the question, because you have post-secondary,
14 where it's understood you're using a computer, but you'll have elementary teachers saying,
15 everyone needs an iPad because that way they'll be able to read and get their homework. But
16 you, know, we didn't have those things growing up, and I wrote everything by hand, and when
17 I had a typewriter I got really excited because it was faster. But umm, just looking at those
18 different things, my thesis is sort of floated around into this question, is the way that we're
19 doing it right, or do we know, are firms looking for different things now, out of graduates, or
20 the same things? And then other things,

21 [I: Yeah.

22 [R: and then sort of approaching that question that has popped up once or twice, you know
23 they're really good, but they seem to be missing something. That something, I don't know if
24 we can tell what it is, but talking to enough people I might center in on something else.

25 I: Yeah, I think there's an opinion about hand drawing versus technology, and I'm sure you've
26 heard it, and I've been in this career, I graduated in eighty-three. Um, from XXX. At that time
27 there was a small group in our class that was trying to dabble in computers with computers and
28 stuff but I wasn't one of those. But then my first job, I started to play with an apple computer
29 and kinda get to know that and start to do written stuff like specifications. I grew into

30 managing projects and such rather quickly, and never really, I went from drawing by hand to
31 managing, and then others would do it on CAD and those things.

32 R: You'll have a very, probably a really nice kind of overview sense of watching it happen.

33 I: Yeah. And see the big thing was in design, that people would, um, sketch, and draw, and
34 would be very facile with that, in my generation, and then we'd get people that knew CAD,
35 and they'd want to design in CAD, and we would say no, you're missing a - you're getting too
36 specific too quickly, you don't keep it loose, then SketchUp came along, and that made it more
37 intuitive, a little looser, and I can just see that now, it really is shifting to, it's all technology,
38 that the sketching side of it is really becoming something in the past. I notice it in the people
39 that we hire, and what we're looking for, and you know, do you know SketchUp, do you know
40 Revit.

41 R: The requirements have changed significantly too, although.

42 [I: Right.

43 [R: Assuming you are still looking for people who can think.

44 I: Thinking is very important, ((Interviewer laughs)) because now I think we've accepted the fact
45 that they think using technology rather than using a pencil or a pen and sketching.

46 R: Do you believe that it's similar? Or does it just depend on the individual?

47 I: I think, there's... a really good example is, we recently had an early design concept, that we, in
48 the old days would've just done hand drawings very quick kinda just to get the feel for what
49 would fit on the site, and um, in today's technology we typically use SketchUp. Which is very
50 loose, and, and you can go pretty quickly and get some data from it. And the team made a
51 decision sort of separately to use Revit, which is a more robust system, but less kind of loose
52 and facile. So they used that, and it was a disaster. Because they were getting so specific so
53 quickly, and their whole idea was well, we'll have a really good data base here, that then when
54 we change things, it'll be if we add units, or delete them it will all just kinda automatically
55 update. But, in that expediency they lost sight of what we were really doing, which is trying to
56 come up with a really cool idea.

57 [R: Start at the beginning.

58 [I: Yeah. And I had a, you know, pretty direct conversation with the team, about why are we
59 using Revit versus SketchUp, and they, they came around, they realized that wasn't the
60 appropriate technology to use, for that.

61 R: Do you think it was maybe, not as much in depth knowledge about knowing which might be
62 the right one to use? Or just a -

63 I: I think what it was, was trying, they were trying to be expedient, to be able to do things
64 efficiently, quickly, and they, and, I mean, people who use Revit here are very good at it. But,
65 um, it's not the kind of program you can sketch it, it's a pretty definitive, you have to know
66 how it all kind of comes together. And it takes longer. And,

67 [R: It's not just lines anymore. I think you can, I've heard a similar sort of conversation with
68 someone regarding doing, starting as-builts just to get a sense of what that space is, and
69 starting off in Revit may not, might work, but a little bit more difficult because of the changes
70 involved until you really know what the space is like [I: Yeah. R: There are three extra feet
71 somewhere in this building and I don't know where they are! ((Laughter from both)).

72 I: And yet I've got a Revit model that closes, and it works.

73 [I : So where so we split it up? Maybe some of that is experience, but the right sort of leading
74 also, I don't know.

75 I: Ummhmm.

76 R: I guess I would ask, in the office, do you typically try to start conceptually in sort of a
77 SketchUp and the move to Revit, is Revit what the office uses now rather than AutoCAD?

78 I: Yeah. The office has been using Revit for a long time. About fifteen years. [R: really. I:
79 Versions thereof. BIM, I guess is what I should say. The software that we use. We have
80 capabilities in CAD, but we, it's not, it's usually dictated by a client, that we have to go into
81 CAD. We have a few projects that we're doing in 2D CAD, AutoCAD and Microstation.

82 R: Oh, you have them both.

83 I: Yeah, we don't have a lot of Microstation people here, a couple that know it, we tend to want
84 to do it in AutoCAD or Revit, and convert it, that's how we tend to do it.

85 R: Instead of starting in Microstation.

86 I: Yeah. But we're doing a subway station in Toronto that has to be in Microstation, 2D, so we
87 have a couple of people who know how to do that.

88 R: Do you find that you, in terms of which software package you use, is sort of dictated by client,
89 consultants, whomever you might be working with?

90 I: We try to do Revit. We call ourselves a BIM firm, we do everything in Revit, everybody's that
91 doesn't have the training is trained. Get's into it. So, buildings, like that one right there
92 ((points to rendering in corner of room)), that's all done in Revit, that's a hand sketch.

93 [R: It's lovely.

94 I: We're doing all our buildings in [this office] in Revit, I think [our other office] as well. So.
95 The two offices. And um, we're actually modeling, because we do a lot of urban design, we're
96 modeling a district in Honolulu right now, but, in the past we would have been in sketch up,
97 we're doing it in Revit for very specific reasons. And that's because of the data that we want to
98 be able to pull out from it, and we want it to be adaptable, so if we change things, that data is
99 available. But that's a little different from doing a building.

100 R: Right.

101 I: It's modeling a district.

102 R: That's quite a, quite a feat.

103 I: Yeah, it's a big one. ((Laughter))

104 R: So, in terms of um, training, we you recommend that a student have a little bit of experience
105 in school in Revit, at least just a taste of it?

106 I: Absolutely.

107 R: That's helpful?

108 I: Oh yeah. We are at the point where we, that's one of the things that we look for. Ummm,
109 obviously, if they haven't used it, in a project, we know that there is a learning curve there.
110 And it's not always, you know, if a person doesn't have Revit, it's not like they're out of the
111 running. But, it's a big factor. Specially for someone that's gonna jump in, into a project. We
112 tend to, just like you talked about ideas, we don't look really look at the skills first, we look at
113 the person, and whether they bring to the table, and then, a lot of times we convince ourselves
114 that, okay, we'll find a way to train them

115 [R: We'll get you trained.

116 I: Yeah.

117 R: I have talked with a few people who have said, you know, if it's the right person, and we'll
118 bring them in, and if it works out, we'll train them whomever we have to, because the team is
119 more important, and the relationships between the people, rather than just a great skill set that
120 walks in, and can do everything they need to.

121 I: Yeah.

122 R: I think it's understood that any graduate has a very small amount of what they will need when
123 they get here, and they'll learn everything else when they get to whichever firm they start at.

124 I: Yeah. We do have a, not at a graduate level, but at a sort of mid-career or early tenured period
125 level, we've hired somebody, who had, you know, knock out Revit skills. And he has helped
126 us grow. But most of the people we have, are not, they don't want, that's not where their focus
127 is. They want to be architects, not Revit technologists.

128 R: Sure, I went to school to be an architect.

129 I: Exactly.

130 R: Well, with sort of that in mind, have you seen, I guess over the years and maybe just looking
131 at what it is now, the type of person that you would hire, the role and responsibilities are based
132 on technological and design ability? I mean we had at one point, obviously drafters,
133 production, and you could do redlines without knowing as much about really designing or you
134 could learn at the same time. Do you look for people who are able to do both essentially, or a
135 more senior person, how does the team work, based on, because of BIM, you can't -you don't
136 want to move something and not know what it's going to impact in the model.

137 I: Well, we have all levels. You know, obviously. There's young people coming out of school,
138 we don't expect them to be able to jump in and know how to put together a building. But as
139 they work on the project, they learn that. So, what we're looking for, and we rarely hire
140 straight out of school. So, umm, we may bring in an intern for summer, but usually they've got
141 a few years of experience before we have, you know, they join us. But um, I think the bigger
142 thing we look for is SketchUp. You know, on building projects, and even on planning
143 projects, if they know SketchUp, that's a great entree, because there's a lot of need for
144 SketchUp. And then what the trick is for that person to be a contributing member on the team,
145 doing SketchUp, which can sometime be months of, just basically, rendering, and drawing
146 things that somebody else is directing.

147 [R: production.

148 I: Kind of production level design, yeah. And not to get pigeonholed into that. And we've had
149 just a series of people who are two, three years out of school, that have been that role, and they
150 get to jump around a bit, from project to project, because we have a lot of early stuff that we're
151 studying, or we have a study over here or a study over there, and they have the SketchUp

152 skills, they can be really contributing to the project. But, we try not to let that go on for more
153 than a eighteen months. So that they

154 [R: they can move up.

155 I: Continuity is the big thing for a lot of folks that they - they want the continuity from
156 beginning to end of a project. And they need it architecturally for their internship for IDP. For
157 planners, is the same sort of thing. They want to be doing - we have two kinds of planners, one
158 that are more about policy, and ones that are more about design. Umm, but those people also
159 need to get the full breadth of experience. So being stuck doing SketchUp for projects for too
160 long, at some point, they gotta move on. But we've usually got one or two people in that
161 position. That they're doing that work. And it's a great learning.

162 R: I was going to say it's probably a developmental place to be, you're sort of contributing what
163 you can, and then learning and contributing more as your able to so, with a little bit of, with
164 guidance as well.

165 I: It works pretty well. We had one guy, when I joined three years ago, he had been with us for
166 about six months, and that's exactly what he was doing, and he kept doing that for another
167 year or so, and now he's on a um, a similar project to this one, which is a from the ground up
168 high-rise, and he's gonna stay on it. I mean he's been doing the SketchUp, but he's also got
169 the - the technical experience now that he's contributing and worked construction a little bit.

170 R: It'll move in to BIM and he can take on

171 [I: Yeah, exactly, it's already in BIM, yeah, and because it's a clone of that one, sort of, we're in
172 BIM a lot quicker. The decisions are made, we're now documenting. And we still design,
173 obviously, in BIM, we keep saying we never stop designing, but we have to stop at some
174 point. It's in what we call design development, but we're working at it, so.

175 R: Have you found that design development, I guess, construction document time has lessened,
176 in terms of the actual production time because of BIM?

177 I: No.

178 R: Still the same.

179 I: Yeah, because there's so much coordination. And um, the owner's decisions, and I'm talking
180 specifically about building projects here, umm, I always have to be careful here because we
181 have urban design, we have infra structure design, bridges, and stuff like that, and we have
182 buildings. So, most of my comments are about buildings.

183 R: The smaller, smallest, in some ways, in terms of footprint.

184 I: Yeah. So, ummm, I'm just trying to think. It takes about the same amount of time. It's not,
185 the check ins, the coordination with the structural engineer, the mechanical, electrical,
186 plumbing, the city, all those processes, haven't gotten any shorter. Yeah. What is cool is that
187 when you get all those entities, structural, mechanical, electrical, plumbing, all into the
188 architectural BIM model, a lot of the coordination, happens, it's obvious, what you have to
189 coordinate. You find it earlier. You work around it.

190 R: the visualization has increased on that end.

191 I: Yes. But it doesn't take less time.

192 R: Understood. Do you think that at that level, because it's become more visual, can someone
193 with less experience catch those kinds of coordination issues?

194 I: No. Well, coordination issues, probably are more obvious. Ummm, but the coordination is at
195 such a sophisticated level that you need to have that experience of understanding how things
196 kinda go together. The other piece, umm, about the whole Revit thing is what you've talked
197 about with the as-builts, you've gotta know how buildings go together if you're gonna work on
198 the model. You can't just kinda, you know, sort say, oh that'll work itself out. It's very, very,
199 specific.

200 R: Right. The reality of the physical, when you get there, and there's always something left over
201 or something missing, understanding what will happen and what you would do, when you
202 come to that issue, I guess.

203 I: The other piece for me, I just want to get this out because of your comment about time, is that,
204 as I'm not a user, I'm more of a manager, and I always thought, what a cool thing, you're
205 designing, you're doing the whole model, you're basically building the building in the
206 computer, and then when you cut sections, you can pick where you want your sections or your
207 plan, and there it is. There's so much work beyond that in documenting it as a 2D set of plans,
208 it's huge.

209 [R: The traditional 2D set.

210 I: that was the, making sure that the dimensions make sense. Making sure that all the notes are
211 there, all that stuff hasn't gone away. So it's a myth to think that, oh wow, put it all together in
212 the model and then pop, we have a - plans. I remember having a conversation with a Revit user
213 who said, yeah, it's just a push of a button ((Laughter)) and then I kinda went along with that,

214 and the I learned, well wait a minute, it's not - that's just the plans. None of the notes, none of
215 the thinking that goes along with it. So.

216 R: I have actually spoken with someone who said you know, he's working with a younger
217 engineer, who believes that he does all these cool things in Revit and then sends them out -
218 he's the architect - for him to review, but there's no notes, it's just a cut. Or there's nothing
219 indicating what this should be or that should be, and he keeps sending them back saying you
220 need to finish these so that I can review them, but they're done, the model's complete, and
221 they're just meeting on the same level in terms of communication, or understanding what
222 they're trying to communicate. He said, it's really frustrating, but I had to ask to talk to his
223 manager, so that he could understand what I was asking for because he didn't really understand
224 what I was asking for. That traditional communication. And I think that's what's interesting
225 too is that, in technology, people have been believing that BIM will take over in the sense of
226 creating these documents that are the traditional way that we create send something - the
227 communication - to the builder, to the general, to the subs, to the city, to everyone that has to
228 look at them. It may be more efficient in it's own way, but we're still communicating the way
229 we used to. Two dimensions.

230 I: yeah, two dimensionally. Well, officially yeah.

231 R: Do you think that will change?

232 I: It may. I mean, definitely, we're working with a contractor right now, on that building, and its
233 sister building, that we have given them our model. And they take that model and they use it
234 for their construction purposes. Coordination, in some areas, you know, they manipulate, and
235 they change, they go to the next higher level. We're all working on the same model. The other
236 interesting thing about that one is, is that the mechanical, electrical, and plumbing engineers
237 are actually, they're design build. So they're working for us, as the engineer, and then they
238 will build it. So, the level of documentation is a little different than if we had a standard
239 engineer, which would then bid from those drawings. It's a lot more integrated process.

240 [R: Yeah, it seems like it would be.

241 I: and on that one it's because, I think we have a pretty sophisticated general contractor,
242 sophisticated design build engineer, and we're pretty sophisticated. Ahh we have other
243 projects, where similar situation, contractors on board, we're working in BIM, and structural
244 engineers are working in BIM, but the mechanical, electrical, plumbing is a different tire or a

245 different level. You know, they work on more lower cost projects, wood frame, metal frame,
246 rather than concrete, and as a result, they don't have that BIM capability. They have the BIM
247 capability but they use it in a different way. They don't use it with us. So we're not sharing our
248 model, and it's an interesting world, because I'm gonna work so well on the high-rises, and on
249 these other mid-rise projects ummm It's been a more of a struggle, a little more traditional.

250 R: I'm assuming you're outputting something for them to work with, and then they're doing
251 something and then that comes back,

252 [I: and that's how they're used to working, and that's how they want to work, and they're really
253 2D, and even on the high-rise, the electrical, we're typically in 2D. They, well, to be a
254 participant, you have to work in BIM. So, the first project we tolerated it, and the second one,
255 we said, if you don't have the capability, you have to find it, and bring it into your team.

256 R: and that's not been a deterrent in any way for most people, they just make it happen?

257 I: No. Because, well, they're gonna build it, they're gonna make profit from building it, I think
258 they probably have internal conversations about hey, this is the new world.

259 [R: This is the opportunity to move forward with something like that.

260 I: Exactly.

261 R: Change is good I suppose.

262 I: Yeah. And it's not, you know, it's not perfect by any means. I mean we still run into issues,
263 that one's being built right now, we'll find coordination issues, even though we did our best, or
264 we did a high level of coordination, through the model, there are still issues that come up.

265 R: But you'll, the assumption is you'll learn from whatever new things come up.

266 [I: Right. R: And improve for the next one, and I suppose just keep moving forward as if it had
267 been any of the other technologies that have come our direction.

268 I: Exactly. Yeah. The city, it's interesting, I don't think the city of Seattle has the electronic
269 document submittal yet. I don't think we've submitted - I think we submit everything hard
270 copy still. But they're moving in that direction, I know some jurisdictions already do it. My
271 experience is mostly with Seattle currently. But that's, that's a really cool thing, procedurally.
272 We don't have to print as many drawings, we don't have to haul them to the city, stamp them
273 all,

274 [R: stamp and sign everything.

275 I: Yeah, so, it's, that's a nice change. And then in construction administration, we have programs
276 that red mark submittals, when we get submittals back from subcontractors, through the
277 contractor, we're marking them up in the computer. We put our electronic shop drawing's
278 stamp on them and send them back.

279 R: have you found, and this is just a curiosity question, that some people still prefer to print
280 something out to review it and then [send] it?

281 I: Yep. Yeah. I'm one them.

282 R: I am too. I just thought I ask.

283 I: I review a lot of contracts, and I do that all, I can't view it on the screen.

284 [R: It's difficult.

285 I: Even though we have track changes and all the different things, it's easier for me to look at a
286 hard copy and have a blue, or green, or red pen.

287 R: I'm imagining, and that's because of the way that students have really started to move along
288 with technology, the assumption is that whenever they show up they going to know how to use
289 everything, you don't have to teach them. The same way we may have had to when you start in
290 an office space, word, and excel, and PowerPoint, they've had to use it in high school, or
291 they've had to use it in elementary school. That will probably continue to move along the same
292 way, that anything else would. I'm also observing a class at the U for a friend who is teaching
293 Rhino at the same time. We did a little survey to ask the students what they thought, and it's
294 very interesting to see what they're thinking about, you know, technology helps me to see
295 things better, and flat out asked, is it easier to sketch or is it easier to use software to do
296 something, and it's kinda still leaning over to sketching is easier, which is kind of a nice thing
297 to see. And a few that do think that technology and software is a lot harder than I thought it
298 would be. Which is kind of an interesting thing too, because there's so many - you can do so
299 many things inside the computer, but when you get to fabrication, that's when you realize, it's
300 not just that you push a button and make it come out.

301 I: Umm, Couple things that come to mind as your talking, one is my son, who is now twenty-
302 two, when he was graduating high school, he and a friend, they just picked up SketchUp off of
303 Google, and they played with it. And they're both artists, one of them, not my son, is studying
304 to be an architect right now. And they just created these fantastic buildings, and really
305 beautifully done in SketchUp. And they learned all that intuitively. Umm, his friend, actually

306 came and did a um, six week program that the high school had, he came and worked at our
307 firm, and at another firm. And I included him in a lot of meetings, and after one, he
308 approached me and said, would it be okay if I took the sketch up model of that and made these
309 revisions to it, you know because we'd talked about different approaches, and I said, that'd be
310 great, but you actually have to do the right heights, lengths, and stuff, it's not just that stuff is
311 coming out of your head. And so he did. And he said that was a little different for him. It
312 wasn't that kind of - it doesn't matter, he had to hold it to some parameters, but it worked. I
313 mean, he enjoyed doing it. Other software, because you're talking about PowerPoint, excel
314 and word, Microsoft project, for people who are more managing projects, is one of the ones
315 that we use a lot, here, and, we use a program called Deltek, for our accounting software, but it
316 has a planning module. So we use that a lot, and that's a learning, curve, and we find that very
317 few people really know how to use that.

318 R: I'd assume just based on the level of representation that Photoshop, InDesign, illustrator all
319 those things are part of what you do as well.

320 I: It is. And not everybody knows it, but most people do. And that's wonderful tool. And in
321 fact, we have some people that are more my age, that will, umm, do hand sketching, and then
322 bring it into PowerPoint, and do something wonderful with it for presentations and such.
323 There's a lot of flexibility out there too, that impresses me. You mentioned Rhino, we don't
324 use Rhino, but a lot of students come in with it. I don't know it, as a result I don't know much
325 more than it's name, but it's something that a lot of students come in, it's on their resumes, we
326 don't use it. There's been some talk about maybe being able to use it. And then, rendering
327 software, like, ahh, I forget all the names but there's several of them

328 [R: Maya, vray, all the others, ahhhh 3D studio,

329 [I: 3D studio, yeah, umm, we have some people that know that, but we don't really use that
330 either. We tend to use SketchUp and then a use a program called Maxwell.

331 [R: Umm-hmm, I think Maxwell render.

332

333 [I: Yeah, Maxwell render, that's how we do it. I think there's another program that's similar that
334 people use here that's an overlay,

335 [R: Could be shaderlight, or one of these others, SketchUp has a lot of plug ins.

336 I: and that kind of satisfies everything that we need, and when the ultra, super realistic stuff
337 comes up, it's hired out. Usually the owner just you know, hires it out, as an entity for their
338 marketing, or whatever, and they take our drawings and plug em in.

339 [R: budgeted for in it's own way because it marketing.

340 I: right. But it's interesting that that ((points to image in room)) is a traditional rendering, by
341 XXX, here in XXX, and that, it's a work of art, there's less, and less, and less of that. In fact, I
342 know XXX, I see her on Facebook all the time, and she's pushing, she's teaching how to draw,
343 painting, watercolor, that kind of stuff and doing a lot less rendering for projects.

344 R: That's too bad. In it's own way.

345 I: It is too bad. It's, it all is just the way software is taking it. I'm the chair of the XXX Design
346 Review Board. I see a lot of presentations every week. And, recently another firm came in,
347 and they had the most beautiful renderings, and they're all basically hand drawn, but over
348 SketchUp. Framed. It was a nice blending. It's a little more relaxed.

349 R: I sometimes think, it would be, and granted, there's not enough time in any degree, let alone,
350 first you need to teach them the foundation skills and everything they should be learning, and
351 then somewhere in there try to slot in all this technology that they want to be learning, let
352 alone anything else, but in whatever I do, when I've taught students to use SketchUp, my hope
353 is simply asking, you need to find your own voice, using something like SketchUp, or
354 Photoshop, or illustrator, any of these tool. Because you don't want your vision to look
355 exactly like anybody else's. So just like when everyone still has to learn how to draft by hand,
356 no body uses it, but everybody has to go through that process, everybody's lettering it all has a
357 distinct sense that it belongs to you, and you don't want to lose that same identity as you go
358 through with just turning something straight out of SketchUp.

359 I: Yeah.

360 R: Because that looks exactly like SketchUp, and everybody knows what that is. You need to
361 tweak that a little bit and give it some personality. Which is lost by not doing everything by
362 hand anymore.

363 I: How do you, I'm sure you've talked about this or researched into it, but the whole idea of the
364 hand and the brain, connecting, and how that encourages more creative thought than, when
365 you do that through the keyboard.

366 R: I've read a few things, and that's the question that's really starting to come up. My point of
367 view is simply that there are other disciplines that have started to look at that, our discipline in
368 architecture has not, because we do something else. Learning, or that, that, that creativity side,
369 is as important in the sense that we're building buildings. This is what we do, and research is
370 not really something, that kind of research is not really funded by anybody. But there is, in
371 terms of learning and cognition, how you think about thinking, embodied cognition is
372 something that exists. The idea of physical, something physical helps you think differently.
373 And there is research out there that does actually talk about sketching, there's a difference
374 between sketching and doing something in the computer, in the sense that sketching is very
375 conceptual, and it's almost more in an effort to save the idea and then go on to the next idea,
376 and go on to the next thing. There was a time when you had five, six, seven, eight, versions all
377 on trace, and you could go back to one,

378 [I: Yeah.

379 R: if you decided, that one was better.

380 I: right.

381 R: And studios were the same way where your instructor would come up and say, you went
382 wrong, about here. As opposed to it, the way , you're doing conceptual on the computer, and
383 we've lost that because, unless you're saving every couple of frames something separate, or a
384 view thereof, you have to undo everything to go back to it. That's something I have wondered
385 about, each office, how does an office manage that, we all collaborate, we work in a team, how
386 do you get that up to where people can see that now. Or do they look at the models and work
387 off of that.

388 I: We're tending to work off the models. Which is that's where my concern is. In fact, had a
389 conversation last week with one of our really senior designers, umm, he's over sixty, and he's
390 an amazing craftsman. He was basically saying, we don't do physical models, here. We do it
391 all in the computer and we're losing that - and I don't mean a presentation model, like that one
392 out there - I mean the little maquettes and little studies that a lot of us are used to from, from
393 our early years,

394 [R: just see what the massing looks like.

395 I: Yeah, and then you can look at it, and now we do that same thing, we look at it on the
396 computer. Ummm, so what we're doing, we're not setting up a model shop, but we are really,

397 one of our people, she went to the UW last year and was trained in umm, 3D printing, digital
398 fabrication, we're gonna start using that. We're going to try it on a project and see what we
399 can do with that.

400 R: Well, even using a laser cutter to cut pieces and then to glue them back together, that's really
401 changed education, just the existence of a laser cutter, to be able to produce a drawing, and
402 then have this thing cut it, gluing it together is easy in comparison to having to cut every single
403 little piece by hand.

404 I: Exactly. Like my wife nearly cut off her hand one studio. ((Laughter))

405 R: and all that drafting tape.

406 I: So, there's that. You know, it's interesting, because I came from a firm that, even though it
407 had a lot of technology, in the middle of the firm, was a model shop. IN fact one of the people
408 that we hired there, straight out of the UW is now about to get her license and she works for
409 us, here. What a wonderful transition, from that craft to doing buildings and such. Now it
410 really affects things like kinda stuff Hoff is doing or the Barclay center, and such that, where
411 you're actually creating stuff and then sending it straight to the fabricator. Scary as hell.

412 R: But it can happen. And that's sort of the concentration at the U and using parametric
413 modeling, it's very accessible to students, in general, both cost and training, that kind of thing.
414 And then in conjunction with Rhino is Grasshopper, which is the programming language.

415 I: Yeah, I hear it all the time, but I only know what it does conceptually.

416 R: I started off in the class and said I'd rather read the code, visually it doesn't work for me
417 where I put these batteries together and then these batteries move this thing, and I change this
418 formula, and it spits this out at the other end. But that's my own shortcoming and married to
419 doing it like this. Rather than imagining it all in here in terms of a program and what it's gonna
420 do. But in any case, there's, that's the direction that things are going, and the branch of the
421 architecture department that I'm in is that digital fab side.

422 I: Oh, okay.

423 R: Most of the people graduate making something, or writing a program that helps architecture
424 and design in terms of technology. I'm sort of on the other end of that thing, okay, we're doing
425 all this stuff, how is it impacting us in general. How is it making change in terms of how we
426 think and I've been to a couple of firms where, it's just understood, some people sketch, other

427 people work in the computer. Okay, I guess that works, as long as we're not losing anything
428 along the way.

429 I: Right.

430 R: I did also step into another firm where because everything is being done in Revit, they
431 produce physical drawings all the time, or sketches, where they are and they maintain separate,
432 not really conference rooms but extra areas but everything gets put up for that particular
433 project. So that the rest of the team can see what each person is working on. Because we've
434 lost that sense of things all over your desk, like we did before.

435 I: It's really interesting because Alan Hart, our founding principal in our Seattle office, he, and
436 one of our premises here is we don't want to grow more than thirty people. We're trying to
437 avoid middle management, we're trying to the connection. So the communication is actually
438 really good. Umm, we have a lot of, we try to do smaller concentrated teams, and so, Alan will
439 check in design, he may not be the key designer, but he'll come in and give crits and such.
440 And a lot of times it's him sitting on one of our stools, next to a 3D [rendering] with a
441 designer, and they're manipulating it right then and there. So, and Alan, is my generation, and
442 he's able to work in that world. He can't manipulate the model, but the designers can.

443 R: Kind of a pairing.

444 I: Right, and there's always flimsy, and what about this? And XXX, who I was taking about
445 before, is such a craftsman, he's fully Revit capable, he does all the Revit stuff, but he still
446 hand draws, and he'll make his own little models of stuff. So around his desk you'll see
447 models, physical models.

448 R: I'd like to, that would be a PhD if I started heading into that kind of research, to find out that,
449 what are we thinking about when we're building as opposed to when we're doing that or when
450 we're sketching.

451 I: And for people like me, I went into architecture originally to design buildings. I now manage
452 a firm, and design, I call it designing a firm, and designing buildings as a result. The, I love
453 drawing, and to lose that, to me, is a huge loss.

454 R: That would be the tragedy in many ways.

455 I: And I know that my son, when he was considering architecture, and he, he, is a visual artist,
456 although he is technically capable, just like all kids are nowadays, he loved to draw. So he's
457 got a sketchbook with lots of drawings. So we do try to, even though a lot of our people work

458 in technology, to encourage sketching and the art side of it. Maybe not as well as we could, but
459 it's a work in progress.

460 R: Deadlines are always going to show up. Not always time.

461 I: So we're at about twenty minutes to ten, and I wanna make sure we get through any specifics
462 you, or if this is helpful.

463 R: This is, you know, I have sort of approached everything, I have a list, in case we get stuck, but
464 in general it's how does this office work, how do you think it should be working. Let me see
465 if there is anything in here that I didn't necessarily... I'm assuming the office was already
466 using technology when you got here, and the office practice has changed sort of how we
467 discussed it to accommodate the different kinds of tools that are being used, but we talked
468 about construction documents and design development, that has not really changed all that
469 much. Umm,

470 I: I would say that right now we're on that cusp of the 3D, model, and that digi [R: digifab? I:
471 yep, 3d printer technology, maybe even getting one, and then I'm personally very interested
472 with one of my colleagues with exploring the idea of direct fabrication. Because there's, I
473 think that's the future. That's gonna, when you look at the Barclay center and you see what
474 they were able to do, that they couldn't do otherwise, it's really exciting. Now I'm not into
475 Frank Gehry designs, but the flexibility of being able to do things in a logical way...umm,
476 they had a great example of more of a rectilinear building on top of an existing building, and
477 I'm sure you know it, where they were able to get a much better building because they could
478 directly communicate to the factory in Europe, and get everything sent over less expensive
479 than going through a traditional system, for the cladding of the building. To me that's huge,
480 because that gives us a lot more flexibility.

481 R: I've heard that from somewhere else before saying over time, very likely, the restrictions of
482 materials the way we're used to thinking about them will go away. Because you can
483 communicate directly to the factory what you'd like to fabricate. As opposed to having to say
484 we're going to start with this particular material, it comes in these kinds of sizes, and then we
485 will make it do what needs to be done. It'll just be I need you to fabricate a window that looks
486 like this, here's the model of what it should be. Now just make it. Done. This might have all
487 different odd tolerances within it, but you can do that now. As opposed to before when you
488 couldn't because of what comes in between.

489 I: Well, there's also the cost. And what was amazing to me is that they did a very unique
490 approach, and it was more cost effective. They got a better system than they would have, off
491 the shelf. So that really intrigues me. ((Laughter))

492 R: I'm sure, well, especially coming from the management side you're looking at more things
493 than just the design alone. The things that impact it including time, cost, budget.

494 I: Well, it's that designing a practice. You know, and what should that practice be.

495 R: It's gonna evolve, it's just gonna keep on moving.

496 I: That's right.

497 R: I guess, one question that I do have, that I find is really kind of interesting, do you think that
498 being that being able to design, essentially creatively and thinking about a concept, should
499 people be required to be able to do that without using technology? We had briefly discussed.

