Ex. 1003

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ROOFR INC.,
Petitioner

v.

PICTOMETRY INTERNATIONAL CORP.,
Patent Owner

IPR2023-00436
Patent 9,183,538

DECLARATION OF TONY CUMMINGS IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW

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Ex. 1001	U.S. Patent No. 9,183,538 ("'538 patent")
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Ex. 1003	Expert Declaration of Tony Cummings
Ex. 1004	U.S. Pat. Pub. No. 2008/0262789 A1 ("Pershing-789")
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Ex. 1006	**INTENTIONALLY OMITTED**
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Ex. 1008	*Pictometry: aerial photography on steroids*, LET Staff, Law Enforcement Technology (July 2002) ("Pictometry")
Ex. 1009	U.S. Pat. Pub. No. 2009/0304227 A1 ("Kennedy")
Ex. 1010	*Roofer: Steep Roofing Inventory Procedures And Inspection And Distress Manual For Asphalt Shingle Roofs*, David M. Bailey, U.S. Army Corps of Engineers, CERL Tech. Rept. (December 1999) ("Bailey")
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GROUNDS OF CHALLENGE (37 C.F.R. § 42.204(b)(2))

No.	Ground for Challenge
1	Pershing-789 And Bailey Render Obvious Claims 1-5 And 8-13 Of The '538 Patent
2	Pershing-789, Bailey And Abhyanker Render Obvious Claims 6-7 And 14-18 Of The '538 Patent
3	Kennedy And Bailey Render Obvious Claims 1-5 And 8-13 Of The '538 Patent
4	Kennedy, Bailey And Abhyanker Render Obvious Claims 6-7 And 14-18 Of The '538 Patent

LIST OF CHALLENGED CLAIMS

Claims
Claim 1a: One or more non-transitory computer readable medium storing a set of computer executable instructions for running on one or more computer systems that when executed cause the one or more computer systems to:
Claim 1b: identify a geographic location of a roof;
Claim 1c: determine a footprint and predominant pitch of the roof by analyzing one or more image showing the roof;
Claim 1d: determine an estimated roofing area of the roof based on the predominant pitch and the footprint of the roof;
Claim 1e: and generate a roof report for determination of an amount of materials needed for a construction project, wherein the roof report includes at least one image showing the roof and the estimated roofing area of the roof.
Claim 2: The one or more non-transitory computer readable medium storing a set of computer executable instructions for running on one or more computer systems of claim 1, that when executed further cause the one or more computer systems to determine contact information of one or more contractors within a region of interest of the geographic location of the roof, and to provide a roof report, wherein the roof report includes one or more ortho images of the roof one or more oblique images of the roof, the estimated roofing area and the contact information of one or more contractor within the region of interest of the geographic location of the roof.
Claim 3: The one or more non-transitory computer readable medium of claim 2, wherein the roof report includes contact information of the customer.
Claim 4: The one or more non-transitory computer readable medium of claim 1, wherein the one or more non-transitory computer readable medium comprises a first non-transitory computer readable medium of a first host system and a second non-transitory computer readable medium of a second host system.
Claim 5: The one or more non-transitory computer readable medium of claim 1, wherein identifying the geographic location of the roof further comprises obtaining contact information of a customer.

Claims
Claim 6: The one or more non-transitory computer readable medium storing a set of computer executable instructions for running on one or more computer systems of claim 1, that when executed further cause the one or more computer systems to receive customer input to validate geographic location of the roof.
Claim 7: The one or more non-transitory computer readable medium of claim 6, wherein the geographic location includes coordinates and validation of the geographic location includes instructions for receiving customer input to alter one or more coordinates of the geographic location.
Claim 8: The one or more non-transitory computer readable medium of claim 1, wherein identifying a geographic location of the roof includes identifying one or more edges of the roof in an image.
Claim 9: The one or more non-transitory computer readable medium storing a set of computer executable instructions for running on one or more computer systems of claim 1, that when executed further cause the one or more computer systems to identify edges of the roof; determine three-dimensional information of the edges including position, orientation and length using multiple oblique images from multiple cardinal directions; and, determine, automatically, one or more line segments forming a portion of a footprint of the roof utilizing position and orientation of the edges.
Claim 10: The one or more non-transitory computer readable medium of claim 1, wherein determining the predominant pitch includes determining a plurality of pitch values with each pitch value associated with a portion of the roof, the predominant pitch based on the plurality of pitch values.
Claim 11: The one or more non-transitory computer readable medium of claim 10, wherein each pitch value is associated with an estimated percentage of roof area to provide an average pitch value.
Claim 12: The one or more non-transitory computer readable medium storing a set of computer executable instructions for running on one or more computer systems of claim 1, that when executed further cause the one or more computer systems to provide the roof report to one or more contractors, the contractor located within the region of interest of the geographic location of the roof.
Claim 13a: A system, comprising: two or more host systems, each host system having one or more non-transitory computer readable medium;

Claims
Claim 13b: the non-transitory computer readable medium of the first host system storing a set of computer executable instructions that when executed by one or more processors causes the one or more processors to:
Claim 13c: identify a geographic location of a roof;
Claim 13d: determine contact information of at least one contractor within a region of interest about the geographic location of the roof
Claim 13e: the non-transitory computer readable medium of the second host system storing a set of computer executable instructions that when executed by one or more processors causes the one or more processors to:
Claim 13f: determine a footprint and predominant pitch of the roof by analyzing one or more image showing the roof
Claim 13g: determine an estimated roofing area based on the predominant pitch and the footprint of the roof; and,
Claim 13h: generate a roof report for determination of an amount of materials needed for a construction project, wherein the roof report includes one or more ortho images of the roof, one or more oblique images of the roof, the estimated roofing area and contact information of one or more contractors within the region of interest.
Claim 14a: A roofing estimate method, comprising: receiving, by at least one computer processor from a user via a user terminal, a geographic location of a roof
Claim 14b: providing to the user, with the computer processor, imagery of the roof based on the geographic location of the roof
Claim 14c: determining and providing, with the computer processor, an estimated roofing area based at least on a predominant pitch and a footprint of the roofby analyzing one or more image showing the roof, the footprint of the roof determined at least in part using at least one image of the roof, and
Claim 14d: generating, with the computer processor, a roof report for determination of an amount of materials needed for a construction project, wherein the roof report includes at least one image showing the roof and the estimated roofing area of the roof.
Claim 15: The roofing estimate method of claim 14, wherein the roof report further includes contact information of one or more contractor within a region of interest of the geographic location of the roof.

Claims
Claim 16: The roofing estimate method of claim 14, wherein the footprint of the roof is determined at least in part with oblique images of the roof.
Claim 17: The roofing estimate method of claim 14, wherein the predominant pitch value of the roof based at least in part on the footprint of the roof as a boundary of the roof.
Claim 18: The roofing estimate method of claim 14, wherein the predominant pitch is based on a weighted average of individual pitch factors for two or more portions of the roof.

I. BACKGROUND AND QUALIFICATIONS

1. I have been retained by Petitioner as a technical expert to analyze claims 1-18 of U.S. Patent No 9,183,538. I am being compensated for my time at a consulting rate of $490 per hour. My compensation does not depend on the outcome of this petition. In this section I have summarized my education, career history, publications, and other relevant information. My curriculum vitae, which includes my qualifications as well as my publications, is attached hereto.

2. I have a Bachelor of Architecture from Kansas State University graduating in 1977. I have been a licensed, practicing architect since 1983 hold architectural licenses in 18 states, 14 are currently active. I also have certification with OSHA 10-hour Construction Safety and Health Training and California Office of Emergency Services Safety Assessment Program Evaluator. I have previously held a Level 2 Certification as an Infrared Thermographer performing building wall and roof evaluations for moisture intrusion. I hold professional memberships at the American Institute of Architects (AIA), Construction Specifications Institute (CSI), International Code Council (ICC), National Fire Protection Association (NFPA), National Institute of Building Science (NIBS), Society of Value Engineering (SAFE), American Society of Professional Estimators (ASPE), and the International

Institute of Building Enclosure Consultants (IIBEC), formally known as The Roof Consultant's Institute (RCI).

3. My experience with evaluation and testimony on construction disputes started in 1984 during the period I had an architectural practice in Colorado. In 1989 and a portion of 1990, I worked for a claims consulting firm in their Clearwater Florida office where I evaluated defective construction claims primarily related to condominium projects.

4. Since 1990, I have owned and operated Construction Forensics, Incorporated (CFI) providing analysis of construction failures and disputes. In that time, I have performed forensic investigations in 16 states, for plaintiffs and defendants to include: code review and conformance, failure analysis of building systems and components, material and workmanship evaluations, Standard of Care for design professionals, CPM schedule analysis, suitability of plans and specifications, analysis of cost estimates and providing cost estimate for remediation, including roofing. Deposition and expert testimony, beginning in 1984, have been for cases in Circuit Courts, District Courts, Superior Court, Arbitration, Mediation, the Armed Services Board of Contract Appeals, and the United States Civilian Board of Contract Appeals.

5. My experience with estimating construction projects began during my architectural internship period assembling preliminary cost

estimates for clients on projects that the architectural firms were designing. The vast majority of these projects were new construction which required cost related to new roofing on both commercial and residential. Between 1980 and 1983 I began as an estimator and later became head of estimating for a firm in Colorado specializing in Department of Defense construction projects (primarily housing rehabilitation). In total, we bid and completed approximately 2,000 housing units across the United States ranging from minor interior renovation to whole house/building repairs. Between 1987 to 1989, I was hired to become head of estimating and overhaul the existing estimating component of the firm which also specialized in Department of Defense construction projects. While at this firm, I became the quality control officer on a 135-unit housing development overseeing the total renovation of abandoned base housing in Newport, Rhode Island. Since 1990, I have provided forensic analysis of numerous roofs and performed estimates which have included estimating the cost to repair for litigation purposes on a variety of project types.

6. While I am not a computer programmer, I have extensive experience using software related to construction. Indeed, I have spent decades working with software related to construction modeling and estimation. For example, I have relied on Computer-aided Design Packages

(CAD), programs that have automated the building code review process, Critical Path Method scheduling packages (CPM), and construction estimating software. I have been using this software for decades. I also have experience collaborating with software developers to create new software in my field. For example, in approximately 2010 I partnered with a computer programmer to develop a photo-documentation and document control software to assist in my Owner's Representative assignments.

II. LEVEL OF SKILL IN THE ART

7. In my opinion, a person of ordinary skill in the art at the time of the alleged invention would have bachelor's degree in architecture or an equivalent with at least five years of experience performing roof estimation. This level of skill is approximate, and more experience would compensate for less formal education, and vice versa.

III. LEGAL STANDARDS

8. I understand that "prior art" includes patents and printed publications that existed before the earliest applicable filing date of the '538 Patent.

9. I understand that in order for a claim to be anticipated, each and every requirement of the claim must be found, expressly or inherently, in a single prior art reference as recited in the claim.

10. I understand that a claimed invention is not patentable if the claimed invention would have been obvious to a person of ordinary skill in the field of the invention at the time the invention was made.

11. I understand that in order to show obviousness based on a combination of references, a particular motivation to combine the teachings in the references must be shown.

12. I understand that claim terms are generally given their ordinary and customary meaning, which is the meaning that the term would have to a person of ordinary skill in the art at the time of the invention. I further understand that a person of ordinary skill in the art must read the claim term not only in the context of the particular claim in which the term appears but in the context of the entire patent, including the specification.

13. I understand that the obviousness inquiry should not be done in hindsight, and depends on the scope and content of the prior art, the differences between the prior art and the claims at issue, the knowledge of a person of ordinary skill in the pertinent art at the time of invention, and any other objective factors indicating obviousness or non-obviousness.

14. I understand that in order to rely on a reference for obviousness, the reference must be analogous art. I also understand that to be analogous art, the reference must be either (1) from the same field of endeavor as the

claimed subject matter, regardless of the problem addressed, or (2) if not in the same field of endeavor, reasonably pertinent to the particular problem with which the inventor is involved. I am also familiar with the premise that for a reference to be reasonably pertinent, it must have logically commended itself to an inventor's attention at the time of invention.

IV. CLAIM CONSTRUCTION

15. Based on my review of the '538 patent, it is my opinion that express interpretations of the challenged claims of the '538 patent are not necessary, as the challenged claims are rendered unpatentable by the cited art under any reasonable interpretation of the claims. I reserve my right to respond to, and/or to offer alternative constructions to any proposed claim constructions offered by Patent Owner. I have taken no position in this declaration as to whether the claims are indefinite, and no statements herein should be interpreted to mean that the terms are definite.

V. OVERVIEW OF THE '538 PATENT

16. The '538 patent is generally directed towards a "system and process for roof measurement" using an image of a roof. Ex. 1001 at Abstract. The challenged claims generally recite: (1) identifying a location of a roof; (2) determining the footprint of a roof; (3) identifying the ***predominant pitch*** of the roof by analyzing an image of the roof; (4) determining an estimate of the

roofing area; (5) generating a report estimating the amount of materials needed for a construction project. Ex. 1001 at claim 1.

17. The specification of the '538 patent includes exemplary flow charts describing the alleged invention. For example, Figure 6 shows a general flow diagram of the process recited in the claims:

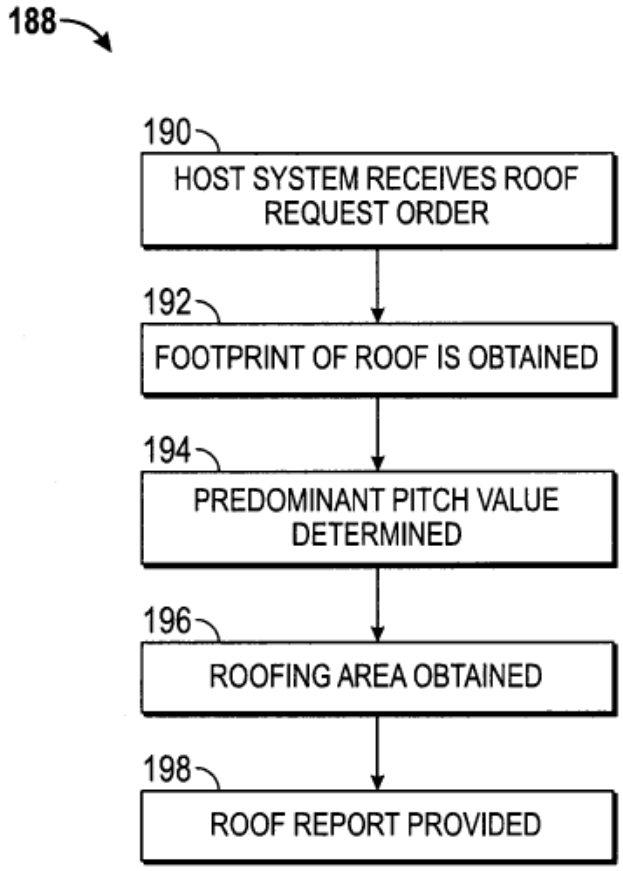


FIG. 6

Ex. 1001 at Fig. 6.

Figure 8 (split into two parts) shows a roof report:

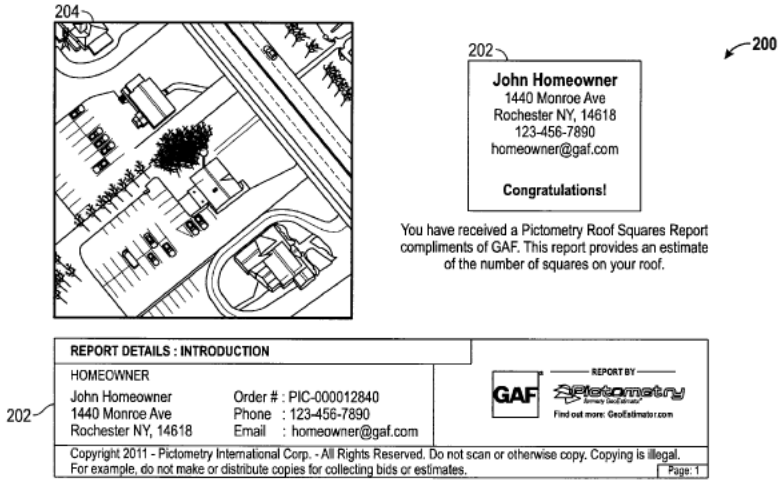


FIG. 8

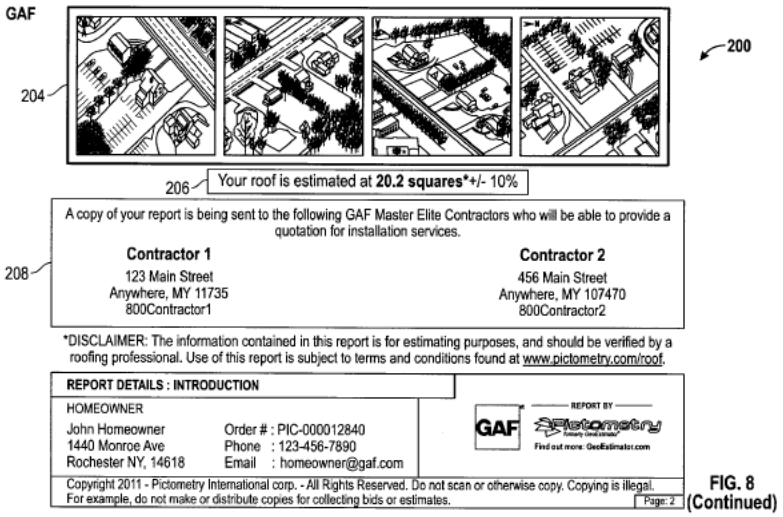


FIG. 8 (Continued)

Ex. 1001 at Fig. 8.

VI. PROSECUTION OF THE '538 PATENT

18. The application that led to the '538 patent was filed on March 19, 2012. On April 16, 2014, the Examiner issued a Non-Final rejection finding that the recited claims were unpatentable under § 101, and anticipated by Como (US 2002/00897332), and rendered obvious by Como in view of Thornberry (US 20210/0296693). In response, applicant amended the claims

to recite "one or more non-transitory computer readable storage medium" to address the § 101 rejection. Ex. 1002, August 15, 2014 Argument at 10-11. Applicant further argued that Como does not teach computer executable instructions for identifying a location of a roof, determining a footprint of a roof, determining a predominant pitch, and determining an estimated roofing area. *Id.* at 12. Applicant asserted that Thornberry does not disclose "predominant pitch," suggesting Thornberry was limited to "pitch direction" only. *Id.* at 13-14.

19. The examiner issued a Final Rejection finding the claims unpatentable under § 101. *Id.*, November 28, 2014 Final Rejection. The Examiner stated that the prior art does not disclose "predominant pitch," which "involves a weighted average of individual pitch factors for two or more portions or a roof." *Id.* at 4.

20. Applicant responded by arguing § 101 does not invalidate the claims and amended the claims to require "determining" a roofing area based on "predominant pitch." *Id.*, May 27, 2015 Argument at 21. The examiner issued a Notice of Allowance thereafter, finding that the prior art did not disclose "determing[ing] an estimated roofing area of the roof based on the predominant pitch and the footprint of the roof." *Id.*, Notice of Allowance at 5.

21. Thus, the examiner ultimately issued the claims based on the perceived lack of a disclosure of finding the "predominant pitch" of a roof in the prior art. As discussed below, this limitation is expressly taught by Bailey.

VII. PRIORITY DATE OF THE '538 PATENT

22. The application that led to the '538 patent was filed on March 19, 2012. The '538 patent does not claim priority to any earlier applications. It is my understanding that the references relied upon in the Grounds of this petition all qualify as prior art based on the '538 patent's March 19, 2012 filing date and are, thus, appropriate to rely on as part of my patentability analysis. The disclosures in these references are consistent with my experience, which confirms that the disclosures in the prior art were well-known before March 19, 2012.

VIII. PRIOR ART

A. Pershing-789

23. U.S. Pat. Pub. No. 2008/0262789 A1 ("Pershing-789") is a U.S. Patent Publication published on October 23, 2008. Accordingly, Pershing-789 qualifies as prior art to the '538 patent under pre-AIA § 102(b). Pershing-789 discloses a "system that allows the remote measurement of the size, geometry, pitch and orientation of the roof…and then uses the information to provide an estimate to repair or replace the roof, or to install equipment thereon." Ex. 1004 at Abstract, [0003].

