Trials@uspto.gov
571-272-7822

Paper 28
Entered: December 14, 2023

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

NEARMAP US, INC.,
Petitioner,

v.

EAGLE VIEW TECHNOLOGIES, INC.,
Patent Owner.

IPR2022-01009
Patent 8,670,961 B2

Before THOMAS L. GIANNETTI, GARTH D. BAER, and RUSSELL E. CASS, *Administrative Patent Judges.*

CASS, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. Background

In this *inter partes* review, Nearmap US, Inc. ("Petitioner") challenges the patentability of claims 1, 2, 7, 8, 21, 22, 24, 25, 27, and 29 (the "challenged claims") of U.S. Patent No. 8,670,961 B2 (Ex. 1001, "the '961 patent"), which is assigned to Eagle View Technologies, Inc. ("Patent Owner").

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision, issued pursuant to 35 U.S.C. § 318(a), addresses issues and arguments raised during the trial in this *inter partes* review. For the reasons discussed below, Petitioner has proven by a preponderance of the evidence that claims 1, 2, 7, 8, 21, 22, 24, 25, 27, and 29 are unpatentable.

B. Procedural History

Petitioner relies upon the following references:

> R.M. Littleworth et al., *Three-Dimensional Mapping and As-Built Computer Modelling by Analytical Photogrammetry*, International Archives of Photogrammetry and Remote Sensing 29 (1992)[1] (Ex. 1005, "Littleworth");
>
> Mark Middlebrook, *AutoCAD 2005 for Dummies*, Wiley Publishing (May 13, 2004) (Ex. 1006, "Middlebrook"); and
>
> Linder, *Digital Photogrammetry Theory and Applications*, Springer-Verlag (2003) (Ex. 1012, "Linder").[2]

[1] Petitioner's identification information for Littleworth is provided here. Pet. iii. The evidence relating to the publication of Littleworth is discussed in Section II.D.1(b) below.

[2] Petitioner's identification information for Linder is provided here. Pet. iii. The evidence relating to the publication of Linder is discussed in Section II.E.2(b) below.

Petition ("Pet.") iii, 3. Petitioner submits declarations from Dr. David A. Forsyth (Exs. 1003, 1028), June Ann Munford (Exs. 1019, 1037), and Karina Silverstein (Ex. 1038). Patent Owner submits declarations from Chandrajit Bajaj, Ph.D. (Exs. 2001, 2010) and Dr. James L. Mullins (Ex. 2020).

Petitioner challenges the patentability of claims 1, 2, 7, 8, 21, 22, 24, 25, 27, and 29 of the '961 patent based on the following ground:

Claims Challenged	35 U.S.C. §	References/Basis
1, 2, 7, 8, 21, 22, 24, 25, 27, and 29	103(a)[3]	Littleworth, Linden, Middlebrook

Pet. 3. Patent Owner filed a Preliminary Response. Paper 6 ("Prelim. Resp."). We instituted trial on all grounds of unpatentability. Paper 7 ("Inst. Dec."), 52.

During the trial, Patent Owner filed a Response (Paper 11, "PO Resp."), Petitioner filed a Reply (Paper 16, "Pet. Reply"), and Patent Owner filed a Sur-reply (Paper 22, "PO Sur-reply").

An oral hearing was held on September 21, 2023, a transcript of which appears in the record. Paper 27 ("Tr.").

C. Real Parties in Interest

Petitioner states that Nearmap US, Inc. is the real party in interest. Pet. 1, 67. Patent Owner states that the real parties in interest are Eagle

[3] The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) ("AIA"), included revisions to 35 U.S.C. § 103 that became effective after the filing of the application that led to the '961 patent. Therefore, we apply the pre-AIA version of 35 U.S.C. § 103.

View Technologies, Inc. and Pictometry International Corp., which are both subsidiaries of EagleView Technology Corporation. Paper 4, 2.

D. Related Proceedings

The parties state that the '961 patent is the subject of the following civil action between *Nearmap and Eagle View Technologies*: *Eagle View Technologies v. Nearmap US*, No. 2-21-cv-00283 (D. Utah). Pet. 68; Paper 4, 2. The parties also state that the '961 patent is the subject of the following civil actions bright by Eagle View Technologies against other parties: *Eagle View Technologies, Inc. v. GAF Materials LLC*, 2-22-cv-00215 (D. Utah), and *Eagle View Technologies, Inc. v. GAF Materials LLC*, 1-21-cv-10669 (D. New Jersey). *Id.*

E. The '961 Patent (Ex. 1001)

The '961 patent is directed to a "roof estimation system, which generates and provides roof estimate reports annotated with indications of the size, geometry, pitch and/or orientation of the roof sections of a building." Ex. 1001, code (57). The system can include "a roof estimating software program and a location-linked, image file database." *Id.* at 1:67–2:3. During use, "the physical address or location information of a building is provided to the program, which then presents aerial images of roof sections on the building at the specific address location." *Id.* at 2:4–7. The aerial images may be produced by "[a]n overhead aircraft, a balloon, or satellite," but also "may include images taken from a ground-based platform, such as a mobile ('street view') photography vehicle, a fixed position (e.g., a tower, nearby building, hilltop, etc.)." *Id.* at 2:7–10, 4:6–10. After the aerial images are received, "[a]n image analysis and calibration is then performed either manually and/or via a software program that determines the geometry,

the slopes, the pitch angles, and the outside dimensions of the roof sections." *Id.* at 2:8–14.

As shown in the embodiment of Figure 3 (reproduced below), the aerial images may be stored in aerial image files 54, which "typically include at least one top plan view 65 and a perspective view 66, also called in the prior art an oblique view or oblique perspective view, of [a] building." *Id.*, 4:10–15.

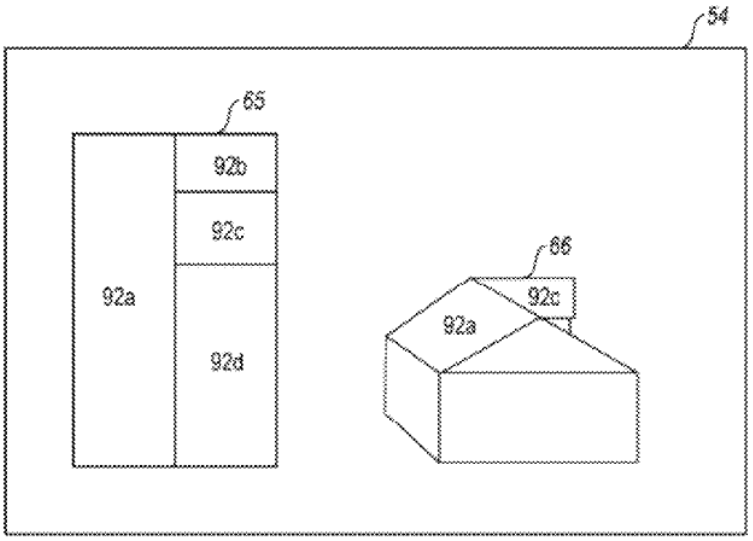


Fig. 3

In Figure 3, oblique perspective view 66 includes "[t]he roof of the building 92," which "includes multiple planar roof sections 92*a*–92*d*." *Id.* at 4:14–15.

In certain embodiments, the roof estimation system includes "roof modeling engine 602" that "generates a model of the roof of the specified building" and "report generation engine 603" that "generates a final roof estimate report based on a 3D model." Ex. 1001, 7:47–50, 8:19–20, 9:56–57. The report "typically includes one or more plan (top-down) views of the 3D model, annotated with numerical values for the slope, area, and/or

lengths of the edges of at least some of the plurality of planar roof sections of the 3D model of the roof." *Id*. at 9:59–62.

F. Illustrative Claim

Of challenged claims 1, 2, 7, 8, 21, 22, 24, 25, 27, and 29, claims 1, 21, 22, 24, and 29 are independent. Claims 1 and 7 are illustrative and are reproduced below.

> 1. [preamble] A computing system for generating a roof report, the computing system comprising:
>
> [1.1] a memory; and
>
> [1.2] a roof estimation module that includes a calibration module, the roof estimation module being stored on the memory and being configured, when executed, to:
>
> [1.3] receive a plurality of aerial images of a building having a roof, the plurality of aerial images having been taken independent of each other, at different times and on different dates,
>
> [1.4] the aerial images providing different views from each other of the roof of the building, the plurality of aerial images including at least a first aerial image that is a top plan view of the roof and a second aerial image that is an oblique perspective view of the roof"
>
> [1.5] wherein at least one of the first and/or second aerial images is calibrated using calibration information received from the calibration module;"
>
> [1.6] perform image analysis on at least two of the plurality of aerial images;
>
> [1.7] calculate a pitch for each one of a plurality of roof sections of the roof based on the image analysis;
>
> [1.8] generate a roof report that includes the pitch of each of the plurality of roof sections based on the calculated pitch; and output the roof report, wherein the roof report includes one or more top plan views of a model of the roof annotated with numerical values that indicate a

> corresponding pitch, area, and length of edges of at least some of the plurality of roof sections using at least two different indicia for different types of roof properties.
>
> 7. The computing system of claim 1 wherein the performing the image analysis includes correlating the first aerial image with the second aerial image.

Ex. 1001, 15:62–16:24 (indentation and bracketed paragraph identifiers added), 16:45–47.

II. DISCUSSION

A. Claim Construction

A claim "shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b)." 37 C.F.R. § 42.100(b). The parties propose constructions for several terms in the challenged claims, which we will discuss below.

1. "Pitch"

Petitioner argues that the term "pitch" should be construed to mean either "pitch" or "slope." Pet. 8. Petitioner asserts that, during prosecution, the applicant stated that prior versions of the claims "use[d] the word 'pitch' while other places use the word 'slope'" and that "[t]hese words ***have the same meaning in the context of these*** claims, however to avoid confusion, the term 'slope' [was] removed and replaced with the word 'pitch' throughout to maintain consistency." Pet. 8 (citing Ex. 1002, 76–77). Petitioner further argues that its construction is "supported by the '961 patent itself which treats the terms interchangeably." *Id.* (citing Ex. 1001, 1:52–67, 3:11–19, 4:19–30, 6:5–17, claims 1, 10, 16, 21–22, 24).

Patent Owner does not dispute Petitioner's proposed construction of "pitch" in its Patent Owner Response. *See* PO Resp.

Based on the full trial record, we agree with Petitioner that "pitch" should be construed to encompass "pitch" and "slope."

2. "Oblique perspective view"

Petitioner argues that the term "oblique perspective view" should "be construed so that it can refer to either a 'perspective view,' 'an oblique view,' or 'an oblique perspective view.'" Pet. 9. Petitioner contends that this construction is supported by the '961 patent's statement that "a perspective view" is "also called in the prior art an oblique view or oblique perspective view." *Id.* (citing Ex. 1001, 4:10–15; Ex. 1003 ¶ 19).

Patent Owner does not dispute Petitioner's proposed construction of "oblique perspective view" in its Patent Owner Response. *See* PO Resp.

Based on the present record, we agree with Petitioner that "oblique perspective view" should be construed to encompass a "perspective view" and an "oblique view."

3. Whether the "correlating" step in claims 21 and 22 must occur before the "performing . . . image analysis" step

Claim 21 recites "correlating the first aerial image with the second aerial image within the plurality of aerial images" and "performing, by the at least one processor of the roof estimation machine, image analysis on the plurality of aerial images based on the correlation." Ex. 1001, 18:57–61. Claim 22 includes similar language. *Id.* at 19:28–32.

Patent Owner argues that the Board should construe claims 21 and 22 to require that the claimed "correlating" step be performed before the "performing . . . image analysis" step. PO Resp. 24 (citing Ex. 2010 ¶¶ 32–34). Patent Owner asserts that "[c]laims 21 and 22 require 'correlating the first aerial image with the second aerial image within the plurality of aerial

images" and then "performing, by the at least one processor of the roof estimation machine, image analysis on the plurality of aerial images ***based on the correlation***." *Id.* According to Patent Owner, "[t]he antecedent basis for 'the correlation'" is "the result of the 'correlating'" in the previous claim element. *Id.* at 25. "Because the step of 'performing . . . image analysis' must be done 'based on the correlation,'" Patent Owner contends, "the 'correlating' step must occur *before* the 'performing . . . image analysis' step." *Id.* (citing Ex. 2010 ¶ 32). Patent Owner further argues that, in his deposition, "Dr. Forsyth stated that 'the claim requires that there is some image analysis that occurs after the correlation,'" and that "Dr. Bajaj provides similar testimony." *Id.* (citing Ex. 2010 ¶¶ 33–34).

Petitioner argues that "[n]othing in the claims limits the 'correlating' and 'image analysis' elements of claims 21 and 22 to having to be performed as discrete and separate functions," and thus "[t]here is no temporal relationship or specific order for the 'correlating' and 'image analysis' elements." Pet. Reply 4 (citing Ex. 1028 ¶ 16). Petitioner cites *Google LLC v. Pers. Audio, LLC*, 734 Fed. Appx. 978, 985 (Fed. Cir. 2018) for "the principle that in [an] obviousness analysis, a ***single*** element, ***feature***, or mechanism can ordinarily ***satisfy multiple claim limitations***, including ***by performing multiple claimed functions***." *Id.* Accordingly, Petitioner contends, the "correlating" and "image analysis" elements of claims 21 and 22 can "be satisfied by either a single function or multiple functions that perform the 'correlating' and 'image analysis' steps." *Id.* (citing Ex. 1028 ¶ 16).

As discussed further in Section II.D.8(b) below, we find that Petitioner has sufficiently proven that the proposed combination teaches

performing the claimed "correlating" step before the "performing . . . image analysis" step, as Patent Owner's construction would require. Therefore, we need not resolve this claim construction dispute for purposes of this Decision. *See Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) ("The Board is required to construe 'only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.'" (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

4. Whether the claims require calibration information to be received before calibration occurs

Claim 1 recites that "at least one of the first and/or second aerial images is calibrated using calibration information received from the calibration module." Ex. 1001, 16:9–11. Independent claims 21, 22, 24, and 29 include similar language. *Id.* at 18:51–55, 19:23–27, 19:62–62–64, 20:43–46.

Patent Owner argues that "[t]he Board should construe all claims as requiring that 'calibration information' be received before calibration is performed." PO Resp. 25 (citing Ex. 2010 ¶¶ 35–36). Patent Owner asserts that "[i]ndepedent Claims 1, 21, 22, 24, and 29 (and by extension their dependent claims) require receiving calibration information ***prior to*** calibrating at least one of the first and/or second aerial images." *Id.* More specifically, according to Patent Owner, "[c]laims 21 and 22 require 'receiving calibration information for at least one of the first and/or second images' Claim Elements 21.3, 22.3)" and then "'calibrating at least one of the first and/or second aerial images ***using the calibration information*** and the calibration module' (Claim Elements 21.4, 22.4)." *Id.* at 25–26.

"The antecedent basis for 'the calibration information' in Claim Elements 21.4 and 22.4," Patent Owner asserts, "is the 'calibration information' received in Claim Elements 21.3 and 22.3." *Id.* at 26. "Because the calibration step in Claim Elements 21.4 and 22.4 must be done 'using the calibration information,'" Patent Owner contends, "the 'receiving calibration information' step must be performed *before* the 'calibrating' step." *Id.* "Similarly," according to Patent Owner, "Claims 1, 24, and 29 require 'wherein at least one of the first and/or second aerial images ***is calibrated using calibration information received from*** the calibration module.'" *Id.* (citing Ex. 2010 ¶ 35). Patent Owner further points to Dr. Forsyth's deposition testimony that "I believe you must receive the calibration information and then you must use the calibration information you received" and that "I believe you need to receive the information before you use it," and asserts that Dr. Bajaj expressed agreement with this understanding. *Id.* (citing Ex. 2011, 32:8–16; Ex. 2010 ¶ 36).

Petitioner does not provide an alternative claim construction of this term, or dispute Patent Owner's claim construction. *See* Pet. 7–9; Pet. Reply 2–4.

Based on the full trial record, we adopt Patent Owner's proposed construction of this limitation.

5. "Aerial images"

Patent Owner argues that "the Board should construe 'aerial image' as 'an image taken from the air, rather than from a ground-based platform.'" PO Resp. 27. Patent Owner asserts that "[t]he '961 Patent repeatedly distinguishes 'aerial images' (e.g., those obtained via aircraft, balloon, satellite) from images obtained from 'ground-based platforms' (e.g., a tower,

nearby building, hilltop, mobile 'street view' vehicle)." *Id.* (citing Ex. 1001, 2:7–8, 4:4–6, 14:2–4, 15:1–3). Patent Owner acknowledges that "some of the excerpts from the '961 Patent's specification" state that "in some embodiments, the aerial image files stored in the aerial image file database may include images taken from a ground-based platform," but argues that the specification "makes clear that images from ground-based platforms are used 'instead or in addition' to the aerial images in those embodiments." *Id.* (citing Ex. 1001, 14:4–6).

Patent Owner also contends that some of the claims of parent U.S. Patent No. 8,078,436 (the "'436 patent") recite "aerial image[s]" while other claims of the '436 patent simply recite "images," indicating that "the inventors intended the use of the more general term 'images' to include both 'aerial images' and 'images obtained from ground-based systems.'" PO Resp. 28 (citing Ex. 2021); PO Sur-reply 11–14. Patent Owner also relies on a dictionary definition defining "aerial" as "1. Of, in, or caused by the air . . . 4. Of, for, or by means of aircraft: *aerial photography*," and argues that Dr. Forsyth testified at his deposition that if he knew an image was not taken from the air, he would not consider it to be an "aerial image." *Id.* at 29 (citing Ex. 2010 ¶¶ 40–42; Ex. 2022, 3; Ex. 2012, 23:10–8, 25:4–7, 25:20–21). According to Patent Owner, "Dr. Bajaj agreed with that testimony" and further explained that an image is understood to be an "aerial" image based on how it is captured, i.e., from the air rather than from a ground-based platform. *Id.* (citing Ex. 2010 ¶¶ 40–42). Patent Owner further points to a statement on Nearmap's website stating that "[f]rom a technical standpoint, aerial imagery is classified as any image taken from an airborne craft.'" *Id.* (citing Ex. 2014, 1).

Petitioner responds that the '961 patent clearly states that "***aerial images*** may include images obtained via one or more ***ground-based platforms***, such as a vehicle-mounted camera that obtains street-level images of buildings, ***a nearby building***, a hilltop, etc." Pet. Reply 2 (citing Ex. 1001, 8:12–18, 4:2–10). Because the '916 patent specification is clear, Petitioner argues, there is no need to turn to extrinsic evidence for claim construction. *Id.* at 2–3. However, Petitioner also points to extrinsic evidence in the form of definitions from several different dictionaries defining aerial as "elevated" or "lofty," and an article listing "mast, pole or boom photography" as examples of "aerial images." *Id.* at 3 (citing Ex. 1031, 3; Ex. 1032, 3; Ex. 1033, 3; Ex. 1034, 2–3).

