

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

METROMONT CORPORATION,
Petitioner,

v.

REIGSTAD & ASSOCIATES, INC.,
Patent Owner.

IPR2021-00467
Patent 10,337,196 B2

Before SCOTT A. DANIELS, JASON W. MELVIN, and RYAN H. FLAX,
Administrative Patent Judges.

FLAX, *Administrative Patent Judge.*

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable and
Denying Patent Owner's Motion to Amend
35 U.S.C. § 318(a)

I. INTRODUCTION

We have authority in this proceeding under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73.

A. BACKGROUND AND SUMMARY OF DECISION

Reigstad & Associates, Inc. (“Patent Owner”) is the owner of U.S. Patent 10,337,196 (Ex. 1001, “the ’196 patent”). Paper 13 (“Response” or “Resp.”). Metromont Corporation (“Petitioner”) filed a Petition for an *inter partes* review challenging claims 1–7, 9, 10, and 13 of the ’196 patent directed to a method for enhancing or repairing a pre-cast load-carrying concrete floor structure (claims 8, 11, 12, 14, and 15 were not challenged). Paper 1 (“Pet.”).¹ Patent Owner filed a Response, to which Petitioner filed a Reply (Paper 17, “Reply”). Patent Owner filed a Sur-Reply in response to Petitioner’s Reply. Paper 26 (“Sur-Reply”). We have considered each of these papers and the cited evidence.

In this proceeding, Patent Owner also filed a Contingent Motion to Amend, wherein Patent Owner requested the Board’s Preliminary Guidance. Paper 14 (“MTA”). Petitioner filed an Opposition to Patent Owner’s Motion to Amend. Paper 18. We issued non-binding Preliminary Guidance on Patent Owner’s Motion to Amend, indicating, *inter alia*, that: (1) Patent Owner did not propose a reasonable number of substitute claims; (2) on most proposed substitute claims, Petitioner had shown a reasonable

¹ To the extent such documents are relevant and require citation herein, Patent Owner also initially responded to the Petition by filing a Preliminary Response (Paper 6, “Prelim. Resp.”), to which Petitioner responded by filing a Preliminary Reply (Paper 8, “Prelim. Reply”), to which Patent Owner responded by filing a Preliminary Sur-Reply (Paper 9, “Prelim. Sur-Reply”).

likelihood that the claims were obvious over the Gleich,² Tumialan,³ and Sika Product Sheets⁴ prior art references asserted in the Petition; and (3) for all other proposed substitute claims, Petitioner had shown a reasonable likelihood that they, too, were obvious over the Gleich, Tumialan, Sika Product Sheets, and Reis⁵ prior art references asserted in the Petition. Paper 24 (“PG”).

After our Preliminary Guidance, Patent Owner filed a Revised Contingent Motion to Amend, proposing new substitute claims 16–19. Paper 25 (“Rev. MTA”). Petitioner filed an Opposition to the Revised Motion to Amend. Paper 28 (“Opp. Rev. MTA”). Patent Owner filed a Reply to this Opposition, which was followed by Petitioner’s Sur-Reply. Paper 31 (“PO Reply Rev. MTA”); Paper 33 (“Pet. Sur-Reply Rev. MTA”). As with the primary briefing noted above, we have considered these papers and the cited evidence.

² Harry A. Gleich, *Carbon Fiber Reinforcing, Making Double Tees in Parking Structures Lighter and Stronger, Building Blocks, discussion and updates on structural materials*, Structure Magazine (2006) (Ex. 1003, “Gleich”).

³ J. Gustavo Tumialan, et al., *Case Study: Strengthening of Parking Garage Decks with Near-Surface-Mounted CFRP Bars*, 11(5) J. Compos. Constr. 523–30 (2007) (Ex. 1004, “Tumialan”).

⁴ SikaTop 123 Product Data Sheet (Edition 8.2003) (Ex. 1008); Sika Armatec 110 Product Data Sheet (Edition 8.2003) (Ex. 1009) (collectively, “Sika Product Sheets”).

⁵ E.M. Reis & U. Dilek, *Non-Destructive Radiographic Evaluation and Repairs to Pre-Stressed Structure Following Partial Collapse*, Forensic Engineering 2012, ASCE 2013 (2012) (Ex. 1011, “Reis”).

A final hearing was conducted on May 31, 2022, where the parties presented oral argument in support of their positions. *See* Paper 36 (“Hr’g Tr.”).

Petitioner bears the burden of proving unpatentability of the challenged claims (as well as of the proposed substitute claims), and the burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). To prevail, Petitioner must prove unpatentability by a preponderance of the evidence. *See* 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d) (2019). Although herein we indicate that some of Patent Owner’s arguments are not persuasive, this should never be taken as an indication that we have assigned Patent Owner the burden of proof on patentability.

After considering the parties’ arguments and supporting evidence, we conclude that Petitioner has proved by a preponderance of the evidence that claims 1–7, 9, 10, and 13 of the ’196 patent are unpatentable as obvious over the asserted prior art. 35 U.S.C. § 316(e). Similarly, and under this same standard, after considering the parties’ arguments and supporting evidence, we also conclude that Petitioner has proved by a preponderance of the evidence that Patent Owner’s proposed substitute claims 16–19 are also unpatentable as obvious over the same prior art.

B. REAL PARTIES-IN-INTEREST

Petitioner identifies itself, “Metromont Corporation,” as the real party-in-interest. Pet. 75. Patent Owner also identifies itself, “Reigstad & Associates, Inc.,” as the real party-in-interest. Paper 3, 1.

C. RELATED MATTERS

The parties indicate there are no related matters. Pet. 75; Paper 3, 1.

D. THE '196 PATENT

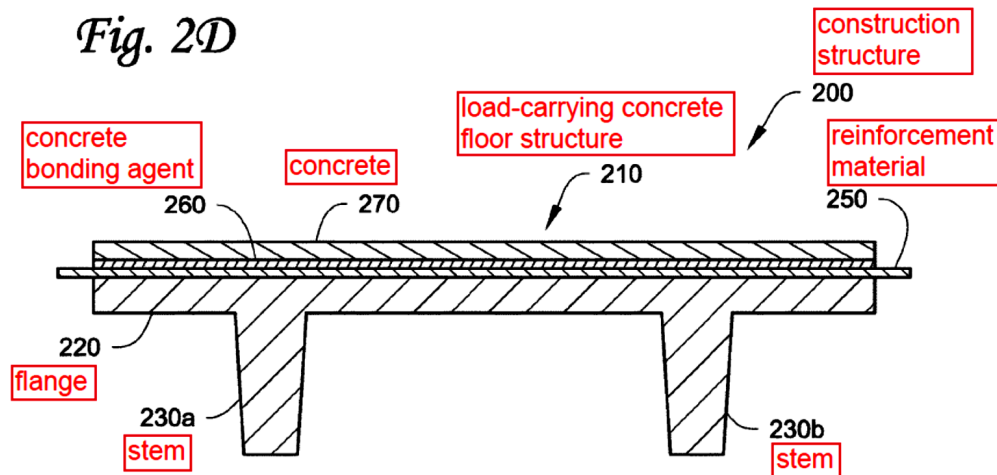
The '196 patent issued on July 2, 2019, from U.S. Application 15/945,318, which was filed on April 4, 2018. Ex. 1001, codes (45), (21), (22). On its face, the '196 patent indicates it is related and should be accorded priority to Provisional Application 62/481,176, filed April 4, 2017. *Id.* at code (60).

The '196 patent's Abstract states:

A construction process for enhancing or repairing a concrete floor structure that includes a carbon fiber grid as a reinforcement component is disclosed. The process includes forming a trench at a top surface of the concrete floor structure, and placing a reinforcement material in the formed trench. Then, a concrete bonding agent is applied into the trench. Then, the trench is filled with concrete. As a result, the concrete floor structure is enhanced or repaired to have at least one additional reinforcement component other than the carbon fiber grid.

Id. at Abstract. Comparing this disclosure with claim 1, reproduced below, the Abstract well-summarizes the most broadly claimed invention. *See id.* at 23:16–30.

To provide context for this disclosure, we reproduce below the '196 patent's Figure 2D, annotated by the Board to label the illustrated features:



Id. at Fig. 2D (annotations added to reflect the '196 patent's defined numerical references as red textboxes). Figure 2D “show[s] [a] schematic front cross-sectional view[] of a load-carrying concrete floor structure according to an embodiment” of the '196 patent. *Id.* at 6:53–55. Figure 2D shows concrete structure 200 having load-carrying concrete floor structure 210 which has flange 220 and stems 230a, 230b; flange 220 may include a C-Grid (not shown or identified in the figure) within concrete.⁶ *Id.* at 8:57–10:36 (describing Figs. 1–2D). Figure 2d shows a repaired and reinforced concrete floor structure 210 having a trench 240 (not labeled) with reinforcement material 250, such as a carbon fiber epoxy-based reinforcing bar, provided therein, as well as concrete bonding agent 260 on the internal

⁶ “C-Grid” refers to a carbon fiber reinforcing grid, which was known in the art to be provided within precast load-carrying concrete systems. Ex. 1001, 1:15–26 (Background); *see also* Ex. 1003 (prior art disclosing a double tee flange having a carbon fiber grid); Ex. 1027; Ex. 1028.

sides of the trench, and concrete 270 filling the rest of the trench. *Id.* The structure as illustrated in Figure 2D is generally referred to in the construction industry as a double-T (or double tee) structure or flange. *See* Ex. 1002 ¶ 34.

The '196 patent concludes with claims 1–15. Ex. 1001, 23:15–24:52. Claim 1, the sole independent claim, is illustrative of the challenged claims and is reproduced below, with added sub-numbering in the fashion added by Petitioner (*see* Pet. 17–18) and its witness (Ex. 1002 ¶ 29), which is referenced also by Patent Owner (*see, e.g.,* Resp. 1):

[1pre] 1. A method for enhancing or repairing a pre-cast load-carrying concrete floor structure, wherein the load-carrying concrete floor structure includes a flange, two supporting members that support the flange, and a carbon fiber grid disposed within the flange between the two supporting members, the method comprising:

[1a] forming a trench at a top surface of the flange between the two supporting members that support the flange of the load-carrying concrete floor structure;

[1b] arranging a reinforcement material into the trench to be above at least a portion of the carbon fiber grid disposed within the flange;

[1c] applying a concrete bonding agent to an internal side surface of the trench; and

[1d] filling the trench with concrete.

Ex. 1001, 23:16–30 (sub-numbering added). Claims 2–15 depend from claim 1, either directly or indirectly, and add additional steps or elements to the claimed method and the components recited as used therein. *Id.* at 23:31–24:52. As noted above, claims 8, 11, 12, 14, and 15 are not challenged in this proceeding.

E. PETITIONER’S ASSERTED GROUNDS FOR
UNPATENTABILITY

Petitioner asserts the following grounds for the unpatentability of claims 1–7, 9, 10, and 13 of the ’196 patent:

GROUND	CLAIMS CHALLENGED	35 U.S.C. § ⁷	REFERENCE(S)/BASIS
A	1–7, 9	103	Gleich, Tumialan
B	1–7, 9	103	Gleich, Tumialan, Sika Product Sheets
C	10, 13	103	Gleich, Tumialan, and Reis
D	10, 13	103	Gleich, Tumialan, Reis, and Sika Product Sheets

See Pet. 27. In the Petition, Petitioner expressly lists three grounds for unpatentability, A–C; however, we count four because Petitioner’s Ground C includes a first ground asserting Gleich, Tumialan, and Reis, and a second ground alternatively asserting these same three references plus the Sika Product Sheets. We separate these two grounds and address these challenges separately as “Ground C” and “Ground D,” as noted in the table above.

In support of these grounds for unpatentability (and in response to Patent Owner’s positions in the Response and MTAs) Petitioner submits, *inter alia*, the Declarations of Antonio Nanni, PhD, who we find qualified to offer testimony on the knowledge and perspective of one of ordinary skill in

⁷ The ’196 patent has an uncontested priority date of April 4, 2017, which is after the AIA revisions to 35 U.S.C. § 103 took effect. 35 U.S.C. § 100 (note). Therefore, the AIA version of Section 103 applies.

the art at the time of the invention. Ex. 1002; Ex. 1030; Ex. 1036; Ex. 1041; *see also* Ex. 1002 ¶¶ 1–15, 28 (Dr. Nanni describing his background and experience, and materials considered). Dr. Nanni testifies that he understands that the ’196 patent’s claims must be interpreted, and their unpatentability for obviousness determined, based on the perspective of “a person having ordinary skill in the art,” and we find his testimony to be so-based. *See, e.g.*, Ex. 1002 ¶¶ 19–25, 51, 66, 125, 135, 153, 158, 168. Patent Owner’s arguments to the contrary are not persuasive.

Patent Owner does not submit witness testimony in support of its positions. *See* Resp. 7, n.3 (Patent Owner explaining it believes expert testimony is unnecessary because the technology at issue is “easily understood.”).

II. DISCUSSION

A. ORDINARY SKILL IN THE ART

Petitioner states,

a person of ordinary skill in the art at the time of the invention (“POSA”) would have had: at least a bachelor’s degree in Civil Engineering, Architectural Engineering, Mechanical Engineering, or a related technical field, and at least three years of experience in the structural design of reinforced or prestressed concrete strengthening alternatives. Ex-1002, ¶¶27-28. Additional work experience in relevant work industries could compensate for less education or an education in a different field, and advanced education or degrees may similarly compensate for less work experience. *Id.*

Pet. 18 (citing Ex. 1002 ¶¶ 27–28).⁸

⁸ Petitioner uses the acronym POSA to refer to the person of ordinary skill in the art. Patent Owner uses the acronym POSITA. Neither is preferred.

Patent Owner does not contest Petitioner’s definition of the ordinarily skilled artisan and takes no position on the definition of the person of ordinary skill in the art. *See generally* Resp.

We accept Petitioner’s unopposed definition of the person of ordinary skill in the art (or ordinarily skilled artisan), which is consistent with the level of skill in the art reflected in the prior art of record and the disclosure of the ’196 patent. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (“the prior art itself [may] reflect[] an appropriate level” as evidence of the ordinary level of skill in the art) (quoting *Litton Indus. Prods., Inc. v. Solid State Sys. Corp.*, 755 F.2d 158, 163 (Fed. Cir. 1985)). It is from this perspective that we consider the claims and the asserted prior art, as has Petitioner and its witness, Dr. Nanni.

B. CLAIM CONSTRUCTION

The Board interprets claim terms in an *inter partes* review using the same claim construction standard used to construe claims in a civil action in federal district court. 37 C.F.R. § 42.100(b). In construing claims, district courts and the Board here, by default, give claim terms their ordinary and customary meaning, which is “the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention.” *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc).

Should claim terms require express construction, sources for claim interpretation include “the words of the claims themselves, the remainder of the specification, the prosecution history [i.e., the intrinsic evidence], and extrinsic evidence concerning relevant scientific principles, the meaning of technical terms, and the state of the art.” *Id.* at 1314 (quoting *Innova/Pure Water, Inc. v. Safari Water Filtration Sys., Inc.*, 381 F.3d 1111, 1116 (Fed.

