

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

FREIGHTCAR AMERICA, INC.,

Petitioner

v.

NATIONAL STEEL CAR LIMITED,

Patent Owner

U.S. Patent No. 8,166,892

IPR Case No. IPR2025-01046

**DECLARATION OF MARK J. VIZ PH.D., P.E.
IN SUPPORT OF PATENT OWNER RESPONSE
OF U.S. PATENT NO. 8,166,892**

I, Mark J. Viz, Ph.D., P.E., being over the age of 18 and competent to make the statements herein, hereby declare the following:

1. I am a citizen of the United States.
2. I understand that FreightCar America Inc. (“FreightCar,” or “Petitioner”) has filed a Petition for Inter Partes Review (“IPR”, No. IPR2025-01046) asserting that claims 2-15 (“the Asserted Claims”) of U.S. Patent No. 8,166,892 (“the ’892 Patent”) are invalid. I also understand that the owner of the ’892 Patent, National Steel Car Limited (“National Steel Car,” or “Patent Owner”) denies that the Asserted Claims are invalid and asserts that the claims are valid and enforceable.
3. I have been retained by counsel Ice Miller LLP to provide my opinion on technical matters concerning the validity of the Asserted Claims of the ’892 Patent. My employer, Exponent, Inc. (“Exponent”), is being compensated for my time at my normal consulting rate in 2026 of \$730 USD per hour. My compensation is not tied to the outcome of this matter.
4. Neither I nor Exponent have a business interest or other conflict of interest with respect to either of FreightCar or National Steel Car.

I. Background and Qualifications

5. My *curriculum vitae* is attached hereto as Appendix A.

A. Educational Background

6. I hold a Doctorate (Ph.D.) in Theoretical and Applied Mechanics from Cornell University, and a Bachelor of Science (B.S.) in Aeronautics and Astronautics from the Massachusetts Institute of Technology (MIT).

B. Professional Background

1. Industry Experience

7. I have extensive experience in the performance evaluation and mechanical analysis of railcar and aircraft structures. I have 25 years of experience investigating the mechanical / dynamic performance, reliability, and conformance to design specifications of railcar and railway structures, both freight and passenger. Prior to my employment at Exponent Inc., I was a Specialist Engineer (in Structural Damage Technology) at the Boeing Commercial Aircraft Company (Renton, Washington), a Senior Engineer at GATX Rail (Chicago, Illinois) and the Director of Applied Mechanics at Packer Engineering (Naperville, Illinois). While at GATX Rail, I performed analysis and field support for a range of mechanical performance matters involving GATX's fleet of over 80,000 railcars; many of these analyses and field support activities involved both covered and open-top hopper railcars. Also, during my time at GATX Rail, I had engineering responsibilities that included aspects of new railcar design and development,

budget and schedule management, and leasing and marketing support. I was also heavily involved in the regulatory environment concerning the transportation of hazardous materials in rail tank cars.

8. As a Principal Engineer with Exponent for the last 23 years, I have been involved in well over one hundred engagements involving railcar performance, from investigations involving claims of out-of-specification or improper structural performance, hunting and aggressive wear of trucks (bogies) and truck components, derailment investigations, ride quality issues and other wheel-rail interface problems. I have performed damage assessments of light rail vehicles involved in accident / incident claims, and I have overseen repair work on behalf of insurers for other light rail systems that have been damaged and then repaired. I have testified in rail matters in deposition, trial and arbitrations, both in the US and internationally (including Canada), and my work on fugitive coal dust emissions from coal railcars has been presented to the US Surface Transportation Board in various tariff disputes between two Class I railroads and various coal shippers.

9. I have been the project lead for approximately 35 major derailment investigations over the last 23 years at Exponent. I was on the ground for weeks in Lac-Mégantic, Québec in 2013 after a 70-car unit train derailed releasing over 1.5 million gallons of crude oil and causing the deaths of 47 people. I have

investigated derailments that have involved the rupture of tank cars and subsequent loss of hazmat containment, as well as derailments caused by anomalous structural and/or dynamic behavior of railcars, such as truck hunting, and track bed / rail defects. In just about all of these matters, quality and performance issues of the mechanical equipment, whether the railcars, track structures, or both, have typically been central aspects of the investigations.

10. In passenger rail, I have investigated railcar performance and/or derailments for engagements including but not limited to passenger rail systems in Dallas, Texas; Portland, Oregon; San Francisco, California; Los Angeles, California; London (England); and Manila (Philippines). I have also performed railcar mechanical analyses and design specification reviews for various manufacturers of light-rail / passenger rail vehicles. In the specialty rail area, I was involved in lengthy projects involving the performance of the Las Vegas monorail and the Seattle monorail when the latter was involved in a collision in 2005.

11. I have performed static strength, fatigue, and damage tolerance analyses of railcar structures and components using commercial finite element analysis codes such as Abaqus and Ansys. These analyses have involved many varieties of railcars, including open-top hoppers (including steel and aluminum coal cars), covered hoppers, pressure differential cars, tank cars, mill gondolas, and various passenger cars, including those with CEM (crash energy management)

provisions. Many of these analyses have included the incorporation of field data and measurements into the various models to capture the mechanical response of the railcars in their “as-is” rather than “as-designed” condition.

12. I have been involved in a number of engagements that have involved the performance of rail castings, axles, and bearings. These have included projects involving casting quality of truck bolsters and ride quality issues involving the dynamic response of trucks (bogies) and related components. These projects have also typically involved the development and implementation of non-destructive examination procedures for both on-car and off-car examination, cyclic fatigue testing, mechanical and metallurgical testing, engineering evaluation of test results with respect to mechanical performance, and development of engineering plans to manage fleet components over the projected remaining useful service life. For some of these engagements, I have presented findings on behalf of clients to the Association of American Railroads (AAR).

13. I am currently a Principal Engineer in the Mechanical Engineering group at Exponent, Inc., with my office being in Chicago, Illinois.

14. I am a Licensed Professional Engineer in the State of Illinois, license no. 062.062247.

15. Additional details about my career history and relevant qualifications are provided in the current version of my curriculum vitae, attached as Appendix A.

2. Academic Experience

16. Both my Bachelor of Science degree from MIT as well as my Doctorate from Cornell University involved successful completion of extensive coursework in areas directly involving and/or otherwise related to engineering design from a mechanics and materials perspective. During both my undergraduate and graduate terms, I was also regularly involved in a number of “hands-on” projects that involved various aspects of metal working and structural fabrication techniques. I received additional instruction in these various “hands-on” techniques during my time at Boeing and during extensive time spent in repair facilities owned and operated by GATX Rail in Indiana, Texas, Georgia, and various locations in Canada.

17. Additional details about my experience in academia are provided in the attached current version of my curriculum vitae. See Appendix A.

3. Publications

18. My publication list is provided in the attached current version of my curriculum vitae. See Appendix A.

4. Expert Evidence History

19. A listing of cases in which I have testified within the last eight years is found following my curriculum vitae. See Appendix B.

C. Scope of Assignment

20. I have been retained to provide my technical opinions regarding certain challenged claims of the '892 Patent (claims 2-15, or "the Challenged Claims"). This declaration presents analysis as to whether certain published prior art references identified in IPR2025-01046 disclose the subject matter recited in the claims of the '892 Patent. I have been asked to review the declaration of Petitioner's technical expert, Dr. Mehdi Ahmadian (Ex. 1003, hereinafter "Ex. 1003" or "Dr. Ahmadian Decl."), and assess whether the Petition and Dr. Ahmadian have presented a likelihood that any of the challenged claims of the '892 Patent are anticipated by, or would have been obvious to a person of ordinary skill in the art based on the prior art cited in the Petition and declaration.

II. INFORMATION CONSIDERED

21. My opinions are based on my 29 years of professional industry experience in mechanical engineering, the numerous and various investigations that I have detailed above, and other matters on which I have given expert testimony. In forming my opinions, I have considered the exhibits accompanying the Petition, including the following:

- A. The Certified File History of U.S. Patent No. 8,166,892
(Exhibit 1002 to IPR2025-01046)
- B. The Declaration of Mehdi Ahmadian in Support of Inter
Partes Review of U.S. Patent No. 8,166,892 (Exhibit 1003 to
IPR2025-01046)
- C. 1946 Car Builder's Cyclopedia Excerpt (Exhibit 1004 to
IPR2025-01046)
- D. U.S. Patent No. 1,321,928 ("Lindström") (Exhibit 1005 to
IPR2025-01046)
- E. U.S. Patent No. 4,941,411 ("Wong") (Exhibit 1006 to
IPR2025-01046)
- F. Coates, L&Y Hopper Wagons ("Coates") (Exhibit 1007 to
IPR2025-01046)

G. High Resolution Version of Excerpts from 1946 Car Builders' Cyclopedia, 17th ed. ("1946 Cyclopedia") (Ex. 1054)

22. Additional information may become available which would further support or modify the conclusions that I have reached to date. Accordingly, I reserve the right to modify or expand this opinion or the bases thereof upon consideration of any further discovery, testimony, or other evidence, including any issues raised by any expert or witness of Petitioner, or based upon interpretations of any claim term different than those proposed in this declaration.

III. LEGAL PRINCIPLES

23. In expressing my opinions and considering the subject matter of the claims of the '892 Patent, I am relying on certain legal principles that have been explained to me by counsel for Patent Owner. Accordingly, I have considered and applied the following standards in providing my analysis in this Declaration.

24. I understand that for an invention claimed in a patent to be found patentable, it must be, among other things, new and not obvious from what was known before the invention was made. I understand the information that is used to evaluate whether an invention is new and not obvious is generally referred to as "prior art." I understand that prior art to the '892 Patent includes patents and printed publications in the relevant art that predate September 14, 2009, the priority date of the '892 Patent. I understand that an assessment of the claims of the '892 Patent should be taken from the perspective of a POSITA as of the September 14, 2009, priority date.

25. I understand that in this proceeding, for the purposes of institution, Petitioner has the burden of proving that there is a reasonable likelihood that Petitioner would prevail with respect to at least one of the claims challenged in the Petition.

26. I understand that there are two ways in which prior art may render a patent claim unpatentable. The prior art can be shown to “anticipate” the claim or it can be shown to have made the claim “obvious.”

27. I understand that anticipation of a claim requires that every element of a claim be disclosed, explicitly or inherently, in a single prior art reference, and that the elements are arranged in the prior art reference as arranged in the claim.

28. I understand that a patent claim is invalid as obvious if the differences between the claimed subject matter and the prior art are such that the claimed subject matter as a whole would have been obvious before the effective filing date of the claimed subject matter to a person of ordinary skill in the art.

29. I understand that an obviousness analysis requires an understanding of the scope and content of the prior art, any differences between the claimed invention and the prior art, and the level of ordinary skill in evaluating the pertinent art.

30. I further understand that certain factors may support a finding of nonobviousness of a claim. I understand that such secondary considerations include, among other things, commercial success of the patented invention, skepticism of those of ordinary skill in the art at the time of the claimed invention, unexpected results of the invention, any long-felt but unmet need in the art that was satisfied by the invention, the failure of others to make the invention, industry

praise of the invention by those of ordinary skill in the art, and copying of the invention by others in the field. I understand that there must be a nexus (i.e., a connection) between any such secondary considerations and the claimed invention. I also understand that contemporaneous and independent invention by others is a secondary consideration tending to show nonobviousness.

31. I understand that patent drawings are not to be interpreted to scale unless so indicated in the specification of the patent.

IV. CLAIM CONSTRUCTION

32. I understand that the claim term “sloped side sheet” has been construed by a district court in a related litigation to mean “a sheet extending in a longitudinal direction with respect to a side of the hopper and which forms a sloped surface.” My analysis and opinions have taken into consideration and are consistent with this construction.

33. I understand that the Petitioner and Patent Owner have agreed to the constructions below. My analysis and opinions have taken into consideration and are consistent with these constructions.

Claim Term	Construction
“said second region of said sidewall extending downwardly or said first top chord” (claim 2)	said second region of said sidewall extending downwardly of said first top chord.
“said sidewall stiffener having web continuity between said first and second portions thereof” (claim 2) “said stiffener having vertical web continuity through said transition portion” (claim 4)	Plain and ordinary meaning, i.e., said [sidewall] stiffener having substantial co-planar alignment of the first and second portions through a transition portion
“mate” (claims 10, 13, and 14)	Plain and ordinary meaning, i.e., directly or indirectly connected to

34. I understand the Board instituted review based on five (5) grounds of unpatentability (Grounds 1b, 1c, 1d, 2b, and 2c) premised on the Board's preliminary view that Petitioner had shown a reasonable likelihood of prevailing on its challenge to independent claim 2 under Ground 1b.

V. OPINIONS

A. **Level of Skill of a Person Having Ordinary Skill in the Art**

35. I was asked by counsel for National Steel Car to provide my opinion by considering each of the '892 Patent claims through the eyes of a "person of ordinary skill in the art" ("POSITA") before the effective filing date of the claimed invention, which I have been advised is September 14, 2009.

36. In considering the characteristics of a hypothetical POSITA, I was advised to consider factors, such as the educational level and experience of people working in the field at the time of the invention, the types of problems faced in the art and the solutions found to those problems, the pace at which innovations are made in the field, and the sophistication of the technology in the field. With this in mind, I placed myself back in the time frame of the effective filing date of the claimed invention, namely, in the September 2009 time frame.

37. I understand that in the parallel District Court litigation related to the '892 Patent, (*National Steel Car Limited v. FreightCar America, Inc., et al.*, C.A. No. 1:24-cv-00594-JLH, D.Del.) National Steel Car has contended that a POSITA in the field of the '892 Patent would have at least a bachelor's degree in a discipline related to mechanical engineering, physics, structural design, or an equivalent discipline, and at least two years of experience designing or analyzing

railcars. I agree that this definition adequately captures the background of a POSITA at the time of the '892 Patent filing.

38. There are a number of reasons why I am able to place myself in the position of a POSITA in the September 2009 time frame. First, I have skills of at least a POSITA relevant to the technology of the '892 Patent, and therefore I have an understanding of what a POSITA would have known and what a POSITA would have learned from studying prior art documents. Second, I had supervised engineers by this time of my career. Third, I was also a Teaching Assistant ("T.A.") in a Solid Mechanics class during my graduate studies at Cornell University and worked directly with students as they became skilled in the art. I also taught after-work classes to program-level staff engineers while employed at Boeing; these classes would address certain aspects of structural design involving static strength, fatigue, and damage tolerance calculations. By teaching students, I understood to various degrees what they learned at different stages, how they reviewed documents they had not yet seen, and what conclusions they drew from these various documents. Fourth, while employed at GATX Rail prior to September 2009, I performed design and analysis work / calculations involving certain structural aspects of both open-top and covered hopper railcars as well as tank cars. Accordingly, I was at least a POSITA in the September 2009 timeframe.

39. My opinions regarding the state of the art and the understanding of a POSITA provided in this Declaration are made before September 2009, unless expressly stated otherwise. For the ease of reading, I may use a verb in this Declaration or any deposition or testimony in its present tense, *e.g.*, “would reasonably understand,” but this should be construed to mean a POSITA before the effective filing date of the claimed invention, that is, September 2009, unless expressly stated otherwise.

40. In my opinion, a slight change to the time frame for the POSITA, such as to 2008 or 2010, would not alter my opinions in this Declaration.

41. I understand that FreightCar contends that a POSITA for the '892 Patent would have had “at least a bachelor’s degree in a discipline related to mechanical engineering, physics, structural design, or an equivalent discipline, and at least two years of experience designing or analyzing railcars or similar vehicles.” *See, e.g.*, Dr. Ahmadian Decl. ¶30. While this definition is substantially similar to the definition put forward by National Steel Car, I disagree with the inclusion of “or similar vehicles” as design or analysis experience with other industrial wheeled vehicles would not necessarily be applicable to the art of the '892 Patent. However, I am also not aware of any substantive way in which my opinions would be altered should FreightCar’s definition of a POSITA be adopted.

42. In addition, in my opinion, although Dr. Ahmadian's background includes academic research in multi-body railcar truck dynamics, which is relevant to the dynamic performance of a railcar, Dr. Ahmadian's background does not appear to include actual industry experience with railcar structures. As a result, in my opinion, Dr. Ahmadian makes the wrong conclusions and conflates various concepts that a POSITA with practical industry experience and knowledge of railcars would not. I will point out Dr. Ahmadian's wrong conclusions and conflated concepts in following sections.

43. The level of skill of a POSITA bears directly on (1) how prior art is understood, (2) whether prior art references/teachings would have been combined, (3) the expectations and motivations of the hypothetical artisan, and (4) the assessment of technical tradeoffs, each of which is central to an obviousness assessment of prior art.

44. The '892 Patent concerns highly specialized railcar structural and operational features, necessitating that the POSITA must be limited to a person with actual experience designing or analysing railcars, and not similar vehicles.

45. Experience with similar vehicles, but not actual railcars, can invoke concepts from engineering domains that do not share the operational limitations, dimensional standards, safety regulations, fatigue behaviors, or coupling and loading conditions that define railcar design.

46. The '892 Patent expressly addresses constraints unique to heavy-haul rail service and ore-car loading/unloading operations, likely in so-called “unit train” service, constraints foreign to engineers whose experience lies outside the rail industry.

B. Overview of the '892 Patent

47. I disagree with the characterization of the '892 Patent in Dr. Ahmadian's Declaration, ¶¶ 25, 35-40. Dr. Ahmadian reduces all of the claims of the '892 Patent to sidewall stiffeners with “web continuity.” However, as discussed in more detail below, the asserted art (including that discussed in the paragraph entitled “Web Continuity was Not Novel in 2009”) relied on by Dr. Ahmadian does not show sidewall stiffeners with “webs.”