We find that the '961 patent specification clearly contemplates that "aerial images' may include images taken from certain ground-based platforms that look like they were taken from the air. As the specification explains:

> In some embodiments, the aerial images may include images obtain[ed] via one or more ground-based platforms, such as a vehicle-mounted camera that obtains street-level images of buildings, a nearby building, a hilltop, etc. In some cases, a vehicle-mounted camera may be mounted in an elevated position, such as a boom.

Ex. 1001, 8:12–18. This portion of the specification expressly states that "aerial images" may include images obtained via "ground-based platforms," and then lists examples of ground-based platforms that may be used to take an image that looks like it was taken from the air, including a "nearby building," a "hilltop" or "a vehicle-mounted camera [that] may be mounted in an elevated position, such as a boom." *Id.* This understanding makes sense in the context of a patent directed to a system for processing a large

volume of previously-captured images of uncertain origin, because it may not be apparent from the image itself whether it was taken from an airborne craft as opposed to a tall building, hill, or tower.[4] Indeed, under Patent Owner's construction, if two images look identical but one was taken from an airborne craft and the other was taken from a nearby building, the first would fall within the claim but the second would not.

Our understanding of "aerial images" is also consistent with Column 4 of the '961 patent specification, which states that:

> The aerial image files 54 may be taken [by] any available means, such as a manned or unmanned aircraft, a balloon, a satellite, etc. In some embodiments, the aerial image files may include images taken from a ground-based platform, such as a mobile ("street view") photography vehicle, a fixed position (e.g., a tower, nearby building, hilltop, etc.).

Ex. 1001, 4:4–10. These statements also indicate that the "aerial image files" (which presumably are made up of aerial images) can include images taken from a ground-based platform that is raised above the site being photographed, such as a tower, nearby building, or hilltop.

We do not agree with Patent Owner's argument that the parent '436 patent supports a different understanding of "aerial images." Although we agree that certain claims of the '436 patent recite "aerial images," while others simply recite "images," under our construction those two terms do not have the same scope. "Aerial images" can include images taken from a raised ground-based platform that look like they were taken from the air, but would not cover images from ground-based platforms that do not appear to

[4] For example, a photograph taken from a tall building may look more like an "aerial image" than a photograph taken by a drone flying low to the ground.

have been taken from the air. The broader term "images," however, would also encompass images that were not taken from a raised location and do not appear to have been taken from the air. Similarly, the fact that certain dependent claims of the '436 patent reciting that the images may be taken from a ground-based platform depend from claims broadly reciting "images" (rather than from claims reciting "aerial images") does not mean that images taken from certain raised ground-based platforms (such as tall buildings, towers, or hills) cannot be "aerial images."

Additionally, we find that the intrinsic evidence cited by Patent Owner does not overcome the meaning of "aerial images" that flows from the '961 specification. The dictionaries provided by the parties include multiple definitions of "aerial," including "lofty" and "elevated," which suggests that images taken from a lofty or elevated building, hill, or tower would be "aerial" images. *See* Ex. 1031, 3; Ex. 1032, 3; Ex. 1033, 3; Ex. 2022, 3. Dr. Forsyth's deposition is also equivocal and includes portions that support Petitioner as well as those quoted by Patent Owner, including testimony that one of ordinary skill would have understood the term "aerial image" to be "an image that looks as though it had been taken from the air," such as a picture taken from a crane. Ex. 2012, 23:7–24:1.

Based on the foregoing, we construe "aerial image" to mean "an image taken from the air," which can include an image from a raised, ground-based platform, such as a building, hill, or tower, that appears to have been taken from the air.

6. Other terms

We determine that it is not necessary to provide an express interpretation of any other claim terms for purposes of this proceeding. *See Realtime Data*, 912 F.3d at 1375.

B. Principles of Law

A claim is unpatentable under 35 U.S.C. § 103 if "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) where in evidence, objective evidence of non-obviousness.[5] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). When evaluating a combination of teachings, we must also "determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue." *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). Whether a combination of prior art elements would have produced a predictable result weighs in the ultimate determination of obviousness. *Id.* at 416–417.

In an *inter partes* review, the petitioner must show with particularity why each challenged claim is unpatentable. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016); 37 C.F.R. § 42.104(b) (2020). The burden of persuasion never shifts to the patent owner. *Dynamic*

[5] Patent Owner has not presented objective evidence of non-obviousness.

Drinkware, LLC v. Nat'l Graphics, Inc., 800 F.3d 1375, 1378 (Fed. Cir. 2015).

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

C. Level of Ordinary Skill in the Art

Petitioner contends that a person of ordinary skill in the art at the time of the alleged invention would have had "at least a Bachelor's Degree in an academic area emphasizing the design of electrical, computer, or software technologies, or a similar discipline, and at least two years of experience related to computerized image analysis and three-dimensional modeling." Pet. 6–7 (citing Ex. 1003 ¶ 16). Petitioner further asserts that "[s]uperior education could compensate for a deficiency in work experience, and vice-versa." *Id.* at 7.

Patent Owner argues that a person of ordinary skill in the art "would have been someone with a bachelor's degree or higher in computer science, computer engineering, computer vision or visualization, physics, or an equivalent educational background, or someone having at least 5 years of industry experience in software development." PO Resp. 24 (citing Ex. 2010 ¶¶ 17-19).

Petitioner responds that Patent Owner's definition of the person of ordinary skill is flawed because it would cover someone "having only a bachelor's degree and '5 years of industry experience in software development' with no relevant experience in computerized image analysis and three-dimensional modeling—the actual field of the '961 patent." Pet. Reply 1 (citing PO Resp. 24; Ex. 2010 ¶ 18; Ex. 1003 ¶ 16; Ex. 1028 ¶ 7).

Patent Owner responds that Petitioner's criticism of Patent Owner's proposed level of ordinary skill "is based entirely on mischaracterizations of Dr. Bajaj's deposition testimony and ignores the actual level of skill Dr. Bajaj set forth in his declaration." PO Sur-reply 28 (citing Ex. 2010 ¶ 18). "Contrary to Petitioner's assertion," Patent Owner contends, Dr. Bajaj's person of ordinary skill "is not someone with 'no relevant experience in computerized image analysis and three-dimensional modeling,' but instead is someone that would have at least some experience in computerized image analysis and three-dimensional modeling from education and/or industry experience." *Id.* at 29 (citing Ex. 2010 ¶ 19). Thus, Patent Owner argues, "there does not appear to be any meaningful distinction between Dr. Bajaj's [person of ordinary skill in the art] and Petitioner's [person of ordinary skill in the art] having a bachelor's degree and 'two years of experience related to computerized image analysis and three-dimensional modeling.'" *Id.* (citing Pet. 6–7).

Based on the '961 patent and the prior art, we agree with Petitioner that a person of ordinary skill in the art would have had "at least a Bachelor's Degree in an academic area emphasizing the design of electrical, computer, or software technologies, or a similar discipline, and at least two years of experience related to computerized image analysis and three-dimensional modeling." Pet. 6–7. The level of ordinary skill set forth in Patent Owner's Sur-reply is substantially the same as the one we adopt here, and our Decision would not change under either party's definition of the level of ordinary skill.

D. Asserted Obviousness of Claims 1, 2, 7, 8, 21, 22, 24, 25, 27, and 29 Based on Littleworth, Linder, and Middlebrook

Petitioner contends that claims 1, 2, 7, 8, 21, 22, 24, 25, 27, and 29 would have been obvious over Littleworth in view of Linder and Middlebrook. Pet. 3, 9–62. Patent Owner disagrees. Prelim. Resp. 7–42.

1. Littleworth (Ex. 1005)

a) Overview of Littleworth

Littleworth is a paper entitled "Three-Dimensional Mapping and as-Built Computer Modelling by Analytical Photogrammetry," and "describes how and why analytical photogrammetry, interfaced with a CAD system, has been used to create 3-dimensional computer models of development sites and engineering structures." Ex. 1005, Abstract. Littleworth explains that "[w]ith the introduction of industry wide CAD packages (e.g. Microstation, Autocad) the potential for introducing analytical photogrammetric techniques to new users has greatly expanded," but that "the accuracy achievable creating 3-dimensional computer models is restricted given the geometric restraints imposed by the CAD system." *Id.* at 754. Littleworth states that the "Engineering Photogrammetry Unit (EPU) was launched in 1988" by City University in London "following the purchase of an Intergraph Intermap Analytic Photogrammetric Workstation (IMA)." *Id.* Littleworth provides "examples of some recent projects undertaken by EPU" to "illustrate the evolution of [a] 3-dimensional photogrammetric product" for "potential new photogrammetric users." *Id.*

Littleworth describes a project involving the "Hatfield Aerodrome" as "one of the first projects undertaken by EPU." Ex. 1005, 754. For this project, EPU used "several aerial photographic libraries and archives held by various organisations" in the United Kingdom, including "[s]uitable vertical

aerial photography at a scale of 1:5000" for "this particular site." *Id.* at 755. Littleworth explains that "it was necessary to adapt the approach so that the detail digitised not only represented ground features accurately but gave a good visual impression of how these features actually appear," as shown in Figure 1, reproduced below. *Id.*

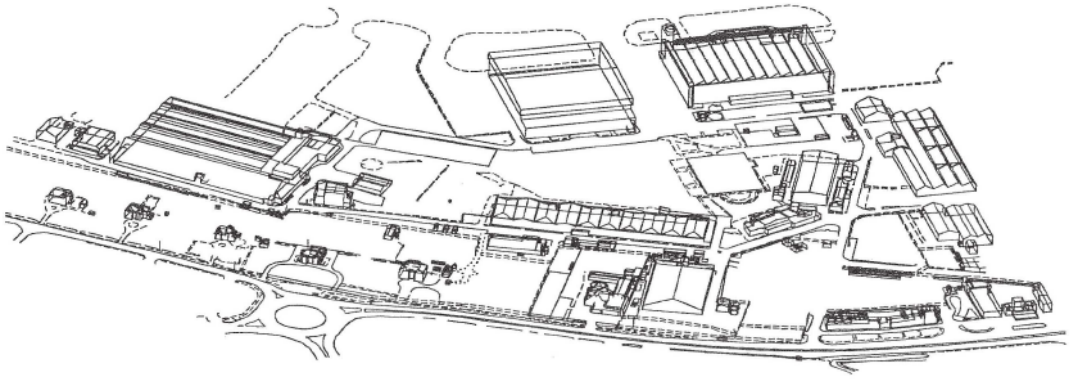


Fig.1 3-d model representing Hatfield Aerodrome.

Figure 1 of Littleworth shows a three-dimensional model representing the Hartfield Aerodrome. Ex. 1005, 754.

Littleworth further explains that, for this project, "[r]oof detail was digitised indicating their pitch, major details on the roofs themselves, tree canopies indicating height and spread, fences and walls showing width and height." Ex. 1005, 755. Littleworth also states that "[t]he ground surface was represented by 0.25 metre contours" which "were derived from pertinent ground detail (kerb lines, boundaries etc.), a grid of spot heights and supplementary height points on important natural changes of slope processed using a digital terrain model package" as shown in Figure 2, reproduced below. *Id.*

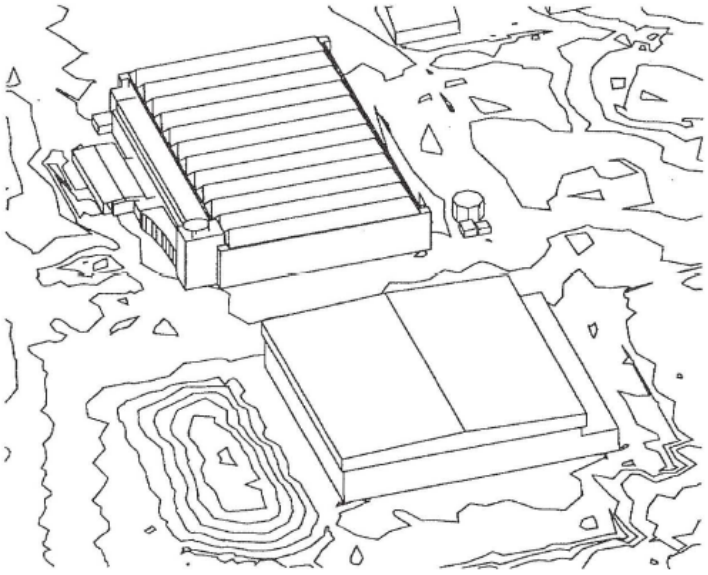


Fig. 2 3-d detail with DTM derived contours

Figure 2 shows a three-dimensional detail of the Hatfield Aerodrome model with the ground surface represented by 0.25 meter contours. Ex. 1005, 755.

b) Whether Littleworth Is Prior Art

With the Petition, Petitioner submits the Declaration of June Munford to support its assertion that Littleworth qualifies as prior art. Pet. 2; Ex. 1019. Ms. Munford states that:

> I have reviewed Exhibit NEARMAP-1005, "Three-Dimensional Mapping and As-Built Computer Modelling by Analytical Photogrammetry" by R.M Littleworth, D.M. Stirling and J.H. Chandler as published in *International Archives of Photogrammetry and Remote Sensing: ISPRS 17th Congress, Washington, D.C., 1992, Volume B5*.
>
> Attached hereto as Appendix LITTLEWORTH01 is a true and correct copy of the MARC record for *International Archives of Photogrammetry and Remote Sensing: ISPRS 17th Congress, Washington, D.C., 1992* as held by the Rochester Institute of Technology library. I secured this record myself from the library's public catalog. The MARC record contained within Appendix LITTLEWORTH01 accurately describes the title, author, publisher, and conference details of *International*

> *Archives of Photogrammetry and Remote Sensing: ISPRS 17th Congress, Washington, D.C., 1992*. In comparing Exhibit NEARMAP-1005 to Appendix LITTLEWORTH01, it is my determination that Exhibit NEARMAP-1005 is a true and correct copy of "Three-Dimensional Mapping and As-Built Computer Modelling by Analytical Photogrammetry" as found in *International Archives of Photogrammetry and Remote Sensing: ISPRS 17th Congress, Washington, D.C., 1992*.
>
> The 008 field of the MARC record in Appendix LITTLEWORTH01 indicates the date of record creation. The 008 field of Appendix LITTLEWORTH01 indicates the Rochester Institute of Technology library first acquired these proceedings as of December 8, 1997. Considering this information, it is my determination that *International Archives of Photogrammetry and Remote Sensing: ISPRS 17th Congress, Washington, D.C., 1992* and therefore "Three-Dimensional Mapping and As-Built Computer Modelling by Analytical Photogrammetry" was made available to the public shortly after its initial acquisition in Winter 1997, if not earlier as presented at the ISPRS 17th Congress in 1992.

Ex. 1019 ¶¶ 6–8 (paragraph numbers omitted).

Patent Owner argues that Littleworth "does not include any information regarding its publication or a publication date," and argues that there is "no identifiable information from Littleworth regarding if, when, where, or how it may have ever been published." PO Resp. 11. Patent Owner also asserts that "the Munford Declaration never explains the basis for the testimony that Littleworth was part of *International Archives of Photogrammetry*—nor does the Munford Declaration provide any evidence supporting this assumption." *Id.* at 11–12 (citing Ex. 1019 ¶ 6). According to Patent Owner, "there is nothing in the MARC record to indicate that *International Archives of Photogrammetry* included any version of Littleworth, let alone the particular version of Littleworth provided by Petitioner as EX1005." *Id.* at 13. Thus, Patent Owner contends, "it is

impossible for Munford to know—based on reviewing only EX1005—whether any paper that may have been published in *International Archives of Photogrammetry* is the same as EX1005." *Id.* at 12.

Patent Owner also disputes Ms. Munford's testimony that "[t]he 008 field of Appendix LITTLEWORTH01 indicates the Rochester Institute of Technology library first acquired these proceedings as of December 8, 1997." PO Resp. 13. Patent Owner asserts that "the content in field 040" of the MARC record "undermines the conclusions in the Munford Declaration by demonstrating that" this MARC record was "*not* created" by the Rochester Institute of Technology library. *Id.* at 14. Patent Owner argues that "MARC record field 040, subfield 'a,' 'identifies the library or other entity that created the catalog record in the MARC format." *Id.* at 15 (citing Ex. 2020 ¶ 13, Attachment C). Patent Owner asserts that field 40, subfield $a of LITTLEWORTH 1 does not include the letters "NRRI" which (according to Patent Owner) is "the MARC code for the Rochester Institute of Technology library." *Id.* at 16 (Ex. 1019, Appendix LITTLEWORTH01; Ex. 2020, 10–11, Attachment A-2). Thus, Patent Owner argues, "the date in field 008 (the creation date of the record) does not reflect when Rochester Institute of Technology library acquired Littleworth." *Id.* at 17.

Petitioner responds by submitting a supplemental Munford Declaration with accompanying evidence and a declaration from Karina Silverstein explaining how she obtained copies of the Littleworth paper and portions of the *Proceedings of the ISPRS Congress 1992* from a library at the University of California-Berkeley. Exs. 1037, 1038. Petitioner argues that "Littleworth is a paper published in a technical journal by established publisher American Society for Photogrammetry and Remote Sensing,"

which by itself "creates a presumption of public accessibility as of the December 8, 1997 publication date." Pet. Reply 27 (citing *VidStream LLC v. Twitter, Inc.*, 981 F.3d 1060, 1065–66 (Fed. Cir. 2020)). Additionally, relying on Ms. Munford, Petitioner argues that "Littleworth's paper was presented at a 1992 International Society for Photogrammetry and Remote Sensing (ISPRS) conference having over 2,371 attendees," and one of ordinary skill "would have understood that ISPRS presenters publish their work in *Proceedings of the ISPRS Congress* in the ordinary course after ISPRS conferences." Pet. Reply 29–30 (citing Ex. 1037 ¶¶ 29–35). "Accordingly," Petitioner contends, one of ordinary skill "would have known to look to *Proceedings of the ISPRS Congress* to find papers previously presented at an ISPRS conference, such as Littleworth." *Id.* at 30 (citing Ex. 1037 ¶¶ 32–35).

Petitioner also argues that "Dr. Mullins testified that the 008 field of a MARC record[] represents a 'date entered on file for that specific MARC record,' 'the date that it was originally catalogued,' and that Littleworth . . . [was] publicly available 'shortly after' the dates in the 008 fields of the respective MARC records relied upon by the Petition." Pet. Reply 28 (citing Ex. 1039, 37:7–38:7, 40:14–41:2, 50:8–51:2). According to Petitioner, Dr. Mullins "agrees that Littleworth was available at the library represented by the code 'RVE,' evidenced by the 040 field of the Littleworth MARC record, shortly after December 8, 1997." *Id.* at 29 (citing Ex. 1039, 39:2–6; 40:14–41:2; Ex. 1019 ¶ 8; Pet. 3).