Cir. 2004)). “[T]he claims themselves [may] provide substantial guidance as to the meaning of particular claim terms.” *Id.* However, the claims “do not stand alone,” but are part of “‘a fully integrated written instrument’ . . . consisting principally of a specification that concludes with the claims,” and, therefore, the claims are “read in view of the specification.” *Id.* at 1315 (quoting *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 978–79 (Fed. Cir. 1995) (en banc)).

Any special definition for a claim term must be set forth in the specification “with reasonable clarity, deliberateness, and precision.” *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). Without such a special definition, however, limitations may not be read from the specification into the claims. *In re Van Geuns*, 988 F.2d 1181, 1184 (Fed. Cir. 1993).

“[W]e need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy.’” *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

“concrete”

Petitioner proposes that the claim term “concrete,” which appears in claims 1, 3, and 14, should be accorded its plain and ordinary meaning as would have been understood by the ordinary skilled artisan in view of the Specification, which is “a ‘cement-based composite material.’” Pet. 19–20 (citing Ex. 1002 ¶¶ 51–64). Petitioner points out that the ’196 patent does not expressly, specially define the term “concrete.” *Id.* at 19. Petitioner asserts that there are a variety of forms of concrete that may have different characteristics, e.g., courser or finer aggregate, different aggregate materials,

etc., but that, fundamentally, all concrete consists of a composite mixture of cement, water, and aggregate. *Id.* at 20–27 (citing, *inter alia*, Ex. 1002 ¶¶ 51–65).

Patent Owner takes no position on the meaning of the term “concrete” and does not contest Petitioner’s position thereon. *See generally* Resp.; *see also* Prelim. Resp. 3 (expressly stating, “Patent Owner . . . takes no position on whether Petitioner’s proposed construction of ‘concrete’ is correct.”). In its Response, Patent Owner does, however, appear to use the terms “concrete” and “cement,” and even “cementitious,” interchangeably, which indicates Patent Owner agrees with Petitioner’s proposed definition. *See* Resp. 1 (“the trench is filled with concrete”), 3 (“Tumialan’s final design used epoxy not cement”), 7 (“cementitious-based pastes” and “cementitious-based materials”).

We agree with Petitioner that the claim term “concrete” can be accorded its plain and ordinary meaning as would have been understood by the ordinarily skilled artisan. Petitioner’s proposed understanding of this term as “cement-based composite material” appears to be consistent with such a plain and ordinary meaning. *See generally* Ex. 1001 (no express explanation of the composition of concrete); *see also, e.g.*, Ex. 1002 ¶¶ 52–64; Ex. 1014, 1 (explaining concrete includes various mixtures of cement, water admixtures, fine and course aggregates); Ex. 1015, 4:26–30 (definition of concrete is broad and includes cement, grout, and mortar). We interpret the claim term “concrete,” as have the parties, to encompass a “cement-based composite material.”

C. APPLICABLE LEGAL STANDARDS

“In an IPR, the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)). As we have already noted, this burden of persuasion never shifts to Patent Owner. *See Dynamic Drinkware*, 800 F.3d 1375, 1378.

Regarding obviousness, the Supreme Court, in *KSR International Co. v. Teleflex Inc.*, 550 U.S. 398 (2007), reaffirmed the framework for determining obviousness set forth in *Graham v. John Deere Co.*, 383 U.S. 1 (1966). The *KSR* Court summarized the four factual inquiries set forth in *Graham* (383 U.S. at 17–18) that are applied in determining whether a claim is unpatentable as obvious under 35 U.S.C. § 103(a) as follows:

(1) determining the scope and content of the prior art; (2) ascertaining the differences between the prior art and the claims at issue; (3) resolving the level of ordinary skill in the art;⁹ and (4) considering objective evidence indicating obviousness or non-obviousness.¹⁰ *KSR*, 550 U.S. at 406.

“The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” *Id.* at 416. “[W]hen the question is whether a patent claiming the combination of elements of prior art is obvious,” the answer depends on “whether the improvement is more than the predictable use of prior art

⁹ There is no dispute as to the definition of the person of ordinary skill in the art. *See supra* Section II.A.

¹⁰ There is no argument or evidence pertaining to objective indicia of non-obviousness. *See generally* Resp.

elements according to their established functions.” *Id.* at 417. The Supreme Court stated, “any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements [of the prior art] in the manner claimed.” *Id.* at 420. “[A] finding that the prior art as a whole suggests the desirability of a particular combination need not be supported by a finding that the prior art suggests that the combination claimed . . . is the preferred, or most desirable, combination.” *Bayer Healthcare Pharm., Inc. v. Watson Pharm., Inc.*, 713 F.3d 1369, 1376 (2013) (quoting *In re Fulton*, 391 F.3d 1195, 1200 (Fed. Cir. 2004); *see also PAR Pharm., Inc. v. TWI Pharm., Inc.*, 773 F.3d 1186, 1197–98 (Fed. Cir. 2014) (the law “does not require that the motivation be the *best* option, only that it be a *suitable* option from which the prior art did not teach away.” (citing *Bayer*, 713 F.3d at 1376)).

With these standards in mind, and in view of the definition of the ordinary skilled artisan and claim interpretation discussed above, we address Petitioner’s challenges below.

D. PETITIONER’S ASSERTED PRIOR ART

As noted above, under Ground B Petitioner asserts that claims 1–7 and 9 would have been obvious over Gleich, Tumialan, and Sika Product Sheets (or “Sika”), and under Ground D asserts that claims 10 and 13 would have been obvious over this same prior art combination also adding Reis. *See supra* Section I.E. Patent Owner does not dispute that these references are each prior art.¹¹ *See generally* Resp. We review this prior art below.

¹¹ In its Preliminary Response, Patent Owner argued that Petitioner had not shown the Sika Product Sheets were prior art. *See* Prelim. Resp. 2–3, 9–14. In our Institution Decision, we found, and we maintain here, that Petitioner has shown that the Sika Product Sheets were publicly available printed

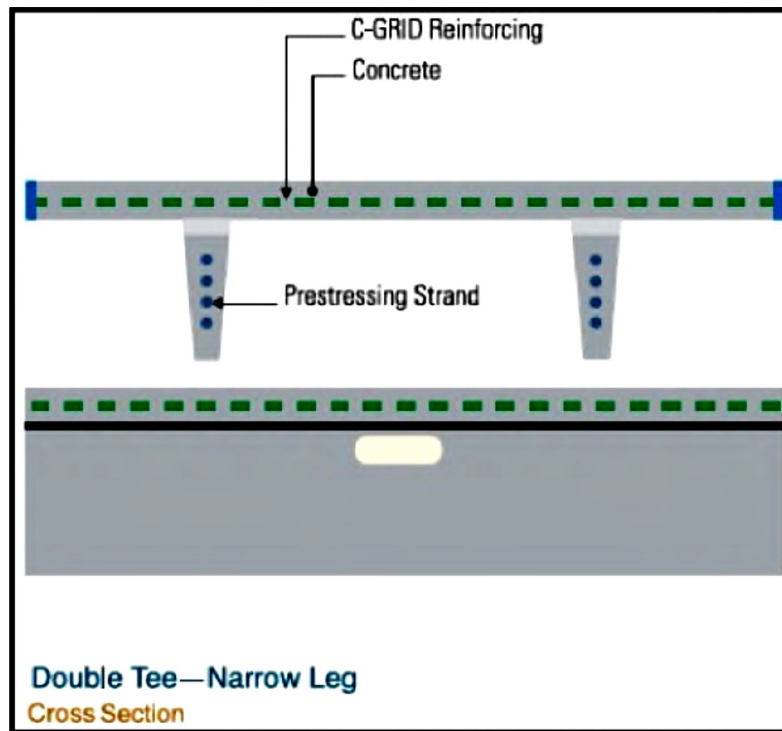
1. *Gleich*

Gleich is an article from the July 2006 edition of Structure Magazine, titled “Carbon Fiber Reinforcing, Making Double Tees in Parking Structures Lighter and Stronger.” Ex. 1003, 11.¹² Gleich, on its face, indicates it is prior art to the claims of the ’196 patent; Patent Owner does not argue otherwise. *Id.*; *see generally* Resp.

Gleich states “[a] new approach to reinforcing double tee flanges involves the use of carbon fiber grid as a replacement for conventional steel mesh reinforcement.” Ex. 1003, 11. By “double tee flanges,” Gleich refers to manufactured concrete structures used, for example, in parking structures, and illustrates such a structure and its reinforcing carbon fiber grid in the following figure:

publications and, thus, were prior art to the claims of the ’196 patent. DI 24–30. Patent Owner did not renew its argument after the trial’s institution and, therefore, has waived the argument. *See generally* Resp; *see also* Paper 11, 7 (“Patent Owner is cautioned that **any arguments not raised in the response may be deemed waived.**”); *In re Nuvasive, Inc.*, 842 F.3d 1376, 1381 (Fed. Cir. 2016) (a patent owner waives an issue presented in its preliminary response if it fails to renew the issue in its response after trial is instituted).

¹² Gleich includes original page numbering and Petitioner-added page numbering where the added page numbers 1 and 2 correspond to original page numbers 11 and 12, respectively.



Id. The image above shows a first (at top) cross-section view of a double tee structure having a flange top surface supported by two legs from a perspective showing an end-view of the legs, which is indicated to be made of concrete (gray) and as having a C-Grid reinforcing structure (green dashed line) inside the flange; it also shows a second (at bottom) cross-section view of the same double tee structure from a side showing the side-length of one of the legs; these illustrations together show that the C-Grid structure is configured inside and throughout the flange, beneath its top surface. *Id.*

Gleich explains that “[a]s a lightweight, non-corrosive ‘enabling technology,’ carbon fiber grid reinforcement allows double tees to be lighter, more durable and often less costly in the long run than conventional precast products that rely on steel reinforcement.” *Id.* Further, “[l]aboratory testing

has affirmed the performance of double tees with carbon fiber reinforcement.” *Id.* at 12. For example, “[f]ire tests confirm that [C-Grid reinforced double tee parking structures] can meet ASTM E-119 fire rating for one-hour performance, and calculations show that, just like steel mesh reinforced tees, they can provide a two-hour fire rating with 4 ⁵/₈ to 4 ³/₄ inch thick flanges.” *Id.*

Gleich provides a photograph of a parking structure using such C-Grid reinforced double tees, which is reproduced below:



The photograph above shows a ground level perspective view of “[a] 270,000-square-foot, four-level parking structure in suburban Milwaukee us[ing] carbon fiber reinforced double tees.” *Id.*

Gleich concludes that “[t]he use of carbon fiber reinforcement is an important innovation because it promises improved corrosion resistance by eliminating steel reinforcement in double tee flanges” and “can deliver reduced weight and life cycle improvements, especially in highly corrosive environments.” *Id.* at 12.

2. *Tumialan*

Tumialan is an article from the October 1, 2007 edition of the Journal of Composites for Construction (published by the ASCE), titled “Case Study: Strengthening of Parking Garage Decks with Near-Surface-Mounted CFRP Bars.”¹³ Ex. 1004, 523.¹⁴ On its face, Tumialan indicates it is prior art to the claims of the ’196 patent; Patent Owner does not argue otherwise. *Id.*; *see generally* Resp.

Tumialan states in its Abstract that it “describes a parking garage retrofitting project where near-surface-mounted carbon fiber-reinforced polymer ([C]FRP) bars were used to strengthen the reinforced-concrete decks. The garage reportedly exhibited numerous signs of deterioration, such as excessive deflections of the decks at bay midspans, extensive concrete cracking, concrete spalling, etc.” Ex. 1004, 523. Tumialan describes “[C]FRP [a]s the go-to method for strengthening of concrete structures in many interior or exterior applications.” *Id.*

Tumialan discloses, “a NSM CFRP system placed in saw-cut grooves on the topside of the slab was considered.”¹⁵ *Id.* at 525. For context, Tumialan includes as Figures 9 and 10 photographs of such a system being installed in a concrete surface, which we reproduce below:

¹³ We understand that “ASCE” refers to the American Society of Civil Engineers.

¹⁴ Tumialan includes original page numbering and page numbering added in the lower corner of each page. We cite the original page numbering herein.

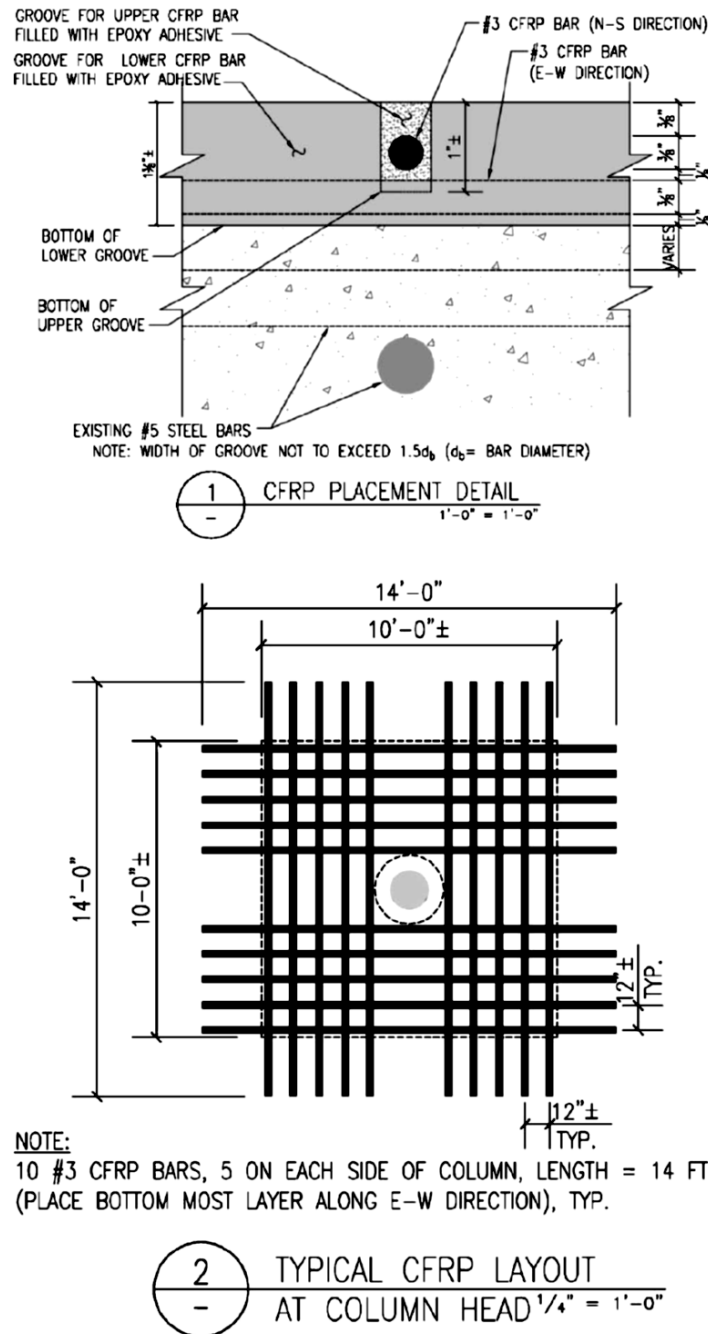
¹⁵ “NSM” refers to near-surface mounted. Ex. 1004, 523. “CFRP” refers to carbon fiber reinforce polymer bars; Tumialan appears to use the acronyms “FRP” and “CFRP” interchangeably as it does not discuss any reinforcement fiber other than carbon fiber. *Id.*