48. Moreover, the characterization of “action and reaction forces” in ¶37 only considers the vertical forces along a single vertical direction and fails to take into consideration other forces that are likely to be applied to the structures during use, such as, for example, commodity inside the hopper pressing against the walls of the hopper. Any analysis and, therefore, conclusions based on this simplistic, incomplete characterization of the forces applied to the structures will be critically flawed since the other forces experienced by the structure are not taken into consideration.

C. Overview of the relevant engineering principles

49. A railcar's structure is a complex, interconnected system that is engineered for safety, efficacy, and efficiency. Visual depictions of railcars may be insufficient to understand their complex innerworkings.

50. Railcar structure is designed to support loads of various types. Design considerations are based on, among other things, where structural components are placed, how they are oriented, their geometric details (for example, thickness, shape of cross-section, etc.), connection to other members, and integration within the overall structure of the railcar. All of these components in the aggregate must be considered to ensure proper load transfer down to the trucks, and ultimately the rails.

51. A POSITA would understand that one individual component of a railcar cannot be added or modified without consideration of the entire structure in satisfying these constraints, some of which have been identified in the previous paragraph. It is important, in reference to existing railcar design, that design choices be justified in the context of a railcar as a whole, and not just as a potential possibility.

52. The Petition and Dr. Ahmadian use impermissible hindsight to propose modifications to existing railcar designs shown in pictures and engineering

drawings or renderings performed to standards not used in North America and/or presented differently than they would have been presented in 2009 without providing adequate basis for why a POSITA would modify proven designs.

53. The gross rail load (GRL) per railcar in the United States and Canada is regulated for a railcar to be acceptable in “interchange” service (that is, a railcar can move seamlessly from one railroad to another). GRL includes both the weight of the railcar and the weight of its commodity.

54. Increasing a railcar’s weight by adding components to the railcar necessarily reduces the allowable weight (and possibly the volume) of the commodity it can carry. Thus, a POSITA would require significant motivation to alter a railcar’s structure, because weight is critical to its function.

55. For example, the AAR Manual of Standards and Recommended Practices (MSRP), Section C, Part II provides weight and axle criteria for railcars:

2.1.2.2 Weight and Axle Spacing Criteria

Table 2.1

Type	Maximum Track Load (lb)		Wheel Size (in.)
	Per Car	Per Axle	
Truck			
4 wheel	286,000	71,500	36
6 wheel	315,000	52,500	30
6 wheel	360,000	60,000	33
6 wheel	394,500	65,750	36

56. In addition, the Cooper Bridge Rating is an established technique for evaluating and qualifying the load input into bridge structures for a specific railcar design, especially with respect to specific aspects of the railcar's overall geometry and wheel/axle spacing. Referring to, for example, Section 2.1.2.3.1 of the AAR MSRP, it would be typical for railcars of the type at issue in the '892 Patent to have to satisfy Cooper Bridge Rating criteria for unrestricted interchange. As the Table below shows, this requires that certain dimensional limits be maintained.

2.1.2.3.2 Method 2 - Dimensional Limits for Cooper Bridge Rating Criteria

Cars having the characteristics listed in Table 2.3 shall comply with the dimensional limits listed in Table 2.4.

Table 2.3

Gross Rail Load (lb)	Truck Wheelbase
220,000	5 ft 8 in.
263,000	5 ft 10 in.
286,000	5 ft 10 in.

Table 2.4

Gross Rail Load (lb)	Bolster Centerline to Striker Face (Overhang)	Truck Centers (Minimum)	Length Over Pulling Faces (Minimum)
286,000 and 263,000	4 ft 11 ½ in.	29 ft 5 in.	41 ft 11 ½ in.
	5 ft 5 ½ in.	28 ft 4 ½ in.	41 ft 11 in.
	5 ft 11 ½ in.	27 ft 4 in.	41 ft 10 ½ in.
220,000	4 ft 11 ½ in.	22 ft 6 in.	35 ft 0 ½ in.
	5 ft 5 ½ in.	21 ft 6 in.	35 ft 0 ½ in.
	5 ft 11 ½ in.	20 ft 6 in.	35 ft 0 ½ in.

57. Another excerpt from the AAR Manual of Standards and Recommended Practices, Section C, Part II is shown below:

4.1.14 Lateral Forces

4.1.14.1 Lateral pressure of granular, lump, or pulverized bulk material shall be considered in the design of the containing structure of all cars in which such pressures may be active, e.g., box, hopper and gondola cars.

For closed-top cars, the lateral pressure may be computed by the following Rankine formula:

$$P = \frac{1}{2} Wh^2 \left(\frac{1 - \sin \phi}{1 + \sin \phi} \right)$$

where P = lateral force (lb/ft of length)
 W = weight of lading (car fully loaded—see paragraph 2.1.3) (lb/ft³)
 h = depth of lading (not including heap)(ft)
 ϕ = static angle of repose (25°)

For open top cars:

$$P = \frac{1}{2} W(h + 1)^2 \left(\frac{1 - \sin \phi}{1 + \sin \phi} \right)$$

The lateral force is to be distributed vertically so that it is at maximum at the floor line decreasing uniformly to zero at the top surface of the lading.

58. The above excerpt describes the method of calculating the lateral pressure applied to the sidewalls of a car by the commodity transported (akin to hydrostatic pressure). As shown below, this pressure varies as a function of the angle of repose (ϕ), which is a property of the particular commodity a car is transporting.

59. As such, certain structural design elements of a railcar designed to transport a particular commodity (such as, for example, aggregate) are not readily applicable to a railcar intended to transport a different commodity (such as, for example, iron ore) that has different characteristics. This is particularly relevant when considering aspects of railcar design such as the angle of the slope sheet, and

speaks to the fact that certain design elements (such as, for example, beam placement) of the structural design of a single railcar cannot be readily applied to the design of a separate railcar without performing a detailed analysis of the loading after making such a design modification.

60. Thus, railcar components are thoroughly analyzed during design regarding where they are placed, how they are oriented, geometric details (e.g., thickness and cross-section), connection to other members, and integration within the overall structure of the car. All these components in the aggregate must be considered to ensure proper load transfer. Addition of members to the railcar structure requires additional engineering analysis pertaining to the manufacturing, cost, material, and servicing considerations for the railcar.

61. The prior art cited by Petitioner supports the interrelated nature of railcar design. *See*, for example, Lindström (Ex. 1005) at 1:34-39, stating “Another object of our invention is to provide a dumping car having novel framings at its sides and ends, which framings are rigidly connected together and which are well adapted to take care of the stresses and strains set up in the car.”

62. General arrangement drawings presented using foreign standards (for example, ISO versus ASME) or rendered in a manner that greater economy of the number and type of renderings, which was not an issue at all in 2009, such as those relied on by Petitioner, would not have been the norm in 2009. However, it is

important in reviewing such drawings to recognize that hidden lines provide a POSITA with limited information related to the depth of a feature within the drawing.

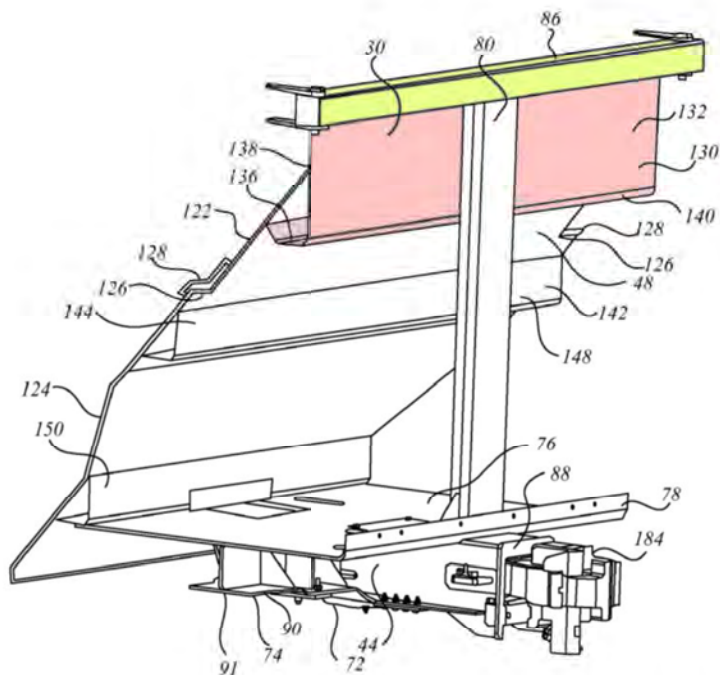
D. Ground 1b

63. I understand that the Petition asserts that claims 2-8 and 10-14 of the '892 Patent would have been obvious over the 1946 Cyclopedia (Ex. 1004) in view of Lindström (Ex. 1005) and optionally Wong (Ex. 1006).

i. Claim Limitation 2i (“said upper, longitudinally outboard end of said first end slope sheet being reinforced by a first cross-wise extending beam.”)

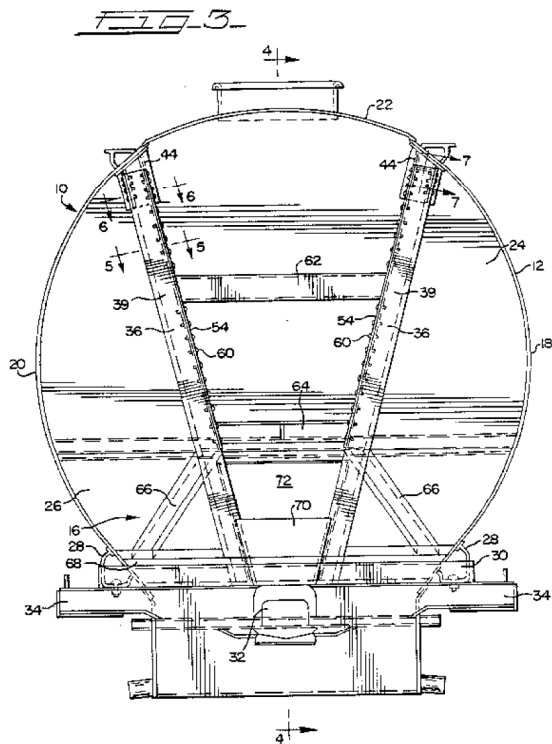
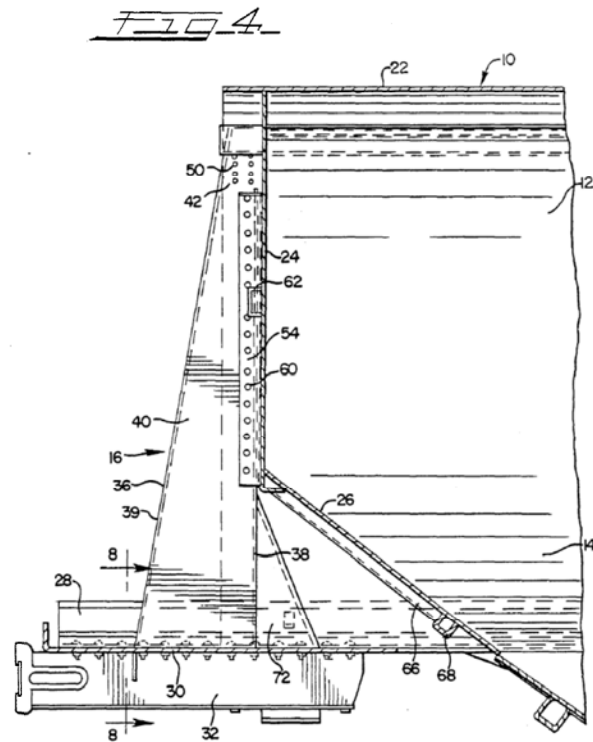
64. I understand that the Petition identifies a “a crosswise beam with a V-shaped cross-section” in the NSC Ore Cars as corresponding to the claimed “end top chord.” Petition at 51, 71. Dr. Ahmadian does not opine regarding this proposed equivalency.

65. In my opinion, a POSITA would not have equated the two structures because their purposes are different. The '892 Patent clearly delineates between the “first crosswise beam” and the “end top chord”:



66. '892 Patent Fig. 3a (annotated to show top chord 86 in green and the structure that comprises the “first crosswise beam” in red.); 16:29-48. The “end top chord” and the “first crosswise beam” are different structures with different purposes and are not shown in the NSC Ore Cars.

67. The Petition and Dr. Ahmadian state that a POSITA would combine the NSC Ore Cars with Wong to add a first cross-wise extending beam. I disagree. Wong teaches an aluminum covered hopper railcar with a steel end structure:



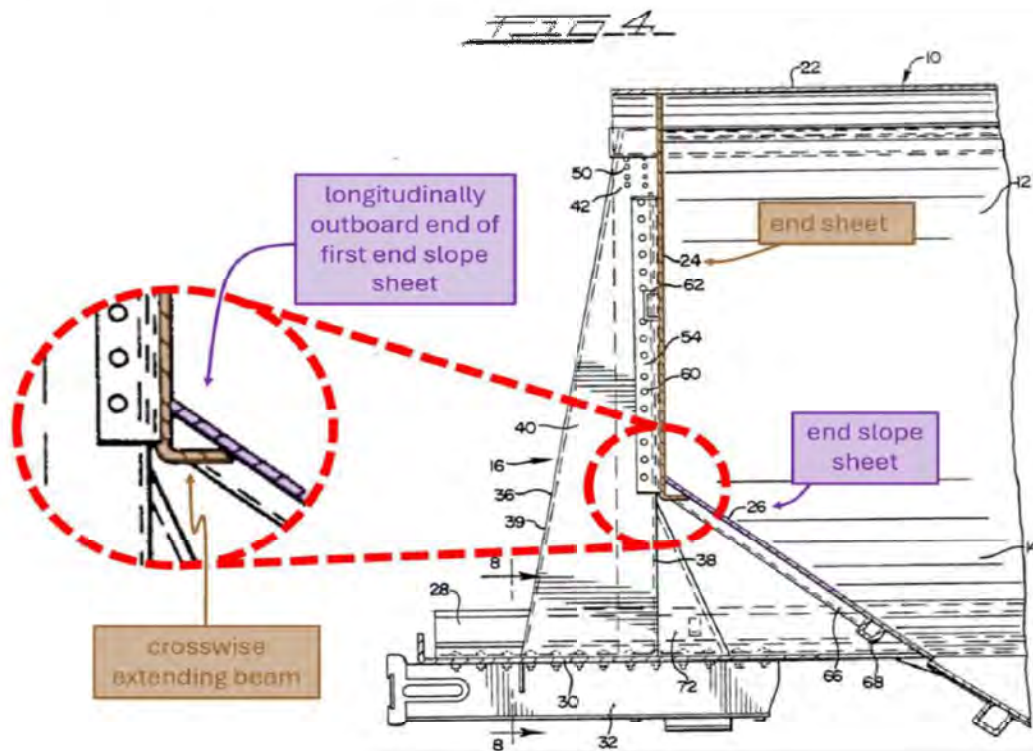
Ex. 1006, Wong Figs. 3, 4.

68. Wong is about how to combine steel and aluminum structure to get needed strength while avoiding the corrosion issues that arise because steel and aluminum are galvanically coupled and will corrode if in contact with each other. Wong is far less concerned regarding lateral reinforcing beams.

69. The L-shaped detail shown in Wong is not similar to the claimed “first crosswise beam” in the ’892 Patent because it is the joint where the slope sheet is connected to the end vertical sheet. Wong does not provide reinforcement, but simply shows two sheets being connected for lading containment and load transfer. The claimed “first crosswise beam” in the ’892 Patent provides reinforcement to

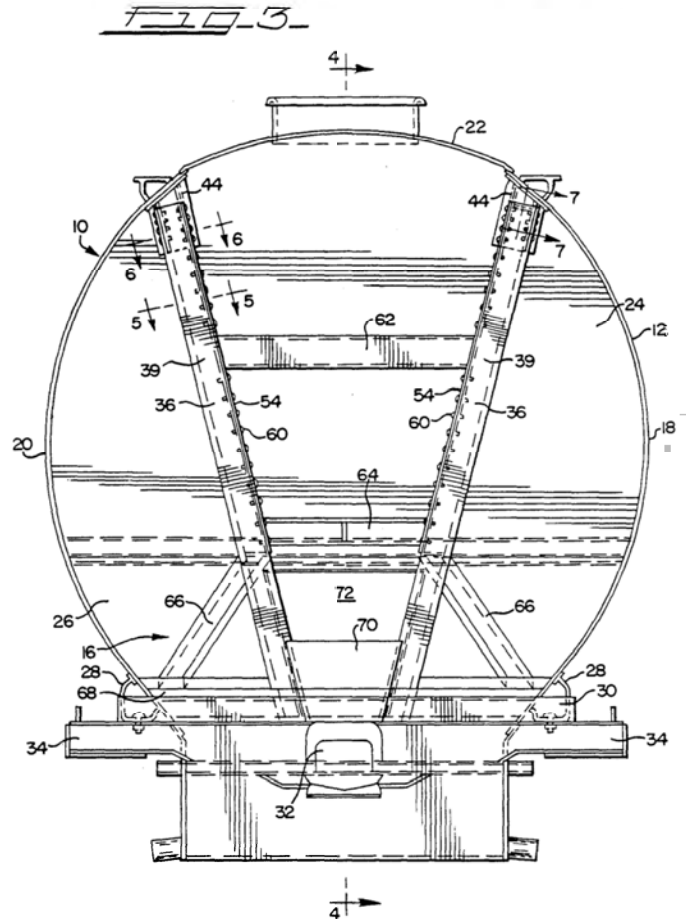
the slope sheet; a POSITA in the relevant time frame would understand and appreciate this difference.