Petitioner further argues that Littleworth would not have been difficult for one of ordinary skill to identify because MARC records were keyword searchable, and one of ordinary skill "would have easily identified the

Proceedings of ISPRS Congress 1992, and subsequently Littleworth, by performing targeted keyword searching of words such as 'photogrammetry,' 'three-dimensional,' 'model,' 'oblique images,' or the like." Pet. Reply 30 (citing Ex. 1037 ¶¶ 8–9, 12–15, 16–17; Ex. 1039, 11:8–16, 16:9-19, 17:19–19:17, 42:1–44:20). Finally, quoting *Voter Verified, Inc. v. Premier Election Sols., Inc.*, 698 F.3d 1374, 1381 (Fed. Cir. 2012), Petitioner argues that the indexing of a reference "is not 'a necessary condition for a reference to be publicly accessible,'" and is "but one among many factors that may bear on public accessibility." *Id.* at 31.

In response, Patent Owner argues that Petitioner has not shown how one of ordinary skill "would have found Littleworth in the technical journal." PO Sur-reply 24. According to Patent Owner, Ms. Munford's evidence is directed to the availability of the *Proceedings of the ISPRS Congress 1992*, not Littleworth itself, and Littleworth "contains no indicia that it was published in the *Proceedings of the ISPRS Congress 1992*, or even if or when it was published." *Id.* (citing PO Resp. 10–13). Patent Owner also argues that Ms. Munford's statements about what one of ordinary skill would have understood are defective because she is not a person of ordinary skill. *Id.* at 25–26. Additionally, according to Patent Owner, Ms. Munford does not show how searching MARC records would have allowed a person of ordinary skill to find Littleworth. *Id.* at 27.

Based on the full trial record, we find that Petitioner has sufficiently proven that Littleworth was publicly available before the critical date. First, Petitioner has introduced as Appendix LITTLEWORTH03 to Ms. Munford's second declaration a copy of the *Proceedings of The ISPRS Congress 1992*, Volume XXIX Part B5, held by the University of

California-Berkeley library listing the Littleworth article in the table of contents, followed by a copy of Littleworth taken from that copy of the *Proceedings*. Ex. 1037 ¶ 14; Ex. 1037, Appendix LITTLEWORTH03, 555, 557–563. Petitioner also submitted a declaration from Karina Silverstein testifying that she obtained LITTLEWORTH03 from UC Berkeley and personally scanned the title, cover page, table of contents, and Middlebrook article. Ex. 1038 ¶ 3. Additionally, Petitioner introduced as Appendix UOFM01 to Ms. Munford's second declaration a copy of Volume XXIX Part A of the same *Proceedings* including entries showing that the Littleworth article was presented as of August 6, 1992. Ex. 1037 ¶¶ 31–34; Ex. 1037, Appendix UOFM01, 102, 175. We find that this evidence is sufficient to show that the Littleworth article was published in and presented at the *Proceedings of The ISPRS Congress 1992*.

We also find that the *Proceedings of the ISPRS Congress 1992*, including the Littleworth article, were published by the American Society for Photogrammetry and Remote Sensing, which is an established publisher, creating a presumption of public accessibility as of the publication date. *See* Ex. 1037, Appendix LITTLEWORTH03 at 548, 550, Appendix UOFM01 at 821; *VidStream*, 981 F.3d 1065–1066. Dr. Mullins also testified that the 008 field of a MARC record, represents a "date entered on file for that specific MARC record," "the date that it was originally catalogued," and that Linder was publicly available "shortly after" the dates in the 008 field of Linder's MARC. Pet. Reply 28–29; Ex. 1039, 37:7–38:7, 39:2–6, 40:14–41:2, 50:8–51:2; Ex. 1019 ¶ 8. Additionally, we find that Petitioner has sufficiently shown that MARC records were keyword searchable, and thus the MARC record for the *Proceedings of the ISPRS Congress 1992* could have been

found using keyword searching. *See* Pet. Reply 30; Ex. 1037 ¶¶ 8–9, 12–15, 16–17; Ex. 1039, 11:8–16, 16:9-19, 17:19–19:17, 42:1–44:20. This evidence provides further confirmation that Littleworth was publicly available as of the critical date.

Patent Owner's arguments do not overcome Petitioner's showing that Littleworth was publicly accessible. First, Patent Owner's argument that Littleworth lacks sufficient information regarding its publication or publication date has been addressed by Ms. Munford's second Declaration, the Silverstein Declaration, and the materials submitted as Appendices LITTLEWORTH03 and UOFM01, as discussed above. Second, we disagree with Patent Owner's argument that Petitioner has not shown how one of ordinary skill would have found Littleworth in the *Proceedings of the ISPRS Congress 1992* because this conference was a significant conference in the field, identified by MARC records in the library, and the published conference proceedings included a table of contents and presentation information about the Littleworth article. Finally, we find that the second Munford Declaration and accompanying evidence were properly submitted with Petitioner's Reply. *See Hulu, LLC v. Sound View Innovations, LLC*, IPR2018-01039, Paper 29 at 14 (PTAB Dec. 20, 2019) (precedential) (explaining that a petitioner may present new evidence of public accessibility after institution, including "in a reply to the patent owner response").

Consequently, we find that Petitioner has proven by a preponderance of the evidence that Littleworth was publicly accessible and qualifies as prior art.

2. Linder (Ex. 1012)

a) Overview of Linder

Linder is a textbook entitled "Digital Photogrammetry Theory and Applications" by Wilfried Linder. Ex. 1012. Linder states that "photogrammetry can be defined as the 'science of measuring in photos,' and is a part of the field of remote sensing (RS)." *Id.* at 1.[6] According to Linder, "Photogrammetry provides methods to give you . . . quantitative data," such as the dimensions of a house that no longer exists from historic photos of the house. *Id.* As Linder explains, "[i]f you would like to determine distances, areas, or anything else, the basic task is to get object (terrain) co-ordinates of any point in the photo from which you can then calculate geometric data." *Id.* Additionally, according to Linder, the principle of "stereoscopic viewing" is "used to get three-dimensional information in photogrammetry," since with "two (or more) photos from the same object but taken from different positions" one can "easily calculate the three-dimensional co-ordinates of any point which is represented in both photos." *Id.* at 1–2. Linder defines "the main task of photogrammetry" as "[f]or any object point represented in at least two photos . . . calculat[ing] the three-dimensional object (terrain) co-ordinates." *Id.* at 2.

b) Whether Linder Is Prior Art

The Petition relies on the Declaration of June Munford to support its assertion that Linder qualifies as prior art. Pet. 2; Ex. 1019. Ms. Munford states that:

> I have reviewed Exhibit NEARMAP-1012, *Digital Photogrammetry: Theory and Applications* by Wilifried Linder.

[6] The citations to Linder refer to the actual pages of the book, not to the page numbers added by Petitioner.

> Attached hereto as Appendix LINDER01 is a true and correct copy of the MARC record for *Digital Photogrammetry: Theory and Applications* as held by the Penn State University library. I secured this record myself from the library's public catalog. The MARC record contained within Appendix LINDER01 accurately describes the title, author, publisher, and ISBN number of *Digital Photogrammetry: Theory and Applications*. In comparing Exhibit NEARMAP-1012 to Appendix LINDER01, it is my determination that Exhibit NEARMAP-1012 is a true and correct copy of *Digital Photogrammetry: Theory and Applications* by Wilifried Linder.
>
> The 008 field of the MARC record in Appendix LINDER01 indicates the date of record creation. The 008 field of Appendix LINDER01 indicates Penn State University library first acquired this book as of March 10, 2003. Considering this information, it is my determination that *Digital Photogrammetry: Theory and Applications* was made available to the public shortly after its initial acquisition in March 2003.

Ex. 1019 ¶¶ 12–14 (paragraph numbers omitted).

In response, Patent Owner makes a similar argument concerning Linder's 008 field as it does for Littleworth. Specifically, Patent Owner argues that MARC record field 40, subfield "a" "identifies the library or other entity that created the catalog record in the MARC format," and that this field for LINDER includes the letters "DLC" which "refers to the Library of Congress—not Penn State University," whose libraries "have MARC codes beginning with 'PSt.'" PO Resp. 15 (citing Ex. 2020 ¶¶ 13–17, Attachments B-1 and B2; Ex. 1019, Appendix LINDER01). "Given that this particular MARC record was created by the Library of Congress," Patent Owner asserts, "the date in field 008 (the creation date of the record) does not reflect when a Penn State University library acquired Linder." *Id.* at 15–16.

As noted above with respect to Littleworth, Petitioner responds by submitting a supplemental Munford Declaration with accompanying evidence. Ex. 1037. Petitioner argues that "Linder is a photogrammetry textbook published by established publisher Springer," which "creates a presumption of public accessibility as of the March 10, 2003 publication date." Pet. Reply 28 (citing Pet. 2–3; Ex. 1019 ¶¶ 12–14; Ex. 1037 ¶¶ 10–11; *VidStream*, 981 F.3d at 1065–66). Petitioner also argues that "Dr. Mullins testified that the 008 field of a MARC record, represents a 'date entered on file for that specific MARC record,' 'the date that it was originally catalogued,' and that . . . Linder [was] publicly available 'shortly after' the dates in the 008 fields of the respective MARC records relied upon by the Petition." *Id.* at 28 (citing Ex. 1039, 37:7–38:7, 40:14–41:2, 50:8–51:2). According to Petitioner, Dr. Mullins "agrees that Linder was 'probably available' in at least the Library of Congress, evidenced by the 040 field of the Linder MARC record, 'shortly after' the March 10, 2003 publication date of Linder evidenced by the 008 field of MARC record relied upon by the Petition." *Id.* at 29 (citing Ex. 1039, 37:7–38:7; Ex. 1019 ¶ 14; Pet. 3).

Petitioner further argues that Linder would not have been difficult for one of ordinary skill to identify because MARC records were keyword searchable, and one of ordinary skill "could have easily identified Linder's *Digital Photogrammetry* textbook by executing keyword searches using words such as 'photogrammetry,' 'three-dimensional,' 'model,' 'oblique images,' or the like." Pet. Reply 30–31 (citing Ex. 1037 ¶¶ 8–11, 16–17; Ex. 1039, 11:8–16, 16:9-19, 17:19–19:17, 42:1–44:20). Finally, quoting *Voter Verified,* 698 F.3d at 1381, Petitioner argues that the indexing of a

reference "is not 'a necessary condition for a reference to be publicly accessible,'" and is "but one among many factors that may bear on public accessibility." *Id.* at 31.

Based on the full trial record, Petitioner has made a sufficient showing that Linder was publicly available before the critical date. We agree with Petitioner that Linder is a photogrammetry textbook published by established publisher Springer, which creates a presumption of public accessibility as of Linder's publication date. Pet. Reply 28; Ex. 1019 ¶¶ 12–14; Ex. 1037 ¶¶ 10–11; *Vidstream*, 981 F.3d at 1065–66. Dr. Mullins also testified that the 008 field of a MARC record, represents a "date entered on file for that specific MARC record," "the date that it was originally catalogued," and that Linder was publicly available "shortly after" the dates in the 008 field of Linder's MARC. Pet. Reply 28–29; Ex. 1039, 37:7–38:7, 39:2–6, 40:14–41:2, 50:8–51:2; Ex. 1019 ¶ 14. Additionally, we find that the MARC record for Linder was keyword searchable. Ex. 1039, 11:8–16, 16:9–19, 17:19–19:17, 42:1–44:20; Ex. 1037 ¶¶ 8–11, 16–17). Based on the above, we find that Petitioner has proven by a preponderance of the evidence that Linder was publicly available before the critical date and qualifies as prior art.

3. Middlebrook (Ex. 1006)

Middlebrook is a book entitled "AutoCAD 2005 for Dummies." Ex. 1006, cover. Middlebrook describes the use of "dimensions" in AutoCAD, which "are special text labels with attached lines that together indicate unambiguously the size of something" in an object. Ex. 1006, 229.[7]

[7] The citations to Middlebrook refer to the actual pages of the book, not to the page numbers added by Petitioner.

Middlebrook explains that "as you edit an object—by stretching it for example—AutoCAD automatically updates the measurement displayed in the dimension text label to indicate the object's new size." *Id.* Middlebrook states that the "most common types" of dimensions are shown in Figure 10-3, reproduced below.

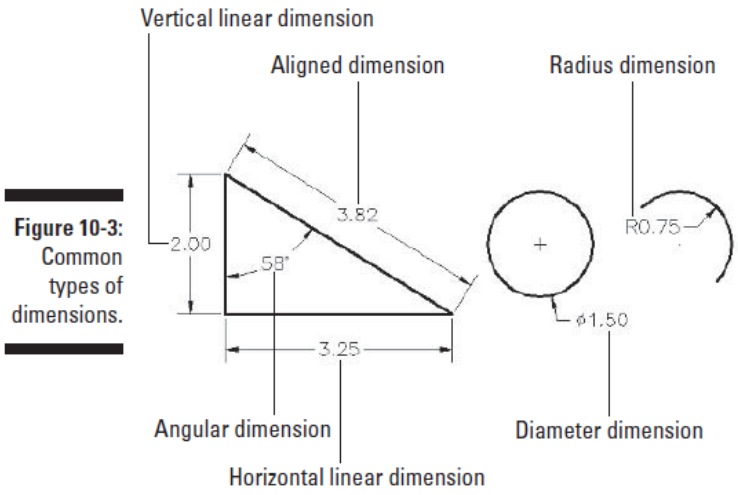


Figure 10-3: Common types of dimensions.

Figure 10-3 of Middlebrook illustrates common types of dimensions used in AutoCAD. Ex. 2006, 253–254.

Middlebrook states that each drawing includes a "paper space," which "is a separate space in each drawing for composing a printed version of that drawing." Ex. 1006, 62. First, Middlebrook explains, "[y]ou create the drawing itself, called the *model*, in *model* space," and then "can create one or more plottable views," each of which "is called a *layout*." *Id.* Middlebrook also states that a "paper space layout" includes one or more "viewports, each showing the 3D model from a different perspective." *Id.* at 65. A user can "[d]efine the arrangement of viewports that AutoCAD should create." *Id.* Figure 8-1 from Middlebrook shows a layout including multiple viewports showing different views of a three-dimensional model:

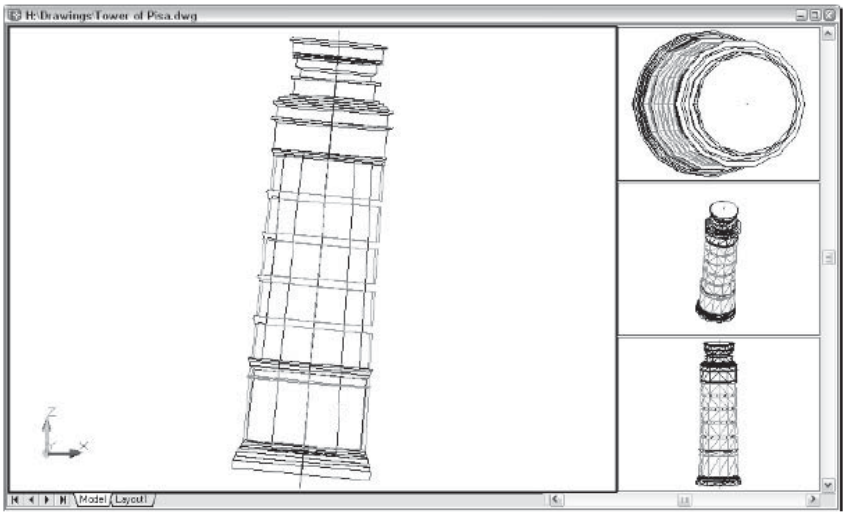


Figure 8-1: Leaning toward 3D.

Figure 8-1 of Middlebrook shows a layout with multiple viewports showing different views of a three dimensional model. Ex. 1006, 180.

4. Proposed Combination of Littleworth, Linder, and Middlebrook

a) Petitioner's Proposed Combination

Petitioner argues that, as previously discussed, "Littleworth discloses generating a three-dimensional model based on a 'vertical aerial' image and an 'oblique' aerial image." Pet. 15. Petitioner argues that Linder "teaches using computer hardware and software modules to implement a digital photogrammetry system," which generates "three-dimensional coordinates of any point represented by two photographs" and "calibrat[es] and correlat[es] a first image and a second image based on a particular object point *P* that is shared between the first and the second images." Pet. 15.

In Petitioner's proposed combination, "the system of Littleworth is implemented using computer hardware and software modules, such as those described by Linder." Pet 15 (citing Ex. 1005, Abstract; Ex. 1012, 13–15, 79–82; Ex. 1003 ¶ 31). Additionally, the combination modifies Littleworth "to calibrate at least one aerial image and to correlate at least one of the 'vertical aerial' images and at least one 'oblique' aerial image in order to

generate three-dimensional coordinates, as described by Linder." *Id.* at 15–16 (citing Ex. 1005, 754, Ex. 1012, 32, 41, 46–50, 65–69, Fig. 15, Fig. 17; Ex. 1003 ¶ 32). "The system then generates the three-dimensional model based on the generated three-dimensional coordinates, as taught by Linder." *Id.* at 16. Petitioner further modifies the combined system of Littleworth-Linder "based on the teachings of Middlebrook, to generate and output a printed report that includes one or more annotated views of the three-dimensional model." *Id.* (citing Ex. 1005, 754–756, Fig. 3, Fig. 5; Ex. 1012, 1, 3, 6, 20–23, 52, 53, Fig. 4; Ex. 1006, 179–187, 232–239, 267–273; Ex. 1003 ¶ 33).

b) Reasons to Combine Littleworth, Linder, and Middlebrook

Petitioner argues that one of ordinary skill would have been motivated to modify Littleworth's three-dimensional model generation system "to correlate the aerial images using identified control points based on the teachings of Linder." Pet. 16. According to Petitioner, "[b]oth Littleworth and Linder describe using photogrammetry techniques to generate three-dimensional models based on aerial photographs." *Id.* (citing Ex. 1005, 754–756; Ex. 1012, 1–3; Ex. 1003 ¶ 34). Petitioner asserts that "Littleworth teaches that images are 'studied and suitable control points [are] selected' as part of generating a three-dimensional model," but "does not describe in detail how these selected control points within the images are used to generate the model." *Id.* at 16–17 (citing Ex. 1005, 756; Ex. 1003 ¶ 34). According to Petitioner, "Linder describes that images are correlated based on control points within the images as part of generating a three-dimensional model." *Id.* at 17. Thus, Petitioner asserts, one of ordinary skill "would have been motivated to correlate the images described in Littleworth based

on the selected control points in order to allow the images to be utilized in the three-dimensional model generation process, as taught by Linder." *Id.* (citing Ex. 1012, 32, 41, 46–50, 65–69, Fig. 15, Fig. 17; Ex. 1003 ¶ 34). Additionally, Petitioner contends, one of ordinary skill "would have been motivated to modify Littleworth's system to correlate its aerial images in order to enable a user to 'digitise points, lines and areas for map production or calculate distances, areas, volumes, slopes and much more,' as taught by Linder." *Id.* (citing Ex. 1012, 3; Ex. 1003 ¶ 34).