500 I: Sketching, yeah. That's a personal opinion, kinda thing, but practically speaking, in today's
501 world, um, it, I've seen that it can be done without doing that. Some of our younger talent, is
502 really able to work in SketchUp. Revit definitely not. But SketchUp, definitely works. I'm
503 starting to come around to understanding that people are wired differently.

504 R: I think we'll find that out. We're not going to, architecture moves so much more slowly in
505 terms of the way that we adopt technology, manufacturing has been doing things completely
506 differently for a long time. We're hanging on to a lot of the old traditions. But I do believe
507 we're going to find out if we take the time to really study that, that people will be thinking
508 differently because they're thinking virtually in a different way from someone who typically
509 would sketch but would still be imagining it in their head. There's a different - I'm not sure
510 how that relationship is slightly different, than it might be.

511 I: And that's the part, I'm not sure what we're losing. And we may be, fifteen years ago, I would
512 have said, absolutely, if you're gonna hire somebody, they have to be able to draw, they have
513 to be able to communicate by hand. Umm, its totally wrong if they would design in AutoCAD
514 at that time. With SketchUp, there's been a bridge. Although, I haven't learned SketchUp,
515 and just from looking at it, it's still not that direct connector, the brain to the hand.

516 R: There's an extra step. How will I make that, do that.

517 I: Umm, but the result of what I've seen come from people, I'm a believer that it can be done
518 different ways. Umm, I worry what we're losing.

519 R: You're not the only one. ((Laughter from both)).

520 I: I know.

521 R: There's a hypothesis floating around, but I don't really know how to pinpoint that. Or
522 identify what it is. So, I don't know that I'll have that answer at the end, but if I find it, I'll let
523 you know.

524 I: Yeah.

525 R: Essentially, I'm trying to find, if I talk to enough people, perhaps one or two trends, in terms
526 of some of the things that we could improve, in terms of preparing students might show up.
527 One of the things that could be very helpful, would be, we don't necessarily, at least at the U,
528 we don't teach technology use, the same way you're going to use it in practice. You have your
529 studio classes, and you can take an elective, in Revit, in AutoCAD, in Rhino, if you choose to.
530 That class will have its own set of design or problems that you need to solve with it. But the
531 idea, many students will take those skills back into the studio, and instructors will allow them
532 to use technology to present their projects. But the explicit, well, we're going to work on that
533 project this way, now maybe these are views you'd like, isn't necessarily something that is
534 specifically done. But we do it in practice all the time. Where you sit together, and you talk
535 about this, and you work on that, and can you build this other side and look at some
536 viewpoints from over here and get a sense of that. I'm thinking perhaps maybe that's where
537 we're going to have to start heading, is training instructors to be able work with those together,
538 or to use them specifically. But I don't know.

539 I: yeah, it would be interesting.

540 R: Because then you'd get to practice understanding this is how we use technology, not oh I
541 know how to do this stuff too. It's like and I do photography on the side.

542 I: Well, I do think that having, you know, I like what I'm hearing, in terms of how you're
543 teaching. But the actual ability to jump in and start working in Revit, and in Revit at least as a
544 contributor, Revit you have to know how it goes together, or you have to have someone telling
545 you how it goes together. But Revit and SketchUp, having the technical ability to work in
546 those is important.

547 I: At least Some familiarity with it,

548 I: it really does help. And it's starting to become pretty standard, that even those people have
549 great ideas, who have great minds, there's enough of them out there that when we're

550 interviewing, they have that ability and they have the technology behind them. And it's like,
551 we don't have to make a compromise.

552 R: That would be ideal.

553 I: Yeah, but we're seeing a lot of that. So it's interesting. It's evolving to the point, where a
554 student coming out of UW, WSU, UO, really should have the technology piece. The one that
555 is over here. Understand that technical ability so that they can be a contributor. I think that is
556 important. The other part is, the model making piece. Using those software to be able to
557 construct models, The tactile, building a model, and that kind of stuff, I don't see the
558 connector, that I do between sketching, but I do see once it's built, the ability to look at it in a
559 different way than on the screen. But there, I really hope that the 3D printers or other
560 technology can come in and make it easier, save people from xacto knife cuts.

561 R: The end result of what architecture does is three-dimensional. We really, we've moved ahead
562 by using software and technology to imagine the 3d virtual space, but it's still two dimensions,
563 on a computer screen, we've not moved away from that either. There's balance in there
564 somewhere.

565 I: the 3d representation on a 3d screen, certainly, it's a lot better than is used to be you can really
566 spin around, go above, below, zoom in, flythrough, but, that part of it is pretty cool. But we've
567 taken a shortcut in not having the physical, hold in your hand, kind of model, that you can
568 study, and often show your clients.

569 R: They love them.

570 I: and they understand them. We have one client, who, has it all modeled in SketchUp, we have
571 no physical models, and he's not getting it. He's basically unconvinced that he's getting what
572 he wants. I keep telling him, you're getting what want. Look, you know, here's this view,
573 here's that view. Yeah, but it's not rich enough, and that's because the software can't convey
574 that actual feel of what it really looks like when the shadows fall on it. That it's a very
575 intricate design, rather than what SketchUp is making look a little more streamlined, clean
576 lined. I think it's a contributor, sometimes, to miscommunication with clients.

577 R: That's most important in many cases, we don't want any change orders down the road.

578 I: Well, we don't want that, but we also want clients to make good decisions. You know, for
579 design. Sometimes we have great design, but if we can't convey them we end up with
580 something lesser. Because they weren't convinced.

Supplemental Material A5. 3012 Interview Summary

1 R: My background is in both design and education, so I'm going to go back along that, kind of
2 the qualitative, and go through the recordings and align them with the transcripts.

3 I: Hey look at that, I'm supposed to be in a meeting with you.

4 R: Oh good, I'm so glad we made it. I have a bunch of questions, but I'm going to ask one or two
5 and wherever we go from there, the two and half hours in some cases, and forty-five in others
6 is fine, just because everyone has a different point of view.

7 I: Sure.

8 R: Um. Let's see, are you far enough along, do you actually use technology?

9 I: Are you saying that I'm so far along that I don't use technology?

10 R: No, but some people are almost strictly management, even though they know how to use
11 technology, they don't use it anymore, because there are other people doing it, in that sense.

12 I: I would say that I do not use it a great deal. Um, technology, being, if you're talking about
13 whether it's Rhino, or Maya, I dabble a bit in Revit, I do a little bit of modeling, 3D viz,
14 whether it's SketchUp or -

15 R: That's nice, that you can find the time to do so. Just based on your title, you're far enough
16 up the food chain that there are others-

17 I: My billing rate is such that it doesn't make sense for me to actually do that kind of thing.

18 R: Umm, so in general, even though you don't use it specifically, you obviously oversee, or
19 work on teams, collaborate in teams with other people who do that sort of thing. Does the
20 office umm, have numerous packages that they use, typically work in Revit, stopped using
21 AutoCAD?

22 I: We have AutoCAD on select projects, projects that had started in AutoCAD, and they're in
23 construction so it makes no sense to. We also have certain clients that have requested that
24 projects stay in AutoCAD.

25 R: So it's almost client driven.

26 I: It's almost client driven. Even when a client says they have no use for Revit, we ask them
27 whether or not we can still do it in Revit and output it the files to CAD. We find that, you
28 know, the 2 dimensional, programs that are strictly limited to 2 dimensional representation are
29 probably numbered in terms of their usefulness.

30 R: Yeah, I think so. And really, it's the collaboration and the level at which other people can
31 function.

32 I: Yeah, there's that and also there's the sense that if you allow people, especially with older
33 people and experienced staff, they're always going to revert back to what's easiest for them
34 and what they know. The faster you know take the training wheels off and push them down the
35 hill. ((Laughter from both)).

36 R: Throw them in the pool, in the deep end!

37 I: Yeah. That's right.

38 R: On no. So in terms of when you're looking at hiring, whether or not the candidate is early
39 on, or a little further along, technology is a requirement at this point, or would you train the
40 right person?

41 I: We train the right person. Nothing beats, you know, inherent talent.

42 R: Yeah. So that is still the foundation that everyone seems to be looking for.

43 I: That is.

44 R: It's consistent, everyone I talk to. Technology or not, I need them to be able to think.

45 I: Yeah, exactly. I mean you can train people to use technology. You can't necessarily teach
46 people to think once they're done.

47 R: One would hope that it can be done somewhere.

48 I: But by this time in their life, if they haven't picked it up, they're probably going to have a hard
49 time.

50 R: I would think so. In addition to Revit and AutoCAD, assuming 3D rendering. Do you use
51 rhino?

52 I: We use rhino a lot in our office, we also use SketchUp as an initial modeling tool. Umm, we're
53 starting to look at utilizing grasshopper more.

54 R: That would have been the next question. And then the typical Adobe suite.

55 I: Yeah.

56 R: Any 3d Studio, Maya, Vray?

57 I: Yeah, we use 3d Studio. That is widespread. That's more for finished graphic packages. We
58 also use several climate modeling programs, and um, environmental programs. So, one of the
59 two big ones we use, you probably have it on your list there.

60 R: I don't actually have it on my list here.

61 I: A ha. I can't, I'm drawing a blank.

62 R: That's all right.

63 I: But we use a lot of those statistically based programs for analyzation.

64 R: At this point, the way that the program at the U works, those programs are even more of an
65 elective than even just Revit. Because Revit is sort of an elective, and AutoCAD would be as
66 well.

67 I: We have people that teach those at XX. So. Especially in the some of the environmental
68 programs.

69 R: The program that I'm in, I'm in the design computing stream, but I'm the weird one, who
70 doesn't want build something. ((Laughter)).

71 I went backwards to the other side, and said, great, we've got all this stuff running, but what are
72 we doing to make sure that we're teaching it right, or - we can't add time to the education,
73 you need to stay and learn these things too, but we have to find a way to be sure that the
74 graduates still get, what they're supposed to. Or what firms are expecting. My point of view
75 here is really, what kinds of things truly expected, and with the anecdotal, hypothesis that
76 something seems to be missing. Can we find what this is, and figure out who to make it.

77 I: I'm sure what most of the large firms that you're talking to, or maybe not. Maybe not now,
78 but within the next few years we'll probably expect everyone coming out of school to know
79 how important Revit is. We train people how to use Revit in house, because we customize it
80 for our own purpose. But, what we found it takes, a person two or three projects before they're
81 really adept at using Revit, and so if they've gotten two or three project cycles out of the way
82 during design studio, rather than learning on the job, then it's just a matter of learning how we
83 utilize it, how we customize the program.

84 R: That's actually very interesting to me that you said that specifically, because that's one of the
85 things that I noticed, some of the studios will allow students to use whatever it is they're
86 learning, but they're not currently integrated in them. And in education, if you have
87 something you want someone to learn, you have them do it at the same time, and have an
88 instructor who can scaffold, and model, and show, this is how you would do this, this is how
89 you would do that, so it becomes inherent, in terms of their ability. Rather, that something else,
90 and might end up being part of my thesis, is that we should be doing it this way.

91 I: I would say part of the issue there is that certainly most of the older faculty, but even some of
92 the younger faculty probably aren't that [set up] in the programs.

93 R: That's true. Like you said, it takes two or three cycles on a project, on a real project. Not a
94 we're going to build a tiny little house, that's not enough. I myself took the Revit class there,
95 and I've used AutoCAD since at least [release] 9 or something like that, so it made sense to me
96 and I understood it, but it was clear that at least 75% of the class, wasn't really sure why you
97 would do a detail at this scale or why you would do a section at that scale because they
98 haven't had to.

99 [I: Exactly.

100 [R: Or understand the reason it could be more efficient to do it this way, because they've not had
101 to pound out a fifty page set or a hundred page set before. That's part of the practical end of it,
102 is something that's a little more difficult to teach. But umm, I appreciate that you've said that's
103 something that's probably gonna become necessary in the future, almost in the same way that
104 AutoCAD, if you come out with AutoCAD it's because you've had to draw sets in AutoCAD,
105 and you get it. Do you think that anything besides Revit, do think the ability in rhino?

106 I: I think the ability in digital fabrication is becoming a crucial, almost everyone coming out of
107 school, whether its at UW, certainly a lot of the east coast schools, whether its Columbia,
108 Penn, I mean everyone has this ability to really utilize rhino and translate that from the screen
109 to a physical model. That's a crucial part of our design process. Umm, you know, it was
110 physical modeling by hand, umm, but you know, it makes it easier, this is where limiting the
111 software becomes handy, is that you don't have to keep translating from one platform to the
112 next platform, in order to get the physical object or to get the drawings out. So, you know we
113 like the creativity that people bring to their desired platform, we are a big firm, and people
114 gotta talk to each other, and we want to be able to work efficiently, too. So.

115 R: When a team starts a project, is it just based on whatever the preferences of the team members
116 are in which to start, or does the office say you're gonna start working in this software?

117 I: Well, I mean it's one everyone is working in Revit, and unless there's a reason not to work in
118 Revit, umm, I think it's partially, the desire of the team, but it's almost always SketchUp,
119 initially. Conceptual, because that has the lowest threshold for getting into, and almost
120 everyone can work in it. Umm. But that being said, as more and more people know how to
121 use Rhino, and they're comfortable with it, I think SketchUp is going to go by the way side.

122 [R: Really.

123 I: I would say so, just because, [
124 R: It's not as powerful.

125 I: It's not as powerful, umm, in a lot of ways, if you understand 3d modeling, Rhino really is not
126 that hard.

127 R: No. And even if you know AutoCAD, you can translate past the two dimensions,
128 [I: Exactly. R: it's far easier that AutoCAD in 3D would be.

129 I: Yeah, yeah, exactly. So I think it's just what people are used to, and as more people as the
130 gospel around, because, you know our 3d modeling, in terms of our, whether it's CNC
131 machines, or 3d printer, they run off of rhinocam. So. You know, right now if you're in
132 SketchUp, you have to translate it, which is another step.

133 R: Which can be a waste of time and occasionally translation doesn't work as well as it could,
134 out you in a place where it's just easier, just learn the other one.

135 I: Exactly.

136 R: So, does sketching still have a place in the ...

137 I: Absolutely. I mean, you know, its still the fastest way to communicate an idea. And I still
138 think it's the fastest way to work things out. Umm. You know. It's also the most, I would say,
139 this is the one issue I seen with technology is, until we learn how to work totally in the digital
140 world, umm, or virtual world, it's not ever going be or it's not going to be as social as the
141 physical sketching.

142 R: Right. I agree with that. I think in terms of education in the studio, when it moves to the
143 computer like that, you've lost that process that most instructors are used to seeing

144 [I: yes.

145 R: Which is, oh, well you went wrong and, flip though all this trace, this was probably better. Or
146 you have other people who pull things out of the trash doesn't happen anymore.

147 I: Or if you're talking to a client, you're talking to a team member, you know, if you're drawing
148 on a piece of paper in front of people and working through the idea, anyone can pick up that
149 pencil, or pen, and start drawing with you, and say what about this. If you have a monitor,
150 whoever has control of the monitor has control.

151 R: Right. And you have this here, let me, kind of thing.

152 I: Yeah, yeah, exactly. It's another step in the communication process.

153 R: So in terms of working in a team, is that something that would happen here, a group of people
154 would be around a monitor, and one person would drive essentially, and other people would
155 say things?

156 I: I would have team people do that. I have seen that especially with senior designers, working
157 with younger staff, saying, hey why don't you do this - and they're standing there in the
158 corner - and I cringe every time I see that.

159 R: Would you prefer that each team member is able to do what they need to do in the software?

160 I: I think that's ideal. I think it's kind of unrealistic. Especially for a lot of older staff. Senior,
161 staff. But still, the idea, I would rather have them, rather than havening them say pull here,
162 pull there, and standing behind the corner, you know, I would rather like the communication
163 occur, if they can't do it by computer, do it by hand. And then, it gives the staff member a little
164 bit more ownership of the process, rather than just being a simple drafting ...

165 R: I believe that with Revit, and with BIM in general, we've moved away from having
166 production,

167 [I: yes.

168 R: essentially, like with AutoCAD. You could hire anyone who could run AutoCAD,

169 [R. Yeah.

170 R: and just draw redlines all the time. But you can't do that in BIM, you can't do that in Revit.

171 I: Well, you can, think of all the firms that use drafting services or model making services
172 overseas. Right, I mean, you design to a certain stage, you redline it, you give it to them, they
173 model it, they give it back to you, you redline it, you give it back to 'em. I know, [our] firms
174 have not done that often, in fact, we rarely do that. But I know a lot of firms, that's the model
175 that they work from. But then again, [we] has never hired drafters, either. So.

176 R: Hire people who can think at the same time.

177 I: Exactly.

178 R: It's more efficient that way. And at least if one skill set is greater than the other, then the
179 other one will eventually develop to meet up. And then that one person is capable of taking
180 care of it.

181 I: Exactly.

182 R: The reason that I asked about that, is it seems in terms of just research and articles, has
183 become kind of a shift of many firms, certainly not all of them, where there is sort of this

184 junior and a senior, and the junior runs technology and the senior instructs as to which - not to
185 say that they're not learning from each other, but it's slightly different in that sense.

186 I: I think that's true to a certain extent. I think it'll change, as the junior staff get more senior.

187 R: They will, that always happens, you can't stop time. Mm, yeah, I think, a few of the other
188 people I've spoken with, it's inevitable, and things are going to continue to change, it's just a
189 matter of being sure that as less experienced designers get more experience, that they get
190 everything they need, and not just one thing, I guess. Umm, does it matter in the firm in terms
191 of visualization, whether one, somebody prefers to visualize in the computer, prefers to
192 visualize sketching?

193 I: I think it's just - it's whatever's appropriate for the project. You now, I mean, we don't have a
194 set design process, or set design tools. In fact, we encourage people, if they've been working
195 almost exclusively in computer, to stop working in it for a while, whether it's actual physical
196 modeling, get out of it, just look at something from a different perspective. And same thing
197 with someone who's been sketching all the time, they can stop and look at something else.

198 R: That's a nice way to sort of balance those two, I think. You really able to utilize the strengths
199 of each.

200 I: Ummhmm.

201 R: And to somehow overcome, if there is the deficiency in one or the other, because you're not
202 visualizing it - I was looking at it this way or I was looking at it that way. Kind of a nice
203 opportunity. Umm. It's clear that everybody uses software, design packages in your, not
204 anyone who wouldn't.

205 I: ummhmm.

206 R: Essentially the office wouldn't necessarily come to a halt, but would not be able to do without
207 -

208 I: Certainly not as efficiently. We still have some old timers that can hand draft.

209 R: I was going to say, there are probably a few people that can still manage to draw, start to
210 finish if they had to, it would take much longer, than before. Does anyone ever, in terms of
211 that graphical representation to a client, is there a mix between hand sketching and

212 [I: Absolutely.

213 R: Not specifically just one or the other.

214 I: We like to show process a lot of the time too.

215 R: That's nice, instead of just the finished - I would assume that most clients would prefer
216 process anyway. There's a point where they don't want to see it finished quite yet.

217 I: Yeah.

218 R: Do you think that if necessary that people would be able to design without using a computer?

219 I: Absolutely.

220 R: I think that's part of that foundations thought process.

221 I: I think, you know if you become too dependent on the tool for your process, then that tells you
222 something about your process. Process should be - it might be more efficient using a computer,
223 it might be more efficient using pencil or a pen or a model, but you know. The process itself
224 should be ore independent of that. I mean, you should be able to design in your head. You're
225 just giving physical form and enabling process. [

226 R: and communicating to someone.

227 I: Exactly.

228 R: Would you have specific skills that you'd be looking for? I don't know if [your company]
229 hires [graduates] right out of school.

230 I: We do. We like to have a broad range of people, so yes.

231 R: That's great, not always the case. For sure. Are there skills specifically, besides technology,
232 that you would be looking for?

233 I: Communication is key. You know, we tend to work on big, complicated projects, umm , but
234 regardless, because we're a very team based, collaborative firm, whether it's with the client,
235 whether it's with our consultants, whether its inside the firm, being able to communicate is one
236 of the most important skills, that anyone can have.

237 R: I would agree with that. ((R laughs)). If that part is there, you can essentially train anybody
238 on what they will be doing, on a computer if that's the case.

239 I: Yeah.

240 R: Has anything in terms of process with the I guess documents, do you feel that the construction
241 document phase has shortened because of BIM or is it about the same, or - ?

242 I: Right now, I would say that it's about the same. You would have hoped that it would've have
243 shortened, and I think that it will eventually get there, but since you know, I mean really, BIM
244 is still in it's infancy, any way you look at it, so there's so many bugs. And that's the problem.
245 I mean, you know. I talked to my colleagues, especially those that work at different sized

246 firms, maybe smaller scale firms that work in, and there, in small, medium sized firms they're
247 working on fairly straightforward projects, the process is absolutely faster.

248 R: Design development and CD?

249 I: Yeah. Because there's less people to coordinate with, they can get their arms around the entire
250 project, and they can understand it, so it's really easy for them. And they're not doing anything
251 too bizarre. But we tend to do really complicated projects that have, they need multiple phase,
252 they may have problematic issues, that change often, and because of that, and Revit, or any 3d
253 program like that, BIM program, has a hard time dealing with things that it wasn't specifically
254 designed to deal with. Whether its a corner detail, there wasn't supposed to be a mullion in the
255 corner, or whether its a curving wall that has odd shapes in it,

256 R: Something that geometrically is different -

257 I: Exactly. That's where a lot of the BIM programs that are different from say a nurbs based
258 program, umm, rhino, or whether it's 3d, where it's, but they're not exact, and you need to be
259 able to produce drawings from those. So you know, somewhere along the line, the two will
260 meld, and it will be come easier.

261 R: So that's really what we should be concentrating on. Finding a way to connect those two.
262 ((Laughter)).

263 I: Yes.

264 R: Umm, in terms of collaboration with outside consultants. Has that changed for you also?

265 I: Yes and no. I mean, The issue is that, the different disciplines are going to be interested in
266 different things. There's a general framework where the sharing the model is extremely useful.
267 But once it starts to get to the granular level, it's not that useful. Because everyone's
268 modeling for a different purpose. So you know, we don't want everything that structural is
269 modeling in their portion of it, because it 's going to crash a model. That's doubly true, you
270 know for MEP. Likewise, they don't want everything in our model, they just want you know,
271 the general framework. So, you know.. At this point, it's more, we reference each others'
272 models more than anything else.

273 R: Coordination.

274 I: Exactly.

275 R: But do you trade back and forth, before you get to that granular level, and then you stop, and
276 everybody starts referencing instead, making changes to their own model.

277 I: Exactly.

278 R: Does the ability to work in Revit ever effect who you can collaborate with at this point? You
279 have to be in Revit or we can't work with you, for an engineer...

280 I: I would say that could be the case, although we haven't' run into it yet.

281 R: for the most part, everybody is, if they're not keeping up, they're further along?

282 I: Especially with the consultants that we work with. They recognize that our clients demand that
283 kind of ability, so they all have that ability to do, or they claim to.

284 R: They claim to. How would you approach work if you were to suggest to someone, these are
285 the things that are best for you to learn, while you are learning in school, studying for an
286 MARCH?

287 I: what are the best things to do? Understand the design process, work on your communication
288 skills, ahh, you know.

289 R: We can't teach them everything, obviously.

290 I: Yeah, I mean technology is great. We expect everyone has a certain amount of umm, technical
291 competence, in terms of programs, but it's nor gonna be the decider, on whether we hire
292 someone or not. It's just raw talent, and you know, whether we sense that the person is going
293 to be a good fit for the firm personality wise, I mean you can have the most talented person
294 portfolio wise, and if you think they're not gonna work out well, we're gonna have to pass.
295 Cause you know, the firm is larger than any one individual.

296 R: That's understood I think these days. Unless you're' going to work for a small firm, then it's
297 probably doubly important.

298 Because everybody knows everyone and all the business that they're doing.

299 I: And that's hard for a lot of students, because I think, especially for a larger firm like this, it's
300 the collaboration of aspect of working on a design project is so different from studio work.
301 You know, its all about yourself, and all about your idea. Which you know, is good, because it
302 allows you to stretch your design learning, but. That's not how the real world works.

303 R: There's always a number of people and a number of opinions and ideas.

304 I: It doesn't matter even if you're working for yourself, because the client's gonna always [R:
305 yeah, they're gonna drive it. ((R laughs)).

306 R: That might be one of the most rude awakenings to have, which is , oh, you don't like my
307 idea...

308 I: Yeah! Exactly. What do you mean we can 't do this. Can you see that's the right idea? But
309 can't you see that I'm writing the check?

310 R: You do what I want because I'm giving you the money to do it. There has to be - I think it's
311 just something that has to happen along the way.

312 I: I think most people realize that fairly quickly.

313 R: You have to. For certain.

314 [...]

315 I: I think the jump from hand drawing to AutoCAD was easier than this jump from AutoCAD to
316 BIM, because, you know, hand drawing and AutoCAD were basically two dimensional
317 depictions of the same thing. Whereas, there's a switch in how you work, When going form
318 2D to 3D. Which is really strange, because, you know, architecture, by nature, is a three
319 dimensional field. And we're taught to distill it down to or dumb it down, or translate it to a
320 two dimensional field. And now we're getting rid of that kind of translation now.

321 R: Do you think we'll ever get past that documents - because construction documents are still
322 two dimensional -

323 I: I think at some point they won't be.

324 R: We won't do that anymore? We'll go straight from this to it gets fabricated that way?

325 I: Yeah. At least for more complicated projects.. I mean you think about some of frank Gehry's
326 work, that's already what happens, right?

327 R: It almost has to.

328 I: it has to.

329 R: Because a 2 dimensional drawing of it would never convey.

330 I: Exactly.

331 R: I cant imagine what the two dimensional drawing should look like for the EMP, or if I would
332 get the whole thing.

333 I: Exactly.

334 R: You have to look at it in 3 dimensions. Whether that's a model or a virtual model. But -
335 physical model building is still something that's really quite used here?

336 I: Absolutely. It's critical to our design process. Because, you know, we use a lot of process
337 models here. So, in the great thing about an actual physical model, versus the computer model,

338 anyone can pick it up, and turn it round. And everyone together can look at it, around at the
339 same time. Again, communication is so key to our process here.

340 R: It's nice to hear, certainly, it think I was somewhere else where that was the same comment,
341 as far as we go with BIM, and how much everybody is using it or using Revit, we can't get
342 away from these physical models. And the ability to use them, even for the communication to
343 the client. Some people just cant see past, for whatever reason that somehow sells it. But it
344 does seem, I have a fellow student, I am observing his class, he's teaching rhino, if you put a
345 3d object in a room with a bunch of people that are that to talk about that, that's always going
346 to get far more interest than any 2 dimensional anything you can bring.

347 I: Exactly.

348 R: They're going to stop looking at all the fancy pictures as soon as that shows up.

349 I: Absolutely.

350 R: I don't know what it is, building blocks, as kids kind of thing, you get excited...

351 I: Well, there's less interpretation that you have to do for everyone. And if you're not trained to,
352 you know again, translate from the two dimensional to the three dimensional, we can look at a
353 drawing and say, that's what I think it's going to be in 3 dimensions, where the layperson's
354 going to have a harder time doing that.

355 R: Well, and they can interpret it from their point of view. Rather than I decided you were going
356 to look at this from this view.

357 I: Yeah, yeah, exactly. That's also why we like physical models in our office, again, you can't
358 control the view so you can see all the warts.

359 R: That's the true. You can't hide those things.

360 I: Yes, exactly.

361 R: I wonder where that's going to happen in terms of a Revit model. You look at it and it's all
362 complete and closed, but somehow there's something missing in terms of what happened to
363 the extra three feet.

364 I: Yeah. That's one of the things that's scary about renderings, where are we going to pick the
365 most flattering angle. Which is great when if you're trying to do a presentation, and you're
366 driving a point, but it doesn't tell you everything you need to know about what the design's
367 actually doing. It's such a controlled perspective of what the project is.

368 R: Do you think you can give a rendering the same kind of emotion and experience that you
369 could do at one point with hand renderings?

370 I: I think you can. I mean, you know. I know for people there's been a trend for the hyper-
371 realistic, which is good, but I tend to like the ones that go in the opposite direction actually.

372 R: Interpretive.

373 I: Yeah.

374 R: This is how we'd like you to think about the space.

375 I: Yeah. That's more evocative.

376 R: I think that's the beauty of sketching was, just three lines and it already tells you something
377 about the space without having to finish it.

378 I: Exactly.

379 R: So maybe that's what we need to explain to students, it doesn't need to be perfect.

380 [I: Yeah.

381 R: You need to convey a feeling.

382 [I: Exactly.

383 R: you need to get the individuality of the project and the design,

384 [I: Ummhmm.

385 R: more than an absolutely perfect.

386 I: You know, early in my career, I used to do a lot of renderings, when I was first starting out,
387 taking all these really early 3D studio, you know, people in my classes would try to model that
388 person perfectly to put it in, and I'm going yeah, but what about the building behind you
389 ((Laughter)).

390 R: There are other things.

391 I: Yeah.

392 R: Well, and I think that's certainly, the sequence of teaching anyone when to be using this kind
393 of thing, you want to know that they have a foundation, otherwise they get stuck trying to fix
394 these things that are so close

395 [I: Yeah.

396 R: The railing is really not that big a deal.

397 [I: Yeah, exactly.

Supplemental Materials A6. 3052 and 3053 Interview Summary

1 R: [...] We're now faced with training students for practice, with the same amount of years, in
2 foundation skills, the kinds of things you need to learn, but we're also faced with AutoCAD,
3 BIM< rendering, Photoshop, SketchUp. The question is where do you slot it in, when should
4 you slot it in, how should you put this in. I'm asking the question what is education doing
5 now, no one has come upon a specific way that seems right in terms of learning theory. I got
6 directed, to go ask, and to find out what the practice is looking for. Whether it is a large firm,
7 or a small firm, or a large enough firm that can force others to use Revit. Every point of view
8 is valid.

9 I1: The educational part of it is interesting, I'm not sure whatever any office is doing would
10 determine how schools could best teach or prepare people necessarily. You will find a range,
11 big, small, or medium range firms.

12 R: What has come out as a consistent type of practice, whether it is BIM, SketchUp, it has gone
13 into the actual process of design. As long as you know how to design, now it has become
14 something that people are using in conjunction with that process. Typically, at least at the U,
15 instructors will allow students to use technology to create and produce, but it's not integrated
16 the way it's integrated in practice. Where someone would say, here's a best practice if you're
17 going to start with conceptual, I've run into some people that have mentioned that part of the
18 trouble with new graduates is that they don't know when to use what. Necessarily. Sketching
19 is good, they know how to sketch, but conceptually, when do you start. So they might make a
20 decision to start in BIM immediately, when it's an as built and there's going to be so many
21 changes this might not be the best use of time yet. It varies.

22 I1: How would they know. ((Laughter))

23 I2: Right.

24 R: Exactly. You haven't had the time to practice. And I've had people say its that simple, if it's
25 the right fit, we'll train anyone on anything. It's not a concern.

26 I1: Well, students probably aren't too different from people that come to work in a professional
27 office, you arrive with skills, you can do certain things, but you can't do other things. You start
28 where you are and you develop the skills that you need. Office can be a, need to be a little

29 more clear and decisive about the software that they work on. We were probably on four
30 platforms at one time.

31 R: So how long has the office, as long as you've been here.

32 I1: It's a 15-year-old practice. You've been here seven?

33 I2: Yeah, over seven.

34 R: In an essence, all fifteen years, there's been some form of - AutoCAD used to produce your
35 construction documents.

36 I1: AutoCAD, was t the very beginning. Even now, small projects, hand drawn, larger
37 institutional projects on AutoCAD. 3d modeling software was pretty primitive 15 years ago.
38 Even in the profession minimal use. You're talking about the crossover where school was
39 ahead. There were relational database programs like BM r(oocaps) a big mainframe that no
40 office had. I think even students were ahead of the curve, form z was the popular 3d modeler.
41 It came into offices from the students. I was in practice, we saw people coming out with those
42 skills. No people who were in the profession went back and acquired them, for the most part.
43 That was an interesting transfer. And then SketchUp of course. People coming out of school
44 had certain mastery, and people in office picked up quickly, so it wasn't a big commitment.
45 About that easy.