70. A POSITA would understand the L-shaped detail (shown below in annotated Fig. 4 of Wong) to be a lip formed at the lowermost end of the semicircular end sheet 24 (shown in brown). As seen in the cut-away view below, the L-shaped detail is an integral part of the sheet 24, all of which is made of the same material as indicated below.



71. The shape of the end sheet 24 is shown in Fig. 3 of Wong (reproduced below). Referring to both the annotated Fig. 4 above and Fig. 3 below, a POSITA would understand these Figures to show that the lowermost portion of the end

sheet 24 includes the L-shaped detail to cover the interface between the end sheet 24 and upper edge of the end slope sheet 26, shown in Fig. 4, above.



72. Referring to the annotated Fig. 4 (above) of Wong, a POSITA would understand that the L-shaped detail provides limited support to the upper end of the end slope sheet 26.

73. Referring to the annotated Fig. 4, a POSITA would further understand that Wong includes a plurality of aluminum channel stiffener members 66

connected to the end slope sheet 26 to support the structure. Ex. 1006, at 4:50-56; Fig. 4.

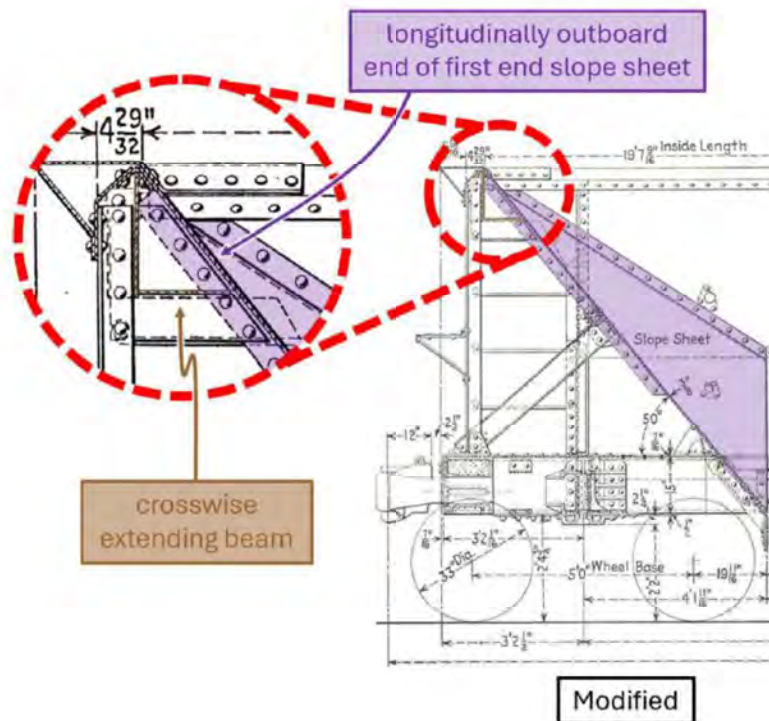
74. Given the shape, aluminum material, and L-shaped detail (the primary function of which appears to be for lading containment and/or to align and hold an upper edge of an end slope sheet during manufacture), a POSITA would not have looked to the structure, much less attempt to incorporate it (or its L-shaped detail) in the NSC Ore Car.

75. A POSITA would have understood that any attempt at, albeit highly non-obvious, modifying the NSC Ore Car to include the L-shaped detail would have necessitated a material redesign of the end sheet 24 (and L-shaped detail) from Wong and the end structures of the NSC Ore Car, as well as, potentially, the overall ore car design.

76. A POSITA would not have had a reasonable expectation of success in incorporating the end sheet 24 with L-shaped detail in the NSC Ore Cars.

77. Accordingly, in my opinion, a POSITA would not look towards Wong to improve the end structure of the NSC Ore Cars.

78. In fact, the proposed combination of the NSC Ore Cars and Wong is unsatisfactory for either railcar's intended purpose. It is not clear how the proposed cross-wise beam in the NSC Ore Cars would transfer load directly down from the end slope sheet to the undercarriage of the car:



Petition at 53, Ex. 1003 at ¶ 56.

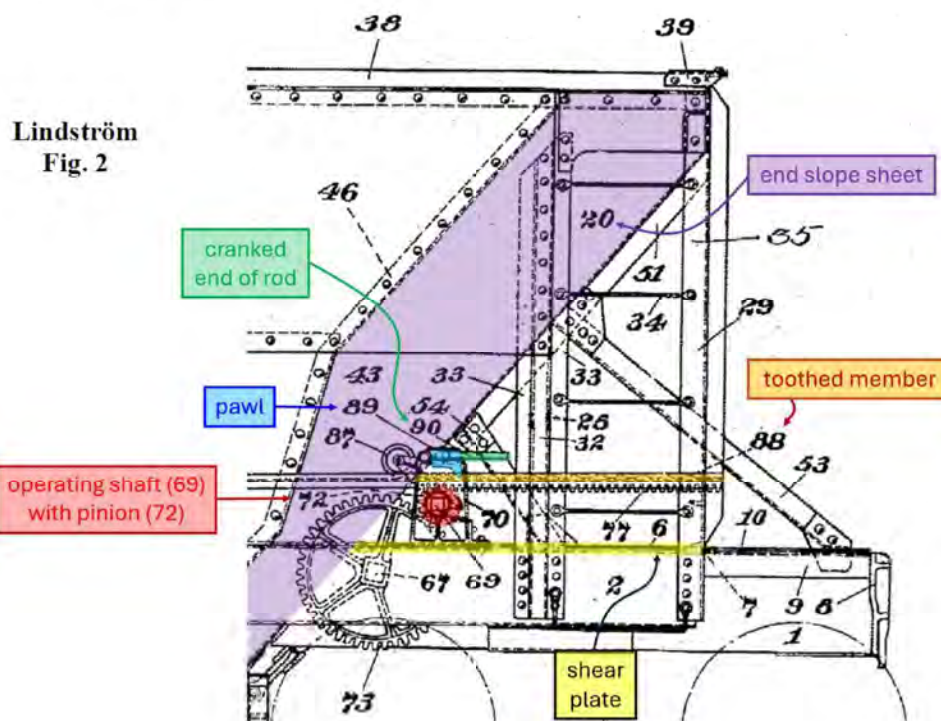
79. The NSC Ore Cars already have structure for holding up the end slope sheet. For example, a POSITA would have understood that adding a redundant beam would require time investments for the redesign and requisite analyses.

80. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

ii. **Claim Limitation 21 (“a door actuator mounted above said shear plate, said door actuator being at least partially overhung by said first end slope sheet; said door actuator being connected to said door by a mechanical transmission”)**

81. The Petition and Dr. Ahmadian assert that the NSC Ore Cars, as modified by Lindström, would have rendered obvious to a POSITA this claim limitation. Petition at 56, Ex. 1003 at ¶¶ 59-60. I disagree.

82. The Petition and Dr. Ahmadian state that Lindström teaches “a door actuator comprising an operating shaft 69 with a pinion 72, a toothed member 88, a pawl 89 and a rod 90”:



Petition at 56, Ex. 1003 at ¶ 59.

83. In my opinion, a POSITA would not seek to combine Lindström's door actuator with the NSC Ore Cars based solely on the minimal details provided in these sources.

84. First, Dr. Ahmadian provides no support that Lindström's door mechanism would fit into the design of the NSC Ore Cars. I find no discussion in Dr. Ahmadian declaration for the proposition that door mechanisms are interchangeable, or that a railcar from 1946 would include a door mechanism from 1915, over 30 years earlier. A more detailed engineering study and analysis would need to be performed that would require more quantitative technical information than what these simple renderings in Lindström show.

85. Petitioner and Dr. Ahmadian provide annotated drawings from Lindström and the 1946 Cyclopedia which appear to show a space at an end of the railcar. *See* Petition at pages 56-69 and ¶¶59-60 of Dr. Ahmadian's declaration (Ex. 1003). However, a POSITA would have understood that the existence of a space in a railcar for addition or retrofitting a component or feature is only one of many factors that must be taken into consideration, before making any attempt to use that space for an added or retrofitted component.

86. A POSITA would have understood that it would have been necessary to consider additional factors, such as: how and where to mount a multi-element

actuator above the shear plate; selection of mount points; transferring reaction loads to primary structure; avoiding conflicts with end-frame members; how to place the actuator so it is “at least partially overhung” by the NSC Ore Cars’ first end slope sheet, while preserving door swing arcs and clearances; and how to connect that actuator to the door by a mechanical transmission – that is, to provide compliant routing of shafts, clutches, pinions/racks, chains/rods, and levers within the NSC envelope without creating interferences.

87. A POSITA would have understood that it would have been necessary to consider additional factors and perform a comprehensive analysis and assessment of those factors in the overall NSC Ore Car, including factors such as dimensions, clearances, and mounting details before even attempting to install a Lindström-style actuator in the NSC Ore Cars’ end frame.

88. Ore Car designs such as those of the NSC Ore Cars are typically governed by AAR standards, which includes a maximum 286,000-lb GRL restriction (for non-regulated commodities such as ore and aggregate), and that designs must accommodate the service environment. Those realities directly affect whether, where, and how an actuator can be mounted above the shear plate, how it is supported, and whether a mechanical transmission can be routed under the slope-sheet overhang without fouling door motions or end-frame members.

89. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or that the asserted art would have rendered obvious to a POSITA this claim limitation.

iii. Claim Limitation 2u (“said sidewall stiffener having web continuity between said first and second portions thereof”)

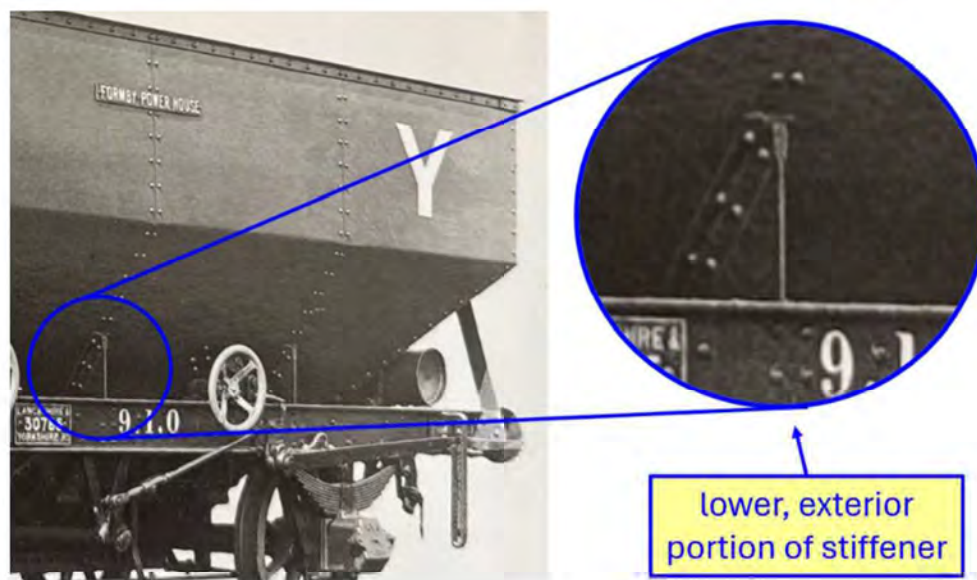
90. The Petition fails to establish the claimed “sidewall stiffener having web continuity between said first and second regions thereof” is taught by the NSC Ore Cars.

91. The NSC Ore Cars do not include, explicitly or inherently, the claimed “sidewall stiffener having web continuity between said first and second regions thereof,” as recited in limitation 2u. Dr. Ahmadian does not opine regarding this claim limitation.

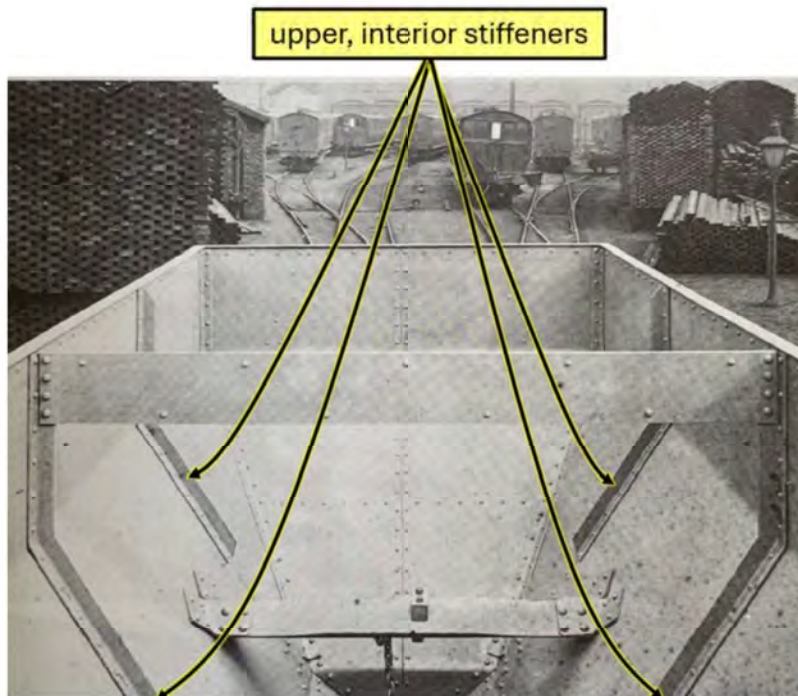
92. The sidewall stiffening elements from the NSC Ore Cars do not have webs. The drawings of the NSC Ore Cars appear to have hat or “U” sections that are fastened to the side wall. There is no disclosure of web continuity between a flange and a web that is perpendicular to the flange that would be considered a side sheet of the car. *See* ’892 Patent at 15:54-57 (“In this arrangement, the vertical stiffener, 102, acts as the web of a T-section, and the local region of the wall section to which it is joined functions as the flange of that T-section.”). A POSITA would not conclude that what is shown in the drawings relied on by Petitioner is

the same thing as what is claimed in the '892 Patent. The '892 Patent teaches that the web of the stiffener is matched to the side wall as if the side wall were the flange of an I-beam. Even if a POSITA could reconstruct the drawings in the asserted art, the web continuity of the I-beam formation feature of the '892 Patent differentiates the claims over that asserted art which utilized L-brackets for securing the lower portion of the stiffener to the side wall and includes a single L-bracket on the interior with no discernible sidewall stiffener.

93. The L&Y Ore Car described in Coates shows an example of the same general type of L-brackets used in the drawings relied on by Petitioner:



Ex. 1007 at 1 (annotated).



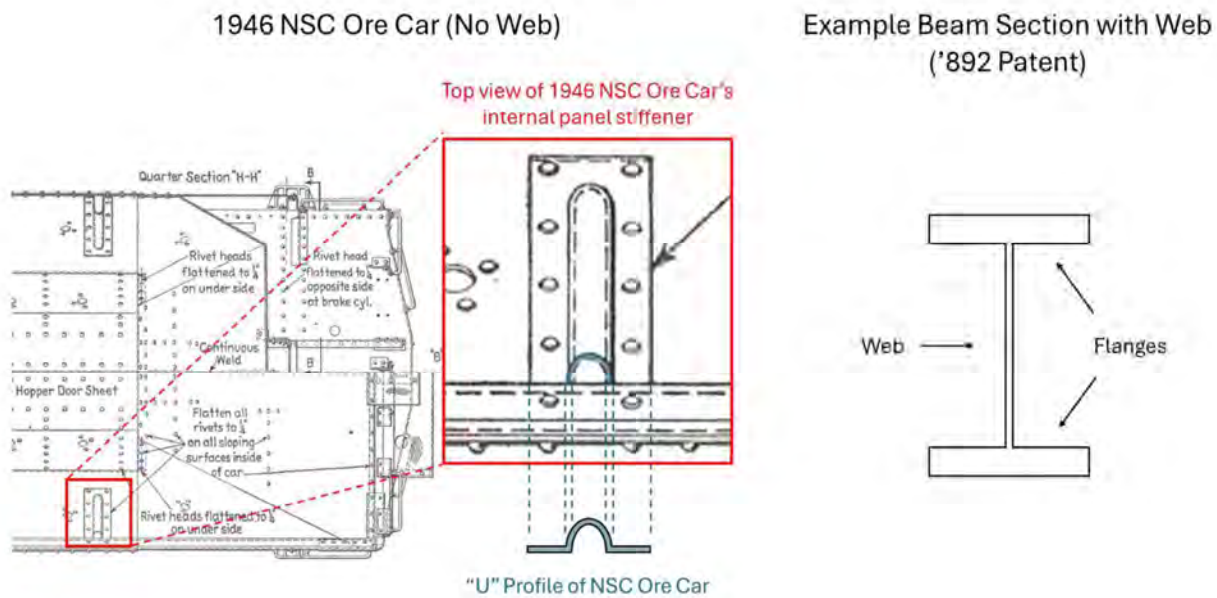
Ex. 1007 at 1 (annotated).

94. After reading the Petition and Dr. Ahmadian's report, and analyzing the asserted art, I am unable to find any basis that would reasonably suggest to a POSITA that any combination of the asserted art teaches, explicitly or inherently, or would have rendered obvious the claimed "sidewall stiffener having web continuity" together with the remaining elements and limitations in any one of claims 1-15 of the '892 Patent.

95. In my opinion, the Petitioner has not shown that the NSC Ore Cars teach, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

96. A POSITA would have been well aware that the web of a beam is the specific component of the beam which primarily resists shear loading.