Id. at 529. Figure 10, above-left, shows an interior view of a parking garage and several workers installing CFRP bars into grooves cut into a concrete surface and Figure 9, above-right, shows another interior view of the parking garage and what appears to be the same workers applying an epoxy paste to fill the grooves over the CFRP bars. *Id.*

Tumialan discloses that such grooves can be sawcut into a 10 ft. x 10 ft. concrete slab (a “drop panel” at each interior column) using two blades to obtain a groove of desired dimensions in a single pass and to control the cut depth so as not to damage underlying reinforcement features (e.g., steel reinforcements). *Id.* at 523, 526 (Fig. 3), 529. Tumialan discloses placing CFRP bars into the grooves and lightly pressing them into epoxy paste within the grooves, and then filling the grooves with more epoxy paste and leveling the surface. *Id.*

Tumialan provides an illustration of a resultant structure at its Figure 3, reproduced below:



Id. at 526. Figure 3 illustrates the typical “CFRP strengthening configuration” of Tumialan’s system and method and shows a cross-section view (at top) of a portion of a concrete slab having a one-inch deep groove

above a steel bar (light grey) in the concrete below, that groove containing a CFRP bar (black) surrounded by epoxy adhesive (speckled shading); and Figure 3 also shows an overhead view (at bottom) of a grid array of 10 spaced apart CFRP bars in one (N-S) direction on either side of a column and 10 other spaced apart CFRP bars in an orthogonal (E-W) direction also on either side of the column. *Id.* at 525–26. The lower portion of Figure 3 shows that the concrete slab into which the grooves are cut and CFRP bars inserted is 10 ft. x 10 ft. and that each CFRP bar is 14 ft. long and extends on both ends beyond the borders of the slab. *Id.* at 526.

Tumialan discloses that, in prelude to performing the actual above-discussed repairs, tests were conducted using a commercially available epoxy-based paste and a commercially available cementitious-based paste. *Id.* at 525. Tumialan explains that the epoxy-based paste was ultimately selected for the repairs because it showed better performance than the cementitious-based paste, which, when pushed to failure, experienced sliding of the CFRP bar within the paste, whereas the epoxy-based paste, when pushed to failure, failed by the splitting of the concrete. *Id.*

Tumialan also states that “[t]he epoxy based paste, if a part of the system, should only be used in the temperature range recommended by the manufacturer,” which “recommend[s] that the paste not be exposed to temperatures exceeding 65°C for prolonged periods.”¹⁶ *Id.* Tumialan states that use of the epoxy-based paste outside of the recommended temperature range “will likely accelerate aging, causing the paste to become unstable, and, therefore, compromise the bond between the concrete and [C]FRP

¹⁶ 65°C converts to 149°F.

reinforcement, and, eventually, the effectiveness of the [C]FRP-strengthening system.” *Id.* According to Tumialan, the typical climatic conditions in the Northeast region of the United States, for example, Boston, Massachusetts, were not expected to cause such a temperature concern and, based on computer modeling “it was concluded that the epoxy embedding paste was suitable for use in [Tumialan’s] project.” *Id.*

Tumialan discloses that a “second floor” (“the most critical garage bay”) and a “third floor” of the parking structure “in an unstrengthened configuration,” i.e., without the addition of NSM CFRP bars, “was able to safely support expected in-service loads of 1.44 kPa (30 psf).” *Id.* at 528. Tumialan further discloses that “[t]he results of the second series of tests at Test Area A (Design Load Test) showed that the most critical bay [on the second floor], when strengthened with CFRP bars, was adequate to support the full design loads of 2.40 kPa (50 psf) live load.” *Id.* Tumialan concludes that “[b]ased on this result, it was expected that all typical bays on both the second- and third-level decks, even though found to be deficient analytically, can support the code-prescribed loads when strengthened with CFRP bars.” *Id.*

3. *Sika Product Sheets*

The Sika Product Sheets are two related documents, one directed to a product called SikaTop 123, a “[t]wo-component, polymer-modified, cementitious, non-sag mortar plus FerroGard 901 penetrating corrosion inhibitor,” and the other directed to a product called Sika Armatec 110 EpoChem, a “[b]onding [a]gent and [r]einforcement [p]rotection” product.¹⁷

¹⁷ Unless greater specificity is required, we herein collectively refer to these two documents as “Sika Product Sheets.”

Ex. 1008, 1; Ex. 1009, 1. Neither document expressly states when it was published, but each includes the same notation as a header indicating “Edition 8.2003.” Ex. 1008, 1; Ex. 1009, 1; *but see* Ex. 1002 ¶¶ 126–127, 130 (indicating that each product sheet is directed to well-known and frequently used products in the construction industry and that the Sika Product Sheets were published and publicly available as of 2003, as indicated per their edition numbers); and Ex. 1029 ¶¶ 1–6 (testimony of a decades-long employee of Sika Corporation, publisher of the Sika Product Sheets, that these documents were publicly accessible in August 2003, as indicated by their edition numbers, per the customary practices of Sika Corporation). As noted above (*see supra* note 10) and discussed further below, Petitioner has shown, and it is uncontested by Patent Owner, that the Sika Product Sheets were printed publications and are prior art. *See* Pet. 52–55; Ex. 1002 ¶¶ 127–128, 130; Ex. 1010, 1–4, 6–10, 12, 15–16, 20–31, 32–47; Ex. 1029 ¶¶ 1–6; *see generally* Resp.

“Whether a reference qualifies as a ‘printed publication’ under section 102 is a legal conclusion based on underlying factual findings.” *M&K Holdings, Inc. v. Samsung Elec. Co.*, 985 F.3d 1376, 1379 (Fed. Cir. 2021) (citing *Jazz Pharms., Inc. v. Amneal Pharms., Inc.*, 895 F.3d 1347, 1356 (Fed. Cir. 2018)). As our reviewing court explains, deciding whether a reference is a “printed publication” requires a case-by-case analysis whether the reference was disclosed to the public, where “the key inquiry is whether or not a reference has been made ‘publicly accessible.’” *Id.* at 1379 (citing *Acceleration Bay, LLC v. Activision Blizzard Inc.*, 908 F.3d 765, 772 (Fed. Cir. 2018)). Of critical importance is determining whether the reference was “disseminated or otherwise made available to the extent that persons

interested and ordinarily skilled in the subject matter or art exercising reasonable diligence, can locate it.” *Id.* (quoting *Blue Calypso, LLC v. Groupon, Inc.*, 815 F.3d 1331, 1348 (Fed. Cir. 2016), which itself was quoting *Kyocera Wireless Corp. v. Int’l Trade Comm’n*, 545 F.3d 1340, 1350 (Fed. Cir. 2008)).

Petitioner asserts several reasons why Sika Product Sheets are a printed publication and prior art. Pet. 52–55; Prelim. Reply 1–5. Petitioner asserts that SikaTop 123 document “is a 2003 product data sheet for concrete mortar material sold by Sika Corporation” and that Sika Armatec 110 document “is [also] a 2003 product data sheet for a bonding agent sold by Sika Corporation.” Pet. 52 (citing Ex. 1008, 1; Ex. 1009, 1; Ex. 1002 ¶ 126). Petitioner asserts the Sika Product Sheets were published in 2003, as evidenced by their common notations as being “Edition 8.2003.” *Id.* at 53, 55 (citing Ex. 1008, 1; Ex. 1009, 1; Ex. 1002 ¶¶ 127–128, 130). Petitioner asserts that Sika Product Sheets were “used in the industry [at least] during the June/July 2010 timeframe” and were “being relied on by those in the construction industry well more than one year before the ’196 Patent’s earliest effective filing date.” *Id.* at 54–55 (citing Ex. 1002 ¶¶ 127–128, 130; Ex. 1010, 1–4, 6–10, 12, 15–16, 20–31, 32–47).

Petitioner relies on Dr. Nanni’s testimony as support for the assertion that Sika Product Sheets constitute a prior art printed publication. Dr. Nanni states that the two products described in the Sika Product Sheets were “frequently used in the construction industry at the time of the invention and would have been well-known to a POSA at the time of the invention,” that the notation on these documents of “Edition 8.2003” “confirms that [each] was publicly available [and being relied on by those in the construction

industry] well before the '196 Patent's filing date," and that Sika AG (the maker of the products disclosed in the Sika Product Sheets) "is one of the world's largest suppliers of chemicals and materials to the construction industry and would have been a household name to a POSA at the time of the invention." Ex. 1002 ¶¶ 127, 130. Dr. Nanni also testifies that people in the construction industry (associated with projects at issue in an FOI Request) were actually relying on the Sika Product Sheets (at least as of August 18, 2011). Ex. 1002 ¶¶ 128, 130 (citing Ex. 1010).

In response to pre-institution arguments by Patent Owner (*see* Prelim. Resp. 2–3, 9–14) Petitioner also submitted the Gillespie Declaration. Prelim. Reply 1, 5 (citing Ex. 1029 ¶¶ 1–5). Mr. Gillespie testifies that he is an executive at Sika Corporation and has been with the company since 1996, and that the notation "Edition 8.2003" on the Sika Product Sheets does "indicate[]" that they "were publicly accessible in August 2003," as initially asserted by Dr. Nanni (Ex. 1002 ¶¶ 127, 130).¹⁸ Ex. 1029 ¶¶ 1, 4–5. Mr. Gillespie also testifies Sika Product Sheets "were publicly available in Sika product catalogs in 2003, and were widely disseminated to Sika customers and product distributors throughout the United States in 2003," further that "[a]ny person interested in cement mortar or bonding agent products (for any purpose) would have been able to easily locate and access both Exhibits 1008 and 1009 as of August of 2003 (and thereafter)," and moreover that "[t]his accessibility was necessary for the Product Data Sheets to serve their intended purpose." *Id.* ¶ 5.

¹⁸ Mr. Gillespie also authenticates Exhibits 1008 and 1009. Ex. 1029 ¶¶ 2–3.

We find the above-noted evidence of record supports Petitioner's undisputed position that the Sika Product Sheets existed in August of 2003 and were publicly accessible before the '196 patent's effective date (i.e., April 4, 2017, at the earliest). *See* Pet. 52–55; Reply 1–5; Ex. 1002 ¶¶ 127–128, 130; Ex. 1010, 1–4, 6–10, 12, 15–16, 20–31, 32–47; Ex. 1029 ¶¶ 1–5. Thus, the Sika Product Sheets are prior art to the claims of the '196 patent.

Turning now to the disclosure of this prior art, the SikaTop 123 product sheet states that the SikaTop 123 product is used “[a]s a structural repair material for parking structures, industrial plants, water/waste water treatment facilities, roads, walkways, bridges, tunnels, dams, ramps, etc.” Ex. 1008, 1. It indicates that the SikaTop 123 product “[c]ontains portland cement and sand (crystalline silica).” *Id.* at 2. The SikaTop 123 product sheet states that the advantages of the SikaTop 123 product include, *inter alia*, high compressive, flexural, and early strengths, freeze/thaw durability, compatibility with coefficient of thermal expansion of concrete, non-flammability, and non-toxicity. *Id.* at 1.

The SikaTop 123 product sheet instructs, regarding preparing a concrete or mortar surface for its use, to “[p]rime the prepared substrate with a brush or sprayed applied coat of Sika Armathec 110 EpoCem (consult Technical Data Sheet).” *Id.* at 2. The referenced Sika Armathec 110 is the subject matter of the Sika Armathec 110 product sheet. Ex. 1009.

The Sika Armathec 110 product sheet indicates that “Sika Armathec 110 EpoCem is a 3-component, solvent-free, moisture-tolerant, epoxy-modified, cementitious product specifically formulated as a bonding agent and an anti-corrosion coating.” *Id.* at 1. The Sika Armathec 110 product sheet indicates that the Sika Armathec 110 product “[c]ontains crystalline silica, quartz

(sand); cement.” *Id.* at 2. The Sika Armatec 110 product sheet states that Sika Armatec 110 should be used, *inter alia*, “[a]s a bonding agent for repairs to concrete and steel” and “[a]s a bonding agent for placing fresh, plastic concrete to existing hardened concrete.” *Id.* at 1.

The Sika Armatec 110 product sheet states that the product’s advantages are that it, *inter alia*, provides excellent adhesion to concrete and steel, can be used exterior on-grade, provides excellent bonding bridge for cement or epoxy based repair mortars, has high strength, and is non-flammable. *Id.*

4. *Reis*

Reis is an article from the 2012 Forensic Engineering publication by ASCE, titled “Non-Destructive Radiographic Evaluation and Repairs to Pre-Stressed Structure Following Partial Collapse.” Ex. 1011, 1015.¹⁹ On its face, *Reis* indicates it is prior art to the claims of the ’196 patent; Patent Owner does not argue otherwise. *Id.*; *see generally* Resp.

Reis discloses “steel retrofit and carbon fiber reinforced polymer (CFRP) repairs” for reinforced, precast concrete parking deck, double-tee structures. Ex. 1011, 1015 (Abstract). Among other things, *Reis* discloses adding “supplemental steel brackets installed through the double-tee stems” to repair concrete decking and *Reis* shows such repairs in its Figure 8 images, reproduced below:

¹⁹ *Reis* includes original page numbering and page numbering added at its lower corner. Herein we reference the original numbering.



Figure 8 includes two images, a graphic illustration (above-left), and a photograph (above-right), each showing dual steel beam members connected to the underside of tee-shaped decking below the surface flange, through-bolted to supports, also bolted to the flange, and spanning a joint between two flange surfaces. *Id.* at 1020–21.

Reis refers to the steel bracket system shown above as “supplemental” because Reis also discloses installing longitudinal strips of CRFP sheets along cracked areas of concrete, which the brackets supplement. *Id.* at 1020.

E. PETITIONER’S PATENTABILITY CHALLENGES

As summarized above, Petitioner asserts four grounds for unpatentability of the claims of the ’196 patent—Grounds A–D. *See supra* Section I.E; *see also* Pet. 27. Under the asserted grounds for unpatentability, in particular Grounds B and D, Petitioner addresses claims 1–7, 9, 10, and 13 of the ’196 patent and details, with citation to, *inter alia*, the asserted prior art and to the supporting testimony of the Nanni Declaration (Exhibit 1002), how the claims and proposed substitute claims are rendered obvious by the combination of Gleich, Tumialan, and Sika Product Sheets, and for claims 10 and 13, also adding Reis. *See* Pet. 28–74; *see also* Reply; Opp.