Petitioner also argues that one of ordinary skill would have been motivated to modify the Littleworth-Linder combination "based on the teachings of Middlebrook, to print different views of a three-dimensional model generated by the system including numerical annotations indicating various features of the model." Pet. 17 (citing Ex. 1003 ¶ 35; Ex. 1006, 62–65, 229, Fig. 10-3). According to Petitioner, a printed version "is convenient and preferred by many users," and "does not require a computer or compatible software to view, thereby allowing the results to be shared with a wider audience." *Id.* at 17–18 (citing Ex. 1003 ¶ 35; Ex. 1006, 288, 230–231). Further, Petitioner contends, "the addition of numerical annotations to the views of the three-dimensional model is beneficial because it enables information about the model (e.g., the dimensions of various components) to be communicated to individuals who may not have access to a computer to inspect the three-dimensional model." *Id.* at 18 (citing Ex. 1003 ¶ 35; Ex. 1006, 230–31). Petitioner also notes that "Littleworth specifically lists 'AutoCAD' (*i.e.*, the system described in Middlebrook) as a CAD system used in 'analytical photogrammetry' projects like those described in Littleworth." *Id.* (citing Ex. 1005, 754).

5. Analysis of Independent Claim 1

a) 1[preamble]: "A computing system for generating a roof report, the computing system comprising:"

Petitioner argues that, to the extent the preamble is limiting, it is taught or suggested by the Littleworth-Linder-Middlebrook combination. Pet. 20. Petitioner asserts that "Littleworth teaches using a computer-aided design or 'CAD' system to 'creat[e] three-dimensional computer models of development sites and engineering structures' from a set of aerial photographs," including "a created model of a structure" that "includes 'roof detail[s]' of the structure." *Id.* at 20–21 (citing Ex. 1005, Abstract, 755, 756, Fig. 2, Fig. 5). "Also in the combination," Petitioner contends, "Middlebrook teaches generating annotated views of three-dimensional models that are 'presentable, usable, printable, and sharable' as a report." *Id.* at 21 (citing Ex. 1006, 1, 267–274, Figs. 12-3, 12-4). Petitioner further argues that, "in the combination, multiple, annotated views of the three-dimensional model described in Littleworth, which includes a roof, are included in a printed report (*i.e.*, a roof report)." *Id.* (citing Ex. 1003 ¶ 38; Ex. 1005, 754–756, Fig. 3, Fig. 5; Ex. 1006, 179–187, 232–239, 267–273).

Patent Owner does not present arguments regarding the preamble. *See* PO Resp. [8]

Based on the full trial record, we find that Petitioner has sufficiently shown that the prior art discloses the preamble.[9]

---

[8] We discuss Patent Owner's arguments concerning motivation to combine the various references in the sections below dealing with specific claim elements disputed by Patent Owner.

[9] Because we are persuaded that Petitioner has shown that the preamble is taught or suggested by the prior art, we need not decide whether the preamble is limiting.

b) [1.1]: "a memory; and"

Petitioner argues that "[i]n the combination, Linder teaches that its system includes "an adequate PC . . . supplied with sufficient ***main memory (RAM)***, ***storage capacity (hard disk)*** and high resolution graphics." Pet. 21 (citing Ex. 1012, 13). Petitioner asserts that one of ordinary skill "would have understood each of the RAM and the hard disk described in Linder to be 'a memory.'" *Id.* (citing Ex. 1003 ¶ 38).

Patent Owner does not present arguments regarding this limitation. *See* PO Resp.

Based on the full trial record, we find that Petitioner has sufficiently shown that the prior art discloses this limitation.

c) [1.2]: "a roof estimation module that includes a calibration module, the roof estimation module being stored on the memory and being configured, when executed, to:"

Petitioner argues that "[i]n the combination, Linder describes that its CAD system includes a 'hard disk,' which is a memory." Pet. 22 (citing Ex. 1012, 13). Petitioner asserts that, "[i]n a chapter entitled 'Installation,' Linder teaches installing a 'digital photogrammetric software package' to the 'hard disk' of the PC from a CD-ROM." *Id.* (citing Ex. 1012, 14-15). Petitioner contends that Linder "further describes that its software system 'is subdivided into several ***modules*** to ensure . . . flexible handling[.]'" *Id.* (citing Ex. 1012, 63, 79). According to Petitioner, it would have been obvious to a person of ordinary skill "to subdivide the combined software system of Littleworth, Linder, and Middlebrook into different modules in order to group related functionality, such as the roof estimation and calibration functionality . . . because such subdivision was well-known and widely used in" the prior art. *Id.* (citing Ex. 1003 ¶ 40; Ex. 1005, 79;

Ex. 1008, 8:20–24, 12:15–25). "Accordingly," Petitioner contends, "the combination of Littleworth, Linder, and Middlebrook renders this limitation obvious." *Id.*

Patent Owner argues that "[i]n the analysis of Claim Element 1.1, the Petition maps the claimed 'memory' to both the 'main memory (RAM)' and 'hard disk' of a personal computer," but for "the 'roof estimation module being stored on the memory' aspect of Element 1.2, Petitioner points to installing Linder's 'digital photogrammetric software package' from a 'CD-ROM' to the 'hard disk' of a personal computer." PO Resp. 71 (citing Pet. 21–22). However, Patent Owner argues, the '961 patent distinguished "memory" storage from "hard disk" storage when discussing the roof estimation module. *Id.* at 72 (citing Ex. 2010 ¶ 110). Specifically, according to Patent Owner, Figure 7 of the '961 patent distinguishes the "roof estimation module" stored on memory 701, from a "hard disk," which is described as being included in "other computer-readable media" 705. *Id.* at 72–73 (citing Ex. 1001, 10:46–48; 10:62–11:4, Fig. 7). Thus, Patent Owner contends, the '961 patent "clearly distinguishes between the 'roof estimation module' being stored on 'memory' and being stored on a 'hard disk.'" *Id.* at 73 (citing Ex. 2010 ¶¶ 110–111).

Petitioner responds that "[t]he fact that a single example of the '961 patent shows multiple types of memory does not change the fact that a hard disk and CD-ROM are both examples of memory that would have been readily recognizable" to a person of ordinary skill. Pet. Reply 26 (citing Ex. 1028 ¶¶ 52–53; Ex. 1003 ¶¶ 39-40). "Indeed," Petitioner argues, one of ordinary skill "would have been readily aware that execution of software by a computing device (as disclosed by all three of Littleworth, Linder, and

Middlebrook) indicates storage of the software in a memory." *Id.* (citing Ex. 1005, 754; Ex. 1012, 13–15; Ex. 1028 ¶¶ 52-53; Ex. 1003 ¶¶ 39-40; Ex. 1030 78:1-2). According to Petitioner, "[t]here is no recitation in the claims regarding whether the memory must be volatile memory or any other characteristics for the memory." *Id.*

Based on the full trial record, we agree with Petitioner that "the roof estimation module being stored on the memory" would have been obvious based on the proposed combination. We agree with Dr. Forsyth that one of ordinary skill "would have known that both RAM and a hard disk are examples of memory," and we do not see anything in the '961 claims or specification that would act as a definition or disclaimer of the scope of the term "memory" so that it covers only volatile memory and excludes non-volatile memory (such as a hard disk). Ex. 1028 ¶ 52; Ex. 1001. We further agree with and find credible Dr. Forsyth's testimony that, even if the claims did require the roof estimation module to be stored on volatile memory such as RAM, one of ordinary skill "would have been readily aware that execution of software by a computing device (such as the CAD software described by all three of Littleworth, Linder, and Middlebrook) indicates a memory storing the software so that it can be executed by one or more processors." Ex. 1028 ¶ 53 (citing Ex. 1003 ¶¶ 39–40).

Therefore, based on the full trial record, we find that Petitioner has sufficiently shown that the prior art discloses this limitation.

d) [1.3]: "receive a plurality of aerial images of a building having a roof, the plurality of aerial images having been taken independent of each other, at different times and on different dates,"

Petitioner argues that, "[i]n the combination, Littleworth describes receiving a plurality of aerial images of a building having a roof," including "receiving 'vertical aerial photography' of a building having a roof, and aerial 'oblique photography' of the same building." Pet. 23 (citing Ex. 1005, 755, 756, Fig. 3). "In addition," according to Petitioner, "Littleworth describes that that 'vertical aerial photography' was '3 years old,' and '[i]t was decided to supplement the vertical photography with oblique photography (Fig. 3) taken from the roof of a conveniently situated building on the site.'" *Id.* "Because the 'vertical aerial' images were taken 3 years before the 'oblique' images," Petitioner contends, a person of ordinary skill "would have understood or at least found it obvious that the 'vertical aerial photography' and the 'oblique photography' were 'taken independent of each other, at different times and on different dates.'" *Id.* (citing Ex. 1003 ¶ 42; Ex. 1005, 755, 756, Fig. 3; Ex. 1001, claim 1; Ex. 1008, code (57), 1:17–2:60, 18:3–28, Fig. 1).

According to Petitioner, "Littleworth explains that 'it was important that recent photography be used [to supplement the vertical aerial images] to get the most from the photogrammetric work and reduce the amount of field completion required.'" *Id.* (citing Ex. 1005, 756). "In addition," Petitioner argues, "Littleworth teaches that the aerial images were obtained independently from different sources (*e.g.*, 'several aerial photographic libraries and archives' and a 'UMK 10/1318' camera)." *Id.* at 23–24 (citing Ex. 1005, 755-56; Ex. 1003 ¶ 42). "Accordingly," Petitioner contends, "the

combination of Littleworth, Linder, and Middlebrook renders this limitation obvious." *Id.* at 24.

Patent Owner does not present arguments regarding this limitation. *See* PO Resp.

Based on the full trial record, we find that Petitioner has sufficiently shown that the prior art discloses this limitation.

> e) *[1.4]: "the aerial images providing different views from each other of the roof of the building, the plurality of aerial images including at least a first aerial image that is a top plan view of the roof and a second aerial image that is an oblique perspective view of the roof"*

Petitioner argues that "Littleworth describes receiving a plurality of aerial images of a building having a roof," including "receiving '***vertical*** aerial photography' (*i.e.*, a top plan view) of a building having a roof, and aerial 'oblique photography' (*i.e.*, an oblique perspective view) of the same building." Pet. 24 (citing Ex. 1005, 755, 756, Fig. 3; Ex. 1003 ¶ 44). "Also in the combination," Petitioner asserts, "Linder teaches that a 'vertical image[]' is taken 'camera looking down' on a subject, thereby producing a top plan view in the resulting image." *Id.* (citing Ex. 1012, 111; Ex. 1003 ¶ 44). Petitioner further argues that Littleworth provides an example of "oblique photography" in Figure 3. *Id.* at 24–25 (citing Ex. 1005, Fig. 3); *see* Ex. 1005, 756 ("It was decided to supplement the vertical photography with oblique photography (Fig. 3) taken from the roof of a conveniently situated building on the site."). "Accordingly," Petitioner contends, the prior art "renders this limitation obvious." Pet. 25.

Patent Owner argues that "Littleworth's 'oblique photography' cannot disclose or render obvious an 'aerial' image because Littleworth states that its 'oblique photography' is captured from a ***ground-based*** (or terrestrial)

camera located on a nearby building, rather than from the air." PO Resp. 55 (citing Ex. 2010 ¶ 83; Ex. 1005, 756).

We find that Petitioner has made a sufficient showing as to this limitation. We do not agree with Patent Owner's argument that Littleworth's oblique photography cannot be an "aerial" image because it was taken from a nearby building, because this argument is based on Patent Owner's claim construction of "aerial image" as excluding all "ground-based" images, which we do not adopt. As discussed in Section II.A.5, we have construed "aerial image" to mean "an image taken from the air," which can include an image from a raised, ground-based platform, such as a building, hill, or tower, that appears to have been taken from the air. Littleworth's image taken from a nearby building therefore falls within the scope of an "aerial image."

f) [1.5]: "wherein at least one of the first and/or second aerial images is calibrated using calibration information received from the calibration module"

Petitioner argues that, "[i]n the combination, Littleworth describes scale information (*i.e.*, calibration information) supplied with the aerial images." Pet. 26 (citing Ex. 1005, 755 ("vertical aerial photography at a scale of 1:5000 was located"); Ex. 1003 ¶ 47). Petitioner also asserts that "Linder describes that its CAD system stores information from '***calibration certificate[s]***' or the 'camera manual[s]' associated with different cameras," and that "[a] calibration certificate includes information used to calibrate images taken with the associated camera, including 'number of columns and rows of the sensor, position of the image principal point in x and y in [mm] . . . focal length in [mm] . . ., [and] the pixel size in columns and rows in [μm]." *Id.* (citing Ex. 1012, at 127; Ex. 1003 ¶ 48). "This information,"

according to Petitioner, "may be combined with additional information supplied by an image database, such as altitude data of the image capture, in order to generate calibration information, such as scale information, for the aerial images." *Id.* (citing Ex. 1012, 8). "Accordingly," Petitioner contends, "the combination of Littleworth, Linder, and Middlebrook renders this limitation obvious." *Id.*

Petitioner also argues, as it did for limitation [1.2], that it would have been obvious "to subdivide the combined software system of Littleworth, Linder, and Middlebrook into different modules in order to group related functionality, such as the calibration functionality." Pet. 25; *see* § II.E.5(c), *supra*.

Patent Owner responds that "Littleworth discloses images that are ***already calibrated*** when received," as "confirmed by page 755 of Littleworth, which states that the images were obtained from existing photographic libraries (i.e., physical prints of the images or associated negatives) at a scale of 1:5000." PO Resp. 56 (citing Pet. 26; Ex. 1005, 755; Ex. 1003 ¶ 47; Ex. 2010 ¶ 87). "Thus," Patent Owner argues, "Littleworth does not and cannot disclose these limitations because Littleworth does not receive calibration information for an image *and then* calibrate the image." *Id.* (citing Ex. 2010 ¶¶ 86–87). "Instead," according to Patent Owner, "the images in Littleworth are already calibrated at a scale of 1:5000." *Id.* (citing Ex. 1005, 755; Ex. 2010 ¶ 87). Patent Owner further argues that "Petitioner admits that Linder's calibration certificates require 'additional information' from some undisclosed 'image database' to 'generate calibration information.'" *Id.* at 57 (citing Pet. 26). "Thus," according to Patent Owner, "Linder 'generate[s]' calibration information rather than receiving it, as

required by the challenged claims," and "Petitioner does not show how any calibration that is purportedly received is then 'us[ed]' to calibrate images as further required by the claims." *Id.*

Patent Owner also argues that "Petitioner does not explain why a [person of ordinary skill in the art] would have modified Littleworth to include the purported calibration techniques from Linder." PO Resp. 57–58 (citing Pet. 15–20; Ex. 2010 ¶ 90). Patent Owner asserts that the Petition "spends multiple pages analyzing why a [person of ordinary skill in the art] allegedly would have modified Littleworth to include Linder's teachings related to *correlation*," but "the Petition does not explain how or why [a person of ordinary skill] would have modified Littleworth 'to *calibrate* at least one aerial image . . . as described by Linder." *Id.* at 58 (citing Pet. 15; Ex. 2010 ¶¶ 91–92). Patent Owner also contends that Petitioner fails to articulate why a person of ordinary skill "would have had a reasonable expectation of success in modifying Littleworth 'to calibrate at least one aerial image . . . as described by Linder." *Id.* at 59 (citing Pet. 15–20; Ex. 2010 ¶ 93).

Petitioner responds that Patent Owner's "assertion that Littleworth's images 'are already calibrated' has no support in the record." Pet. Reply 20 (citing PO Resp. 56; Ex. 1028 ¶ 45). According to Petitioner, "Littleworth indicates that the scale of the images is known but does not disclose that the images are calibrated ahead of time or that other calibration (such as that disclosed by Linder) would not be necessary." *Id.* (citing Ex. 1005, 756). "Rather," Petitioner argues, one of ordinary skill "would have understood that the known photo scale of Littleworth is calibration data that is received

and used to calibrate the photos to measure the size of objects in the photos." *Id.* (citing Ex. 1028 ¶ 45).

"Indeed," Petitioner asserts, "Littleworth describes calibrating the images by using 'the photographic scale to determine the final accuracy' of the identified control points. Pet. Reply 20–21 (citing Ex. 1005, 756). "Therefore," Petitioner contends, "Littleworth discloses receiving calibration information (the scale information)" and "teaches calibrating the images using the calibration information." *Id.* at 21 (citing Ex. 1028 ¶¶ 45–46; Ex. 1003 ¶ 43; Ex. 1012, 8-10). "This image calibration using received scale information" according to Petitioner "includes converting distance in pixels to a physical length, such as by using the altitude (hg) and focal length (f)," and "includes calibration between the co-ordinate system of the camera, the co-ordinate system of the film, and the co-ordinate system of the three-dimensional object (terrain)." *Id.* (citing Ex. 1012, 1–3, 5, 8–10; Pet. 26). "Converting the distance between coordinates in the coordinate systems of the camera or film to the real-world lengths of the 3D object," Petitioner contends, "is an express example of calibrating an image as described in the '961 patent." *Id.* at 22 (citing Ex. 1001, 6:44–50, 4:57–60).

With respect to motivation to combine, Petitioner argues that "[t]he Petition identifies that Linder's calibration techniques would have been predictably applied to Littleworth as part of the correlating process of Linder," because "Linder's calibration of the images is an integral part of identifying the control points and generating the three-dimensional model." Pet. Reply 23–24 (citing Pet. 15–16; Ex. 1003 ¶¶ 30, 32. "The benefits of applying Linder's correlating process to Littleworth described in the Petition," Petitioner asserts, "are therefore also benefits derived from

Linder's calibration techniques." *Id.* at 24 (citing Pet. 16–20; Ex. 1028 ¶¶ 47–48).

Patent Owner responds that Petitioner's Reply "sets forth entirely new theories" and "rel[ies] on entirely new portions of Linder not found in the Petition." PO Sur-reply 16 (citing Pet. Reply 20–23). "Therefore," Patent Owner argues, "the Board should decline to consider or adopt Petitioner's new arguments related to receiving 'calibration information' before performing calibration." *Id.* at 17.