24. Pershing-789 discloses receiving first location data, such as an address (Ex. 1004 at [0011]), and displaying an aerial image of the address in question to enable roof measurement:

> The software program 50 is linked to ***an aerial image file database 52 that contains aerial images files 54*** of various building 92 in a region. The aerial image files 54 may be taken any available means, such as an aircraft, balloon, a satellite, etc. ***As shown in FIG. 3, the image files*** 54 typically include at least one a top plan view 65 and a perspective view 66 of the building 92.

25. *Id.* at [0022] (emphasis added). Pershing-789 discloses, after taking measurements of the roof in question, generating a report: "From these determinations, the overall shape, slopes and square footage of the roof sections are determined and a ***report*** is produced." Ex. 1004 at [0012] (emphasis added). An exemplary report is shown in Figure 5C:

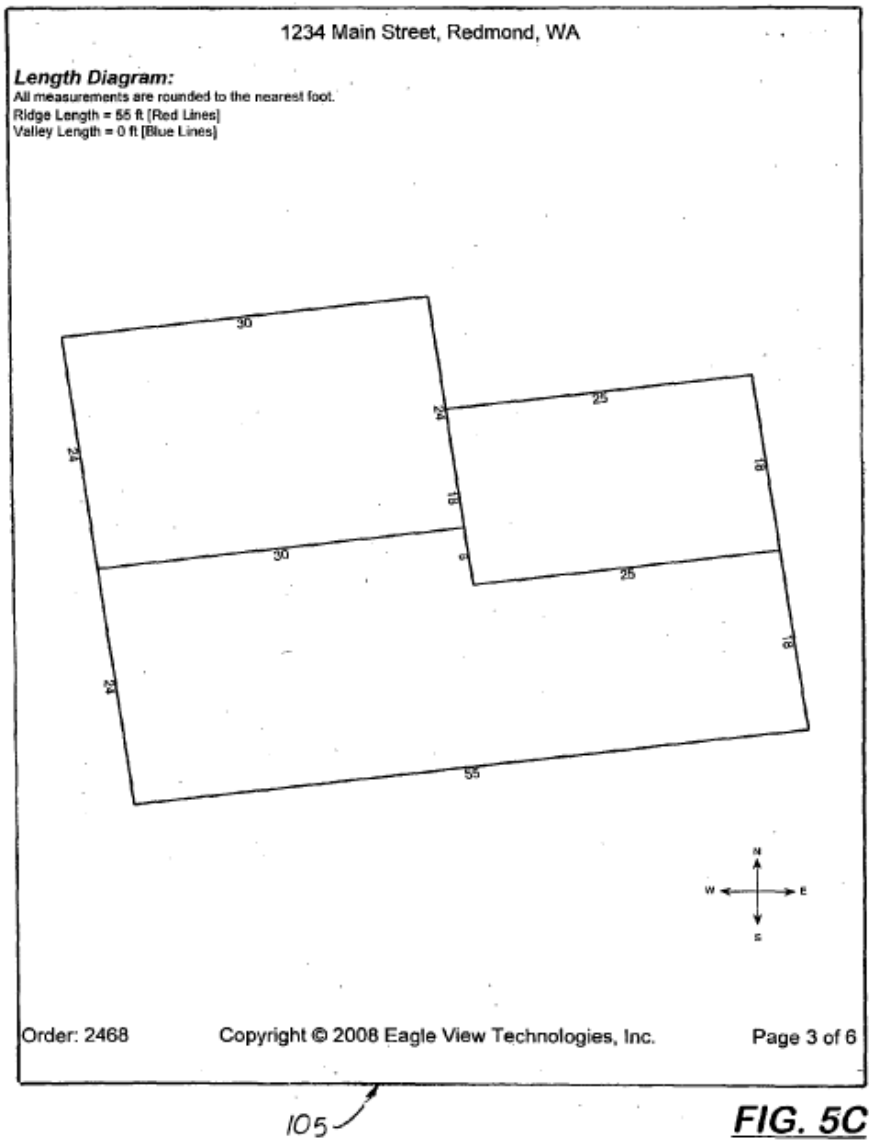


FIG. 5C

Ex. 1004 at Fig. 5C; *id.* at [0038].

B. Abhyanker

26. U.S. Pat. Pub. No. 2007/0220174 A1 ("Abhyanker") is a U.S. Patent Publication published on September 20, 2007. Accordingly, Abhyanker qualifies as prior art to the '538 patent under pre-AIA § 102(b). Abhyanker discloses a system that allows "***marker placement in a mapping environment***." Ex. 1005 at Abstract (emphasis added). Abhyanker discloses

that its mapping environment may include, *e.g.*, "***aerial photography*** over neighborhoods and/or places in a terrestrial environment (e.g., the Earth)." Ex. 1004 at [0005] (emphasis added). Abhyanker teaches a "marker" (e.g., a pushpin, an indicator, a pointer, a pin, etc.) may be placed on a landmark in the aerial image by an algorithm. *Id.* at [0004].

27. Abhyanker notes that, in some cases, an algorithm may not correctly place the marker. Abhyanker explains that the algorithm may mistakenly "place [a] marker nearby, but not precisely on, a correct rooftop" or other landmark. *Id.* at [0005]. This glitch may cause problems because, for example, a misplaced marker may result in incorrect driving directions and would result in customer disappointment. *Id.*

28. Abhyanker teaches remedying marker misplacement by allowing a user to "drag and drop" a market to a corrected location:

> Furthermore, the method may include applying a ***drag and drop*** algorithm that enables the user to sequentially and/or concurrently relocate markers in the mapping environment, iteratively performing additional verifications when any particular marker has been previously moved[.]

29. Ex. 1005 at [0011] (emphasis added). Abhyanker further teaches that, once the marker has been placed by a user, the user may "lock" the location of a marker, confirming its placement:

> The locking module 220 may process a marker ***locking request*** when the particular user claims the wiki profile associated with

> the address data. In addition, the locking module 220 may enable the user(s) to control the future relocation of the marker in the mapping environment.
>
> *Id.* at [0064] (emphasis added).

C. Bailey

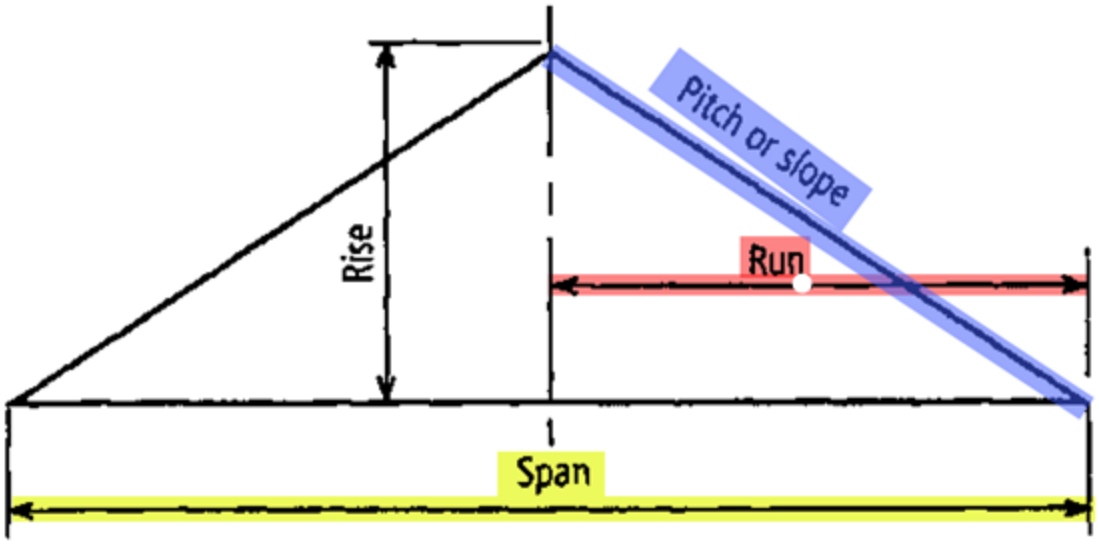
30. *Roofer: Steep Roofing Inventory Procedures And Inspection And Distress Manual For Asphalt Shingle Roofs*, David M. Bailey, U.S. Army Corps of Engineers, CERL Tech. Rept. (December 1999) ("Bailey") is a printed publication published December 1999. Accordingly, Bailey qualifies as prior art to the '538 patent under pre-AIA § 102(b). Bailey discloses steep roofing inventory procedures and inspection techniques. Baily generally teaches methods for collecting data about a roof, including the "***predominant slope***" of the roof:

> Section 33 - Slope. The ***predominant slope*** of the roof section. The roof plan will ***generally indicate the slope*** (e.g., 4 in. in 12). If the slope is not noted on the roof plan, the section drawings may indicate the slope. If such information is not available, field measurement will be required (use the method in Appendix B).

31. Ex. 1010 at 17 (emphasis added); *see also id.* at 15 (showing a "primary" slope at entry line 33).

32. Bailey explains that "slope" and "pitch" are equivalents, both describing the "degree of incline" of a roof. Ex. 1006 at 134 ("The degree of incline a roof possess is usually expressed as its ***'pitch' or 'slope.'***") (emphasis added).

33. Bailey explains that pitch uses the entire span of the roof (*i.e.*, the entire length of the base of the roof) to express this incline, and slope uses the run of the roof (*i.e.*, half the length of the base of the roof), but, as shown in Figure 14 of Bailey, both pitch and slope represent the ***same thing***—the degree of incline of the roof:



Id. at Fig. 14 (annotated), 134-35.

34. As Bailey further explains, pitch and slope are interchangeable for purposes of area calculations: "Whether a particular roof incline is expressed in pitch or slope, ***the results of area calculations will be the same***." *Id.* at 134 (emphasis added).

35. Bailey explains that finding the "predominant slope [*i.e.*, pitch]" for a "roof section" means any roofing area of 10,000 square feet or less—for example, Bailey teaches that "all exposed roof areas on the building shown in Figure 2 would comprise ***one roof section***" (*id.*):

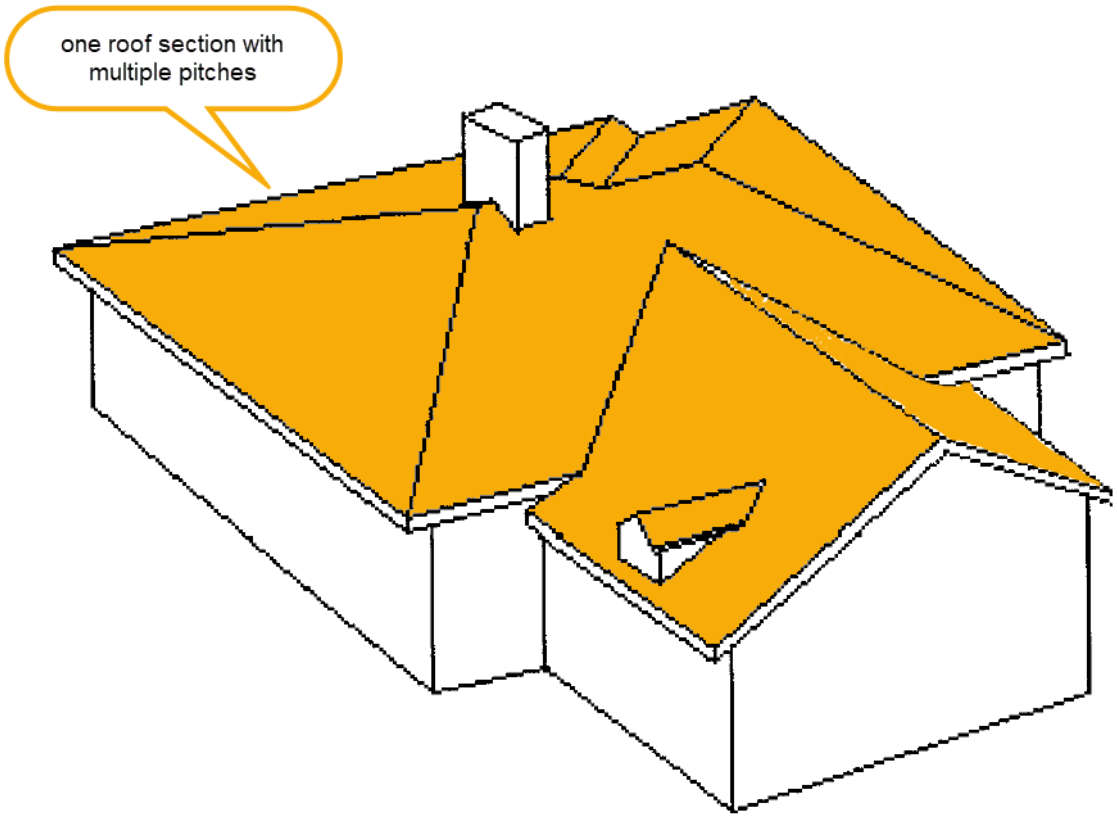


Figure 2. Example of a building roof comprising a roof section.

36. *Id.* at Fig. 2 (annotated). Thus, Bailey teaches finding the "predominant slope [pitch]" for, *e.g.*, an entire residential roof, like that shown in Figure 2.

D. Kennedy

37. U.S. Pat. Pub. No. 2009/0304227 A1 ("Kennedy") is a U.S. Patent Publication published on December 10, 2009 claiming priority to provisional applications filed February 1, 2008 and April 22, 2008. Accordingly, Kennedy qualifies as prior art to the '538 patent under pre-AIA § 102(e). Kennedy teaches a computer implemented method for generating a

roof estimate. Kennedy teaches a "roof estimating software program." Ex. 1009 at Abstract. Kennedy teaches displaying an aerial image of a building having a roof comprising a plurality of planar roof sections that each have a corresponding pitch. Kennedy teaches that some embodiments of the system "include a sizing tool for determining the size, geometry, and pitch of the roof sections of a building being displayed." Ex. 1009 at Abstract. This is shown, for example, in Figure 36:

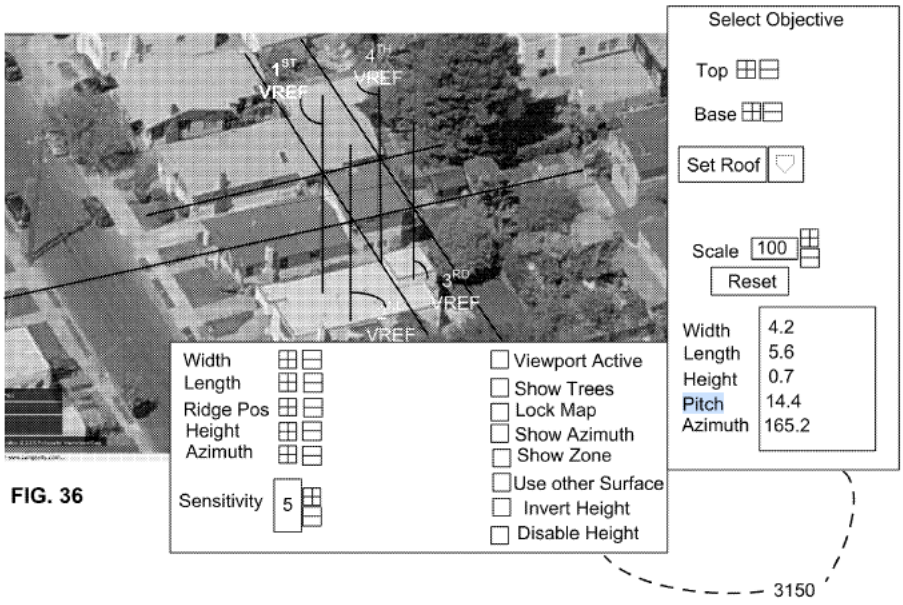


FIG. 36

Id. at Fig. 36.

38. Kennedy discloses a sizing subsystem with a "sizing tool" that can be used to determine pitch:

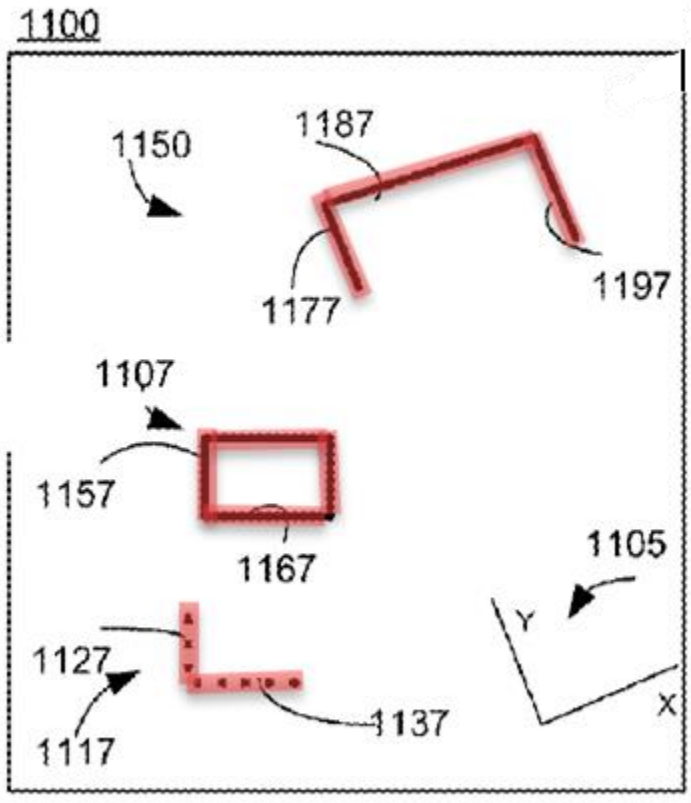
> In one embodiment of the invention, a graphical user interface (best illustrated in FIGS. 8-9) cooperates with sizing subsystem 500 of system 100 to implement a sizing tool enabling user 107 to ***determine surface dimensions and pitch of a surface, for***

> ***example a roof*** 191 of a house ***appearing in the retrieved image*** 153. Thus there is no need to physically visit the installation site to make measurements and perform sizing calculations.

Id. at [0058] (emphasis added).

39. In one embodiment, Kennedy's "sizing subsystem" includes an "***interactive measuring tool***…for use in sizing surfaces such as roof of house 600 in Fig. 6." *Id.* at [0105] (emphasis added). The sizing tool is shown, for example, in Figure 11:

FIG. 11



Id. at Fig. 11 (annotated). Kennedy explains that its measuring tool is "rotatable and scalable by a user 507 to align at least two sides of the tool an

image [sic] of an object to be measured, for example a roof surface to be measured." *Id.* at [0105]. Kennedy further explains that "an orientation of measuring tool with respect to axes 670 [the x/y/z axis] is determined." *Id.* at [0108].

40. Kennedy makes clear that the sizing tool is "superimposed" over an aerial image. *Id.* at [0110] ("To size surface 1215 user 507 superimposes sizing tool, in this example tool 1117 (illustrated in Fig. 11) of at least a portion of image 1215…in some embodiments, information defining an orientation of shape 1215 with respect to a reference axis 1211 is generated by comparing orientation of adjusted tool 1107 to reference axis 1211.").

41. Kennedy discloses that the measuring tool can be used to determine the pitch of a roof. *Id.* at [0116] ("…measuring tool 1107 [can be] used to measure displacement of a ridge of roof 650 from base 635. The displacement information is used by modeling unit 591 (Fig. 5) to determine ***pitch of roof*** 600.") (emphasis added).

IX. GROUND 1: PERSHING-789 AND BAILEY RENDER OBVIOUS CLAIMS 1-5 AND 8-13 OF THE '538 PATENT

42. Ground 1 relies on the teachings of Pershing-789's computer-implemented roof estimation system which covers nearly every element of claims 1-5 and 8-13. Ground 1 further relies on the teachings of Bailey which discloses the "predominant pitch" limitation (through its teaching of

"predominant slope") that the examiner believed was missing from the prior art during prosecution. *See* Section V, *supra*.