Rev. MTA; Pet. Sur-Reply Rev. MTA. Where asserted unpatentability is based on a modification of prior art, Petitioner also details the ordinarily skilled artisan's reasons or motivation to combine and modify the references. *See* Pet. 37–40, 45–46, 55–60, 67–69; *see also* Ex. 1002 ¶¶ 82–152 (Dr. Nanni testifying on this).

Because we are persuaded by Petitioner's arguments and the evidence that the challenged claims are obvious under Grounds B and D, that the proposed substitute claims also would have been obvious over the same prior art asserted under Ground B, and because Grounds A and C are subsumed within Grounds B and D, we do not address Grounds A and C.

We review Petitioner's challenges and Patent Owner's arguments below.²⁰

1. *Obviousness of Claims 1–7 and 9 Over Gleich, Tumialan, and Sika Product Sheets (Ground B)*

Under its Ground B, Petitioner asserts that claims 1–7 and 9 would have been obvious over Gleich, Tumialan, and Sika Product Sheets. Pet. 52–64. However, Petitioner's Grounds A and B address the same claims and are closely related. Under Ground B, Petitioner relies on teachings of Gleich and Tumialan initially introduced and discussed in the Petition under Ground A, and Petitioner adds Sika Product Sheets' teachings to address

²⁰ Patent Owner argues in its Response that Petitioner's expert witness, Dr. Nanni, lacks credibility, presents merely conclusory opinions, and resorts to hindsight bias in his testimony. *See* Resp. 10–11. We do not agree with Patent Owner's positions. The evidence shows that Dr. Nanni is qualified to testify on the issues in this proceeding and we find his opinions are based on his understanding of the perspective of the ordinarily skilled artisan, his experience, and the disclosures of the prior art, and are supported by evidence, and do not rely on the '196 patent as a roadmap so as to infect his opinions with improper hindsight. *See generally* Ex. 1002; Ex. 1026.

claim 1's step 1c (applying a concrete bonding agent) and 1d (filling the trench with concrete, although Petitioner also asserts this would be obvious from Tumialan, too). *Id.*; *see also id.* at 28–51 (Petition discussing the disclosures of Gleich and Tumialan). Petitioner refers to assertions under Ground A regarding the ordinarily skilled artisan's reasons or motivation to combine Gleich and Tumialan and how their teachings apply to the claims, and then, under Ground B, asserts and discusses why such a person of ordinary skill in the art would also have added the Sika Product Sheets to that prior art combination. *Id.* at 37–40, 55–60.

Because the issue of whether there would have been reasons or motivation to combine and modify the prior art is the central issue of dispute in this proceeding, we address it first.

Motivation to Combine Gleich, Tumialan, and Sika Product Sheets, and Reasonable Expectation of Success

As discussed in detail below, Petitioner asserts that the ordinarily skilled artisan would have been motivated to combine Gleich's, Tumialan's, and Sika Product Sheets' teachings in method for repairing/reinforcing Gleich's double tee parking structure, as claimed in the '196 patent, with a reasonable expectation of success. Pet. 37–64; *see also* Ex. 1002 ¶¶ 82–124, 135–152 (Dr. Nanni testifying on the same, as well as how the references would have been combined by the ordinarily skilled artisan); Reply 1–17 (Petitioner responding to Patent Owner's arguments on this issue); Ex. 1030 ¶¶ 5–26 (Dr. Nanni further testifying on this issue in response to Patent Owner's arguments); *see also supra* Sections II.D.1–3 (discussing these references).

Although there is no dispute that the individual steps and related components of claim 1 were disclosed in the asserted prior art, Patent Owner

argues that “[a] person of ordinary skill in the art (‘POSITA’) would not form ‘a trench at a top surface of the flange between the two supporting members that support the flange of the load-carrying concrete floor structure’ and then fill ‘the trench with concrete,’ as claim 1 requires,” because “a POSITA would NOT be motivated to use cementitious-based pastes with Tumialan’s grooves and NSM CFRP designs.” Resp. 4–16; *see generally id.* This is Patent Owner’s keystone argument.

Petitioner begins by addressing Gleich’s and Tumialan’s teachings and asserts:

Gleich discloses a C-Grid® reinforced precast load-carrying concrete floor structure having all of the structural features recited Claim 1. Ex-1002, ¶¶82, 90-92. Tumialan discloses a well-known NSM method for enhancing and repairing reinforced load-carrying concrete structures, which includes every step recited in elements 1[a] to 1[d]. Ex-1002, ¶¶82, 93-107. It would have been obvious to use Tumialan’s NSM method to enhance and/or repair a parking deck or other structure made from the C-Grid® reinforced precast concrete double tees disclosed in Gleich. Ex-1002, ¶¶82-97.

Pet. 37. Petitioner asserts that the ordinarily skilled artisan would have had several reasons to seek a method for repairing a C-Grid reinforced concrete double tee structure as taught in Gleich, for example, to enhance it for supporting greater loads, to enhance durability, to repair deterioration, and to repair improper initial construction. *Id.* at 37–38 (citing Ex. 1002 ¶ 83).

Regarding such repairs, Petitioner asserts that there are several reasons an ordinarily skilled artisan would have looked to Tumialan for repair methods, such as, Tumialan’s methods were effective to enhance and repair such C-Grid double tee structures, the concrete slabs of Gleich and Tumialan are each reinforced-load-carrying concrete floor structures, both

Gleich's and Tumialan's concrete structures are engineered for use in multi-level parking structures, and both Gleich's and Tumialan's concrete structures utilize negative-moment regions that require sufficient strength and durability. *Id.* at 38 (citing Ex. 1002 ¶¶ 84–88; Ex. 1004, 523–24, 529); *see also* Ex. 1003; Ex. 1004.

Further, Petitioner asserts that the ordinarily skilled artisan would have recognized that the CFRP bars of Tumialan's methods were "highly compatible with Gleich's C-Grid® double tee[]" structures. Moreover, Petitioner asserts that an ordinarily skilled artisan would have recognized Tumialan's NSM reinforcement methods as preferred to other concrete structure repair alternatives because they result in structures not subject to abrasion or other potential damage, and facilitate simple techniques. *Id.* at 39–40 (citing Ex. 1002 ¶¶ 86–88; Ex. 1004, 523).

As for the Sika Product Sheets, Petitioner asserts that the two documents thereof would have been considered together by the person of ordinary skill in the art because one "express[ly] recommend[s]" that the two products of focus should be used together for concrete repair. *Id.* at 55–56 (citing Ex. 1002 ¶¶ 132–134; Ex. 1008, 2; Ex. 1009, 1, 3). Petitioner asserts that an ordinarily skilled artisan "performing Tumialan's NSM method . . . would have reviewed the Sika Product Sheets to select an embedding paste for filling the trenches formed on the top-surface of Gleich's double tee" structures, which the Sika Product Sheets teach should be SikaTop 123 "concrete mortar" used in combination with "Sika Armatex 110 . . . bonding agent for adhering the SikaTop 123 to the internal side surface[] of the trenches." *Id.* at 57 (citing Ex. 1002 ¶¶ 82–107, 135).

Petitioner asserts that such an ordinarily skilled artisan “would have known that Sika [was] one of the world’s leading suppliers of concrete renovation products, including cement repair mortars and bonding agents,” and that Sika had received awards from the International Concrete Repair Institute; Dr. Nanni called Sika (AG) “a household name” in the construction industry.²¹ Pet. 57–58 (citing Ex. 1002 ¶¶ 135–136; Ex. 1021, 1–2, 5–9, 43–44); *see also* Ex. 1002 ¶¶ 127, 130 (Dr. Nanni’s testimony on Sika Product Sheets’ wide availability).

Petitioner also asserts that the Sika products of focus in the Sika Product Sheets were known to be high performance materials for cementitious repair, useful on concrete parking structures, and would have been recognized by ordinarily skilled artisans as suitable for Gleich’s structures. Pet. 58–59 (citing Ex. 1002 ¶¶ 137–139; Ex. 1003, 11–12; Ex. 1008, Ex. 1009). Petitioner asserts that the skilled artisan would have recognized these products provided performance advantages, such as high compressive and structural strength, high early strengths, freeze and thaw durability, ASTM compliance, corrosion resistance, non-sag properties, high-temperature effectiveness, low cost, ease of installation, reduced environmental hazards, improved aesthetics, suitability of purpose, excellent bonding for cement and epoxy, excellent concrete adhesion, and moisture resistance. *Id.* at 58–59 (citing Ex. 1002 ¶¶ 137–139; Ex. 1005, 525; Ex. 1008; Ex. 1009; Ex. 1019, 190, 193, 198–199).

²¹ Dr. Nanni, in rendering his opinions on obviousness, identifies that a reasonable expectation of success is required when considering whether prior art reference would have been combined by a person of ordinary skill in the art, and concludes that Gleich, Tumialan, and Sika Product Sheets would have been combined. Ex. 1002 ¶¶ 22, 26, 82–88, 132–140.

Patent Owner responded to Petitioner’s assertions in its Response. As noted above, Patent Owner’s arguments are foundationally based on its position that the person of ordinary skill in the art would not have been motivated to use concrete (or cement or cementitious material) for “filling the [Tumialan] trench with concrete” (as recited by claim 1) for holding CFRP bars, were such an ordinarily skilled artisan to use Tumialan’s methods to reinforce Gleich’s double tee structures. *See* Resp. 6–7 (citing Ex. 1004).²² As we noted above, Patent Owner submits no supporting witness testimony for its position, but avers that the technology is so easily understood and the cited prior art so clear that “expert testimony is unnecessary.” *Id.* at 7, n.3 (citing *Wyers v. Master Lock Co.*, 616 F.3d 1231 (Fed. Cir. 2010); *Perfect Web*, 587 F.3d 1324, 1330 (Fed. Cir. 2009); *Union Carbide Corp. v. American Can Co.*, 724 F.2d 1567, 1573 (Fed. Cir. 1984)). Furthermore, this is essentially Patent Owner’s only real dispute with Petitioner’s positions, at least over Ground B. *See generally* Resp. and Sur-Reply; *In re NuVasive, Inc.*, 841 F.3d 966, 974 (Fed. Cir. 2016) (we are not required to address undisputed matters).

Patent Owner argues that Tumialan discloses testing both epoxy-based and cement/concrete-based pastes (each “commercially available” but unidentified) in prelude to filling trenches to hold CFRP bars and Tumialan determined that epoxy would ultimately be used, having considered its performance superior and identified its compatibility with temperatures to which it would be exposed. *See, e.g.*, Resp. 8–9 (citing Ex. 1004, 525,

²² At Resp. 3, Patent Owner cites Exhibit 1025 (a trademark renewal email), but we understand this to be a clerical error and intended to cite Ex. 1004 (Tumialan).

Fig. 2). Recognizing that, based on Tumialan's disclosure, climatic temperature was an issue of concern in selecting between epoxy and cement as a trench-filler in Tumialan's repair/reinforcement systems, Patent Owner argues that there is no evidence suggesting that any parking garage, even outside the Massachusetts region, would experience 65°C (149°F) or greater temperatures to cause concern with use of the stronger-holding epoxy filler. *Id.* at 9–10.

Patent Owner also argues that a person of ordinary skill in the art would not substitute cement/concrete for epoxy in such repair system “because doing so would cause safety issues and risk failure of the structure” due to the testing failures reported by Tumialan. *Id.* at 10. Further, Patent Owner argues that Petitioner's assertion that concerns about fire-resistance in trench-filling materials would encourage the use of cement/concrete was “complete speculation,” and argues that there is no evidence that a cement filler would even be suitable at ambient temperatures. *Id.* at 12–15 (discussing Burke, Exhibit 1019).

Ultimately, to summarize, Patent Owner's argument is that Tumialan's choice to use epoxy filler material for its trenches over cement-based filler is the same decision the person of ordinary skill would always make. Meaning concrete filler was not an option. Again, Patent Owner submits no witness testimony to corroborate or support any of its arguments.

Petitioner responds to Patent Owner's arguments in its Reply. Petitioner argues that its Petition asserts reasons why a person of ordinary skill in the art would choose cement-based material to fill NSM trenches, such as certain performance advantages like high-temperature resistance, lower costs, and aesthetics, and also because the Sika Product Sheets

disclose that the SikaTop 123 product, a cement mortar, was “especially useful ‘as a structural repair material for parking structures” like Gleich’s and Tumialan’s structures. Reply 4–5 (citing Pet. 44–46, 58–59).

Petitioner argues that, although Tumialan discloses a failure of the cement-based paste, *both* the cement and epoxy fillers were shown to fail in tests designed to deliberately push the systems to failure and the fact that epoxy paste exhibited a stronger bond performance than cement was already well known. *Id.* at 5–6 (citing Ex. 1004, 525; Ex. 1030 ¶¶ 9–13; Ex. 1019, 195; Ex. 1031, 1, 4).

Petitioner argues that, although Tumialan disclosed ultimately selecting epoxy-based paste over cement, this choice was not a universally final choice as evidenced by the reference itself leaving the door open to alternatives in stating “[t]he epoxy-based paste, *if a part of the system*, should *only be used* in the temperature range recommended by the manufacturer,” and the fact that Tumialan never indicated that cement-based paste was insufficient, only that epoxy was preferred. *Id.* at 7–8 (quoting Ex 1004, 525 (emphasis Petitioner’s); Ex. 1030 ¶¶ 14–18; Ex. 1019, 197). Petitioner’s argument here is that Tumialan itself, even in choosing epoxy, identified that there are circumstances (e.g., climates where parking decks may reach 65°C or where fire resistance is desired) where epoxy-based paste would not be selected to be a part of its system, leaving the commercially available cement-based alternative as the other choice. *Id.* at 8–11.

Regarding Patent Owner’s argument that there is a lack of evidence that a cement-based paste would perform adequately at ambient temperatures, Petitioner cites Burke (published in 2012). *Id.* at 11 (citing Ex. 1019). Petitioner argues that Burke evidences that cement-based pastes

were evaluated at ambient temperatures, with the test results reported at Burke’s Table 3, which is reproduced (as annotated by Petitioner) below:

Table 3
Selected results of ambient temperature testing

	Specimen ^a	Failure load (kN)	Failure moment (kN m)	Strength increase (%) ^b	Failure Mode
No strengthening	C-21-1	12.7	3.2	–	Crushing (under-reinforced)
	C-21-2	11.4	2.9	–	Crushing (under-reinforced)
NSM w/epoxy	E-21-1	33.5	8.5	178	Shear crack induced debond/failure
	E-21-2	34.9	8.9	190	Debonding by epoxy/concrete split
NSM w/cement	G-21-1	24.6	6.3	104	Debond @ grout-strip interface
	G-21-2	27.1	6.9	125	Debond @ grout-strip interface
	EB-21-1	33.4	8.5	162	Shear crack induced debond/failure

Comparison of Epoxy-based and Cement-based NSM Performance at Ambient Temperatures (Ex-1019, Table 3; annotated by Petitioner’s Expert)

Burke’s Table 3 shows “selected results of ambient temperature testing” (highlighted by Petitioner in blue) for several specimens (all of which failed at some point), two of which (G-21-1 and G-21-2, highlighted by Petitioner in yellow) are indicated to be cement (labeled by Petitioner as such in blue text); the results show that epoxy (E-21-1 and E-21-2, labeled by Petitioner in blue text) withstood a greater failure load than cement and provided a 178–190% strength increase to the reinforced structure, while the cement provided a 104–125% strength increase to the reinforced structure. *Id.* at 11–13 (citing Ex. 1019, 195).