We agree that Petitioner has made a sufficient showing as to this limitation, and note that Patent Owner does not dispute the explanation provided in Petitioner's Reply other than to argue that it is improper new argument that should be disregarded. We disagree with Patent Owner's assertion in this regard. The Petition argued that Littleworth discloses receiving calibration information in the form of scale information, and calibrates the images using this scale information. Pet. 26. The Petition also argued that Linder receives calibration information in the form of a "calibration certificate," and uses it to calibrate the images. *Id.* Petitioner's Reply merely fleshed out and further explained these arguments in response to Patent Owner's argument that Littleworth's images are already calibrated when received and that Linder generates calibration information rather than receiving it. PO Resp. 56–57. This is a permissible use of a reply brief and does not add "an entirely new theory" of unpatentability to the Petition. *See Corephotonics, LTD. v. Apple Inc.*, 84 F.4th 990, 1008 (Fed. Cir. 2023) ("The 'newness' restriction prohibits the petitioner from raising, in reply, 'an entirely new theory of *prima facie* obviousness absent from the petition.'")

With respect to motivation to combine, Petitioner has argued and introduced testimony from Dr. Forsyth that Littleworth itself discloses calibration of aerial images. *See* Pet. 26; Ex. 1003 ¶ 47. Specifically, Dr. Forsyth testifies that "[i]n the combination, Littleworth describes scale information (*i.e.*, calibration information) supplied with the aerial images," and references Littleworth's disclosure that "vertical aerial photography at ***a scale of 1:5000*** was located." Ex. 1003 ¶ 47 (citing Ex. 1005, 755). Therefore, a combination of Linder with Littleworth is not necessary to meet this limitation.

Additionally, Dr. Forsyth testifies that Linder describes the "calibration certificates" as part of Linder's CAD system, and notes that Littleworth also describes the use of a CAD system (like AutoCAD) in its analytical photogrammetry projects. Ex. 1003 ¶ 48. Dr. Forsyth also explains that because of the similarities between the systems, one of ordinary skill "would have found it obvious to modify Littleworth's CAD system based on the teachings of Linder" because "doing so entails the use of known solutions to improve similar systems and methods in the same way." *Id.* ¶ 36. Additionally, Dr. Forsyth testifies that "applying the teachings of Linder" to "augment Littleworth's CAD system would have led to predictable results without significantly altering or hindering the functions performed by Littleworth's system," and one of ordinary skill "would have had a reasonable expectation of success modifying Littleworth based on Linder." *Id.* ¶¶ 36–37.

Based on the full trial record, we find that Petitioner has made a sufficient showing as to this limitation.

g) *[1.6]: "perform image analysis on at least two of the plurality of aerial images;"*

Petitioner argues that in the Littleworth-Linder-Middlebrook combination, "Linder describes performing image analysis including correlating multiple aerial images (*e.g.*, the 'vertical aerial' and 'oblique' images from Littleworth)." Pet. 26–27 (citing Ex. 1005, 754; Ex. 1012, 32, 41, 46–50, 65–69, Fig. 15, Fig. 17; Ex. 1003 ¶ 49; Ex. 1024, 1). "For example," Petitioner asserts, "Linder explains that '[t]he programme carries out ***an image matching algorithm***' using 'control points' appearing in both images." *Id.* at 27 (citing Ex. 1012, 40–41, 100–102). According to Petitioner, Linder also "explains that during this image matching process 'the programme compare[s] parts of ***two different images showing the same object from different positions***,'" and then "***correlate[s] both images*** in well-known positions taken for example from the control point file." *Id.* (citing Ex. 1012, 46–50). Petitioner contends that one of ordinary skill "would understand the image correlation described in Linder to be image analysis." *Id.* (citing Ex. 1003 ¶ 50; Ex. 1012, 32, 41, 46–50, 65–69, Fig. 15, Fig. 17).

Patent Owner argues that one of ordinary skill would not have been motivated to combine Littleworth and Linder to achieve this limitation because such a person "would have known that Linder is limited to ***stereoscopic*** correlation and would not have been suitable for correlating the ***non-stereoscopic*** vertical aerial imagery and oblique imagery from Littleworth." PO Resp. 31. Patent Owner asserts that "the two sets of images Petitioner relies on from Littleworth (i.e., vertical photography and oblique photography) are not stereoscopic pairs," as shown by Figure 3's oblique image having "a drastically different view than a 'vertical' image

that includes a top plan view of a roof.'" *Id.* at 45 (citing Ex. 1005, 755; Fig. 3); *see id.* (citing Ex. 2015, 17; Ex. 2012, 33:8–12; Ex. 2010 ¶ 74). Patent Owner acknowledges that, at the time of the invention, one of ordinary skill "would have understood how to correlate a pair of stereoscopic images, as described in Linder," but argues that one of ordinary skill "seeking to correlate *non-stereoscopic* images (e.g., a top plan view image and an oblique image) would not have looked to Linder's technique that is for correlating *stereoscopic* images" and would have had difficulty applying Linder to non-stereoscopic images. *Id.* at 45–50 (citing Ex. 2010 ¶¶ 75–80; Ex. 2016, 1:42–45; Ex. 1012, 6–7, 10–11, 42–43, 49, Figs. 6, 40; Ex. 2015, 296); *see also id.* at 31–44 (arguing that "Linder correlates only *stereoscopic* images").

In response, Petitioner argues that Linder's teachings are not restricted to stereoscopic image pairs. Pet. Reply 5. Petitioner argues that "Linder includes no reference to 'stereoscopic pairs' and only minimal, passing references to the terms 'image pair' or 'stereo images,'" and includes "numerous examples of correlating non-stereoscopic images." *Id.* (citing Ex. 1012, 18–19, 22, 121, 133, 145). Petitioner asserts that Patent Owner did not provide a definition of "stereoscopic images," and Petitioner relies on testimony from Patent Owner's expert explaining that stereoscopic images must have "a fixed . . . spatial relationship to them" and must be "taken at the same time," and that "the term 'stereoscopic' applies only to image pairs and not to three or more images." *Id.* at 5–6 (citing Ex. 2010 ¶¶ 56, 61–67; Ex. 1029, 61:22–62:1, 63:16–64:12, 65:2–8, 67:16–17; 70:4–7, 71:5–13, 71:17–72:2, 73:18–74:12). Applying this definition, Petitioner identifies "numerous examples throughout Linder of correlation of images

that do not fit within" the definition. *Id.* at 6 (citing Ex. 1028 ¶¶ 27–30); *see id.* at 8–12 (providing examples from Linder of images that are not stereoscopic pairs). Instead, according to Petitioner, Linder's input images "only need to be 'two (or more) photos from the same object but taken from different positions'" and "[a]ll that is required" is that "[e]ach point on the terrain surface (object point) is represented in at least two images." *Id.* at 7 (citing Ex. 1012, 1–3, 46–50; Ex. 1028 ¶¶ 19, 21–22, 27).

Patent Owner responds that "Petitioner's arguments are based on a strawman definition of 'stereoscopic images' that Petitioner falsely attributes to Dr. Bajaj," and argues that Dr. Bajaj merely "discussed some examples of the stereoscopic images used in Linder" but "in no way provided a definition." PO Sur-reply 1–2 (citing Ex. 1029, 61–74). Patent Owner asserts that Petitioner improperly "focuses on select sentences or portions of sentences, asserting that those snippets stand for broad propositions that are contradicted by the actual disclosure of Linder." *Id.* at 2; *see id.* at 2–8 (discussing Petitioner's examples of non-stereoscopic images in Linder).

Based on the full trial record, we find that Petitioner has made a sufficient showing as to this claim limitation. First, we need not define the term "stereoscopic images" to resolve the issue before us because claim 1 does not require the correlation of "stereoscopic images" or "non-stereoscopic" images and, in fact, never even uses the term "stereoscopic." Claim 1 merely requires that the system "perform image analysis on at least two of the plurality of aerial images." Ex. 1001, 16:12–13. And, although claim 1 requires that the system receives "a plurality of aerial images," including "at least a first aerial image that is a top plan view of the roof and a second aerial image that is an oblique perspective view of the roof," the

claim language does not require that the "image analysis" be performed on these "first" and "second" images. Instead, the "image analysis" need only be performed on "at least two of the plurality of images," which could be any two of the received images, including two oblique perspective view images or two top plan view images. Littleworth also does not use the terms "stereoscopic images" or "non-stereoscopic images," or limit its teaching to images that are not stereoscopic. *See* Ex. 1005. Therefore, the relevant inquiry here is not whether Linder's disclosures or examples are of "stereoscopic images," or what the proper definition of "stereoscopic images" is, but rather is whether one of ordinary skill would have found Linder's disclosure to be pertinent to Littleworth as Petitioner contends.

Turning to Littleworth, we agree with Petitioner that Littleworth identifies "suitable control points" among images followed by "coordinat[ing] all control points" to generate a three-dimensional model. Ex. 1005, 756 ("All sets of photography were studied and suitable control points selected which were coordinated by field survey to give 3-dimensional coordinates"); *id.* ("[I]t was decided to coordinate all control points to the higher precision and allow the photographic scale to determine the final accuracy."); *see* Pet. 9–10, 15–17; Pet. Reply 15; Ex. 1003 ¶ 34; Ex. 1028 ¶ 34. Dr. Forsyth explains that "Littleworth does not describe in detail how these selected control points within the images are used to generate the model," and relies on Linder to describe details of how "images are correlated based on control points within the images as part of generating a three-dimensional model." Ex. 1003 ¶ 34; Ex. 1028 ¶ 34. Therefore, the key issue here is whether one of ordinary skill would have found Linder's teachings to be pertinent to Littleworth's use of control points to generate a

three-dimensional model. As discussed below, we agree with Petitioner and Dr. Forsyth that one of ordinary skill would have so found.

We agree with and find credible Dr. Forsyth's testimony that "Linder describes the properties of images used in its calibration, correlation, and three-dimensional model generation process as simply being 'two (or more) photos from the same object but taken from different positions' such that corresponding points can be identified in both photos to allow for proper correlation." Ex. 1028 ¶ 35. Linder's introduction describes the principle "used to get three dimensional information in photogrammetry," as follows:

> If we have two (or more) photos from the same object but taken from different positions, we may easily calculate the three-dimensional co-ordinates of any point which is represented in both photos. Therefore we can define the main task of photogrammetry in the following way: For any object point represented in at least two photos we have to calculate the three-dimensional object (terrain) co-ordinates.

Ex. 1012, 1–2. We find credible Dr. Forsyth's testimony that these disclosures of Linder directly relate to Littleworth, which "describes identifying 'suitable control points'" in the images used to create the three-dimensional model. Ex. 1028 ¶ 35.

Furthermore, we agree with and find credible Dr. Forsyth's testimony that the designation of the images in Linder as "stereoscopic" or "non-stereoscopic" would not have prevented one of ordinary skill from finding Linder's teachings to be applicable to Littleworth. Ex. 1028 ¶ 39. As Dr. Forsyth explains:

> A [person of ordinary skill in the art] would have recognized that arbitrary classification of techniques as being "stereoscopic" or "non-stereoscopic" would not have prevented certain teachings from one technique from being applied to another technique so long as the application of such teachings

> from one reference to another would have led to beneficial outcomes. In this specific case, Littleworth discloses generating a three-dimensional model from images of the same buildings taken from different angles and Linder discloses techniques for generating such a model based on such images by correlating identified control points. . . . Therefore, even if it were true that Littleworth and Linder fall into two different classifications of photogrammetry (which they do not), a [person of ordinary skill in the art] would have still found Linder's teachings regarding . . . correlation of images to be directly applicable to Littleworth.

Ex. 1028 ¶ 39.

We do not agree with Patent Owner and Dr. Bajaj that Linder's teachings would have no applicability to the images in Littleworth's system. *See* PO Resp. 30–50; PO Sur-reply 1–11; Ex. 2010 ¶¶ 56–80. Dr. Bajaj opines that "Petitioner's obviousness rationale is flawed because Linder does not disclose a correlation between a top plan view image and an oblique perspective view image," but claim 1 does not require such a correlation between a top plan view image and an oblique perspective view image. *See* Ex. 2010 ¶ 63. Claim 1 only requires that the system "perform image analysis on at least two of the plurality of aerial images." Ex. 1001, 16:12–13. For similar reasons, Dr. Bajaj's testimony that "the challenged claims require correlating *non-stereoscopic* images" conflicts with the language of claim 1, which includes no limitation requiring the correlation of non-stereoscopic images. *See* Ex. 2010 ¶ 62; Ex. 1001, 15:62–16:24.

Additionally, we disagree with Dr. Bajaj that one of ordinary skill would not have combined Littleworth and Linder because "the two sets of images Petitioner relies on from Littleworth (i.e., vertical photography and oblique photography) are not stereoscopic pairs." Ex. 2010 ¶ 74. Littleworth does not limit its discussion to the correlation of non-

stereoscopic pairs, but rather contemplates using a variety of images. Ex. 1005, 756 (explaining that "[a]ll sets of photography were studied and suitable control points selected" to "give 3-dimensional coordinates"). As Dr. Forsyth persuasively explains, Linder's teachings "are directly applicable to Littleworth because Littleworth discloses a plurality of images of the same object (in Littleworth's case, various buildings in the London redevelopment area) taken from different positions." Ex. 1028 ¶ 18 (citing Ex. 1005, 756).

Furthermore, the portions of Linder that Dr. Bajaj references do not support the conclusion that Linder has no applicability to Littleworth. For example, Dr. Bajaj references Linder's example on page 11 of a series of images taken by an airplane and "photographed strip by strip, turning around the aircraft after every strip, so that the strips are taken in a meander-like sequence." Ex. 2010 ¶¶ 65, 67 (citing Ex. 1012, 10–11). Dr. Bajaj points to Linder's statement that "[t]he two images of each model have a longitudinal overlap of approximately 60 to 80%," "neighbouring strips have a lateral overlap of normally about 30%," and that "this is not only necessary for stereoscopic viewing but also for the connecting of all images of a block within an aerial triangulation." *Id.* This portion of Linder, however, is only an example, and merely illustrates that there needs to be a certain amount of overlap between the images in order to correlate them. It is consistent with Littleworth, which also contemplates that the overlapping images are correlated by identifying and coordinating "suitable control points" among the images "to create the three-dimensional model." Ex. 1005, 755–756; *see* Ex. 1028 ¶¶ 34–35, 37.

Next, Dr. Bajaj points to Linder's Figure 1 showing "[g]eometry in an oriented *stereo model*" which "depict[s] two representations of an object (P) from the same height and similar views, where one representation is from the left and one representation is from the right." Ex. 2010 ¶ 67. Linder, however, presents Figure 1 to illustrate how "two (or more) photos from the same object but taken at different positions" can be used to "calculate the three-dimensional co-ordinates of any point which is represented in both photos." Ex. 1012, 1–2. As Dr. Forsyth persuasively explains, this principle also applies to Littleworth, which describes correlating images with common control points. Ex. 1028 ¶ 35; Ex. 1005, 756. Dr. Bajaj also points to Linder's statement that "the radial-symmetric displacements are a pre-requisite to view and measure image pairs stereoscopically" (Ex. 2010 ¶ 65 (citing Ex. 1012, 6–7), but we agree with and find credible Dr. Forsyth's testimony that what Linder is describing as a "pre-requisite" is merely "that the images have a sufficient level of overlap" as well as "a sufficient level of displacement (e.g., not exactly overlapping) to allow for three-dimensional measurements to be made from the images," and that these are the "types of images described in Littleworth" (Ex. 1028 ¶ 27).

Next, Dr. Bajaj points to Linder's Figure 15, which shows "two images being correlated" that "appear to have been taken from approximately the same height and similar views, and share a significant portion of overlap between both images." Ex. 2010 ¶ 68 (citing Ex. 1012, Fig. 15). Linder also explains that these images show "the positions of the control points" between the images. Ex. 1012, 41. Dr. Bajaj also points to similar images in Figure 17. Ex. 2010 ¶ 68. As with the previous examples, we agree with Dr. Forsyth that Figures 15 and 17 are applicable to

Littleworth, which also describes correlating overlapping images with common control points. Ex. 1028 ¶ 35; Ex. 1005, 756.

Finally, Patent Owner and Dr. Bajaj rely on other references not cited by Petitioner, but we find that these references do not undermine Petitioner's showing as to this limitation. *See* Ex. 2010 ¶¶ 70–72; PO Resp. 41–43. First, Patent Owner relies on a September 2008 Technical Note from the Bureau of Land Management (Ex. 2017), and points to Dr. Bajaj's testimony that this reference "repeatedly emphasized the need for stereoscopic images to derive accurate 3D data using photogrammetry." Ex. 2010 ¶ 70 (citing Ex. 2017, 1–3, 5, 7) PO Resp. 40–41. The Technical Note, however, is not related to Linder and its system and its discussion does not necessarily apply to Linder's teachings. *See* Exs. 1012, 1017. We also agree with and find credible Dr. Forsyth's testimony that this Technical Note is merely "describing stereoscopic viewing principles, rather than specifying that all input images for photogrammetry processes need to be stereoscopic image pairs" and "indicates that all that is required of the images is sufficient 'overlap' for the concept of stereoscopic viewing to be applied." Ex. 1028 ¶ 32 (citing Ex. 2017, 1–2).

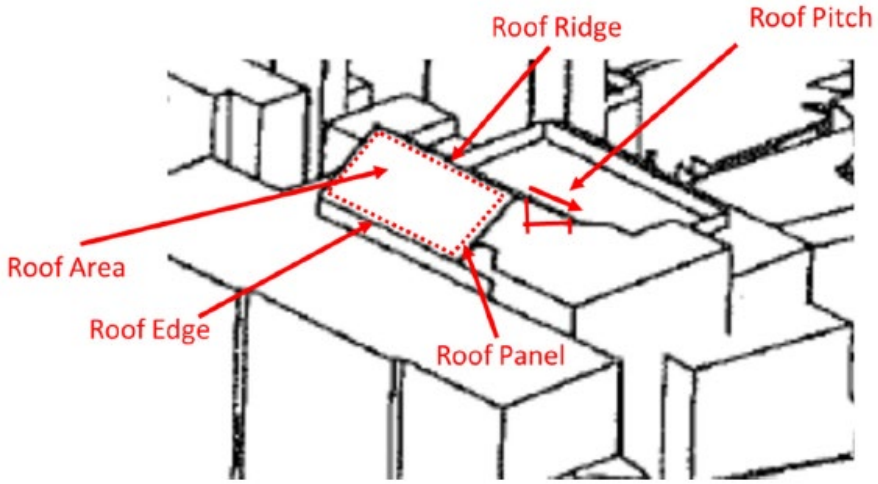
Patent Owner also relies on a statement in a different Littleworth paper (not relied on by Petitioner) that "the requirement[s] . . . for analytic photogrammetry" include "[a] minimum of two photographs taken from slightly differing locations" to "provide[] the stereoscopic overlap (Figure 2) which is essential for deriving three-dimensional information." PO Resp. 42–43 (citing Ex. 2015, 291); Ex. 2010 ¶ 71 (citing Ex. 2015, 291–292). However, we agree with and find credible Dr. Forsyth's testimony that this reference merely "indicates that all that is required to apply the concept of

stereoscopic viewing is a sufficient degree of overlap between the images, not that the images be a stereoscopic image pair." Ex. 1028 ¶ 33.