46 I2: The learning curve was really small.

47 I1: It seemed ideal, but that was kind of a golden age of ((laughter)) technology platforms. Now
48 I'm not sure who is leading whom.

49 I2: Regarding BIM.

50 I1: Well, you know the different platforms, or what you can do in terms of digital fabrications as
51 opposed to general documents. Design, and development of design.

52 R: Communication and which direction that goes. The U actually teaches a Revit class, I took the
53 class, but it's interesting because its really taught, and Revit is a difficult one to learn if you've
54 not had any experience putting together any kind of set. There's no correlation of knowledge.
55 Yore going to cut these sections and then decide on the granularity of that particular thing
56 based on what it's going to be. It's not an easy cut and dry, it should be half scale, but there's
57 only maybe 3 or 4 of us that say yes, I've had that problem, yes I've had that issue, but
58 everyone else would say I'll do what you tell me to do. And learn how to use the software
59 because it's clear I need it.

60 I1: Right, well you just described a documentation problem that's really a professional problem,
61 it's not really a student issue. As so from a design point of view, no one asks that question of
62 SketchUp. You make it like you're making a cardboard model. Maybe I want to see the
63 outside, so I'll futz on the outside, or maybe I want to get in it, so I'll make it hollow. So
64 people literally just plow their way through it, guided by what feedback they needed to get
65 about their design. And um, Revit just because it emerged as a professional interface between
66 construction and design its all about the documentation that gets handed off to people that
67 make it. And the team that coordinates and builds it. We thought when we're trying to see
68 how we can use it in the design phase, because it has 3 dimensional visualization capability,
69 and has dimensional control and all this stuff, which you do need at different phases of design,
70 it's pretty cumbersome when you don't need that. Early on, when it's an idea about how
71 people are going to sit around a table, BIM's not helping you out too much there.

72 R: It's almost too detailed.

73 I2: It's so complex, where people should spend more time sketching using trace, and relying on
74 those skills, and actually thinking out about creating the design with different models, and then
75 actually going into the model and creating it form scratch. And we see a lot of people
76 struggling with that because SketchUp was such an easy intuitive tool to go from you know a
77 thought directly to the digital media. But there's that additional stuff when you need to think it
78 out , sketch it out, figure out how it's going to go together before you step into Revit. So.

79 R: Sort of going from concept to design development, you can't go right into Revit for design
80 development necessarily.

81 I2: True.

82 R: But people might try.

83 I1: [R2] is a young dinosaur but is still a dinosaur. He started out drawing first. Everyone in the
84 office draws, really proficiently, by hand, and I think that that's something I wouldn't say is an
85 absolute, but it been pretty valuable for us to have that capability.

86 R: And you'd look for that capability now. Would you?

87 I1: I think we would, especially knowing what we know about Revit and it's limitations. And the
88 value and ability to sketch quickly, and example of that is that your sitting down, at a table
89 having a conversation, and if only one person can draw, it's a one sided conversation. And
90 because we're trying to get more precision in our communication about space and form, I

91 don't know how else to do it. Without wasting more words than I already wasted. I think it's
92 really important for me to know what other people are thinking, and there's no delay. Are we
93 seeing the same thing, that we're imagining, or am I going to come back after 3 days of
94 intensive BIM modeling and go no, that's not what I thought you were saying. And we can
95 work thing out together, and I think it allows us to do more because we can get full
96 participation for people's background and experience. People like [R2] with a lot of
97 construction experience, digital fabrication experience, he can teach me what I don't know,
98 maybe I did something before, this worked before, we could try that.

99 R: It sounds like it's become, especially when you're looking at skill, a combination of two
100 different sets of skills, if one person is more proficient in one and the other is more proficient
101 in the other, that there's an open communication, you have a level of communication here
102 that's consistent, and can take it in either direction and then bring it back and have it be
103 the similar, this is what I was thinking and now it's presented in a different manner, so visual
104 representation is if it's in SketchUp, now you can say, that's what we had talked about.

105 I1: What I meant about [R2] and I both understanding a language of an elevation, or a plan or a
106 sectional detail. So we know that is a cross section, and the vocabulary of drawing conventions
107 where poche means something, and the line weights mean something and modeling is kind of
108 a different thing, you're building a model, you're taking views of it.

109 R: But then you don't necessarily, the construction isn't necessarily part of the model yet.

110 I1: Well the construction of the model, I meant when we used to draw this stuff, [R2] used to set
111 it up more like I did, you visualize the stuff in the conventional views, the plans, sections,
112 elevations perspective, obliques, isometrics, then you build up a drawing that represented an
113 idea, and none of the views are fully consistent because the idea was evolved. When you're
114 modeling, you're essentially building this thing virtually. Or somehow, and all of the views are
115 updated simultaneously. And you can view it any way you want. So you're really viewing
116 something. You're not really thinking in a drawing necessarily kind of (...) views. That seems
117 to me one of the weird differences. And I don't know how students now, if they're introduced
118 to modeling before drawing, how they understand the language of representation.

119 R: That's a very interesting point, I had a discussion with one of the instructors, who said, it
120 seems like we're getting to the point where students don't understand the point of two
121 dimensional representation, when is it a plan, why do we draw elevations, we don't ever see

122 buildings in elevational views, because, they're building them in SketchUp or building them in
123 rhino, and looking at them that way instead. This flattened out view that we're used to
124 imagining as an elevation, in two, not in 3, it doesn't have relevance per se.

125 I1: What is the answer given? If I were to ask you why would you do a plan or an elevation,

126 R: For me it's communication.

127 I1: What do you want to communicate?

128 R: Essentially the construction or the concept of what that's going to be. That's an ongoing sort
129 of question. If we're not using them except to communicate the building side, do we still have
130 the right answer to say to a student, this is why we need to do them that way?

131 I1: I have a really clear answer for that. Maybe it's because I started drawing.

132 R: I'd love to hear it.

133 I1: When we're designing, we need to know the relationships of the parts and the geometric
134 organization. So, it's only really in the elevation view that we can look at that and say, it's
135 wider than it is tall, that these 3 equal spaces, roughly, not only to dimension, the geometrical
136 relationship is orthogonal, and the position of this in relative to that is real clear now and in a 3
137 dimensional view I might see all those parts, but I still can't see the registration of all of those.
138 Orthographic views are the only views that show you true length, and true geometry, so, if I
139 want to understand the proportional relationships of something, I'm going to look at the
140 elevation view, the plan view.

141 I2: But they're important communication tools too. Contractors, or in a scaled drawing you're
142 conveying dimension,

143 R: That's essentially the answer that came up, but that's the question, proving it seems to be -
144 well, I can look at it from this view.

145 I2: But it's still a perspective view and doesn't describe the relationship of the other objects.

146 R: To be able to function in this communication, it's about knowing how to think about your
147 design first, before just throwing it up there.

148 I1: I don't know if people articulated these ideas to me. Because contractors have to build it, but
149 we do actually in a limited way, if we we're building a table, we would have to do a plan view,
150 but somebody would ship out the dxf file, and somebody would cut that, the contractor might
151 never have to see and actual view of it. Probably good to show them a view, but when they cut
152 it, that's what I'm doing.

153 I2: That dxf view, that drawing view would basically be a plan view.

154 R: But experience is talking, wanting him to see it.

155 I1: But it's not, the tradition of handing someone a drawing of scalable views, could change
156 because you can just exchange the model file, and they'll just extract the views from your
157 model, but it's a bit risky.

158 I2: The liability especially with that would be tremendous.

159 R: I think people would like to see that happen, but we have too much red tape too many other
160 things in the way of being able to say we built this, we're confident, here you go, and every
161 consultant is going to have their point of view and what is important to put into that view.
162 What's important in mechanical, is not necessarily going to be important to someone that is
163 working on structural.

164 I1: Right.

165 R: Far more detailed in this over this. All this technology of everything in one file.

166 I1: well, those external forces, are not really that serious, the construction industry has a lot of
167 expensive tooling, and tradespeople that are used to working in certain way. I don't think it
168 can spin around immediately, certain industries in fabrication, specialists, that are using
169 computer driven tooling, they're like the easy first people to collaborate with, it's kind of nice,
170 more cost effective, limited fabrication options now. If people had to cut those things out by
171 hand and finish the edges and do all that work it might not have happened.. There's a really
172 interesting opportunity of the craft application side for architects that can communicate
173 digitally. So, we have some contractors, fabricators you could just do a sketch of something
174 and they scan it, and create the file for you and make it.

175 R: There's definitely some of the ability in the digital technology, it's just easier. Students now
176 they don't run around with xacto knives making their models, they just throw it on the laser
177 cutter, get all off of there, and then start. With the gluing, no one's getting big callouses.

178 I1: I wonder if people making models with their files are getting a better sense of the relationship
179 of the model and the physical thing? If they ever built your model. Are you getting-

180 R: Would you get the sense, because of the physical sense of creating.

181 I1: Is your understanding full and complete.

182 I2: I don't know, I mean, I think its' definitely a draw back to use the laser cutter to develop the
183 model, because you're spending so much time to create he cut paths, and not focusing on more

184 of the design, understanding the relationships of how it goes together, you're more concerned
185 about developing the design in AutoCAD and making it construable via the laser cutter. So.

186 R: That's a very interesting perspective rather than having to struggle with this is quite the right
187 size, if things don't line up.

188 I2: And if you see something that's an issue you can easily modify it, umm, I guess you could do
189 so the same way with the laser cutter, but you'd have to revise the file and recut it, where an
190 xacto blade and some glue you can whip it out in a few minutes and be done with it, it may be, I
191 don't know, a drawback.

192 R: I'm also observing a class at the U a friend of mine is teaching which is computers in
193 architecture, intro to, and he's combining the two, his background is very craftsmanship
194 related, sort of physical making, and he's back in school because he realizes he has to do the
195 digital thing, too, but his point of view has really been, it's not a button push.. You have to
196 struggle with it, forcing them to get a sense of that, with the digital at the same time. A lot of
197 them have said this is a lot harder than I thought it was going to be, I thought it was going to
198 be simple.

199 I1: We could probably say that's true about some of the software, instead of just drawing, we
200 have to draw rectangles, drawing an extruded rectangle in Revit, it's not like a hammer where
201 you know which end to pick up. And so I think a certain amount of our RAM is occupied by
202 trying to make the software do something kind of simple. So it consumes some of your time,
203 and I think AutoCAD was like that too, some sort of learning curve to become fast and
204 efficient and make it do stuff. At the end of the day its just sort of a digital etch a sketch, is
205 what I've always thought, one view doesn't necessarily relate to the next. Copy elements in,
206 coordinate some views. It's not a really intelligent data set.

207 R: It was just another tool.

208 I1: Yeah but not, I mean, they're all tools, I'm trying to think of the advantage of some tools over
209 other tools. Cause it had a similarly, graduated learning curve, I remember trying to draw
210 things that we could draw so much faster by hand. The interface for AutoCAD for certain
211 things was just too cumbersome.

212 I2: Linetypes, layers,

213 I1: It wasn't WYSIWYG.

214 I2: Those were all new concepts.

215 I1: Things like absolute coordinates, for example on a survey, trying to get a survey to close, and
216 that's not a 90 degree corner, so it's like a crap shoot. ((Laughter)). They're just highly
217 abstract, you're not seeing it as it goes in. Like word processing, where it would be wrong, but
218 you had no idea what was wrong in the command line, it would just keep saying reject, reject.
219 You keep going back to the command line to figure out what am I doing wrong. It gets to the
220 point where it takes you away from the task at hand. Which is how is this building going
221 together, how does the space feel, are the proportions right, is that mullion slender or heavy,
222 you don't get to think about that, you're so worried about the software trying to interpret your
223 intent. You forget what your intent looks like.

224 I2: I think that's an even bigger problem these days with Revit, and users not sketching out and
225 trying to solve the problem ahead of time before using the software. I mean how much time
226 do we waste on Revit, it seems like it takes an immense amount of time trying to get stuff in
227 there.

228 I1: Remember why we're doing this.

229 R: Are you switching over to Revit?

230 I2: We've been in the process for about 5 or 6 years,

231 I1: We last year, made the 100 percent switch, everyone on all projects at every scale. There's
232 just no more AutoCAD unless we have to open someone's file to do something, I think we
233 observed that trying to have a couple of people to do AutoCAD and a couple to do Revit,
234 having to staff projects, not with the person that should be doing the library, but it if had to be
235 done in Revit, having the Revit person. We got that people were off Revit for a while the,
236 they'd get rusty, then they'd get off AutoCAD, and they'd be rusty at AutoCAD. Suffer some
237 productivity, and we just didn't want to keep doing it year after year after year. We do a lot of
238 public work and Revit became almost a requirement, several public clients that we work for
239 including XX. That same thing happened in AutoCAD when I was [R2]'s age. You have to be
240 in AutoCAD, these layers these line weights, or you can't do our work. We for the purpose of
241 architecture, thought this is a great program, we should just get on board. The choice of
242 software, is somewhat limiting, clients, big clients, they're kind of big players. Even corporate
243 clients.

244 R: I imagine there are a lot of developers that want it that way.

245 I1: There's advantages for them. Not all bad though, there's a silver lining somewhere. [R2]'s
246 been sort of most advanced cross platform user, and I trust his opinion because he can also
247 draw really well, it's not like he's going to do this because he's a geek or can't do the other
248 thing.

249 R: That kind of ability demands respect. Because it will get lost. One company I talked to
250 advocates cross training, and spending time in each. [...] We have to be able to sketch.

251 I1: I think that's where we have to get with Revit.

252 R: Do you think we can?

253 I1: I don't know, I'm not gonna.

254 R: I'm sorry, do you think we can? (To R2).

255 I2: Yeah, I think people can, but the learning curve for Revit is tremendous. Especially for new
256 students,

257 R: Because they don't know how to build really.

258 I2: Exactly. You know it kind of requires that knowledge of construction to develop a model. So
259 umm, yes, but I still think it's very important for an individual to be able to sketch, to draw out
260 the solution for the problem before going into Revit, the more complex the problem, the more
261 important it is to sketch it. You'll just kind of waste your time, spinning your wheels. Prime
262 example is the gaming industry or the movie industry where they have these tremendous
263 complex programs, and they spend a large quantity of their time sketching and drawing,
264 storyboarding,

265 R: There's a question I ask everyone, do you think anyone coming into the industry should be
266 able to design strictly without technology? I can come up with a solution without having to go
267 to the computer to visualize it.

268 I2: I would say yeah, technology is just another tool. If you don't know how to process, or use
269 another tool to solve the problem, then there's an issue there. You're just relying on one tool
270 then you become specialized, and you're not really a generalist anymore. I think of this firm,
271 we prefer those types of people that are generalists, that are a board band of skills.

272 I1: We do know firms that do more repetitive work, come out of school, and feel real
273 powerhouse Revit or cad users, can just crank out stuff, you're not being asked to solve or
274 work anything out. You're more or less, reassembling information that's already been
275 conceived of by someone and transforming it, reediting it. Reforming it, I guess. So they're

276 probably a lot of people doing that. I wouldn't deny that's possible to get a job. I'd say if you
 277 want to be a person that thinking of new things, you want to have those skills. Well fluency
 278 and transparency in whatever you're doing, whether it's writing or drawing, is the point you
 279 want to reach. So if you're working with a modeling program, you want to get to where
 280 you're thinking about the design, not about the command structure and the software. [R2]'s
 281 described a situation where modeling is a very different conceptual approach to design, not
 282 construction thinking, but I'm thinking about relational data sets between elements of design,
 283 maybe like an assembly, the roof structures associated with the wall tops because if you
 284 explore changing the height of the roof or the ceiling in these rooms, and if I haven't really
 285 thought that through, that those relationships, then when I try to edit my model I have to raise
 286 every column. It's not about it's going to be built, it's about how are these elements
 287 associated. Just saying all my columns are going to go to the underside of the roof, because
 288 they're going to hold the roof up. So when I build my model, I'm going to make those
 289 associations present, you don't have to know everything necessarily about construction, but
 290 you do have to start thinking more systematically in order to get the editing benefits rather
 291 than just using the etch sketch again. And you're moving that thing, and that's great, and it's
 292 changed in all the views, but you have to change them all, and in AutoCAD you had to do that.
 293 There was no extend all or cut stich, and trim, it's ridiculous.

294 I1: There were a few things you could probably do. So that to me is more of a design thinking
 295 approach in how windows relate to walls, And that's maybe about having a sense of the things
 296 you want to manipulate and explore in the design process, thinking of a room or a building
 297 form,.

298 R: Just based on that you have to know where you're headed already. Like you said before taking
 299 it into Revit, you need to know where you're headed. You can make changes as you go along,
 300 but

301 I2: Right yeah, understanding those relationships is I think key, and then just basically mapping a
 302 path to construct a model. The more time you spend thinking about it, putting it together, it's
 303 going to be save you time down the road,

304 R: It's never wasted time., essentially. Well rarely wasted time.

305 I1: If you ever remodel it. Think this notion of grouping in editing is an advantage, and it was
 306 true in SketchUp too, how you formed relationships, made it easier to, harder to subsequently

307 remodel it or if you're editing in InDesign or Photoshop. It's easier to manipulate things. That
308 kind of thinking translates to modeling if you're lucky,

309 R: But if you were designing like that, this element is its own element, regardless of where it
310 goes. It's going to stay like this.

311 I1: Fundamentally, as a cognitive skill, that's nothing that ever happened here. You might have
312 thought that these things were associated, but when you drew them, ink on paper has no
313 association, its all in your head. But the data set is a little more alive, and [?]. It has that to the
314 advantage, I think, that you can exploit those relationships, once you've made them. Cause we
315 all know that the editing capabilities of digital design software, like the adobe suite, is pretty
316 phenomenal. Like erasing, or cutting and pasting stuff, but it's not much fun to edit stuff
317 underneath if the relationship isn't there. You've used Photoshop, right? If you don't create
318 the appropriate layer and then you mix up stuff, and you try to edit one layer and undo it, redo
319 it. It's a thought process. So people coming out with digital, might be more aligned with the
320 things that will make them better Revit users and the people you're talking to, my age, they're
321 not really thinking that way, normally or only partially, so it's a more problematic retraining
322 process.

323 R: Essentially you probably don't need to use that kind of software, all the time.

324 I1: That's sort of a good question, what do you think?

325 I2: No. ((Laughter from the group)). Well.

326 R: I guess it would be an individual desire to learn more and be better at it, as opposed to the
327 business demands it that you be capable of doing it. Because of where you are and the
328 decisions and the level at which you make decisions.

329 I1: Well, the office needs to know it, but people at [R2]'s level don't need to know it, I don't
330 think. It helps me understand it, like when I ask [R2], because we have a client that asks for all
331 these visualizations, can we make a little lighting study of that thing, maybe what I don't
332 understand is not as easy as what he requested, it's maybe an eight hours project, we can do it.
333 Probably think we can do some magical thing, but is that realistic,

334 I2: But it would be advantageous, let's say, to have the ability to go in the model, to review the
335 employee's work, or the status of the model. But, I think, our projects that are really small, you
336 just ask the individual to print out, easily generate whatever.

337 I1: The collaboration thing is a little harder, cause it does happens on screen a little bit, but I
338 don't know how those thing are related in the model, which I don't do, otherwise I'm kind of
339 relying on the output, so I can look at this and if I wonder why is that gray, and - so I see an
340 anomaly there and I don't know if that's something that's in the model, or whether...

341 R: But you still have had that type of experience of looking at something like a line weight and
342 wondering why this is different from this. I have been in the instance where someone says,
343 well that's just the way it has to be, true but not true.

344 I2: That's typically the answer that I hear, especially from inexperienced users. They would love
345 to tell the higher ups, that the way it has to be ((laughter from the group)). And it's totally not
346 that. I mean, it's -

347 R: Do you think that sometimes too, if you don't have a built in - inherent ability to see why line
348 weights are necessary, because you haven't used them the same way, it's easier to let that
349 slide?

350 I2: I think it's just a...it's true about a lot of things. It could be line weights, it could be tags, I
351 could be titles, there's any numerous things. Because in Revit, in software, there are millions
352 and millions of different options, and scenarios,

353 R: Right, I did have one friend who attended a Revit class - the question came up, they were
354 showing them how to do tags, well, what if I need to put the arrow in the other side? The
355 answer was well, you don't. From the trainer. But when you've been trained more classically
356 in terms of drawing, there's a consistency and a symmetry to the drawing itself that is
357 important, at that level, as a representation.

358 I1: I don't like to be told that your tool can't produce clear documentation. But I think that's a
359 more professional level kind of thing, most office, and we have standardized approaches to
360 things. Like [R2] has worked out to save everybody a lot of existential questioning, like should
361 I do them to the left or the right, so we [R2]'s in to it and knows kind of what is possible and
362 like what fits the BIM, the Revit model more or less. So I think that saves a lot of that kind of
363 on the professional side. I don't think we would expect people coming out of school to know
364 how Revit wants to do notes, anyway. But I would love people coming out knowing that clear
365 concise communication is essential to convey the sense of your design, first, and then second,
366 helps if you know how to build it right. That's all they really need to know. So then we - I
367 don't know, the training in offices is one of those questions that is more professional, like, can

368 offices afford to send everyone to BIM classes, how people in there offices work for some
369 number of months while they're only partially productive,

370 R: Trying to see if they will be a good fit later on.

371 I2: We've gone back and forth on that issue. Some people have gone to SCC, taken the Revit
372 course up there, some people have just learned it within the office.

373 R: Because they have to.

374 I1: What's out thinking on that?

375 I2: Well, our thinking on that today is that, ummm, I guess the class, at school is great, it teaches
376 you basically how to use the software, but they can only teach you so much because each
377 particular office will have standards, or BIM standards, they have a particular way of doing
378 things. And they can't reach you that at school. And sometimes it's, you know, easier just to
379 immerse the individual within the business standards. Pick it up that way. That's my personal
380 theory. I don't know.

381 I1: Well, from an office point of view, there are firms in town that won't hire someone with less
382 than three years of professional experience be cause they want not only that you get your BIM
383 experience somewhere, but you're like, what's construction, what are they all about, how do I
384 behave in an office. Umm. We don't think like that, but I know it's more profitable to not
385 invest in training and then have people go to another office. That's happened too, literally,
386 people will take a BIM class, for a thousand bucks, then it gets portable, and I think there are
387 other questions about, I think it's perfectly reasonable for people to get out of school and
388 require more professional training, but the portability, versus the profession and the individual
389 office's responsibility to train people, no body wants to feel like they don't want people to
390 learn, but that's really counterproductive, but it is expensive, and it's more expensive for
391 smaller offices than for big offices.

392 R: Everybody needs billable time.

393 I1: Well, it all comes out of everybody's pay somehow, right? ((Laughter)). I mean, it's not
394 magical.

395 R: No.

396 I1: People have a certain amount of money you give it all back except what you need to pay your
397 bills, and that just becomes a bill. So the faster you learn, the more productive everybody is,
398 the more productive the better design, you can generate in the same amount of time, the more

399 successful we can be. So I'm hoping we can explore things quickly and get to better solutions
400 more efficiently than we used to be able to and then, they can get to the documents more
401 efficiently than with AutoCAD. I believe that the more elegant system but it's certainly not a
402 magic system.

403 R: Have you found a change in the actual time frame that's required for design development,
404 construction document? Some firms think that it's greater on this end, less on this end now, or
405 it's all the same now, even though BIM is now the standard in the office as opposed to
406 AutoCAD?

407 I1: Well, you probably have to measure your own project time start to finish in Revit versus
408 AutoCAD, and then whatever else.

409 I2: I guess it depends on the client. ((Group laughter)).

410 R: What they're asking for?

411 I2: Well, it's a good point. There's a variable, change...

412 I1: Late design changes.

413 I2: Late design changes, they're extremely expensive with Revit, umm, just because they're tied
414 together. So. Umm, where in AutoCAD, if a change occurred you could usually change it in
415 one drawing and you know, you kind of fudged. But,

416 R: But if the change is going to affect the whole model

417 I2: Yeah. I would say, BIM is faster but you need an experienced user to you know, produce it.

418 R: From what I've heard, this is consistent. The type of user for Revit is different from the type
419 of user for AutoCAD, the way they it used to be maybe five to ten years ago, you could do
420 redlines, with someone who didn't know as much in AutoCAD, as opposed to doing redlines
421 in Revit.

422 I2: Yeah, that's probably true.

423 I1: Yeah, I found that redlines was kind of hard because you're looking at in progress 2D plots
424 that didn't have all the background stuff turned off, or wrongly missing that, so you're just
425 thinking, is that missing, is that a mistake, does that person know that's not supposed to be
426 there. All I can respond to is what's here. And we have to have kind of a little conversation so
427 the red marking isn't as good as, and maybe that has caused us to change how we work
428 through the finalization of documentation. But, we do have some clients - our hope was - my
429 hope was at least, that we would go on a project from quicker sketches to something that

430 would get clients to understand this thing is going to be kind of like this, and the we could
431 show variations on that, and get to a design and commit to it, because they could really see and
432 visualize what it was going to be.

433 And umm, so this is really pretty early in the design of this project.

434 R: And what is this in?

435 I1: That's Revit but the model's in -

436 I2: Postproduction is in Photoshop.

437 I1: Yeah, with no other. Well, how'd you light it?

438 I2: Revit.

439 I1: So that's the Revit lighting. With some skillful kind of, you know, made up stuff, probably.

440 I2: I did the renderings,

441 I1: But you did kind of advise on this thing, this is actually XXX's first Revit project. Kelly
442 worked on the front end of the model and it was her first Revit project, so they got a lot of
443 help, I think, but it came together.

444 R: It does represent though, in terms of a person looing at that, I'm sure they could say, okay, I
445 get it. Certainly more here than say, here ((points to another sketch)), it's still very conceptual.

446 I1: You deal with transparency and color in ways that are pretty close to the final thing. We
447 think. A classic misconception is you know, the shelving, you know, this is a really early
448 design, I don't think we made them as families, so when we decided what the final design was,
449 updating the model was a little cumbersome, and we created families, and the nice thing was
450 that the client, when we need proportions to change, when we edit the families, of course, it
451 updated, like all of this stuff, and all of the views. But that the kind of thing that could be
452 really helpful, you know, those kinds of things, because they do 3 dimension edit or
453 modifications. So I think if we get better at that, either we should get closer in the early
454 model. It's a late design decision for the client to tell you that these shelves have to be six
455 inches high, and those need to be [...] inches high. While we might need to show that for the
456 contract, I didn't feel like we need to show them a new design drawing because the design will
457 be whatever the client needs it to be,

458 R: So in this case, did that part of the contract include having the shelves made as well.

459 I1: We showed them these shelves, had these proportions, and an opaque part, and that was part
460 of the design. I know in traditional 2d representation, it would have been really hard to explain

461 to the client well, this line here means that's out on that side and I can see through it, where,
462 they kind of got this immediately. These are a bunch of library professionals who don't look at
463 this kind of drawing. The good news is that they can understand, the bad news is they then will
464 have an opinion on it, and I think there's a lot more trust, like if you showed a client a drawing
465 like this ((holds up a detail)) they go, well, I don't know what it means, but you're the
466 architect. So this actually invites clients to the conversation in a way that creates challenges,
467 it's like, oh, if that's how it is,

468 R: I've heard that. And I've read that research is noticing that. The level of collaboration is
469 moving in a different way, it didn't used to be. This I'll know it when I see it is really
470 becoming very prevalent I need to see it then I can tell you if I like it.

471 I1: The effect of a bright color, against the foreground, middle ground, background, we kind of
472 know that from experience, because we think about it a lot, but clients it's harder. One of the
473 worst things you can hear from a client though, though, is you go into a space, and they go, oh
474 I didn't' thin it was going to look like that.

475 R: That's not what I thought it was gonna be.

476 I1: Yeah, so I have, I actually really appreciate it when we take photographs of our projects,
477 some of these views that we've modeled are like eerily predictive. And um, I think that has
478 value for all of use, since, these aren't the most expensive projects that we could be doing, but
479 people give us a lot of money to do this thing, and sometimes we do something that's better,
480 but not the simplest cheapest way, and so at the end of the project, you want them to still
481 believe, well that was a good idea. And you gotta kind of convince them early on that well we
482 should really use frameless glass and round wood columns, with a certain kind of hardware,
483 and it's like what are you talking about.

484 So we're struggling with diagramming I think, which is that early design thing.

485 R: How you use technology?

486 I1: Yes, Revit isn't' really working.

487 I2: No, we actually don't use Revit, in kind of the diagraming stage, we think the massing
488 features just because, personally, I feel as though our experience level with the program isn't
489 there yet, so we have to build that comfort level. And plus our projects aren't' really that large
490 to accommodate those features. So.

491 R: How do you do it currently?

492 I2: Basically, by hand, doing diagrams,

493 I1: What I think of another. Turns out that the help of the diagramming doesn't really get you
494 um, further into your documentation or the 3d modeling. That 3d view that we got of that
495 storefront has all of the things that were going to be part of the interior elevation, that the
496 contractor needed to bid, so I guess if it looks like that, diagrammatically. Messier than that.

497 I2: We tried it on a couple projects, like we laid out in Revit I guess; it's fairly easy to do it
498 Revit.

499 R: I guess the question because of the sense of permanence that sometimes something like Revit,
500 do clients tend to really relate to something like this better, oh yeah , I kind of like that, but
501 there's this sort of a wall that they hit if its done, and they feel like it's done.

502 I2: Yeah, I think there's a perception that if it's in a visual program which is Revit, it's hardlined,
503 the architect has spent some time, and there's this perception that they don't feel like they can
504 change it, it's not fluid, so yeah, we have a tendency to go towards the sketch.

Supplemental Material A7. 3051 Interview Summary

- 1 R: I've talked to different people, management, production, etc.
- 2 I: Big firms, small firms?
- 3 R: talked to [...] They have a very different way of working.
- 4 I: Yeah, right.
- 5 R: You have to sketch first. Where the software goes and how you use it is very different. But,
- 6 there's a movement, that people are starting to think differently.
- 7 I: Yeah.
- 8 R: We still need them to think. We can teach someone anything.
- 9 I: I would agree with that.
- 10 R: I think probably one of the things we don't currently do is teach students, you're going to
- 11 learn AutoCAD, your going to learn rhino, but they sort of just creep in. We don't let them
- 12 know exactly how to use what when.
- 13 I: I think there's a lot of that in the profession, where people kind of
- 14 [...]
- 15 I: There is a partially budget pressure, the schedule, there's a tendency to want to jump right in,
- 16 whether or not it's the right idea. By the time a client decides to start, the deadline never
- 17 changes.
- 18 R: What I've found very interesting, in going in as a student but having been a professional.
- 19 I: it's a very interesting perspective.
- 20 I: I think I have a very interesting perspective on whatever you're going to ask me. I worked at
- 21 XXX for over 13 years. I was an architect for the first 9 years, then the marketing director for
- 22 the last 4. Then 4 of us left, had our own firm for 7 years. I have a perspective on that. XXX
- 23 acquired us 1-1/2 years ago. They're a giant gorilla in the architecture world, progressive in
- 24 terms of technology. I've sort of been through everything.
- 25 R: I talked to XX - the history of where everything has been.
- 26 I: When I was in school at the U, I was applying for a job, and computers were not - at that time,
- 27 the mentality was that computers were so expensive, we had two in the firm, they need to be
- 28 working twenty four seven. Literally, we have an opening in our night shift. When I started at
- 29 XXX in the 90's there wasn't a computer at everyone's desk, there was only 3 or 4, and they

30 were only used for floor plans. That was it. No details, no - one of the guys I worked with,
31 was the first guy that made them understand - you're still just drawing 2D lines. Computer
32 doesn't care that you're drawing a wall section. It was a real ah-ha moment, you could
33 produce the whole set on the computer, but not everybody has a computer, and they were
34 changing so fast - every month there was like another, and then when I started my own firm in
35 2004, Revit wasn't where it was today. But we decided we were going to use Revit 100%.