97. The structure shown in the 1946 Cyclopedia is not a web as can be seen in the below figure comparing an annotated higher resolution scan of the 1946 Cyclopedia, Ex. 1054, with an example of a beam section comprising a web as required by the '892 Patent.



iv. Claim 4 (“The rail road hopper car of claim 2 wherein said first upstanding sidewall has a third region intermediate said first and second regions, said third region including a side sheet transition portion passing across said sidewall stiffener from an inboard margin thereof to an outboard margin thereof, and said stiffener having vertical web continuity through said transition portion.”)

98. The Petition fails to establish that the claimed “web[s]” or “vertical web continuity through the transition portion” is taught by the NSC Ore Cars. *See* Section V.D.3. (limitation 2u) above, in addition to the following. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim.

99. The NSC Ore Cars do not include, explicitly or inherently, the claimed “stiffener having vertical web continuity through said transition portion,” as recited in claim 4. Dr. Ahmadian does not opine regarding this claim limitation.

100. The sidewall stiffening elements from the NSC Ore Cars do not have webs. The drawings of the NSC Ore Cars appear to have hat or “U” sections that are fastened to the side wall. There is no disclosure of web continuity between a flange and a web that is perpendicular to the flange that would be considered a side sheet of the car. *See* ’892 Patent at 15:54-57 (“In this arrangement, the vertical stiffener, 102, acts as the web of a T-section, and the local region of the wall

section to which it is joined functions as the flange of that T-section.”). A POSITA would not conclude that what is shown in the drawings relied on by Petitioner is the same thing as what is claimed in the ’892 Patent. The ’892 Patent teaches that the web of the stiffener is matched to the side wall as if the side wall were the flange of an I-beam. Even if a POSITA could reconstruct the drawings in the asserted art, the web continuity of the I-beam formation feature of the ’892 Patent differentiates the claims over that asserted art which utilized L-brackets for securing the lower portion of the stiffener to the side wall and includes a single L-bracket on the interior with no discernible sidewall stiffener.

101. After reading the Petition and Dr. Ahmadian’s report, and analyzing the asserted art, I am unable to find any basis that would reasonably suggest to a POSITA that any combination of the asserted art teaches, explicitly or inherently, or would have rendered obvious the claimed “stiffener having web continuity” together with the remaining elements and limitations in claim 4.

102. In my opinion, the Petitioner has not shown that the NSC Ore Cars teach, explicitly or inherently, or would have rendered obvious to a POSITA this claim.

v. Claim 5 (“the transition portion is located a distance above the first side sill that is in the range of $\frac{1}{4}$ to $\frac{2}{3}$ L”)

103. A POSITA would have understood that real hopper geometry is set by engineering constraints such as commodity angle of repose, hopper discharge mechanics, load paths, and system profiles/clearance rules, not by back-solving to meet a target ratio.

104. A POSITA would not, as a matter of design choice, simply select dimensions consistent with the NSC Ore Car drawings and Lindström. Each dimension of each component in a railcar such as the NSC Ore Car or railcar of Lindström necessitates careful consideration and analysis because dimensional changes to parts of the railcar have a direct effect on load distribution, component stiffness, door performance, and discharge efficacy, among other things, and are governed by AAR clearance plates and other operational geometric constraints, among others, not by aesthetic preference or convenience.

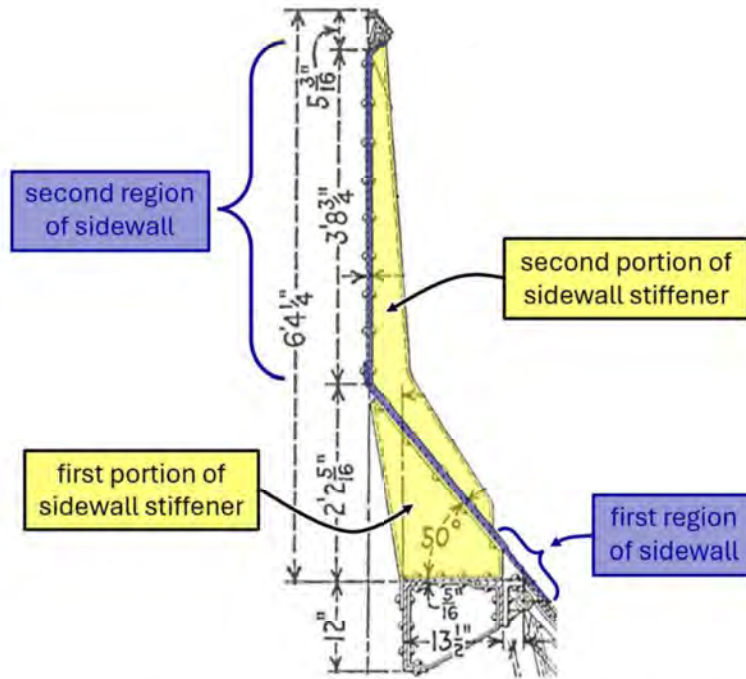
105. In my opinion, the Petitioner has not shown that the NSC Ore Cars teach, explicitly or inherently, or would have rendered obvious to a POSITA this claim.

vi. Claim Limitation 6b (“said hopper includes first and second sloped side sheets; and said first sloped side sheet meets said first sidewall at said transition portion.”)

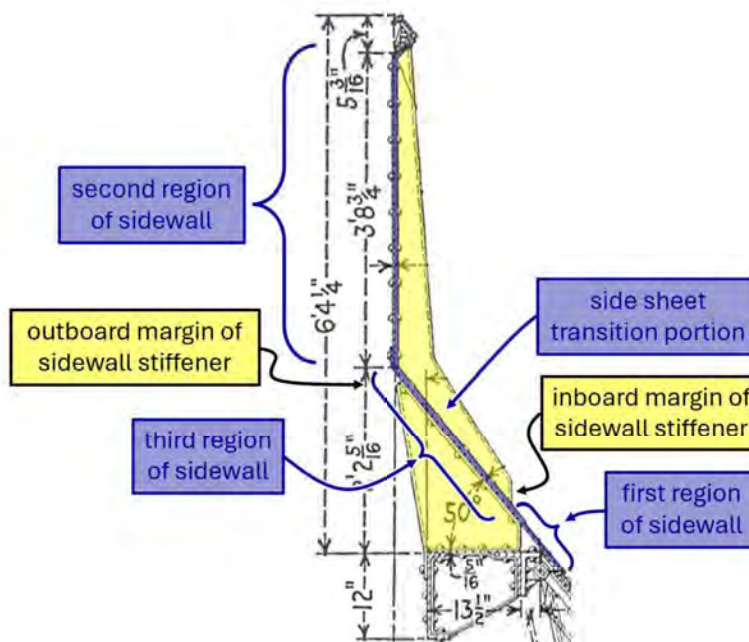
106. Petitioner and Dr. Ahmadian use a claim construction for “sloped side sheets” based on an infringement claim chart for Claim 6 in the District Court Litigation. I have been informed that claim construction should not be performed based on the accused infringing product. Petitioner claims it uses this claim construction for the purposes of this *ground* but appears to use it only for the purposes of this claim limitation. Petition at 68. Notably, Petitioner and Dr. Ahmadian use a different construction of “sloped side sheet” in its discussion of this claim limitation in Ground 2b. Petition at 118-20; Ex. 1003 at ¶ 84. Regardless, Petitioner fails to establish that the claim construction it seeks is proper.

107. This claim limitation requires “first and second sloped side sheets,” yet Petitioner and Dr. Ahmadian only identify a single alleged sloped side sheet.

108. Petitioner initially identifies the following features as providing the claimed “first portion” and “second portion” of the “sidewall stiffener” and “first region” and “second region” of the “sidewall” (Petition at 29, 63):



109. Petitioner also identifies the following features as providing the claimed “third region” and “side sheet transition portion”:



Petition at 66.

110. Petitioner and Dr. Ahmadian thus admit that the NSC Ore Cars do not teach or suggest the claimed “sloped side sheet.”

111. Petitioner attempts to use Lindström to show that which is missing from the NSC Ore Cars. At a minimum, Lindström does not teach or suggest any structure corresponding to the claimed “sloped side sheet.”

112. The Petitioner and Dr. Ahmadian pick and choose pieces from each of the references to argue that a POSITA would seek to make the NSC Ore Cars’ side wall “wrap around” its “lower stiffener.” However, such a modification would be redundant and unnecessary.

113. However, Petitioner and Dr. Ahmadian argue that a POSITA would, based on Lindström, (1) wrap the sidewall of the 1946 around the lower portion of the alleged sidewall stiffener and (2) add back a sloped side sheet that was removed to wrap the side wall around the alleged sidewall stiffener.

114. In my opinion, Petitioner and Dr. Ahmadian fail to provide a reason as to why a POSITA would have modified the NSC Ore Cars in view of Lindström as proposed by Petitioner. Indeed, Petitioner merely uses the disclosure and teachings of the ’892 Patent as a roadmap to modify the asserted art.

115. For example, Petitioner states that “it would have been obvious to add a sloped side sheet, as shown below in green, to ensure the side wall of the hopper has a continuous sloped surface without discontinuities that could impede the

movement of the lading to the hopper doors.” Petition at 70. However, this is the exact teaching of the ’892 Patent, showing that Petitioner and Dr. Ahmadian are using the patent as a guide. ’892 Patent at 15:46-50.

116. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

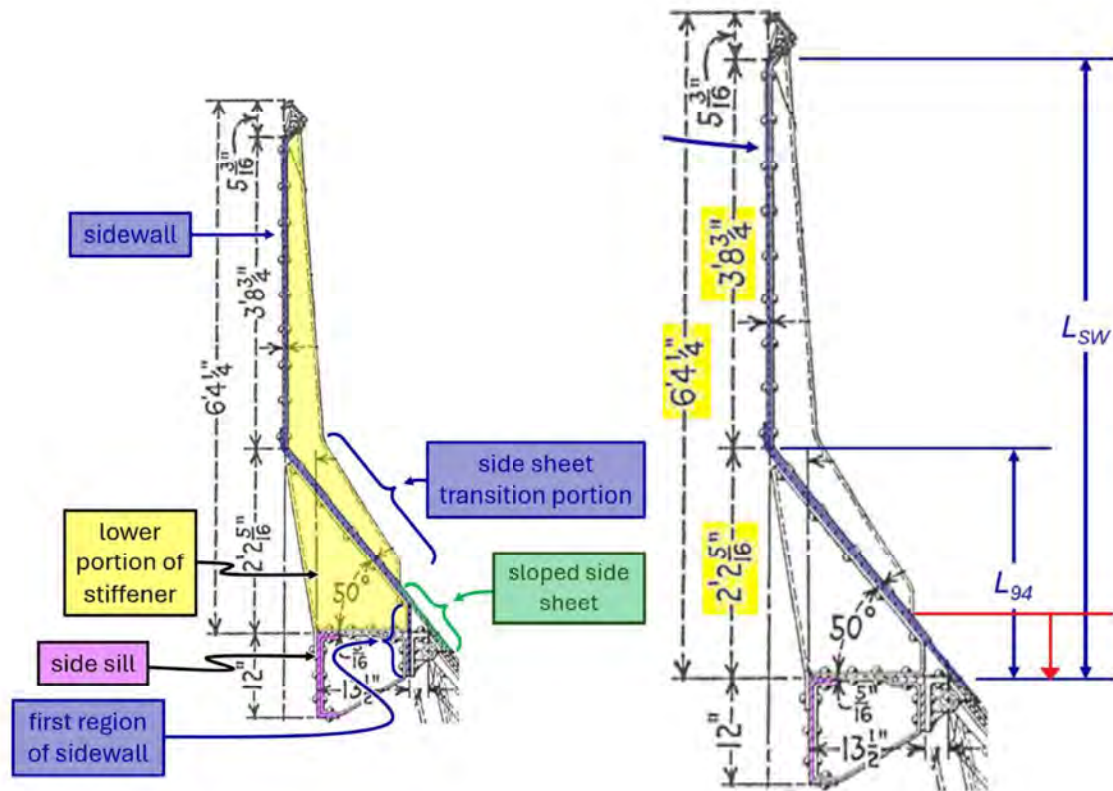
vii. Claim 7 (“The rail road hopper car of claim 6 wherein said first sidewall has an overall height from said first side sill to said first top chord, L, and said first sloped side sheet meets said transition portion at an height that is in the range of $\frac{1}{4}$ to $\frac{2}{3}$ L above said first side sill.”)

117. The Petition relies on its discussion in claim 5 for this limitation and provides no further analysis. Petition at 67-68, 71. Dr. Ahmadian does not address this claim limitation.

118. Claim 7 requires that the “. . . said first sloped side sheet meets said transition portion at an height that is in the range of $\frac{1}{4}$ to $\frac{2}{3}$ L above said first side sill. . . .”, while claim 5 requires “said transition portion is located a distance above said first side sill that is in the range of $\frac{1}{4}$ to $\frac{2}{3}$ L.”

119. The Petition and Dr. Ahmadian’s analysis of claim 5 does not properly consider where the “sloped side sheet meets” the “transition portion”

because the “sloped side sheet” is not recited in claim 5 or any of the claims on which it depends — “sloped side sheet” is first introduced in claim 6. Regardless, according to the Petition, the “sloped side sheet” meets the “transition portion” at a much lower location than where the Petition makes its measurement for claim 5:



Petition at 70 (showing sloped side sheet), 67 (annotated with red line and arrow to show height of where the sloped side sheet meets the transition portion). This location is clearly outside the range of “1/4 to 2/3 L.” However, a POSITA would rely on actual measurements as the transition from the vertical side sheet to the side slope sheet is typically governed - in one sense - by the properties of the anticipated commodities, such as the angle of repose of the commodity.

51. The Petition makes no effort to explain why, and a POSITA would not understand that, the “end top chord” and “first cross-wise extending beam” would be the same structure when the ’892 Patent clearly describes them as separate. *See* Section V.D.1. above.

122. Moreover, the Petition does not explain why, under its alternative theory regarding the “first cross-wise extending beam,” a POSITA would have modified the NSC Ore Cars in view of Wong as it proposes, nor whether the NSC Ore Cars’ top chord would be retained. As explained in Section V.D.1., a POSITA would not look towards Wong to modify the NSC Ore Cars.

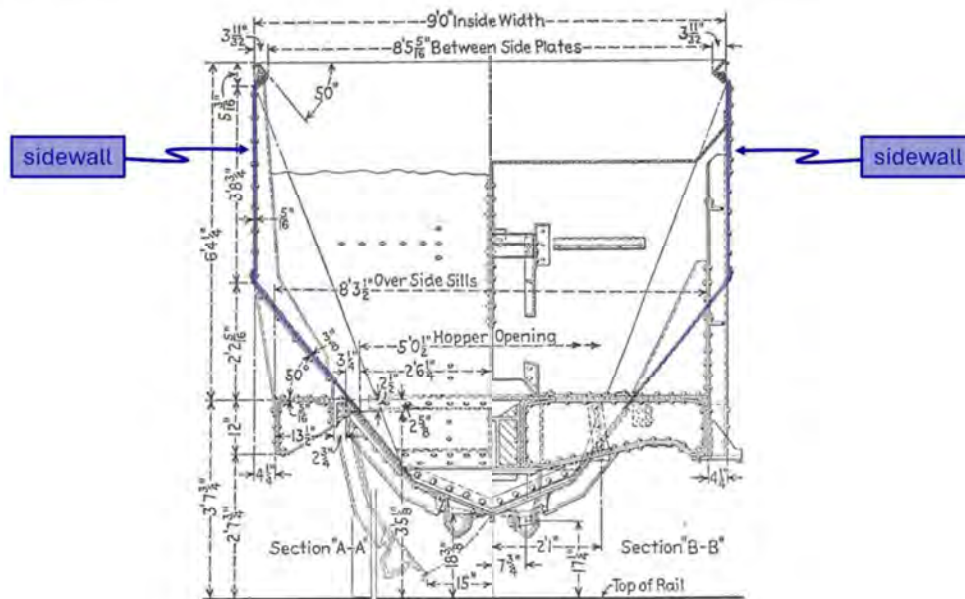
123. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

ix. Dependent Claim 11 (“The rail road hopper car of claim 10 wherein said main bolster has first and second ends; and first and second corner posts extend upwardly from said first and second ends respectively to mate with said sidewalls.”)

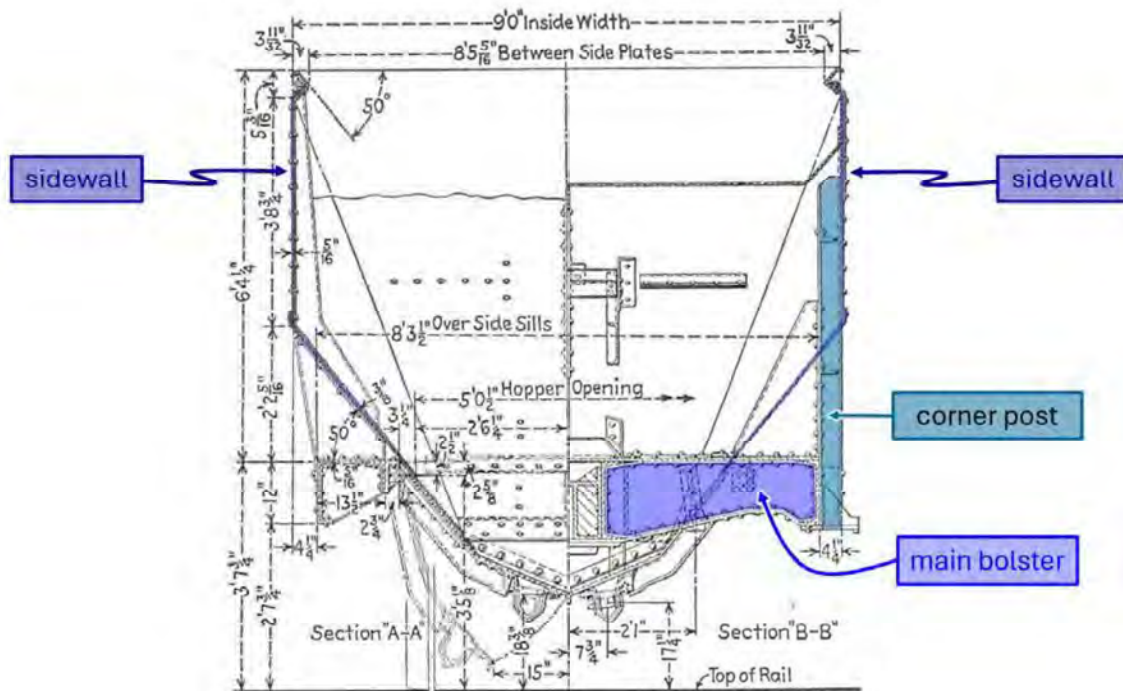
124. Dr. Ahmadian does not provide opinions regarding this dependent claim for this ground. In its discussion of claim 2, the Petition asserts that the claimed “sidewalls” are shown in the below figure:

Petition at 73; Ex. 1003 at ¶ 88.