A. Motivation To Combine Pershing-789 and Bailey

43. A POSITA would have been motivated to combine the teachings of Pershing-789 and Bailey. As discussed in more detail below, Pershing-789's teachings broadly disclose calculating the pitch of a roof: "It should be understood that the system and method described herein may be used to any individual or company that would find the calculation of the size, geometry, ***pitch*** and orientation of the roof of a building from aerial images of the building useful." Ex. 1004 at [0016] (emphasis added). A POSITA would understand that this broad reference to a pitch calculation would include pitch weighted averages typically used in estimation. Using an average pitch value for a roof is useful because it simplifies area calculations. A POSITA would understand that using a weighted average that gives greater weight to roof facets with larger surface area is desirable because it enhances accuracy in the area estimation process. Accordingly, a POSITA considering Pershing-789 would be motivated to use a weighted average to compute pitch.

44. As discussed with respect to claim 1, below, Bailey expressly teaches finding the "predominant slope [*i.e.*, pitch]"—which is a weighted average of roof pitches. Bailey teaches calculating the predominant slope of

a "roof section," *i.e.*, any roof area 10,000 square feet or less, which may include an entire residential roof. A POSITA would have been motivated to incorporate Bailey's predominant pitch estimation into Pershing-789 for a variety of reasons. For example, Bailey is a guide from the U.S. Army Corps of Engineers that teaches calculating the predominant pitch of a roof for, *e.g.*, repair assessment. Ex. 1010 at 1, 15, 17. As discussed below, Bailey's roof report collects the same types of attributes as Pershing-789's report (area, pitch, length). Ex. 1010 at 11-22. A POSITA considering Pershing-789's system for collecting roof data and generating a corresponding report would have been motivated by Bailey's teaching to include predominant pitch as part of its estimation techniques. Including Bailey's predominant pitch would allow Pershing-789's system to estimate roof area accurately with simplified calculations, as discussed above.

45. Further, similar to Pershing-789, Bailey expressly teaches its methods can be used to assess "needed level of repair" of a roof. *Id.* at 1, 10. This is ***exactly*** the same assessment considered by Pershing-789. Ex. 1004 at Abstract. Accordingly, a POSITA would have been motivated to incorporate Bailey's predominant pitch measurement into Pershing-789's system which is also designed to estimate materials needed for, *e.g.*, repair. This would enhance Pershing-789, because it would allow for a more streamlined, yet

accurate, estimation of materials using a "predominant pitch" instead of different pitch values for each facet.

46. In addition, calculating a predominant pitch, which is merely the computation of a weighted average of pitch values of a roof, has been used in the art ***for decades***. Indeed, there are only a finite number of ways to measure roof pitch, including calculating precise pitch values for every roof facet or creating a single pitch estimate for an entire roof (or roof section). A POSITA would be motivated to use Bailey's single pitch value (the "predominant slope") for a roof section of 10,000 square feet to simplify the calculations used by Pershing-789 related to roof repair or replacement. *Id.* Indeed, Pershing-789 discloses a roof ***estimation*** system. Ex. 1004 at Title, Abstract. Accordingly, a POSITA considering Pershing-789 would be motivated to use Bailey's pitch estimation technique which generates a single pitch value instead of using every single pitch value for a given roof. in Pershing-789's system at least because it is a technical report from the US Army Corps of Engineers which provides instructions for evaluating roofs. Ex. 1010 at 1. A POSITA would have been highly motivated to consider the teachings of such a well-respected guide. Further, including "predominant pitch" in Pershing-789's estimation process would have been nothing more than a mere design choice. There are only a finite number of ways to calculate pitch for a roof,

including using pitch values for every facet or a single "predominant pitch" value, and, thus, it would have been a simple design choice with a predictable solution that a POSITA would have been motivated to pursue.

47. Bailey would have also motivated a POSITA to use its teachings in Pershing-789's system at least because it is a technical report from the US Army Corps of Engineers which provides instructions for evaluating roofs. Ex. 1010 at 1. A POSITA would have been highly motivated to consider the teachings of such a well-respected guide. Ex. 1003 at ¶ 47. In addition, a POSITA would have been motivated to use the teachings of Pershing-789 and Bailey because they are in the ***same field of endeavor*** as the '538 patent. Both Pershing-789 and the '538 patent are directed towards systems that locate and measure roof dimensions to estimate costs for repair or replacement. Ex. 1001 at Abstract; Ex. 1004 at Abstract. Similarly, Bailey is broadly directed towards collection of roof data, such as pitch, to estimate roof area to assess, *e.g.*, level of roof repair needed. Ex. 1010 at 1, 134-35. Pershing-789, Bailey and the '538 patent all user ***similar techniques to solve the same problems***. As discussed below, Pershing-789 uses the same techniques to locate roofs and measure their dimensions as the '538 patent, and Bailey uses the exact same pitch estimation technique as the '538 patent: predominant pitch estimation. A POSITA would also have a ***reasonable expectation of success***

in including the teachings of Bailey in Pershing-789. Bailey's teachings confirm that predominant pitch estimation was well known, and Bailey specifically teaches that its system can be used the same context as Pershing-789—measuring roof attributes. Ex. 1010 at 15, 17, 134-35. Accordingly, Bailey itself would motivate a POSITA to apply its teachings of user confirmation steps to improve Pershing-789's efficiency.

B. Claim 1

1. Claim 1a: One or more non-transitory computer readable medium storing a set of computer executable instructions for running on one or more computer systems that when executed cause the one or more computer systems to:

48. Pershing-789 discloses "one or more non-transitory computer readable medium storing a set of computer executable instructions for running on one or more computer systems." In particular, Pershing-789 discloses a "system that allows the remote measurement of the size, geometry, pitch and orientation of the roof…and then uses the information to provide an estimate to repair or replace the roof, or to install equipment thereon." Ex. 1004 at Abstract; *see also id.* at [0003] (describing "systems and methods for estimating construction projects") (emphasis added).

49. Pershing-789 discloses that its system "includes the use of a roof estimating software program and an location-linked, image file database." *Id.*

at [0011]. A POSITA would understand that this software comprises "instructions for running on one or more computer systems." Further, Pershing-789 discloses that the "software program [is] loaded into its working memory[.]" *Id.* at [0012], [0024], [0025], [0027], [0039]. This description of "working memory" is not limited to any specific type of memory, and, thus, can include non-transitory memory (*i.e.*, the claimed "non-transitory computer readable medium"). Thus, Pershing-789 discloses "one or more non-transitory computer readable medium storing a set of computer executable instructions for running on one or more computer systems."

2. Claim 1b: identify a geographic location of a roof;

Pershing-789 discloses "identifying a geographic location of a roof":

> During use, the ***physical address or location information*** of the building ***is inputted into the program*** which then presents aerial images of roof sections on the building at the specific address location.

50. Ex. 1004 at [0011] (emphasis added), Abstract, [0012]-[0014], [0019], [022]-[0023], [0026]-[0029]. As discussed below, this identified roof location is used as part of Pershing-789's estimation process.

3. Claim 1c: determine a footprint and predominant pitch of the roof by analyzing one or more image showing the roof;

51. Pershing-789 teaches analyzing an "image" of the roof in question:

During use, the physical address or location information of the building is inputted into the program which then ***presents aerial images of roof sections on the building at the specific address location***.

Ex. 1004 at [0011] (emphasis added), [0012]-[0016].

52. For example, a first image showing the roof in question is shown in Figure 3:

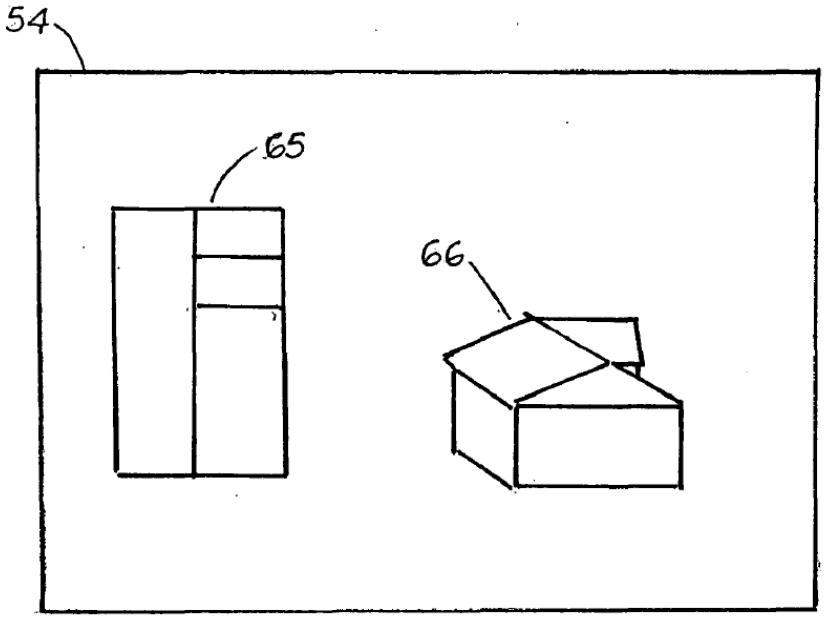


FIG. 3

53. Ex. 1004 at Fig. 3, *see also* 4, 5A-F. Pershing-789 explains that this hand-sketched drawing is meant to represent actual aerial images of a building stored in its system's database:

The software program 50 is linked to ***an aerial image file database 52 that contains aerial images files 54*** of various building 92 in a region. The aerial image files 54 may be taken any available means, such as an aircraft, balloon, a satellite, etc. ***As shown in FIG. 3, the image files*** 54 typically include at least

one a top plan view 65 and a perspective view 66 of the building 92.

Id. at [0022].

54. Pershing-789 teaches "determine[ing] a footprint" of the roof. The '538 patent teaches that the "footprint may provide a two-dimensional boundary and/or outline of the roof." Ex. 1001 at 12:8-9. Thus, the "footprint" of the roof includes at least its area. Pershing-789 teaches determining the claimed "***footprint***" of the roof by drawing two-dimensional boundaries/outlines of roof sections, *e.g.*, to compute area. This is shown, for example, in Figure 5E:

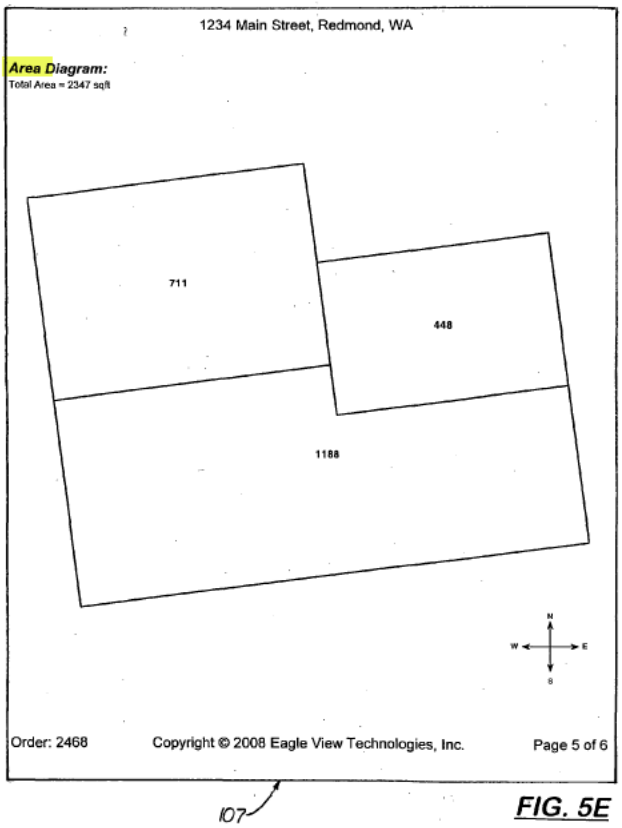
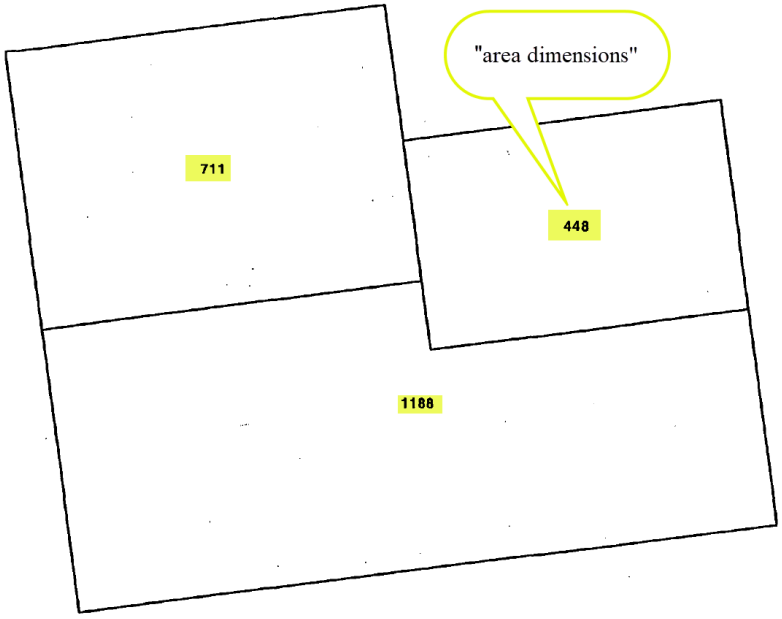
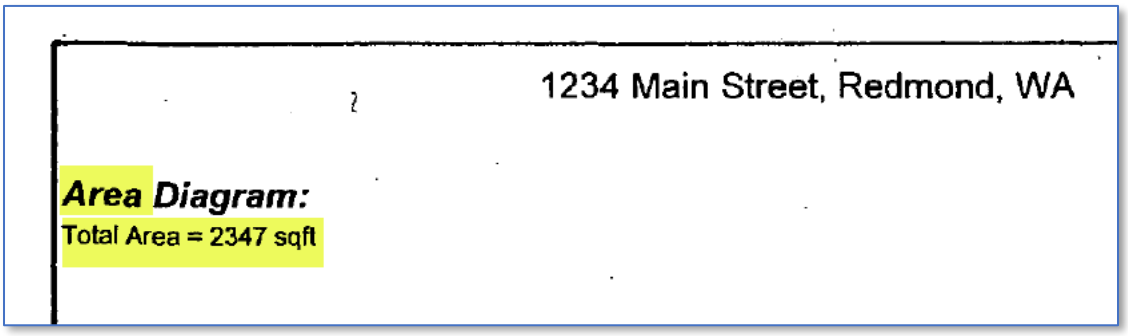


FIG. 5E

55. Ex. 1004 at Fig. 5E (annotated). Pershing-789 explains that, "FIG. 5E is an illustration of the fifth page 107 of the report showing the ***square footage of each roof section*** along with the total square foot ***area*** value." *Id.* at [0028] (emphasis added). A closeup of Fig. 5E shows the area of different roof facets:



Id. at Fig. 5E (annotated). Likewise, another closeup of the figure shows the total ***area*** calculation:



Id. (annotated).

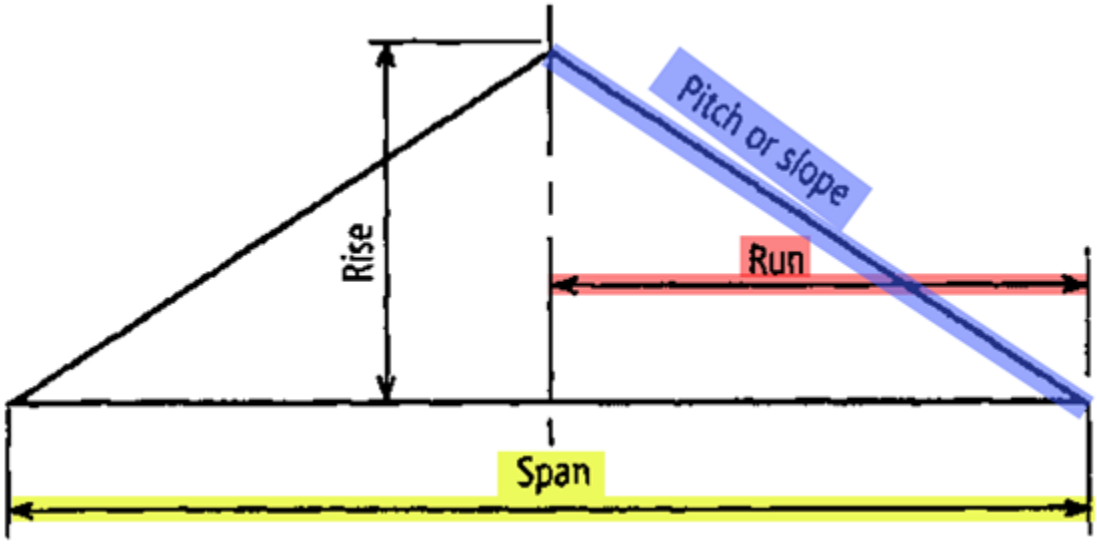
56. Pershing-789 broadly discloses a calculation of pitch: "It should be understood, that the system and method described herein may be used to any individual or company that would find the calculation of the size, geometry, ***pitch*** and orientation of the roof of a building from aerial images of the building useful." Ex. 1004 at [0016] (emphasis added).

57. Bailey expressly teaches calculating the "***predominant slope***" of the roof:

> Section 33 - Slope. The ***predominant slope*** of the roof section. The roof plan will ***generally indicate the slope*** (e.g., 4 in. in 12). If the slope is not noted on the roof plan, the section drawings may indicate the slope. If such information is not available, field measurement will be required (use the method in Appendix B).
>
> Ex. 1006 at 17 (emphasis added).

58. Bailey explains, as was well-known in the art, that ***"slope" and "pitch" are equivalents***, both describing the "degree of incline" of a roof. Ex. 1010 at 134 ("The degree of incline a roof possess is usually expressed as its ***'pitch' or 'slope.'***") (emphasis added). Accordingly, Bailey's disclosure of "predominant slope" is an express disclosure of "predominant pitch."

59. Bailey explains that pitch uses the entire span of the roof (*i.e.*, the entire length of the base of the roof) and slope uses the run of the roof (*i.e.*, half the length of the base of the roof), but, as shown in Figure 14 of Bailey, both pitch and slope are the ***same thing***—the degree of incline of the roof:



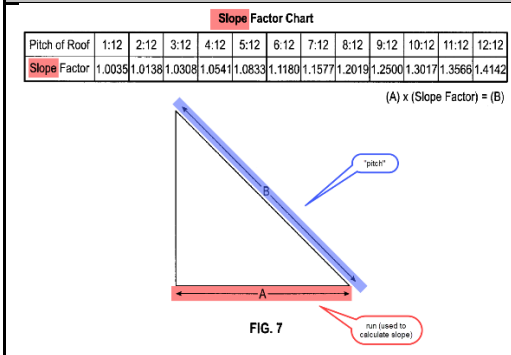
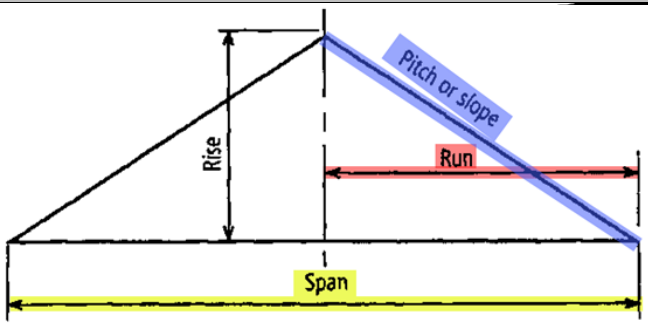
Id. at Fig. 14 (annotated).

60. As Bailey further explains, pitch and slope are equivalent for purposes of area calculations (like those claimed in the '538 patent): "Whether a particular roof incline is expressed in pitch or slope, ***the results of area calculations will be the same***." *Id.* at 134-35 (emphasis added).