For the foregoing reasons, we find that Petitioner has made a sufficient showing that it would have been obvious to combine Littleworth and Linder, and that the proposed combination teaches this claim element.

h) [1.7]: "calculate a pitch for each one of a plurality of roof sections of the roof based on the image analysis;"

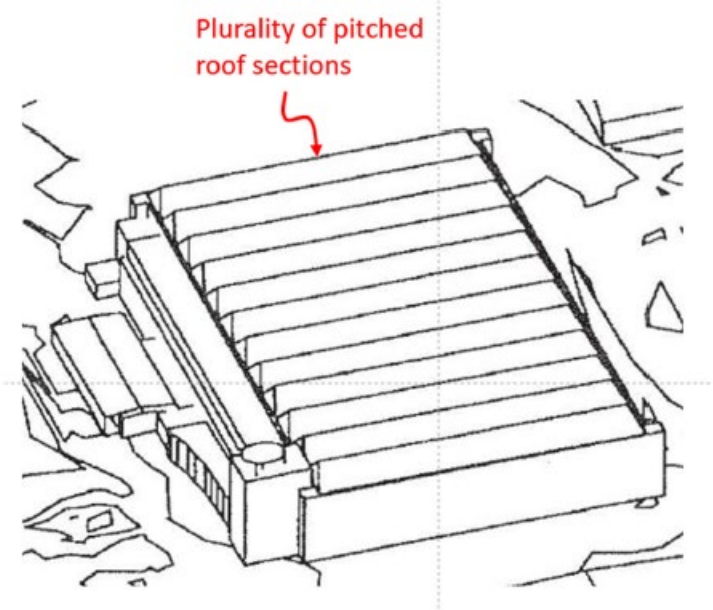
Petitioner argues that in the Littleworth-Linder-Middlebrook combination, "Littleworth teaches determining (or calculating) roof details including roof 'pitch' for a plurality of roof sections of a building's roof, as evidenced by Littleworth's three-dimensional model including angled sections modeling a building's pitched roof." Pet. 27 (citing Ex. 1005, 755, Figs. 1–2, 5). "For example," Petitioner asserts, "Littleworth shows a three-dimensional model of a building including a pitched roof having two sections" in Figure 5, reproduced below with Petitioner's annotations included in red. *Id.* at 27–28.



Petitioner's annotated version of a portion of Figure 5 of Littleworth showing different parts of a pitched roof annotated in red. Pet. 28 (citing Ex. 1005, 754).

Petitioner argues that "[t]he inclusion of a pitched roof in Littleworth's three-dimensional model of the roof indicates that Littleworth's system made a determination of the pitch of the roof shown in the aerial images from which the model was generated." Pet. 28 (citing Ex. 1003 ¶ 52; Ex 1005, 755 ("Roof detail was digitised indicating their pitch [and] major details on the roofs themselves."), Figs. 1–2, 5).

Petitioner argues that "Littleworth provides multiple additional examples of three-dimensional models of pitched roofs having multiple roof sections, such as the model shown in the following detail from FIG. 2," which is reproduced below with Petitioner's annotations. Pet. 28.

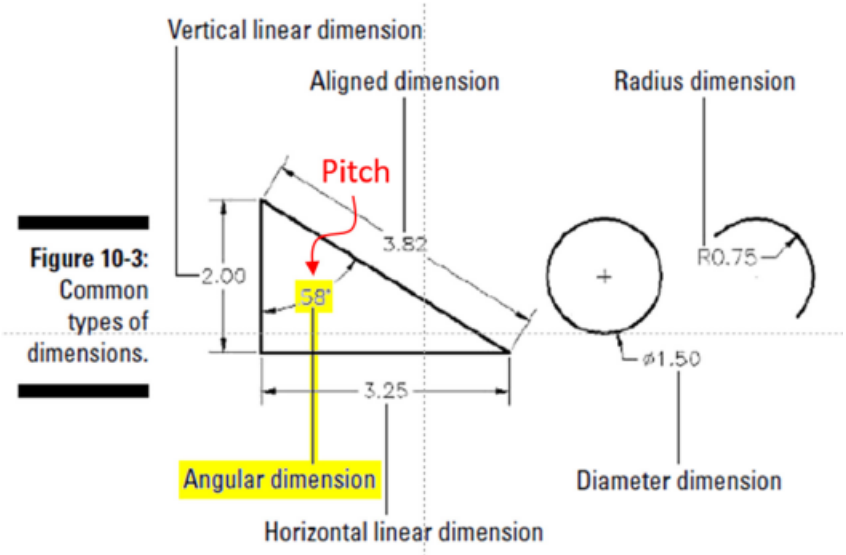


Petitioner's annotated version of a portion of Figure 2 of Littleworth showing a plurality of pitched roof sections. Pet. 28–29 (citing Ex. 1005, 755).

Petitioner argues that, as shown in the annotated portion of Figure 2 above, "the roof of the modeled structure includes 12 different pitched portions, each having 2 roof sections." Pet. 29 (citing Ex. 1005, Fig. 2; Ex. 1003 ¶ 54). "Again," Petitioner asserts, "because Littleworth teaches that its

three-dimensional models are generated based on aerial images, the inclusion of these pitched roof sections in the three-dimensional model of FIG. 2 indicates that the system calculated the pitch of each roof section." *Id.* (citing Ex. 1003 ¶ 54; Ex. 1005, 755 ("Roof detail was digitised indicating their ***pitch*** [and] major details on the roofs themselves."), Figs. 1–2, 5).

Alternatively, Petitioner argues that "Middlebrook teaches automatically 'calculat[ing] distances and dimensions' from a three-dimensional model," including "'[a]ngular dimensions' (*i.e.* pitch)," as shown in Petitioner's annotated version of Middlebrook's Figure 10-3, reproduced below. Pet. 29–30.



Petitioner's annotated version of Middlebrook's Figure 10-3 showing dimensions provided by AutoCAD, including angular dimension. Pet. 29–30 (citing Ex. 1006, 232–233; Fig. 10-3).

Petitioner argues that, in the combination, "the CAD system of Littleworth is modified to annotate the three-dimensional model with numerical values indicating various properties, such as the pitch of angled sections of a model (e.g., a roof), as taught by Middlebrook." *Id.* at 30 (citing Ex. 1003 ¶ 56). And, Petitioner contends, "[t]o the extent this limitation is interpreted to

require calculation of an explicit numerical value for the pitch of the roof sections," Middlebrook "teaches such a calculation," and the combination modifies Littleworth's CAD system "to include this functionality." *Id.* at 30–31 (citing Ex. 1003 ¶ 56).

Patent Owner argues that Petitioner fails to demonstrate that the references necessarily calculate a pitch based on the image analysis. PO Resp. 60–71. As to Littleworth, Patent Owner asserts that Petitioner "does not identify any disclosure from Littleworth stating that Littleworth actually *calculates or determines* a pitch that is suitable for use in a roof report, let alone doing so based on performing actual image analysis." *Id.* at 62 (citing Ex. 2010 ¶¶ 98–99). "Instead," Petitioner contends, "Petitioner appears to rely on what it believes is an inherent disclosure in Littleworth that creating a three-dimensional model of a roof necessarily requires the system to calculate or determine the pitch of each roof section shown in the model," but "Petitioner has not explained why that is necessarily true." *Id.* at 62. According to Patent Owner, Littleworth's statement that "[r]oof detail was digitised indicating their pitch" "merely indicates that an angled roof is generally shown in the visualized model," but "depicting an angled roof *visually* in a 3D rendering is not the same as calculating or determining a numerical pitch value of a roof." *Id.* at 65 (emphasis added) (citing Ex. 2010 ¶ 102). Patent Owner further argues that Dr. Forsyth agreed at his deposition that "Littleworth is obscure on the question of whether there is a particular number of pitch in his system" and "I don't think it is necessarily the case that Littleworth calculates the numerical value of pitch." *Id.* at 62–63 (emphasis omitted) (citing Ex. 2012, 14:18–20, 15:2–4).

Patent Owner also points to Littleworth's statement that digitized features "act as a background template from which shapes representing roofs and walls are interpolated," and argues that "[i]nterpolation" here "generally refers to the process of filling in gaps in shapes" and "where information is not otherwise available to accurately reflect the content of gaps in a computed image." PO Resp. 63 (emphasis omitted) (citing Ex. 2010 ¶ 100; Ex. 1012, 53). Thus, Patent Owner contends, "the interpolated roof sections in Littleworth do not necessarily reflect a calculation or determination of the pitch of those roof sections," much less a calculation that "is suitable for use in a roof report." *Id.* at 63–64 (citing Ex. 2010 ¶¶ 100, 104). Patent Owner also points to Dr. Forsyth's deposition testimony that "[t]here are all sorts of ways of creating the model in Figure 1, ***including just sitting down on a CAD work session and drawing it out***." *Id.* at 64 (citing Ex. 2012, 20:15–17); *see id.* at 66–67. Patent Owner further argues that the "degree of expected inaccuracy" in Littleworth's model "would significantly alter the pitch calculation or determination of a given roof section," and thus "shows that the model is *not* calculating or determining the pitch of the roof sections." *Id.* at 64 (citing Ex. 2001 ¶ 101).

With respect to Middlebrook, Patent Owner argues that the portions of Middlebrook cited by Petitioner do not calculate or determine a pitch based on aerial image analysis, but rather "merely provide basic information about setting up AutoCAD for drawing and displaying and, then, define what an 'angular dimension' means for the AutoCAD model." PO Resp. 67 (citing Ex. 2010 ¶ 105). More specifically, Patent Owner argues that page 42 of Middlebrook does not describe "automatic calculations of distances or dimensions from an image analysis," but instead "simply states that, when

drawing in AutoCAD, a user may draw in 'real-life units' such as 'feet and inches, millimeters,' etc., and AutoCAD will then 'calculate distances and dimensions for you and add them to the drawing.'" *Id.* at 67–68 (citing Ex. 1006, 42; Ex. 2010 ¶ 106). Patent Owner also contends that Middlebrook requires the user to provide "the basic dimension parameters for the drawing," such as "drawing scale, paper size, and units" to use this basic functionality of the AutoCAD system, and states that "[t]he computer ***can't*** aid [the user's] drafting (or design)' unless the user provides such information." *Id.* at 68–69 (citing Ex. 1006, 42; Ex. 2010 ¶ 106).

Patent Owner further argues that Middlebrook's Figure 10-3 and accompanying pages 232 and 233 do "not describ[e] any calculations at all," but rather "are merely a 'review' of 'AutoCAD dimensioning terminology.'" PO Resp. 69 (citing Ex. 1006, 231; Ex. 2010 ¶ 107). "Thus," Patent Owner contends, "when Middlebrook refers to '[a]ngular dimensions' on page 233, Middlebrook is merely defining that term." *Id.* (citing Ex. 1006, 233; Ex. 2010 ¶ 107). Additionally, Petitioner contends, none of the cited disclosures of Middlebrook "refer[] to the pitch of a roof" or "disclose[] *calculating or determining* the pitch of a roof" based "on aerial image analysis." *Id.* at 69–70 (citing Ex. 2010 ¶ 1007). Finally, Patent Owner argues that Petitioner never explains how any purported calculation or determination of pitch in the references is "based on the image analysis." *Id.* at 70–71 (emphasis omitted) (citing Ex. 2010 ¶¶ 107–108).

Petitioner responds that "[i]n describing the three-dimensional model, Littleworth states that '[r]oof detail was digitized ***indicating their pitch***,' indicating that the pitches are calculated as part of the three-dimensional model generation, based on the image analysis." Pet. Reply 25 (citing

Pet. 27–29; Ex. 1003 ¶¶ 51–54; Ex. 1005, 754–756). "Therefore," Petitioner argues, "the various geometric parameters determined as part of the three-dimensional model generation process (including pitch/slope) are determined based on the image analysis." *Id.* (citing Ex. 1028 ¶¶ 49–51; Pet. 26–31; Ex. 1003 ¶¶ 51–56). Additionally, according to Petitioner, Linder describes "this calculation of pitch/slope" of "buildings depicted in the images through generation of the three-dimensional model." *Id.* (citing Pet. 17, 30–31; Ex. 1012, 3). Finally, Petitioner contends, "Middlebrook's disclosure of displaying angular dimensions of three-dimensional CAD models indicates to [a person of ordinary skill in the art] that the angular dimensions were calculated," and the combination thus "provides displaying a calculated numerical value for pitch of each roof section." *Id.* at 25–26 (citing Pet. 17–19, 29–31, 12–14; Ex. 1003 ¶¶ 55–56, 34–38; Ex. 1006, 42, 62–65, 229–233; Ex. 1028 ¶ 51).

Patent Owner responds that Littleworth's statement that "[r]oof detail was digitised indicating their pitch" does not mean that "Littleworth necessarily calculates or determines a pitch" because "the preceding sentence of Littleworth clarifies what 'indicating their pitch' means in this context" by explaining that the detail digitized "gave a good visual impression of how these features actually appear." PO Sur-reply 19 (citing Ex. 1005, 755). Patent Owner also argues that Petitioner's argument that Linder calculates pitch/slope is an improper new argument that should be disregarded. *Id.* at 20–21.

We determine that Petitioner has sufficiently proven that this limitation would have been obvious over the proposed combination. In particular, Littleworth states that "[r]oof detail was digitised indicating their

pitch [and] major details on the roofs themselves," and Petitioner has introduced testimony from Dr. Forsyth that "[t]he inclusion of a pitched roof in Littleworth's three-dimensional model of the roof indicates that Littleworth's system made a determination of the pitch of the roof shown in the aerial images from which the model was generated." Ex. 1005, 755; Ex. 1003 ¶¶ 52, 54. We also find that Middlebrook teaches that AutoCAD can "calculate distances and dimensions" from a three-dimensional model and "add them to the drawing," including "[a]ngular dimensions" (i.e., pitch). Ex. 1006, 42, 232–233, Fig. 10-3; Ex. 1003 ¶ 55. Moreover, Petitioner does not rely on this disclosure in isolation but rather combines it with Littleworth's CAD system "to annotate the three-dimensional model" created by Littleworth "with numerical values indicating various properties, such as the pitch of angled sections of a model (e.g., a roof), as taught by Middlebrook." Pet. 30; Ex. 1003 ¶ 56. Therefore, we agree with and find credible Petitioner's and Dr. Forsyth's assertions that Middlebrook teaches "calculation of an explicit numerical value for the pitch of the roof sections." Pet. 30–31; Ex. 1003 ¶ 56.

We do not agree with Patent Owner's arguments to the contrary. As for Patent Owner's argument that Petitioner does not show that Littleworth inherently discloses determining a pitch, we do not understand Petitioner to be relying on inherency, but rather to argue that one of ordinary skill would have understood from Littleworth's statement that roof detail was digitized "indicating their pitch" that Littleworth's system calculates the pitch in order to create and display the model. *Id.* As for the deposition testimony of Dr. Forsyth cited by Patent Owner, we note that Dr. Forsyth also testified that "[i]f the detail that is digitized indicates pitch, then pitch has been

determined," and even if Littleworth did not expressly "calculate[] a numerical value of pitch," Littleworth calculates "numbers equivalent to pitch," such as "slope." Ex. 2012, 14:1–15:6. Moreover, as discussed above, we find that Middlebrook teaches calculating an explicit numerical value for a pitch based on a three-dimensional model, and that it would have been obvious to combine this teaching of Middlebrook with Littleworth as Petitioner proposes. *See* Pet. 30–31; Ex. 1003 ¶ 56.

As to Patent Owner's assertion that "the interpolated roof sections in Littleworth do not necessarily reflect a calculation or determination of the pitch of [Littleworth's digitized] roof sections," we note that, as Patent Owner acknowledges, "neither Petitioner nor Dr. Forsyth relied on Littleworth's discussion of interpolation to disclose a determination of pitch." PO Resp. 63. And, although Patent Owner argues that interpolation "does not ***require*** calculation of a pitch that is suitable for use in a roof report," Patent Owner does not show that interpolation would be inconsistent with calculation of a pitch of Littleworth's roof sections. *Id.* at 64 (emphasis added). Moreover, the testimony that Patent Owner cites from Dr. Forsyth's deposition stating that "[t]here are all sorts of ways of creating the model in Figure 1 [of Littleworth], ***including just sitting down on a CAD work session and drawing it out***," was in response to a question about how it would be "possible" to create the model in Figure 1, and does not suggest that Littleworth actually discloses having a user sit down and draw out this model. Ex. 2012, 20:4–17; PO Resp. 64. And, with respect to Patent Owner's argument that the "degree of expected inaccuracy" in Littleworth's model "would significantly alter the pitch calculation or determination of a given roof section," we do not see anything in claim 1 that requires any

particular accuracy of the pitch calculation. *Id.* at 64 (citing Ex. 2001 ¶ 101).

Turning to Middlebrook, Patent Owner arguments appear to misperceive the manner in which Petitioner is relying on Middlebrook in the proposed combination. As noted above, Petitioner relies on Middlebrook to teach that, given a three-dimensional model, a CAD system can calculate and display the slope or pitch of a particular portion of the model. Petitioner combines this disclosure with Littleworth's three-dimensional model to annotate the model with numerical values indicating the pitch of Littleworth's roof sections. Pet. 29–30; Ex. 1003 ¶¶ 55–56. Patent Owner argues that Middlebrook does not disclose "automatic calculations of distances or dimensions from an image analysis," but instead allows a user to draw in AutoCAD and have the system "calculate distances and dimensions for you and add them to the drawing." PO Resp. 67–68. However, Petitioner relies on Littleworth, not Middlebrook, for the automatic generation of the model from images in the system, and merely relies on Middlebrook to teach that a CAD system can calculate and display the pitch of a portion of a three-dimensional model. Pet. 29–30; Ex. 1003 ¶¶ 55–56; Ex. 1006, 42 (explaining that Middlebrook's AutoCAD system can "calculate distances and dimensions for you and add them to the drawing").