Petitioner argues that Burke discloses that its results for cement paste exceed the reasonable strength increases permitted for designs in real-world strengthening applications, which would normally only be in the range of 40–60%. *Id.* Petitioner’s point is that, for practical purposes, the use of a cement-based paste in an NSM reinforcement is evidenced to be more than adequate.

In response to Petitioner’s Reply, Patent Owner submits arguments in a Sur-Reply. Patent Owner argues that Tumialan’s failure tests showed

concrete-paste failed because the CFRP bars slipped, which Patent Owner argued implicates safety concerns with the material. Sur-Reply 2. Patent Owner argues that, perhaps, concrete would be used with steel bars for cement structure reinforcement, but it would not be used with CFRP bars for NSM reinforcement. *Id.* at 3–4 (citing Ex. 2007 and Ex. 2008 (De Lorenzis articles published in 2004 and 2006, respectively)). Patent Owner argues that two De Lorenzis articles evidence that, although there are potential benefits to the use of cementitious groove filler (e.g., cost, environmental impact, temperature resistance), cement’s inferior mechanical and durability properties when compared to epoxy would limit its use absent further research “to provide a better understanding of the performance of cement grout as a groove filler.” *Id.* at 5 (emphasis omitted) (citing Ex. 2008, 121, 141).

Patent Owner also argues that Petitioner’s point about some climates producing 65°C or greater temperature in concrete parking structures is not supported by the evidence. *Id.* at 11–12 (citing Ex. 1033, 44 (temperature in Arkansas reached only 60°C); Ex. 1034, 170, 177 (temperature in Saudi Arabia only actually reached 63°C unless surfaces were painted black, where they would reach 70°C)).

We have considered the parties’ positions and the evidence and find that Petitioner has shown that the person of ordinary skill in the art would have had reasons and been motivated to combine Gleich, Tumialan, and Sika Product Sheets, in particular to fill trenches with concrete, with a reasonable expectation of success. We are not persuaded by Patent Owner’s arguments.

We find Gleich, Tumialan, and Sika Product sheets are appropriately considered in combination for an obviousness unpatentability analysis over

the claims of the '196 patent. A prior art reference is analogous when it is: (1) “within the field of the inventor’s endeavor” or (2) “reasonably pertinent to the particular problem with which the inventor was involved.” *In re Wood*, 599 F.2d 1032, 1036 (C.C.P.A. 1979); *see also In re Clay*, 966 F.2d 656, 658–59 (Fed. Cir. 1992); *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004). Here, the cited prior art references are each directed to the same field of endeavor—concrete structures and the repair or reinforcement of concrete structures, such as parking structures; and each is also reasonably pertinent to the inventor’s problem—repairing and enhancing concrete structures. *See* Ex. 1001, 23:16–17 (claim 1 directed to a “method for enhancing or repairing a pre-cast load-carrying concrete floor structure”); Ex. 1003 (Gleich directed to precast, concrete, C-Grid reinforced, parking structures); Ex. 1004 (Tumialan directed to strengthening of concrete parking garage decks using NSM CFRP reinforcement system); Ex. 1008 (Sika Product Sheet directed to SikaTop 123, a “high performance repair mortar” material used for structural repair for parking structures); Ex. 1009 (Sika Product Sheet directed to Sika Armatec 110, a bonding agent for repairs to concrete for placing fresh, plastic concrete to existing hardened concrete); *see also* Ex. 1002 ¶¶ 67–88 (discussing Gleich and Tumialan and their combination), 126–140 (discussing Sika Product Sheets and their combination with Gleich and Tumialan). As analogous art, Gleich, Tumialan, and Sika Product Sheets are correctly used in analyzing the obviousness of the '196 patent’s claims. *See Unwired Planet, LLC v. Google Inc.*, 841 F.3d 995, 1000–01 (Fed. Cir. 2016).

Having confirmed, in agreement with the Petition’s assertions, that Gleich, Tumialan, and Sika Product Sheets are appropriate prior art

references for combination in an obviousness unpatentability challenge, we turn to the main point of contention in this proceeding: whether the evidence of record supports that it would have been obvious to use concrete/cement (such as the SikaTop 123 product taught by Sika Product Sheets) to fill a trench formed (as taught by Tumialan) in a concrete double tee parking deck structure (as taught by Gleich) holding a CFRP reinforcement bar (after applying a concrete bonding agent as taught by Sika Product Sheets). We find the evidence supports that the person of ordinary skill in the art would, indeed, have had such motivation. We accept Petitioner's positions on this, as set forth above, as our own and explain further below.

First, there is ample evidence that the teachings of Gleich and Tumialan would have been combined by the ordinarily skilled artisan because Gleich teaches well-known (as of the invention date) double tee, carbon fiber grid (C-Grid) reinforced concrete structures that can be used for parking deck structures and Tumialan teaches a well-known (as of the invention date) technique for repairing or reinforcing concrete parking deck structures—the obviousness of pairing these two disclosures is apparent because when one's structure needs repair the other's technique would be used. *See* Pet. 37–40; Ex. 1002 ¶¶ 82–107; *see generally* Ex. 1003; Ex. 1004. The fact that methods like Tumialan's (NSM reinforcement using CFRP bars) for reinforcement of concrete structures were well known and even in widespread use before the '196 patent (before 2017) is further supported by other evidence, such as Burke, Bournas, and two De Lorenzis publications. *See* Ex. 1019; Ex. 1035; Ex. 2008, Ex. 2009.

Would the teachings of Sika Product Sheets also be incorporated into this prior art combination by an ordinarily skilled artisan? Yes, we find the

evidence supports this and we agree with Petitioner’s rationale. Would it have been obvious to a person of ordinary skill in the art to use a concrete product like SikaTop 123 as taught by Sika Product Sheets to fill trenches holding CFRP bars in Tumialan’s methods for the repair/reinforcement of a double tee structure as in Gleich? Again, yes, the evidence supports that it would. As explained by the Supreme Court, “any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements [of the prior art] in the manner claimed.” *KSR*, 550 U.S. at 420. As we explain below, there are a variety of reasons the ordinarily skilled artisan would have used such concrete filler.

We agree with Petitioner that Tumialan itself supports that concrete paste would have at least been an option to use with its methods; perhaps not the best performing option from a pure bond-strength standpoint, but an option nonetheless. Pet. 44–46; Ex. 1002 ¶¶ 101–105; Ex. 1004, 525. “[A] finding that the prior art as a whole suggests the desirability of a particular combination need not be supported by a finding that the prior art suggests that the combination claimed . . . is the preferred, or most desirable, combination.” *In re Fulton*, 391 F.3d at 1200.

Tumialan indicates that, when selecting a material to hold a CRFP bar in a groove or trench cut into a concrete parking deck’s surface, there were two commercially available options: an epoxy-based material and a cementitious-based material. Ex. 1004, 525. Tumialan indicates that, for its purposes, ultimately the epoxy-based material was selected because it “showed a better performance,” i.e., stronger bonding to the CFRP bar, but Tumialan still indicated that such epoxy-based material may or may not be a part of its system; and, if it was not used, the only other option was cement

paste. *Id.* (“The epoxy-based paste, if a part of the system, should only be used in the temperature range recommend by the manufacturer.”); *see also* Ex. 1002 ¶ 102. As explained in *Fulton*, the cement-filler choice need not have been the preferred or most desirable trench-filler. *Fulton*, 391 F.3d at 1200; *see also PAR Pharm.*, 773 F.3d at 1197–98 (“Our precedent, however, does not require that the motivation be the *best* option, only that it be a *suitable* option from which the prior art did not teach away.”); *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 567 F.3d 1314, 1327 (Fed. Cir. 2009) (a reference’s mere preference for one option does not teach away from its alternative).

The evidence supports that temperature, among other things, would have been a factor considered by the person of ordinary skill in the art when choosing a material with which to fill CFRP-bar-holding trenches and that ambient and fire-induced temperatures were both concerns that would point an ordinarily skilled artisan toward cement-based filler material. *See* Pet. 44–45; Ex. 1003, 12 (“two-hour fire” testing and rating were of focus in recommending C-Grid double tee structures)); Ex. 1004, 525 (“The epoxy-based paste, if a part of the system, should only be used in the temperature range recommended by the manufacturer.”); Ex. 1008 (“Not flammable”); Ex. 1019, 190 (Abstract: “It has been suggested in the literature that, thanks to superior bond performance and thermal protection from embedment within the concrete cover, NSM systems may outperform externally bonded FRP systems at elevated temperatures, particularly if inorganic adhesives are used”); *see also* Ex. 1002 ¶¶ 102–103 (discussing temperature and cement-based paste).

Other factors that would have also motivated an ordinarily skilled artisan to use a cement-based filler would have been lower cost, reduced environmental concerns, ease of installation, and improved aesthetics. *See* Pet. 45–46; *see also* Ex. 1002 ¶¶ 104, 138 (discussing these advantages of cement-based trench filling material, including SikaTop 123); Ex. 2009, 121 (identifying these factors as potential advantages of cement or mortar paste in NSM systems), 141 (“There are benefits with the use of a cementitious groove filler as discussed earlier in the paper. Research is needed to provide a better understanding of the performance of cement grout as a groove filler and to formulate stronger cementitious groove fillers.”). As explained by the Supreme Court, “any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.” *KSR*, 550 U.S. at 420. Thus, any of these noted advantages of cement-based filler material for trenches would provide a motivation for the ordinarily skilled artisan to use a concrete filler, like SikaTop 123, for trenches, as claimed.

We are unpersuaded by Patent Owner’s arguments that no parking structure in the world would ever reach a temperature under normal environmental conditions to cause a concern that would motivate the use of cement over epoxy, and that epoxy offers superior performance for NSM systems, which makes it the only choice for such purposes. *See supra* discussion.

However, even if Petitioner’s evidence did not show that the temperatures at some locations for concrete parking structures might cause concern over the use of epoxy filler material (*see, e.g.*, Ex. 1034, 169–170 (describing surface temperatures for concrete structure in Saudi Arabia as

high as 70°, 71° or 73°C), the evidence shows that ambient or environmental temperatures are not the only temperature concerns for concrete parking structures—temperatures may also be elevated by fire. We find fire-elevated temperature concerns also would have been a motivator. *See* Ex. 1002

¶¶ 103, 138 (identifying fire temperatures as a concern); Ex. 1003, 12 (identifying fire rating as important); Ex. 1008 (identifying non-flammability as an advantage of SikaTop 123); *see also* Ex. 1030 ¶ 21 (discussing this issue).

Also, the superiority of epoxy-based paste’s bond strength compared to cement (asserted by Patent Owner) appears to be well documented and is a fact uncontested by Petitioner. But, Petitioner points to evidence that the person of ordinary skill in the art would have known that the bond strength of cement filler more than met the needs for structural repair and reinforcement for it to have been an option for the ordinarily skilled artisan as of the invention. *See* Reply 6–8 (e.g., identifying that Tumialan never indicates the commercially available cement paste’s bond strength was insufficient, only inferior), 11–14 (discussing Burke’s disclosure of cement-based paste’s capabilities at ambient temperatures). We credit Petitioner’s evidence in Burke, noted above (*see supra* reproduced, annotated Burke Table 3), which shows that, at ambient temperatures, cement-based filler offered strength improvements in NSM CFRP systems that exceeded the then-current (in 2012) design requirements, i.e., cement provided strength increases up to 125% where no more than 60% was required. *See* Ex. 1019, 193–195 (ambient temperature tests); *see also* Ex. 1030 ¶¶ 22–26 (discussing the same). For these same reasons, we also do not agree with

Patent Owner that there is any evidence of “safety concerns” regarding the use of cement filler.

Thus, for the reasons above, we find that Petitioner has shown that the person of ordinary skill in the art would have had several reasons to “fill[] [a] trench with concrete,” such as Sika Product Sheet’s SikaTop 123, when repairing or reinforcing a Gleich double tee structure by Tumialan’s NSM CFRP system. Moreover, we find, for the above-noted reasons asserted by Petitioner, which we adopt as findings of fact, the person of ordinary skill in the art would have been motivated to combine Gleich, Tumialan, and Sika Product Sheets with a reasonable expectation of success. *See NuVasive, Inc.*, 841 F.3d at 974 (we do not and are not required to address undisputed matters).

We turn next to Petitioner’s assertions that the prior art combination teaches the steps of the claims.

Analysis of Claim 1

Petitioner asserts that independent claim 1, and dependent claims 2–7 and 9, would have been obvious over Gleich, Tumialan, and Sika Product Sheets. Pet. 28–64. We address Petitioner’s assertions and evidence over each of these claims, beginning with independent claim 1.

Claim 1’s preamble recites

A method for enhancing or repairing a pre-cast load-carrying concrete floor structure, wherein the load-carrying concrete floor structure includes a flange, two supporting members that support the flange, and a carbon fiber grid disposed within the flange between the two supporting members, the method comprising:

Ex. 1001, 23:16–21 (italics added).

With respect to the preamble (“1pre”), Petitioner states that “the combination of Gleich and Tumialan (and thus the combination of Gleich, Tumialan, and the Sika Product Sheets) discloses the preamble of Claim 1 and elements [1a] and [1b]” and points to its assertions under Ground A. Pet. 60.

Petitioner asserts that

Gleich discloses “[a] new approach to reinforcing double tee flanges involves the use of carbon fiber grid as a replacement for conventional steel mesh reinforcement.” Ex-1003, 11. A POSA would immediately understand that a C-Grid® reinforced double tee includes “a flange, two supporting members that support the flange, and a carbon fiber grid disposed within the flange between the two supporting members,” as recited in the preamble. Ex-1002, ¶90. In fact, these features are clearly depicted in Gleich’s illustration of the C-Grid® reinforced double tee, which is shown below annotated by Petitioner’s expert (Dr. Nanni). *Id.*

Id. at 40. The figure to which Petitioner refers is reproduced above at Section II.D.1 (without annotations), and Petitioner’s annotations of the same in the Petition highlight the parts of Gleich’s double tee structure that are the pre-cast load-carrying concrete floor structure, flange, carbon fiber grid, and supporting members of the claims. *Id.* at 41 (citing Ex. 1002 ¶ 91; Ex. 1003, 11–12). Petitioner further asserts that “Tumialan discloses a method of enhancing and repairing a reinforced load-carrying concrete structure,” such as the double tee structures of Gleich. *Id.* at 41–42 (citing Ex. 1002 ¶ 92; Ex. 1004, 523, 529).

Patent Owner does not dispute Petitioner’s above-noted assertions. *See generally* Resp.