61. Indeed, in my experience "slope" and "pitch" are often used interchangeably in the industry because they refer to the same incline, as confirmed by the teachings of Bailey. *See also* Ex. 1013 at 462 (defining "roof pitch" as "the ***slope*** of a roof…more roofing material is required to cover the increased roof area when the ***slope or pitch*** is great," and cross-referencing "roof pitch" in the definition of "roof slope") (emphasis added). In fact, also consistent with my industry experience, the '538 patent itself uses "slope" and "pitch" interchangeably. For example, the '538 patent discloses relying on a

"1.1180…***pitch*** factor" from Figure 7 (Ex. 1001 at 12:17), but this number is labeled a "***slope*** factor" in Figure 7 (*id.* at Fig. 7). The '538 patent uses the terms interchangeably a second time, referring to a "***pitch*** factor of 1.0833 in the table in Figure 7" (*id.* at 12:36), whereas Figure 7 labels 1.0833 as a "***slope*** factor" (*id.*at Fig. 7). The '538 patent uses slope and pitch interchangeably twice more in Equations 1 and 2. Both Equations refer to the "***slope*** factors" in Figure 7 as a "***pitch*** factors." *Compare id.* at EQs. 1 and 2 *with* Fig. 7.

62. Moreover, Bailey's "slope" is the same as the '538 patent's "pitch" at least because the claimed "pitch" (labeled "B" (blue)) in the '538 patent at Figure 7 is the ***same*** incline being calculated in Bailey (labeled "pitch or slope" (blue)):

'538 Patent	Bailey
	

63. *Compare* Ex. 1001 at Fig. 7 *with* Ex. 1010 at Fig. 14. Accordingly, the "predominant slope" disclosed in Baily is an express disclosure of the claimed "predominant pitch."

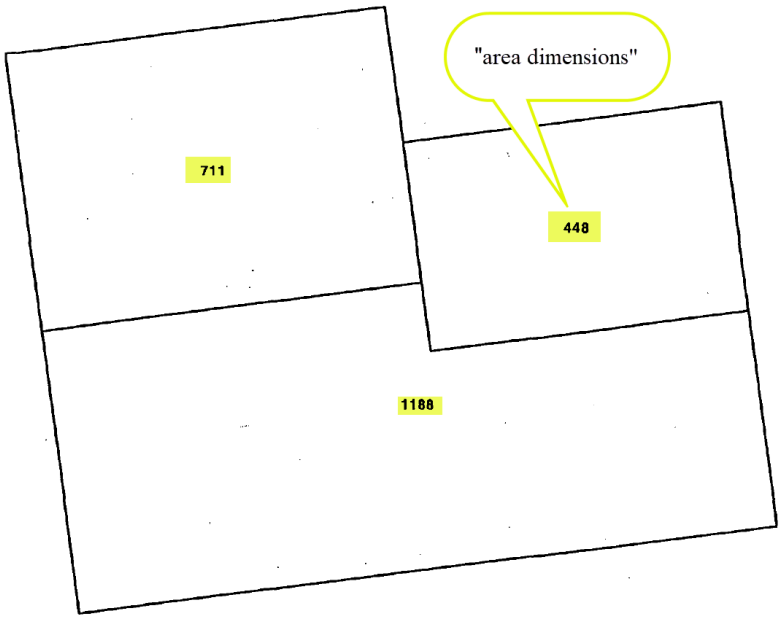
4. Claim 1d: determine an estimated roofing area of the roof based on the predominant pitch and the footprint of the roof;

64. As discussed above, Pershing-789 uses a "footprint" of the roof and its pitch to calculate an estimate of its area. Ex. 1004 at [0013]-[0015], [0028]. As taught by Bailey, a roof's area is calculated based on the footprint of a roof and its pitch. Ex. 1010 at 134-36. Further, Bailey teaches the a "predominant slope [*i.e.*, pitch]" may be used for an entire roof. Accordingly, Pershing-789 and bailey render obvious determining an "estimated roofing area" based on the "predominant pitch and the footprint" of the roof.

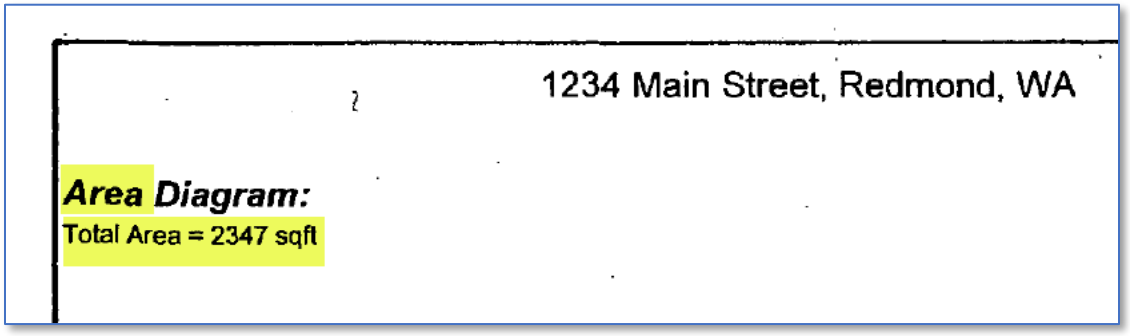
5. Claim 1e: and generate a roof report for determination of an amount of materials needed for a construction project, wherein the roof report includes at least one image showing the roof and the estimated roofing area of the roof.

65. Pershing-789 teaches that its system generates "a roof report for determination of an amount of materials needed for a construction project": "The information can then be used to prepare a cost estimate for the repair or replacement of the roof or installation of roof equipment." Ex. 1004 at Abstract; [0012] (describing a "report").

66. Pershing-789's roof report includes "at least one image showing the roof and the estimated roofing area of the roof":



Id. at Fig. 5E (annotated). Likewise, another closeup of the figure shows the total area calculation:



Id. (annotated).

C. Claim 2: The one or more non-transitory computer readable medium storing a set of computer executable instructions for running on one or more computer systems of claim 1, that when executed further cause the one or more computer systems to determine contact information of one or more contractors within a region of interest of the geographic location of the roof, and to provide a roof report, wherein the roof report includes one or more ortho images of the roof one or more oblique images of the roof, the estimated roofing area and the contact information of one or more contractor within the region of interest of the geographic location of the roof.

67. As discussed with respect to claim 1, Pershing-789 discloses the "one or more non-transitory computer readable medium storing a set of computer executable instructions for running on one or more computer systems" of claim 1. *See* claim 1, *supra*.

68. Pershing-789 discloses "the one or more computer systems to determine contact information of one or more contractors within a region of interest of the geographic location of the roof." Pershing-789 teaches that the "roof estimating entity 130 prepare a preliminary report 101 which is then transmitted to various roof companies…associated with the entity…Accompanying the preliminary report 101 may be the name and contact telephone number(s) or email address of the customer 90." Ex. 1004 at [0027].

69. First, a POSITA would understand that in order for the estimating entity to "transmit" a preliminary report to roof companies, it

would ***have to*** determine their contact information (*e.g.*, email) first. Thus, Pershing-789 teaches determining contact information of one or more contractors. Second, in any case, it would have been obvious to use Pershing-789 to determine contact information of one or more contractors at least because it already determines contact information for potential customers which it lists on its report. Ex. 1004 at [0014], [0027]. It would be equally important to determine contractor contact information so that customers could be put in communication with a contractor.

70. Pershing-789 also teaches that these contractors are within a "region of interest." In particular, the '538 patent discloses that the region of interest "may be determined by the customer via user terminal and/***or the region of interest may be a pre-programmed determination***." Ex. 1001 at 10:21-23.

71. Pershing-789 teaches that its aerial images are limited to roofs within a "the roof companies [sic] service area." Ex. 1004 at [0012]. Pershing-789 also teaches contacting roof companies "associated with the estimation service. *Id.* at [0014]. Pershing-789 also teaches that its contractors may be "associated with the [estimation] entity." *Id.* at [0027]. Thus, Pershing-789 discloses a pre-programmed list of contractors within a "region of interest."

72. Indeed, it would make no sense to use Pershing-789's system with contractors located outside of a geographic area of interest. This is because estimates of remote contractors would be inaccurate based on variability of materials and labor costs across geographic regions. For example, the cost of materials and labor will differ greatly between Nebraska vs. New York City. And roofers typically only offer their services within a given service area. Pershing-789's estimates would not have any value to a customer if they pertained to remote contractors, because they would not reflect estimates by a contractor in close enough proximity to actually perform the work the customer needs and a price commensurate with the customer's location.

73. Pershing-789 further discloses "providing a roof report," as discussed with respect to claim 1. *See* claim 1, *supra*.

74. Pershing-789 also discloses that the roof report includes "one or more ortho images of the roof." The plain meaning of an "ortho" image is an "orthogonal" image—*i.e.*, an image taken straight down. Ex. 1008 at 114 (Pictometry…uses aerial photography to capture, process and analyze ***orthogonal (straight down)*** and oblique (taken from angles) images[.]")

(emphasis added).[1] As discussed with respect to claim 1, Pershing-789 discloses such images of a roof:

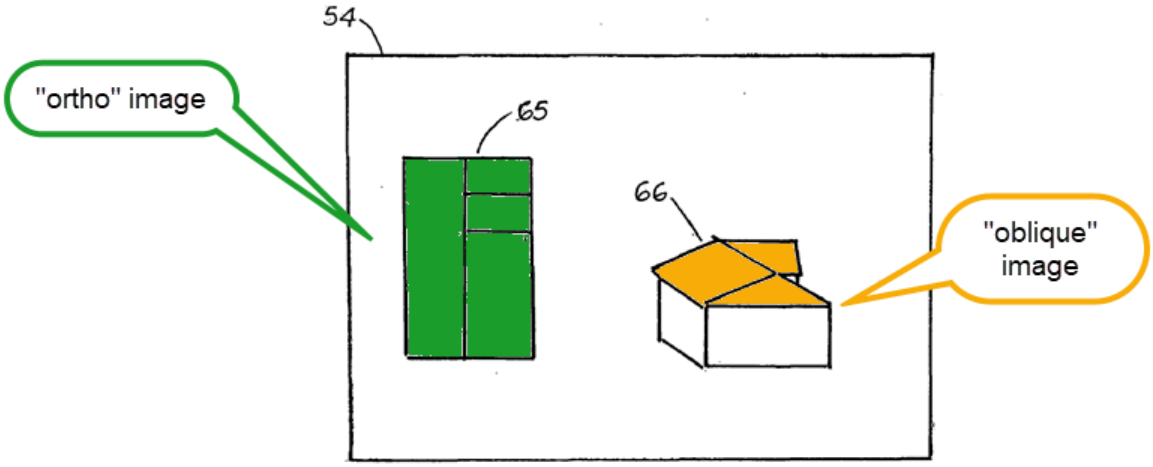


FIG. 3

75. Ex. 1004 at Fig. 3, Abstract (describing "oblique" and "top plan" views). As noted in claim 1, Pershing-789 explains that this hand-sketched drawing is meant to represent actual aerial images of a building stored in its system's database. *Id.* at [0022].

76. Pershing-789 teaches that its report "includes one or more oblique images of the roof." A POSITA would understand the plain meaning of an "oblique image" is one captured at an angle. Ex. 1007 at 114 (Pictometry…uses aerial photography to capture, process and analyze

[1] I am not relying on Pictometry (Ex. 1008) as part of the proposed combination. Instead, I am relying on Pictometry to confirm a POSITA's understanding of the '538 patent's reference to an "ortho" image.

orthogonal (straight down) and ***oblique (taken from angles)*** images[.]") (emphasis added). Pershing-789 teaches including such an oblique image of a roof in its report, for example, in Figure 3:

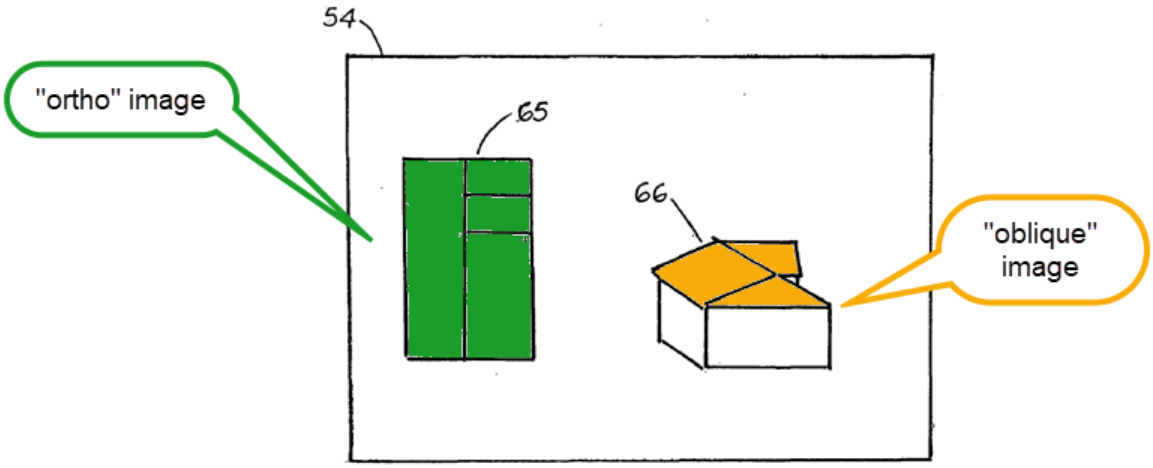


FIG. 3

Ex. 1004 at Fig. 3, Abstract (describing "oblique" and "top plan" views).

77. Pershing expressly discloses including these types of images in its reports, for example, in Figure 5B:

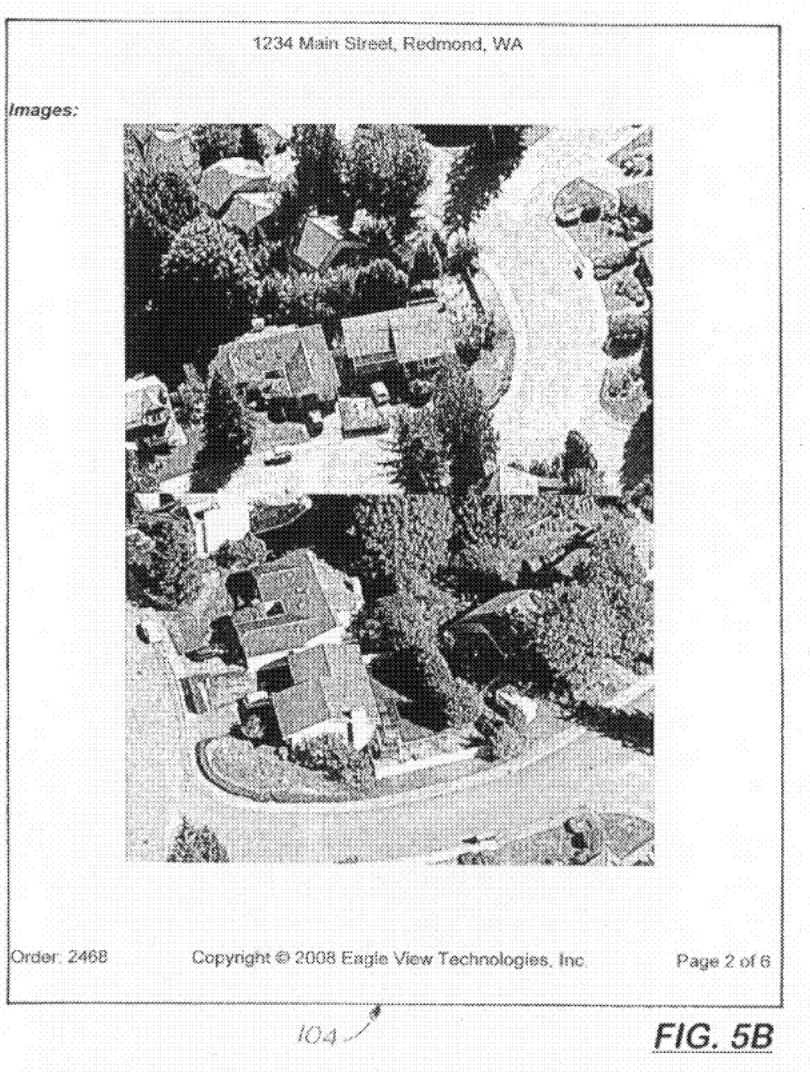


FIG. 5B

Ex. 1004 at Fig. 5B.

78. Pershing-789 teaches that its report includes the "estimated roofing area" as discussed with respect to claim 1. *See* claim 1, supra.

79. Pershing-789 renders obvious including "contact information of one or more contractor within the region of interest of the geographic location of the roof." As discussed above, Pershing-789 already teaches including a customer's information on a preliminary report to be provided to a contractor

and, thus, it would be obvious to also include a contractor's contact information on a report. Ex. 1004 at [0027]. Indeed, Pershing-789 teaches that a "final report" which includes estimates from a variety of contractors is transmitted to the customer, and that the customer may contact the roof company. *Id.* at [0026]-[0027]. It would be obvious to include the contractors' contact information so aid the customer.

D. Claim 3: The one or more non-transitory computer readable medium of claim 2, wherein the roof report includes contact information of the customer.

80. As discussed with respect to claim 2, Pershing-789 expressly discloses including a customer's contact information in its report. *See* claim 2, supra.

E. Claim 4: The one or more non-transitory computer readable medium of claim 1, wherein the one or more non-transitory computer readable medium comprises a first non-transitory computer readable medium of a first host system and a second non-transitory computer readable medium of a second host system.

81. The '538 patent broadly discloses that, "[g]enerally, the first host system 102 may include one or more processors 108 capable of executing a first set of processor executable code and the second host system 126 may include one or more processors 128 capable of executing a second set of processor executable code." Ex. 1001 at 5:35-41. The '538 patent provides Figure 1 as an example of two "host systems":

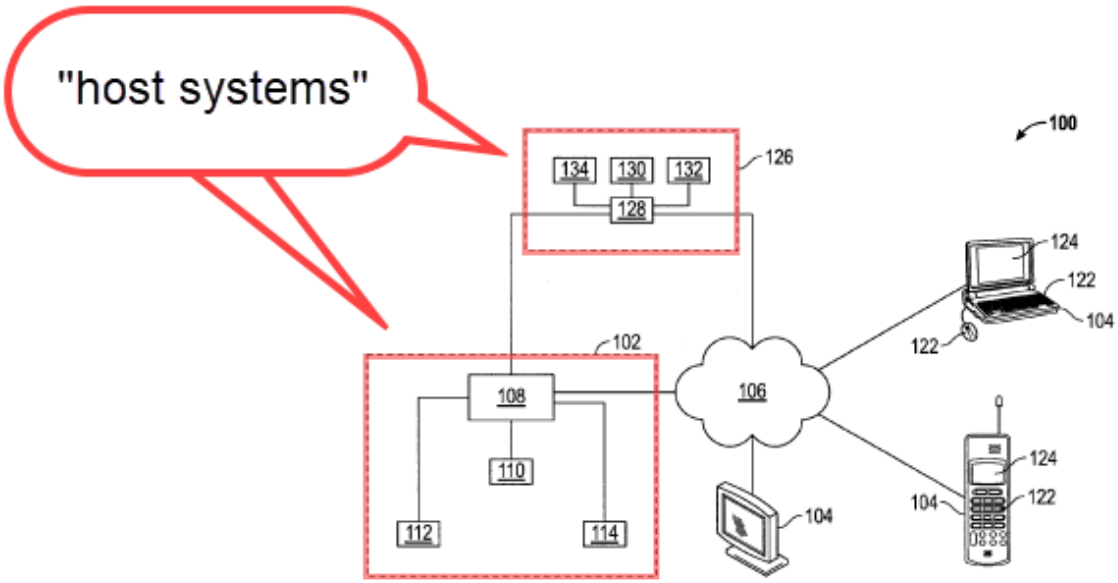


FIG. 1

Ex. 1001 at Fig. 1, 3:21-25.

The '538 patent explains that in some embodiments the two host systems may be controlled by different entities:

> [H]ost systems 102 and 126 may be independently controlled by separate entities. Host system 102 may be controlled by a first company and host system 126 may be controlled by a second company distinct from the first company. For example, host system 102 may be controlled by a roofing material supplier and host system 126 may be controlled by a roofing report company. The roofing material supplier may be a separate entity from the roofing report company.

Ex. 1001 at 4:13-21.