Similarly, Patent Owner's argument that the user in Middlebrook must provide "the basic dimension parameters for the drawing" does not detract from the key teaching of Middlebrook upon which Petitioner relies—the ability to calculate a pitch based on a three-dimensional model. *See* PO Resp. 68–69; Pet. 29–30. As to Middlebrook's display of a numerical

"angular dimension" in Figure 10-3, although we agree with Patent Owner that this portion of Middlebrook defines the term "angular dimensions," we also agree with Petitioner that this drawing shows that Middlebrook's CAD system calculates a numerical value for pitch, which is what Petitioner relies on from Middlebrook in the proposed combination. Ex. 1006, 232–233, Fig. 10-3; PO Resp. 68–69; Pet. 29–30. Additionally, Patent Owner's argument that none of the cited disclosures of Middlebrook "refer[] to the pitch of a roof" or "disclose[] calculating or determining the pitch of a roof" based on "aerial image analysis" misses the mark because Petitioner does not rely on Middlebrook to teach those claim elements. *Id.*

Finally, we do not agree with Patent Owner's argument that Petitioner never explains how the calculation or determination of pitch in the references is "based on the image analysis." *See* PO Resp. 70–71. Rather, we agree with Petitioner and Dr. Forsyth that Littleworth's statement that "[r]oof detail was digitized indicating their pitch" indicates that the pitches are calculated as part of the three-dimensional model generation, which is based on the image analysis. Pet. Reply 25; Ex. 1028 ¶ 49; Pet. 27–29; Ex. 1003 ¶¶ 51–54.

For the foregoing reasons, and based on the full trial record, we find that Petitioner has made a sufficient showing as to this claim limitation.[10]

[10] Patent Owner argues that the Petition never addressed the "determining pitch" element of independent claim 22. PO Resp. 74–75. Petitioner responds that "[a] typographical error in the Petition led to the inadvertent omission of the 'determining pitch' element of claim 22," but argues that "this element of claim 22 is *identical* to" a corresponding element of claim 21, and thus the Petition "demonstrates how the proposed combination provides this element." Pet. Reply 27. We find that the Petition's discussion of the corresponding element in claim 21 demonstrates how the

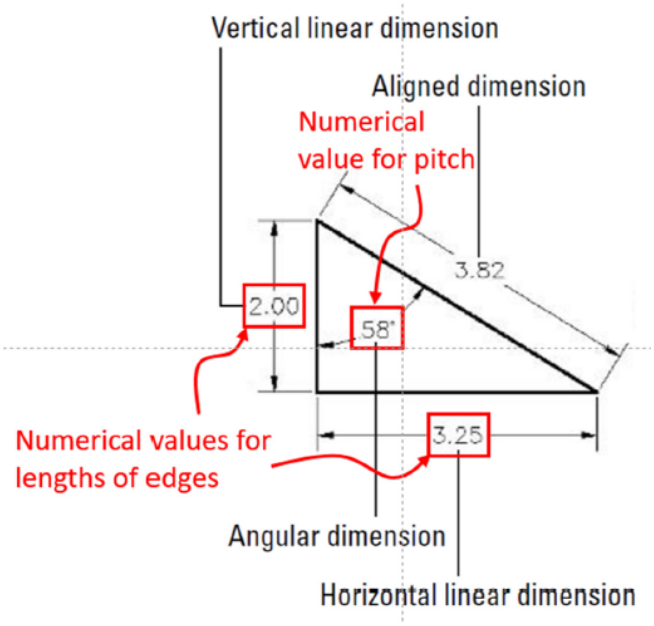
i) *[1.8]: "generate a roof report that includes the pitch of each of the plurality of roof sections based on the calculated pitch; and output the roof report, wherein the roof report includes one or more top plan views of a model of the roof annotated with numerical values that indicate a corresponding pitch, area, and length of edges of at least some of the plurality of roof sections using at least two different indicia for different types of roof properties."*

Petitioner argues that the Littleworth-Linder-Middlebrook combination renders this limitation obvious. Pet. 31–32. "In the combination," Petitioner asserts, "Middlebrook describes annotating a view of a model, such as the roof model described in Littleworth, with different dimension measurements for structures represented in the model." *Id.* at 32 citing Ex. 1006, 229; Ex. 1003 ¶ 57). Petitioner points to Middlebrook's disclosure that "[i]n drafting —either CAD or manual drafting— ***dimensions are special text labels*** with attached lines that together ***indicate unambiguously the size of something***" and that "as you edit an object — by stretching it for example—AutoCAD automatically updates the measurement displayed in the dimension text label to indicate the object's new size." *Id.* (citing Ex. 1006, 230; Ex. 1022, 71–76, Figs. 33–37).

Petitioner also argues that "Middlebrook teaches annotating several different properties using these techniques." Pet. 32. As an example, Petitioner includes an annotated version of Middlebrook's FIG. 10-3 showing "a view of a model annotated with numerical values for lengths of edges and for pitch," as reproduced below. Pet. 32–33.

---

proposed combination teaches this element, and that the statement in Petitioner's Reply is sufficient to correct the typographical error leading to the inadvertent omission of this element in the Petition's discussion of claim 22.



Petitioner's annotated version of Middlebrook's Figure 10-3 showing a view of a model annotated with numerical values for lengths of edges and pitch. Pet. 32–33 (citing Ex. 1006, 232–233, Fig. 10-3; Ex. 1003 ¶ 58).

According to Petitioner, "Middlebrook describes several other types of annotations indicating different dimensions and properties in views of three-dimensional models." Pet. 33 (citing Ex. 1006, Fig. 10-5 (annotating edge lengths and angles of a model having an irregular shape), Fig. 10-10 (annotating edge length, pitch angle, circle radius, and circle diameter)).

Petitioner argues that one of ordinary skill "would have understood that annotated numerical values for the dimensions of each roof section indicate the area for the respective roof section as they could have been used to calculate the area of that roof section." Pet. 33 (citing Ex. 1003 ¶ 60; Ex. 1012, 1, 3; Ex. 1021, Fig. 16). "For example," Petitioner asserts, "the annotated numerical values of the edges of a square or rectangular roof section would have indicated the area of the section to a [person of ordinary skill], who would have been capable of multiplying the length and width of the roof section (shown by the numerical values) mentally to determine the

area of the roof section." *Id.* 34 (citing Ex. 1003 ¶ 60; Ex. 1010, 3:7-26). "Moreover," according to Petitioner, a person of ordinary skill "would have understood that CAD applications offered well-known built-in visualization tools and basic quantity calculation features for calculating roof areas, and that it would have been obvious to annotate a model with such calculations particularly." *Id.* (citing Ex. 1003 ¶ 60; Ex. 1006, 42; Ex. 1010, 3:7–26). Additionally, Petitioner argues, it "would have been obvious to display the area of different roof sections on a roof model or view of a roof model because a [person of ordinary skill] would have understood surface area to be an important characteristic of many modeled objects, and especially of roofs." *Id.* (citing Ex. 1003 ¶ 60; Ex. 1025, 1–6; Ex. 1026, 1–4, Figs. 2–3, 5; Ex. 1010, 3:7–26).

"Additionally or alternatively," Petitioner argues, "Linder explains that 'the basic task [of image analysis] is to get object (terrain) co-ordinates of any point in the photo from which you can then ***calculate geometric data***' such as 'distances, ***areas***, volumes, slopes[,] and much more.'" Pet. 34–35 (citing Ex. 1012, 1, 3). According to Petitioner, it would have been obvious to a person of ordinary skill "to use Linder's teachings for calculating areas of objects to determine '[r]oof detail' of a roof or building object, such as the area of each roof section of a roof having . . . multiple roof sections, such as the roofs shown in FIGS. 2 and 5 of Littleworth." *Id.* at 35 (citing Ex. 1003 ¶ 61; Ex. 1012, 1, 3; Ex. 1005, 755; Ex. 1006, 58, Fig. 8-8; Ex. 1021, 56-59, Fig. 16). "Indeed," Petitioner asserts, one of ordinary skill "would have been motivated to use Linder's teachings to determine the roof area of each of a plurality of roof portions for the reasons [previously discussed] and because the roof area of each roof portion would be an important metric for

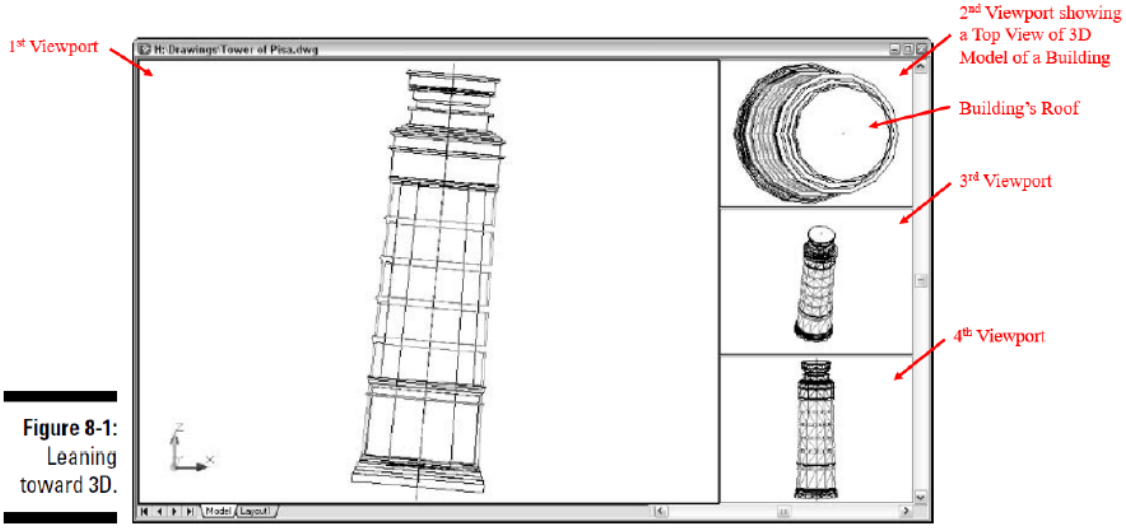
calculating forces on the building." *Id.* (citing Ex. 1003 ¶ 61; Ex. 1005, 755; Ex. 1021 56–59, Fig. 16; Ex. 1025; Ex. 1026, 1–4 Figs. 2–3, 5; Ex. 1010, 3:7–26).

"Furthermore," according to Petitioner, "in the combination, Middlebrook teaches that [the] AutoCAD program calculates geometry data for objects represented in a 3D model, including surface area of the objects." Pet. 35 (citing Ex. 1006, 58, Fig. 8-8). "For example," Petitioner contends, "the AutoCAD program calculates the geometry for a first object in a 3D model containing three objects when the first object is selected." *Id.* (citing Ex. 1006, 58, Fig. 8-8). According to Petitioner, it would have been obvious to a person of ordinary skill "to apply this AutoCAD functionality to a roof object representing a roof section in the 3D model shown in Littleworth to determine the surface area of the roof sections, and a [person of ordinary skill] would have been motivated to do so for the reasons" previously discussed. *Id.* at 35–36 (citing Ex. 1003 ¶ 62; Ex. 1021, 56–59, Fig. 16).

"Also in the combination," Petitioner argues, "Middlebrook provides that the annotations for a view of a model include a variety of indicia in addition to the numerical values." Pet. 36–37. "For example," Petitioner asserts, Middlebrook discloses that the numerical value annotations (e.g., "[d]imension text") on a view of a model are accompanied by different indicia for different type of structural properties. *Id.* at 37 (citing Ex. 1006, 231-42, Figs. 10-2, 10-3, 10-6). For example, "'linear dimension measures' for the edges of a roof section are accompanied by 'extension line' indicia and straight 'dimension line' indicia with 'dimension arrowheads.'" *Id.* (citing Ex. 1006, 231-232, Figs. 10-2, 10-3). "In contrast," according to Petitioner, in Middlebrook "'angular dimension . . . measurement[s]' for the

pitch of the roof sections are accompanied by different indicia in the form of a 'dimension line [that] appears as an arc' with 'dimension arrowheads' and no extension line indicia." *Id.* (citing Ex. 1006, 232-33, Fig. 10-3).

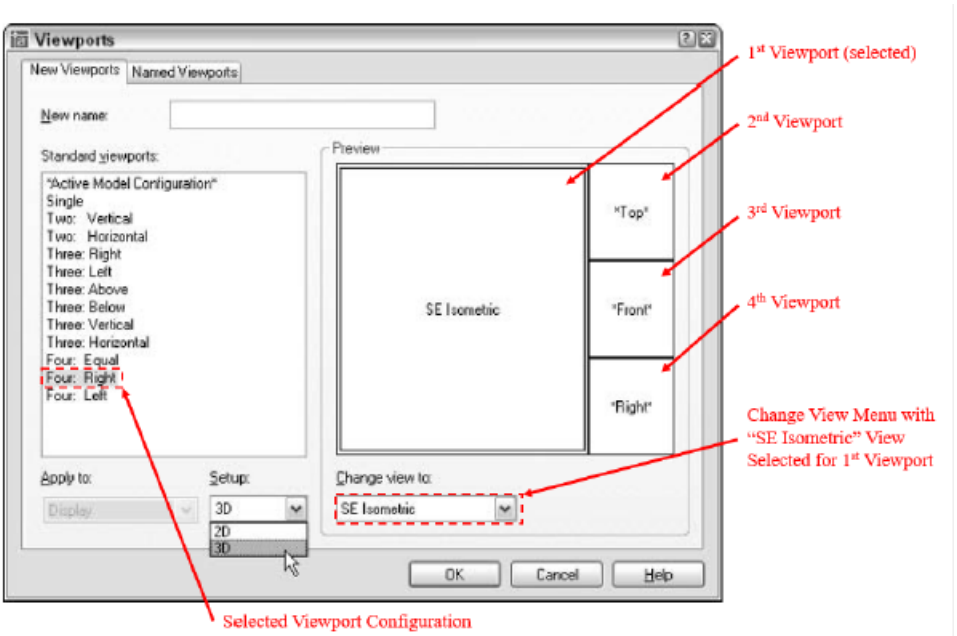
Petitioner also argues that, "in the combination, Littleworth's CAD system is modified to include features for generating and outputting a printed document including multiple annotated views of its roof model (i.e., a roof report) based on the teachings of Middlebrook," as it previously discussed when describing the proposed combination. Pet. 39 (citing Pet. 15–20). "For example," Petitioner asserts, "in the combination, Middlebrook teaches AutoCAD features for presenting multiple viewports, each containing a view of a three-dimensional model," as shown in Petitioner's annotated Fig. 8-1, reproduced below. *Id.*



Petitioner's annotated version of Middlebrook's Figure 8-1 showing multiple viewports each containing a view of a three-dimensional model. Pet. 40 (citing Ex. 1006, 65, Fig. 8-1).

According to Petitioner, "Middlebrook explains that these 'paper space layout viewport[s] [are] window[s] into model space' and that '***3D models often benefit from multiple viewports***.'" *Id.* at 39–40 (citing Ex. 1006, 65).

Petitioner argues that, "[i]n the combination, Middlebrook explains that a user can use the dialog box shown in FIG. 8-2" to "select from among several viewport configurations and options to specify which view of the model is shown in each of the viewports." Pet. 40 (citing Ex. 1006, 184–187, Figs. 8-2, 8-3). Petitioner's annotated version of Middlebrook's Figure 8-2 is reproduced below.



Petitioner's annotated version of Middlebrook's Figure 8-2 showing a dialog box allowing the user to select from among several viewport configurations and to specify which view of the model is shown in each viewport. Pet. 41 (citing Ex. 1006, Fig. 8-2).

"For example," Petitioner argues, "a user can select a viewport in the 'Preview' area of the dialog box and then select the 'Change view to:' menu to change the model view of that particular viewport." Pet. 40 (citing Ex. 1006, 184–186, Fig. 8-2). "Additionally or alternatively," Petitioner argues, "the user can use the 'View' menu to access the '3D Views submenu'" to "change the model view shown in any particular viewport." *Id.* (citing Ex. 1006, 185-187, Fig. 8-3). "With these options," according to

Petitioner, "a user is able to specify that a 'Top' view or 'plan view, which is ***a top-down view*** of ***either the world coordinate system or a user coordinate system***,' of the 3D model be displayed in one or more of the viewports so that one or more separate top plan views of the 3D model are displayed." *Id.* at 40–41 (citing Ex. 1006, 184-187, Figs. 8-2, 8-3; Ex. 1003 ¶ 66; Ex. 1023, 1, 4, 6, Fig. 8).

Petitioner also argues that "Middlebrook explains that 'X-Y plane (the set of points where Z = 0) is the construction plane in which you create 2D objects'" and is "also important for creating 3D objects, because many commands operate with respect to the X-Y plane." Pet. 42 (citing Ex. 1006, 190). "When a user selects a top view or plan view of the 3D model," according to Petitioner, "the model will be oriented with the X-Y plane of the world coordinate system, permitting the use of the dimensioning features described above." *Id.* (citing Ex. 1003 ¶ 67; Ex. 1006, 186, 190).

Petitioner argues that "Middlebrook further provides that after a view of a model is annotated, a report that includes the annotated view of the model is generated and outputted in response to a '[c]lick [of the] OK' button in the 'Plot dialog box' which 'create[s] the plot' of the model." Pet. 42–43 (citing Ex. 1006, 272–273, Figs. 12-2, 12-3, 12-4). "When AutoCAD finishes generating and sending the plot," Petitioner asserts, "it displays a 'Plot and Publish Job Complete' balloon notification from the status bar." *Id.* at 43 (citing Ex. 1006, 273). Petitioner also points to Middlebrook's statement that "AutoCAD and most CAD users make no distinction between plotting and printing." *Id.* (citing Ex. 1006, 268).

Patent Owner does not present arguments regarding this limitation. *See* PO Resp.

Based on the full trial record, we find that Petitioner has sufficiently shown that the prior art discloses this limitation.

j) Summary for Claim 1

For the foregoing reasons, and based on the full trial record, Petitioner has proven by a preponderance of the evidence that claim 1 would have been obvious based on Petitioner's proposed combination.

6. Dependent Claims 2 and 8

Petitioner contends that dependent claims 2 and 8 are unpatentable over the Littleworth-Linder-Middlebrook combination. Pet. 44–50.

Claim 2 depends from claim 1 and further recites that "the roof estimation module that is stored on the memory is further configured, when executed, to determine a combined area of the plurality of roof sections based on the image analysis." Ex. 1001, 16:25–28. Petitioner argues that it would have been obvious to use Linder's teachings for calculating areas of objects to determine the combined roof area of one or more of the roofs shown in Figures 2 and 5 of Littleworth, with each roof having a plurality of roof sections. Pet. 44 (citing Ex. 1003 ¶¶ 69–70; Ex. 1012, 1, 3; Ex. 1005, 755; Ex. 1006, 58, FIG. 8-8). Petitioner also argues that Middlebrook's AutoCAD program calculates the geometry for a first object in a 3D model containing three objects when the first object is selected, and it would have been obvious to one of ordinary skill to apply this functionality to a roof object in Littleworth's 3D model to determine the combined surface area of the roof. *Id.* at 45 (citing Ex. 1012, 58, Fig. 8-8; Ex. 1003 ¶ 71).