125. The Petition also relies on the following image to show the sidewalls, but does not indicate the posts are part of the claimed sidewalls:



Petition at 21, 36. In fact, the posts are shown as being distinct from the sidewalls in the Petition and Dr. Ahmadian's Declaration:



Petition at 74; Ex. 1003 at ¶ 50.

126. The Petition is unclear regarding what it identifies as the sidewalls in the cited asserted art. That ambiguity is carried forward to claim 11. Petition at 73, 74. The '892 Patent states: “[p]osts 82 and 84 extend upwardly from this junction to mate with various elements of the end and side walls, as may be described below.” ’892 Patent at 14:23-26. If the Petition’s analysis of the asserted art is to be interpreted to have the corner posts be a part of the sidewall, then it is impossible for the corner posts to “extend upwardly from said first and second ends respectively to mate with said sidewalls.”

127. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim.

x. Dependent Claim 12 (“The rail road hopper car of claim 2 wherein said main bolster has first and second ends; and first and second corner posts extend upwardly from said first and second ends respectively to mate with said sidewalls.”)

128. Dependent claim 12 includes the same further limitations as dependent claim 11, but depends directly from claim 2 instead of from claims 10, 8, and 2, as does claim 11. Thus, for the reasons discussed in Sections V.D.9. and V.D.8., in my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

E. Ground 1c

129. I understand that the Petition asserts that claim 9 of the '892 Patent would have been obvious over the 1946 Cyclopedia in view of Lindström and Wong.

i. Claim Limitation 9a (“The rail road hopper car of claim 8 wherein said hopper has an end wall extending downward of said end top chord”)

130. Claim limitation 9a adds to the inventions of claims 2 and 8 that “said hopper has an end wall extending downward of said top chord.”

131. The Petition admits that the NSC Ore Cars does not disclose this limitation and relies on Wong to cure this deficiency. In my opinion, a POSITA would not be motivated to include an end wall in the NSC Ore Cars based on Wong.

132. First, Petitioner contends that the NSC Ore Cars could be modified by increasing the overall height of the hopper. However, railcars are based on standardized sizes or profiles, which cannot be exceeded. All railcars are designed to “clearance plates” that are established and enforced by the Association of American Railroads (“AAR”). A POSITA would understand that increasing the height of any railcar is not simply a matter of deciding to do so; there are design constraints that would have to be consulted and adhered to. Railcars are also specifically designed with particular geometries and load capacities in mind. A POSITA would not on a whim and without more simply increase the height of a hopper car like the NSC Ore Cars. This could leave an ore car ineffectual for its intended purpose, for example because it would not be able to carry a full load due

to the increased weight of the car caused by making it taller. Raising the height on a design like that of the 125 year old L&Y Hopper Car as Petitioner proposes, which already had end walls, would have been vastly different than adding end walls and raising the height. Petition at 81; Ex. 1003 at ¶ 69.

133. Petitioner suggest reducing the inclination of the slope sheets so that their outboard ends terminate at a lower height (i.e., lower along the end wall). Again, railcars are specifically designed with geometries and load capacities in mind. Lowering the slope sheet as proposed in the modified image provided in the Petition would have changed load distribution in the railcar. Moreover, it might have lowered the effectiveness of the railcar when dumping its load because the lower angle may not be sufficient to gravity drop all its contents based on the characteristics such as the angle of repose of the intended commodity. A POSITA would also have to address the hydrostatic pressure from the commodity “pushing out” on the hopper walls.

134. For at least these reasons, the asserted art combination proposed by the Petition would not be one of a finite number of well-understood options or a routine design choice. Petition at 80-81; Ex. 1003 at ¶ 69. Instead, the Petition and Dr. Ahmadian are merely engaging in more improper hindsight and picking and choosing pieces of the asserted art in an attempt to meet the claimed invention.

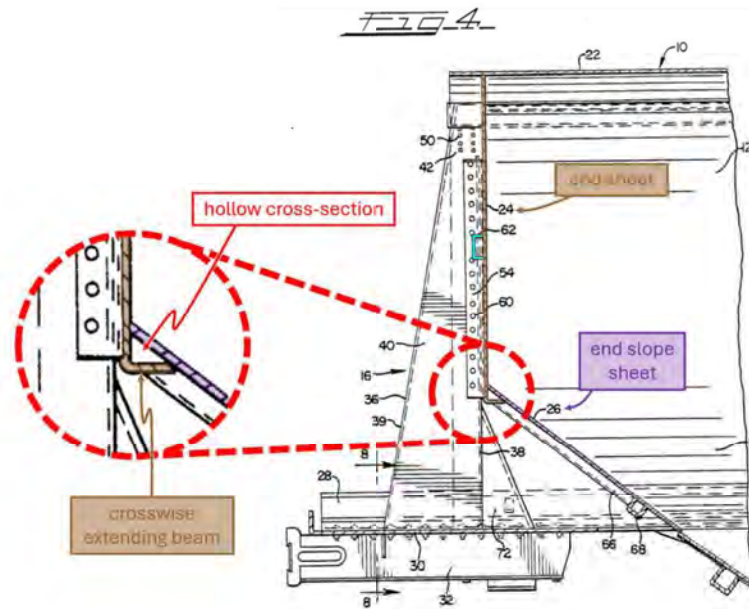
This is shown by the different railcar designs that Petitioner relies on as allegedly showing other railcars with end walls. Petition at 78-80.

135. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

ii. Claim Limitation 9b (“said upper, longitudinally outboard end of said first end slope sheet meets said downwardly extending end wall; and said first cross-wise extending beam is located where said downwardly extending end wall meets said first end slope sheet; and said first cross-wise extending beam is of hollow crosssection.”)

136. As discussed in Section V.D.1., a POSITA would not be motivated to add a first cross-wise beam from Wong to the NSC Ore Cars.

137. Additionally, the placement of the first cross-wise beam as suggested by Petitioner is another use of improper hindsight. Petitioner and Dr. Ahmadian do not state or suggest why, for example, aluminum channel stiffener member 62 is not incorporated from Wong into the NSC Ore Cars.



Ex. 1003 at ¶ 70 (modified to highlight beam 62); Petition at 83.

138. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

F. Ground 1d

139. I understand that the Petition asserts that claim 15 of the '892 Patent would have been obvious over the 1946 Cyclopedia in view of Lindström, optionally Wong, and Coates.

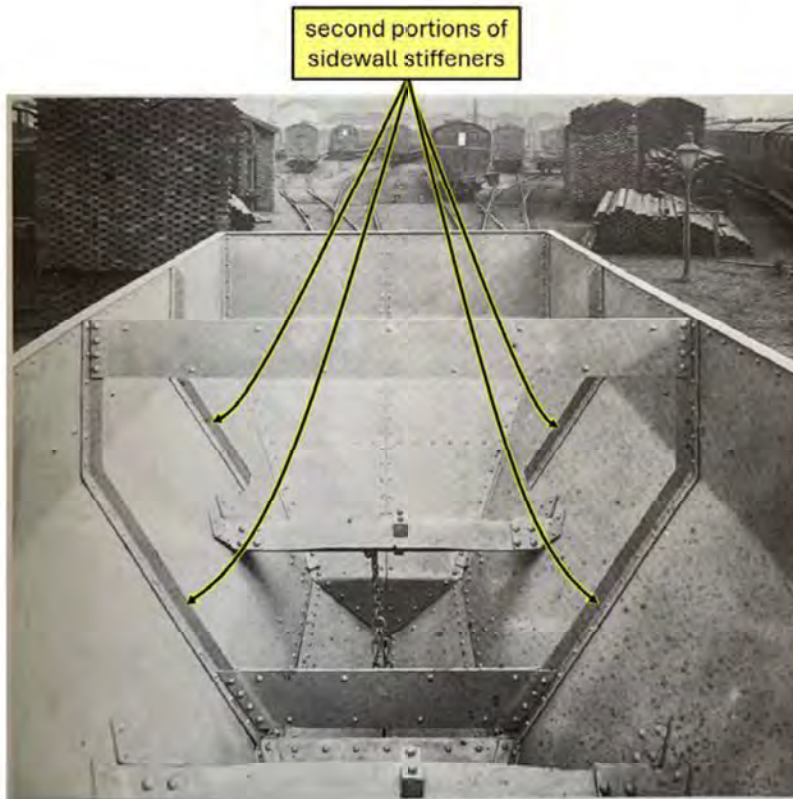
140. Notably, this ground does not include any discussion of what features would optionally be added by Wong because it states only that “[f]or the reasons discussed in connection with Claim 3, the NSC Ore Cars, as modified by

Lindström, discloses all aspects of Claim 15 except the requirement that the sidewall stiffener be made of flat bar.”

- i. Dependent Claim 15: “The rail road hopper car of claim 2 wherein said first and second portions of said sidewall stiffener are made of flat bar, are positioned in vertical-transverse planes, are substantially co-planar, and are substantially vertically aligned when seen in a sectional view looking along the car.”**

141. I have not found any reasoning in the Petition or Dr. Ahmadian’s declaration that explains why Coates’ discussion of the L&Y Hopper Car teaches “flat bar.” Instead, they merely conclude that flat bar is taught or suggested. A POSITA in the relevant time frame would not consider the triangular plates to be made from “flat bar” as the gussets are made from either sheet or plate. The stiffeners on the inside of the car hopper are likely formed “L” sections, not flat bar somehow manipulated into an “L” section. A POSITA would not agree with Petitioner’s or Dr. Ahmadian’s interpretation of these structural elements.

142. Moreover, it is not clear that a POSITA would modify the 1946 Cyclopedia in view of Lindström and optionally Wong with Coates.



143. It is not clear, and would not be clear to a POSITA in the relevant time frame, that the photos of the L&Y car show the use of flat bar as the Petitioner and Dr. Ahmadian claim.

144. Neither the Petition nor Dr. Ahmadian supplies any analysis, drawings, connection details, or load calculations to show that a flat bar could be dropped in the NSC Ore Car or Lindström framework without undermining the web-continuity and co-planarity/vertical-alignment features it simultaneously relies on.

145. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

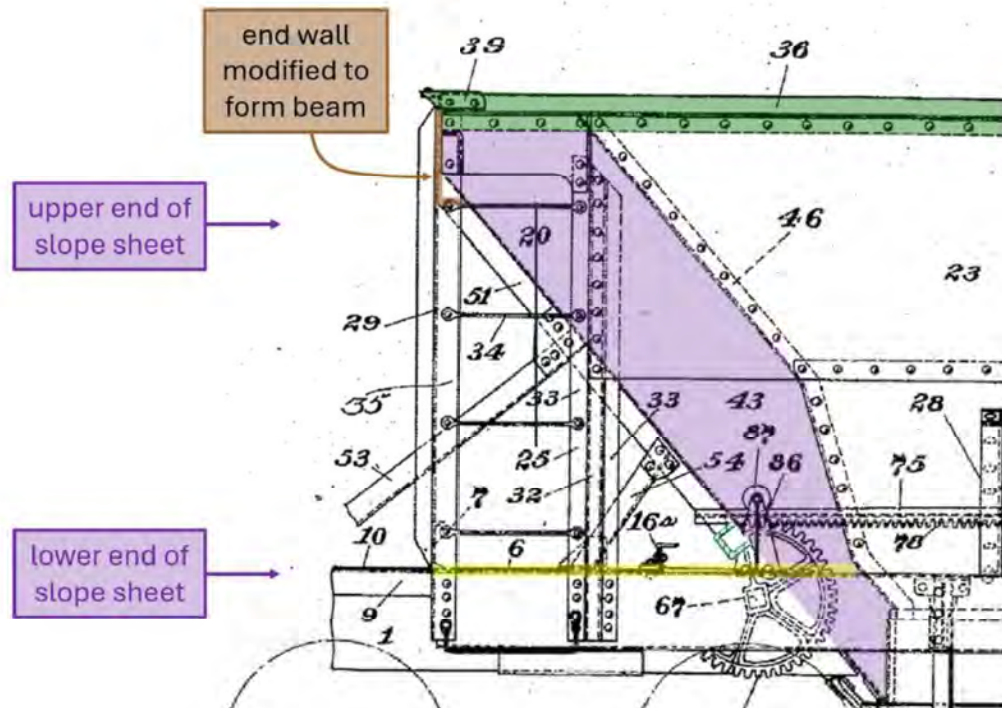
H. Ground 2b

146. I understand that the Petition asserts that claims 2-14 would have been obvious over Lindström in view of the NSC Ore Cars and Wong.

i. Claim Limitation 2i (“said upper, longitudinally outboard end of said first end slope sheet being reinforced by a first cross-wise extending beam.”)

147. Petitioner and Dr. Ahmadian cite their discussion in Ground 1b as providing support to combine the asserted art to provide “said upper, longitudinally outboard end of said first end slope sheet being reinforced by a first cross-wise extending beam.” Petition at 106-07; Ex. 1003 at ¶ 78. The same arguments that refute this combination in Section 63 also apply here.

148. In addition, a POSITA would not have “slightly lengthened and bent” Lindström’s end wall based on Wong as proposed by the Petition. Petition at 106-07; Ex. 1003 at ¶ 78. It is not clear how this would have been accomplished given that outwardly extending stiffening flanges 51 appear to be directly in the way of the proposed modification:



Petition at 107. Moreover, simply bending the end of the end wall is not enough to meet the claim limitation. A POSITA would need to have a way to fasten this new detail to the slope sheet. Putting a C-channel or similar bend detail into the bottom of the end wall could make it challenging or even impossible to properly fasten it to the slope sheet. Petitioner and Dr. Ahmadian need to consider more than just whether a member such as the end wall can be shaped differently at one edge.

149. Wong addresses a steel end structure joined to an aluminum car-body, and the L-shaped detail there is part of a sheet-to-sheet joint used for lading containment, and perhaps to align and hold the edge of the end slope sheet 26 in contact with the lower-most part of the end sheet 24, not a separate reinforcement

beam added to strengthen the slope sheet. Indeed, a POSITA would have understood Wong to teach against using the L-shaped detail for reinforcement or support, particularly because Wong includes a plurality of aluminum channel stiffener members 66 connected to the end slope sheets for this purpose. Ex. 1004, 4:50-56. A POSITA would not equate Wong's L-shaped detail with the '892 Patent's reinforcing member; the purposes and problems addressed differ.

150. The Petition's proposed "slight lengthening and bending" of Lindström's end wall to emulate Wong's cross-member runs head-on into Lindström's existing structure, including outwardly extending stiffening flanges (51) that occupy the very space where Petitioner wants to insert the new beam. Simply "bending" Lindström's end wall is not enough, a POSITA would still need a viable fastening path to the slope sheet, which the Petition and Dr. Ahmadian do not supply.

151. A POSITA would not have had any reasonable basis to modify Lindström's end structure in this particular way, particularly given potential trade-offs, such as changed load paths, potential new fastening details, and modified end-wall integrity that a POSITA would have needed to address to achieve a functioning assembly.