82. Pershing-789 discloses two such "host entities": one belonging to the "estimating entity 130" and the other belonging to "roof company 70":

> FIG. 2 shows a third embodiment of the system 10 where the customer 90 contacts a roof estimating entity 130 who receives a

request 100 from the customer 90 via the wide area network 60 or telecommunication network 96. The roof ***estimating entity 130 prepares a preliminary report 101*** which is then transmitted to various roof companies 70, 70', 70" associated with the entity 130. Accompanying the preliminary report 101 may be the name and contact telephone number(s) or email address of the customer 90. Each ***roof company 70***, 70', 70" reviews the preliminary report 101 and any associated images sent therewith and ***then prepares a final estimate*** 102, 102', 102". The final estimate 102,102', 102" is then mailed, emailed or faxed to the customer 90 or back to the estimating entity 130.

83. Ex. 1004 at [0027] (emphasis added). For example, the two host system is shown in Figure 2:

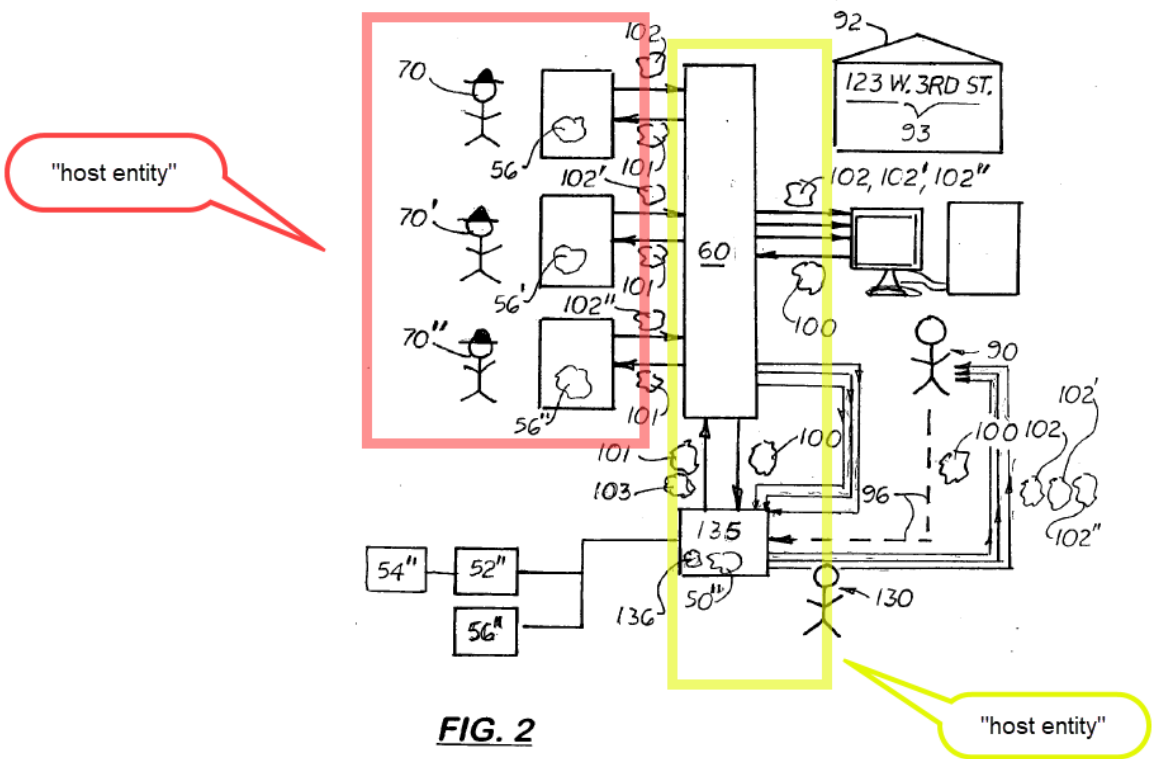


FIG. 2

84. Ex. 1004 at Fig. 2 (annotated). As discussed with respect to claim 1, Pershing-789 also discloses that its system may use "working memory," which would include the claimed "non-transitory computer

readable medium" in these host entities. Accordingly, Pershing-789 teaches this limitation.

F. Claim 5: The one or more non-transitory computer readable medium of claim 1, wherein identifying the geographic location of the roof further comprises obtaining contact information of a customer.

85. As discussed with respect to claim 1, Pershing-789 discloses obtaining contact information of a customer. *See* claim 1, *supra*.

G. Claim 8: The one or more non-transitory computer readable medium of claim 1, wherein identifying a geographic location of the roof includes identifying one or more edges of the roof in an image.

86. As discussed with respect to claim 1, Pershing-789 teaches identifying one or more edges of the roof in an image, *e.g.*, to measure area. *See* claim 1, supra.

H. Claim 9: The one or more non-transitory computer readable medium storing a set of computer executable instructions for running on one or more computer systems of claim 1, that when executed further cause the one or more computer systems to identify edges of the roof; determine three-dimensional information of the edges including position, orientation and length using multiple oblique images from multiple cardinal directions; and, determine, automatically, one or more line segments forming a portion of a footprint of the roof utilizing position and orientation of the edges.

87. Pershing-789 teaches the "one or more non-transitory computer readable medium storing a set of computer executable instructions for running on one or more computer systems" of claim 1. *See* claim 1.

88. Pershing-789 teaches that its "one or more computer systems to identify edges of the roof." *See* claim 1.

89. Pershing-789 teaches determining "three-dimensional information of the edges including position, orientation and length using multiple oblique images from multiple cardinal directions." First, as discussed with respect to claim 2, Pershing-789 teaches using "oblique images" as part of its image analysis. *See* claim 2. Pershing-789 teaches determining three-dimensional information about the edges of a roof: "An image analysis…determines the geometry, the slopes, the pitch angles, and the outside dimensions of the roof sections." Ex. 1004 at [0011]. Pershing-789 further teaches that "reference points" identified in each image is used to reconstruct a "three dimensional geometry" of the roof. *Id.* at [0034]. Pershing-789 teaches that a variety of algorithms can be used, including algorithms that "triangulate points of interest." *Id.* Pershing-789 also teaches that its algorithm may rely on "a number of factors such as the ***spatial relationships between the photographs***, the number and locations of the reference points." *Id.* at [0035] (emphasis added). Pershing-789 also teaches using cardinal directions as a reference point in image analysis. *See, e.g.*, Fig. 5C-F. Thus, Pershing-789 renders obvious determining "three-dimensional

information of the edges including position, orientation and length using multiple oblique images from multiple cardinal directions."

90. Pershing-789 also "determines, automatically, one or more line segments forming a portion of a footprint of the roof utilizing position and orientation of the edges." As discussed with respect to claim 1, Pershing-789 uses line segments to draw the footprint of the roof based on the position and orientation of its edges. *See* claim 1, supra.

I. Claim 10: The one or more non-transitory computer readable medium of claim 1, wherein determining the predominant pitch includes determining a plurality of pitch values with each pitch value associated with a portion of the roof, the predominant pitch based on the plurality of pitch values.

91. Bailey renders obvious "wherein determining the predominant pitch includes determining a plurality of pitch values with each pitch value associated with a portion of the roof, the predominant pitch based on the plurality of pitch values." As discussed with respect to claim 1, Bailey expressly discloses the claimed "predominant pitch."

92. Bailey further renders obvious basing its "predominant pitch" on a "***plurality of pitch values***" as required by the claims. In particular, Bailey teaches determining the "predominant slope [pitch] ***of the roof section***." Ex. 1010 at 17 (emphasis added). Bailey defines a "roof section" as an area of 10,000 square feet or less: "As a rule, a building having a steep roofing system

of approximately 10,000 SF or less should be managed as ***one section***." *Id.* at 10 (emphasis added). This means that an entire roof is a single roof section as long as it is 10,000 square feet or less. For example, Bailey discloses that "all exposed roof areas on the building shown in Figure 2 would comprise ***one roof section***" (*id.*):

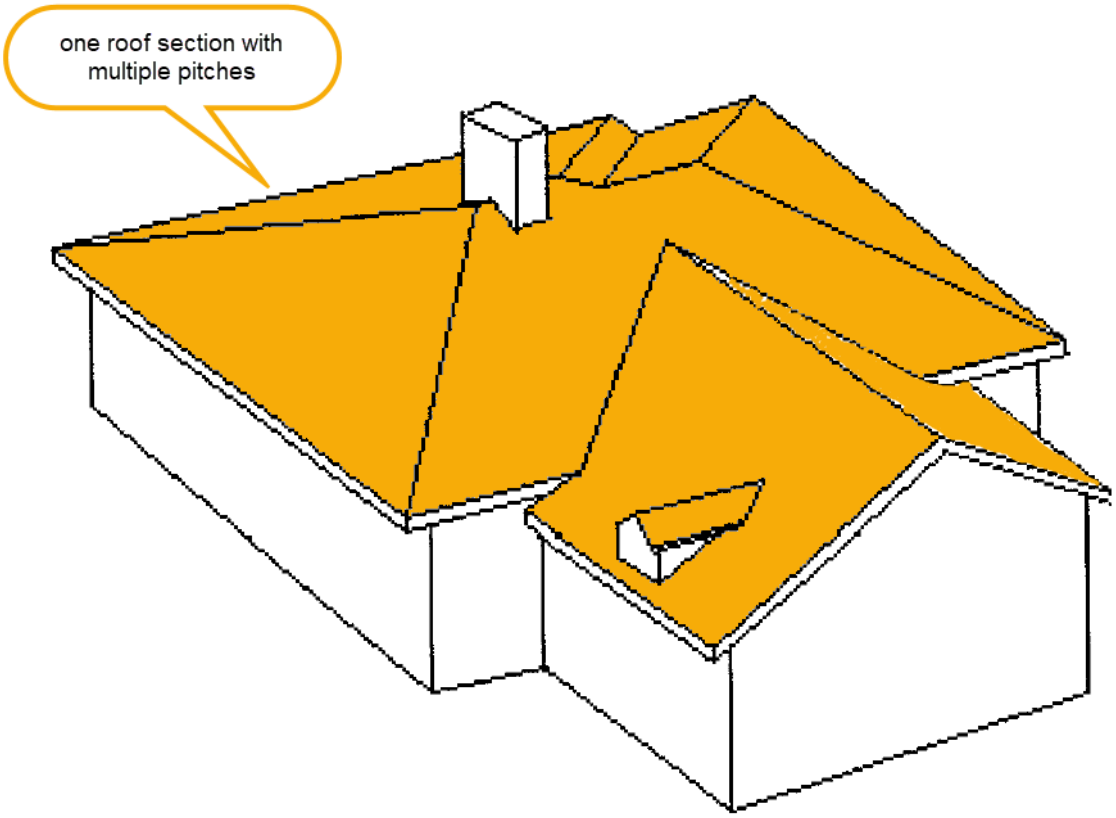


Figure 2. Example of a building roof comprising a roof section.

93. *Id.* at Fig. 2 (annotated). To determine the single "predominant slope [pitch]," for the entire roof shown in Figure 2, Bailey teaches relying on slopes indicated in, *e.g.*, a roof plan, drawings or through field measurement. *Id.* at 17. Thus, Bailey renders obvious using multiple pitch values for a multi-

sloped roof to calculate a single "predominant slope [pitch]" as required by the claims. *See also id.* at Fig. 3 at line 33 (referring to the "predominant slope [pitch]" for a roof as its "slope (***primary***)") (emphasis added).

94. Indeed, a POSITA would have been motivated to rely on all a roof section's different pitch values when calculating a single "predominant slope" value to promote accuracy. As Bailey explains, the pitch of a roof is used in conjunction with its footprint to compute area. Ex. 1010 at 134-36. When estimating a single predominant slope value, it would be important to account for all of the pitches of a roof, giving greater weight to pitch values associated with greater surface area of the roof. For example, if 80% of a roof section had a pitch value of 4:12 and 20% of the same roof section had a pitch of 7:12, a POSITA would understand greater weight should be given to the 4:12 pitch value when computing a single "predominant" or "primary" pitch, as disclosed by Bailey. Otherwise, the single pitch value could not properly be referred to as the "predominant" or "primary" pitch, since it would represent a simple average. *See also* claims 11, 17, 18.

J. Claim 11: The one or more non-transitory computer readable medium of claim 10, wherein each pitch value is associated with an estimated percentage of roof area to provide an average pitch value.

95. As discussed with respect to claim 1, Bailey teaches determining a "predominant pitch" based on slope values for a given roof. Bailey further

renders obvious "wherein each pitch value is associated with an estimated percentage of roof area to provide an average pitch value."

96. A POSITA would understand that Bailey's disclosure of a single "predominant" or "primary" pitch value is a weighted average pitch value that accounts for the amount of surface area taken up by roof facets, as discussed with respect to claim 10. This is because Bailey teaches using its estimates for purposes of "selecting repair strategies, and establishing planning and budgeting needs for accomplishing necessary work." Ex. 1010 at 7. A POSITA would understand that, consistent with Bailey's express teachings, pitch values are used in conjunction with the footprint of a roof to calculate area. *Id.* at 134-36. Bailey's disclosures of a single pitch value, therefore, would be understood to account for the amount of surface area taken up by a roof facet of a given pitch, because doing so would provide the most accurate single pitch value to be used in roof area calculations. Indeed, this is ***why*** Bailey (and the '538 patent) refer to the single pitch value as the "predominant" (or "primary") pitch.

97. Moreover, as confirmed by my experience in the industry, such weighted average calculations are extremely common in construction, including roofing, and were in widespread use many years before the '538 patent. Indeed, the RSMeans Illustrated Construction Dictionary—frequently

referred to by those of ordinary skill in the art as a "complete source of construction terms and concepts," including myself—defines a weighted average in the construction context "[a]n average in which certain entries, usually at the extremes of the range of values, are manipulated so a number is obtained that is believed to be more representative of the true mean that that obtained by straight averaging." Ex. 1013 at 1, 605. Thus, as a POSITA would understand, ***by definition*** a weighted average can be used to give a "more representative" number in the face of a range of values than a straight average. This is precisely the situation called for when estimating a predominant pitch as taught by Bailey. For example, if 90% of Bailey's 10,000 square foot roof section has a pitch of 4:12 and 10% of the roof section has a pitch of 7:12, a POSITA would be motivated to weight the pitches according to their surface areas because doing so would most accurately result in the true "predominant" or "primary" pitch of the roof. If each section were weighted equally, it could not be understood as a "predominant" pitch—indeed, there would be nothing "predominant" about it.

98. Thus, in my opinion a POSITA would be motivated to use the well-known weighted averaging technique prolific in construction to generate Bailey's "predominant slope [pitch]" because it would provide the most accurate estimate of pitch (and, thus, materials required for a job).

99. Moreover, based on my experience there are only a finite number of ways to calculate a single pitch value (predominant pitch) from a plurality of pitch values, including a simple average (giving equal weight to all pitch values) and a weighted average. For the foregoing reasons, a POSITA would be motivated to use a weighted average to promote accuracy.

K. Claim 12: The one or more non-transitory computer readable medium storing a set of computer executable instructions for running on one or more computer systems of claim 1, that when executed further cause the one or more computer systems to provide the roof report to one or more contractors, the contractor located within the region of interest of the geographic location of the roof.

100. As discussed with respect to claim 1, Pershing-789 generates a preliminary report which is provided to a contractor within the region of interest of the geographic location of the roof. *See* claim 1.

L. Claim 13

1. Claim 13a: A system, comprising: two or more host systems, each host system having one or more non-transitory computer readable medium;

101. *See* claims 1, 4.

2. Claim 13b: the non-transitory computer readable medium of the first host system storing a set of computer executable instructions that when executed by one or more processors causes the one or more processors to:

102. *See* claims 1, 4.

3. Claim 13c: identify a geographic location of a roof.

103. *See* claim 1.

4. Claim 13d: determine contact information of at least one contractor within a region of interest about the geographic location of the roof

104. *See* claim 2.

5. Claim 13e: the non-transitory computer readable medium of the second host system storing a set of computer executable instructions that when executed by one or more processors causes the one or more processors to:

105. *See* claim 1, 4.

6. Claim 13f: determine a footprint and predominant pitch of the roof by analyzing one or more image showing the roof

106. *See* claim 1c.

7. Claim 13g: determine an estimated roofing area based on the predominant pitch and the footprint of the roof; and,

107. *See* claim 1d.

8. Claim 13h: generate a roof report for determination of an amount of materials needed for a construction project, wherein the roof report includes one or more ortho images of the roof, one or more oblique images of the roof, the estimated roofing area and contact information of one or more contractors within the region of interest.

108. *See* claims 1, 2.

X. GROUND 2: PERSHING-789 AND BAILEY IN FURTHER VIEW OF ABHYANKER RENDER OBVIOUS CLAIMS 6-7 AND 14-18 OF THE '538 PATENT

109. Ground 2 relies on the same combination of Pershing-789 and Bailey discussed in Ground 1 but adds the additional disclosure of Abhyanker to address the additional limitations of claims 6-7 and 14-18 (requiring various user input).

A. Motivation To Combine Pershing-789, Bailey and Abhyanker

110. For the same reasons discussed above, a POSITA would have been motivated to combine the teachings of Pershing-789 and Bailey. A POSITA would have been further motivated by the teachings of Abhyanker to allow users of Pershing-789's roofing system the option to specifically designate the geographic position of a roof to be analyzed, and to include a subsequent user confirmation option to ensure that the correct roof is being analyzed. There are a variety of reasons a POSITA would be motivated to use these teachings from Abhyanker in Pershing-789.

111. A POSITA would have been motivated by the teachings of Abhyanker to allow users of Pershing-789's roofing system the option to specifically designate the geographic position of a roof to be analyzed using a marker, and to include a subsequent user confirmation option to ensure the

correct roof is being analyzed. There are a variety of reasons a POSITA would be motivated to apply these teachings from Abhyanker to Pershing-789.

112. For example, allowing a user to designate a geographic position of a roof and to subsequently confirm that the roof location is correct would promote the ***accuracy of the system***. Abhyanker's teachings expressly address this motivation. Abhyanker discloses that automated systems used to pinpoint geographic locations (like Pershing-789's) are not always 100% accurate, and mistakes will result in user disappointment. Ex. 1005 at [0004]-[0005]. That is especially true here: if Pershing-789's system inadvertently marked a neighboring roof (or a roof with the same address in a different state or town), the resulting materials estimate would be incorrect. This would cost both the user and the service provider time and money (and would potentially cost the software provider business). Thus, it would have been obvious to include Abhyanker's teachings of allowing a user to place a "marker" on the roof in question and to affirmatively "confirm" the right selection was made. This accuracy check would ***save money***, ***save time*** and ***avoid customer losses***.

113. In addition, applying Abhyanker's teachings to Pershing-789's system would also ***add convenience*** to a user. For example, if a user inadvertently input a neighbor's address it would be convenient to allow the user to apply a drag-and-drop feature, like that taught by Abhyanker, to correct

this error by simply sliding the marker to the correct location. This would also add to the convenience for users who may have difficulties typing or reading smaller print in the form fields in a screen—dragging a colored "marker" would assist such users in marking the right roof.

114. As explained above, Pershing-789 and Bailey are in the same field of endeavor as the '538 patent, use similar techniques to solve the same problems as the '538 patent and their combination would result in a reasonable expectation of success. Similarly, a POSITA would have been motivated to combine the teachings of Pershing-789 and Abhyanker because they are in the ***same field of endeavor*** as the '538 patent. Both Pershing-789 and the '538 patent are directed towards systems that locate and measure roof dimensions to estimate costs for repair or replacement. Ex. 1001 at Abstract; Ex. 1004 at Abstract. Similarly, Abhyanker is broadly directed towards accurate placement of markers in a "mapping environment," like the ones used in the Pershing-789 and '538 patent systems. Ex. 1005 at Abstract, [0012]. Further, Pershing-789, Abhyanker and the '538 patent all user ***similar techniques to solve the same problems***. As discussed above, Pershing-789 uses the same techniques to locate roofs and measure their dimensions as the '538 patent, and Abhyanker uses the same techniques to ensure accurate roof placement. A POSITA would also have a ***reasonable expectation of success*** in including

the teachings of Abhyanker in Pershing-789. Abhyanker's teachings confirm that user confirmation options in "mapping environments" such as Pershing-789's were well known, and Pershing-789 specifically teaches that its system can be used the same context—locating roofs. Ex. 1005 at Abstract, [0012]. Accordingly, Abhyanker itself would motivate a POSTIA to apply its teachings of user confirmation steps to improve Pershing-789's system.