36 R: Really.

37 I: Well it was a mistake actually. There's four of us, pretty technologically savvy, bit also starting
38 a firm, starving, no staff, and two really big jobs. A 24-story condo tower across from the
39 library, we'd never done condos, we literally could not produce the work. We were mired in
40 trying to learn Revit. At the same time, it was on a older building, and there were no
41 drawings, so we shipped the drawing to India and had them build a Revit model, we had
42 presentations every week, we couldn't get stuff out that was any way graphically compelling,
43 and still build a company we had to call time out, we're committed to Revit, but not right
44 now.

45 R: Well, it's the learning curve, and everything that goes with it.

46 I: We couldn't do it. We called a time out.

47 R: There's some questions, to see where they head, we all have different perspectives. All the
48 people in a room are going to learn the same things differently.

49 I: I remember, it took me a couple years, even when MS word, I couldn't compose at the
50 keyboard. I'd write it, then I'd input it.

51 R: I have difficulty teaching a CAD I class - I don't know what I do anymore.

52 I: Yeah, yeah, you don't think about it. But I think that's a little bit in design. Some people
53 generate ideas while they're in the software. Other people have to think, then they get
54 someone to input. But not everybody works that way.

55 R: That's an interesting thing, I'd like to ask you about. Recent graduates, it almost seems like
56 they are starting to think differently.

57 I: I also have kids, an I'm watching that. There's a big knock on youngsters, well they can't
58 draw. They can draw, maybe they don't.

59 R: I don't know the answer to that. It's maybe that they're using a computer the same way we
60 might have use a pen.

- 61 I: Is it important that they draw, or that they get to the right idea.
- 62 R: Being able to think, and the level of creativity.
- 63 I: That's the value add of an architect.
- 64 R: That's the question - you don't want to be tethered to a computer. If you're in a job site, you
65 want to be able to document that. The level of communication between senior and junior, that
66 you can collaborate.
- 67 I: It's hard to see what's in the box, when someone is in front of that.
- 68 R: I'm assuming that in your time frame, you've done that, stood over someone and sat in front
69 of a computer.
- 70 I: Yeah, I hate it. It's really hard. I'm of the generation, that I have to have it on a piece of paper.
71 Look at it and get the scale, that's another thing, kids they don't get the scale. It's not in scale.
- 72 R: I think it's getting lost. There's now an area of uncertainty, do they know this line is incorrect,
73 I: There's nothing I can do. We're still in a world where we're not yet using the model, we're
74 still printing it on paper. The line weight has to be right, it has to be legible - you don't know
75 that until you print it out, looks great on the screen. on the screen the lines are green, yellow...
- 76 R: I was taking to BRJ, students are asking why do we have to draw elevations, why do we have
77 to draw plans, that's not how we see them in real life.
- 78 I: Right, yeah, yeah, yeah.
- 79 R: But there a lot of things you can't see.
- 80 I: Right.
- 81 R: Photorealism isn't how we see things, I guess its the same struggle.
- 82 I: I was at the AIA convention, maybe three years ago now, and [...] gave a talk on integrated
83 delivery, and BIM, and his thesis was that over the last 20 years almost every industry has
84 advances and used technology to become more efficient. The architecture, design, and
85 construction industry is one of the only ones, that hasn't, everything takes longer and costs
86 more, and he said that our industry is now just below farming. That's not good but I think
87 that's why there's so much pressure on universities, and private sector, everyone is looking for
88 that magic efficiency.
- 89 R: There's a button.
- 90 I: We've got to be able to go faster, and how do we do that?
- 91 R: The other industries have more or less figured it out.

92 I: The excuse is always that manufacturing can do it because it's not a one off. They're doing
93 thousands, and it's automated. But what we do isn't automated. [...] Then I look at it, and I
94 look at several projects we're doing right now, and especially in construction and CA, and how
95 inefficient the whole, you draw, we're still in this mode where we draw, and it's well thought
96 out, then you send it to the fabricator, and he draws it, then you make sure his drawings match
97 yours. We put all this thought into specifying ceiling tile, drywall, and the contractor takes it,
98 and the we say that's the one we want - why do we keep having to do this over and over?
99 How about this - we put time into picking out the tile, then we put time into specifying it, how
100 about we use that ceiling tile. I don't need to see it again. How about we just use it!

101 I: I've talked to a few people. You're going to take this model, and you're going to send it
102 directly, and they're going to manufacture right out of it. We'd like to be there.

103 I: We're not there. I think there's a lot of talk- in the industry certainly at the scale of firm that
104 Perkins Will is, that where is your, where is your value, added as an architect. There really no
105 need for a firm to have the production capacity. What your value add as an architect is in the
106 ideas, and what you care about is materials, and the critical details that you can see. The
107 execution and documentation of it - that's not really our value added. When you think about
108 that in the whole architecture world, that's a lot of people. Partition details, grid layouts. You
109 could still do the same amount of projects, and keep doing [the thing that takes] creativity.

110 R: That's a very interesting thought - the more people move into BIM, everyone wants to use it,
111 where does the responsibility of when something happens. And architects care about different
112 things. I was reading an article that was saying that it is starting to dilute what your core
113 business is - because now the client is involved, and we have to keep producing, so that they
114 can see the representation, make changes.

115 I: In my mind, as long as we, as architects still have the creative control of what it looks like, it
116 makes no difference who produces it. I think eventually its going to go away, right now
117 everybody is worried about who owns the model at what time and who is accountable, it's all
118 lawyers stuff they're worried about that. I think over time that's going to go away. I mean
119 you look at, almost every major contractor in this town has hired architects on their staff to do
120 BIM and Revit, it's because they're producing stuff, because they think it's more efficient.
121 They can go faster. They don't want to wait for us, to do a half-baked model that doesn't
122 reflect how they're actually going to build it. But we model it based on how it's designed, they

123 model it based on how they're going to build it. So they get someone who knows there
124 business, and that is the challenge, with technology, and I agree with XXX or whoever, that
125 the kids coming out of school, they can learn software in a day. They don't know how a
126 building goes together. We can find people who know Revit, who know how to lay out sheets,
127 sections but they don't really know what they're doing yet, so that's part of the internship,
128 mentorship process.

129 R: It seems that there's a change in the process, we use that software, in the process, you can't
130 put someone really new in a BIM model and not make a mistake, and in CAD, you could, say
131 here's the redlines, make it look like this.

132 I: Right, right. BIM is really hard to manage. I can't do it every day. Go in and see what's
133 drawn, first of all I don't know Revit very well, that's my fault.

134 R: And at a certain point, you don't need to be in it, you just need to know what's happening.

135 I: Yeah, so if someone is working at their desk for a week, if what they've modeled is what I
136 need, you have to really manage it, every couple days. Make sure that someone is not - we're
137 doing this condo building, and some young guy, he was modeling the toilets. I don't need a
138 perfect 3D toilet. I just need some sort of graphic representation of a toilet. Four days later we
139 don't have any wall sections.

140 R: I think there's a need to know what part needs to be communicated. I took the class in Revit,
141 and it's very geared towards architects. How many of you have ever run into this issue?
142 Maybe three hands go up. Because everyone else has never done that before. They haven't
143 had to produce a 50-page set. They learn how to do these faster. But they don't know about
144 the model, and what details, and then I'm gonna cut this section.

145 I: How much do I need to draw, and to what level of detail, and at some point do I just need to
146 extract it, and draw it in 2D. That's the other thing, you don't need to model every single
147 condition, probably just need to draw it.

148 It's an interesting time. It's interesting too, that, I'm on the board on the AIA, we had our
149 retreat, there's other people on the board that are outside of the architectural profession,
150 contractors, engineers, other people. The topic came up about, where are we in the profession,
151 what are we trying to do, what is the, all in the context of what are the educational programs
152 that we're offering, and what are we training the next generation to do, and what's our goal
153 here. And there was a lot of push back for the contractor, and the electrical engineer, couple

154 other guys in the room who are not architects. Basically said, you guys, if you guys as
155 architects don't wake up, and see how the profession relative to the amount of work that the
156 contractors are doing in that office, or the integration of contract, or whatever it is, you're
157 going to wake up and find out that somebody else shaped your profession and you didn't. So
158 you need to decide, proactively, what do you think it's doing and where do you want it to go?
159 There's a lot of that kind of discussion.

160 R: That's a wake up call, but it's essential, the people that work with you and manage the
161 profession, we need to do this together, so that one person is not behind. It's that domino
162 effect.

163 [...]

164 R: I've read a few things, things don't change, unless you A: explicitly choose to make them
165 change, or you allow them to change. If you don't put up a fight, it's going to change anyway.

166 I: One way or another. That's right.

167 R: So there are those who like the idea of using technology to connect, and those that advocate
168 we absolutely have to do it this way, and then you get the other, most of the educational, well,
169 we'll throw in a couple of classes and see what happens. We'd have to retrain everybody.

170 [...]

171 R: One guy is asking if can you create the same in accuracies in a computer that we do by hand -
172 it's very conceptual.

173 I: Eventually. In theory that's the next iteration of technology.

174 [...]

175 R: One of my other fellow students is teaching the computers in architecture class, we took some
176 surveys, we've taken a few, they're learning. Is software, or is sketching easier, there's a
177 lot that are still saying that sketching is easier, this is a way harder than I thought it would be.

178 I: Yeah, yeah, yeah, because they're trying to get something compelling out of it.

179 R: Well, they're trying to fabricate too, you have something fabulous and then you have it cut
180 and it doesn't work. It's not that easy.

181 So over the years, you've see the design process, the deliverable process change, CDs are
182 changing, DDs are changing, is it speeding things up yet?

183 I: No. I think that's the challenge. At the end of the day, you're still making all the same all the
184 same decisions. What it made of, what's the exciting, what's the - the computer doesn't make

185 the decisions faster. Ahh, but we're trying to work with a tool that - we had a guy, internally,
186 because we do a lot of analysis, what is the capacity of the lot, or the parcel, to try to find a
187 way to automate that, it generates the maximum envelope with all the right set backs, the air
188 rights calculated, very complicated - we're not there yet. It's not automated.

189 R: Is there anyone in the office specifically programming for some of the needs that the office
190 has?

191 I: Not in this office, there are in [?] research group, like there's this guy from Dallas that does a
192 lot details, and then another group working in healthcare, and the data, that the clients have,
193 you have 6 ORs and you have this case load, and the equipment and stuff, sort of a live model
194 that can help make up their casework. There's a lot of that kind of stuff, so we can track
195 energy, and model, we have a lot of different. It takes so much time to get the work and do the
196 work.

197 R: It's difficult to make the time - like when you opened the firm. You've gotta get the job done.

198 I: Right, you've got to produce the work in a small window of time, within the fees, right, That's
199 what clients care about.

200 R: I think I'm not going to find the answer immediately, its like the AIA, we've got to make
201 some decisions before it gets away from us.

202 I: But we have people hat are using rhino, and tons of people using SketchUp, and we have
203 people drawing by hand, and everything. Depending on who get's assigned - we as a firm are
204 100 percent Revit, we don't do anything in CAD, but we definably have different schools of
205 thought on the skills set of the team that you sort of get. There's still a lot of debate about do
206 we use Revit or do we not use Revit, there's still debate.

207 R: That seems consistent, across, everyone, even smaller firms that have made the decision to
208 move to Revit, its still easier to do it in many different ways.

209 I: Exactly. Unless you're really, really, mentally able to dumb Revit down in your brain and not
210 prompt you for so much minutia early on, you have to be willing not to fall into that trap. - Let
211 me just draw a line for now. But I think it's also people, its harder to study a bunch of
212 alternatives when you're entering a bunch of data in the box.

213 R: I've actually experienced, if students get into too early, or get into learning how to use
214 technology, before they've learned foundation skills, they get into this and you pull out, and
215 there's nothing here, it's just crap.

216 I: Right.

217 R: But it's done really well.

218 I: It's funny, I was in Alaska one time, and the CEO was in the meeting, and he noticed, the
219 collective group was sort of advancing a particular approach or idea, too far before, and his
220 quote was , let's make sure we do the right thing, and then we'll do the thing right. Which I
221 thought was brilliant, everyone was mired in we might not have enough money to this, and
222 budget, and schedule. An he's like, let's make sure, let's do the right thing first, and then we'll
223 figure out how to go do it. Which was great, that he noticed, that the group had gone off the
224 track, and was worried about the wrong stuff at the wrong time.

225 R: Well I've actually, wanted to ask, the idea, hat when you're sketching, you're really problem
226 solving, which one is gong to be the right one. It's problem solving, and problem analysis.
227 And in some ways technology is creating this tendency to do solution analysis.

228 I: Yeah, it's linear.

229 R: Here's your solution, now let's make sure this is right, instead of [...] let's do this, and then
230 spit it out.

231 I: Yeah, that's exactly what it is.

232 R: Now I've just got to prove it.

233 I: Right, prove it.

234 R: It's a struggle, it's interesting, maybe it just needs to be [...]

235 R:I think that's what it is, we're trying to do exactly that. When we sit down and start project,
236 we talk out loud, about what tools are we going to use, for what purpose, for what milestone. I
237 can't tell you how many times, someone got it in Revit, we're early SD, pushing all bathroom
238 stalls eight hundred different ways, laying out the toilet rooms. I don't need to know where all
239 the toilet partitions are right now. We'll get to it. ((Laughter)) for some people that's their
240 comfort zone. We're in document mode. Sometimes they'll get it.

241 R: I think for people it's the function of their level of competence. I'm good at this.

Supplemental Materials A8. 3141 Interview Summary

1 Started in practice when drawings were done ink on mylar, then moved to pin bar.
2 Feels that when projects moved in to CAD, and design was forced to think in layers, that
3 a major transition occurred in thinking. People learned more 3D when sketching and
4 visualizing in drawing. Breaking up the design into flat pieces has forced people to
5 stop thinking in 3D. Now we're trying to think in 3D again through Revit.
6 We rely on old expertise for QA and QC.
7 Architects are different in design after they've done CM. Once you see it being built, you
8 understand every line on paper.
9 Scope and scale are undecipherable from drawing and representation. [virtual models
10 cannot convey the same sense as reality]
11 ((Her son graduated from XXX, where the program is equal parts drawing and
12 construction. The way that the curriculum there is structured, had Revit proficiency by
13 the time he graduated.))
14 No matter the technology [ability] you still have to build it.
15 What skills do students need to start with? They have to realize you cant be good until
16 they are older. You have to experience [it].
17 Coming out of school - there is a conflict - between studio and the office - what it will
18 be like. (The comprehensive studio project, and critiques, versus coming out and
19 having to learn.) A humble attitude is the first step.
20 There are often tracks that emerge. Design architects and technical architects. Those
21 that are proficient in graphics and design, work with senior architects.
22 The challenge is that those with wisdom and experience have to rely on those with the
23 tool ability to make this [architecture] happen.
24 Technology goes beyond the design software to management software, accounting
25 software, etc.
26 Design professionals ask for equal competence, adaptive and efficient. ((Interviewer
27 explains the idea of expertise as viewed through cognitive theory.)) You can't let one
28 of over the other.

29 There is a lot of tension between design and technical architects. A good manager is
30 difficult to find.

31 [XXX] worked in small offices of 15-30 people. Design is (harder) with technology.
32 Comment on construction - [she] has not yet worked with a GC that is truly [integrated]
33 - like XXX.

34 [She is on a project where the] PE is building the building in SketchUp. He gives [the
35 model] to the guys in the field. [While it's good to have a stalled project back in
36 process, it's odd] to go to the site and we sit and look at his computer, not going to look
37 at the construction.

38 He's just like a student, enamored with the SketchUp model. [She] sees it with students
39 in the studio – they are captivated with the imagery. [But] they don't know what they
40 see.

41 The best teachers don't have the [technological] tools. They have experience and
42 technical knowledge.

43 Perhaps students need to start tracking as a young age. Will Revit eventually become like
44 MS office, where every body knows it and uses it? If that happens, will college then
45 go back to theory? Are there schools that aren't fighting that?

46 Architecture is stepping back from using the technology because of a fear of liability.
47 The GC becomes like a student in class, they make the model, the owner looks at it,
48 and says they've built it. Clients can take software, then say, I've designed it.

49 Construction and participation as an intern – what do you need out of school to do that.
50 [She asks if I will be looking at this topic from] a gender perspective. Studios seem to be
51 half/half, but the field is not the same. It's closer to 10% female.

52 Do women choose not to invest in technology and construction?

Supplemental Material A9. 3151 and 3152 Interview Summary

- 1 I1: Reimagining architecture. – Autodesk, Phil Bernstein. Possibly another book on
2 technology in education. ((you should look it up. It might help in your research.))
- 3 R1 and I2: Technology currently used in office:
4 Revit
5 AutoCAD - rarely
- 6 I1: [The specific] Use is driven by consultants – to some degree. Survey information
7 usually arrives in AutoCAD format. Manufacturer details are slow to catch up. Their
8 blocks aren't on Revit – some are producing neutron [?] files for use in house – for a
9 3d rendering. The blocks are smart enough to build it in, width to drop ratio – rare, but
10 won't allow you to use if it is too small for the space.
- 11 I2: SketchUp was used as recently as two years ago, don't you remember when it came
12 out 8 years ago. Building more from Revit more often.
- 13 I1: Autodesk has a strangle hold on things. Have made it difficult for 3rd party renders to
14 do anything – no plugins for Revit. They have done - Maxwell for Revit. Revit,
15 Maxwell – are the cumulative effect of changes.
- 16 I2: There are some users of rhino, 8 interns. A lot of time [software] use is directed by
17 what the students are coming in with. Someone has a new idea, just learned in school –
18 we let them run with it. True with rhino. Doesn't rhino drive our 3d printer?
- 19 I1: Have always had a laser cutter. It has, I haven't used rhino much. You can unfold
20 things, there are some attributes that make it, like you say, more capable. There are
21 some individuals that can model things very accurately. It has a lot more applicability
22 that SketchUp. Much more worked out, even if you take it as far you can.
- 23 R: Rhino or SolidWorks?
- 24 I1: I have looked at SolidWorks vs. inventor, in terms of Revit to fabrication. That's our
25 mainstay. It would be an interesting exercise to see how that would be. Seems like that
26 the industry will go that direction. Certainly headed that way for IDP.
- 27 R: Training?
- 28 I2: both in terms of hiring staff and interns,

29 Intern – 0-3 yrs. More flexible, decent amount of graphics, make sure it's strong, we
30 really like to see Revit. Functioning on that level would be great, it allows them to
31 interface with the model. Capable on their own. Even coming from another office, we
32 would still need to train [a candidate] in office standards. For full time it is becoming
33 required to have Revit experience. [We] Evaluate each individual for strengths.

34

35 R1 and I2: Design and technical architects are the same thing [at XXX]. That is the
36 strength of firm. Don't; think anyone in the firm had Revit experience when we started
37 using it. Some have been forced [to learn it], some have tried [to learn it].

38 I1: It takes a lot of time to be facile. You have to have an understanding of construction
39 to use Revit. It has been an issue. Ideal scenario would be - We had an in-house
40 education plan, [using] a legacy project to train [staff]. That's quite time consuming
41 and waiting till you have enough people to have a class – we will probably try to pick
42 up people with experience, and focus no standards. We will use Lynda.com and online
43 type training. Ideal scenario, teams of 2-4, sometime bigger, and they will be put with
44 a seasoned user who could mentor them. Challenge is to find seasoned users.

45 R: Other than technology, what skills do you value?

46 I2: Looking for people to solve the problem, a design sense. Good presentation skills,
47 abilities, a wide range of skills – full gamut – this person can actually draw. You want
48 a depth in their work, so we can put them on any task that we would need to. Hand
49 drawings, building models, computer models – careers (strong) people should be as
50 agile as possible. We will also bring them up to speed in the anything we need to. We
51 don't have formulas in our projects. We know who ever we have, and their specific
52 skills to complement.

53 I1: The first impression is what they send us. The production is amazing, with the
54 production that is available – exquisite books, boxes. A general team player is
55 essential. You don't see that team [dynamic] in college. Can do attitude. A sense of
56 humor. There are absolute requirements in terms of technology. You can see that
57 [proficiency] in what they send [to us].

58 I2: [I look to see [that they identify what they did in a project. You can sniff out
59 exaggeration.

- 60 R: Do see that the representation is more developed than the design?
- 61 I2: Change in the last few years - huge advancement in presentation ability, ability to
62 make things look believable. That comes across more in interviews - do you know
63 how to put this together? There has been such emphasis on presentation, [it needs to
64 reign back because what is being done actually needs to be produced.
- 65 I2: Just in being in student reviews – I was encouraging them to work on presentation.
66 Now there’s almost an over focus – give me a section of what that meant, diagraming,
67 how did you get there. [Show] the full range of the project development – don’t focus
68 on the technology. There needs to be a base level of the understanding of these things.
69 Last two weeks of a school quarter– different work flow,[now with technology instead of
70 analogue methods].
- 71 I2: Design process – varies per project Seeing it go from diazo to now, the design process
72 has not changed, just how we interact with the technologies.
- 73 I1: You can test things more quickly – building a physical model because of a
74 presentation -[the shop manager said] you refit guys we never see you anymore.
- 75 I1: Physical models – [the impact] is so immediate - renderings leave room for
76 interpretation – We don’t do as many [models] – I think there is a different way that we
77 do things now – because we can do them now.
- 78 I2: It took a long time for the firm to become comfortable with ultra realistic renderings.
79 [When representation is] Too realistic upfront, [it’s] too dangerous – process we go
80 through, same thing with cad, hand drawings had to be done early in the project,
81 because clients would be scared because it was “done” and the weren’t done making
82 decisions yet.
- 83 I1: Trying to find ways to make rendered image more vague and hazy. [Those that
84 sketch], They don’t use computers for their work tools. Others who still do them,
85 present that way.
- 86 I1: You first sketch in pencil, then want to test in computer. It’s a back and forth.
- 87 I2: I think one of the most interesting thing about this transition is the way that you thing
88 about buildings and the training of your architects will be indefinable in a while - we
89 were trained to think in sections and details, it was a different way of developing a
90 project- more incremental in the growth – to look at it as a model, then responsible for

91 doing this. Instead of 2D , it is imagining it as a model, rather than in section and in
92 parts. I think its going to change the industry in the way that buildings are conceived.

93 I1: It's inevitable the industry will think differently – I've never taken a step back to think
94 about how my traditional training influences my 3d -

95 Contractors – some have not seen the value [of BIM] – seems impossible that thy haven't
96 taken it up.

97 I1: A good case in point – the 3d printing – there is a whole process to ready a digital
98 model for printing on the laser cutter. Taking a step back to the question in the process
99 – take a project from conception – a couple of years ago it would be SketchUp – Revit
100 is too specific – but as people become more facile, people have become better at it.

101 I2: I'm realizing the value and quickness of things that I thought would take too long. Its
102 kind of amazing what you can do with it when you are really good. It's like you have to
103 add in a whole nother year, to demand them to learn these things and to know the
104 design. You don't' want to hamper their learning with too much technical detail –
105 Teaching them the technology - we still try go teach them to be good architects first.
106 If you have no presentation skills, no one can se their brilliance. I imagine that's the
107 currency of bring a student –

108 I1: Even before you could tell the difference. A good presenter or a bad architect.

109 I1: The interface is everything - perhaps we'll have drawing boards [again]. It takes
110 time.

Supplemental Material B1. Classroom Observation 1

1 ((Instructor enters class, students select seats as possible. Class is full – they look for seats that
2 will allow them to see the dual screens at the front of the room. Some chatter.))
3 ((Instructor introduces himself, asks them all to take an online quiz that will tell him what their
4 tech proficiency is.))
5 Teacher: Get off Facebook, and hop online to catalyst.
6 Student 1: I can't get to the page? It says Internet Explorer cannot load the page?
7 T: Then you can sit quietly and put your head down. You got lucky.
8 Student 2: I just tried Facebook and it doesn't work. I tried msn and it doesn't work.
9 T: Are you registered for the class?
10 S2: Yes.
11 Student 3: It doesn't work for me either.
12 T: Tell you what, how many of you can get to the quiz? Most of the class raises their hands.
13 How many of you are finished? ((Most of the class raises their hands.))
14 Student 4: What?!
15 T: I told you it was easy.
16 Instructor counts the hands up. T: It helps me figure out how to run this class.
17 T: No one asked me what Rhino is, that's good. I don't like this stat. 47% didn't like it and
18 went back to SketchUp.
19 T: Laser cutter questions...What is a laser cutter – good – honesty is important. All right, who
20 fell asleep during the training that Jeff gave? Be honest.
21 T: Thirty-four percent not familiar with renderings. 1 ringer. I am confident and I know what
22 I'm doing. I wouldn't do that either.
23 T: All right, cool, guess what were going to learn this quarter? This stuff.
24 T: This class seems to be taught differently every time it's taught. Some of you might remember
25 I came to your classes at your review, and I think I can help you at this particular junction in
26 your careers.
27 T: Basically we're going to dive into Rhino. Who's excited? One student raises a hand. All
28 right, one person is excited.

29 T: What we're going to do, we're going to build one fairly small project and create renderings
30 with it, then we are going to take that and make physical objects. Hopefully by the end of the
31 class you will be able to use Rhino to inform your design and use it for your work. ((He
32 passes out a number of 3D printed objects.)) Take a look at these, pass them around and hand
33 them back at the end.

34 T: Does anybody recognize this? ((Instructor holds up a San Carlo model.)) Who took 350?
35 Excuse me, 351? ((The class doesn't seem to really remember.)) Instructor tells them.

36 Students: Ohhhhh. ((Teacher explains that it is a 3D print of a model. The rest of the items
37 are also 3D prints.))

38 ((Instructor takes attendance. He calls out the students' names one by one, they correct him to
39 what they would prefer to be called.))

40 T: [Student1], weren't you in my 210 class like a long time ago? The class laughs, ((seems like
41 an inside joke, perhaps because of how long it's been.))

42 T: [Student2]?

43 S: [Student2].

44 T: Nice. [Student3]?

45 S: I go by [Student3]

46 ((He asks if he pronounces names right one by one.)) T: Who did I not call? ((Two people
47 speak up.)) T: Only two need to add this class?

48 T: Let's talk about what this class will be. I didn't print out a syllabus because I realize that no
49 one reads them. I want you to jump on to a long term project.

50 T: Show up, participate, be helpful, help your neighbors. Anytime anyone is having trouble,
51 email me, I generally get back quickly. I hang out in XXX, across the street in the basement.
52 How many of you remember where XXX's office is? (2) Only one troublemaker got sent
53 down? If you go past that, to the XXX. I don't have office hours per se, but you can pound on
54 the door and I'll help you.

55 T: When do you have studio? ((Students say right before this.)) T: I am fully sympathetic to
56 what you have subjected yourselves to, so I will work with what you have due in those classes.
57 Do you know when your mid review is yet? If one of you, better yet all of you, will let me
58 know when you have items due, I will fully support and work with you.

59 T: Who knows what NURBS mean? Who's heard of NURBS? ((Hands go up of a few
60 questions. Instructor continues to explain where fits Rhino and discusses how it came to be.))

61 T: Round curvy swoopy things that will allow creating these. (He indicates the images on the
62 projection screen.)) What we're going to try to do is to take advantage of what it can do.

63 ((He likens Rhino to a martini glass.)) T: You're at the bottom, just getting to learn, and then it
64 opens up and goes left or right. ((He gestures with his hands)) Rhino is like that. You can go
65 to the left, and do fabrication; you can go right and do design. Then you can use all the things
66 inside. Through the quarter, you'll do that.

67 T: The playground (.) I'd like you to experiment with all the shapes (.) Build slides, bike racks,
68 (.) I'm not too concerned with design. I'd like to see you experiment with the tools. In your
69 class last quarter I saw some really impressive work.

70 ((He continues to read out the requirements for the playground assignments. He asks them to
71 think about modularity.)) T: Does that sound good? ((A few students nod.))

72 6:56

73 T: How many of you guys built those models (.) You all built that model last quarter. How many
74 of you used an x-acto knife? I'm old school, I like to do things by hand, analogue fashion, but
75 laser cutters make life really easy. I'd like to give you that as soon as possible.

76 T: It doesn't matter to me what the model is made of, I just want you to do a good job.

77 The last part of the project is a cool box. ((He gives an example of a conversation with a model
78 builder and the story of putting a cool model into a wood box. He goes to the front of the desk
79 and starts acting out the story – students laugh as he “shuts” the box and describes the
80 importance of presenting the model well.))

81 T: Think about when you go to a critique, (.) you're not ready, it doesn't look so good. When
82 you have everything ready, you go in and can do a great presentation. We're going to do that
83 with what?

84 Students: Rhino.

85 T: Any questions? ((Silence.)) T: Not a one.

86 This is a 3 hour class. Studies show that no one can go longer than 45 minutes. Now lets' do a
87 little test.

88 I would like you guys using version 5 because the rendering engine on it is completely different.

89 Go ahead and open version 5, I'm gonna have you guys try a little something.

90 ((Students stretch, some are talking, looking around, as they do that and wait. Instructor opens an
91 email on the screen. He brings up an image of chairs.))
92 ((The back row is chatty – low voices, can't hear what they are saying. Low murmur around.))
93 T: You guys will find out about me, I really, really like chairs. These are not my favorite or my
94 least favorite I just googled chairs to see what comes up. Why don't you pick one and try and
95 make it in Rhino. ((The class erupts in laughter.)) Who knows which one is the Verner Panton
96 chair? ((No one knows which one it is.)) Who can make the swoopy red one? ((The class
97 comes down until they choose the easiest ones in the corner of the image. They all laugh.)) T:
98 Which one would you like me to show you how to make? S: the red one. ((The whole class
99 laughs. It looks like the most complex chair in the image.))
100 T: Let me back up. Who can't open rhino? Okay, why don't we try something simple?
101 Lets go back. Has everyone opened Rhino? How about I give you an overview of Rhino? How
102 many of you haven't touched it since [...]. ((inaudible))
103 T: What is Rhino(.) What should we use it for? What are these windows? Viewports, right.
104 ((He shows the tabs at the bottom and how quickly a user can see the top/front/right/perspective
105 views. Someone sounds like they think its cool.))
106 T: Here's the most important thing you will learn from me today. ((He shows them the help
107 button.)) I want you to click on that. It gives you a command help. What ever you're trying
108 to do, it will tell you how to do it.
109 T: There's basically three ways you can tell Rhino how to do something: icons, command line,
110 menu at the top of the page.
111 T: Let's jump onto perspective, draw a box, circle, a tube...whose looks like that?
112 T: How many of you like models that look like that, just line. Does anyone know what that's
113 called? A few say wireframe. Right. No go to the views – I like ghosted.
114 T: Does everyone know how to navigate (.) orbit. ((He shows them on screen.))
115 T: Anyone know what a control point curve is? No? You click this, you get these points, you hit
116 enter. Now select, and hit F10. Tell me what happens. You get these dots. These are control
117 points. You can click on it, it highlights it, you can then change the curve with that.
118 T: Do a selection window around everything, let's just delete everything,
119 T: What's the long-term assignment? ((They say playground.)) What's in a playground? A
120 slide. Let's draw a slide.

121 T: Let's do line, you type in 0, it will start the line at origin. Go down to the bottom and select
 122 "Osnap". Does everyone know what snaps are? ((Student answers.)) That's right. I want you
 123 go to ortho – what does that do? Right. It makes you go in straight lines. Where it says end
 124 of f line, I want you go to 10, 0.