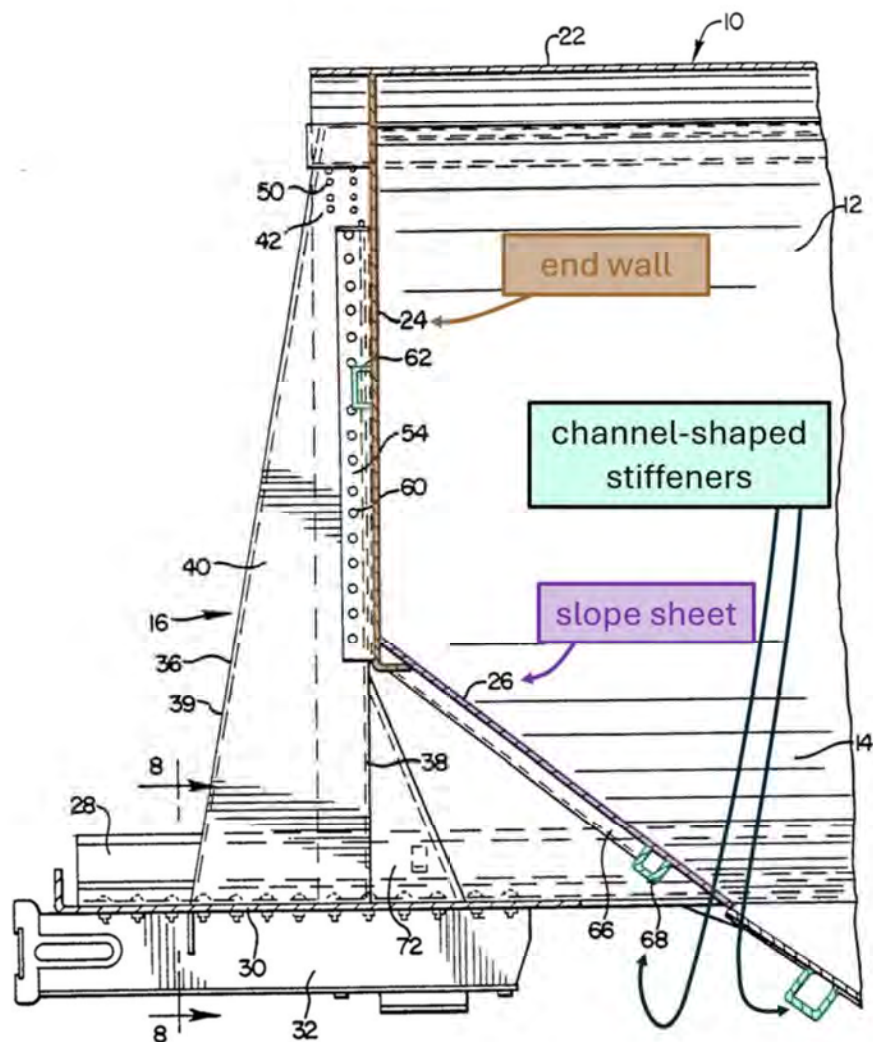
152. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

ii. Claim Limitation 2j (“said lower, longitudinally inboard end of said first end slope sheet being reinforced by a second cross-wise extending beam”)

153. Petitioner and Dr. Ahmadian cites their discussion in Ground 1b as providing support to combine the asserted art to provide “said lower, longitudinally inboard end of said first end slope sheet being reinforced by a second cross-wise extending beam.” However, the Petition does not make an argument regarding adding a lower, longitudinally inboard end of said first end slope sheet being reinforced by a second cross-wise extending beam from Wong in Ground 1b. Petition at 54-55; Ex. 1003 at ¶ 57. Moreover, the citation Petitioner uses to Section IV.B.1.i appears to be unrelated to his limitation.

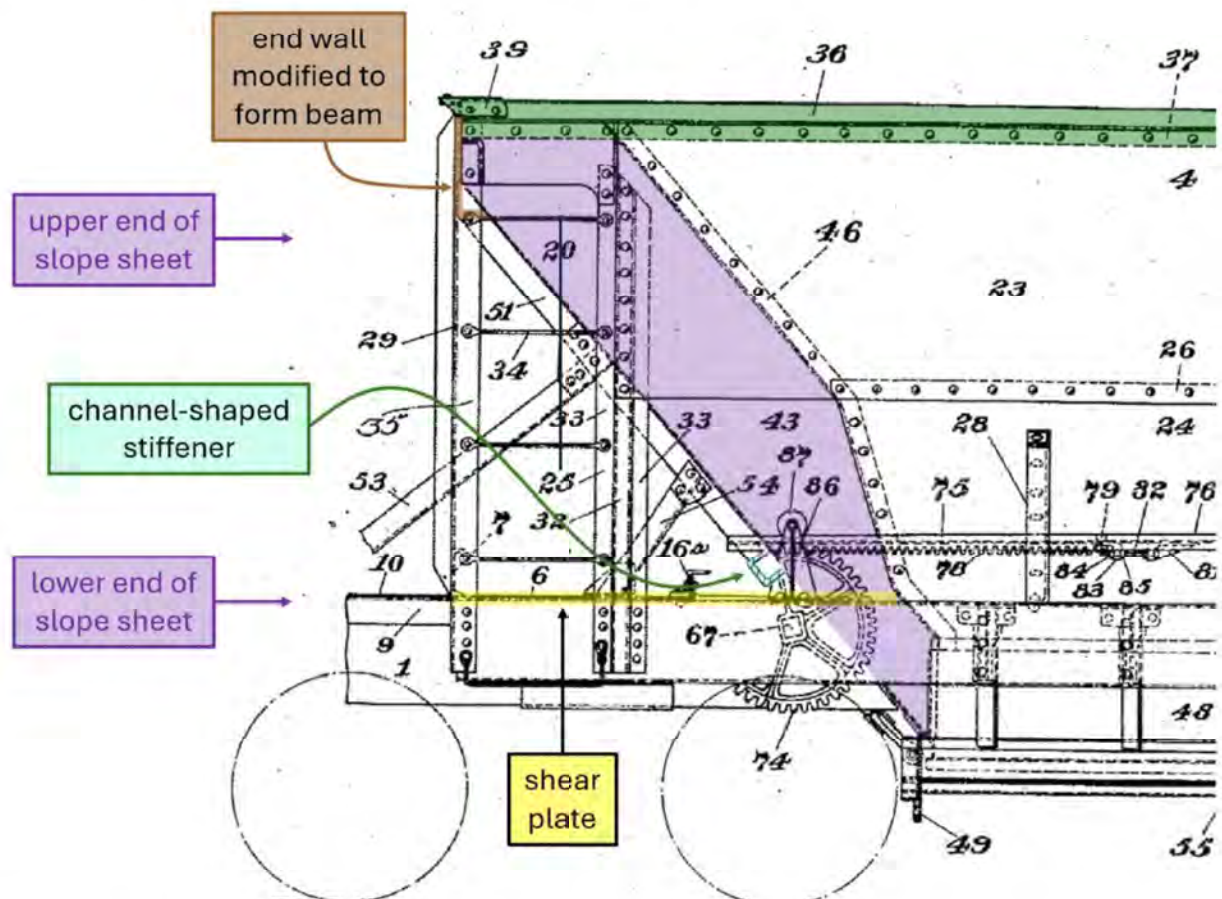
154. To the extent Petitioner is incorporating its arguments as to why to add any beam from Wong to Lindström or the NSC Ore Cars, this only further highlights the improper hindsight basis for Petitioner’s arguments. For the same reasons why a POSITA would not have added a first cross-wise extending beam at the upper, longitudinally outboard end of said first end slope sheet in the NSC Ore Cars or Lindström, a POSITA would not have added the second cross-wise

extending beam proposed by the Petition. Moreover, it is likely that there would be interference for this proposed second cross-wise extending beam provided by stiffening member 51 in Lindström.



Petition at 108. However, only one of these channel-shaped stiffeners, with reference number 68, is on “said lower, longitudinally inboard end of said first end slope sheet” as required by the claim. Petitioner and Dr. Ahmadian provide no support for their cherry-picking of features from the asserted art improperly using the claims as a road map to try to invalidate the claims.

156. Moreover, the Petition and Dr. Ahmadian fail to consider the impact that adding a beam in the location it chose on Lindstrom:



Petition at 109. Moreover, it is entirely in the location of outwardly extending stiffening flanges 51 and would likely destroy the structural integrity of

Lindström's slope sheet. Further, it is hovering in the air, and thus would not have provided any benefit to transferring forces to the undercarriage.

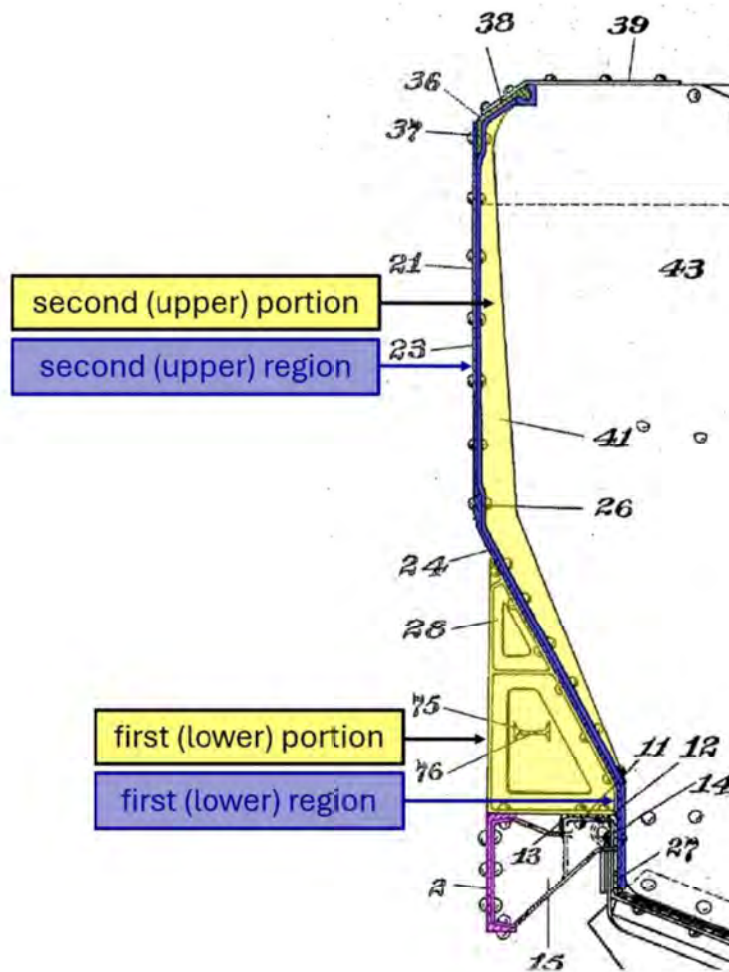
157. Thus, not only is impermissible hindsight being used, but the proposed combination of the asserted art would have rendered it unsatisfactory for its intended purpose.

158. For similar reasons why a POSITA would not have added a first cross-wise extending beam at the upper, longitudinally outboard end of said first end slope sheet in the NSC Ore Cars or Lindström, a POSITA would not have added the second cross-wise extending beam proposed by the Petition.

159. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

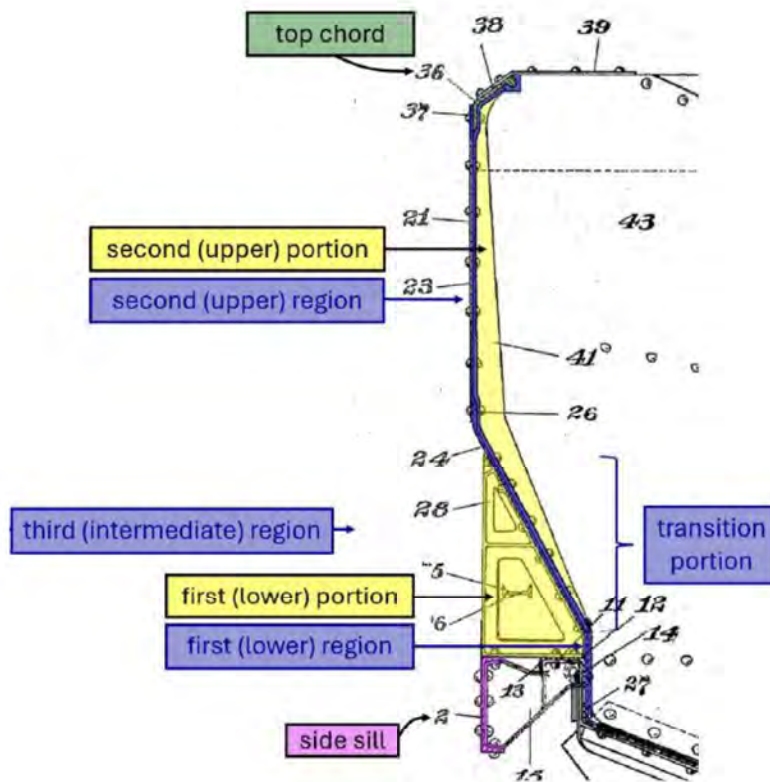
iii. Claim Limitation 2r (“said sidewall stiffener having a first portion, said first portion being a lower portion thereof, said first portion being mounted to said first region of said first upstanding sidewall; said sidewall stiffener having a second portion, said second portion being an upper portion thereof, said second portion being mounted to said second region of said first upstanding sidewall;”

160. Petitioner and Dr. Ahmadian contend the following image allegedly shows the sidewall stiffener mounted to the first (lower) region:



**Lindström
Fig. 5**

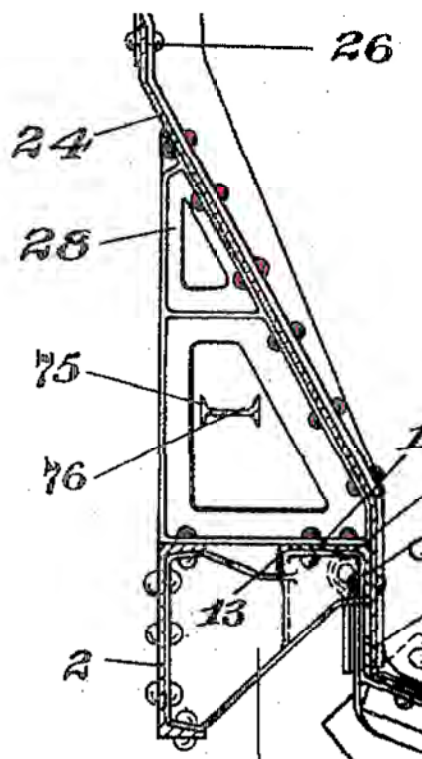
Petition at 95 (modified to make image smaller); Ex. 1003 at ¶ 74. As is made clear by Petitioner’s discussion of claim 4, the first (lower) region is the vertical portion of the sidewall, and not the diagonal transition portion:



**Lindström
Fig. 5**

Petition at 116.

161. Lindström's first portion of the sidewall stiffener is bolted or riveted to the inclined transition portion, not the first region of the sidewall, as required by this claim:



162. Lindstrom Fig. 4 (portion, highlight added). Notably, it appears from the available renderings that none of the bolts or rivets mount the first portion to the first region, and neither the Petition nor Dr. Ahmadian’s declaration address this issue. Petition at 95-96; Ex. 1003 at ¶ 74. Thus, the identified first portion of the sidewall stiffener is not mounted to the first region of the sidewall.

163. The Petition either treats the transition area itself as part of the “upper region” or relies on the same ambiguous annotations used elsewhere, never tying the upper portion of the stiffener to the second region as opposed to the transition. That is fatal to what is claimed in limitation 2r, which demands two-region mounting.

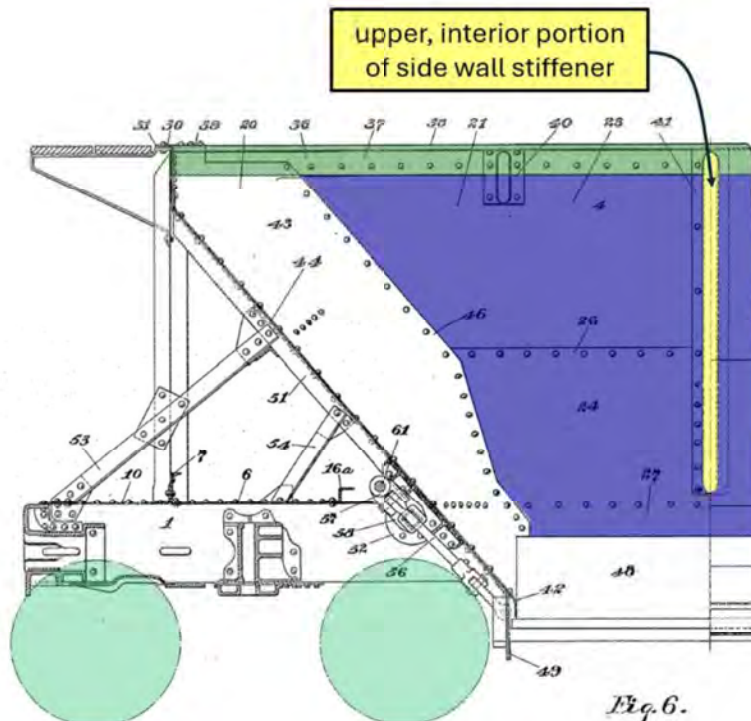
164. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

165. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

iv. Claim Limitation 2s (“said first portion of said first upstanding sidewall stiffener being laterally outboard of said first region of said first upstanding sidewall; said second portion of said sidewall stiffener being laterally inboard of said second region of said first upstanding sidewall;”)

166. Petitioner relies on its discussion of limitation 1h for this claim limitation, and adds no further analysis. Dr. Ahmadian provides no opinions regarding this limitation.

167. Petitioner’s argument for this limitation consists of two sentences: “[i]n the preceding illustration, ‘inboard’ is to the right and ‘outboard’ is to the left. Accordingly, Lindström discloses this limitation, as shown above.” Petition at 97. However, there is no preceding illustration in the discussion of this limitation in the Petition. The preceding illustration on page 96 for limitation 1g shows the following:



Petition at 96. It is unclear how “inboard” is to the right and “outboard” is to the left” in the above illustration. A POSITA would not have understood from the above illustration how this claim limitation is met by Lindström, much less the proposed combination of the NSC Ore Cars in view of Lindström, or Lindström in view of the NSC Ore Cars.

168. Petitioner's own figures do not define (or hold constant) what it calls the "first region" (vertical lower sidewall) and the "second region" (upper sidewall). Instead, it slides those baselines so that the same inclined transition surface sometimes counts as part of a "region," other times as the "transition," which breaks the logic of 2s: the lateral (inboard/outboard) positions must be relative to the regions, not to a shifting transition surface.

169. A POSITA would have understood limitation 2s to require that the lower portion be laterally outboard of the first region and the upper portion be laterally inboard of the second region. The Petition does not provide a dimensioned rendering (e.g., section views, offsets, or centerline references) demonstrating those relative lateral positions in the Lindström geometry.