B. Claim 6: The one or more non-transitory computer readable medium storing a set of computer executable instructions for running on one or more computer systems of claim 1, that when executed further cause the one or more computer systems to receive customer input to validate geographic location of the roof.

115. For the reasons discussed in Ground 1, the combination of Pershing-789 and Bailey render obvious claim 1.

116. In addition, Abhyanker teaches that the "one or more computer systems to receive customer input to validate geographic location of the roof." Abhyanker teaches that a user may "drag and drop" a marker to choose a location:

> Furthermore, the method may include applying a ***drag and drop*** algorithm that enables the user to sequentially and/or concurrently relocate markers in the mapping environment, iteratively performing additional verifications when any particular marker has been previously moved[.]

117. Ex. 1005 at [0011] (emphasis added). Thus, a user has freedom to relocate a marker anywhere desired within the aerial image, including a location that is different from the original address entered by a user.

118. Thereafter, Abhyanker discloses that "additional verifications may be iteratively performed when any particular marker has been previously moved[.]" *Id.* at [0053]. For example, Abhyanker teaches a user may "lock" the location of a marker, preventing its future relocation:

> The locking module 220 may process a marker ***locking request*** when the particular user claims the wiki profile associated with the address data. In addition, the locking module 220 may enable the user(s) to control the future relocation of the marker in the mapping environment.
>
> *Id.* at [0064] (emphasis added).

C. Claim 7: The one or more non-transitory computer readable medium of claim 6, wherein the geographic location includes coordinates and validation of the geographic location includes instructions for receiving customer input to alter one or more coordinates of the geographic location.

119. As discussed above with respect to claim 6, Abhyanker teaches that a customer may provide input to alter one or more coordinates of the geographic location, for example, by dragging-and-dropping or user verification. *See* claim 6, supra. For the same reasons, Abhyanker teaches "the geographic location includes coordinates and validation of the

geographic location includes instructions for receiving customer input to alter one or more coordinates of the geographic location."

D. Claim 14

1. Claim 14a: A roofing estimate method, comprising: receiving, by at least one computer processor from a user via a user terminal, a geographic location of a roof

120. *See* claims 1, 6.

2. Claim 14b: providing to the user, with the computer processor, imagery of the roof based on the geographic location of the roof

121. *See* claim 1.

3. Claim 14c: determining and providing, with the computer processor, an estimated roofing area based at least on a predominant pitch and a footprint of the roofby analyzing one or more image showing the roof, the footprint of the roof determined at least in part using at least one image of the roof, and

122. *See* claim 1.

4. Claim 14d: generating, with the computer processor, a roof report for determination of an amount of materials needed for a construction project, wherein the roof report includes at least one image showing the roof and the estimated roofing area of the roof.

123. *See* claim 1.

E. Claim 15: The roofing estimate method of claim 14, wherein the roof report further includes contact information of one or more contractor within a region of interest of the geographic location of the roof.

124. *See* claims 1, 2.

F. Claim 16: The roofing estimate method of claim 14, wherein the footprint of the roof is determined at least in part with oblique images of the roof.

125. *See* claims 1, 2.

G. Claim 17: The roofing estimate method of claim 14, wherein the predominant pitch value of the roof based at least in part on the footprint of the roof as a boundary of the roof.

126. As discussed with respect to claim 1 in Ground 1, the footprint of the roof may be represented by the roof's boundary lines. *See* claim 1. Any pitch value estimation must necessarily account for these boundary lines in order to estimate the pitch from peak to edge. Accordingly, the proposed combination renders obvious this limitation for the same reasons discussed with respect to claim 1 in Ground 1.

H. Claim 18: The roofing estimate method of claim 14, wherein the predominant pitch is based on a weighted average of individual pitch factors for two or more portions of the roof.

127. Bailey also expressly teaches using the same "pitch factors" shown in Figure 7 of the '538 patent to calculate area (as shown below). Ex. 1010 at 137. Thus, Bailey also renders obvious "wherein the predominant pitch is based on a weighted average of individual pitch factors for two or more portions of the roof." *See also* claims 10, 11.

'538 Patent (Fig. 7)

Slope Factor Chart

Pitch of Roof	1:12	2:12	3:12	4:12	5:12	6:12	7:12	8:12	9:12	10:12	11:12	12:12
Slope Factor	1.0035	1.0138	1.0308	1.0541	1.0833	1.1180	1.1577	1.2019	1.2500	1.3017	1.3566	1.4142

(A) x (Slope Factor) = (B)

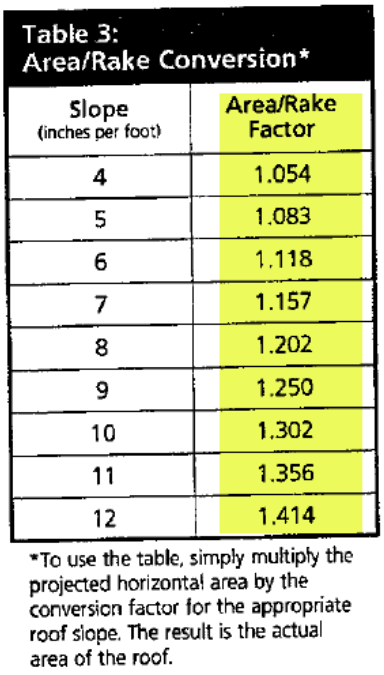
Bailey	

Table 3:
Area/Rake Conversion*

Slope (inches per foot)	Area/Rake Factor
4	1.054
5	1.083
6	1.118
7	1.157
8	1.202
9	1.250
10	1.302
11	1.356
12	1.414

*To use the table, simply multiply the projected horizontal area by the conversion factor for the appropriate roof slope. The result is the actual area of the roof.

XI. GROUND 3: KENNEDY AND BAILEY RENDER OBVIOUS CLAIMS 1-5 AND 8-13 OF THE '538 PATENT

128. Ground 3 relies on the teachings of Kennedy, which disclose almost every claim element recited in the '538 patent, in combination with Bailey's teachings of generating a roof report and determining the "predominant pitch" of a roof.

A. Motivation To Combine Kennedy and Bailey

129. A POSITA would have been motivated to generate a report and to incorporate a "predominant pitch" estimation in Kennedy's system based on the teachings of Bailey. The motivations described in Ground 1 with respect to the predominant pitch limitation apply equally to the combination of Kennedy and Bailey.

130. In addition to those motivations, Bailey generates a report based on roof attributes, including predominant pitch. Ex. 1010 at 15. Bailey's roof report collects the same types of roof attributes as Kennedy's system (area, pitch, length). Ex. 1010 at 11-22, Ex, 1009 at [0072], [0081]-[0087]. Thus, a POSITA considering Kennedy's system for collecting roof data would be motivated by Bailey to generate a report reflecting that data, including predominant pitch.

131. A POSITA would likewise be motivated to combine the teachings of Bailey and Kennedy because they are both in the ***same field of endeavor*** as the '538 patent, roof estimation. Ex. 1001 at Abstract; Ex. 1009 at Abstract; Ex. 1010 at 1, 17, 134. As discussed below, both Kennedy and Bailey use ***similar techniques to solve the same problems*** as the '538 patent—indeed, Kennedy discloses nearly all of the limitations of the '538 claims, and Bailey discloses generating a report and determining the predominant pitch as required by the claims. A POSITA would have had a ***reasonable expectation of success*** applying Bailey's teaching of generating a report and computing the predominant pitch into Kennedy's system at least because Kennedy already teaches collecting and storing the same type of roofing data taught by Bailey.

B. Claim 1

1. Claim 1a

132. Kennedy teaches a "roof estimating software program." Ex. 1009 at Abstract. Kennedy teaches using its system's roof estimation to prepare a "quote" for customers. Ex. 1009 at ¶¶ 164, 169. For example, Kennedy teaches:

> A system according to one embodiment of the invention remotely determines the measurements of a roof. An exemplary system comprises a computer including an input means, a display means and a ***working memory***. An aerial image file database contains a plurality of aerial images of roofs of buildings in a selected region. A roof estimating ***software program*** receives location information of a building in the selected region and then presents the aerial image files showing roof sections of building located at the location information. Some embodiments of the system include a sizing tool for determining the size, geometry, and pitch of the roof sections of a building being displayed.

133. *Id.* at Abstract (emphasis added); *see also id.* at [0169] ("In one embodiment of the invention a quote for the displayed system is provided in association with the image of the system."). Kennedy further teaches:

> For example a commercially available processor or computer system adapted in accordance with the teachings herein implements system 100 including at least one of subsystems 110, 2000, 3000, 3100, 500 and/or 200. For example, one of ordinary skill in the art will recognize upon reading this specification, that commercially available ***processors, memory modules***, input/output ports and other commercially available hardware components are suitable for use in constructing embodiments of system 100. These may be assembled as taught in this specification to arrive at the various embodiments.

134. *Id.* at [0051] (emphasis added). These "memory modules" would include the claimed "non-transitory computer readable medium."

2. Claim 1b

135. Kennedy teaches that its user interface is configured to receive "user information, for example, ***site location information from a user***[.]" Ex. 1009 at [0053]-[0054] (emphasis added). Kennedy teaches providing visual access to a first image corresponding to the first location data, the first image including a roof structure of a building:

> [S]ystem 100 uses the location information received from user system 106 to ***retrieve an image*** 153 of the location (or site) from a geophysical database 109. In response to receiving the location information, system 100 provides an image corresponding to the location, for example ***an image of a roof of a house 391 for display on screen*** 380 of display device 108 of a user system 106.

Ex. 1009 at [0056] (emphasis added).

3. Claim 1c

136. Kennedy expressly discloses a "sizing tool" that is superimposed on an aerial image to determine "surface dimensions" of a roof:

> In one embodiment of the invention, a graphical user interface (best illustrated in FIGS. 8-9) cooperates with sizing subsystem 500 of system 100 to implement a sizing tool enabling user 107 to determine surface dimensions and pitch of a surface, for example a roof 191 of a house appearing in the retrieved image 153. Thus there is no need to physically visit the installation site to make measurements and perform sizing calculations.

137. Id. at [0058]; see also id. at [0110] ("***To size surface 1215 user 507 superimposes sizing tool***, in this example tool 1117 (illustrated in Fig. 11) of at least a portion of image 1215…in some embodiments, information defining an orientation of shape 1215 with respect to a reference axis 1211 is generated by comparing orientation of adjusted tool 1107 to reference axis 1211.") (emphasis added). Kennedy discloses "***generating length and width measurements*** for a generally rectangular planar installation surface such as a side of a roof." *Id.* at [0082] (emphasis added); *see also* [0109], Fig. 12.

138. Kennedy discloses that the measuring tool can be used to determine the pitch of a roof. *Id.* at [0116] ("…measuring tool 1107 [can be] used to measure displacement of a ridge of roof 650 from base 635. The displacement information is used by modeling unit 591 (Fig. 5) to determine ***pitch*** of roof 600.") (emphasis added). Kennedy expressly teaches including the "pitch" dimension on its outline drawing, *e.g.*, in Fig. 36:

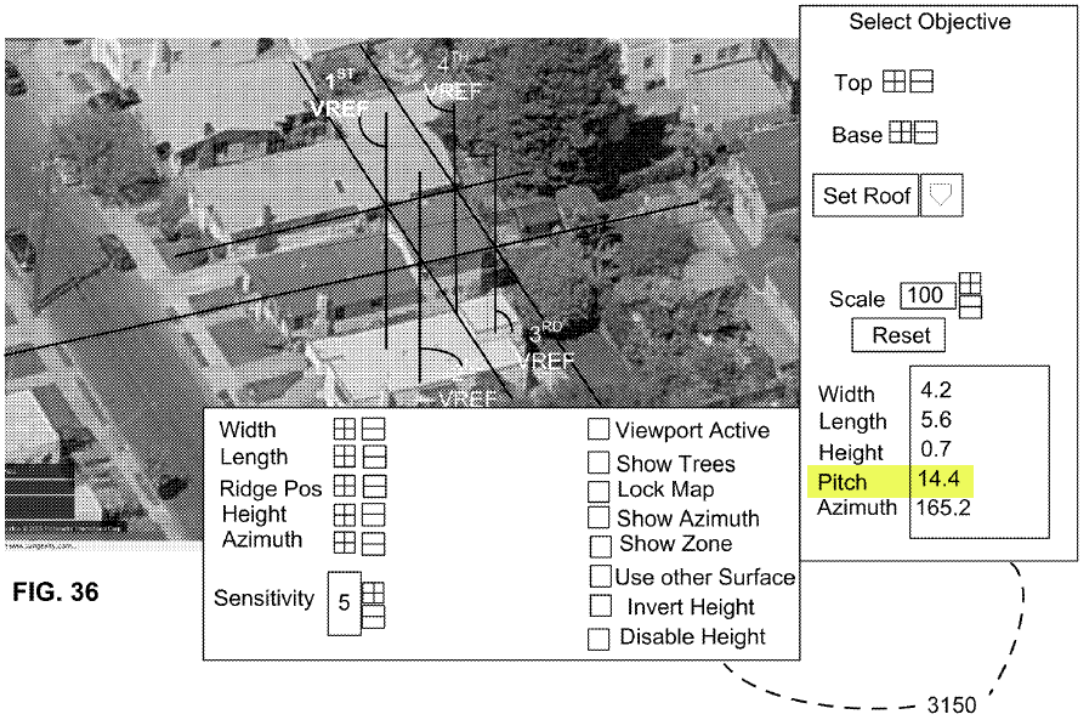


FIG. 36

Id. at Fig. 36 (annotated).

139. As discussed with respect to Ground 1, Bailey expressly discloses predominant pitch. A POSITA would have been motivated to include predominant pitch in Kennedy's system based on the teachings of Bailey as discussed above. *See* Section A.

4. Claim 1d

140. Kennedy teaches measuring the area dimension of a roof: "Referring now to FIG. 6, in order to ***measure an installation surface area***, such as a ***roof 640 area*** of house 600 in FIG. 6, user 507 ***positions measuring tool 1150 over an image of roof 600*** in alignment with a side of the image of

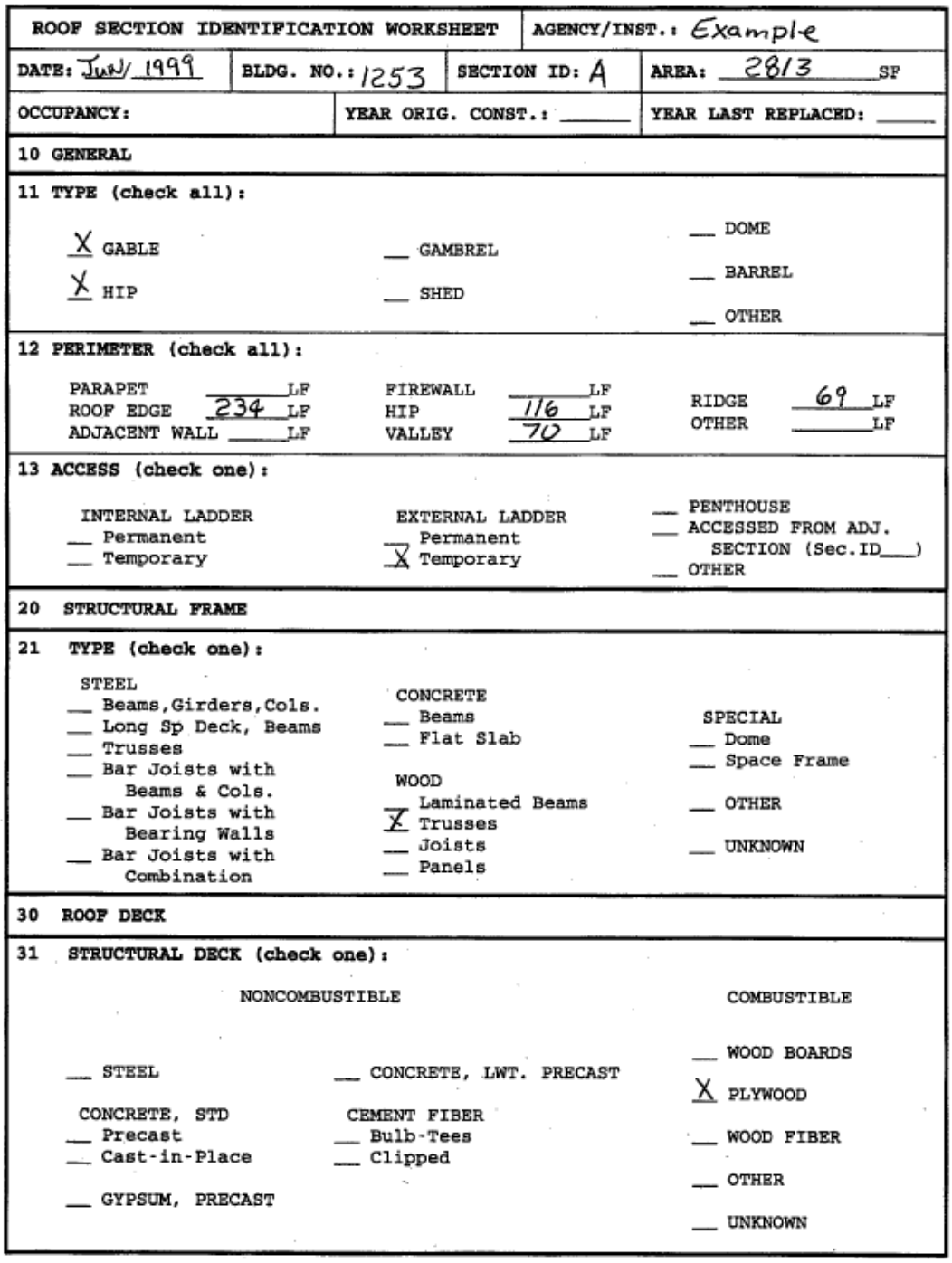
roof 600." Ex. 1009 at [0106] (emphasis added). Kennedy further calculates the pitch of a roof as part of its estimation as discussed above.

141. As discussed above, a POSITA would have been motivated to use Bailey's teaching of calculating the predominant pitch for use as Kennedy's "pitch" value. As taught by Bailey, the pitch is used in conjunction with the footprint of a roof to compute area. Ex. 1010 at 134-36.

5. Claim 1e

142. Kennedy teaches preparing a "quote" for customers based on the data collected. Ex. 1009 at ¶¶ 164, 169. Kennedy broadly teaches that "In one embodiment of the invention ***a quote for the displayed system is provided in association with the image of the system***." *Id.* at ¶ 169 (emphasis added). A POSITA would readily understand that such a quote would be a roof estimate ***report***.