Claim 8 depends from claim 1 and further recites that "a spatial relationship between the different views from each other of the roof of the building is undefined before the image analysis is performed." Ex. 1001,

16:48–51. Petitioner argues that one of ordinary skill would have understood that the spatial relationship between Littleworth's vertical aerial photography and oblique aerial photography was undefined before image analysis was performed. Pet. 48 (citing Ex. 1003 ¶ 75). Additionally, Petitioner contends, Linder explains that the spatial relationship between the different aerial images is defined during the image analysis and not before. *Id.* at 49.

Patent Owner does not separately address these claims. *See* PO Resp.; PO Sur-reply.

Based on the full trial record, we find that Petitioner has proven by a preponderance of the evidence that claims 2 and 8 are unpatentable over the Littleworth-Linder-Middlebrook combination.

7. Dependent Claim 7

Claim 7 depends from claim 1 and further recites that "the performing the image analysis includes correlating the first aerial image with the second aerial image." Ex. 1001, 16:45–47. As noted above, claim 1 recites that the "first aerial image" is "a top plan view of the roof" and the "second aerial image" is "an oblique perspective view of the roof." *Id.* at 16:6–9.

Petitioner argues that "Littleworth describes that the aerial images used to generate each three-dimensional model include 'vertical aerial' images as well as 'oblique' aerial images." Pet. 10 (citing Ex. 1005, 756), 15 ("Littleworth discloses generating a three-dimensional model based on a 'vertical aerial' image and an 'oblique' aerial image."), 26–27. In Petitioner's combination, "the system of Littleworth is modified . . . to correlate at least one of the 'vertical aerial' images and at least one 'oblique' aerial image in order to generate three-dimensional coordinates, as described

by Linder." *Id.* at 15 (citing Ex. 1005, 754; Ex. 1012, 32, 41, 46–50, 65–69, Fig. 15, Fig. 17; Ex. 1003 ¶ 32). Petitioner also argues that "Littleworth teaches that images are 'studied and suitable control points [are] selected' as part of generating a three-dimensional model," and "Linder describes that images are correlated based on control points within the images as part of generating a three-dimensional model." *Id.* at 16–17 (citing Ex. 1005, 756; Ex. 1012, 32, 41, 46–50, 65–69, Fig. 16, Fig. 17; Ex. 1003 ¶ 34). According to Petitioner, one of ordinary skill "would have been motivated to correlate the images described in Littleworth based on the selected control points in order to allow the images to be utilized in the three-dimensional model generation process, as taught by Linder." Pet. 17 (citing Ex. 1003 ¶ 34).

Patent Owner relies on essentially the same arguments for claim 7 as for claim 1. *See* PO Resp. 30–50; PO Sur-reply 1–11; Ex. 2010 ¶¶ 56–80.

We agree with Petitioner that Littleworth discloses correlating a "vertical aerial" image and an "oblique" aerial image. Littleworth describes creating "a 3-dimensional model of a redevelopment area of London" with "a simplified block model of all structures with selected façade information, road edges and some detailed facades of certain buildings." Ex. 1005, 755–756. This model was created using "vertical aerial photography" supplemented with "oblique photography" taken "from the roof of a conveniently situated building on the site," as well as "terrestrial photography that was required for the detail façade work." *Id.* at 756. Littleworth also discloses that "***[a]ll sets of photography were studied*** and ***suitable control points selected*** which were coordinated by field survey to give 3-dimensional coordinates based upon the Ordnance Survey National Grid so that any subsequent site survey or additions could be more easily

linked with the model." *Id.* (emphasis added). Additionally, Littleworth explains that the accuracy requirement for the project varied according to the subject, but "it was decided to coordinate all control points to the higher precision and allow the photographic scale to determine the final accuracy." *Id.*

Based on these disclosures, we agree with and find credible Dr. Forsyth's testimony that "Littleworth describes identifying 'suitable control points' in the plurality of vertical and oblique aerial images" to allow for proper correlation of the images. Ex. 1028 ¶ 35. We also agree with Dr. Forsyth that Littleworth "discloses a plurality of images of the same object (in Littleworth's case, various buildings in the London redevelopment area) taken from different positions." Ex. 1028 ¶ 18. We further credit Dr. Forsyth's testimony that one of ordinary skill "would have recognized from the disclosures of Littleworth as a whole that for at least some of the vertical aerial images in the plurality of images, a corresponding oblique image depicting the same object (such as one of the buildings in the redevelopment site) would have been present in the collection of images." *Id.* ¶ 38. Additionally, we agree with Dr. Forsyth that Linder teaches correlating overlapping images of the same object and therefore one of ordinary skill applying Linder to Littleworth "would have known to select oblique and vertical images depicting the same building from different angles when generating the three-dimensional model based on the teachings of Linder." *Id.* (citing Ex. 1012, 1–3, 65–69).

Additionally, we credit Dr. Forsyth's testimony that "Linder describes additional details for correlating" control points "as part of a three-dimensional model generation process that would have been directly

applicable to Littleworth," and that this correlation "would have enabled the resulting system to 'digitise points, lines and areas for map production or calculate distances, areas, volumes, slopes and much more,' as taught by Linder." Ex. 1028 ¶ 34 (citing Ex. 1003 ¶ 34; Ex. 1005, 756; Ex. 1012, 3, 32, 41, 46–50, 65–69, Fig. 15, Fig. 17); *see id.* ¶ 37 ("[B]oth Littleworth and Linder describe using photogrammetry techniques to generate three-dimensional models based on control points identified in aerial photographs depicting buildings from different angles.") (citing Ex. 1003 ¶¶ 21, 24, 34, 50; Ex. 1005, 754–756; Ex. 1012, 1–3, 65–69). We further agree with Dr. Forsyth that "nothing in Linder's teachings" would "have excluded the vertical and oblique aerial images described by Littleworth from being used as the input images to Linder's calibration and correlation techniques," particularly because "Linder describes the properties of images used in its calibration, correlation, and three-dimensional model generation process" as "being 'two (or more) photos from the same object but taken from different positions' such that corresponding points can be identified in both photos to allow for proper correlation." *Id.* ¶ 35 (citing Ex. 1012, 1–2, 65–69, 32, 41, 46–50).

Furthermore, as discussed with respect to claim 1, we need not define the term "stereoscopic images" to resolve this dispute because claim 7 does not require the correlation of "stereoscopic images" or "non-stereoscopic" images and never uses the term "stereoscopic." *See* § II.D.5(g); Ex. 1001, 16:12–13. Additionally, as Dr. Forsyth persuasively explains, the designation of the images in Linder as "stereoscopic" or "non-stereoscopic" would not have prevented one of ordinary skill from finding Linder's teachings to be applicable to Littleworth. Ex. 1028 ¶ 39. We further credit

Dr. Forsyth's testimony that "[t]he fact that Littleworth provides the type of images that are used in Linder's correlation and three-dimensional model generation process (two or more photos from the same object taken from different positions)" indicates that one of ordinary skill "would have had a reasonable expectation of success in modifying Littleworth based on the teachings of Linder." *Id.*

We disagree with Patent Owner's arguments that it would not have been obvious to combine Littleworth and Linder for the reasons discussed above with respect to claim 1. *See* § II.D.5(g), *supra*. Although claim 7 additionally recites that the images correlated include "a first aerial image that is a top plan view of the roof" and "a second aerial image that is an oblique perspective view of the roof," Petitioner persuasively demonstrates, as discussed above, that one of ordinary skill would have understood Littleworth to teach correlation of such images, and would have recognized that "for at least some of the vertical aerial images in the plurality of images, a corresponding oblique image depicting the same object (such as one of the buildings in the redevelopment site) would have been present in the collection of images." Ex. 1005, 755–756; Ex. 1028 ¶¶ 18, 35, 38. As also discussed above, Petitioner sufficiently demonstrates that Linder's correlation techniques would have been applicable to Littleworth's corresponding top plan view and oblique perspective view images of the same building, regardless of whether those images are categorized as "stereoscopic" or "non-stereoscopic." Ex. 1003 ¶¶ 21, 24, 34, 37, 50; Ex. 1028 ¶¶ 34, 37; Ex. 1012, 1–3, 32, 41, 46–50, 65–69, Fig. 15, Fig. 17.

For the foregoing reasons, and based on the full trial record, we find that Petitioner has proven by a preponderance of the evidence that claim 7 is unpatentable over the proposed combination.

8. Independent Claims 21 and 22

Petitioner contends that independent claims 21 and 22 are unpatentable over the Littleworth-Linder-Middlebrook combination, relying on many of the same arguments it made for claim 1. Pet. 50–59. Patent Owner argues that Petitioner fails to establish that these claims are unpatentable, focusing on certain specific limitations. PO Resp. 30–53, 74–75. We will discuss the disputed issues among the parties below.

a) Whether it would have been obvious to use Linder's techniques for correlating a top plan view image of a roof and an oblique perspective view image of the roof.

Claim 21 recites correlating "a first aerial image" which is "a top plan view of the roof" with "the second aerial image" which is "an oblique perspective view of the roof." Ex. 1001, 18:47–58. Claim 22 includes a similar limitation. *Id.* at 19:19–29. As discussed with respect to claims 1 and 7, we find that Petitioner has sufficiently proven that one of ordinary skill would have found this limitation obvious over Petitioner's proposed combination. *See* §§ II.B.5(g), II.B.7, *supra*.

b) Whether Petitioner's Combination Shows Performing Image Analysis "Based on the Correlation."

Claim 21 recites "correlating the first aerial image with the second aerial image within the plurality of aerial images," and "performing, by the at least one processor of the roof estimation machine, image analysis on the plurality of aerial images based on the correlation." Ex. 1001, 18:57–61. Claim 22 includes a similar limitation. *Id.* at 19:28–32.

In the Petition, Petitioner relies on its argument for claim 1 for this limitation. Pet. 51–53. Patent Owner responds that claims 21 and 22 "require the 'correlating' step . . . to be performed before the 'performing . . . image analysis' step," and argues that Petitioner fails to adequate address this requirement. PO Resp. 51–52. According to Patent Owner, Petitioner's analysis "is limited to arguing that the image analysis step is met by the correlation of images" and "simply equates correlation with image analysis." *Id.* at 52–53. Patent Owner contends that, in claims 21 and 22, "correlation is a separate step from the image analysis step" and "expressly requires the 'image analysis' to be '***based on the correlation***.'" *Id.* at 53 (citing Ex. 2010 ¶ 54).

Petitioner responds that a single feature can satisfy multiple claim limitations by performing multiple claim functions. Pet. Reply 17 (citing *Google*, 743 Fed. Appx. at 985). Accordingly, Petitioner argues, the correlation techniques of the proposed combination are "image analysis of the plurality of images *based on* correlation because these techniques are image analysis conducted by correlating the first and second images." *Id.* (citing Pet. 26–27; Ex. 1003 ¶¶ 49–50, 86; Ex. 1028 ¶¶ 40–41). Alternatively, Petitioner contends, even if claims 21 and 22 require that the "image analysis" must be a distinct action separate from the correlation, the proposed combination satisfies this interpretation because the combination "discloses correlating the vertical and oblique aerial images of Littleworth" and uses this correlation "in 'image mapping' and '[t]he creation of 3D building models,'" which one of ordinary skill "would have recognized as the claimed image analysis of the images based on the correlation." *Id.* at 18

(citing Pet. 26–27, 52–53; Ex. 1003 ¶¶ 49–50; Ex. 1012, 1–4, 32, 42, 97; Ex. 1028 ¶ 42).

Further, according to Petitioner, the Petition explained that in the combination "generation of the three-dimensional model based on image correlation allows for additional image analysis such as 'determin[ing] distances, areas' or other 'geometric data' for 'any point ***in the photo***.'" *Id.* at 18–19 (citing Pet. 11–12, 15–17; Ex. 1012, 1–3, 32, 40–41, 46–50, 65–69). Petitioner asserts that one of ordinary skill "would have recognized that analysis of 'the photo' to produce maps and determine 'geometric data' such as distances and areas based on the three-dimensional model generated based on the correlation are examples of image analysis of the images based on the correlation." *Id.* at 19 (citing Ex. 1028 ¶ 43).

Patent Owner responds that Petitioner's position that the "correlation" and "image analysis" can be satisfied by a single function is incorrect, and that both parties' experts testified that the "correlating" step must be performed before the "performing . . . image analysis" step. PO Sur-reply 21 (citing Ex. 2010 ¶¶ 33–34; Ex. 2011, 16:9–11). Patent Owner also argues that Petitioner's alternative argument that the combination shows separate "correlating" and "image analysis" steps is improper new argument that should be disregarded. *Id.* at 21–22.

We agree with Petitioner that, even if claims 21 and 22 require that the "image analysis" must be a distinct action separate from and based on the correlation, the proposed combination satisfies this claim element. In Petitioner's proposed combination, Linder is applied to Littleworth to teach correlating Littleworth's vertical and oblique aerial images. Ex. 1005, 754; Ex. 1012, 32, 40–41, 46–50, 65–69, 100–102, Fig. 15, Fig. 17; Ex. 1003

¶¶ 49–50; Ex. 1028 ¶ 42. As Dr. Forsyth explains, "the correlation process described by Linder is part of a larger 'image matching algorithm' that is used in '[t]he creation of 3D building models," and "[c]reation of this 3D building model therefore indicates that an image analysis based on the correlation was performed." Ex. 1028 ¶ 42; Ex. 1003 ¶¶ 49–50, 86, 96. We also agree with and find credible Dr. Forsyth's testimony that one of ordinary skill "would have therefore recognized that image matching and creation of a 3D building model based on the correlation of the aerial images provides the claimed image analysis of the images based on the correlation." Ex. 1028 ¶ 42.

We also agree with Dr. Forsyth that one of ordinary skill "would have been motivated to modify Littleworth's system to correlate its aerial images in order to enable a user to 'digitise points, lines and areas for map production or calculate distances, areas, volumes, slopes and much more,' as taught by Linder," and that "this is image analysis because Linder describes that the geometric data is determined for 'any point ***in the photo***.'" Ex. 1028 ¶ 43 (citing Ex. 1012, 1–3; Ex. 1003 ¶¶ 23, 34). Additionally, as Dr. Forsyth explains, "Littleworth similarly describes generating the '3-dimensional' model after identification of 'suitable control points' in the images" and "Linder's correlation techniques are used in generating the three-dimensional model" in the proposed combination. *Id.* (citing Ex. 1005, 756; Ex. 1003 ¶¶ 29–30, 32, 34). We agree with and find credible Dr. Forsyth's testimony that one of ordinary skill "would have recognized that analysis of 'the photo' to produce maps and determine 'geometric data' such as distances and areas based on the three-dimensional model generated

based on the correlation are examples of image analysis of the images based on the correlation." *Id.*

We disagree with Patent Owner's argument that these assertions are improper new argument that should be disregarded. PO Sur-reply 21–22. The Petition and Dr. Forsyth's original declaration explain that the combination of Littleworth and Linder describe "correlating multiple aerial images," such as the "vertical aerial" and "oblique" images from Littleworth. Pet. 26; Ex. 1003 ¶ 49. The Petition and Dr. Forsyth also explain that Littleworth carries out this correlation as part of the process of "creat[ing] three-dimensional computer models of development sites and engineering structures, and that the selection of "suitable control points" and correlation is "part of the model generation process." Pet. 10; Ex. 1003 ¶¶ 20–21. The Petition and Dr. Forsyth also explain that Linder's "image matching algorithm" "correlate[s]" images as part of the process of "generat[ing] three-dimensional models from multiple aerial images." Pet. 12; Ex. 1003 ¶ 24. We understand the steps used to create the "three-dimensional models" following the image correlation to be subsequent steps that are "based on" the correlation. Petitioner's Reply merely expanded on these points made in the Petition, and does not set forth an entirely new theory that was absent from the Petition. *See Corephotonics, LTD. v. Apple Inc.*, 84 F.4th 990, 1008 (Fed. Cir. 2023) ("The 'newness restriction prohibits the petitioner from raising, in reply, 'an entirely new theory of *prima facie* obviousness absent from the petition.'").

c) Summary for Claims 21 and 22

For the foregoing reasons, and the reasons discussed above with respect to claim 1, Petitioner has proven by a preponderance of the evidence

that claims 21 and 22 would have been obvious based on Petitioner's proposed combination.

9. Claims 24, 25, 27, and 29

Petitioner contends that independent claims 24 and 29 are unpatentable over the Littleworth-Linder-Middlebrook combination, relying on its arguments for claims 1 and 21. Pet. 59–62. Petitioner also argues that dependent claims 25 and 27 are unpatentable over the same combination, relying on its arguments for claims 1 and 2. *Id.* at 60. Patent Owner does not separately address these claims. *See* PO Resp. Based on the evidence of record, we determine that Petitioner has proven by a preponderance of the evidence that claims 24, 25, 27, and 29 are unpatentable over the Littleworth-Linder-Middlebrook combination.

III. CONCLUSION

For the reasons discussed above, Petitioner has proven, by a preponderance of the evidence, that the challenged claims are unpatentable, as summarized in the following table:[11]

[11] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1, 2, 7, 8, 21, 22, 24, 25, 27, 29	103(a)	Littleworth, Linder, Middlebrook	1, 2, 7, 8, 21, 22, 24, 25, 27, 29	
Overall Outcome			1, 2, 7, 8, 21, 22, 24, 25, 27, 29	

IV. ORDER

Accordingly, it is

ORDERED that claims 1, 2, 7, 8, 21, 22, 24, 25, 27, and 29 of the '961 patent have been proven by a preponderance of the evidence to be unpatentable; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

For PETITIONER:

Walter Renner
Thomas Rozylowicz
Dan Smith
Patrick Darno
Patrick Bisenius
Craig Deutsch
Yao Wang
FISH & RICHARDSON P.C.
axf-ptab@fr.com
tar@fr.com
dsmith@fr.com
darno@fr.com
bisenius@fr.com
deutsch@fr.com
ywang@fr.com

For PATENT OWNER:

Kyle Howard
Gregory Webb
Angela Oliver
Jonathan Bowser
HAYNES & BOONE LLP
kyle.howard.ipr@haynesboone.com
greg.webb.ipr@haynesboone.com
angela.oliver.ipr@haynesboone.com
jonathan.bowser@haynesboone.com