125 T: All right. So you should have (.) this. I want you go down here, where it says smart track,
 126 make sure that's on. I want you to go to the control point curve, click on that. Go to the very
 127 bottom, and I want you to click "end". Go to smart track, click on it so it's bold.

128 S: I don't have that end on the bottom.

129 T: If you don't have that, click on ortho, it should show up. Everyone, please help your neighbors
 130 out. There's many of you and one of me.

131 ((He continues to demonstrate on the screen, then asks if everyone's looks like his. A question
 132 comes up.)) S: My line just disappears. T: your line just disappears? That's a pickle. ((He
 133 walks to the student's desk to investigate the issue. Some students talk, others, are still
 134 looking and working.))

135 T: So if you click on it and it disappears, hit enter. When you get confused, read the command
 136 line, it will tell you what to do.

137 7:24

138 ((He returns to the front of the class.))

139 T: Do most of you have the lines? ((Someone says no.)) T: You two don't? Then watch him.
 140 ((He indicates the student near the front he is talking to.)) T: See how this line won't do what
 141 I want? Why is it doing that? S: Ortho. T: right. If I click it off, then I can move anywhere
 142 around. Go ahead and hit F11, and that turns off the control points. Now go to perspective
 143 view. Now we're going to use my favorite command, extrude. ((He describes what to do.)) T:
 144 Right up here, where it says distance/direction. See where it says both sides? Does it say no?
 145 Click it. Ooohh, ahhh. It's like the fourth of July! The extruded line now extends both ways.
 146 ((He asks what a good length of slide would be good – he does one at 55'.)) T: What can I do to
 147 undo? S: Control Z. T: Now if I wanted to do it again what do I do next? S: space bar, right
 148 click.

149 T: Now click on the menu (.) yes layers, just like SketchUp. What do these do they make our
 150 lives easier. Who can tell me what layer I'm on?

151 SS: default.

152 T: How do you know that?
153 SS: Check mark.
154 T: How do I change that?
155 SS: Double click.
156 T: What color is my next line going to be?
157 SS: Red.
158 ((Instructor continues to describe commands, and what to do. Every time he does something, he
159 describes what it will do. Then he uses a piece of paper to expels how control points work –
160 how it keeps things from moving like an anchor. He demonstrates creating the swoopy slide
161 along the extruded curve.))
162 T: Go back to perspective. How do I zoom in on this? This is zoom extents. Does everyone
163 have something that looks like this? That might not make a good slide.
164 I want you to type in project. I am going to see what it tells me. I going to select the red line,
165 select, then the surfaces, and I'm going to select the wall, I hit enter, something happens.
166 Jump back into perspective... You should have two lines. Does everyone have something like
167 that? Does anyone not have something like that? S: I don't have something like that.
168 T: What I like is honesty. ((Instructor goes to the student's desk to help.. The other students talk
169 to each other, some are actually working on the exercise, asking questions, others are
170 checking their phones, one gets up and tries to leave the room.))
171 T: Wait don't go yet! I'm kidding, it's about time for a break. If you're having difficulty, stay
172 and I can help you with your slide.
173 7:39
174 ((About 11 students remain in the class. Only a couple are actually still working on the
175 software.))
176 7:49
177 T: Start up again – let's get back to our slide. ((He asks them to make another layer, “keepers” to
178 hide the things that don't need to be seen.)) What do you think the command is to undo hide?
179 SS: Show.
180 T: You guys are good. I've tried to unhide. Whey you need to “untrim” later you'll get it.
181 You just asked, what just happened? Does anyone not have a single piece of spaghetti floating in
182 the air? Anyone? Back row okay? Befuddled? ((Class seems to be okay.))

183 T: Now go to polyline...How wide do you think a slide is?
184 S1: 15.
185 T: Inches? Yeah, wild waves. ((The class snickers.))
186 S2: Three feet?
187 T: I want you guys to enter one foot.
188 I want you to draw something like that about a foot wide. I'm hoping that what we do tonight is
189 not your final slide, but we are walking through the process.
190 T: Yes?
191 S: I'm kind of lost.
192 T: Okay, I'm coming back. ((The chatter starts up again as the instructor goes to the student to
193 help him catch up. The students in front of me are redoing the last sets of commands.))
194 S1: Pick the light bulb. Yeah. Now, pick that. It's this one here. ((There are some pointing to
195 their screens. As the instructor goes back, someone asks him a question.))
196 T: That's such a good question we're going to share it with the class. ((Laughter.))
197 T: Continue to talk amongst yourselves, Help your neighbor.
198 So if you click on setting you can see what you did – if you click one thing, you can hide
199 everything.
200 ((The students in front row, two others, are talking.))
201 S1: Why did he show us that?
202 S2: That's kind of cool.
203 T: It's almost slide time. ((Instructor returns to the front.)) What you've done is draw half the
204 slide, you'll want to mirror it perfectly for the other side. Any idea [SS: Mirror. ((Instructor
205 reads off the command line and what the next steps are.))
206 T: You should have something that looks like that. You notice that you can click on one, the
207 other, but not both. I want a crossing window – anyone not know what a crossing window is?
208 ((Everyone knows, but he describes and demonstrates anyway.))
209 T: Get both of those highlighted, click join. Everybody have that? Nice.
210 I want you to go into your perspective, see everything you drew as well as your curve. I want
211 you to type in orient...orient on curve. Select objects to orient – we want to take this part of
212 our slide, and stick it on our slide and then get this to follow. ((He describes this clicking,
213 entering, points, and reads the command line.))

214 ((In front of me, one student helps the other to catch up.))
215 T: Who is having trouble with this? ((Some are, not all.)) That's impressive. Who got it right?
216 Then help your neighbors. I will come around.
217 ((One student moves from his seat and goes to help another. The student in front of me that was
218 helping the other to his right is now helping the one to his left again. It seems that along most
219 tables, one student works the software and the neighbor points out what they should be doing.
220 Then they switch.))
221 ((Another student who finished his slide, moves his seat across the aisle to help the other.)) S1:
222 Ohhhhh, awesome.
223 ((In the back, another student is standing and watching another as he works.))
224 ((Laughter – many are done.))
225 T: Anybody else befuddled? S1: Right here!
226 ((Some students that are done go back to their phones – ones that don't seem to know their
227 neighbors. Much of the class seems to know each other – possibly because of the studio class
228 that is scheduled previous to this one.))
229 T: Okay, we're moving on. This is the part where eight percent of you go, dude, and the other go
230 what?!! Type, sweep 1 rail. Click one, do not touch anything. ((It sounds like a student has a
231 problem.)) Someone touched something. ((Class laughs.))
232 T: Okay, who has a complete train wreck on their screen ? Okay, quick show of hands, who has
233 something that looks like a slide? Who has a train wreck? Help your neighbors! ((The class is
234 louder – they're helping))
235 S1: got it.
236 S2: hit enter.
237 S3: It's like a free fall.
238 S4: I'm gonna do a tube slide.
239 S5: You could put a sphere in it and get it to turn.
240 S6: It's not a slide, it's like a mattress.
241 S7: You should be able to put a solid in it.
242 T: Oh we're doing two curves. It tells us to select the object, base point is the one in the middle,
243 up there where it says perpendicular.
244 S: I don't know where that line is coming from - umm.

245 T: When you did your curve did you make that thing? How about a spiral one? You're killing
246 me smalls.

247 T: Surprisingly nice slides. S: A spiral slide. T: I want you to click the top, you should get a
248 menu like that – if you can't find it, I don't know where I put it? Type in select – curve, click
249 that, you get two curves. Move them out of the way.

250 T: Type in helix – they're making a spiral slide. It's not working for me.
251 8:20

252 ((About half of the students are taking notes as well as working alongside.))

253 T: If I don't like the size of this how can I change it? Anyone know what I would do?
254 SS: Scale.

255 ((Instructor starts to demonstrate changing scale.)) T: If I do this right, you'll know. Okay, how
256 do I change that? ((No one answers. They're working on each of theirs.)) Then I do sweep
257 one, we got another one.

258 T: Anyone befuddled? ((He steps back out to the desks to help. It's quiet. Most students are still
259 working on the spiral stair.))

260 S1: Oh it's sideways.

261 S2: What if I want to repeat it?

262 S1: Yeah.

263 S2: How do you do it? Like orient?

264 S1: Yep. It's cause it started drawing on that.

265 S2: What is that?

266 S1: Try to get it to the top, see what happens.

267 ((Most students seem to be waiting, with their screens open – little talking.))
268 8:28

269 Instructor walks around and looks at different students' work.

270 T: You should render that.

271 T: Save that, it will make you famous someday.

272 T: Would you like a step-by-step instruction on catalyst? SS: YES! T: It's already there.

273 T: What else would one find at a playground? Syringes. ((Laughter.)) Sandboxes? You can
274 make a sandbox. A swing? Could you make a swing?

275 S: How detailed do you want us to be? Do you want rivets?

276 T: NO!

277 T: Two things I want you to remember from this class:

278 T: First thing. Lots of polygons take a long time to model. Like a chain link fence with every
279 last detail will take a long time to render. I do most of my rendering during football season.
280 More polygons means a very expensive model in terms of processing. Make the most efficient
281 model you can make for visualization.

282 T: Second thing. Fabrication does not mean just pushing a button.

283 T: Third thing. [There are infinite ways to make things.]

284 T: Back to my first question ...what else do we find in a playground? A ladder? A spinning
285 wheel?

286 S: What's a spinning wheel?

287 T: Like a carousel. Let's make a spinning wheel.

288 T: Draw a point, then a circle. Anyone know how to make this into something? Extrude?

289 T: Planar? How big should our spinning wheel be? Three feet, good! ((Instructor answers his
290 own question. Laughter. He finishes making the disk.))

291 T: What else do we need?

292 S: Rails?

293 T: Yes! Rails, this is very dangerous without rails. It is going to end up on tosh.0 if we don't add
294 rails. ((Laughter.)) How tall do you think these are?

295 S: Two feet?

296 T: I'm going to go thirty inches.

297 T: I've got something that looks like this. Do you have something that looks like that? Do you
298 have 1 or 2 lines? If you do, I want you to do a crossing window and explode. I want you to
299 hit the outside and then click join. How's it going, Vincent? You getting it done? How does
300 this look – is it safe? Nope. How about this sharp edge? Would you put your kids on it?
301 How do we smooth that out?

302 S1: Fillet? S2: Fillet? T: Yes, fillet? Now if I hadn't been an idiot and joined those, that would
303 have worked. Get back in there and blow those bad boys up and fillet again. Mine looks a
304 little small, so I'm going to make my radius bigger. Everyone have something that looks nice
305 and round?

306 8:50

307 ((Students are still working – looking at their models, trying things out. Others are starting to
308 chat.))

309 S: I'm thinking about partitioning my hard drive.

310 ((Some are checking email, there's talking, stretching, phones – texting.

311 The middle row where the instructor is are all working. One student in the back has his feet up
312 on the desk, is drawing in a sketchbook.))

313 T: You've done the next step – put your head down on the desk. What's your name? ((Everyone
314 laughs.)) What did you do?

315 S: I swept a circle.

316 T: That's a long way to do that. I am always finding there is more than one way to do it. I take
317 lots of classes and I find there is a command to do what I've been doing the long way.

318 T: What's the thing made of that they're holding? A rail? A pipe. Type in pipe. Click once.

319 ((Everyone in the back row is laughing, one of the students did something that turned out
320 unexpectedly.)) Just make the radius the same on both ends. Everybody have that? Now we
321 need more of those. Anyone know how to do that? S: Array? T: Yes, nice!

322 T: Everyone type in array. How about array polar? I don't think 2 is enough. 8?

323 ((Students seem to be working to master the spinning wheel.))

324 S: I believe they're called merry-go-rounds.

325 S: 360 degrees ((More stretching, movement, appear restless.))

326 T: We can just use the same commands on other things, the tube thing, hamster wheel thing for
327 children ((Laughter.)) You know what I mean. Can I explain what I'm doing? I just drew
328 some lines and fillet. Sometimes it doesn't work – we call that most times.

329 T: Take the next 20 minutes, experiment, ask me for help, I believe there's homework on the
330 catalyst site. ((He opens the web page.)) There it is, right there. I'm giving you guys
331 something to start with. Take the site plan, start to create a few elements. I'm not sure what
332 the deliverables are, but I want a model and some jpgs, we'll talk about it.

333 T: You guys feeling pretty confident with this? Isn't this more fun than drawing squares? Or
334 not? All right, have it. Any questions? No? I set you guys free and you have no questions.

335 ((A few students get started, checking the course website for the files, downloading to complete.
336 Others are talking, trying out. Instructor and student are talking at the front, he's trying to add
337 the class. They agree, he returns to his seat.))

338 T: Oh, is that it? I wonder. Someone has a question. How would I make two exactly the same
339 shape? Good question.

340 9:11

341 T: Whoa Nellie! That's awesome.

342 T: That's one way to do it.

343 S1: How would I tell it to pipe the two – is that a Boolean command?

344 S2: What?

345 S3: Its like you take an object...

346 ((Interestingly, the whole class stays in the classroom – 10 minutes left and on their own. The
347 instructor is still helping students.))

348 S4: What were you trying to move?

349 S5: Fancy park?

350 S6: She's making a waterslide.

351 S7: Fillet

352 S1: Oh here it is, Boolean.

353 S8: Have you heard of the gravitron? That's what they call it – its like a big one of these, it starts
354 spinning, you can walk up the wall. S9: is it dangerous? S8: The force is so strong just pulling
355 your head up. S9: that sounds awful. S8: After a while you just start feeling sick.

356 ((Loud laughter from the middle row.))

357 S10: I'm electric.

358 S11: I'm gonna make it like, kinda like a pipe, so they swing, like an octagon – make a pipe
359 out of it, then twist it – how would you twist it? Is there like a twist?

360 S12: God! You're like ruining it.

361 S11: Is that like twist axis? Yeah...oh! Oh wait. It won't work for the z axis. You can go to
362 front view and try to pull it up – it should work. Oh, it snapped to the end.

363 S13: That's it right? Going home. ((A student gets up and shuts down his computer, another
364 puts on his jacket. Computers are logged off.))

365 ((Instructor is in back row, helping out a student. The others leave the room one by one. Lots of
366 shuffling, talking.))

367 9:21

368 S11: I really liked that spaceship he showed us. From one of my favorite shows. Really
369 detailed.

370 S12: Did somebody make that?

Supplemental Material B2. Classroom Observation 2

1 ((I'm late – traffic means I've walked in 45 minutes late))

2 7:17

3 ((Students have moved around in their seats in the room from last week. The room is still
4 full – I don't see any empty computers.))

5 T: While you guys open rhino, do you remember the two slash three things I told you to
6 remember about the class?

7 S: Just to make things simple?

8 T: Just that polygons are expensive. And the second that ... (missed)

9 A few things I forgot to tell you last week – save your work? There is an autosave, but
10 save as often or unoften as you like. You can pretty much control z as far back as you
11 need to. Even if you have saved it, you can still go back up until you opened it. You
12 can go back pass where you save which is pretty nice.

13 I want you to go over here to this thing that looks like a piece of pie, where layers are. I
14 think I covered this last week, but I can't tell you how many times I said I wouldn't
15 need a curve and then needed it later. Take all of your curves and put it on that saved
16 curves layer. Don't do what Johnny does, do what Johnny don't.

17 T: yes?

18 S: How do you get that tool bar if you open it and it's missing?

19 T: This happened over here last week? ((Student nods.)) T: Close it an open it and hope
20 for the best. That pretty much takes care of it.

21

22 When I see a view I like, you can go up to here, in named views, and do a save as, call it
23 Mr. Bigglesworth because I watched Austin Powers last week ((laughter)), and when I
24 want to go back to it, I can go here, oh what was it called? I can go back to set view,
25 named views, select Mr. Bigglesworth and go back to that view.

26 Does that make sense? Yes?

27 S: Oh, nothing. T: just scratching your head? How many of you had trouble getting your
28 views... yeah yeah yeah?

29 S: How do I get my points to oh, point click? Oh, never mind...

30 T: Okay, who had trouble getting your views out to me? Because I didn't show you how
31 to do it? How did you do it?

32 S: Export selected? T: Like in Sketch up?

33 T: You can screen capture file, then you can save it to any file you want. Then you can
34 go right here to the desktop and get it. I apologize because I should have done that last
35 week.

36 How you guys doing? Do you need a break? ((No answer from class. Student on right
37 says no.... under her breath.)) T: You guys are ready to roll. All right, we'll go for a
38 bit and then stop. What?

39 S: I lost my tool bar. ((Teacher goes to front to help. Another student's phone goes off,
40 he gets it out to turn it off.)) T: That was very unprofessional. ((Class laughs)) That
41 was Wussie, singing Wrist rocket, in case anybody was wondering...

42 ((Teacher continues helping the student up front.)) T: Ah. You must restart it, now
43 you're good.

44

45 T: So how many of you work a little or just get a control point curve and mess around
46 with it? S: Answer two. T: See this is an easy class.

47 T: I want you to go over here and make a sphere, click more or less at 0,0. Can you see
48 where my cursor is? I want you to not leave it where mine is, say, 2,0, but go over here.

49 S: How big?

50 T: We're just learning a process, don't worry about the size. Then make another one, say
51 about this big, and move it over here.

52 Does everyone have something more or less like that? Jump to out of your perspective
53 view, make sure you have soothing more or less like that? Then go back to your
54 perspective. I want you to type rebuild. See how mine says 10 and 10? I want you to
55 type 8 and 8.

56 We're gonna make a rubber duck. Who made the duck with springs on it? ((something
57 unintelligible. Laughter from a student in front.)) I want you to turn on control points,
58 who knows how to do that? S: F10? T: Yes. That turns on your control points.

59 We're going to take this sphere and flatten the bottom so it can sit. I want you to type in
60 set point.

61 S: What is it?

62 T: S-E-T-P-T. This sets your control points, were going to uncheck x and y. If you ever
63 forget where your axis is, you can go down here to the right...

64 ((Student requests help up front, teacher goes to help, students start talking to each other
65 – seem restless.))

66 T: Then you can move this like that. ((He demonstrates moving the bottom up and
67 down.)) Everybody have something that looked like this? ((waits about 2 seconds.))
68 Yeah, sweet. Now everybody turn their control points back on ((a few have it, not all))
69 I'm going to turn one of the lights down.

70

71 Now what I'm going to do is I'm going to grab – and you have to use a crossing window,
72 since there are a lot of points behind it – and I'm going to grab this control point, and
73 give my duck a tail. Did you ever see Hell Raiser? This point is like a pin in his head,
74 and I can pull it out and make this. Then you can look at the perspective, my duck is
75 starting to look good. Does everybody have something like this? Yeah? Great.

76 S: ((something unintelligible.))

77 T: You're having trouble? Good. ((He goes to help him out. A few students have it
78 complete, some are trying other things. A few don't have it at all. Along each row,
79 students are helping each other, some have it completed or look bored.))

80 T: You guys have some good lucking ducks.((goes to the back row to help another
81 student.)) Now do a crossing window, now you've got the one...Now, these are some
82 good looking ducks.

83 Okay, our ducks need a head, so turn on the control points, I'm gonna give my duck a
84 beak. Since I don't exactly like where the control points are, I'm gonna rotate it, so
85 rotate, and I'm gonna turn on my control points again, that's a little better. So I'm
86 going to do this, take this, pull that out, give the duck a beak, oh that's too much. And
87 I got a duck.

88 S: How do you select the center, to rotate?

89 T: How do you select the rotation?

90 S: Well, how do you select the center?

91 T: Well, I sort of just guessed.

92 S: Can you add in more control points?

93 T: You know when we set setpt? We set the number of control points. We can add
94 more. He draws a sphere. This one has 8, we can do less, , it has more effect. If we
95 add in more, like 20, it has a different effect. More control points means more
96 polygons. If you were going to be an industrial designer, you want less points. Good
97 question though. All right. How's everybody doing? ((No pause, no answer.)) Okay, I
98 want you to draw a control point curve, kind of like I'm drawing on the object itself,
99 I'm gonna have you do it on another layer, like a beak.

100 T: Yes?

101 S: how do you turn the control points off?

102 T: F11.

103 S: What kind of curve?

104 T: A control point curve.

105 Now I might want to change colors later, Anybody know what the command is to split an
106 object? SS: Split.

107 T: YEAH! Split. It doesn't matter if the curve is on the object, as long as I select it, and
108 then if the Rhino gods are with me, don't laugh, there are rhino gods, I have two
109 separate objects.

110 Why don't' you guys take a break, take 8 minutes, don't' take 10.

111 ((Students get up, lots of shuffling, they are talking about other things and not the class or
112 the project. Student exits the classroom, says, what the fuck?! One students says
113 quack, quack – another student looks back, laughs at him. Instructor walks around and
114 helps out the students that have questions.))

115 7:55.

116 ((Students trickle in. Ducks are in various stage of completion, already set up in different
117 colors.))

118 T: All right you guys, duck is almost done some of you have asked about getting
119 surfaces to connect. I want you to draw a line, I want to be sure you use the same line
120 for what we're about to do. I want you to draw it so it goes across like that , then I
121 want you to copy that – how do you copy?

122 S: copy.

123 T: Now we're going to split, go ahead and type enter, the top one we are gonna split,
124 select that line, then hit enter... etc, etc. and you should be able to delete the upper
125 parts. You should have something that looks like that. Then you want to delete both
126 those lines. Now I want to blend these two surfaces together? Blend? See how I do
127 that? Type in blend, you'll see the options, select blend surf. Now when you go like
128 this, make sure you use select surface close together or your gonna end up with
129 something that looks like a bow tie. Now all of you will have something that looks a
130 little different, but see those arrows at the line? That's the seam. Every blend has a
131 seam. So back to that. I can use the control points to control the profile of the blend.
132 I'm gonna go ahead and hit okay. ((Laughter from the students.)) Some of you
133 screwed that up, I can tell.

134 T: Who's having trouble? ((Hands go up. He leaves his desk and starts helping students.
135 Most of the back row has a completed duck. Some are still trying to figure it out.))

136 S1: Join?

137 S2: I think I got it. For the most part.

138 T: It just looks like that because of the where the head was. ((He goes to the next
139 students.)) Okay. Drag it, yeah, like that. ((Students in the middle row are talking to
140 each other, huddled around the middle screen.))

141 T: I knew that would happen. No need to worry.

142 ((Some intently looking at screen, talking to each other.))

143 T: How's It going guys? Having trouble? You guys are working in perspective you're
144 gonna have a very interesting neck. You're not going to hear me say this often, but
145 that is unacceptable. ((Laughter.)) Your duck is upside down..so rotate it...((Laughter
146 from those behind her.)) T: They're laughing with you. It's all right. I'll come back.
147 Why am I coming back? ((He stays to help her.)) You know why? Remember that
148 seam? That's why it's like that.

149 ((Two of the students in the back row discuss a movie.))

150 S1: What's that bin laden film?

151 S2: I saw a part of that, I didn't really like it.

152 ((Teacher starts back up, asks about the different concepts.)) T: What were those?

153 S: Rebuild?

154 T: We had UV, but I didn't tell you what that is, because I am a terrible teacher. ((He
155 draws on a piece of paper, shows xy on a flat surface.)) If you curve it, then these
156 aren't in a flat plane anymore . UV gives us a way to determine where the points are.
157 And what is at each of those locations? A control point. What else did we learn?
158 SS: Blend.
159 T: Anything else?
160 SS: Split.
161 T: We're gonna learn one more thing. Make sure that your smart tracking is on, right
162 down here at the bottom. I want you to make a couple points. Smart tracking is this –
163 see these lines? Let me make one more point, we got this point here, so, if my smart
164 tracker is on, then my point gets a white line when it's in line with it.
165 I want you to go to your duck's head, draw these points. I want you to type in conic, and
166 conic is a way to ...that won't work. Lets try this instead. Go to the arc command,
167 open a flyout window, click those two diagonally, I want you to start dragging
168 something so we have something that looks like a nice, semi arc. Semi arc? That's not
169 a word. Does everyone have something that looks like that? Were going to make an
170 eyeball out of it.
171 What should I do to make this an eyeball? Rotate it or revolve it. Try revolve, start on
172 the axis at the top of the axis, bottom is the other, you should get – if we look at our
173 perspective, something that looks like that. Everyone have something that looks like
174 that? Yup? Nope? Who has half a ...
175 S: Could you do that again?
176 T: Yeah. How far would you like me to go back?
177 S: That's good.
178 T: I'm gonna take this,and I have a little dome. Everyone have a little dome? So
179 now...everybody caught up? Good. I want you to select those two points we drew,
180 and I want to set them at the z axis. Does anyone remember how we did that?
181 S: Setpt?
182 T: Type in SETPT, and everything pretty much stays fixed , and I'm gonna move those
183 points about a third of the way up and hit enter. Now were going to use these points to
184 orient the duck.

185 S: can you repeat that one more time?

186 T: Sure. ((He repeats the demo. A bunch of students are done, swinging in their chairs.))

187 T: Does everybody have their points about, yea? We'll learn about coloring later.

188 Now this is a command I get wrong about fifty percent of the time, so I fully expect some

189 of you to have trouble. I'm going to go down to orient, and I'm going to take this little

190 ball, and smash it on to the face. Transform orient on surface, select object, we'll

191 select the eyeball, then we'll select the other side, that is not the center, then the surface

192 to orient on. And now I have an eyeball, stuck to my duck's head – I can't believe it's

193 working, I mean, it's working just like it should.

194 S: Can you select it in that command?

195 T: yes, I can. If you discover that your eyeball doesn't fit, you select the eyeball, type in

196 scale, select the center, and you can scale the size. Because the duck is at the origin, I

197 can select the eyeball, type in mirror, around the axis ((He has trouble with it – one

198 more time – he gets the eye completed.)) Everybody have some eyes on their duck?

199 ((Most of the class does not have the eye even on the ducks head. Lots of students

200 rare trying to master the process. Teacher walks around the room to help. There is

201 some laughter, some concentration, it just depends on where they are.))

202 8:24.

203 ((Quiet discussion, most actually concentrating, on the lesson, lots of hands raise every

204 time he moves on. Students have very specific questions for each of their models.

205 T: Yeah , that's what I'm talking about. I knew somebody would put forty eyes on their

206 duck. ((He's at the far end of the room now, front row.)) T: try it now.

207 ((One student asks another what did the teacher say when the eyeballs upside down? Oh,

208 I wasn't listening - my eyeball's upside down. Laughter in the middle row, where

209 there are three girls sitting.))

210 T: Select the eye and then mirror it.

211 ((The other student says to his friend across the aisle, select the eye and then mirror it.))

212 S: What does that do?

213 T: All right you guys, save your ducks, I'm gonna jump into something a little easier.

214 ((He stops at the front row to answer a question on his way up to the front of the

215 classroom.))

216 T: Well played you guys, good job. Okay, I chose this one because it has a lot of
217 complicated stuff. The McNeel how to learn rhino has this at the back. If you took
218 rhino training, this is about hour twenty, so you guys are way ahead. All right save
219 your models, save your ducks, start a new model. I want you to draw a box, start your
220 box at the origin, and I want you to draw something about like this. Who know what
221 this is?

222 S: A cool box?

223 T: A cool box, check, done? If you want to know what this is, you basically type my
224 favorite command, just type WHAT. It tells you its' an extrusion, control points, ...
225 What do control points do? Select this, turn on the control points, what happened?
226 There are more control points. It wont allow you to manipulate a polysurface, which is
227 lots of things joined together. Type explode, and then you can manipulate separate
228 things. Now undo. So you're back to the polysurface. You can use extract, just to do
229 separate ones. Select that one, that one, that one, type enter. Now if I select, I have
230 three separate planes. Now just delete the others, and you should have a box with
231 sides. Okay, hit F10, how many control pints do I have? One? Not enough. What do I
232 do?

233 S1: setpt?

234 T: No.

235 S2: Rebuild?

236 T: yeah! I'm excited, we'll do four, and four. Now use a cross window, and select those
237 points, and we're going to move these up so it makes a nice gentle curve. Does
238 everybody have that? No? Okay, I'll be right there. Can you guys see how this might
239 be useful say, in a slide? ((Teacher goes to middle row to assist. Half the back row is
240 working, a few others who have succeeded sit back, chat. Most appear to have had no
241 problem with the commands or process.))

242 T: How's everybody doing? Easy? So, turn off your control points, F11. Now we've got
243 these holes here, how do we close these?

244 S: Cap?

245 T: Did it work? All of you should say that. Why didn't' it work? Because we have one
246 polysurface here, and one here. So join, and now try it. Did it work? Now we have one

247 big object, I want you to select that object, select any layer except the one that it's on,
248 and do copy to layer. You should have two of these you can move one over. Okay, do
249 that again, copy the red one. Select the blue one, then turn off the red ones. When
250 you're working on a model, when you're at a half way point, take all these flat planes
251 and save it.

252 T: If we were to make this shape a candy bar, how would we improve that?

253 S: grooves.

254 T: Grooves, but that wasn't what I was thinking, so we're not going to do that. How
255 many of you made playground furniture with hard edges? Ouch. We're going to use a
256 command, fillet, and select these edges...

257 T: I'm going to select the verticals, then show radius, and then type point five, and take a
258 look at it, that looks too big, I'll try point two, that looks better, hit enter, now it
259 doesn't look like a candy bar, it looks like soap. This is virtual, you can make it
260 anything you want it to be.

261 T: Fillet is a command that only works on edges . You will bang your head against a wall
262 trying to fillet a curve, it only works on edges. Does everybody have something like
263 that?

264 S: Yes sir.

265 T: I want to try doing something that doesn't work. Fillet using a radius bigger, and that
266 shouldn't work.

267 S: Whoa.

268 T: do you have something that looks kind of like spaghetti? How many of you have
269 something that didn't work. Learn from your neighbors' mistakes. Now undo and try
270 that again using a radius that is smaller. ((Teacher goes to other students to help
271 them.))

272 8:48

273 ((Hands in the air with questions. Movement, talking, experiments.))

274 T: All right, good job you guys. Now, if I said to you, you have this candy bar, and I said
275 I wanted you to make a model of it. There's a few things you could do. Anyone know
276 what a developable surface is? A developable surface is one that you can lay flat. It is

277 made flat and then rolled, into a single curved surface. ((He uses a piece of paper.))
278 This is a single curved surface, this is a double curved surface. See That?
279 T: You can unroll to get a flat surface. Turn off you blue layer, I want you to select your
280 surface, type unrollsurf, make sure it says explode. Woooo. Sweet.
281 T: Can I repeat that? Of course of course. ((Students sound excited, see results of what
282 rhino can do as it takes a solid and turns it into a flat pattern.))
283 T: Listen to that! That is the sound of learning. Wait, wait, there is more learning afoot.
284 ((Students snicker.))
285 T: Go ahead ads select another one, and unrollsurf, when it says explode, then you get
286 something like that.
287 S: Wow....
288 T: See, a week ago you guys didn't want to make models. Now you're feeling really
289 good. That command again is unroll. Let's add some ridges, what happened – error
290 message – may produce inaccurate results. Maybe you don't care! You just want it to
291 work. And you get mad at it. What do you want to do?
292 S: Smash it.
293 T: What?
294 S: Smash it.
295 T: Type it in. Mine exploded, but it will work for you.
296 S1: What???? S2: Don't hit that.
297 T: We are probably going to make something simple like this in the fabrication,
298 something to hold your ipod or something. Can you see the martini glass, the
299 representation and the fabrication.
300 T: Are there any questions?
301 S: Smash the duck.
302 T: Smash the duck? Don't do that, that will hurt my feelings. What do you guys want to
303 do? I can show you more nuggets of wisdom or you can ask me questions and I can try
304 to get to you.
305 S1: Love.
306 S2: Nuggets.
307 S3: Nuggets.

308 T: Nuggets! ((He starts a new model, show them Distance.)) If I want it to be say 20.5, I
309 can use the scale command, and while it's scaling, you can type in the number.