143. In any case, as discussed above, a POSITA would be motivated to use Kennedy's roof estimation software to generate a report for a customer based on the teachings of Bailey. Bailey is directed at providing instructions for collecting "roofing inventory" in connection with maintenance and repairs. Ex. 1010 at 1. Bailey expressly teaches that, once roofing data (such as pitch and length) are calculated, that data should be included in a report—examples are shown in Figures 4 and 10 below:



ROOF SECTION IDENTIFICATION WORKSHEET | AGENCY/INST.: Example

DATE: Jun/ 1999 | BLDG. NO.: 1253 | SECTION ID: A | AREA: 2813 SF

OCCUPANCY: | YEAR ORIG. CONST.: _____ | YEAR LAST REPLACED: _____

10 GENERAL

11 TYPE (check all):

- [X] GABLE
- [X] HIP
- [ ] GAMBREL
- [ ] SHED
- [ ] DOME
- [ ] BARREL
- [ ] OTHER

12 PERIMETER (check all):

PARAPET	____ LF	FIREWALL	____ LF	RIDGE	69 LF
ROOF EDGE	234 LF	HIP	116 LF	OTHER	____ LF
ADJACENT WALL	____ LF	VALLEY	70 LF		

13 ACCESS (check one):

- INTERNAL LADDER: [ ] Permanent [ ] Temporary
- EXTERNAL LADDER: [ ] Permanent [X] Temporary
- [ ] PENTHOUSE
- [ ] ACCESSED FROM ADJ. SECTION (Sec.ID___)
- [ ] OTHER

20 STRUCTURAL FRAME

21 TYPE (check one):

STEEL
- [ ] Beams,Girders,Cols.
- [ ] Long Sp Deck, Beams
- [ ] Trusses
- [ ] Bar Joists with Beams & Cols.
- [ ] Bar Joists with Bearing Walls
- [ ] Bar Joists with Combination

CONCRETE
- [ ] Beams
- [ ] Flat Slab

WOOD
- [ ] Laminated Beams
- [X] Trusses
- [ ] Joists
- [ ] Panels

SPECIAL
- [ ] Dome
- [ ] Space Frame
- [ ] OTHER
- [ ] UNKNOWN

30 ROOF DECK

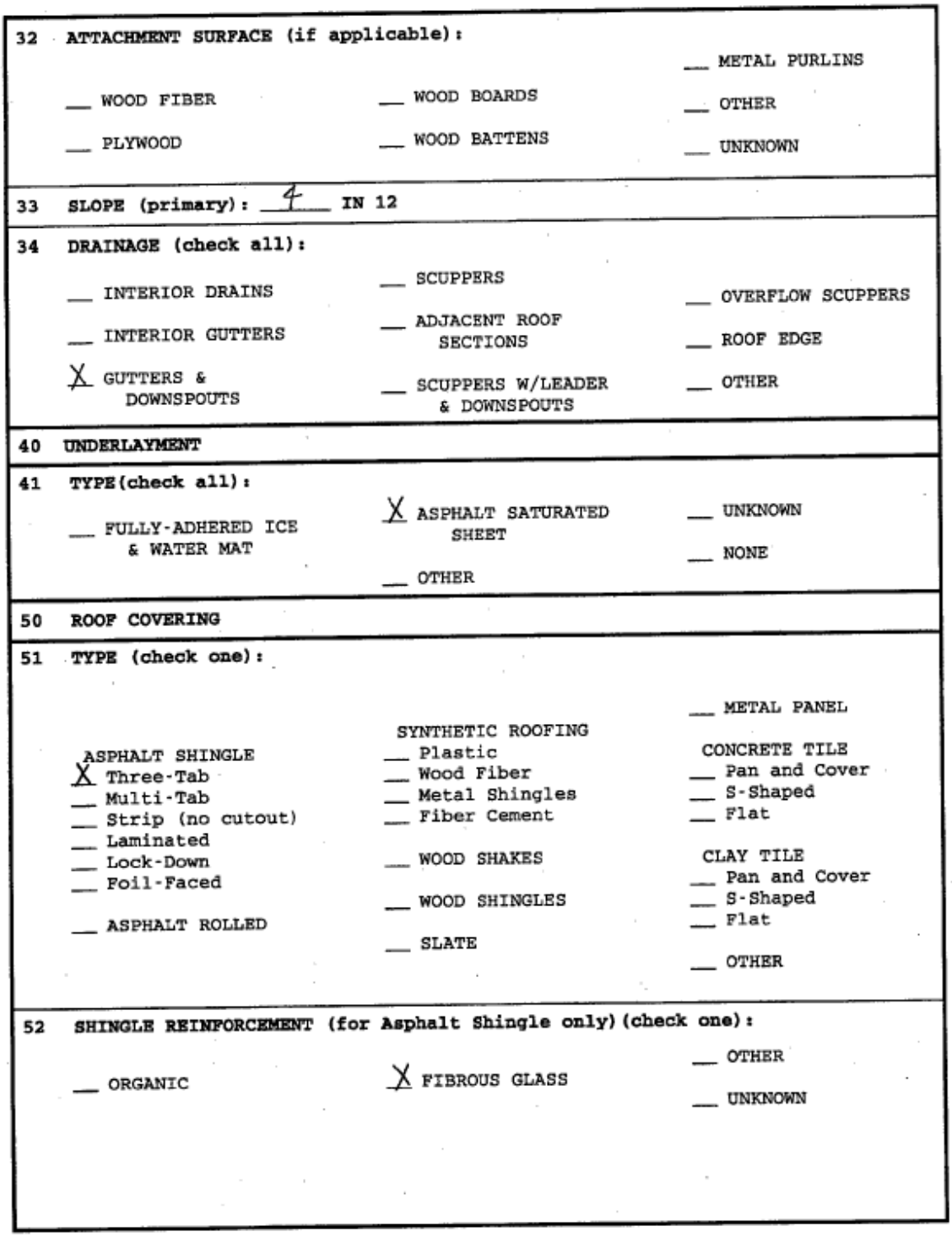
31 STRUCTURAL DECK (check one):

NONCOMBUSTIBLE
- [ ] STEEL
- [ ] CONCRETE, LWT. PRECAST
- CONCRETE, STD: [ ] Precast [ ] Cast-in-Place
- CEMENT FIBER: [ ] Bulb-Tees [ ] Clipped
- [ ] GYPSUM, PRECAST

COMBUSTIBLE
- [ ] WOOD BOARDS
- [X] PLYWOOD
- [ ] WOOD FIBER
- [ ] OTHER
- [ ] UNKNOWN

Figure 4. Completed Roof Section Identification Worksheet.

Ex. 1010 at Fig. 4 (Part 1).



32 ATTACHMENT SURFACE (if applicable):

__ WOOD FIBER
__ PLYWOOD
__ WOOD BOARDS
__ WOOD BATTENS
__ METAL PURLINS
__ OTHER
__ UNKNOWN

33 SLOPE (primary): 4 IN 12

34 DRAINAGE (check all):

__ INTERIOR DRAINS
__ INTERIOR GUTTERS
X GUTTERS & DOWNSPOUTS
__ SCUPPERS
__ ADJACENT ROOF SECTIONS
__ SCUPPERS W/LEADER & DOWNSPOUTS
__ OVERFLOW SCUPPERS
__ ROOF EDGE
__ OTHER

40 UNDERLAYMENT

41 TYPE (check all):

__ FULLY-ADHERED ICE & WATER MAT
X ASPHALT SATURATED SHEET
__ OTHER
__ UNKNOWN
__ NONE

50 ROOF COVERING

51 TYPE (check one):

ASPHALT SHINGLE
X Three-Tab
__ Multi-Tab
__ Strip (no cutout)
__ Laminated
__ Lock-Down
__ Foil-Faced
__ ASPHALT ROLLED

SYNTHETIC ROOFING
__ Plastic
__ Wood Fiber
__ Metal Shingles
__ Fiber Cement
__ WOOD SHAKES
__ WOOD SHINGLES
__ SLATE

__ METAL PANEL

CONCRETE TILE
__ Pan and Cover
__ S-Shaped
__ Flat

CLAY TILE
__ Pan and Cover
__ S-Shaped
__ Flat

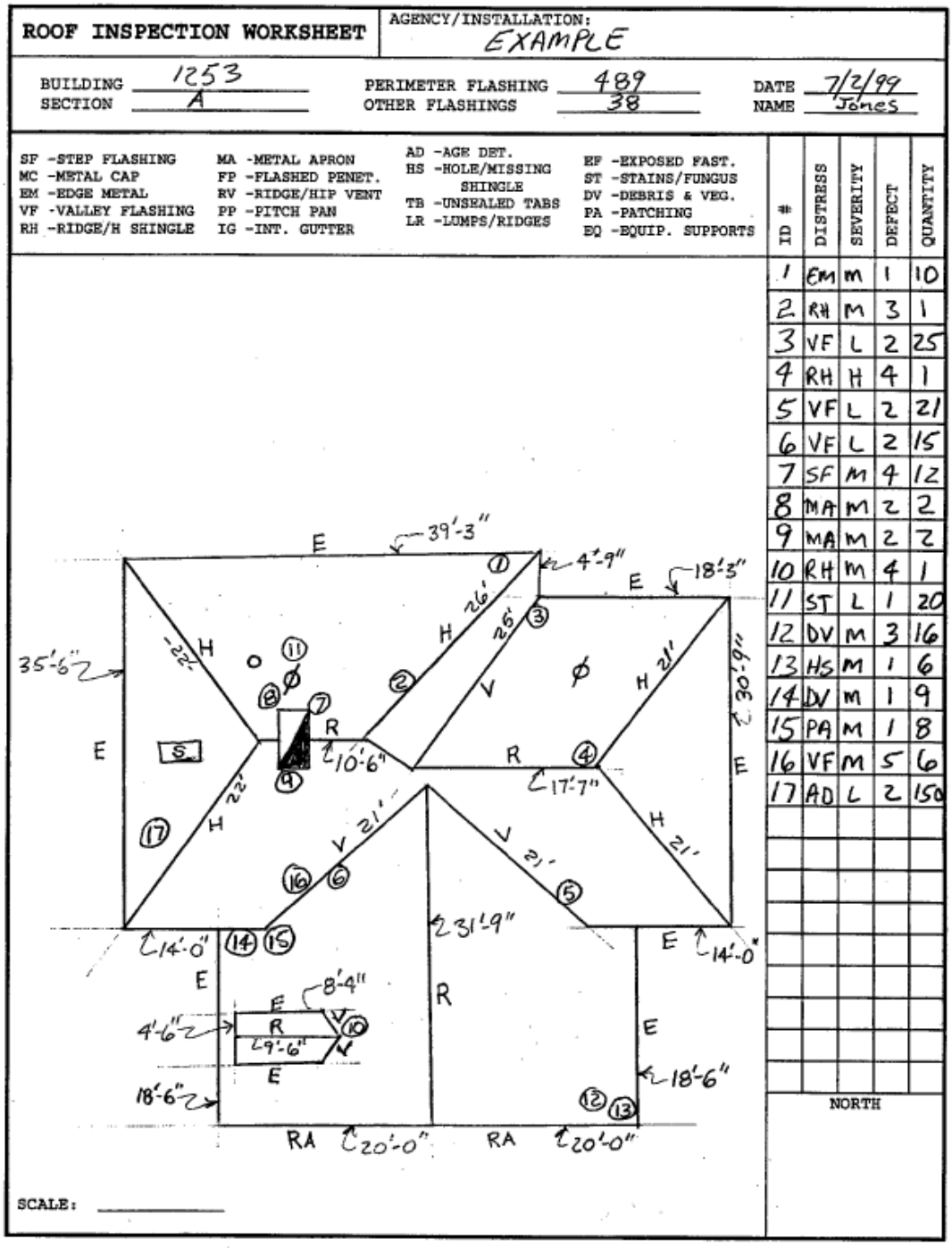
__ OTHER

52 SHINGLE REINFORCEMENT (for Asphalt Shingle only) (check one):

__ ORGANIC
X FIBROUS GLASS
__ OTHER
__ UNKNOWN

Figure 4 (continued). Completed Roof Section Identification Worksheet.

Ex. 1010 at Fig. 4 (Part 2).



ID #	DISTRESS	SEVERITY	DEFECT	QUANTITY
1	EM	M	1	10
2	RH	M	3	1
3	VF	L	2	25
4	RH	H	4	1
5	VF	L	2	21
6	VF	L	2	15
7	SF	M	4	12
8	MA	M	2	2
9	MA	M	2	2
10	RH	M	4	1
11	ST	L	1	20
12	DV	M	3	16
13	HS	M	1	6
14	DV	M	1	9
15	PA	M	1	8
16	VF	M	5	6
17	AD	L	2	150

Figure 10. Completed Roof Inspection Worksheet.

144. Ex. 1010 at Fig. 10. A POSITA would be motivated based on Bailey to generate a report for its customers for the same reasons.

C. Claim 2

145. Kennedy discloses "the one or more non-transitory computer readable medium storing a set of computer executable instructions for running on one or more computer systems of claim 1." *See* claim 1, *supra*.

146. Kennedy discloses "one or more computer systems to determine contact information of one or more contractors within a region of interest of the geographic location of the roof." Kennedy teaches a "contractor database 113" which stores contractor information which can be accessed by a customer:

> Some embodiments of the invention include a ***contractor database 113***. In that case, ***contractor database 113 stores information, including for example, contractor location, qualifications, availability etc. related to contractors*** and installation support personnel. In that manner some embodiments of system 100 enable a ***user 107 to interact with GUI 200 to select a contractor*** to install an energy system procured using system 100.

147. Ex. 1009 at [0074] (emphasis added). Accordingly, Kennedy discloses this limitation.

148. As discussed with respect to claim 1, Bailey teaches providing a "roof report." *See* claim 1, *supra*.

149. Kennedy and Bailey render obvious "wherein the roof report includes one or more ortho images of the roof one or more oblique images of the roof, the estimated roofing area and the contact information of one or more contractor within the region of interest of the geographic location of the roof." In particular, as discussed above, it would have been obvious in view of Bailey to generate a roof report using the data collected by Kennedy. Kennedy teaches that its system collects and display the claimed "ortho" image of a roof (*i.e.*, an overhead view) as shown, for example, in Figure 35:

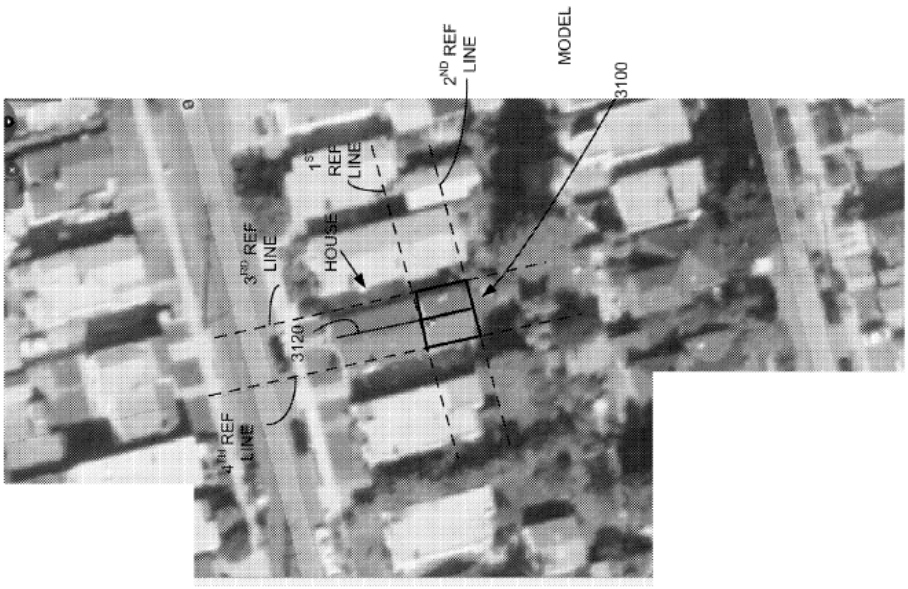


FIG. 35

150. Ex. 1009 at Fig. 35, [0041] ("***FIG. 35 illustrates a top plan view of a roof*** to be sized as the roof appears in an image obtained from a geographical information service (GIS) and further illustrating reference lines

for generating a model in accordance with an embodiment of the invention.") (emphasis added).

151. Likewise, Kennedy also teaches collecting the claimed "oblique image" of a roof for display, as shown, for example, in Figure 36:

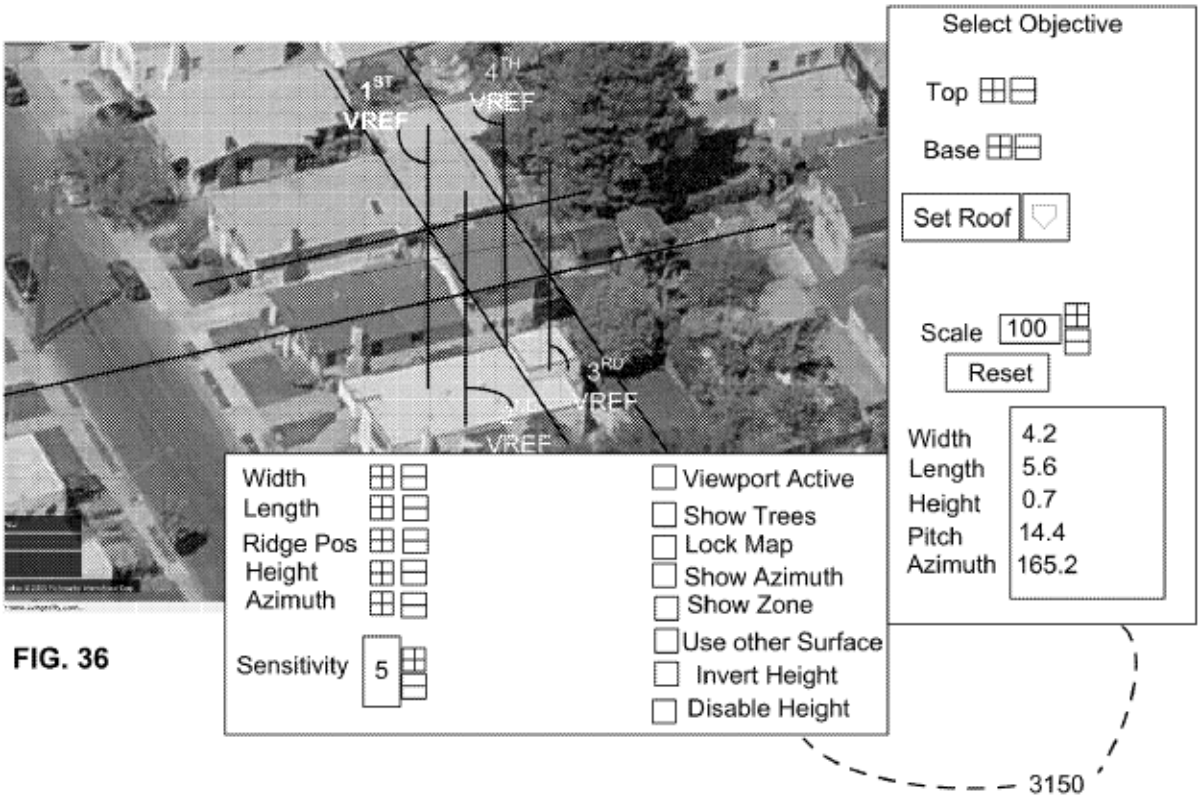


FIG. 36

Id. at [0042], [0189] (referring to Fig. 36 as a "perspective[2]" view).

152. As discussed with respect to claim 1, it would have been obvious to include area in Kennedy's report based on Bailey. *See* claim 1, *supra*.

153. Finally, as discussed above, Kennedy teaches collecting contact information for contractors in an area of interest. A POSITA would have been motivated to include all of Kennedy's collected data in a roof report based on Bailey for the reasons discussed above.