We note, the preamble includes the open and inclusive transitional term “comprising,” which means the claim can include additional steps or

elements not expressly recited. *CIAS, Inc. v. Alliance Gaming Corp.*, 504 F.3d 1356, 1360 (Fed. Cir. 2007) (“In the patent claim context, the term ‘comprising’ is well understood to mean ‘including but not limited to.’”). “Generally, the preamble does not limit the claims.” *Allen Eng’g Corp. v. Bartell Indus., Inc.*, 299 F.3d 1336, 1346 (Fed. Cir. 2002). Regardless of whether the preamble is limiting, Petitioner shows that the recitation in the preamble is satisfied by the prior art combination because Gleich teaches the structural subject matter of the preamble of claim 1 and Tumialan relates to similar concrete structures and teaches their enhancement/repair. Ex. 1002 ¶¶ 90–92; Ex. 1003, 11–12; Ex. 1004, 523, 529.

Claim 1 next recites (step “1a”):

forming a trench at a top surface of the flange between the two supporting members that support the flange of the load-carrying concrete floor structure.

Ex. 1001, 23:22–24 (italics added).

Petitioner asserts that this step is taught by the prior art combination because, “[i]n Tumialan’s method, saw-cut grooves are formed on the top surface of concrete deck slabs. Ex.1004, 529. A POSA would understand that these saw-cut grooves would be ‘trenches’ as recited in Claim 1.” Pet. 42 (citing Ex. 1002 ¶ 94); *id.* at 60 (referring back to assertions under Ground A). Petitioner asserts that the ordinary skilled artisan would have found it obvious to cut trenches, as disclosed in Tumialan, in the top surface of Gleich’s flange between the underlying supporting members, based, in part, on the physical forces impinging on Gleich’s C-Grid structure and an understanding of “basic structural design.” *Id.* at 42–43 (citing Ex. 1002 ¶ 95; Ex. 1004, 526, 529).

Patent Owner does not dispute Petitioner's above-noted assertions.
See generally Resp.

We agree with Petitioner. Tumialan discloses cutting grooves into the top surface of a concrete parking structure; Petitioner asserts these grooves are trenches. Ex. 1004, 523–29; Ex. 1002 ¶¶ 94–95. Moreover, based on the disclosure of Gleich, we agree with Petitioner that, were one to repair or reinforce Gleich's double tee structures using the grooves/trenches disclosed by Tumialan, they would be formed between the supporting members, as claimed. *See* Ex. 1003, 11–12; Ex. 1004, 526 (Fig. 3), 529 (Figs. 9, 10); Ex. 1002 ¶¶ 94–95.

Claim 1 next recites (step “1b”):

arranging a reinforcement material into the trench to be above at least a portion of the carbon fiber grid disposed within the flange.

Ex. 1001, 23:25–27 (italics added).

Regarding this step 1b, Petitioner asserts that Tumialan's method includes placing CFRP bars as a reinforcement material into the aforementioned grooves/trenches to supplement the existing reinforcement materials in the flange, which, in Tumialan are steel bars (and in Gleich is C-Grid); Tumialan's grooves/trenches and the added CFRP bars are above the steel bars. Pet. 43 (citing Ex. 1004, 525); *see also* Tumialan 526 (Fig. 3) (showing position of the steel reinforcement bars with respect to the added CFRP bars); *see also* Pet. 60 (referring back to assertions under Ground A). Petitioner asserts that it would have been obvious to the ordinarily skilled artisan to perform this step for a structure as taught by Gleich, but where the trenches and added CFRP bars would be above its C-Grid (carbon reinforcement grid), rather than above Tumialan's reinforcing steel bars, so

as to support but not damage the C-Grid. Pet. 43–44 (citing Ex. 1002 ¶¶ 97–99).

Patent Owner does not dispute Petitioner’s above-noted assertions.
See generally Resp.

We agree with Petitioner. Tumialan’s CFRP bars would have been arranged in Tumialan’s disclosed trenches when the trenches were formed in Gleich’s double tee structure, but above Gleich’s C-Grid rather than above Tumialan’s steel bars. *See* Ex. 1002 ¶¶ 97–99; Ex. 1003, 11–12; Ex. 1004, 523, 526, 529.

Claim 1 finally recites (step “1c” and step “1d):

applying a concrete bonding agent to an internal side surface of the trench; and

filling the trench with concrete.

Ex. 1001, 23:28–30 (italics added).

Petitioner asserts that Sika Product Sheets teach using SikaTop 123, a concrete mortar, and Sika Armatec 110, a bonding agent, for concrete repair. Pet. 57–60 (citing Ex. 1002 ¶¶ 82–107, 135–140; Ex. 1008; Ex. 1009).

Petitioner asserts that, as required by claim step “1c,” an ordinarily skilled artisan would have applied Sika Armatec 110 to the Tumialan trenches in the Gleich double tee structure’s surface holding the arranged CFRP reinforcing bars, and, as required by claim step “1c,” also filled the trenches with SikaTop 123, i.e., concrete. Pet. 60 (citing Ex. 1002 ¶¶ 135–140, 142–143).

Petitioner emphasizes that Sika Armatec 110 is a “concrete bonding agent,” as the reference states “Armatec 110 is useful ‘[a]s a bonding agent for repairs to concrete.’” Pet. 61 (citing Ex. 1002 ¶¶ 130–131, 139, Ex. 1009, 1). Further, Petitioner asserts that SikaTop 123 is “concrete,” as

recited by claim 1, because it is a “cement-based composite material.” *Id.* (citing Ex. 1002 ¶¶ 51–62, 127–129, 146–147; Ex. 1008). Further, Petitioner also asserts that Tumialan teaches claim step “1d” (“filling the trench with concrete”) because it teaches that NSM grooves should be filled with an embedding paste, which may be an epoxy-based paste or a cement-based paste, i.e., concrete mortar. *Id.* at 44–46 (citing Ex. 1002 ¶¶ 101–105; Ex. 1004, 525).

Patent Owner does not dispute that Sika Product Sheets teach SikaTop 123 is a concrete filler and Armatech 110 is a concrete bonding agent, or that the two products would be used together. *See generally* Resp. Patent Owner’s only dispute on this subject matter is that concrete would not be used to fill Tumialan’s trenches; however, this argument is not persuasive and has been addressed above. *See supra* Section II.E.1 (discussion regarding motivation to combine the prior art). We find there are several reasons the ordinarily skilled artisan would fill trenches (like Tumialan’s) with concrete.

As we discussed in detail above, the ordinarily skilled artisan would have combined Gleich, Tumialan, and Sika Product sheets and would have been motivated to fill trenches with concrete, as claimed. We are persuaded that Sika Product Sheets teach claim steps “1c” and “1d” (and for step “1d,” that Tumialan also suggests) for the reasons set forth above, as asserted by Petitioner. Sika Product Sheets teach applying a concrete bonding agent and a concrete mortar to repair concrete, which an ordinarily skilled artisan would find useful in combination with Tumialan and Gleich to fill trenches holding CFRP bars in a double tee concrete parking deck structure. *See*

Ex. 1008; Ex. 1009; Ex. 1003; Ex. 1004, 525; Ex. 1002 ¶¶ 51–62, 82–107, 127–131, 135–140, 142–143, 146–147.

For the reasons set forth above, we agree with Petitioner that Gleich, Tumialan, and Sika Product Sheets render claim 1 obvious.

Analysis of Dependent Claims 2–7 and 9

Claims 2–7 and 9 depend from claim 1. Ex. 1001, 23:31–24:5. As it did regarding claim 1, Petitioner sets forth how the Gleich, Tumialan, and Sika Product Sheets combination teaches each step or element of these dependent claims. Pet. 47–51, 62–64 (citing Ex. 1002 ¶¶ 108–109, 111–113, 115–118, 120, 123–124, 148–151; Ex. 1003, 11–12; Ex. 1004, 525–526 (Fig. 3), 529; Ex. 1008, 2 Ex. 1020 §§ 1.1, 3.1.1, 6.0, 7.0, 8.1, 8.6, 8.10, B.5.1). Patent Owner does not specifically address Petitioner’s challenges to dependent claims 2–7 and 9. *See* Prelim. Resp. 4–16. Nonetheless, the burden remains on Petitioner to demonstrate unpatentability. *See Dynamic Drinkware*, 800 F.3d at 1378. We address these dependent claims below.

Claim 2

Claim 2 depends directly from independent claim 1 and further requires that “*the reinforcement material includes at least one selected from a group consisting of a steel reinforcing bar, an epoxy-coated reinforcing bar, a carbon fiber bar, a carbon fiber epoxy-based reinforcing bar, and a stainless steel bar.*” Ex. 1002, 23:31–35 (italics added).

Petitioner asserts that

Tumialan discloses that CFRP bars (i.e., a “a carbon fiber bar”) are used as reinforcement materials disposed in the saw-cut trenches. Ex-1004, 525. It would have been obvious to a POSA to use Tumialan’s NSM CFRP bars to enhance or repair the Gleich’s C-Grid® double tee. Ex-1002, ¶¶ 108-109.

Accordingly, dependent Claim 2 is obvious in view of Gleich and Tumialan (Ground A).

Pet. 47, 61–60 (also citing Ex. 1002 ¶ 148).

Patent Owner does not dispute Petitioner’s assertions regarding claim 2, which we accept and adopt as findings of fact.

We agree with Petitioner that, for the reasons stated above, the subject matter of claim 2 would have been obvious over Gleich, Tumialan, and Sika Product Sheets.

Claim 3

Claim 3 depends directly from independent claim 1 and further requires “*the trench is at least 1.5 inches deep from the top surface of the load carrying concrete floor structure.*” Ex. 1001, 23:36–38 (italics added).

Petitioner asserts that this subject matter would have been obvious over Gleich, Tumialan, and Sika Product Sheets because Tumialan teaches cutting trenches having depths of 1.375 inches so that the reinforcement bars are placed therein above existing bars in the parking deck concrete, and that adjusting this trench depth to increase it to 1.5 or 2 inches, or even decrease it, would have been mere design choice influenced by however deep within the flange the C-Grid was so as to avoid its damage. Pet. 47–49 (citing Ex. 1004, 525–26 (Fig. 3), 529; Ex. 1002 ¶¶ 111–113), 61–60 (also citing Ex. 1002 ¶ 148). We also note, Figure 3 of Tumialan indicates that the “bottom of lower groove” depth “varies,” which supports Petitioner’s assertion that some variance would have been obvious. Ex. 1004, 526 (Fig. 3).

Patent Owner does not dispute Petitioner’s assertions regarding claim 3, which we accept and adopt as findings of fact.

We agree with Petitioner that, for the reasons stated above, the subject matter of claim 3 would have been obvious over Gleich, Tumialan, and Sika Product Sheets.

Claim 4

Claim 4 depends directly from independent claim 1 and further requires “*forming the trench across a width of the top surface of the flange.*” Ex. 1001, 23: 39–41 (italics added).

Petitioner asserts claim 4 would have been obvious over Gleich, Tumialan, and Sika Product Sheets because Gleich’s C-Grid reinforcement spans the full width of its flange and reinforcing the full width of such a flange using Tumialan’s techniques would have been obvious to the ordinarily skilled artisan. Pet. 49–50 (citing Ex. 1002 ¶¶ 115–117; Ex. 1003, 12; Ex. 1004, 525–26). Petitioner asserts that, in actual use, specifying CFRP bars to be used so as to extend across the full width of Gleich’s double tee structure would have been obvious. *Id.* (citing Ex. 1002 ¶ 116). We note also that Tumialan expressly teaches that its trenches are formed to span the entire width of 10 ft. x 10 ft. concrete slabs, and teaches providing 14 ft. CFRP bars within those trenches so they extend even beyond the boundaries of the concrete slabs. *See* Ex. 1004, 526 (Fig. 3). Petitioner asserts that providing full-width (and beyond) trenches and reinforcing bars would provide symmetric strengthening. Pet. 49 (citing Ex. 1002 ¶ 117).

Patent Owner does not dispute Petitioner’s assertions regarding claim 4, which we accept and adopt as findings of fact.

We agree with Petitioner that, for the reasons stated above, the subject matter of claim 4 would have been obvious over Gleich, Tumialan, and Sika Product Sheets.

Claim 5

Claim 5 depends directly from independent claim 1 and further requires “*forming the trench across at least a half of a width of the top surface of the flange.*” Ex. 1001, 23:42–44 (italics added).

Petitioner asserts claim 5 would have been obvious over Gleich, Tumialan, and Sika Product Sheets because Gleich’s C-Grid reinforcement spans the full width of its flange (thus, spanning at least half) and similarly reinforcing the full width (again, at least half) of such a flange using Tumialan’s techniques would have been obvious to the ordinarily skilled artisan. Pet. 49–50 (citing Ex. 1002 ¶¶ 115–117; Ex. 1003, 12; Ex. 1004, 525–26). Petitioner asserts that, in actual use, specifying CFRP bars to be used so as to extend across the full width of Gleich’s double tee structure would have been obvious. *Id.* (citing Ex. 1002 ¶ 116). Again, we note that Tumialan expressly teaches that its trenches are formed to span the entire width of 10 ft. x 10 ft. concrete slabs, and teaches providing 14 ft. CFRP bars within those trenches so they extend beyond the boundaries of the concrete slabs. *See* Ex. 1004, 526 (Fig. 3). Petitioner asserts that providing full-width (and beyond) trenches and reinforcing bars would provide symmetric strengthening. Pet. 49 (citing Ex. 1002 ¶ 117).

Patent Owner does not dispute Petitioner’s assertions regarding claim 5, which we accept and adopt as findings of fact.

We agree with Petitioner that, for the reasons stated above, the subject matter of claim 5 would have been obvious over Gleich, Tumialan, and Sika Product Sheets.

Claim 6

Claim 6 depends directly from independent claim 1 and further requires “*the trench is at least 2 inches deep from the top surface of the flange.*” Ex. 1001, 23:45–46 (italics added).

Petitioner asserts that this subject matter would have been obvious over Gleich, Tumialan, and Sika Product Sheets because Tumialan teaches cutting trenches having depths of 1.375 inches so that the reinforcement bars are placed therein above existing bars in the parking deck concrete, and that adjusting this trench depth to increase it to 2 inches would have been mere design choice influenced by however deep within the flange the C-Grid was so as to avoid its damage. Pet. 47–49 (citing Ex. 1004, 525–26 (Fig. 3), 529; Ex. 1002 ¶¶ 111–113), 61–60 (also citing Ex. 1002 ¶ 148). We note, Figure 3 of Tumialan indicates that the “bottom of lower groove” depth “varies,” which supports Petitioner’s position that the trench depth can obviously vary. Ex. 1004, 525 (Fig. 3).

Patent Owner does not dispute Petitioner’s assertions regarding claim 6, which we accept and adopt as findings of fact.

We agree with Petitioner that, for the reasons stated above, the subject matter of claim 6 would have been obvious over Gleich, Tumialan, and Sika Product Sheets.