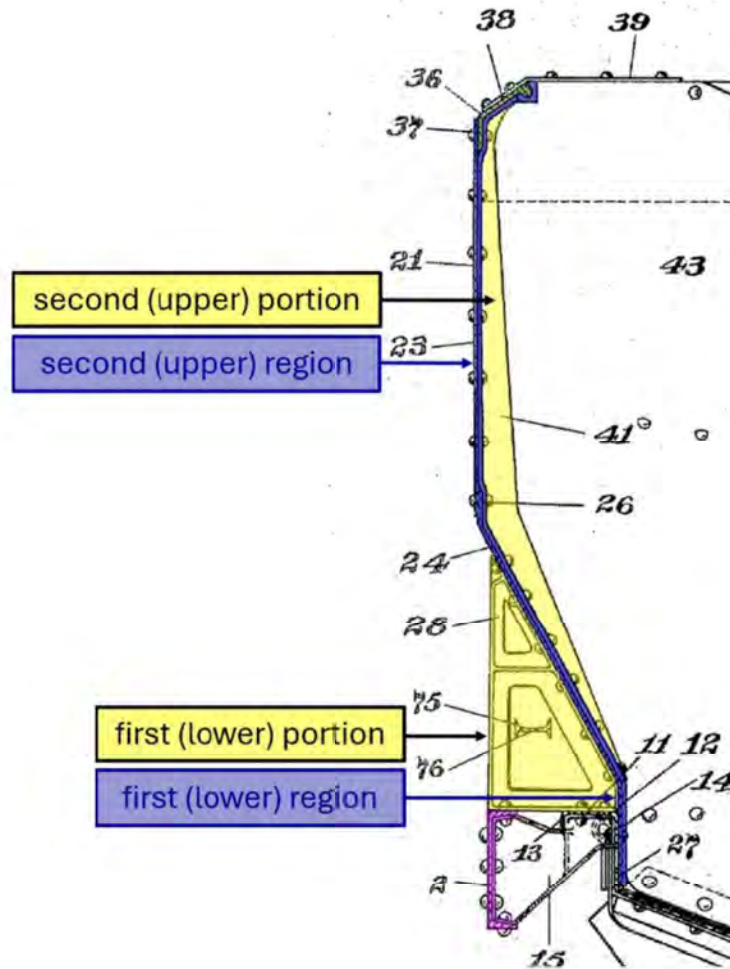
170. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

v. Claim Limitation 2u (“said sidewall stiffener having web continuity between said first and second portions thereof”)

171. Petitioner relies on its discussion of limitation 1j for this claim limitation, and adds no further analysis. Dr. Ahmadian provides no opinions regarding this limitation. In addition to the reasons discussed in Section V.D.3. above, the asserted art does not teach or render obvious these claimed features for the following reasons.

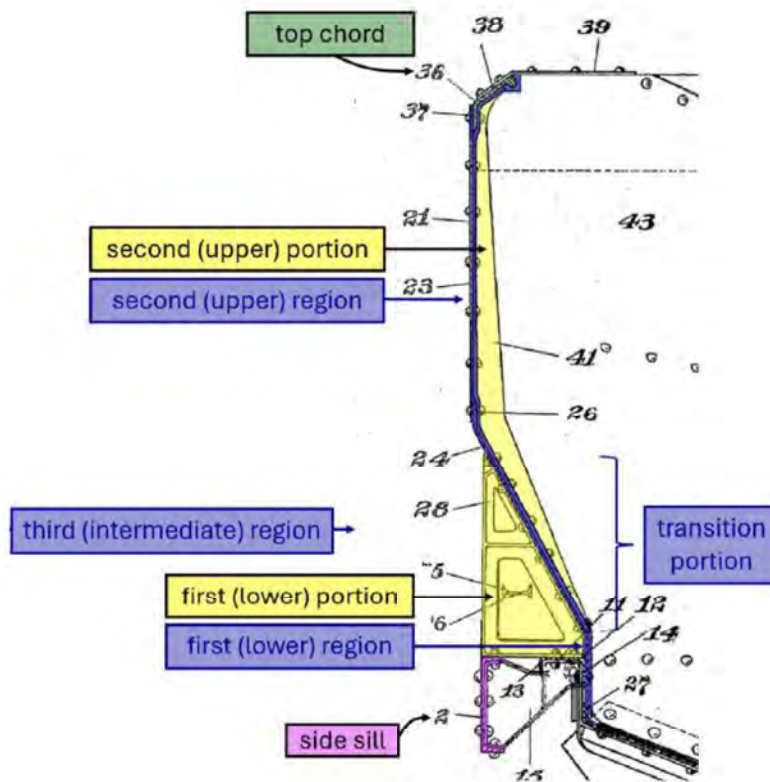
172. The Petition and Dr. Ahmadian fail to establish that this claimed feature is taught by Lindström or the NSC Ore Cars.

173. Petitioner and Dr. Ahmadian contend the following image allegedly shows the sidewall stiffener mounted to the first (lower) region:



**Lindström
Fig. 5**

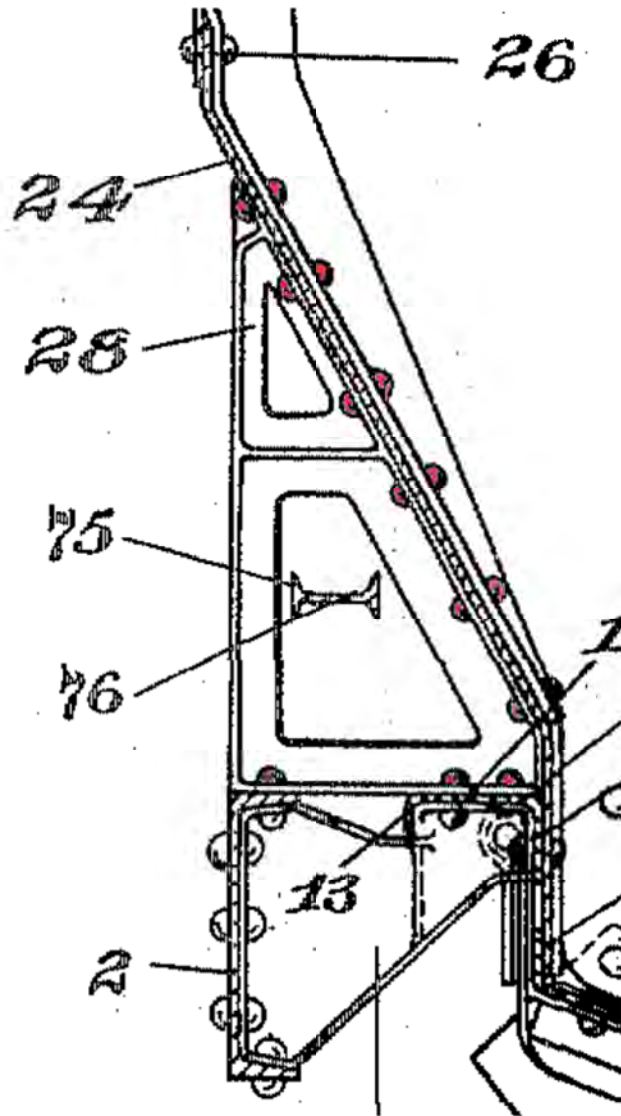
Petition at 95 (modified to make image smaller); Ex. 1003 at ¶ 74. As is made clear by Petitioner’s discussion of claim 4, and the below figure, the first (lower) region is the vertical portion of the sidewall, and not the diagonal transition portion:



**Lindström
Fig. 5**

Petition at 116.

174. Lindström's first portion of the sidewall stiffener is bolted or riveted to the inclined transition portion, not the first region of the sidewall, as required by this claim:



Lindstrom Fig. 4 (portion, highlight added). Notably, it appears from the available renderings that none of the bolts or rivets mount the first portion to the first region, and neither the Petition nor Dr. Ahmadian's declaration address this issue. Petition at 95-96; Ex. 1003 at ¶ 74. Thus, the identified first portion of the sidewall stiffener is not mounted to the first region of the sidewall.

175. The Petition and Dr. Ahmadian never identify a web that is continuous from the first portion through to the second portion as required; instead, they relabel ordinary attachments or planes as a “web.”

176. A POSITA would not have found it obvious to re-engineer the NSC Ore Cars, Lindstrom, and/or Wong as proposed by the Petition to create a unified web spanning the two stiffener portions (and through the transition), with the side sheet serving in a general sense as the flange. The proposed Wong additions are joint details for steel/aluminum interfaces (galvanic isolation, sheet joining), not disclosures of a continuous stiffener web. Wong is not about web continuity in hopper side stiffeners and does not provide a teaching or motivation to convert the disparate pieces in Lindström/NSC Ore Cars into a continuous-web section.

177. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

- vi. Claim 5 (“The rail road hopper car of claim 4 wherein said first sidewall has an overall height from said first side sill to said first top chord, L, and said transition portion is located a distance above said first side sill that is in the range of $\frac{1}{4}$ to $\frac{2}{3}$ L.”)**

178. I understand that patent drawings are not to be relied on as being to scale unless otherwise indicated in the specification. There is no such indication in Lindström. Petitioner and Dr. Ahmadian err in adopting dimensions from Lindström as if it was to scale.

179. Moreover, Dr. Ahmadian states:

It would have been obvious to select dimensions consistent with the Lindström’s drawings and with the NSC ore car for the additional reason that the precise dimensions are a matter of design choice. A POSITA would know to modify the angle of the transversely angled portion of the side sheet—thereby modifying the location of the transition portion—based on design constraints that are standard and well-understood, including maximizing hopper capacity, supporting the loads within the hopper including those seen at the slope sheet and hopper doors, and maximizing the car’s efficiency in loading and discharging its intended lading. Selecting elements that efficiently carry the loads from the longitudinal beam at the top of the hopper car to the still, aligning them co-

planarly, spacing them properly, connecting various elements to reduce stress concentration, supporting the weights on bolsters, etc. are all examples of engineering practices for maximizing capacity and efficiency. A POISTA would be aware of such practices.

Ex. 1003 at ¶ 82.

180. I disagree. A POSITA would not make wholesale modifications to a railcar to obtain the claimed dimensions. Dr. Ahmadian fails to explain how having the claimed dimensions maximizes the design constrains he discusses, or even establish that Lindström's sloped sheets are at different angles than the NSC Ore Cars'. Instead, this is an improper use of hindsight by Dr. Ahmadian and Petitioner.

181. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

vii. Claim Limitation 6b (“said hopper includes first and second sloped side sheets; and said first sloped side sheet meets said first sidewall at said transition portion.”)

182. Petitioner and Dr. Ahmadian are applying a different claim construction for this claim limitation in this ground than it did in Ground 1b. *See* Section V.D.6. Petitioner does not address which of these two constructions is the

plain and ordinary meaning that a POSITA would understand. As discussed above with respect to this claim limitation in Ground 1b, a POSITA would understand that a sloped side sheet would be a separate feature from the claimed side wall. *See* Section V.D.6. However, under Petitioner and Dr. Ahmadian’s interpretation, the claimed “sloped side sheet” is the same as the claimed “transition portion.” This interpretation would not be understood by a POSITA because the claimed “first sloped side sheet” cannot “meet” the “first sidewall at said transition portion” – because they are one and the same.

183. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

viii. Claim 7 (“The rail road hopper car of claim 6 wherein said first sidewall has an overall height from said first side sill to said first top chord, L, and said first sloped side sheet meets said transition portion at an height that is in the range of $\frac{1}{4}$ to $\frac{2}{3}$ L above said first side sill.”)

184. Petitioner argues that Lindström discloses this limitation for the same reasons as in Claim 5. Dr. Ahmadian does not address this claim limitation. As discussed above in Sections V.D.6., the Petition uses the wrong definition of sloped side sheet in claim 6. Under Petitioner’s proposed construction, the sloped

side sheet and the transition portion are one and the same and cannot “meet” each other. *See* Section V.D.6.

185. Petitioner (and Dr. Ahmadian) simply re-uses the Claim 5 analysis to address Claim 7 and does not perform a measurement to the meeting point between a sloped side sheet and the transition. That is technically incorrect since claim 5 concerns where the transition is located, while claim 7 concerns where the sheet–transition meeting occurs. Petitioner never provides that interface-specific measurement. Worse still, the Petition’s own annotated imagery places the supposed “meeting” at a much lower location than the red-line measurement it uses for claim 5, plainly outside the $\frac{1}{4}$ – $\frac{2}{3}$ L window it asserts.

186. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

ix. Claim Limitation 8b (“and an end post extends from said draft sill to said end top chord, said end post being mounted above said draft sill between said truck center and said striker.”)

187. The Petition and Dr. Ahmadian effectively admit that Lindström does not have the claimed “end post.” The Petitioner and Dr. Ahmadian assert that modifying Lindström with the NSC Ore Cars cures this deficiency.

188. Lindström does not have an end post, as the Petition admits. The Petitioner contends that modifying Lindström with the NSC Ore Cars cure this deficiency. However, this is just another instance of improperly using the claims as a roadmap to attempt to invalidate the claims.

189. Instead, it appears that Petitioner and Dr. Ahmadian are using the claims as a check list to be filled with individual disclosure from disperse pieces of prior art, and are identifying post-hoc justifications for their proposed combinations. But this is pure hindsight, and not how a POSITA would view the prior art.

190. The Petition's annotated snippets never establish a continuous structural path that originates at the draft sill and terminates at the end top chord. The lower end is shown only in proximity to the sill, not from it, and the upper end is not shown connected to the chord (as opposed to a gusset or web below it).

191. The Petition's earlier figures sometimes include the corner/end posts within the blue-outlined "sidewalls," and elsewhere treat those same verticals as distinct posts. That inconsistency makes it unclear when the post is counted as part of the sidewall. The Petition's simultaneous treatment of this element as both a separate member that extends to (and mates with) the end top chord above the sill and in the specified window is intrinsically inconsistent.

192. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

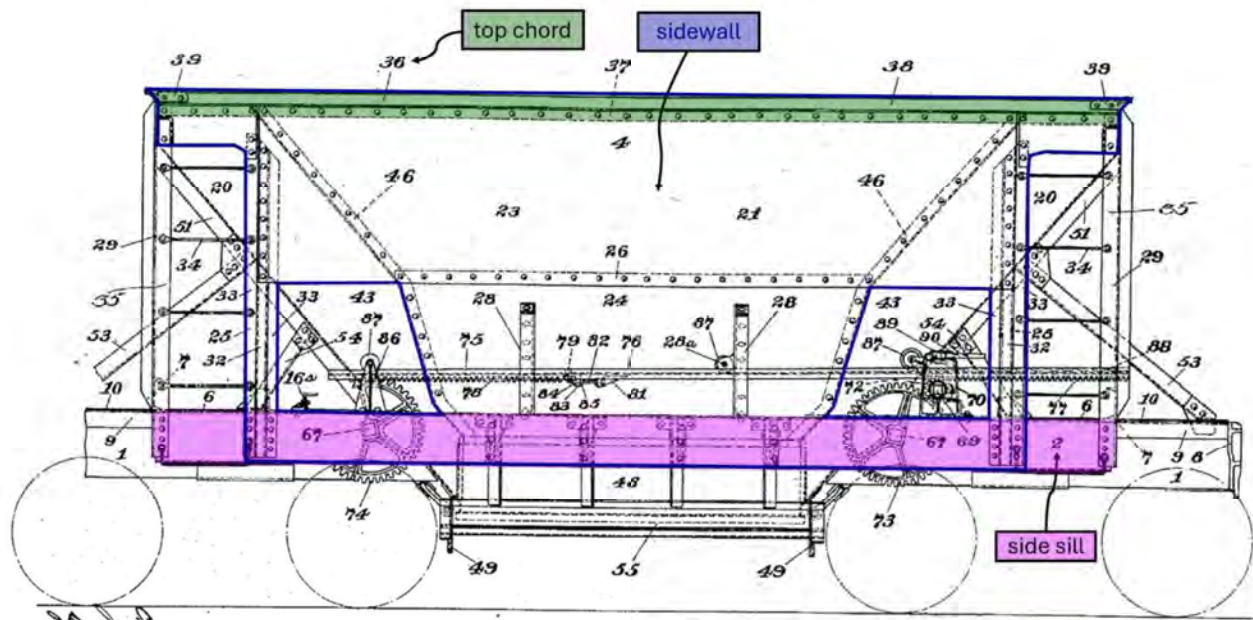
x. Claim Limitation 9b (“said upper, longitudinally outboard end of said first end slope sheet meets said downwardly extending end wall; and said first cross-wise extending beam is located where said downwardly extending end wall meets said first end slope sheet; and said first cross-wise extending beam is of hollow crosssection.”)

193. For the reasons provided in Sections V.E. and V.G.1., a POSITA would not be motivated to make this combination, which is driven by hindsight analysis by Petitioner and Dr. Ahmadian. Petition at 125-27; Ex. 1003 at ¶ 87.