D. Claim 3

154. Kennedy and Bailey render obvious wherein the roof report includes contact information of the customer. Kennedy teaches that its system includes a "customer database 103" which includes "a customer's information." Ex. 1009 at [0075]. Kennedy further teaches that its method includes contacting a customer with an offer. *Id.* at [0180]. It would have been, thus, obvious to include the customer contact information stored by Kennedy in a roofing report based on the teachings of Bailey for the reasons

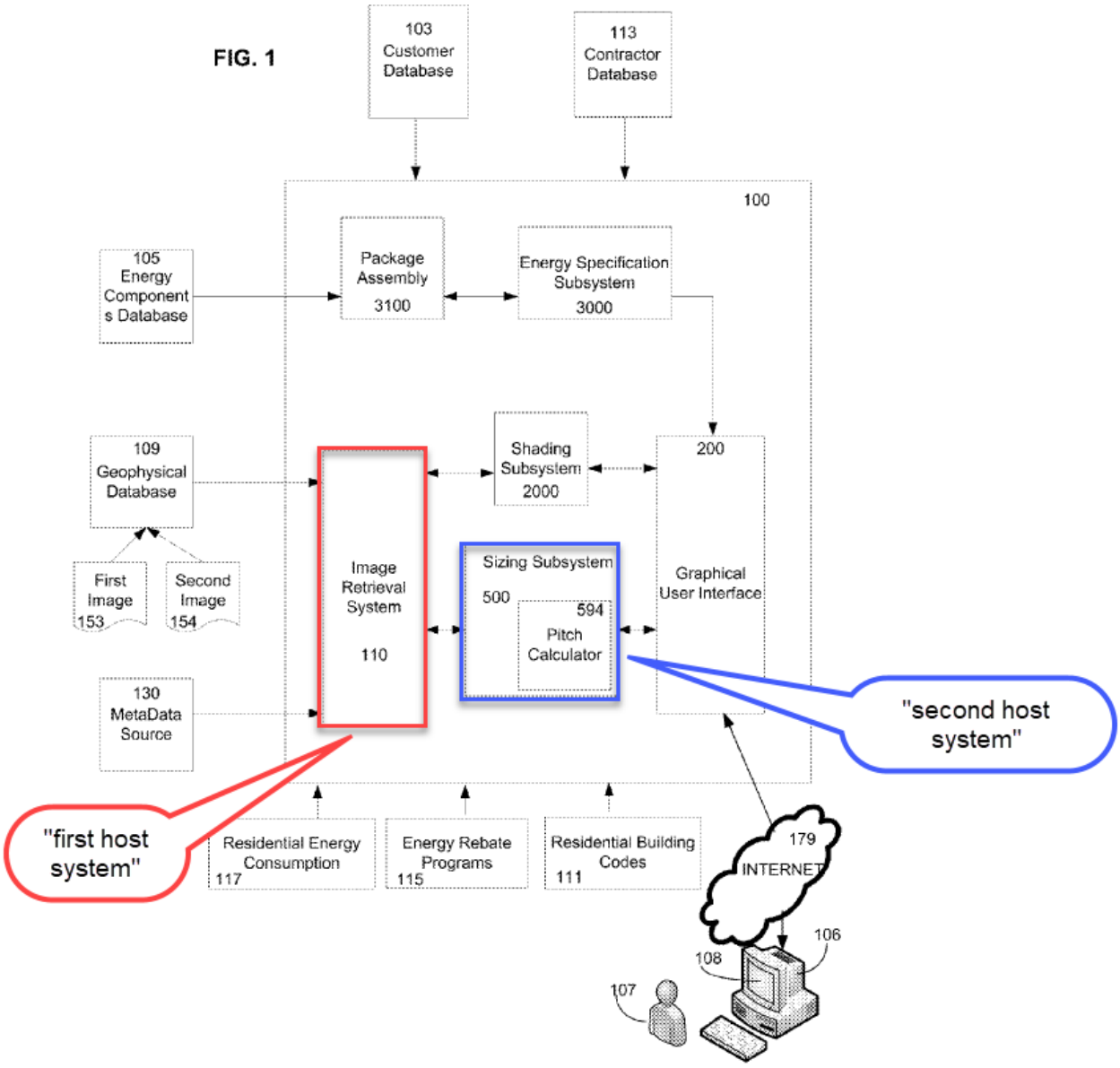
[2] Kennedy equates "oblique" view with "perspective" view. *Id.* at [0186] ("FIG. 34 illustrates ***a perspective view, i.e., an oblique view***, of a structure 5 including the roof illustrated in FIGS. 32-33 above.") (emphasis added).

discussed above. Indeed, this would facilitate easy communication between a contractor reaching out to provide an offer to a customer.

E. Claim 4

155. As discussed with respect to Ground 1, the '538 patent broadly discloses that "[g]enerally, the first host system 102 may include one or more processors 108 capable of executing a first set of processor executable code and the second host system 126 may include one or more processors 128 capable of executing a second set of processor executable code." Ex. 1001 at 5:35-41. Thus, at least one example of a host system includes a system with a processor capable of executing a set of processor executable code.

156. Kennedy discloses multiple host systems. In particular, Kennedy teaches a plurality of "subsystems" used to, *e.g.*, calculate the size of the roof, calculate the pitch of the roof and retrieve images of the roof from a database. Ex. 1009 at [0050] ("System 100 comprises a graphical user interface module 200 and at least one of an energy specification subsystem 3000, a ***sizing subsystem 500*** including a ***pitch calculator 594***, a shading subsystem 2000, an ***image retrieval subsystem 110*** and a package assembly subsystem 3100.") (emphasis added). These subsystems—each of which are a "host system" are shown, for example, in Figure 1:



Id. at Fig. 1 (annotated).

157. While exemplary Figure 1 depicts Kennedy's "subsystems" (*i.e.*, "host entities") as housed within system 100, Kennedy teaches that its subsystems may also stand alone and communicate with each other ***remotely***. *Id.* at [0052] ("Other embodiments of the invention are configured for ***wireless*** or wired internet communication between subsystems of system 100."). For

example, Kennedy's image retrieval subsystem 110 communicates with an image source to retrieve images. *Id*. at [0059]-[0060]. Separately, sizing subsystem 500 may be "coupled for communication, for example, via the Internet 179" with the image retrieval subsystem 110 and computes roof attributes (such as pitch). *Id.* at [0065]-[0067]. Kennedy teaches that its system may use "commercially available processors" and "memory modules." *Id.*at [0051]. Non-volatile memory is one type of "memory module," and, thus, Kennedy teaches two "host entities" with non-volatile memory.

F. Claim 5

158. Kennedy teaches that in "reverse geo coding" a customer's "textual location such as a street address" can be found "based on geographic coordinates." Ex. 1009 at [0063]. A customer's address is one type of contact information of a customer, which Kennedy identifies through its "geographic location of the roof." Accordingly, Kennedy teaches this claim.

G. Claim 8

159. Kennedy teaches that identifying a geographic location of the roof includes identifying one or more edges of the roof in an image:

> FIGS. 6 and 9 illustrate respectively a perspective view and a side elevation view of a "real world" surface to be measured wherein the surface comprises a roof 600. Roof 600 is defined by roof side surfaces 640 and 641 (641 not visible in FIG. 6). As seen in FIG. 6 ***roof surface 640 is defined by parallel side edges 631 and 731 and parallel side edges 630 and 730***. Roof side

> surfaces 640 and 641 meet to form a roof ridge 641. Roof ridge 641 is elevated with respect to a bottom side surface edge 630. The elevation of roof ridge 641 with respect to ***bottom edge 630*** is represented by dimension H. A roof span of 600 is indicated as B. Roof 600 is oriented in FIG. 6 as indicated by axes 670. In FIG. 9 orientation of roof 600 is indicated at 970.
>
> Ex. 1009 at [0087] (emphasis added).

H. Claim 9

160. Kennedy discloses "one or more non-transitory computer readable medium storing a set of computer executable instructions for running on one or more computers systems of claim 1, as discussed with respect to claim 1." *See* claim 1, *supra*.

161. Kennedy further teaches that its system identifies "edges of the roof" as discussed with respect to claim 8. *See* claim 8, *supra*.

162. Kennedy further teaches that its system determines "three-dimensional information of the edges including position, orientation and length":

> FIGS. 6 and 9 illustrate respectively a perspective view and a side elevation view of a "real world" surface to be measured wherein the surface comprises a roof 600. Roof 600 is defined by roof side surfaces 640 and 641 (641 not visible in FIG. 6). As seen in FIG. 6 ***roof surface 640 is defined by parallel side edges 631 and 731 and parallel side edges 630 and 730***. Roof side surfaces 640 and 641 meet to form a roof ridge 641. Roof ridge 641 is elevated with respect to a bottom side surface edge 630. ***The elevation of roof ridge 641 with respect to bottom edge 630 is represented by dimension H.*** A roof span of 600 is indicated

as B. Roof 600 is oriented in FIG. 6 as indicated by axes 670. In FIG. 9 ***orientation of roof 600 is indicated at 970***.

Ex. 1009 at [0087] (emphasis added).

163. Kennedy also teaches that the roof "edges" which "defin[e]" a roof are used to calculate roof size. *Id.* at [0182] ("The roof 3110 is defined by four lateral side edges…and a ridge."). Kennedy teaches that edges can be used as "reference lines" to measure the size of a roof. *Id.* at [0183]-[0184]. Kennedy makes clear that the term "sizing" refers to "obtaining or generating length and width measurements[.]" *Id.* at [0082]. Accordingly, Kennedy teaches determining edge position (*e.g.*, by identifying the location of parallel edges 630 and 730), orientation (*e.g.*, through identifying the orientation of roof 600) and length (*e.g.*, through roof sizing).

164. Kennedy teaches that this three-dimensional information is calculated based on multiple roof images, as required by claim 9. *Id.* at [0080]-[0082] ("In other embodiments of the invention, for example, for embodiments relying on 3-dimensional models, more than one image is retrieved from a source of images…The site dimensions are determined by analyzing the images obtained[.]"

165. As discussed with respect to claim 2, Kennedy also teaches obtaining "oblique" images. *See* claim 2, *supra*. Accordingly, the multiple images used by Kennedy include oblique images.

166. Because these images are taken using real-world satellite imagery, they are "oblique images from multiple cardinal directions."

167. As discussed with respect to claim 1, Kennedy teaches that this information is also used to compute a "footprint" as required by claim 9.

I. Claim 10

168. Bailey discloses this claim for the same reasons discussed with respect to Ground 1. *See* Ground 1 at claim 10, *supra*.

J. Claim 11

169. Bailey discloses this claim for the same reasons discussed with respect to Ground 1. *See* Ground 1 at claim 11, *supra*.

K. Claim 12

170. Kennedy and Bailey render this claim obvious. Bailey expressly teaches providing a report, *e.g.*, for use by contractors in repair. *See* claim 1. It would have been obvious to provide a report to contractors using Kennedy's system based on the teachings of Bailey. Indeed, this is consistent with the Bailey's disclosure that the invention is meant to provide, *inter alia*, "contractors" with "tools and resources for gathering site specific information[.]" Ex. 1009 at [0008].

L. Claim 13

1. Claim 13a

171. *See* claims 1, 4.

2. Claim 13b

172. *See* claims 1, 4.

3. Claim 13c

173. *See* claim 1.

4. Claim 13d

174. *See* claims 1, 2.

5. Claim 13e

175. *See* claim 1, 4.

6. Claim 13f

176. *See* claim 1c.

7. Claim 13g

177. *See* claim 1d.

8. Claim 13h

178. *See* claims 1, 2.

XII. GROUND 4: KENNEDY AND BAILEY IN FURTHER VIEW OF ABHYANKER RENDER OBVIOUS CLAIMS 6-7 AND 14-18 OF THE '538 PATENT

179. Ground 4 relies on the same combination of Kennedy and Bailey discussed in Ground 3 but adds the additional disclosure of Abhyanker to address the additional limitations of claims 6-7 and 14-18 (requiring various user input).

A. Motivation To Combine Kennedy, Bailey and Abhyanker

180. For the same reasons discussed above, a POSITA would have been motivated to combine the teachings of Kennedy and Bailey. A POSITA would have been motivated by the teachings of Abhyanker to allow users of Kennedy's roofing system the option to specifically designate the geographic position of a roof to be analyzed, and to include a subsequent user confirmation option to ensure that the correct roof is being analyzed. There are a variety of reasons a POSITA would be motivated to use these teachings from Abhyanker in Kennedy, including the same reasons discussed with respect to Ground 2 (Pershing-789 and Abhyanker).

181. A POSITA would have been motivated by the teachings of Abhyanker to allow users of Kennedy's roofing system the option to specifically designate the geographic position of a roof to be analyzed using a marker, and to include a subsequent user confirmation option to ensure the correct roof is being analyzed. There are a variety of reasons a POSITA would be motivated to apply these teachings from Abhyanker to Kennedy.

182. For example, allowing a user to designate a geographic position of a roof and to subsequently confirm that the roof location is correct would promote the ***accuracy of the system***. Abhyanker's teachings expressly address this motivation. Abhyanker discloses that automated systems used to

pinpoint geographic locations (like Kennedy's) are not always 100% accurate, and mistakes will result in user disappointment. Ex. 1005 at [0004]-[0005]. That is especially true here: if Kennedy's system inadvertently marked a neighboring roof (or a roof with the same address in a different state or town), the resulting materials estimate would be incorrect. This would cost both the user and the service provider time and money (and would potentially cost the software provider business). Thus, it would have been obvious to include Abhyanker's teachings of allowing a user to place a "marker" on the roof in question and to affirmatively "confirm" the right selection was made. This accuracy check would ***save money***, ***save time*** and ***avoid customer losses***.

183. In addition, applying Abhyanker's teachings to Kennedy's system would also ***add convenience*** to a user. For example, if a user inadvertently input a neighbor's address it would be convenient to allow the user to apply a drag-and-drop feature, like that taught by Abhyanker, to correct this error by simply sliding the marker to the correct location. This would also add to the convenience for users who may have difficulties typing or reading smaller print in the form fields in a screen—dragging a colored "marker" would assist such users in marking the right roof.

184. As explained above, Kennedy and Bailey are in the same field of endeavor as the '538 patent, use similar techniques to solve the same problems

as the '538 patent and their combination would result in a reasonable expectation of success. Similarly, a POSITA would have been motivated to combine the teachings of Kennedy and Abhyanker because they are in the ***same field of endeavor*** as the '538 patent. Both Kennedy and the '538 patent are directed towards systems that locate and measure roof dimensions to estimate costs for repair or replacement. Ex. 1001 at Abstract; Ex. 1009 at Abstract. Similarly, Abhyanker is broadly directed towards accurate placement of markers in a "mapping environment," like the ones used in the Kennedy and '538 patent systems. Ex. 1005 at Abstract, [0012]. Further, Kennedy, Abhyanker and the '538 patent all user ***similar techniques to solve the same problems***. As discussed below, Kennedy uses the same techniques to locate roofs and measure their dimensions as the '538 patent, and Abhyanker uses the same techniques to ensure accurate roof placement. A POSITA would also have a ***reasonable expectation of success*** in including the teachings of Abhyanker in Kennedy. Abhyanker's teachings confirm that user confirmation options in "mapping environments" such as Kennedy's were well known, and Kennedy specifically teaches that its system can be used the same context—locating roofs. Ex. 1005 at [0012]. Accordingly, Abhyanker itself would motivate a POSTIA to apply its teachings of user confirmation steps to improve Kennedy's system.

B. Claim 6

185. Abhyanker teaches this limitation for the same reasons discussed with respect to Ground 1. *See* Ground 1 at claim 6, *supra*.

C. Claim 7

186. Abhyanker teaches this limitation for the same reasons discussed with respect to Ground 1. *See* Ground 1 at claim 7, *supra*.

D. Claim 14

1. Claim 14a

187. *See* claim 1, 6.

2. Claim 14b

188. *See* claim 1.

3. Claim 14c

189. *See* claim 1.

4. Claim 14d

190. *See* claim 1.

E. Claim 15

191. *See* claim 2.

F. Claim 16

192. *See* claim 2.

G. Claim 17

193. As discussed with respect to claim 1 in Ground 3, the footprint of the roof may be represented by the roof's boundary lines. *See* Ground 3, claim 1. Any pitch value estimation must necessarily account for these boundary lines in order to estimate the pitch from peak to edge. Accordingly, the proposed combination renders obvious this limitation for the same reasons discussed with respect to claim 1 in Ground 1.

H. Claim 18

194. *See* claim 11, Ground 1 claim 18.

195. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on January 3, 2023, in Springfield, VA.

/s/ Tony Cummings
Tony Cummings

Tony L Cummings, AIA, CSI

Construction Forensics, Inc. - President

Registrations & Certifications

Vermont, New Hampshire, Massachusetts, Maine, Rhode Island, Connecticut, New York, Delaware, Pennsylvania, Maryland, Virginia, N Carolina, S Carolina, Tennessee, Missouri, Oklahoma, Florida, Texas, Colorado, Montana, Oregon.
*Contact CFI for license status
National Council of Architectural Registration Boards
OSHA 10-hour Construction Safety and Health Training
California Office of Emergency Services Safety Assessment Program Evaluator
Infraspection Institute – Level II Certified Infrared Thermographer

Education

Bachelor of Architecture – Kansas State University

Professional Service Organizations

Member – American Institute of Architects (AIA)
Member – Construction Specifications Institute (CSI)
Member – International Code Council (ICC)
Member – National Fire Protection Association (NFPA)
Member – International Institute of Building Enclosure Consultants (IIBEC)
Member – National Institute of Building Science (NIBS)
Member – Society of American Value Engineering (SAFE)
Member – American Society of Professional Estimators (ASPE)

Lectures, Seminars & Publications

"Mitigating Moisture Intrusion": Oregon Washington Community Association Managers
"Construction Defects & Forensic Applications": Build Virginia Mid-Atlantic Conference
"Construction Defects & How to Avoid Them": Commercial Builder/Architect Magazine
"The Use of Experts": Community Association Institute, National Law Review
"Preserving & Protecting Your Investment": Various Condominium Associations
"Making the Complex Simple - How To Keep The Jury Awake": Insurance Adjusters
"Failure to Plan – What Could Possibly Go Wrong": KSU College of Architecture
"Failure to Plan – What Could Possibly Go Wrong": Kansas Chapter AIA

Professional History

Construction Forensics, Inc.

Founded in 1990 in Virginia, Mr. Cummings is president of CFI, a consulting firm specializing in analyzing and investigating construction disputes. CFI has performed forensic investigations in 16 states, for plaintiffs and defendants to include: code review and conformance, failure analysis of building systems and components, claims analysis, material and workmanship evaluations, Standard of Care for design professionals and contractors, CPM schedule analysis, cost estimating, and the suitability of plans and specifications. Mr. Cummings has qualified as an expert and provided testimony numerous times in 9 states and the Federal Contractor Board of Appeals. Experience as an architect and contractor offers a unique perspective when assessing construction disputes and forensic evaluations. Previously named one of two forensic experts for the State of Tennessee Board of Architecture and Engineering to evaluate Standard of Care claims against architects brought before the Board.

High Point Schaer, Senior Consultant

Mr. Cummings served as Senior Consultant in the Forensic Analysis Department of High Point Schaer (HPS) Florida office. HPS was an international construction-consulting arm of the High Point/Rendel Group. Responsibilities included the analysis and forensic evaluation of numerous defective construction claims related to Florida's condominium market. In addition to forensic investigations, Mr. Cummings provided expert testimony on claims of faulty construction, improper maintenance, moisture intrusion, material failures, and A/E professional standard of care.

Bill Strong Enterprises

Mr. Cummings was hired to head the estimating department of six estimators for the general contracting firm specializing in DOD military base housing throughout the United States. Mr. Cummings was the lead estimator for a ten-million-dollar multi-family housing rehab project at the Naval War College in Newport, RI. Contract requirement resulted in Mr. Cummings becoming the on-site quality control representative responsible for reviewing shipments received, daily documentation of work performed, evaluation of workers, and workmanship.

TL Cummings & Associates

Mr. Cummings owned a full-service architectural firm in Colorado Springs, Colorado. Services included conceptual design development, land planning, the architectural design for residential, multi-family, commercial, industrial, hospitality, shopping plazas, offices, and financial institutions. Responsible for initial design and specifications, reviewing all documents issued by this office, and supervising drafting staff. Mr. Cummings provided a forensic evaluation and expert testimony for claims of faulty construction to an underground parking garage.

DANAC, Inc.

Mr. Cummings began as an estimator and one of the four individuals in the establishment of western division of this general contracting firm specializing in DOD military base housing. Located in Colorado Springs, Colorado, DANAC was an arm of Danish Arctic Contractors (DAC), a firm specializing in construction and services to military installations worldwide. Mr. Cummings was one of two estimators responsible for reviewing contract documents suitability for construction, evaluation errors and ambiguities in the drawings, and preparing cost estimates for competitive bidding. Mr. Cummings became head of estimating, overseeing six additional estimators, coordinating and reviewing all estimates before they were released. DANAC was responsible for renovating over 2,000 multi-family living units in numerous locations around the United States, Bachelor Enlisted Quarters, and a prototype day-care center at the Air Force Academy. During my employment at DANAC, we also performed a design/build joint venture of 100 multi-family housing units at Guantanamo Bay, Cuba.