Claim 7

Claim 7 depends directly from independent claim 1 and further requires “*forming a second trench at the top surface of the flange, wherein the trench and the second trench have a spacing between them.*” Ex. 1001, 23:47–50 (italics added).

Petitioner asserts that claim 7 would have been obvious over Gleich, Tumialan, and Sika Product Sheets because “Tumialan discloses forming multiple trenches side-by-side in a spaced apart configuration.” Pet. 50–51 (citing Ex-1004, 525–26; Ex. 1002 ¶¶ 120–121).

Patent Owner does not dispute Petitioner’s assertions regarding claim 7, which we accept and adopt as findings of fact.

We agree with Petitioner that, for the reasons stated above, the subject matter of claim 7 would have been obvious over Gleich, Tumialan, and Sika Product Sheets.

Claim 9

Claim 9 depends directly from independent claim 1 and further requires “*roughening a surface of the trench.*” Ex. 1001, 24:4–5 (italics added).

Petitioner asserts that claim 9 would have been obvious over Gleich, Tumialan, and Sika Product Sheets because

a POSA would have found it obvious to “roughen[] a surface of the trench” as recited in Claim 9. A POSA would have known that roughening the trench surface is a common practice to remove bond-inhibiting materials. Ex-1002, ¶123; Ex-1020, §§ 3.1.1, 6.0, 7.0, 8.6.14, 8.10.14. Indeed, surface roughening is recommended by the International Concrete Research Institute (ICRI). Ex-1002, ¶123; Ex-1020, §§ 1.1, 3.1.1, 6.0, 7.0, B.5.1. By ensuring the internal trench surfaces have a suitably rough concrete surface profile (“CSP”), an effective bond can be achieved between the trench filling material (concrete mortar) and the trench walls. Ex-1002, 123.

Pet. 51. Petitioner further asserts that Sika Product Sheets instruct users to high-pressure-water-blast or mechanically expose aggregate surface in preparation for using their products. *Id.* at 62–64 (citing Ex. 1002 ¶¶ 149–

152); *see also* Ex. 1008, 2 (“How to Use”); Ex. 1009, 2 (“How to Use”; “blast cleaning”). Petitioner proposes this is the claimed roughening.

Patent Owner does not dispute Petitioner’s assertions regarding claim 9, which we accept and adopt as findings of fact.

We agree with Petitioner that, for the reasons stated above, the subject matter of claim 9 would have been obvious over Gleich, Tumialan, and Sika Product Sheets.

Summary for Ground B

Based on the evidence of record, we find that Petitioner has shown by a preponderance of the evidence that the person of ordinary skill in the art would have been motivated to combine Gleich, Tumialan, and Sika Product Sheets, including filling trenches with concrete as taught by the references and required by the claims, would have had a reasonable expectation of success, and that claims 1–7 and 9 would have been obvious over this prior art combination.

2. *Obviousness of Dependent Claims 10 and 13 Over Gleich, Tumialan, Sika Product Sheets, and Reis (Ground D)*

Petitioner asserts claims 10 and 13 would have been obvious over the combination of Gleich, Tumialan, Sika Product Sheets and Reis. Pet. 64–74.

Motivation to Combine Gleich, Tumialan, Sika Product Sheets, and Reis with a Reasonable Expectation of Success

Petitioner renews its assertions and rationale as set forth above for the combination of Gleich, Tumialan, and Sika Product sheets, and Petitioner asserts it would have been obvious to also combine Reis with this prior art because Reis is similarly directed to methods of repairing damaged parking decks of precast concrete double tee structures and an ordinarily

skilled artisan would have looked to Reis for additional ways to enhance or repair structures as taught by Gleich. Pet. 67–69 (citing Ex. 1002 ¶¶ 82–107, 154–164; Ex. 1011, 1015–20, 1022–23).

Patent Owner argues that the person of ordinary skill in the art would not have been motivated to add Reis to the other prior art because “Tumialan already examined whether to use ‘externally bonded CFRP sheets to strengthen the garage slabs,’ finding it inferior to NSM systems. Resp. 16 (citing Ex. 1004, 524–25), 20–21. Patent Owner argues that Reis is directed to such external reinforcement techniques. *Id.* at 17–18 (citing Ex. 1011, 1020).

Patent Owner argues there was no need to add Reis’s systems to Gleich’s double tee structures because such structures do not incorporate materials that corrode and they have increased life spans and durability. *Id.* at 18–19 (citing Ex. 1003, 2). Patent Owner also argues that Reis’s systems relate to repairs of steel-reinforced structures, not CFRP reinforced structures, which means the ordinarily skilled artisan would not have looked to Reis for teaching repairs to the latter. *Id.* at 19–20.

Responding to these arguments, Petitioner argues that

Patent Owner also does not dispute that a POSA would have understood that Reis’ steel support bracket could be successfully secured to Gleich’s double tee stem “without damaging the existing tendons in the stem.” Pet., 68-69; Ex-1002, ¶162. Finally, Patent Owner does not dispute that a POSA would have understood that Reis’ steel support brackets—when secured to Gleich’s double tee stem—could provide additional support at expansion joints between adjacent precast double tees. Pet., 69; Ex-1002, ¶163.

Reply 22.

We find the record supports Petitioner's position that there would have been reason to combine Gleich, Tumialan, Sika Product Sheets, and Reis. We will not restate the rationale for combining the first three references as analyzed above, which applies equally here as it does for Ground B. *See supra* Section II.E.1. We find that Reis is also analogous art and properly considered in an obviousness analysis because, like Gleich, Tumialan, and Sika Product Sheets, Reis is directed to the same field of endeavor as the other prior art and the claimed invention, that is, concrete structures and the repair of concrete structures, such as parking structures, and is also reasonably pertinent to the inventor's problem, repairing and enhancing concrete structures. *Unwired Planet*, 841 F.3d at 1000–01.

Further, we agree with Petitioner that the ordinarily skilled artisan seeking to find a way to bolster the strength of a concrete parking structure would look to Reis just as she would look to Tumialan and would look to the two in combination because Reis is directed to supplementing CFRP repairs with exterior steel brackets. Ex. 1011, 1015 (Abstract). That is, Reis on its face indicates its disclosed steel brackets are a supplemental reinforcement system to be used with another reinforcement system. *See* Ex. 1002 ¶ 159 (explaining this concept of adding further reinforcement/repair to a Gleich double tee structure, above what Tumialan offered). Moreover, Reis shows actual photographs of its supplemental reinforcement bracketing system installed on a concrete double tee structure similar to that disclosed in Gleich, which not only evidences there would have been motivation to combine Reis's teachings with the other prior art, but also a reasonable expectation of success. Patent Owner's arguments, unsupported by any

expert testimony, are simply not persuasive to overcome such strong evidence of motivation to combine.

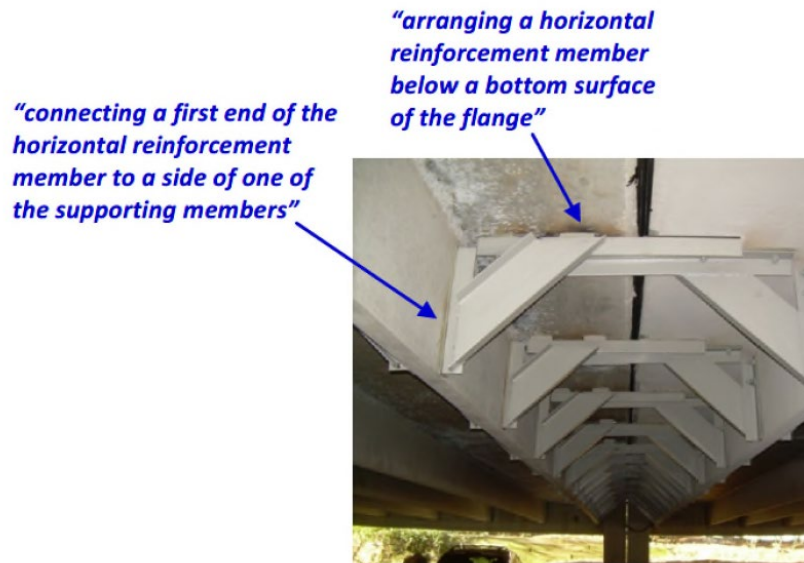
Analysis of Claims 10 and 13

Claim 10 depends from claim 1 and further requires “*arranging a horizontal reinforcement member below a bottom surface of the flange, and connecting a first end of the horizontal reinforcement member to a side of one of the supporting members.*” Ex. 1001, 24:6–11 (italics added).

Claim 13 depends from claim 10 and further requires “*the horizontal reinforcement member includes at least one selected from a group consisting of a steel reinforcing bar, an epoxy-coated reinforcing bar, a carbon fiber bar, a carbon fiber epoxy-based reinforcing bar, and a combination thereof.*” *Id.* at 24:32–37 (italics added).

Petitioner asserts that Reis, similar to Tumialan, teaches repair of a precast concrete parking deck, similar to that of Gleich. Pet. 64–65, 70 (citing Ex. 1011, 1015). Petitioner asserts that this repair includes externally applying CFRP material and steel brackets below the underside of a double tee structure and bolted to the stems thereof. *Id.* (citing Ex. 1011, 1015, 1017, 1020–23). Petitioner asserts that these steel brackets are bolted at their ends to the double tee stems, where a horizontal portion of the bracket extends below the double tee’s flange and is also bolted to the flange. *Id.* at 65–66 (citing Ex. 1011, 1015, 1017–23; Ex. 1002 ¶¶ 154–157). Petitioner asserts that repairing a concrete structure as taught by Reis meets the elements of claim 10. Pet. 70–72 (citing Ex. 1002 ¶¶ 165–166). Petitioner asserts that Reis’s reinforcing bars are steel, which teaches the elements of claim 13. *Id.* at 72–73 (citing Ex. 1002 ¶ 166, 168).

In support of these positions, Petitioner provides the following annotated version of Reis's Figure 8:



Reis – Figure 8 (Steel Support Bracket Under Double Tee)

Pet. 70 (citing Ex. 1002, 1065–1066). The annotated figure above shows the underside of a double tee style parking deck structure where steel reinforcement bracketing has been connected below the structure's flange, spanning two flanges, and to the vertical support members of the flanges. Blue text has been added by Petitioner to identify that the top of the Reis bracket is "arrang[ed] [as] a horizontal reinforcement member below a bottom surface of the flange" and the lower part of the Reis bracket is "connecting a first end of the horizontal reinforcement member to a side of one of the supporting members." *Id.*

Patent Owner, other than the above-discussed arguments against motivation to combine, presents no arguments that the Gleich, Tumialan, Sika Product Sheets, and Reis combination teaches all steps of claims 10 and 13. *See generally* Resp.

We agree with and adopt Petitioner’s assertions as findings of fact. Based on the evidence of record, and for the reasons above, we find that Petitioner has shown claims 10 and 13 would have been obvious over Gleich, Tumialan, Sika Product Sheets, and Reis as challenged in the petition.

F. PATENT OWNER’S MOTION TO AMEND

As noted above, Patent Owner files a first and a second Revised Contingent Motion to Amend replacing the first. Paper 18; Rev. MTA; *see supra* Section I.A (background and summary). Between these filings and as requested by Patent Owner, we provided Preliminary Guidance addressing the first Contingent Motion to Amend. PG. Patent Owner states that its Revised Contingent Motion to Amend is submitted “in response to [our] preliminary guidance.” Rev. MTA, 1.

Below, we address Patent Owner’s Revised Contingent Motion to Amend, which we find meets statutory and regulatory requirements, but nonetheless proposes substitute claims that are unpatentable over Gleich, Tumialan, and Sika Product Sheets, as argued by Petitioner.

1. *Legal Standards and Regulatory Requirements*

In an *inter partes* review, amended claims are not added to a patent as a matter of right; rather, they must be proposed as a part of a motion to amend. 35 U.S.C. § 316(d). In reviewing a motion to amend, the Board assesses the patentability of the proposed substitute claims “without placing the burden of persuasion on the patent owner.” *Aqua Prods., Inc. v. Matal*, 872 F.3d 1290, 1328 (Fed. Cir. 2017) (en banc); *see Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-01129, Paper 15 at 3–4 (Feb. 25, 2019).

Notwithstanding the foregoing, a patent owner's proposed substitute claims must meet the statutory requirements of 35 U.S.C. § 316(d) and the procedural requirements of 37 C.F.R. § 42.121, which the Board considers first before addressing the patentability of proposed substitute claims.

Lectrosonics, Paper 15 at 4–8. In particular, a patent owner must demonstrate: (1) the amendment proposes a reasonable number of substitute claims; (2) the proposed claims are supported in the original disclosure (and any earlier filed disclosure for which the benefit of a filing date is sought); (3) the amendment responds to a ground of unpatentability involved in the trial; and (4) the amendment does not seek to enlarge the scope of the claims of the patent or introduce new subject matter. *See* 35 U.S.C. § 316(d); 37 C.F.R. § 42.121.

Patent Owner presents four proposed substitute claims (16–19) to replace four existing claims (1, 2, 4, and 5). Rev. MTA 2, 4–5. Petitioner does not dispute that Patent Owner proposes a reasonable number of substitute claims. *See generally* Pet. Opp. Rev. MTA. We find the one-for-one ratio of proposed substitute claims for replacing existing claims a reasonable number.

Patent Owner asserts that its proposed substitute claims are supported by the written description in U.S. application 15/945,318 (Ex. 1005, 79–121) and provisional application 61/481,176 (Ex. 2002, 1–23) from which the '196 patent issued and provides analysis for such support. Rev. MTA 5–14. Petitioner does not dispute that Patent Owner's proposed substitute claims are supported by the applications' written descriptions. *See generally* Opp. Rev. MTA. We find the proposed substitute claims to be supported as asserted by Patent Owner (the claims do not introduce new matter).

Patent Owner asserts that the proposed substitute claims are responsive to the grounds for unpatentability, most particularly to the assertions of obviousness over Gleich, Tumialan, and Sika Product Sheets (possibly also including Bournas), and Patent Owner presents several pages of briefing seeking to distinguish the proposed substitute claims over this prior art. Rev. MTA 14–24.

Petitioner argues that the proposed substitute claims are not responsive to a ground of unpatentability because the subject matter added to the proposed substitute claims, as compared to the original claims challenged in the Petition, does not add any subject matter not already addressed under a ground for unpatentability. Opp. Rev. MTA 4–10. Petitioner argues that if existing claims 2 and 4 are held to be obvious under Petitioner’s Grounds A or B, then proposed substitute claims 16–19 necessarily also must be held unpatentable because they cover the same (or essentially the same) subject matter. *Id.*

Under Rule 42.121, the requirement is for a patent owner’s amendment to be *responsive* to “a ground of unpatentability.” 37 C.F.R. § 42.121(a)(2)(i). There is no requirement for a response to be “adequate” on a given point or to address every element of the asserted prior art in a ground in order to be responsive. Patent Owner has explained how it intends its proposed substitute claims to respond to a ground of unpatentability. *See* Rev. MTA 14–24. Further, although claims 16, 17, and 18 arguably merely incorporate subject matter from existing challenged claims into the proposed substitute claims, e.g., reinforcement material is carbon fiber bar and the trench spans the entire width of the flange, proposed substitute claim 19 does not appear to suffer this issue. Thus, we find that, regardless of whether or

not its response is ultimately adequate, Patent Owner has met the requirement that its proposed substitute claims respond to a ground of unpatentability.