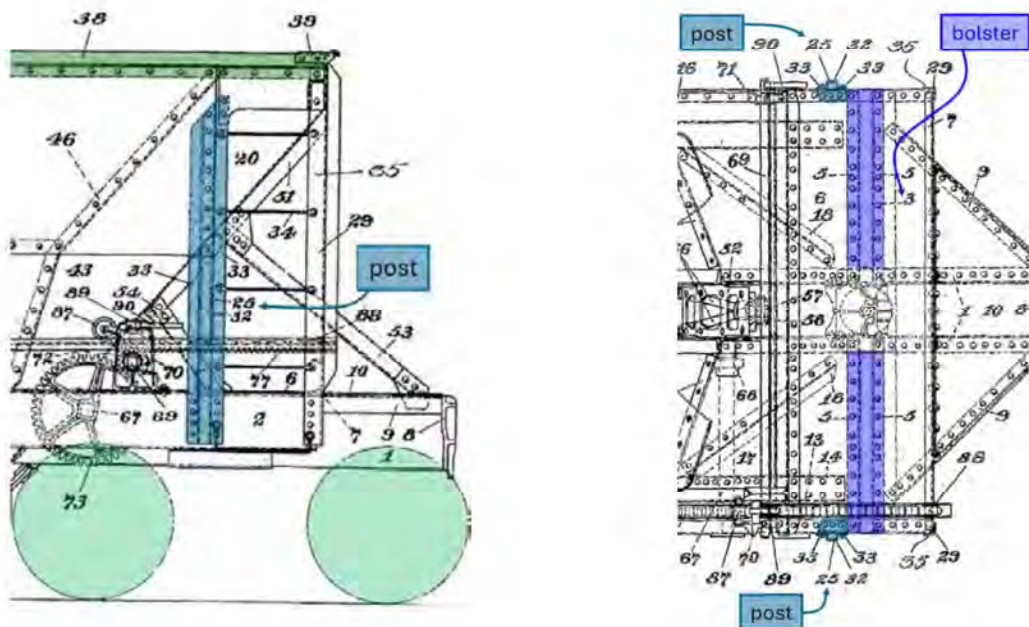
194. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

xi. Claim 11 (“The rail road hopper car of claim 10 wherein said main bolster has first and second ends; and first and second corner posts extend upwardly from said first and second ends respectively to mate with said sidewalls.”)

195. The Petition, in its discussion of claim 2, asserts that the claimed “sidewalls” are shown in the below figure.



Petition at 90. This identification includes the two posts towards the sides of the railcar:



Petition at 128-129; Ex. 1003 at ¶ 88.

196. If the Petition is interpreted to have the identified corner posts be a part of the sidewall, it is impossible for the corner posts to “extend upwardly from said first and second ends respectively to mate with said sidewalls.”

197. In my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

xii. Claim 12 (“The rail road hopper car of claim 2 wherein said main bolster has first and second ends; and first and second corner posts extend upwardly from said first and second ends respectively to mate with said sidewalls.”)

198. Dependent claim 12 includes the same limitations as dependent claim 11 but depends directly on claim 2 instead of claim 10, which also depends on claim 2 indirectly through claim 8. Thus, for the reasons discussed in Section xi, in my opinion, the Petitioner and Dr. Ahmadian have not shown that the asserted art teaches, explicitly or inherently, or would have rendered obvious to a POSITA this claim limitation.

I. Ground 2c

199. I understand that the Petition asserts that claim 15 would have been obvious over Lindström in view of the 1946 Cyclopedia, Wong, and Coates. The Petition fails to establish a reasonable likelihood that the asserted art would have

rendered obvious claim 2 as discussed above, much less dependent claim 15 which includes further patentable subject matter. For example, each and every limitation of claim 2, from which claim 15 depends, is not taught or suggested by the asserted art. *See* Section A.a.H.

200. For at least these reasons, the Petition does not establish a reasonable likelihood of prevailing on Ground 2c and institution on this ground should be denied.

Executed in Chicago, Illinois on March 13, 2026.

A handwritten signature in black ink, appearing to read 'Mark J. Viz', with a long horizontal flourish extending to the right.

Mark J. Viz, Ph.D., P.E.



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Professional Profile

Dr. Viz specializes in performance evaluation and mechanical analysis of railcar and aircraft structures. He also specializes in risk, reliability, and mechanical integrity assessments of a variety of process plant equipment such as pressure vessels and tanks, and certain types of transportation vessels including railcar tanks, intermodal vehicles, and over-the-road tank trailers.

Dr. Viz also has experience in component life reliability assessments, “repair or replace” risk decisions, and statistical analysis of in-service component performance. Other areas of Dr. Viz’s specific academic expertise include nonlinear finite element analysis, metal and composite material testing, fatigue and fracture mechanics, and statistical data reduction methods. He has investigated and/or consulted in matters involving railcar derailments, tank car ruptures, releases of hazardous materials in transportation, coal mining haulage accidents, rotor failures, bus rollovers, pressure vessel explosions, and other industrial accidents.

Given his expertise in engineering mechanics, Dr. Viz also performs engineering evaluations and analyses involving the mechanical performance of a variety of machines and products. Some of these devices include elements of cranes and lifting devices (e.g., wire rope failures, hydraulic and valve failures), elements of elevators, a variety of industrial machines (e.g., printing equipment, CNC machine tools, pumps, compressors), certain aspects of machine guarding and lock-out/tag-out procedures, and specialized evaluations of consumer products. Dr. Viz’s involvement in these types of cases typically involves the synthesis and execution of a variety of engineering mechanics calculations and analyses.

Prior to joining Exponent, Dr. Viz was a Product Development Engineer at the GATX Rail Corporation. His responsibilities included new rail car design and development, budget and schedule management, and sales and marketing support. Dr. Viz was also heavily involved in the regulatory environment concerning the transportation of hazardous materials in rail tank cars. Dr. Viz also served as a Specialist Engineer in the Structural Damage Technology group at the Boeing Company. He was responsible for the durability and damage tolerance analysis and testing of a wide variety of aircraft structures from wing and fuselage sections to individual fasteners. He has also taught probability, statistics, and mechanics of materials at the college level.

Academic Credentials & Professional Honors

Ph.D., Theoretical and Applied Mechanics, Cornell University, 1996

B.S., Aeronautics and Astronautics, Massachusetts Institute of Technology (MIT), 1990

Licenses and Certifications

Professional Engineer, Illinois, #62062247

Respirator and SCBA fit-tested and trained

Mining Safety and Health Administration (MSHA) Part 46 and Part 48 trained

Prior Experience

Director of Applied Mechanics, Packer Engineering, 2001-2003

Product Development Engineer, GATX Rail, 1999-2001

Specialist Engineer - Structural Damage Tolerance, Boeing, 1997-1999

Professional Affiliations

American Society of Mechanical Engineers—ASME (member)

American Institute of Aeronautics and Astronautics—AIAA (member)

Society for Risk Analysis—SRA (member)

Publications

Viz MJ. Failure analysis in the design cycle. Presented as a guest lecture for CIV-ENG 395-0 Engineering Forensics course, Evanston, IL, April 16, 2008.

Viz MJ, Mornsen RH. Reliability and risk management of railcar truck castings in high mileage, high gross rail load service: A case study. Presented at the Annual Meeting of the Society for Risk Analysis, Baltimore, MD, December 5, 2006.

Morrison III DR, Ogle RA, Viz MJ, Carpenter AR, Su YS. Investigating chemical process accidents: Examples of good practices. Process Safety Progress 2006; 25:71-77, March.

Ogle RA, Morrison III DR, Viz MJ. Emergency response to a non-collision HAZMAT release from a railcar. Process Safety Progress 2005; 24:81-85, June.

Morrison III DR, Ogle RA, Viz MJ, Carpenter AR, Su YS. Investigating chemical process accidents: Examples of good practices. Presented at the Process Plant Safety Symposium, 2005 Spring National Meeting, American Institute of Chemical Engineers, Atlanta, GA, April 11-13, 2005.

Zehnder AT, Viz MJ. Fracture mechanics of thin plates and shells under combined membrane, bending, and twisting loads. Applied Mechanics Reviews 2005; 58:37-48, January.

Ogle RA, Viz MJ, Morrison III DR, Carpenter AR. Bulk transportation of hazardous materials by rail: Lessons learned from non-collision accidents. Presented at the 2004 Annual Symposium, Mary Kay O'Connor Process Safety Center, Texas A&M University, College Station, TX, October 2004.

Ogle RA, Morrison III DR, Viz MJ. Emergency response to a non-collision HAZMAT release from a railcar. Presented at the 19th Annual CCPS International Conference, Emergency Planning: Preparedness, Prevention and Response, American Institute of Chemical Engineers, Orlando, FL, June 2004.

Ogle RA, Viz MJ, Carpenter AR. Lessons learned from HAZMAT accident investigations. Presented at the 17th Annual AAR/BOE Hazardous Materials Seminar, Association of American Railroads/Bureau of

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Explosives, Houston, TX, May 2004.

Zehnder AT, Potdar YK, Viz MJ. Fatigue fracture in plates in tension and out-of-plane shear. *Fatigue and Fracture of Engineering Materials and Structures* 2000; 23:403-415.

Viz MJ. Fatigue fracture of 2024-T3 aluminum plates under in-plane symmetric and out-of-plane anti-symmetric mixed-mode deformations. Ph.D. Dissertation, Cornell University, 1996.

Potyondy DO, Viz MJ, Zehnder AT, Rankin CC, Riks E. Computation of membrane and bending stress intensity factors for thin cracked plates. *International Journal of Fracture* 1995; 72:21-38.

Viz MJ, Zehnder AT, Bamford JD. Fatigue fracture of thin plates under tensile and transverse shear stresses. *Fracture Mechanics*, 26th Volume. ASTM STP 1256, Reuter WG, Underwood JH, and Newman JC (eds), American Society for Testing and Materials, pp. 631-651, 1995.

Viz MJ, Zehnder AT. Fatigue crack growth in 2024-T3 aluminum under tensile and transverse shear stresses. *Proceedings, FAA/NASA International Symposium on Advanced Structural Integrity Methods for Airframe Durability and Damage Tolerance*. NASA CP-3271, pp. 891-910, 1992

Viz MJ, Zehnder AT, Ingraffea AR. Fatigue fracture in thin plates subjected to tensile and shearing loads: Crack tip fields, J integral and preliminary experimental results. *Proceedings, 7th International Congress on Experimental Mechanics*, Society of Experimental Mechanics; 1992: 44-50.

Project Experience

Directed, managed, and performed numerous rail tank car failure cause and origin investigations, most involving the release of hazardous materials. Projects typically involve extensive field investigations, including confined space entry of tank cars, mechanical and metallurgical analysis, mechanical integrity assessments, non-destructive examination, and sample collection.

Managed and performed numerous rail tank car loading and unloading incident investigations, often involving worker injuries or fatalities.

Investigated the unintentional uncoupling of mining service cars in a Virginia underground coal mine. The uncoupling resulted in a runaway car situation that led to the fatalities of two miners. Project work included incident modeling and reconstruction, performance calculations, and inspections.

Actively directing a lengthy study involving the investigation of railroad track ballast fouling and coal dust mitigation evaluations for coal transport out of the Powder River Basin in Wyoming. Project work includes measurement of fugitive dust emissions, static and dynamic (over-the-road) monitoring of dust loss from railcars, cost analysis for proposed mitigation techniques, and analysis of health and safety issues.

Managed and performed projects for multiple clients involving the mechanical integrity assessment and fitness-for-service evaluations of railcar truck castings (bolsters and side frames). These projects have typically involved the development and implementation of non-destructive examination procedures for both on-car and off-car examination, cyclic fatigue testing, mechanical and metallurgical testing, engineering evaluation of test results with respect to mechanical performance, and development of engineering plans to manage fleet components over the projected remaining useful service life. Have presented findings to the Association of American Railroads (AAR) for multiple clients.

Performed risk, reliability, and mechanical integrity assessments for a variety of process plant equipment including piping and tanks. Select assignments have involved flash train tanks at a bauxite to alumina processing plant, piping and vessels at a district cooling ammonia refrigeration plant, liquid carbon dioxide storage tanks, baghouse equipment at cement kilns, and a variety of other equipment subject to OSHA

PSM (process safety management) and EPA RMP (risk management plan) regulations.

Directed, managed, and performed numerous incidents involving the release of hazardous materials from transportation vessels, including rail tank cars, intermodal containers, and over-the-road tank trailers. Projects typically have involved extensive field investigations, including confined space entry of tank cars, mechanical and metallurgical analysis, mechanical integrity assessments, non-destructive examination, and sample collection.

Performed design evaluation and risk assessment of a manufacturer's new product offering that provides GPS location and condition monitoring of railcars while in-transit. System includes remote sensing, GPS and satellite uplink equipment, all packaged in a field-hardened package. Project work included FMEA (failure modes and effects analysis), reliability modeling, and predictions for warranty structuring and material compatibility analyses.

Performed mechanical performance and stress analysis calculations for a fleet of coal railcars that exhibited top chord and side sheet buckling failures. The project involved performing detailed field inspections of the damaged railcars, finite element analysis (FEA) of the cars, and a determination of the in-service loads that were needed to produce the exhibited damage.

Managed and performed a collision damage assessment and engineering repair oversight for a major accident involving a monorail train in the Pacific northwest. Project work included responsibility for oversight of repair plans, mechanical contractor selection and qualification review, quality assurance oversight, schedule analysis, and general technical consulting. Project involved extensive field work and multiple presentations to technical staff and insurance adjusters.

Performed numerous mechanical performance analyses/evaluations for a variety of machines and products including:

- Manufacturing machinery (printing and binding equipment, forming and cutting machines, product conveying equipment, certain types of CNC machine tools)
- Elements of machine guarding and lock-out/tag-out procedures (drum foamers, printing and binding equipment, packaging equipment)
- Elements of crane and lifting devices (e.g., scissor lifts), including wire rope failures, hydraulic cylinder failures, holding valve failures, and stability issues
- Elements of consumer product performance including structural performance and mechanical response.

Additional Education & Training

Completion of Highway-Rail Grade Crossing Safety course offered through the University of Wisconsin - Madison, 12-13 November 2019

Completion of Aircraft Accident Investigation Orientation for Aviation Professionals course offered by the NTSB, 27-28 October 2021

Completion of Accident Investigation Orientation for Rail Professionals course offered by the NTSB, 8-10 November 2021

Completion of Ethics for Engineers course offered by ASME, 5 January 2022

Mark J. Viz, Ph.D., P.E. – Testimony List (eight years prior to 18 August 2025)

DEPOSITIONS

1. George Holloway and Georgia Holloway v. Harbor Freight Tools USA, Inc., United States District Court for the Western District of Missouri, Southwestern Division, No. 3:15-CV-05047-DPR, 28 March 2017.
2. Milton Banks, Jr. v. Hiab USA, Inc. and Deep South Equipment Co., United States District Court for the Middle District of Louisiana, No. 3:15-CV-00263, 6 April 2017.
3. George Holloway and Georgia Holloway v. Harbor Freight Tools USA, Inc., United States District Court for the Western District of Missouri, Southwestern Division, No. 3:15-CV-05047-DPR, 8 May 2017, (second deposition for this matter).
4. Colette Carpenter, individually and as Administrator of the Estate of Clayton O. Carpenter, deceased; Jon Ternstrom, an individual; Maria Ternstrom, an individual; Cameron Witzler, an individual; and Michelle Witzler, an individual v. Sikorsky Aircraft Corporation, a Delaware corporation; Sikorsky Support Services, Inc. dba Sikorsky Aerospace Maintenance, a Delaware Corporation, United States District Court, District of Connecticut, No. 3:15-CV-01582-JBA, 20 December 2017.
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7. Timothy Juve Jr., by and through his legal guardian, Timothy Juve, Sr., v. Premier Tech Technologies, Ltd., f/k/a Premier Tech Ltd., d/b/a Premier Tech, Premier Tech Chronos, Premier Tech, Inc., and Premier Tech Horticulture, v. Pine Products, Inc., United States District Court, District of Minnesota, Court File No. 0:17-CV-04545 (DWF/LIB), 12 July 2019.
8. Martin McCallion v. Michael Nemlich, Circuit Court of Cook County, Illinois, County Department, Law Division, No. 2017 L 001387, 16 July 2019.
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14. Jennifer Barr, as Personal Representative of the Estate of Matthew Barr, Deceased, v. Walter Matisiak, James Blase, Progress Rail Locomotive, Inc., Progress Rail Services Corporation, Progress Rail Welding Corporation, Progress Rail Equipment Leasing Corporation, and Caterpillar, Inc., Circuit Court of Cook County, Illinois, County Department, Law Division, No. 2021 L 007441, 14 March 2024.
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18. Rodney Romans and Regina Romans v. SWVA, Inc. d/b/a Steel of West Virginia, Inc., United States District Court, Southern District of West Virginia, Huntington Division, Case No. 3:24-cv-00301-RCC, 25 July 2025.

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1. Martin McCallion v. Michael Nemlich, Circuit Court of Cook County, Illinois, County Department, Law Division, No. 2017 L 001387, *jury trial*, 29 July 2019.
2. Airbus SAS (France), Airbus Operations GmbH (Germany), Airbus Operations SL (Spain), Airbus Operations SAS (France), Airbus Operations Limited (United Kingdom), Airbus Defence and Space GmbH (Germany) (Claimants) v. Howmet Aerospace Inc. (USA), Howmet Europe SARL (Switzerland), Arconic Manufacturing (GB) Limited (United Kingdom) (Respondents) AND Airbus Defence and Space GmbH (Germany) (Claimant)

v. Howmet Aerospace Inc. (USA) and Arconic Manufacturing (GB) Limited (United Kingdom) (Respondents), International Court of Arbitration, International Chamber of Commerce, ICC Case Nos. 23279/FS and 23281/FS, respectively, *three-member panel*, London, 26 October – 13 November 2020.

3. Korean Air Lines Co., Ltd. (Claimant) v. Greenpoint Technologies, Inc. and Aviation Technical Services (Respondents), International Centre for Dispute Resolution, No. 01-19-0001-7823, *three-member panel*, virtual hearing, 21 January 2021.