310 S: You said you'd show us how to do windows?

311 T: Yes. Do you still have your candy bar?

312 T: Rats, I don't. But I have control z. I'm going to go to another layer, a black one.

313 Who wanted it on their castle thingy? ((Hand raises.)) Right. ((He shows them how to
314 draw two rectangle curves.)) If you go into perspective, you'll see they're not on the
315 top. where you'd want them. So I'm going to project them. So you type in project,
316 and then select them, and then the surface you want them on, and they go to the top.

317 T: Now you can use split, there is more than one way to do it, but I'd like to use
318 commands you're familiar with, and then you can delete the one.

319 9:05.

320 ((All the students are working, following along, listening, looking at the screen. At the
321 moment no one is doing something else.))

322 T: Does everyone have something like that? Or maybe you're just watching. That's
323 okay too.

324 T: So I select my surface, and it should work...or I could have screwed it up...that's
325 okay, it happens all the time. One more time. It's always fun to watch people
326 flail...extrude surface, then I pull it up, and then it's wrong....wait, we did it. See, I
327 knew you guys were losing faith in me. When it seems to be going all catty-wampus,
328 you want to check the direction.

329 T: Does that make sense? Any other balloon animals that need to be made? We have 10
330 minutes. I know your brains are pretty full. We go fast and slow.

331 T: What are the two things I want you to learn? Number one is fabrication is not just
332 pushing a button, number two is polygons are expensive.

333 T: What am I doing – I'm done with you guys and I'm going on Facebook ((laughter)).
334 No, I'm trying to get to the class website. What are my friends doing? I'm at work! So
335 basically what I want to see next week is the same thing. Look at the assignment, save
336 yourself a file, a pdf of your views. Start working on your slide, you don't have to
337 make a merry go round.

338 S: Do we have to be sure every thing fits in the 25' square?

339 T: It's pretty small. If you need to stretch it out, that's okay, but think about the final
340 project. What are you going to present? Is it the whole park, a fabrication of your
341 connection, a vignette...

342 T: This isn't a design class, well it is, but it's a computer class, I'd rather have you
343 learning the software than worrying about whether your benches fit or not

344 T: Okay we have a few minutes, pack up your stuff, catch your bus, ask me if you have
345 any questions, not just about this class, but anything rhino related.

346 ((Some students immediately start packing up, others, sit and chat, they start leaving the
347 room. A few get up and talk to each other.))

348 S1: what's up brother? S2: I love this class dude. Computer class.

349 ((Laughter, chatting, students continue leaving the room.))

350 S3: Okay, let's ride.

351 T: Anything else?

352 S4: Just wait outside S5: I'll use the elevator.

353 ((Most students push in their chairs, all log off the computers. One student returns to the
354 room to retrieve his phone.))

355 9:18

356 ((3 students left at the front talking to teacher. All female. Two students at the back,
357 looking at papers, two at the front, just chatting.))

Supplemental Material B3. Classroom Observation 3

- 1 T: All right you guys, let's just assume it's 6:30 or thereabouts. Why don't the first of
2 you guys bring your stuff up here and we'll have an informal chitchat of what you've
3 done. ((Students begin bringing up their items to the front table.))
- 4 T: The first row? Everybody. Sweet. Shorter people up front. So you guys, pass these
5 around. ((general laughter.))
- 6 T: Who's is this?
- 7 S: This is mine, with the shelf on the bottom,
- 8 T: Cool. Did you do any field testing?
- 9 S: yeah.
- 10 T: Any issues?
- 11 S: The tabs never fit in first.
- 12 T: Who made the elephants? ((The same student raises her hand.)) T: Apparently this is
13 successful. ((Students laugh, she is red.)) T: What is it? S: A iPhone holder.
- 14 T: So what you're saying is you didn't learn anything here, but you did here. ((She has 3
15 items.)) Never mind, I can see where you went awry. How did you choose your
16 materials? Or did I specify?
- 17 S: Whatever was left.
- 18 T: There are a few material secrets I have.
- 19 S: I tried using plastic, it melted as it cut.
- 20 T: It will do that. Nice attempt though. Pretty nice bends, here. Did you try to work
21 with the grain? It's a 50/50 chance.
- 22 S: I just sort of did it.
- 23 T: This material has a grain, just like wood. You did well, along the grain here, then not
24 so much here.
- 25 T: Who did the (_____)? ((Students laugh.)) T: this could be a million dollar idea.
26 Any issues with the tabs? S2: [...]
- 27 T: Gonna tell you a story. ((Laughter.)) The first time I did this, I thought I would use
28 these tabs. About 75% of the tabs worked great, the others I had to use needle nose
29 pliers to pull them through.

- 30 T: Who's is this one?
- 31 S3: That's mine. It's pen holder.
- 32 T: cool.
- 33 T: Has anyone looked a the cool box project? You probably should in the next few
- 34 weeks.
- 35 Nice. Any issues?
- 36 S3: This area didn't turn out well. I did perforations, but it still didn't.
- 37 T: All you guys are using pretty thick materials. Do you remember the example I
- 38 brought in? Significantly thinner material . You should think about that.
- 39 T: Who did this?
- 40 S4: I did – it's a tooth. It's a toothbrush holder. ((Something unintelligible. Students all
- 41 laugh.))
- 42 T:V____, what do we have going on here?
- 43 S5: It's the better one of the three in the studio.
- 44 T: Bring them all – I want to see all the failures till now. 5 weeks from now you don't
- 45 what to be failing. So what's this?What went wrong?
- 46 S5: First I used [...]
- 47 T: Do you guys remember when I said last week about testing little areas first? Did
- 48 anyone do that first? This is cool. Valuable lesson learned. These are lessons I had to
- 49 learn the hard way too. Go ahead and take these back, I asked you to photograph these
- 50 and upload them. We'll want to take a look at these again at the end.
- 51 T: Okay, next ten or twelve, go ahead and bring your goodies up here please.
- 52 All right. (Students laugh.)) Sweet this one comes with a phone. So I can tell - whose is
- 53 this. I can tell, of your choice of glue. So you used the section command and got it to
- 54 work?
- 55 S6: Yeah.
- 56 T: any trouble?
- 57 S6: No, well, it took a few tries.
- 58 T: I can tell you put a lot of effort into it. I saw your model last week too.
- 59 T: Whose is this?
- 60 S7: It's a paper holder.

- 61 T: Yeah, for flimsy. I can tell you use computers a lot. So if the drawing goes in here.
- 62 T: I like this one, it's a DIY kit. Learned something about cardboard? What did you use,
63 unroll or just smash?
- 64 S8: I used smash.
- 65 T: My concern is that you managed to make something flat, and you used the laser
66 cutter. I love to see an epic fail.
- 67 T: There you go, it holds an apple product.
- 68 S8: And tissue, at the same time. Not a lot.
- 69 T: I see it's useful, fold it up, put a new one in. Any problems?
- 70 S8: A lot. The openings were supposed to have speakers, it didn't work out so well. The
71 tubes were twisted, I couldn't do that with chipboard.
- 72 T: Next week, the assignment is doing a rough prototype of the cool box. As we
73 learned, trying to do it in one fell swoop is difficult. Next week we will try to learn
74 from our mistakes. Like I said I like to see errors.
- 75 T: Whose is this?
- 76 S9: Holds phone, have to think of cords.
- 77 T: I like it, highly efficient.
- 78 S9: it has my name on it too. Your hand is covering it.
- 79 T: Is this one or two people's? This is Gehry's first attempt. No, I'm serious. What's
80 going on here?
- 81 S10: I tried it with [...] material, became like a popcorn holder or something like that.
- 82 T: Any problems?
- 83 S10: I tried to [...]
- 84 T: I applaud your scale, and your effort of doing it twice.
- 85 T: Whose turtle? Any trouble?
- 86 S11: At first I tried [...] So I tried it like three times.
- 87 T: Who else has pieces swept away by the vent?
- 88 S11: And then it wouldn't assemble properly. I sent you a picture.
- 89 T: I like to see failures as well
- 90 T: Whose going retro? This looks like my parents' phone. Nice. I take it holds a iPhone.
91 Any trouble?

- 92 S12: Tabs.
- 93 T: Yeah, tabs are trouble. Use the calipers in the shop, test it, will it bend or break?
- 94 Figure what it takes to get these tabs through there. Cool.
- 95 T: Whose is the mickey mouse? What does it do? S13: [...] Oh, okay, cool. So what
- 96 would have helped is some holes here, for some other tabs. Other strategies, and I'm
- 97 not picking on you, if its loose, ((T draws a pentagon and one offset around it)) –
- 98 there's no reason you can't put another around it. Cool.
- 99 T: What do we have here?
- 100 S14: It's the head of...I had trouble, couldn't get it to bend. It's curves.
- 101 T: Yeah, cardboard likes to curve, but it dents too.
- 102 S14: and the tabs don't align.
- 103 T: Whenever you bend material, it doesn't matter what it is, there is a distortion. You
- 104 can't get a clean corner without cutting pieces and butting the edges.
- 105 T: What do we have here?
- 106 S15: it's a ...paper holder. I used pins.
- 107 T: Let me tell you about pins. Pins are great, they're fast. You weren't able to work out
- 108 the tabs idea, but mostly due to your choice of materials.
- 109 S15: yeah.
- 110 T: And that's what this class is about, that you learn about materials, and that you will
- 111 use metal, etc., but that you learn before it's your money on the line.
- 112 T: Okay, next group. Someone is serious about his glue. Sweet. Whose is this? Nice.
- 113 Any issues with this? This is a thinner material than last week. No? Pretty successful,
- 114 looks like you got this to bend, this has potential to become [...]
- 115 S16: I used the laser cutter, but the other one left burn marks.
- 116 T: Now you know which one to use.
- 117 T: All right. ((holds two pieces.)) What is this? Someone is an American with no
- 118 regards for space. I live in the suburbs, dammit and can use all the space for glue.
- 119 S17: I even tried test cutting it, thinking how can I improve this? I ended up jamming all
- 120 my tabs.
- 121 T: Wait a minute is that tape?

122 S17: Yeah, I forgot about, I had many different ways, so I had to bend it the other way, it
123 ended up ripping.

124 T: I know were using all these digital tools, but sometimes digital tools aren't the best, a
125 knife would have been just as good. You can spend 45 minutes, or just turn it over and
126 use the knife. Sometimes digital tools aren't the be all end all,

127 T: Whose is this? Bendy?

128 S18: I couldn't get it to turn. I could have used a rib system all the way across, but I
129 didn't have [...]

130 T: No, nice.

131 S18: I had trouble with the tabs, shoving the tabs in that.

132 T: Definitely pushing the envelope on what is possible with the materials
133

134 S19: That's [...] Mr. J's paint brushes. [...] Construction management.

135 T: Judging from the response this is extremely successful. Something to think about
136 when you're kerfing the material it's going to not break, but take the time to smooth.

137 T: Whose is this?

138 S20: It holds pens

139 T: I'm going to come into your studio and see if you're using these. Any troubles?

140 S20: The holes are too small, the tabs, I mean they're not even really tabs.

141 T: Cool. How did the holes not end up? I only ask because [...]

142 T: Every hour is happy hour. And this holds a glass? Sweet. Any trouble?

143 S21: Tabs.

144 T: Always tabs. Tabs, cool. This must have given you a lot of trouble.

145 S21: I tried etching first.

146 T: I can tell you went through the second laser cutting...he told the second group about
147 tabs.

148 S21: No, he told us too.

149 T: Cool, awesome you guys, these are great. We've learned al lot, and we'll learn more.

150 T: So guys, I guarantee that were going to learn how to light your models. Two things:
151 how to light your models and how to change and manipulate your materials. And then
152 the other thing may be how to fabricate your things. For most of you it looks like

153 you've figured out how to get your things together. I'm going to show you strategies for
154 fabrication, and while I do that, go to the 380 page and download the mouse, if not go
155 back and download it. If people's toolbars aren't open I can trouble shoot that.

156 ((PPT on the board – fabrication techniques.))

157 T: Are you guys starting to grasp the idea how this software can go more than one
158 direction, and how what you want to do can change your way of thinking? I hope
159 that's working out for you. I want to talk to you about fabrication and how you can do
160 these things. There are five ways to do that, I'm going to talk about four ways, or three
161 ways to do that. It should take 10-15 minutes.

162 T: Sectioning. Who thinks they used sectioning in their models? Hold them up. The
163 models, not your hands. Yes, elephant is sectioning, turtle is sectioning, ...yes.

164 T: Another way to fabricate things is tessellating. Very close to folding, but the geodesic
165 dome is made utilizing tessellation. 381 – the byzantine mosaics. Mosaics can be
166 considered tessellation. How many used tessellation?

167 T: Folding. Who thinks they used folding? Hold those models up. 1, 2, 3. Yeah,
168 folding is one to the most common ways. ((Laughter at the right side of the
169 classroom.))

170 T: Another way is contouring which is very old school. The old way, where you took
171 things away, carving, the Hepplewhite, Chippendale. You either take away or add to.
172 We won't be doing any of that, but I wanted you to be aware of it.

173 T: Let's talk more about sectioning. ((7:17.)) Also called bi-lateral contouring. Putting
174 things in one direction and then another. This one is sectioning, also contouring.
175 Sectioning doesn't need to be a flat material, here Massey used the idea of sectioning
176 using tubes. This is another piece using Shop. (PS1 sectioning). ((Dunescape on the
177 screen.)) They used a model, dry fit everything and to build it they just changed the
178 scale. This is the serpentine gallery, this is where they have a heavy hitting architect
179 create a gallery that might stay up for a whole summer.

180 T: Tessellating, and shiny object in London is Norman - his work is all tessellation. I
181 want you to think about materials. Glass is a material, fabric is a material. Just
182 because it isn't wood or steel doesn't mean you can't utilize it for something. This is
183 also tessellating, MOMA has young architects build these.

184 T: Tessellation, lots of little things that sort of bend together. These processes are not
185 necessarily stand alone. Just because you're using tessellating doesn't mean you won't
186 use folding, etc. Most of this you can do on the laser cutter. Folding is a common way
187 of doing things. Everyone know the Bauhaus? Yeah the coffee shop in downtown.
188 No, they had a paper folding studio. Gropius would say that is not good ((he mimics a
189 German accent and the students laugh.)) He folds a piece of paper)) That is the most
190 efficient use of paper.

191 T: Folding is an old technique that works. Folding is another, ah, efficient way to use
192 materials, Who knows what oil canning is? That when you bend something and they
193 start to distort. Who has been to EMP? ((Not very many raise their hands.)) All right,
194 who hasn't been? Who has been to Seattle? You should go, its important. The
195 bending already sort of distorted due to folding. ((He changes the slide on the screen.))
196 Water cube is basically folded.

197 T: I can't to put this on the site, this is Tom Wiscombe, it's done in Catia, a more
198 expensive version of rhino, well, not really, they built this all together, they knew
199 exactly how it would go together, ended up banging it together.

200 T: Contouring is removing from - it's labor intensive. Something like this we are used to
201 seeing, even though it is contouring, we as architects. You can have this milled out,
202 rather than stacking everything.

203 T: This looks like it's sectioned, but its actually contoured and cut.

204 T: Again, this is a model. And this is the thing, you can learn so much more by using the
205 digital tool and then fabricating.

206 T: Let's go to 3d printing. This is something that I did for Stevens Pass, I took their little
207 bird, I made the model in rhino, then printed. This is an iPod holder, I modeled in
208 rhino, then had printed on the other side of the cage. It requires pretty accurate
209 modeling. These are chairs that are 3d printed. This is basically animation turned into
210 something physical.

211 T: That is it in a nutshell, the types of fabrication methods. We are going to focus on
212 three of them. If you take other classes here, you might get to the others . We're going
213 to take a break and make sure you have the mouse, and then we're going to work on
214 lights.

215 7:31 ((Student goes up to talk to the teacher.))
216 T: I want to see the disaster.
217 S: I tried two different, tabs.
218 T: Like I said, I like to see the mistakes. Take a picture, I mean, more or less, you have
219 the whole quarter to get this down.
220 S: Basically, until I unrolled them they were fine, but then I unrolled it and they were all
221 overlapping. At two at the morning, right?
222 T: yeah, yeah.
223 ((Most students don't leave, but stay at their desks.))
224 7:38 ((Chatting, laughter, the back row is talking and looking at their screens. Others are
225 surfing, working on rhino models.))
226 T: All right, everyone have their mouse open? Did anyone experiment with lights last
227 week, or did you go straight to fabrication? Fabrication? Do you want me to start
228 from the beginning, or the end?
229 S: the middle.
230 T: The middle? Tell you what I'll go uber fast, and you can stop me if you haven't heard
231 something.
232 T: Up at the top here, there are tabs that open these huge toolbars, Most of what you need
233 is at the top. Like I said last week, these blue guys are for rendering, we don't need to
234 worry about he mesh. What we need to worry about tonight are the lights, this is a
235 spotlight, this is a sphere, this is a directional light, which is like the sun, but not
236 because it is not far away. This is a rectangular light, which you can think of as a
237 florescent light. This is a linear light, which is like the florescent light. This is
238 spotlight. These are for editing the lights, these are for animation. Mostly well talk
239 about these for lighting. ((He points to each of the buttons on the rhino toolbar with
240 his cursor as he describes them.))
241 T: Go ahead and zoom out , go to the layers first, click on layer two, oh oh, awesome, I
242 was hoping it would let me do this, and make that your light layer. All right, now we
243 have a layer for these lights, we can experiment with them and turn them on and off.
244 T: Go to your [...], click, then go to your front view, this is the point where the light will
245 hit, this is the distance, and this is the angle. Go ahead an go like so, go to your

246 perspective, go to your shaded mode, and you can see it like this. Go to your layers,
247 turn on your floor, and you can see it more like this.

248 S: can you tell me how to see the lines?

249 T: go to you your menu on the left, make sure your lights are checked.

250 T: this is new in version 5. You can render and look the light and manipulate it a bit.

251 You can rotate, you can pick a point you can choose another pint, and as you do that
252 you can see the lights change. Go ahead and turn on your control points for your light, I
253 f I click on my control point I can control the hard edge, the shadows look better.

254 T: So I want you to go back to that little circle, which is more or less the properties, once
255 you get something that you like, oh I'm sorry I forgot to [talk] about this one, this
256 control point is more or less the dolly, meaning if I click it, I can move this think back
257 and forth. The thing it's aiming at and the angle will remain the same. You can
258 change the intensity of the light without changing anything else. Once you get
259 something you like, I'm going to turn my control points off, just select my light, I can
260 go to properties, I can use either the object or the light. One of ways that you can
261 control how bright a light is by changing the color. If I click here, just like in
262 Photoshop, I get this menu.

263 T: What?

264 S: On the properties thing, I don't get the [...]

265 T: It's floating? ((Teacher goes to help the student.)) Just click on the thing. Oh. I love
266 questions like that.

267 T; All right, you basically mess with color of the light. I'm going to brighten up so you
268 can see what I'm talking about, now you can also see this looked pretty good here, but
269 the shadow looks dark. You change the shadow on the shadow bar, but you can also
270 mess with the shadow intensity. This one that says spotlight hardness, does just about
271 the same thing as the control points. Spotlight can add a lot of drama.

272

273 T: Let's go ahead and go got your top view, I want you to go to your point light, that's
274 the round one, drop it anywhere you' like. Go back and now that we have a point light
275 and a spotlight, now you can see I have selections. If I go over here, I can turn off the

276 light that I have selected. It basically projects to the construction plane, if I take this
277 light, in the perspective, I can move the light up and down, that's a pretty bright light.

278 T: The last one had a pretty bright light. I can turn it down. Now the intensity, here, the
279 main light between 75 and 50 is pretty good. Let's go to our perspective and look,
280 little dark, go to my other one, it's a little light. As I mess with the shadow intensity on
281 one, the other side gets a little less.

282 T: Now just because it look good here doesn't mean that it will look good in the render.
283 So we'll go up to our sphere...and that was a pretty fast render. More than one light
284 will make that go slower. You can also make everything a block that will make it go
285 faster.

286 T: Now, I'm going to make this...I'm going to make sure that my near snap is on, and
287 then whatever I want to emphasize, I click on it, and the point of view is always going
288 to be where that arrow is. You can see it's got some light on it.

289 T: Now because I can't click on my light, and I know it's the only one there, I should be
290 able to click on my properties, now I'm going to zoom it, let's go post apocalyptic, turn
291 that [...] and red. ((He changes it again.)) There we go, it's like an old timey photo.
292 This gives a nice even light over the entire scene.

293 T: You can also, make a second one. The more lights you put in a scene, the more chaotic
294 things are going to get, but...

295 T: And then you can go back to your layers, turn the other lights on, you can see, as you
296 start turning on the others, its really easy to get hot spots. Really, the fewer the better,
297 but this is a learning experience.

298 T: Go ahead and go to the green layer, turn the lights off, and the last light I'm going to
299 show you, go into your top view, and go to your rectangular light, and its like drawing
300 a rectangle, go to your right view, I can actually say, this is the angle I'd like it to be,
301 and I can move it up and over. This is a really nice, soft, studio light.

302 8:01

303 T: That looks pretty good, lets go ahead and render it just for fun. There is a ton of trial
304 and error when it comes to rendering, it will take you as long as it took you to model,
305 to render. That why I like to do this during football season Any questions on lights?
306 Pretty self-explanatory.

307 T: Close this, go back to the website, I want you open the one called mouse materials. Its
308 basically the same one, but we're going to do materials. Have you guys done any
309 texture mapping? Any? Okay that's good, we'll all learn together. We won't start with
310 any real materials yet. You guys are working on playgrounds, with lots of shiny stuff.
311 Next week I'll how you how to do grass, etc.

312 T: Does everyone have this open? Or you can't get it on catalyst, just open the old mouse
313 model and use that one. I want you to start clicking on these, is it a poly surface, and
314 what layer is it on? I want you to click on the bottom one, what's different about this
315 one?

316 S: ((in front)) it's a block.

317 T: what is the reason for this?

318 S: it's a way to simplify the model.

319 T: yes, but you can't manipulate it. I want you to mess with it for awhile, and then when
320 you run across this, you'll remember we did this in the class.

321 T: You'll notice that even though there different colors in the model, they render the
322 same. There are two ways to change the materials. You can put all the objects on the
323 same layer and then change the material on the layer, or you can in a small model like
324 this, change the material an object at a time. The best practice is probably to put like
325 items on the same layer and then change the materials.

326 T: I want you to hover over this guy that looks like a crumpled paint tube, and you can
327 change by layer, object, or parent. Nothing changed. Because all we changed was how
328 it was going to render, not in ghosted [view]. I want you to highlight it again, go over
329 to this, the GL is gloss, and the RF is reflection. Go ahead and change the GL, you can
330 see the [...].

331 S: what do you do when your tool bar disappears?

332 T: What would I do personally or do if I were you?

333 S: Personally.

334 T: Swear. ((Laughter.)) That was a trick question. While I trouble shoot, mess with the
335 GL and the RF, and over here, you can mess with the highlights. You remember that
336 this is 220, and then you can go to hue, and remember this was 220, and get a fairly

337 realistic reflection color. ((Teacher goes back to the back row, they decide to restart.))
338 And you can watch your neighbor.

339 T: All right, now what I want you guys to do, start going to different parts and do the
340 same thing. Make things a little glossy a little reflective, and you can see, it doesn't
341 matter what the material is, the gloss and matte stay pretty much the same. Now if I go
342 the bottom and change this, what happens?

343 S: nothing.

344 T: why does that happen?

345 S: It's a block.

346 T: So I go to here, and use one of my favorite commands, explode, and then since it was
347 mirrored, I can join these, now it's a polysurface. I can change color by object, leave it
348 white. I can go to my mouse cord, make it green. I know that a mouse would never
349 look like this.

350 T: Go back into your properties, unlock your floor, let's change that to something bright
351 pink. Now, the lights are off here, go into your lights, turn them on, and hit render.
352 Guys getting an immediate render? Takes a while, huh? But this gives you a much
353 better idea of what the object is going to look like. ((Students are staring at their
354 screens, waiting for the render to complete.))

355 T: So you guys, mess with this for a little bit, I'm going to walk around and answer
356 questions. Mess with it for about five or ten minutes. Start changing the gloss. And
357 you guys, if parts of your mouse looks really washed out, if parts of you mouse look
358 really washed out, check your reflections, the closer it gets to 100, the more light is
359 picks up.

360 S: Where is the reflectivity?

361 T: Where is your reflectivity? It's at 0, yes. Go to your layers, go to your lights, you can
362 go to your intensity. ((student manipulates, as the teacher points to the menu.)) Drag it
363 down, drag it just a little – ah see that? There is no easy way to do this. Keep up the
364 good work.

365 T: I'm imagining I'm going to look at a lot of bright and shiny parks.

366 S: If I have my lights on, I'm getting a lot of shadows.

367 T: Is this a screaming machine? Yeah, that might be part of it. This is where you send a
368 email to McNeel, ask them if there is a problem, you can't be the only one.

369 T: yes . ((he goes to help a student in the black row.)) Is it still a block? Yeah, explode
370 it, and then join it, there you go. Actually, you want to be exactly that color? I know,
371 right?

372 ((Goes back to front.)) So, we had a good question in the back. Things to learn, remember
373 fabrication is more than pressing a button, you're getting to understand that, and the
374 second thing is that polygons are expensive. Lights are polygons. If you get that out
375 of this class, I will be a happy, happy lad.

376 T: All right, another good question was, what if I want to get that green? I could write
377 these numbers, but I'm lazy. So I click on the color, I go back to the bottom, I click
378 match, and there it is. That's all well and good, until I decide that that is a little glossy,
379 or I decide to change it to pink. They both change because they're linked. So up here,
380 if I go to duplicate, then that breaks the chain. That will happen. Remember you can
381 break the change with the duplicate command.

382 Now let's decide I want this whole mouse red, but I want these two guys to be different .
383 So what I do , is I have the same color red, if I go to render, the finishes look different.
384 This render takes an awful long time, this edge looks hard, maybe I need to mess with
385 one of my shadows a little bit.

386 S: I think its reflectivity, because the bottom is supposed to be green and now its kind of
387 purple.

388 T: Ah yes, good call. Thank you for using my words against me. Yeah, reflectivity is
389 way up high. Now I hesitate to show you this, but its fun - I haven't done the wheel
390 yet I'm going to the TR, that is transparency, this looks really good with balloons, in
391 sure some one is going to do balloons next week. ((giggle in the second row.))

392 T: Now you can see, the wheel is kind of see through.

393 T: Now the last thing I want to show you, is that we've made changes to things as
394 different objects, Go ahead and turn your lights off. Put everything on the same layer.
395 Go to object properties, click on this, where it says assign materials, go to layers, now
396 that you've put everything to the default layer, it all goes gray. You'll see I gave you a
397 bunch of different layers, click the objects, put it on the bottom layer, etc., etc., and

398 you'll see them change. ((Teacher continues to demonstrate assigning materials by
399 layers instead of object.))
400 ((Some students look like they are losing interest – rotating in their chairs, talking to each
401 other, one student leaves the room. Yawns. One student in the front row leans against
402 her hand.))
403 8:35
404 T: Any questions about this? I don't want to overwhelm you all with these - I want you
405 to practice lights, materials. Next week I want to see some attempts, not attempts, but
406 efforts at your cool box. I don't want you to run out of the class, I want you to spend
407 some time working so I can go around and help you. There's a chapter I will put on
408 the catalyst site about planning a model, also do you want some tips on working with
409 materials?
410 S: yes.
411 T: I'll put another chapter on that on catalyst. It's in the library. Any other questions?
412 Yes?
413 S: Can we do the same things with reflectivity, gloss, with other materials?
414 T: The nice thing about rhino 5 is that it has the ability to render. Next week I will show
415 you flamingo, nice thing is that everything you make in rhino will transfer to flamingo.
416 It comes with trees, grass, you can say I want a tree and boom. You have a tree. We
417 have 30-40 minutes I want you to work so I can help you.
418 S: I have a question. T: Yes!
419 8:41
420 ((Student in the back row packs up here things and escapes. Student in the middle row
421 shuts down her computer, goes to talk to another student in the back row. One student
422 in the front row left gets up, looks over the shoulders of the other two in his row. He
423 sits back down. Two student in the left middle row look at each others' models,
424 discuss what they are working on. Student in the middle row who shut off her
425 computer packs up her things, goes to the other student in the front row, chats. Three
426 students in the front row chat, but not about the software or assignment. None of them
427 have the model up on their screens. Another student in the back row packs up, gets
428 ready to leave, middle row student also gets ready to leave.))

429 8:45

430 ((Teacher in the middle row, works with a student. Four students leave the room. student
431 in the back row on his phone – texting? Three last students in the back row, are still
432 intent on their screens, can't see what's on them from here. Student in the front left
433 row says bye, leaves. Student in front right row runs out of the room.))

434 8:47

435 ((Most other students left are still working on the assignment. Students in front and
436 middle row are chatting. Teacher is still with the same student. She laughs.))

437 T: you got it! Yeah, colors, right. Any other questions?

438 T: yes – you have a question? ((He goes to the back row.)) Radius is point one two five.

439 That was easy. Anything else?

440 ((Another student leaves the room. One student in the middle row has his arm resting on
441 his head, not unlike raising a hand in for a question. Not clear if he is trying to get help
442 from the teacher. He stretches it out straight in the air, then puts it down.

443 One of the last three students in the front row asks a questions.))

444 T: Sweep one? Do you remember the bend and the twist command?

445 S: yeah, but...

446 T: umm. Go, let's go – widen that...

447 ((About half of the students left are no longer working on the assignment, but are still in
448 the room, chatting from their seats.))

449 8:58

450 ((The student that had his hand up has it up again. All the way up. 9:01 now its resting
451 on the armrest, but still up.))

452 9:04 ((Teacher finally gets to the student who had his hand up.))

453 9:06 ((Four more students pack up. They leave the room. Another student leaves the
454 room. Three more get up to leave.))

Supplemental Material B4. Classroom Observation 4

1 ((Despite the fact that major projects are due in studio classes, the class is full and looks
2 to be lacking very few students.))

3 T: So how's it going out there, ladies and gentleman? I'm seeing squints from the peanut
4 gallery. Hanging in there? You have a test in structures?

5 S1: Friday.

6 T: you want me to tell them to back off?

7 S1: It's Tyler.

8 T: I don't have any clout with Tyler. Do you know my name? uhhhh, the bald guy....

9 How's the progress in this class? You all got that email. I understand that you're under
10 the gun, so we won't have anything due, but turn in anything that you have, even a
11 word document that states that.

12 T: Any problems, here or in the shop?

13 S2: I was making a site model, and the laser cutter wouldn't go all the way through.

14 T: What material were you using?

15 S2: [seafnut]

16 T: you should be able to right click.

17 T: Any other questions?

18 S3: My file I was trying to make a surface, is there a way to make a 3dimensional point?

19 T: I'll show you how to do that.

20 T: Anyone try playing with their materials? Was it more fun? I'm going to show you
21 about a half hour of rendering tips. You can still use the Photoshop, your skills will
22 serve you well. Does everyone have this open?

23 S4: Is the model supposed to be 4" in height?

24 T: Yeah, you guys, remember you're making the cool box, for the final, which is due next
25 week? I need to make a little bit of a design problem, they need to be 12x12x6, then
26 need to fit in the under seat compartment. It's a bit of a problem, how to fit an 11x17
27 in a 12x12 box, but I think that with 28 smart people in the room I'm gonna see
28 something.

29 Enough patter.

30 S4: I may need that ((indicates the usb with the file that the teacher has.))

31 T: So okay guys, were going to touch on the skills we learned last week, mess a little bit
32 with reflections, mess a little bit with texture, mess a little bit with a thing called a
33 bump map. How many of you have started your renders, and realized, man this is
34 taking a long time. How many of you have not? ((A student raises her hand.))