In a general way, Patent Owner asserts that its proposed substitute claims are narrower than the existing claims they seek to replace, for example, claim 16 is a combination of existing claims 1 and 2, claim 17 is based on claim 2 but narrower, claim 18 is based on claim 4 but narrower, and claim 19 is based on claim 1, but narrower. Rev. MTA 4–5. Petitioner does not dispute that Patent Owner’s proposed substitute claims do not expand the scope of the existing claims. *See generally* Opp. Rev. MTA. In fact, Petitioner indicates there is “no meaningful difference” between the existing claims and the proposed substitute claims. *Id.* at 1. We find the proposed substitute claims do not enlarge the scope of the challenged claims, as asserted by Patent Owner.

In summary, we find that Patent Owner meets the statutory and regulatory requirements with its Revised Contingent Motion to Amend.

2. *Claim Construction*

Other than the meaning of the claim term “concrete,” which is recited by the proposed substitute claims in the same fashion as the challenged existing claims, and has already been addressed above (*see supra* Section II.B, claim construction), neither Patent Owner nor Petitioner proposes that any claim language in the the proposed substitute claims requires express construction. *See* Rev. MTA; Opp. Rev. MTA. We do not further expressly interpret any claim language.

3. *Unpatentability of Proposed Substitute Claims 16–19
Over Gleich, Tumialan, and Sika Product Sheets*

Petitioner has the burden of persuasion as to the alleged unpatentability of proposed substitute claims 16–19. *See* Rules of Practice To Allocate the Burden of Persuasion on Motions To Amend in Trial Proceedings Before the Patent Trial and Appeal Board, 85 Fed. Reg. 82,923, 82,924, 82,935 (Dec. 21, 2020) (codified at 37 C.F.R. pt. 42) (stating that “[a] petitioner bears the burden of persuasion to show, by a preponderance of the evidence, that any proposed substitute claims are unpatentable” as to any motion to amend filed on or after January 20, 2021).

Patent Owner’s proposed substitute claim 16 is identical to existing claim 1, but adds after the original end of the claim “*wherein the reinforcement material includes at least one selected from a group consisting of a steel reinforcing bar, an epoxy coated reinforcing bar, a carbon fiber bar, or a carbon fiber epoxy based reinforcing bar*” and “*wherein the steel reinforcing bar is not a stainless steel reinforcing bar.*” Rev. MTA, App’x A (italics added; amendment markups removed).

Regarding the limitations of proposed substitute claim 16 that are also found in existing claim 1, Petitioner asserts the same positions and evidence for unpatentability over Gleich, Tumialan, and Sika Product Sheets, which we will not review here because they have been addressed above. Opp. Rev. MTA 10–13. Suffice it to say, we find Petitioner’s rationale for the obviousness of these common limitations persuasive for the reasons above. *See supra* Section II.E.1.

Petitioner argues that claim 16, as compared to claim 1, requires certain materials for a reinforcing bar, one of which is a carbon fiber bar, and Petitioner states that “the parties have agreed since the inception of this

IPR that Tumialan discloses the use of a ‘carbon fiber bar.’” Opp. Rev. MTA. 1–2, 5–7. Petitioner states,

Curiously, Patent Owner reaffirms *in the Revised MTA itself* that Tumialan discloses the use of “a carbon fiber bar” as a reinforcement material. RevMTA, 16 (“Tumialan investigated the use of a carbon-fiber reinforced polymer (CFRP) bar”); 18 (“in Tumialan the ‘CFRP bars [were] used to supplement the existing negative moment steel reinforcement”).

Id. at 6. We confirm that these quotes from Patent Owner’s briefing, as identified by Petitioner, are accurate.

Petitioner also notes that Patent Owner, in the Response, did not dispute Petitioner’s assertions from the Petition that Tumialan discloses CRFP bars, i.e., carbon fiber bar, used as reinforcement materials in cut trenches. *Id.* at 5–6, n.2 (citing Pet. 43–44, 47; generally Resp.). Petitioner argues that there can be no dispute now that Gleich, Tumialan, and Sika Product Sheets render unpatentable the subject matter of claim 16, including the requirement that the reinforcement material be *a carbon fiber bar*. *Id.* at 13–14 (citing Pet. 31–40, 43–44, 47, 60–62; Ex. 1004, 523–25; Ex. 1002 ¶¶ 73–81, 85–86, 96–99, 108–109; Ex. 1041 ¶¶ 5–7; Resp. 2–16; Sur-Reply 2).

Patent Owner does not directly address Petitioner’s points, noted above, but renews its argument that, considering the Gleich, Tumialan, and Sika Product Sheets combination, the ordinarily skilled artisan would not have been motivated to “fill[] the trench with concrete.” Reply Opp. Rev. MTA, 2–6.

Patent Owner’s argument regarding the cited prior art and the claim step of filling a trench with concrete is no more persuasive for proposed substitute claim 16 than it was regarding claim 1. *See supra* Section II.E.1

(discussing claim 1). Further, as asserted by Petitioner and conceded by Patent Owner, Tumialan teaches carbon fiber bars as reinforcement materials, as claimed. For these reasons, as well as those set forth above regarding claim 1, we find Patent Owner’s proposed substitute claim 16 obvious over Gleich, Tumialan, and Sika Product Sheets.

Patent Owner’s proposed substitute claim 17 depends from proposed substitute claim 16 and requires “*the reinforcement material includes at least one selected from a group consisting of an epoxy-coated reinforcing bar, a carbon fiber bar, or a carbon fiber epoxy-based reinforcing bar.*” Rev. MTA, App’x A (italics added; amendment markups removed).

Petitioner argues proposed substitute claim 17 merely removes “a steel reinforcing bar” from the list of materials, but still includes “a carbon fiber bar,” which is taught in Tumialan. Opp. Rev. MTA, 2, 5–7. Petitioner argues that claim 17 would have been obvious for the same reasons as claim 16. *Id.* at 14–15.

Patent Owner does not argue anything different for proposed substitute claim 17 than for claim 16. Reply Opp. Rev. MTA 6. This consistency makes sense because claim 17 requires the same reinforcement material as claim 16; a carbon fiber bar, which is taught by Tumialan, as discussed above. Thus, claim 17 is obvious over Gleich, Tumialan, and Sika Product Sheets for the same reasons as for claim 16.

Patent Owner’s proposed substitute claim 18 depends from proposed substitute claim 16 and requires “*forming the trench includes forming the trench across an entire width of the top surface of the flange.*” Rev. MTA, App’x A (italics added; amendment markups removed).

Petitioner argues that the difference between proposed substitute claim 18 and existing claim 4 is the addition of the word “entire” to the new claim, but Petitioner argues that it already asserted and submitted evidence that “it would have been obvious to a POSA to install Tumialan’s CFRP bars substantially across the full [] width of Gleich’s flange.” Opp. Rev. MTA 7–8 (citing Pet. 49–50; Ex. 1002 ¶¶ 115–118). Petitioner asserts its prior unpatentability assertions concerning claim 4, relating to a trench spanning the full width of the claimed flange, also apply to claim 18’s “entire width” limitation and that Patent Owner’s failure to oppose such arguments in the Response waived those arguments. *Id.* at 15. Petitioner argues (again) that it would have been obvious to form Tumialan’s trenches for reinforcement materials across the entire width of Gleich’s flange just like Gleich teaches providing C-Grid across such an entire width. *Id.* at 17; *see also supra* Section II.E.1 (addressing claim 4).

Patent Owner argues “Petitioner cannot possibly prevail on claim 18 as there is no prior art disclosing this limitation.” Reply Opp. Rev. MTA 7. Patent Owner, however, overlooks certain issues.

Patent Owner overlooks that the challenge to claim 18 is based on obviousness not anticipation, thus, what matters is not what the prior art combination expressly discloses, but what it teaches and would have rendered obvious to the ordinarily skilled artisan. Petitioner presents consistent expert testimony in two declarations, as well as on cross-examination, that when providing trenches and reinforcement bars in a Tumialan system to reinforce a Gleich C-Grid-double-tee, extending the trenches and bars across the entire double tee would have been the obvious way to do it. *See* Ex. 1002 ¶¶ 115–118; Ex. 1041 ¶¶ 12–14; Ex. 2009, 90:5–

10, 91:4–24; 92:21–93:8. We credit and agree with Dr. Nanni’s (just-cited) explanations as to why the ordinarily skilled artisan would have provided reinforcement bars in trenches spanning the entire width of a double tee flange.

Second, Petitioner is correct that it has already presented the same challenge and argument over the subject matter of claim 18 that it presented in the Petition for claim 4 and Patent Owner did not oppose or dispute Petitioner’s assertions over claim 4, specifically. Thus, Patent Owner has waived such arguments.

Patent Owner’s proposed substitute claim 19 depends from proposed substitute claim 16 and requires “*the reinforcement material has a longitudinal axis*” and “*the longitudinal axis of the reinforcement material is perpendicular to a longitudinal axis of the flange*” and “*a length of the reinforcement material exceeds a length of the flange.*” Rev. MTA, App’x A (italics added; amendment markups removed).

Petitioner argues that Patent Owner’s proposed substitute claim 19 is nearly identical to one previously submitted (formerly proposed substitute claim 18) in its first Motion to Amend, which was addressed as likely unpatentable in our Preliminary Guidance. Opp. Rev. MTA 9 (citing PG 11–12). Nevertheless, Petitioner asserts that a normal CFRP bar, as taught in Tumialan, has a length and, thus, a longitudinal axis, as claimed. *Id.* at 18–19 (citing Ex. 1004, 525). Petitioner asserts that Tumialan teaches forming trenches and installing CFRP bars in a concrete slab in both E-W and N-S directions such that some trenches and bars are perpendicular to a longitudinal axis of the flange, as claimed. *Id.* at 19 (citing Ex. 1004, 525, 529, Figs. 3, 9, 10; Ex. 1041 ¶¶ 16–24). Petitioner also asserts that, as

Gleich's C-Grid reinforcement spans the entire width of its double tee flange, it would also have been obvious to do the same when adding Tumialan's trenches and CFRP bars, and that it also would have been obvious to have such CFRP bars exceed the length of the flange because in parking deck structures the double tee flanges are positioned one-next-to-the-other and the bars would extend from one flange to the next. *Id.* at 20–21 (citing Ex. 1003, 1–2; Ex. 1041 ¶¶ 16–24).

Patent Owner argues that Petitioner has not shown the prior art teaches reinforcement material having a length exceeding that of the flange it is used to reinforce. Reply Opp. Rev. MTA, 8. Patent Owner argues Petitioner's positions on this subject matter are merely conclusory and rooted in hindsight. *Id.* at 8–9 (citing Ex. 1036 ¶¶ 17–23; Ex. 1041 ¶ 23).

We disagree with Patent Owner's argument. Dr. Nanni's explanations about why using CFRP bars longer than the double tee structure is wide would have been an obvious choice for an ordinarily skilled artisan, i.e., because a reinforcement project would entail forming trenches and adding reinforcement bars in and across several double tee parking structures arranged side-by-side and continuing trenches and bars from one to the next would be the most efficient way to do it (and, in fact, needed to be done in such a way), is logical, makes sense, and is based on the expert's years of experience. Ex. 1036 ¶¶ 22–23. As we have noted above, there is no indication that Dr. Nanni relied on hindsight in forming his opinions. And, we again note, Patent Owner provides no counterpoint expert testimony to contradict Dr. Nanni's positions.

Finally, Patent Owner overlooks that we directly addressed the subject matter at issue in proposed substitute claim 19 in our Preliminary Guidance

at page 12, footnote 5, where we discussed Patent Owner’s then-proposed substitute claim 18, which similarly required that the reinforcement material “have a length” to “exceed a width of the flange.” PG 10–12. There we explained that

the lower portion of Tumialan’s Figure 3 shows two sets of CFRP bars running in perpendicular directions with respect to each other such that, when they are incorporated into Gleich’s double tees, the CFRP bars would be perpendicular to a longitudinal axis of the flange of Gleich’s double tees. Moreover, this same Figure 3 of Tumialan shows that the CFRP bars are 14 feet long and the concrete panel into which they are laid is 10 foot x 10 foot, which discloses that the reinforcement bars may extend beyond the boundaries of the concrete structure. Ex. 1004, 523, 526.

Id. at 12, n.5. Tumialan’s Figure 3 is reproduced above at Section II.D.2. It shows CFRP bars longer than the reinforced concrete slab is wide and extending beyond that slab’s borders. Thus, Tumialan itself supports Dr. Nanni’s opinion that it would have been obvious to the ordinarily skilled artisan to use reinforcement bars that are longer than the concrete structure to be reinforced is wide, in the fashion claimed.

In summary, we agree with and are persuaded by Petitioner’s arguments and evidence that Patent Owner’s proposed substitute claims 16–19 are obvious over Gleich, Tumialan, and Sika Product Sheets for the reasons set forth above. Petitioner has established this by a preponderance of the evidence.

III. CONCLUSION

Petitioner has established by a preponderance of the evidence that claims 1–7, and 9 of the ’196 patent would have been obvious over Gleich, Tumialan, and Sika Product Sheets, and claims 10 and 13 would have been

obvious over this same prior art combination also including Reis. Therefore, all challenged claims are unpatentable.^{23, 24} Further, Petitioner has also established by a preponderance of the evidence that Patent Owner's proposed substitute claims 16–19 also would have been obvious over the same prior art combination and, therefore, are unpatentable.

Our final decision is summarized as follows:

Claims	35 U.S.C. §	References/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–7, 9	103	Gleich, Tumialan ²⁵		
1–7, 9	103	Gleich, Tumialan, Sika Product Sheets	1–7, 9	
10, 13	103	Gleich, Tumialan, Reis		
10, 13	103	Gleich, Tumialan, Sika Product Sheets, Reis	10, 13	
Overall Outcome			1–7, 9, 10, 13	

²³ 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).

²⁴ As noted above, claims 8, 11, 12, 14, and 15 of the '196 patent are not challenged in this proceeding.

²⁵ As noted above, we do not reach a conclusion on Petitioner's Grounds A and C, which do not include Sika Product Sheets as a part of the prior art combination because such grounds are subsumed within those that do.

Motion to Amend Outcome	Claim
Original Claims Cancelled by Amendment	
Substitute Claims Proposed in the Amendment	16–19
Substitute Claims: Motion to Amend Granted	
Substitute Claims: Motion to Amend Denied	16–19
Substitute Claims: Not Reached	

ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has proved by a preponderance of the evidence that claims 1–7, 9, 10, and 13 of the '196 patent are unpatentable;

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; and

FURTHER ORDERED that Patent Owner's Motion to Amend is *denied*.

IPR2021-00467
Patent 10,337,196 B2

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