35 S5: Oh no, I mean its happening to me.

36 T: remember the three things I told you? Polygons are expensive, you're learning this.

37 T: So everyone have this open? The Jedi mind trick is that you can use the lights that are
38 in this, if you like them, and resize them as you need to. Just saying.

39 T: We're going to take the layers, and mess with them, were just going to mess with the
40 color a bit, click on the color, we're going to make this a nice deep red, so go ahead
41 and click on the red. Go ahead to the gloss finish, select the red there, drag it over,
42 that's going to make the highlight just a little pinker. You're gonna have something lie
43 this.

44 T: Right now I'm happy with the gloss and the color, let's test render, and see, it's good
45 to through our a test render fairly often, you don't have to let the whole thing go, but as
46 I'm looking at this, I'm not really happy with the color of the floor, so I'm going cancel
47 out of this. I'm gonna go to the floor layer, unlock it, and take down the gloss a little,
48 take down the reflectivity about 10%, and render, and we should notice...yeah. The
49 color of the floor was washing out the color of the mouse. Everything making sense
50 right now? This part should be review.

51 T: One of the most important things is a really good object will reflect all the things
52 around it, not just the floor, bit the sun, the clouds, the sky, basically the environment.
53 And rhino allows us to do the environment. I want you to click the layer, go to the
54 environment, click on abstract, just open it, and click okay. You should have
55 something that looks like that.

56 S6: Can you just repeat that?

57 T: sure! How far would you like me to go back?

58 S6: umm, the beginning? From the mouse top?

59 T: From the mouse top, yes. If one of you is asking me to go back, that means more of
60 you need me to.

- 61 T: So go back to mouse top, go back to environment, click on environment, and then it
62 says empty, click to assign.
- 63 S7: We just don't know where the download file is.
- 64 T: Is it in my documents?
- 65 S8: You have to unpack it.
- 66 T: Is it still a zip file? ((He goes over to the student to help her find out where it we nt.))
67 There you go, drag that to your desktop.
- 68 T: So yeah ,they'll probably be in your downloads, drag that to your desktop, you should
69 be able to open it, pull that entire folder to your desktop.
- 70 T: Did you get it? Who else has nothing? ((The teacher goes to the back row.)) Ahhh,
71 yes, click on that and drag it to your desktop. Hey, you're learning on your own.
72 What's going on?
- 73 S: [unintelligible]
- 74 T: So lets go to...
- 75 T: All right. So I'm gonna go back to environment, click to assign, click on the abstract,
76 click open, click okay, does everyone have something that looks like this?
- 77 S: Yeah!
- 78 S2 ...
- 79 T: You got it. Cool, cool, cool, sweet!
- 80 T: So basically what we've done is apply a decal to the surface of the mouse, and it looks
81 like a reflection. We have two different objects on the same layer, you'll see that the
82 really nice flat rendering is gone now. Their reflections that are twisted, along the back
83 and the front of the mouse – wont' work. Go ahead and click out of the rendering, go
84 back to the layer and click out of the environment map, and your mouse should be flat
85 again.
- 86 T: So we're going to do that again, go to the command line and type environment, and
87 environment editor should pop up, you'll get a window like that. What we're going to
88 do is put in a background, and everything should reflect off of that. I'm going to hit
89 that plus sign, and ask what I want to add to the environment. I want you to click on
90 environments, click on rhino sky, and go ahead an open that.
- 91 S: it says that we're out of memory. Rhino says to restart after it closes.

92 T: Who is still standing? Half the class raises their hands
93 S; They're all on their own laptops though.
94 T: okay, I was hoping something like this would happen. I'm gonna walk you through
95 this and then we'll open it and try again.
96 S: I don't have an okay button.
97 T: I don't have an okay button either.
98 S: Why do they?
99 T: Because they're cooler than we are. How about this. Let's close out of this and do the
100 command again.
101 T: so you guys, once you get the environmental editor up click on that, select spherical,
102 you should have the spinning wheel of death, you don't have to click okay. You told
103 rhino to do this, and you should have something that looks like this.
104 S: whoa.
105 T: does your floor look kind like the sky? Go to your floor layer, and change your
106 reflections down, so that it doesn't, and then hit render, and you're going to have
107 something that looks this, where there is a really nice reflection on the back of the
108 mouse.
109 T: So you should all have something that looks like that. That you guys, is called an
110 environment map. Throw that in to your model, it will be much, much cooler.
111 T: I want you to go to the mouse bottom, open your layer material, we're going to do
112 something called a bump map. I'll go deeper into that in future weeks but I just want
113 to introduce you to that. We're going to make the bottom like it has a rougher surface.
114 Click on where it says surface, click on --- click okay, you're gonna get something
115 gross looking, but it looks like its textures. We've got something, but it didn't really
116 change the physicality of the model. So we're going to make this look a little better.
117 Click the layer, reduce the color, the reflectivity, it's going to look a lot better, when
118 you render it, it will look better, in fact, let's give it a quick render. You'll see it looks
119 better
120 T: There's a couple of different ways to make this look better. What you had was a jpg,
121 and it was a certain size. See where it says 100 What I'm going to do is change the
122 size, I'm gonna hit 30, and hit okay, and you'll see that the nubbins got smaller.

123 T: You can pretty much go in and do this bitmap in Photoshop, you'll see the menu we
124 can make changes, you can make changes so that the scale is better.

125

126 T: Who's making AstroTurf for their playground? There's your texture, done! Who's
127 making a dangerous playground? Only three of you? For those of you, we'll do
128 concrete next. That will also have other opportunities in architecture . ((Student
129 laughs)).

130 S: How do you save an image as a bitmap?

131 T: You can save it from Photoshop as a bmp, a png or a tif. So that's a bitmap, I'm
132 sorry, a bump map.

133 T: Go ahead and zoom out a bit, were going to make our mouse a little bit ridiculous. Go
134 to the mouse top, go to the texture editor, where it says color, I want you to go right
135 over here, and go to 140 [arches], hit okay, hit okay, it give s you a nice chrome look,
136 basically the pacific science center. Go back to 1402, click on 1403 dark wood, hit
137 open, and hit okay and okay, basically, we have the most expensive mouse ever,
138 because this is hardwood. It doesn't look quite right yet, because we have to do a bit of
139 editing. Click in the layer, and instead of hitting the highlight, hit the triangle, you'll
140 get an eyedropper, like Photoshop, and select a darker part of the mouse, and we'll
141 have changed the color of the reflection.

142 T: Let's do a little more, we can mess with the color of the reflectivity, maybe I want to
143 change the color of the brown square, hit okay, hit okay again. Let's go ahead and
144 render this, see what it looks like.

145 T: The computer is thinking. You can see we have a plastic, wooden and sort of rubber
146 mouse going there. If you want to rough up the mouse a bit, you can add a bmp map to
147 the texture map. Click out of the render, underneath the texture, find the bmp, select
148 that very same wood , hit okay, and on your rhino window it will look completely dark.
149 What has happened, zoom in a bit, what we've done is added in a texture that exactly
150 matches the wood, it makes it look a lot rougher, can you guys see the difference?

151 T: Now it's sill a little shiny, I'm gonna bring the reflectivity down a bit, and then
152 render. You you're gonna find that it takes almost as long to render as the model takes.
153 Go ahead and click out of that, my wood is sill a little dark. I'm gonna go back to the

154 eye dropper, find the lightest part on the wood, or maybe just do it this way, I'm gonna
155 lighten it up a little, add a little reflectivity, I want you to go back to your dark wood,
156 one thing we haven't messed with, the grain goes with the mouse, lets say you're
157 working on something, and you want the grain to go a different way, go down here
158 where it says rotation, I want you to hit 90, hit okay, then hit okay again. And that did
159 nothing – mine changed! Yours did.

160 T: Well it seems that the guy who made this model in two parts, and then mirrored it, and
161 didn't make it as tidy as it could be. Let that be a lesson to you!

162 S: I have a question, there's something on the mouse, down a little.

163 T: what is that?

164 S: It's been there since the beginning,. It's part of the mouse.

165 T: that's when you fix that in Photoshop with our mad skills. You guys are seeing my
166 flaws, but there's still like month left.

167 T: Basically what you can do is to start looking for images – you guys have done a little
168 texture mapping ?

169 S: nope.

170 T: none? I want you to minimize rhino, and go to a place called flying architecture,

171 S: Flying?

172 T: flying. ((students get online and go to site, as teacher does on screen.))

173 T: So you guys, where it says flying materials, go to materials, and go to vray materials
174 one, and let's go to wood. And what you have here are textures, you can download any
175 of these textures, sometimes they ask for a little donation, you can download these and
176 use them. I'm gonna dive deeper into this later, but I want you to know it's here.

177 You're welcome, that's why I'm here.

178 T: Let's do some [...] with the bmp map. Go to the wheel, I want you to click on 1403
179 tubes, and basically what we've done is we're trying to add some dents into your
180 mouse so we can get a little traction. Go ahead and hit render, and see what a bmp
181 can do – it will look like you have some geometry there, but its actually smooth.
182 We're going to edit that, there's a couple ways to do that, we're going to change that to
183 50, that didn't change much, go to where it says tubes, make sure you lock it, then hit
184 5, both the n and the v will repeat at 5, you'll see that drastically changed it, do a quick

185 render, see how that looks. I look at this one, and repeating it at 5, it still doesn't look
186 right, I'm gonna go back to my wheel, back to my tubes, and instead of five I'll go 12,
187 that looks better. I think I'm pretty happy with my wood mouse, it's the world's most
188 expensive mouse, and it's not even wireless. ((laughter)) Forget about learning, let's
189 google wooden mice! ((laughter.))

190 T: Okay I'm gonna walk around, see where you're learning, see what you're doing,
191 basically desk crits and work time. That okay? Cool, okay, take a break, I'm gonna ask
192 you guys questions, sound good?

193 T: Oh wait, we only lost one person, we have a teacher's assistant, this is XXX, she is in
194 my department, the design machine group. She sits in my office, because you guys are
195 in studio when I'm in my office, and when you guys are free, I'm at work teaching at a
196 totally different school far away from here. When are you guys free for office hours?
197 When is studio?

198 S: MWF 12-5.

199 7:32 p. m. ((Students stay and work on projects, teacher and new assistant roam the room
200 to help.))

201 8:42 ((Approximately 3/4 of the class still remains. Not all are working on their class
202 assignments. Teacher and assistant are still checking in with individual students.))

203 9:05 pm ((about 1/4 of the students remain.))

Supplemental Material B5. Classroom Observation 5

- 1 ((6:30, the students start trickling in. Then a large group shows, then the rest.))
- 2 T: Let's start with your cool box project. Why don't you bring up your first four or five
- 3 boxes and then the rest of you can go. Nice. Sweet! Why's it wet?
- 4 S1: It's raining outside.
- 5 T: My background is art, and there was a sculpture that I forget that was a Pyrex box that
- 6 condenses water. You can argue about the importance of condensing water. I was
- 7 impressed [by your box]. So what do we have here?
- 8 S1: A box.
- 9 T: A box. So the 11 x17 stays there, what goes here?
- 10 S1: I had the pins here. Basically I tried to mimic an Xbox 360. SS: Whoa.
- 11 S1: The pins go here, that's the hard drive, and then the external hard drive.
- 12 T: Did you do it on the laser cutter? Then you used [...] Any trouble?
- 13 S1: At first it [...] then cutting it too.
- 14 T: Yeah, cutting. How long did it take?
- 15 S1: A long time. And then melting.
- 16 T: Yeah, melting. No, I think your model just has to be smaller. ((Class laughs.)) T:
- 17 Nice job. Sweet!
- 18 T: All right, where's L___? What do we have here? It's adorable. Let's hope the
- 19 contents match.
- 20 S2: So you open this first, then you stack it, it's like...
- 21 T: And the model stays here? So when you present it, I'm you and you're the audience?
- 22 A how do you present it? And then you can literally stand there like this. ((Class
- 23 laughs.)) And if things go poorly for you, you can go like this. It's always great to be
- 24 able to disappear. Well thought out. Any problems?
- 25 S2: The drawer wouldn't fit when I first laser cut it. I used tape to hold it together, but
- 26 when I took it off, it ripped off the surface.
- 27 T: Do you know what drafting tape is? How much is drafting tape?
- 28 S: About eight dollars for ½". ((Teacher goes on to tell the student that regular masking
- 29 tape works fine, as long as you put in on your jeans first. Then it's not so sticky.))

- 30 T: Any other? You might want to think about putting something up here
- 31 S2: Yeah...
- 32 T: And feel free to go ahead and keep working on these. Some of you while your
- 33 working on your models might feel you need to change these.
- 34 T: Let's look at J___'s top secret...
- 35 S3: Not really for your eyeballs.
- 36 T: Nice, so, show me. Pretend you're smart about[...] your.
- 37 S3: And there's (ht) mode, and then I can show you all my contents.
- 38 T: What I want you to think about is, the lighting that you do in your rendering. See if
- 39 you can get this model lit the same way your model is. Maybe batteries.
- 40 T: So you guys had a structures class, and you told me about it, then you had a studio
- 41 review, and no one mentioned it?
- 42 S: We're the wimpier class. That was the other class.
- 43 T: Oh, there's two classes.
- 44 T: So this has a theme that goes with your whole project?
- 45 S4: Oh... yes, it goes like this.
- 46 T: Nice. And you can, put the paper here.
- 47 S4: That's just going to be stuck here.
- 48 T: Pins go here, and CD's here?
- 49 S4: Yeah.
- 50 T: Nice! Did you find it helpful doing a full scale model first?
- 51 S4: No.
- 52 T: That is not the right answer. What did you not find helpful?
- 53 S: Well, this isn't really the concept I was going to do.
- 54 T: so you made changes?
- 55 S4: yes.
- 56 T: So, the first one helped?
- 57 S4: yeah...
- 58 T: see? ((Class laughs.))
- 59 T: So....

60 S5: So, it will have front and back, and then I have cork board, these folded down, but I
61 might just make them screens.

62 T: So where does the model go? And you can remove it?

63 S5: I was thinking that ...

64 T: And where are the pins?

65 S5: Right here stuck on it.

66 T: I think... do I have an Andrew in this class? Nice. Just refine it for the final.

67 T: Nice job with these, hold on to these, I will do the final, final grading when we get the
68 full package deal at the end of the quarter. Thus far I'm really excited by what we've
69 seen. Okay, next group.

70 T: Is this V----'s? So...Umm. ((Class is laughing.)) So when I see milk cartons, I often
71 think of missing children, and then I think playground...((Class continues to laugh.))

72 S6: Missing children?

73 T: That's a connotation, so be careful. It's adorable. Walk us through.

74 T: And then the model goes there?

75 S6: Yeah.

76 T: Oh nice, nice, cool. Do you have a theme behind your park?

77 S6: It's an orange theme.

78 T: Seriously guys, think about how does this box relate in some way to your park. When
79 I told you about the cool box the model was made out of rich woods like the space.

80 That is clever, nice job. Who is next?

81 S7: So, paper is supposed to go here, but I'm going to rethink that, these would have
82 pins, and then this would be my model, and this would be the CD.

83 T: Cool. What's the metal thingy o the end of the CD?

84 S7: I was just thinking it was a handle.

85 T: So you're going to have a very small, tall model? You're going to spend a lot of
86 money and 3D print it?

87 S7: Yeah.

88 T: Mom, Dad, I don't have time can I have 300 dollars to print out my model?

89 T: Cardboard can be a really beautify material if you choose to work it well. The great
90 thing is if you can use a simple material and craft it really beautifully. All the things
91 you do with this can tell your future employer about yourself.

92 T: Who is next? Who's got the chevrons?

93 S8: So the copier paper goes here, and the model goes here.

94 T: So you pull the model out?

95 S8: Yeah.

96 T: Will it hold it? It looks like you've sort of weakened it.

97 S8: Oh...

98 T: You're the boss, you're the architect. Entire model? Just part of it?

99 S8: I'm not sure.

100 T: That's the next big thing. Your mode of presentation is gong to drive the next step of
101 the model. Cool cool.

102 T: Okay, who has...

103 S9: That's mine. It's pretty cool, it's a box. ((Class laughs.)) Push it out, it has some
104 symbols on it. Pull this down, paper, and then you see the inside, then you take that
105 out.

106 T: Nice. Can you mount your model upside down and do this?

107 S9: Oh, yeah.

108 T: Bump it up a notch. There's a huge chance this would go wrong, but if it goes right...
109 Nice, really well thought out it terms of you're standing there. You're dong the walk
110 of shame.

111 T: All right , Leah , lay-ah.

112 S10: it's not final, so model goes here, CDs go there.

113 T: Nice, so you don't even need to pin up. Let's see the walk of shame... Nice, nice.

114 S10: I'm think of doing a magnet.

115 T: It's wonderful in it's simplicity.

116 T: Let's golf clap for this group...and let's see the next four or so. ((Class reshuffles,
117 some return their models to their seats others, bring theirs up.))

118 S: I'm excited

119 S: I hope it works...

120 T: okay, ummm. Let's uh..Let's start with this one cuz it's colorful. ((Student opens it...
121 T: Cool. Where does, the model goes right in there? Is the model brightly colored?
122 S11:no....
123 T: no? You guys? Thinking about what does this say about the potential about what's
124 inside? You created a sense of mystery, but if it's just this? A monochrome thing, this
125 could compete with your renderings. You might want to rethink it if it's just that.
126 Model pops out, where do you put the model. Cool. Let's see what you have
127 inside...11x17, pins, CDs. So is this the final?
128 T: Whose is this one?
129 S12: Mine. It's a simple design, where you have shadows cast by the design on the side,
130 you can kind of see but you can't see.
131 T: Nice. Now do you know what I want to see? I want another layer of this, so there's a
132 moiré pattern, and then you need a turntable. ((He spins the model.)) So you guys
133 know what a moiré pattern is? If you just turn your head, you get a movement. So
134 maybe you just need a turntable. Another layer would be great, I think it has some
135 really great potential.
136 T: Who's next?
137 S13: So the model goes here, the CDs go here, the pins go here.
138 T: cardboard is really hard.
139 S13: No, it lined up.
140 T: I would have just believed you... and what's going to be inside the box?
141 S13: Some of my towers.
142 T: 11x17 goes here? Did you do a 1:1 test? No, I mean when the paper rolls up. It looks
143 a little tighter than the paper wants to roll up. We don't want our paper to get dented.
144 Heaven forbid.
145 S13: Well, I think it can fit.
146 T: Okay, you're the boss. Think about that you guys.
147 T: All right, who is, whoa, who's is this?
148 S14: I started to play a bit with the three-dimensional model here. ((class giggles.))
149 Gonna be easier to bring it out, and then you have the papers, come out of here, and
150 then pins on the other side.

- 151 T: Nice, nice job. Start bringing that up so you can make that work quicker. Very nicely
152 thought out. So what's the model?
- 153 S14: I am thinking of a very small scale of the whole thing. I was looking for a light that
154 I can use...
- 155 T: So that is very cool. Very clever. Did you have issues getting it to line up?
- 156 S14: Not really, I had the files really organized.
- 157 T: One thing that will help if you're scaling things, if you're doing a ziggurat, if you just
158 do an etched line...it make is it easier to line up. Took me about 5-6 years to figure that
159 out.
- 160 T: Okay, who's next?
- 161 S15: The CDs go here, and then this comes out.
- 162 T: And the model's right there?
- 163 S15: ummmhumm.
- 164 T: Nice, so this is one of those cases where, because you have such a strong presence in
165 the box itself, you ask your instructor if you can shrink your 11x17's down. I give you
166 guys these requirements, so you can decide if they're' right. You have to learn ho to
167 make your client know why, they should buy your design. You have to convince me.
168 And some of you have done that. We're learning a lot of different things - if you can
169 justify your request.
- 170 T: All right, whose is this?
- 171 S16: That mine. Pretty much the same thing from last week, the model here, the pins, the
172 11x17, and closed.
- 173 T: Nice. Quick fast, and if you get shamed, you don't even put them together, you just
174 stack and bail. Very nice. Okay, clap for this group. ((Students go back to return their
175 models, next group brings their up.))
- 176 T: Uh, oh...Lights are always nice. Tell us, what do we have here?
- 177 S17: I found a box here, it can go vertically or horizontally. I was thinking of having the
178 handle here.
- 179 T: Nice.
- 180 S17: This opens up like this, and you can have your model horizontal or vertical.

181 T: Nice, I appreciate that you have designed a box that allows you to be flexible, very
182 clever.

183 S17: And these are drawers and that's pretty much it. I have my name here, and some
184 stuff.

185 T: How do you turn it off?

186 S17: I was thinking of having the switch off to the side. I want to keep it as simple as
187 possible.

188 T: Maybe it switches off when you pick it up. Think about that.

189 S17: Umm the lights, is there any kind of lights I should use? I found these.

190 T: Are these Christmas lights? Well, it doesn't seem to be getting hot, oh, to diffuse it?
191 It can be pretty difficult; it plagues interior designers a lot. A lot of times if it's further
192 from the surface... again I might forget that it lights up. It's got a great sense of
193 mystery, nice choice of a paper that diffuses the light, does this tie into the concept of
194 the park?

195 T: A lot of times, the 2d objects will be forgotten if there is a 3d object on the table .

196 T: Who's next? Who's got the Brutalist box?

197 S18: This one? So I was going around, and I was thinking of presentation methods, Hey,
198 Roark you wan to open that for me? Yeah, open it? ((Teacher opens it, and there are
199 beers inside. ((Class exclaims.))

200 S18: No model.

201 T: Who needs a model? I like the way it all fell apart though. I don't think your model
202 will be as good as your mockup.

203 S18: I used a little weight.

204 T: And this is the paper?

205 S18: Yeah, I like to fold the paper.

206 T: That's all right, to fold your paper, but it doesn't come out...

207 S18: You have to yank it.

208 T: That's quick, efficient, quite the attention getter. Did you bring enough for the whole
209 class? (They all laugh.)

210 T: All right, we got two more here...

211 S19: You got the C box...CD goes up here, model, and...

212 T: it makes perfect sense. Does the model go here, or does it go there?
213 S19: Yup. ((Class laughs.))
214 T: That's a good answer. You don't have to know. It allows for... Y---, help here.
215 Y: Flexibility.
216 T: yeah. It's quick, simple, if I don't like it you're out boom.
217 T: I almost forgot about the lunch box.
218 S20: Yeah, paper goes here, pins here, model goes on the center.
219 T: Nice. I like the lunch box idea better than the mailbox. Where does [...]
220 S:20 [...]
221 T: Nice, simple, very nice. Sometimes things work, sometimes they don't, maybe you
222 want to look for a different material. All right, round of applause for this section.
223 T: Two more boxes? Who's next? Go for it.
224 S21: The box goes like this, pins, I'm thinking about switching the place for the model to
225 here.
226 T: Nice. Yeah, I think that works too, if it's here, I can look around here, but if it's here, I
227 can't. You can be standing here, here, here, and everyone can be looking at it and each
228 other. If one person goes, like this, and the other like this, then you know, but if they
229 look at each other, you know you got to break out the silver tongue. Is there a handle?
230 S21: umm. Yeah,
231 T: you might think about that so it can just fall out. Really nice. You changed it quite a
232 bit from last week, huh?
233 S21: Yeah.
234 T: nice.
235 T: L----.
236 S22: So the CDs, the pins, right here, still working on it, if you don't like it, you can
237 shove it back in, if you do, then you can pull it out.
238 T: this is another case of when you might want to talk to your instructor, and maybe you
239 put them here, you fold them.
240 S22: Yeah.
241 T: Convince me.
242 S22: Can we retrofit that?

243 T: Yeah, we can retro fit, you aren't done till you guys get your first job. Nice. Are we
244 done with this group? Now we can golf clap.

245 T: Who's next? ((Three more are placed on the table.)) All nice, cool. Who should
246 start?

247 S23: This might take a while. It's not's working right. ((She starts taking apart a
248 circular model and then putting pieces back in a different configurations.))

249 S23: So that was the easy part. Can I get some help? ((A couple of students help her put
250 the top on. She takes off the top and unfolds it.))

251 T: Nice! ((Class says, Oooh ahhh.))

252 T: I think this might be a case when you do your final presentation the bottom is already
253 set up. If that part is done, I don't think it is a problem, and the model sits in the
254 middle there?

255 S23: Yeah, I think its strong enough.

256 T: And the paper goes?

257 S23: Yeah.

258 T: And how quickly does the top go back together?

259 S23: Ummm.

260 T: There's zombies coming for you.

261 S23: I think I have to rethink this.

262 T: Definitely, you guys should be thinking about the zombie apocalypse. ((Laughter.))

263 T: Brains!!!!

264 T: All right, S-----.

265 S24: All the CDs go here, the usb, and kind of thinking about a turntable.

266 T: Yeah, having a model that can spin is a great thing. The best place to get a lazy susan
267 is to take it off a chair that you find in the street.

268 S: What's a lazy susan?

269 T: It's a round thing with ball bearings that allows you to spin.

270 S2: Like for condiments and things .

271 T: I like this because you have a geodesic dome going on in your park.

272 S24: I really wanted to change this, but I already had this made.

273 T: Who's is this?

274 S25: That's mine. So it goes like this, the model goes in here, then the paper.
275 T: Nice.
276 S25: But the structure is pretty flimsy, when you do this, it just falls apart.
277 T: I understand, we may need to rethink this, maybe we can add some tabs.
278 S25: Okay...
279 T: And what does this do?
280 S25: Well you have to take this off.
281 T: and then this?
282 S25: Well, you have to take this off too.
283 T: No, well thinking about what they had to do to build the Milwaukee art museum, does
284 anyone know that?
285 SS:[...]
286 T: No? It's Calatrava.
287 S: The bird? Yeah, with the wings.
288 T: I think all of these with one vertical element, it will be fine. I think it's got some great
289 potential.
290 T: Is that? No, there's this one.
291 S26: There's a joint here, and the things go in there, the CDS, and the model, and the box
292 can be two individual boxes.
293 T: Oh, look at that.
294 S26: And here, will be a cup holder, and a pen.
295 T: Nice, you're playing the long game. And it spins? And the model can go on top?
296 S26: Yeah.
297 T: Real simple, and I like that you're thinking of, ummm, cups and pens. Sooo. That's
298 this four, golf clap? Have we done them all? Nice job!
299 T: How many of you have never used a laser cutter before this class? Nice. Okay, take 5
300 minutes, then I have something I need you to do, then I can help you all individually,
301 7:37
302 7:48

303 T: Everybody here? Thanks you guys, these are pretty sweet projects for a few weeks of
304 Rhino, and a few on the laser cutter. And you're in architecture school. So you should
305 be pretty proud of yourselves.

306 T: I have a survey I'd like you to fill out, at the beginning I told you I wanted to get you
307 what you wanted out of this, so I'd like to know if I'm giving you what you need. It's
308 really short, about 5 questions. I'd like to do two things, open up your catalyst site, and
309 at the top you'll see the survey, and then open up the mouse model that we've been
310 working on.

311 S: which one?

312 T: the latest one. Or whatever you want to opens.

313 ((Students open up the survey, and start checking off things, I see one student fill in the
314 "other" answer on number 1. Most finish very quickly. Some talking. The teacher
315 gets up to turn down the lights, he has the shiny mouse up on the screen.))

316 S: R----, which one do we open?

317 T: It doesn't matter. Just whatever we open should help you to see what I'm going to
318 show tonight. Nice. Everybody have a mouse on the screen? Or are you still copying
319 your neighbors on the survey?

320 T: How many of you have been experimenting with materials in addition to all the other
321 things we're having you do? All of two and a half? I suggest you start doing that. I
322 want to talk about a few things that can expedite the rendering problem. First thing is
323 going to be a render mesh, I'm not going to go too deep into it, but it can affect how
324 fast your model renders, I'm gonna give you the keys to the kingdom. I want you to go
325 to your toolbar, go to the [...]that's the render mesh. Everyone's should be set to
326 jagged and faster. If you guys start seeing empty spaces, you can go to smooth and
327 lower. What do you think that does?

328 T: I'm gonna give you some tips,.....((he lists out what to do))....these will give you a
329 cleaner model, but will go a little faster. What you'll see is that the edges of the model
330 will be cleaner, it goes a little slower. You might want to write this down, if you guys
331 have a pencil...

332 S: It's just me.

333 T: Great, one pencil, twenty-eight students, just pass it around.

334 T: Cool, I want you to go to the round sphere next to the mesh, this will give you some
335 more options, I think we've used this before. We can turn off the lights, but still see
336 the layers, this will help you to figure out your model.

337 T: Another thing up here is anti-aliasing, anyone know what that is? It's kind of like
338 pixilation. You have a line, it's like smoothing. The higher it is, it will be cleaner, but
339 its gonna take a lot, lot ,lot longer. For this call, you can leave it at normal, and when
340 you work for Disney and work on toy story you can bump it up to 10.

341 T: Now in your viewport, when you render, it does everything in the viewport. What I
342 want you to do now is click it so you have four views, zoom right in the front view, and
343 then hit render. What you should have a is a much smaller viewport, and the render is
344 much, much faster. It's about a quarter of the size. This is a really good strategy for
345 being able to set your lights and to see what you've got. Now go back to your
346 perspective, sometimes you want a bigger window, you can go back to custom, if you
347 like lock the viewport size, and then I can choose how many pixels, and it gives me
348 something really small, but it goes much faster. I just saved you guys an hour next
349 week. This is the sort of thing, when you start really digging into rendering should
350 make things go quite a bit faster. Any questions?

351 S: If you were doing a final, what resolution would you do it at?

352 T; It' s like you're in my head. That 's the next thing I'm gonna do. For your final
353 you're gonna think about the size you are going to present. These are 11x17. Do you
354 guys know what a book is? They used to sell then in bookstores? Before we had
355 kindles? ((Laughter.)) Well, when you used to go to print, your publisher would asks
356 for 300 dpi at 5x7 or something like that. To J---'s questions, we'll go to this, at the
357 top. Every program renders at 72dpi, but that can get confusing when you're thinking
358 about the size. In custom, you can select the size, and the dpi, and Rhino will do some
359 math and tell you what the resolution will be. Before this you would have to go back
360 and forth in Photoshop. I've saved you about 30-45 minutes. Any questions? Yes?

361 S1: Are you going to teach us Flamingo?

362 T: Do you want to learn flamingo?

363 S2: Yes.

364 S3: Yes.

365 T: I can give you a lesson in flamingo next week, or do you need it sooner?
366 S4: Next week is fine.
367 T: What do you want to learn? Trees, lights, interiors, etc.?
368 S5: All of the above.
369 T: if you really want, you can take a class called 481, modeling and rendering, and you'll
370 dive really deep. I haven't used Flamingo since last summer. If you want 3 hours of
371 Flamingo I can give you 3 hours of flamingo next week.
372 S6: Why haven't you taught Flamingo?
373 T: Why? Because I figured, how many of you bought flamingo? That's why. Because I
374 don't think you guys would have bought it.
375 S7: What do you use to render?
376 T: Flamingo. I don't know, not so good at Vray, but I know flamingo.
377 T: All right you guys, I don't want you to run off, I know you need to sleep, but Y--- and
378 I are going to come around and help.
379 8:17
380 ((One or two students pack up and leave, most stay. One by one Teacher and assistant go
381 around the room to answer individual questions.))
382 9:02 ((Eight students left.))

Supplemental Material B6. Classroom Observation 6

- 1 6:33. ((Teacher is at the front of the room. Students are chatting, waiting. Very few
2 have the program open yet.))
- 3 T: Is that a question?
- 4 S1: How come Rhino render doesn't...((inaudible))
- 5 T: because that's the way rhino render rolls. If you wait a little I will cover something
6 like that tonight.
- 7 T: ((To whole class)) So how are the 16 out of 28 of you?
- 8 S2: Tired. Can we go home?
- 9 T: So let's take a look at what we've got going on this evening.
- 10 S3: There's no drop box.
- 11 T: Put in the one for final and I'll make another.
- 12 T: Who's is this? ((He has turned on the projectors and is showing student's rhino
13 generated images on the screen.))
- 14 S3: That's mine. I did it when I was a beginner and I want to do it again.
- 15 T: Well, you have all seven days.
- 16 T: Who's is this? D----? He's not even here.
- 17 S5: That's flamingo.
- 18 T: Yes. Why do you say this?
- 19 S5: Because it's in black and grey.
- 20 T: It could be, because of the soft shadows.
- 21 T: Is L----- here?
- 22 S6: yes.
- 23 T: Oh good.
- 24 SS: Whoa.
- 25 T: Nicely done. ((A very nice render and park are on the screen.)) What did you use to
26 render this Lydia?
- 27 S6: Rhino render.
- 28 T: Cool. Who's GCHH? Someone else who isn't here.
- 29 S7: That's G----. She said she'd be late.

- 30 T: Who's...what am I looing at here? ((class laughs.)) Is this V-----? Is he here? What
31 happened to the background? I don't' know, because I'm not here.
- 32 T: Where's L---?
- 33 S9: She's waiting for critique.
- 34 T: I can't exactly compete with that.
- 35 T: Who's Mushi? ((Student raises hand.)) All right we need to get some naming
36 conventions here. What do you have here?
- 37 S10: A spinning wheel... I'll do more later.
- 38 T: You're studio gets in the way.
- 39 T: Who...Beast mode! ((The image on the screen is a set of goalposts with swings
40 hanging from them, on a grass field.)) It makes football do so much more interesting
41 and so much more dangerous. We have to talk about the size of your grass ((Class
42 laughter)).
- 43 S11: That's my Gatorade trash can.
- 44 T: Who's is this?
- 45 S12: That's mine. I need to put some grass.
- 46 T: Who's (switamoy)...Wow. Who's is this? You have some nice texture, and the
47 wheel,...what is this texture here?
- 48 S13: It's metal.
- 49 T: Who's is this?
- 50 S14: Mine.
- 51 T: It's nice. That is the happiest bench I've seen all week. What's...is that a model? ((It
52 looks like a physical model.))
- 53 S14: Yeah.
- 54 T: You built it already? I was looking at it and thinking that's the nicest render...my
55 work here is done! ((Class laughs))
- 56 T: What about this do you feel is different about this image? ((He has a specific image
57 on the screen.)) Who know what a horizon line is? Who doesn't? Okay perfect. This
58 is a more realistic view of a park. Most of yours have been god's eye or bird's eye
59 views. I want you to think carefully about your views, you'll have two or three. Did I

60 tell you how to save your views? ((Class murmurs yes.)) Quick, someone tell me how
61 to do it all at once.

62 T: Who's is this? Nice. You have a nice environment map in the back, some nice looking
63 shadows...

64 T: And who do we have here...a nice close up. Is that a hand in the air, S---?

65 S: Yeah, did you want us to email these to you?

66 S2: He said put it in the final.

67 T: Just put in the final, and I'll make another.

68 T: You can be honest, who hasn't touched this since...((hands go up.))

69 S: No wait, I did work on it.

70 T: Who has rendering due this week?

71 SS: This Friday.

72 T: Who has a rendering due this Friday? Who doesn't have a rendering due this Friday?
73 Cool. Put your head down on the desk and sit quietly.

74

75 T: How would you feel turning everything in the week of finals? Who wants to turn this
76 in next Wednesday? The final for this is the Wednesday night of finals. Who wants to
77 get out of town next week? We'll have a minor review at the final. You three, you
78 four come talk to me.

79 T: Okay. I'm gonna start off telling you a little about flamingo, everyone wants to learn.
80 I talked with Jim and he said you have a day rendering and a nigh rendering due.

81 SS: yeah.

82 T: I figure you know how to do a day rendering, and the night rendering is a little harder.
83 What I am going to do is tell you a little about what flamingo does, we'll do a few
84 renderings, and some tutorial I pulled off the flamingo site, we'll work through them
85 together.

86 T: All right. This is not my wonderful presentation, it is from a webinar. Basically it is a
87 plug in for Rhino, I'll show how to use it. How may of you have used Kerkythea for
88 Sketchup? Vray for Sketchup? Basically it is the same thing for flamingo, the
89 difference between this and the other one is it does a multi-pass. Who asked? ((Student

90 raises hand.)) L----, not layah, right? Asked why rhino does a single pass and stops.

91 Because that's what it does.

92 T: Light never stops bouncing, in the real world. What flamingo does is try to figure out
93 what really is going on. I want to talk about layhs questions ((class laughs)) I'm sorry,
94 l----. I am a star wars fan, and in some movies she's Leah, and in others she's leeah, I'll
95 get your name right by week 11. What flamingo does, is with additional passes, things
96 start to diffuse, and flamingo gets in there and starts changing things. (...) By the 45th
97 pass, there is something completely different.

98 This is something I would write down...about 12-15 passes is enough for an industrial
99 design project. For an architectural exterior 15-20 will give you a really nice render.
100 Interiors are the hardest, 25-30 will give you (...) there are a lot of things going on, a
101 lot of reflections, a lot of shadows. I would write this down, www.flamingo3d.com
102 this software is six months old, if you have a question lots of other people are working
103 on this, your neighbor might know, but if not, we may need to go to flamingos 3d.

104 T: Notice in this, we have clear reflection, and sharpness will allow you to choose
105 between clear, or dull and scratch. See this? Anyone know what fresnel is? It's
106 pronounced "frenel". There are different areas that turn white – there are darks and
107 lights, we call that chiasscuro, if were going to Italy, right? Even your clothes are
108 going to have a highlight, that is known as fresnel. Flamingo next, you can add
109 transparency, if someone is studying architecture, and I think of using glass, that is the
110 key to making your glass look good. Whenever you're making architectural glass, you
111 go to index of refraction and make it 1.35. if you're making a diamond, it is 2.2. Air
112 has its own, it's zero, you guys don't need to know that ((smirks)). Have you ever
113 seen someone with a beverage, you basically have a diffraction for the beverage and
114 one for the glass.

115 T: Who's gone to flying architecture and gotten a bunch of textures and had a lot of
116 things going on? L-----. Basically flying arch does layered materials you will
117 download three things: you get a diffuse map – that is the texture, you get a normal
118 map, have we talked about normal maps? This class goes pretty fast. A normal is
119 basically perpendicular to the surface. ((he draws on the board.)) If you have a sphere,
120 the normal will be completely different. If you have something shaped like that, the

121 normals will be completely different. Based on the shape it reflects differently. What
122 a normal map does, it tells flamingo that it wants to reflect in different directions, it is
123 basically a way to get pretty nice objects without too much computation. A specular
124 map, it's black and white, it will control the reflection. The shiny areas, are white, the
125 areas that a little duller, are the black areas. We don't need to go to terribly deep into
126 this, but I want to be sure that these are covered. I'm going to show you how to take
127 all these things in one fell swoop, and make something.

128 T: Remember we took those HDRIs, and put them in our renderings, flamingo does that
129 as well. When we take these environments, it reflects differently, This cup and saucer.
130 This is an important safety tip you guys, you go online, www.food4rhino.com, get some
131 nice night images and you'll have an evening scene reflecting on your model.
132 Hopefully with the next couple days you can get a nice nighttime HRDI. We will talk
133 about how to actually do that.

134 T: How many of you guys have been trying to put lights into your models? It's kind of a
135 pain. Basically you can just put an object in and tell it to glow. I'm gonna take a
136 building, and tell rhino that I want the windows to glow and they'll glow like lights.
137 Another thing is you can take this channel, I'll put the sun on this channel, I'm going to
138 put the lights on this channel, and you can control these. Something that we are not
139 going to cover, we would if you take the rendering class, it's called caustics, getting
140 refractions off of transparency or semi-transparency. You can get the lights reflecting
141 through.

142 T: There's a couple different engines in flamingo, there's the default I'd suggest you use
143 that, there's also a path tracer. What the default does is on the first pass, you get a
144 harsh shadows. With path tracer, you get a soft shadow, but the image is really noisy.
145 If you wait for more passes, the noise goes away. If you wait four hours on either,
146 they'll be good. Block objects don't count as memory, they take less time.

147 T: How many of you guys have done photography, digital photography, worked with a
148 camera raw file? You can save your rhino file as a native next file, it's just like a raw
149 file. We won't need to worry about that.

150 T: One thing you can do with flamingo is that you can pause a rendering. Then you can
151 adjust from a day to a night and continue. There's also a histogram, just like in

152 Photoshop. We're going to do that all in 2 hours and 10 minutes. Are you ready?
153 We're going to go to the catalyst site, do one rendering, and then I'll give you guys a
154 break.

155 T: I want you to get the fishing reel on the catalyst site, and the we're going to render
156 that. Oh, it's not applicable to you what you're doing but it's a good start, and you can
157 get more a less an idea of what you're doing, and then we can do an architectural
158 render and day render, a night render, I'll show you guys some bump maps, and if
159 there's time...we can do decals.

160 T: Make sure you pull it out of the zip file. ((Everyone is downloading the file from the
161 site. Instructor has some issues.))

162 T: All right, no I did not make this one. I'm gonna walk you guys through a tutorial you
163 can find on line, so if you get confused or befuddled you can go online and find this
164 tutorial. ((He opens the file...it looks empty.)) Where is it? ((Students have theirs
165 open, they are looking around.)) T: Am I the only one that doesn't have this open yet?

166 SS: Yup.

167 T: Seems we have a lot more people in here now, yeah? 1,2,3,4,5,6,7...

168 All right. Awesome. Everybody has this up?

169 S: Yes sir.

170 T: All right, my dad's here. ((Laughter.)) T: Let's get our flamingo on. Go the to the
171 bottom, see where you can choose form flamingo next, (...c)lick on that, got to control
172 panel, a nice big control panel should pop up, there it is...and there a lot of similarities
173 between rhino render and flamingo, that why I has us dip our toe into rhino render.
174 This will let us choose materials, textures, lighting, daylight studio lighting, it will
175 allow us to use backdrops, we can change our rendering, just like we did before. But
176 what we really want to do here is working on materials. Click on render front, and I
177 want you to click on the render tab.

178 T: Who's been messing with flamingo?

179 S: I've just done some trees.

180 T: I know, trees are money right? No one else? Who's been messing with rhino - oh
181 good, two students. You can see that this is rendering very quickly, because there
182 aren't very many lights yet. ((He continues to discuss the different buttons.))

183 S: Can you repeat that please?

184 T: Ahhh, which part? Hi, my name I R----?, welcome to 380? Don't worry I will go
185 back over that again.

186 S: I was getting worried.

187 T: everything you hear from me tonight you will hear at least four times.

188 T: Let's go into the materials, the very first thing well do make sure you go to the
189 materials tab, there's a little sphere, click the tab next to the sphere, you'll get a whole
190 lot of options. I'm going to make it simple, and make it gray, then I'm going to go to
191 advanced, and you can see you can select the highlight color, the intensity, it's a
192 bushing I'm going to make it (...)

193 S1: Roark?

194 T: Yes.

195 S1: It won't let me change the highlight colors.

196 S2: it's (..) the intensity

197 S1: Oh.

198 T: You good?

199 ((He continues to demonstrate different steps by step.))

200 T: So what I've done is this part right here.

201 S2: It's a good looking part.

202 T: What's that?

203 S2: is a good looing part.

204 T: Yes, it is. Who was asking me about metal? This part here is metal. I'm gonna click
205 advanced, and make this...

206 S3: What's the difference between intensity and fresnel?

207 T: Fresnel is the highlight on the - see the bottle in front of you? See the white parts?
208 That's fresnel.

209 S3: Ohhh.

210 T: Check it out, now I have two materials. Do you remember how to assign these to
211 layers? I can right click or I can drag it .

212 S: Whoa.

213 T: Yeah, I can do it two different ways. But wait there's more! ((Students laugh.)) I can
214 also take this and drag it on to the objects – in theory it will work, last night it would.

215 S: Is it cause it's locked?

216 T: It is because it locked, good job. You get to go to Rome for your prize. ((She's the
217 student that had mentioned she needed to turn in work early because she was leaving
218 for Italy.))

219 T: So you guys can take these materials and move them around your model . I'm gonna
220 work on my grips now.

221 S2: Does this work better than importing materials?

222 T: Well, how long would it have taken to go into Photoshop and made a material. And if
223 I send you this file, all the materials I made will be in it too. Not like InDesign when
224 you open it an go, where are all my images? There are a lot of ways to do anything so
225 you can decide what works. Does that answer your question? S

226 S2: Yup.

227 T: Yup.

228 ((He goes back to making materials for each of the parts. He calls out each step, going
229 back to the sphere, saving, hit okay, rename, etc. He does the handle, metal parts, the
230 rod.)) T: As you can see, we're getting a nice looking fishing rod. ((He goes back to
231 making and assigning materials.)) Now I'm going to go here, and this place is where
232 you can assign bump maps. I'm going to go here to bump patterns, and I'm gonna
233 choose rubble, and I can assign it, which one was I doing? Sometimes when you're
234 assigning, it doesn't necessarily render. Go ahead and render and let's see what's
235 popping up.

236 S: You clicked the wrong one. You have two grips.

237 T: I know. I'm glad you guys are paying attention. I'm too busy doing this.

238 S: You still did the wrong one.

239 T: Which one should I do?

240 S: down, down...

241 T: This one? I want to go home.

242 T: to answer J---'s question, is it better to work here or to bring in an new texture, let's
243 bring in the cork texture that they gave us. I'm gonna go here, and I'm gonna click the

244 first one, I think I stuck it on my desktop, it should be in the file that you downloaded,
245 that's the texture map you're gonna put on the handle, hit okay, hit okay. I'm gonna
246 assign it to a layer, cool. Once you get that on there, go ahead and give it a render, see
247 what you have.

248 T: So you guys see how on the first one, when we did have material, we would have been
249 on pass 12 by now. But it's starting to look pretty darn nice. If we go to pass 15 it's
250 going to look pretty nice. I'm gonna stop it, and get out of it. How are you guys
251 doing? All right? We can get to these later. There's materials, lighting, a render tab,
252 an environment tab, (...)

253 S: Is the refraction different for different materials?

254 T: We can go here and check the index of refraction, it's 1.35, and if you did diamond,
255 you'd do 2.2, glad you're listening. And air is?

256 SS: Zero.

257 T: And it disappears.

258 S: What's the difference between the "new glass" at the top and ones down there?

259 T: I don't know I just started using this.

260 S: Well, glass is pretty important to architecture.

261 T: well, McNeel is really good about allowing three ways to do everything. This is
262 probably one of those ways. That's my final answer, I'm sticking to it. Now let's add
263 in the deck... ((he adds a few more.)) Let's render. ((the class goes ooh, ahhh,
264 because it looks so good.))

265 S: It has those lines.

266 T: Yes it does, it makes it not so cool.

267 S: How did you give it a ground plane? ((T walks him through the steps.))

268 T: We thought it was cool, but it wasn't so cool because of the lines, it's basically where
269 the image ends. We can go here and do mirror, and it will take care of some of those.
270 Now let's re-render.

271 S: Can you go back to your materials?

272 T: Let's go back to the ground plane. I'm going to go to environment and select ground
273 plane, it puts the object on a ground plane, and then it lets' you pick an image. So I go
274 over here to material, and that basically opens my materials editor, ((he continues to

275 re-demonstrate the materials, texture maps. He draws on the board the idea of the tiled
276 image that created the lines.)) So make sure that you select mirror tiles, and that will
277 make the grain match up a little more.

278 S3: Is there another way to get to this window? It seems like the only way to get to this is
279 to click on the desktop.

280 TA: You have to create a new material, and that allows you to select that.

281 S4: Will it reflect when you add lights?

282 T: Well, it doesn't reflect the way wood would, because it doesn't have a displacement
283 map. If I went through the trouble of making a displacement map, then it would reflect
284 like it should, does that answer your question?

285 S4: Yes.

286 T: Now let's go to the lighting tab, let's change it from studio light. Let's pick exterior
287 daylight. Go to sky . Seattle is basically a (...) the sun, it says 2, you guys are still in
288 studio. Leave it the way it is and lets render. If I remember correctly, the sun is behind
289 it. Let's get this and move the shadows behind it, I'm going to the azimuth and
290 attitudes – it's got attitude - and I'm gonna move this, and then hit render, and see if
291 I've changed my shadows a little bit.

292 S: It's got no shadow.

293 T: I don't like that. What did I do?

294 S: You put the sun underneath the ground.

295 T: I put the sun underneath the ground? That's power.

296 S: You need to have a positive attitude.

297 S2: The altitude.

298 T: I can have a negative attitude if I feel like it.

299 S: It's under the ground again.

300 T: Now, oh, the line is the ground. Good, you guys are paying attention. That's much
301 better, my attitude is more positive. Tell you what you guys, whose head is full?
302 ((Makes exploding sound)). Take 7-10, when you get back we're going to do an
303 exterior rendering.

304 7:55

305 T: Okay, a couple of things, go back to the catalyst site, and download the exterior
306 rendering.

307 T: Who wants extra credit? ((Almost all hands go up.)) Myself and another graduate
308 student may or may not want to use your projects in a thesis. If you would like to give
309 us permission, I have forms. And you can let me know if you want credit or not. If you
310 want credit, where I can name you, I will, if you don't want it, you can say anonymous.
311 So once you get that thing open, go ahead and hit render, while you guys are filling out
312 your forms. All right are you guys ready to roll? Y---, can you collect those forms?

313 T: All right you guys, anyone not have this open? Get on it. Hold up. Oh wait, you want
314 extra credit? Yes.

315 T: Are you ready? Roark's about to talk. You see we have pass 15, it looks pretty good.
316 Go ahead and stop it, adjust the image, once it stops, it takes awhile to stop it.

317 T: Brightness and burn, that's where you'll make the change, for a good night, I'll like to
318 go to minus 65, I'm making it darker, darker, and darker, if I like it, I can go back to
319 resume render, and it goes back to that brightness setting, and it continues to render.

320 T: I'm gonna go back, and go back to 0.1, and then aim gonna get rid of it. Go back to
321 flamingo, go back to your control panel, most of the materials have been assigned,
322 we're going to concentrate on lighting.

323 T: I'm gonna right off the bat go to daylighting, and let's give it a quick render. The first
324 one that we did was studio lighting, this one is daylight render. I want you to go back
325 and experiment a little. You can take these models, import your models, from your
326 studios, and then use these.

327 T: Yes?

328 S: Can you remind me how to (inaudible)

329 T: Yes, you go back to the bottom of the render window, you can select flamingo next,
330 rhino render, or (...) ((he goes back to the students desk to help her find the panels.))

331 T: All right you guys. So I don't know if you noticed, but the last time we did the render,
332 the area under the eaves was a little dark. I want you to go the advanced, and right
333 under here under indirect, where it says method, hit exterior, leave the ambient the way
334 it is, and do a quick render. You'll see that the deep shadows will get a lot clearer a lot

335 quicker. But if you're really struggling, with that, try to remember what was that trick
336 the Roark taught me? Part of this is in the tutorial part of it is not.

337 T: Yes, from the peanut gallery.

338 S: can you do that again?

339 T: Go back to lighting. ((he repeats it.)) As you can see this takes a while, so let's forget
340 about that. Go ahead and go to your top view, I want you to go to your layers, I want
341 you to go to your site, and I want you to unlock it. I'm going to show you how to do
342 some trees, who wants to do trees? Come on, more than that. It's 8:17 on a
343 Wednesday, you need to party more. Okay, go back to your standard view, put some
344 points down, but they're on the construction plane, not the undulating surface. How do
345 I get those down?

346 S: Project.

347 T: Yes, thank you for using applied knowledge. Select your points, select the surface,
348 and you'll see that the points are now on the surface.

349 T: Okay, go to flamingo next, go to plants insert plant, and you can select your plant. I'm
350 gonna go for large, and why not. I'm gonna make sure my point snap is on, and I'm
351 going to take these trees and put them on these points. It's literally that easy. You
352 guys are wondering why aren't you teaching us trees? Because that's easy.

353 T: Now, I want you to be leery of this, these trees are -

354 S: Big.

355 T: That's right. You can either copy them, or make them into blocks so they don't take
356 up memory. If your trees aren't the right size, you can scale them, go back to your
357 perspective. I don't like the snow, in this particular case I don't like snow. Take the
358 grass that is in there, assign to layer, assign it to your site.

359 T: Get a really good view, and hit render. Yeah you guys, please resist the temptation to
360 get carried away with the trees.

361 T: Yes, J---?

362 S: People?

363 T: People, trees. Basically anything that is entourage is something that gives scale to
364 your model. How many of your are planning to put a little person in your model? ((No
365 one answers)). Oh, good all 27 of you, hint, hint.

366 S: What is your recommendation on grass? Cause ahhhh.

367 T: What is my recommendation?

368 S: Because it really doesn't look good.

369 T: I'm still wrestling with that. I would suggest going on to flying architecture, see what
370 you can find, maybe change the scale, mirror it...

371 T: Okay, let's go back to your panel, and on background tab, where it says sky, and says
372 solid color, make it black. So a quick render, what do you think we're going to get?

373 Anyone know why you would want to render in one solid color for the sky?

374 S: you can mask it?

375 T: Yes!! You can go back into Photoshop and then delete and add in the sky that you
376 want.

377 So. Let's go ahead and turn this into a night shot.

378 S: Yay.

379 T: Yay. Under the environment tab, and you probably want to write this down. I'm
380 going to go to hdr, I'm going to look for the darkest one, and select it. That's going to
381 give me a good night shot. Right now I'm going to choose sky, and leave it at that .

382 I'm going to go to sky, select that, set our location to earth. We're setting our location
383 to earth, don't get lost. I'm going to make it 1:00 a.m. I'm going to go to advance,
384 make sure the sun stays on, sky level it at auto, and go down here to ambient, make
385 sure it says exterior, and says lights, on, take a look at that, pull out your phones, take a
386 photo of that.

387 T: So now, I'm going to go to windows, unlock the windows, right click on that, and say
388 select objects. I should be able to highlight every single window. Now, with those
389 windows highlighted, I'm going to go to flamingo next, go to lights, select tag objects
390 as lights.

391 S: Can you do that again?

392 T: I will, but let me make sure I haven't screwed it up. Because I've done this a lot of
393 times. Yeah!!! It worked. I just saved you guys about three hours. I want you to work
394 hard on your finals.

395 S: Can you take a picture and use that as a material?

396 T: Yes, you can. Did you guys hear that question?

397 S: No.

398 T: you didn't hear that because you weren't listening. Someone asked if you could take
399 your own picture and make it grass. You would have to take a really large picture to
400 do it.

401 S: Can you change the color of the trees? I mean if I wanted to make the trees dark or fall
402 like.

403 T: So guys, if you want to change this, you can take down your brightness and you'll see
404 it become more like night. Oooohhh ahhhhh.

405 So what I want you to look at here, each one of these windows is a 100 watt light, you
406 can change them to like a 40.

407 S: Can you select them all at the same time?

408 T: I'm not sure yet how to do that.

409 TA: you basically go to the object and (...) ((she walks to the student and talks to him
410 directly while the instructor continues.))

411 T: You can do it in other ways, with the walls with the floors, but the windows seem to
412 be a good way to do it. You can also leave some windows dark and work with it like
413 that. Do you want me to do that again?

414 S: I figured it out.

415 T: Does anyone want to see that again? Let's do that again. We'll control Z for a while.
416 You guys remember how to do trees, right? ((He runs through it again.))

417 S: My sky is yellow.

418 T: What? That's not right. ((He goes to her desk to help.))

419 ((He continues to walk around, students are waiting for their models to render, talking,
420 looking at their results. Some have done dusk, others have done different views.))

421 T: So, you guys are good for Friday, you're good for your day rendering, you're good for
422 your night rendering. Do you want to do texturing, do you want to go to flying
423 architecture and learn how to use those three images?

424 S: Yes.

425 T: You want to keep going?

426 S2: No.

427 T: Who says no?

428 What was the problem with the last 3 star wars movies? Well first was jarjar binks.
429 ((laughter.)) They were too slick. The first 3 were gritty, they were dirty. I'm sure
430 George Lucas thinks of me when he's working on his movies.

431 T: Let's go back to catalyst and download the graffiti tutorial, we're going to tag some
432 things. Open brick starter. Yes, I did make this model. I don't know why I gave you
433 this model. Open Rhino and make a square. ((Class laughs.)) You can all pretty much
434 do that by now. That's why, make a cube that's eight feet tall.

435 T: We're going to take this and make an awesome brick building. I want you to go to a
436 new texture set. Go to new texture material, and go back to your file and get bricks
437 red. You're going to get all the files, the texture map, the normal map and the diffuse
438 map. The nice thing about flamingo, you can select them all together, and it brings
439 them all in. I'm not going to worry about anything else, I'm just going to hit okay, I'm
440 going to name them red bricks, I'm going to assign them to a layer. Hit okay. I'm
441 going to hit render, and you'll see that the render will have a nice brick building. Now
442 the temptation is to do this all over your model, but resist that, it takes a long time.

443 T: Click on the building, go to object properties, and you'll have object, material, texture
444 mapping, click on flaming next decals, and delete both those things.

445 T: Zoom back in and render it. Take a look at it. You can see there is still quite a bit of
446 texture, you can see that everything looks three dimensional, L----, where are you?
447 You were asking about the corrugated metal, this may be the way to do that.

448 T: Go to (...) we're going to make a decal. Go to flamingo next decals, select the image,
449 and then you'll click three times, two at the bottom and one at the top. I'm going to
450 turn on my ortho so it goes straight up.

451 T: You can do this same thing, and create your semitransparent people you 're so fond of
452 and put them in your model, rather than in Photoshop.

453 T: Now let's do the same thing and do some grunge. We'll select he image that shows
454 grunge, you'll see the green, that's where the regular brick will show through. It's
455 basically easy, you just use the corners of the windows.

456 T: So, while we're waiting for this to render, is there anything else you want to learn for
457 your presentation for Friday.

458 S: can you put the presentation on the website?

459 T: Yes the presentation is on the catalyst site.

460 T: All the tutorials are on the flamingo next site. They're all the same up until the trees.

461 That's not on there. The night rendering, the lights, that's not on there.

462 T: Who wants to turn in projects the Wednesday of finals? ((Almost all the hands go

463 up)). Who wants to turn it in early? ((One hand goes up)). Those of you that want to

464 turn it in early, come talk to me. When are your presentations due?

465 S: Friday.

466 T: Tomorrow or next?

467 S: Next.

468 T: Okay, basically, don't do anything - wait I don't want to say that - don't worry about

469 anything until after Friday. Tell you what. I'll open up a dropbox, start throwing

470 things in, and try to make it to class next week. Otherwise, I'll see you the Wednesday

471 of finals week.

472 T: Okay, in 2 hours and 35 minutes, that's flamingo 101. Thanks you guys for sticking

473 with me. Y--- and I will walk around and answer any questions.

474 9:08

475 ((About half the class packs up and goes home. T and TA start making rounds in the

476 room, answering any last questions.))

Supplemental Material B7. Classroom Observation 7

- 1 S1: Some of the other students are still in critique.
- 2 S2: Yeah, she just figured out that we had another class.
- 3 T: You've always had class.
- 4 S2: Well, she just assumed that she could keep us late. She asked if they could do it
- 5 tomorrow.
- 6 T: The other 20 students?
- 7 S2: No, the three in my class. So they should be coming in soon
- 8 6:35 ((Other students are coming in. One student comes up to the desks in the second
- 9 row. He has been rendering on 3 computers for 11 hours.)) S3: Oh, sweet! 11 hours
- 10 and 13 minutes.
- 11 T: 19 out of 28, that's pretty good. Anybody have anything they'd like to show? Up on
- 12 the big board? How is everybody tonight? Sweet? Let' start with a sliding scale
- 13 where bad is the best it can be. Who's worse than bad? Who's the best?
- 14 T: Your renderings are washing out? Did you get to the bottom of the speckled thing?
- 15 S4: Huh? Oh, I used the speckles.
- 16 T: Way to go brother. Work with technology.
- 17 T: I sent out an email about that.
- 18 S4: Yeah?
- 19 T: Did you read it?
- 20 S5: Some students are still having desk crits. Will they be coming in? Maybe, maybe
- 21 not.
- 22 T: thank you.
- 23 T: Who can take responsibility for this? ((He holds up the survey envelope.)) You can
- 24 basically just slide it under the door. ((Teacher passes out the student surveys.)) All
- 25 right, I'm going to get out of your hair....pencils? I'm amazed at the number of
- 26 students that don't have pencils.
- 27 S: Can you spell your name?
- 28 T: write my name on the board?
- 29 T: I'll come back in 10 or twelve minutes. If you're done.

30 ((Students are all doing the surveys. There is talking, but not really about the survey or
31 the class. They are talking about the crits they've just come from. All heads are bent
32 over the desk. Student in front of me is re-rendering his model.))

33 S: It's in our major. Right?

34 S2: Unless you're in construction.

35 6:46

36 ((One by one the students put the surveys on the table at the front of the room. In the
37 back row there are students talking about data, about the air content.))

38 S: I thought AC meant air conditioning, but then I realized it was air content.

39 S: I'm like really nervous. Every time I use the laser cutter it (works?). This is like the
40 third time. I'm gonna have to do it by hand.

41 ((Getting louder.))

42 S3: Get some sleep A--! Go to bed. ((Giggles.))

43 S2: Whoa...

44 S. I don't know if I need to change the color. Also, it should be darker. That looks pretty
45 dark.

46 S5: Do I need to collect these?

47 ((Teacher comes in.) T: is it safe? Can I come in?

48 S:5 Yeah. ((He goes to the front and turns on the projector.))

49 T: All right, I wrote out everything I expect to see next Wednesday, it is right next to
50 Waldo. We're having trouble with this screen, so I will write down to the best of my
51 ability what I expecting. Nothing should be a surprise.

52 T: Your cool box, your park model maquette, that's a fancy word for model. Two pdfs,

53 S: It's two?

54 T: It's always been two.

55 S: I thought it was four.

56 T: would you like to do four? So you feel like you're not getting your money's worth?

57 We can make it four.

58 T: 11x17 park presentation. Two, a presentation of your park presentation. You all have
59 mad InDesign skills. On your second 11x17, show me your diagram, the model,
60 basically think about your box like a building. You had to think this through, explain

61 what the box does, explain the relationship between the box, the model, and the
62 presentation.

63 If I'm lucky enough to get to teach this class again, imagine that I use your presentation
64 to show exactly what I'm expecting. Bam! Then the next class knows exactly what to
65 expect. That's an instant A.

66 Turn in digital versions of your PDFs, and your rhino model, CD. Again this is off the
67 top of my head.

68 S: Can it be a USB?

69 T: Instead of a CD?

70 S: yeah.

71 T: Next Wednesday bring your study models as well. I really like to look at the process
72 you went through to get to where you are today.

73 S8: Aww, man!

74 T: Who through away their study models? Show me what you have. Finally, the most
75 important thing, he writes extra credit on the board, at the very bottom there is room
76 for you to drop in anything else that you want me to see. Put that in there.

77 Then lastly, there is one more survey. I know you guys have just finished a survey, but
78 this will help me if I decide to make this class a thesis. It will show me that you've
79 taken it, but not who you are, so you can write anything that you want to.

80 Are you guys using these skills for your reviews?

81 When are your studio reviews?

82 S9: Friday 1-5, Architecture hall.

83 S10: There's another one on Monday, 1-5:30 the studio on the right.

84 T: And Tuesday?

85 S10: Same place.

86 T: Do you mind if I come?

87 S10: Say good things.

88 T: thank you for your hospitality. All right guys, I know you probably will run off to
89 your studio, but I would really like the chance for me and Y--- to go around and help
90 you with your last questions. Who's first?

91 ((Student working on his 3 computer renderings puts his hand up.))

92 7:17

93 ((Most of the room is still full. Students keep asking questions, and also working. Both

94 Instructor and Assistant are helping as the can.))