A Structural Composite Glulam-Steel Rig Mat includes a unique steel frame and manufactured with unique tongue and grooved glulam beams with the boards horizontally arranged. The unique steel frame includes unique lifting eyes for cranes in the corners of the rig mat and smooth radius steel channel around the perimeter of the rig mat to enable easy handling by forklifts. The unique steel frame surrounds unique full length, engineered glulam beams which together with the steel frame make the resulting rig mat significantly stronger than the traditional rig mat.
ENGINEERED LAMINATED HORIZONTAL GLULAM BEAM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit under 35 U.S.C. 119(e) of U.S. Provisional Patent Application No. 61/403, 166, the disclosure of which is hereby expressly incorporated herein by reference; and the benefit under 35 U.S.C. 119(e) of U.S. Non-Provisional Patent Application No. 13/065,532, the disclosure of which is hereby expressly incorporated herein by reference; and the benefit under 35 U.S.C. 119(e) of U.S. Non-Provisional Patent Application No. 13/0005,365, the disclosure of which is hereby expressly incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to the improved more efficient and more flexible design of an engineered, laminated, wooden glulam beam that is made with twice glued, twice pressed, tongue and groove billets, and designed specifically for the use in manufacture of rig mats, or in another terminology, ground cover mats.

BACKGROUND OF THE INVENTION

[0003] Rig Mats have been manufactured for the oil and gas industry and other industries for many years. They have been made from various sizes and shapes of wide flange beams, steel channel and/or steel formed channel that forms a frame in and around various arrays of timbers or of boards glued and sometimes glued and nailed together, often with lateral rods or top and bottom straps fastened through the boards to help keep them in place.

[0004] Non-Provisional Patent Application number US 13/0005,365 filed on Jan. 12, 2011 describes a Combination of Elements that makes up a Portable Refrigerated Rig Mat System for which I, Michael Chris Wold, am the Inventor and the applicant. One of the Sub Elements of this Combination of Elements is the Protective Hybrid Steel-Glulam Rig Mat which is described in the same application.

[0005] A second Non-Provisional Patent Application number US 13/065,532 filed on Mar. 23, 2011 describes a Provisional Patent for a Structural Composite Glulam-Steel Rig Mat for which I, Michael Chris Wold, am also the Inventor and the applicant. This second improved rig mat design, is an evolution and improvement of the original Protective Hybrid Steel-Glulam Rig Mat and concentrates on three primary elements of the design:

[0006] 1. Implementation of engineered, full-length glulam beams which therefore contribute to the overall bridge strength of the rig mat.

[0007] 2. Implementation of a unique, more useful frame which is designed to facilitate easier and safer handling by cranes, forklifts and personnel.

[0008] 3. Implementation of a modular design to the rig mat which enables more efficient manufacturing with fewer man hours than the traditional rig mat.

[0009] In both of the previous inventions, Non-Provisional Patent US 13/0005,365 filed on Jan. 12, 2011 and Non-Provisional Patent US 13/065,532 filed on Mar. 23, 2011, the glulam beams used in the manufacture of the rig mats are purchased from outside glulam beam manufacturers. However, the glulam beam industry builds glulam beams to be utilized in the building industry, not the rig mat industry. Standard glulam beams are manufactured by horizontally laying up and gluing boards flat side to flat side so as to create a stack of boards (lams) glued and pressed together and always used in this upright position, that is, to where the beam is always much taller than it is wide and the load is perpendicular to the flat side of the board (lam) and parallel to the flat side of the beam. In this way the strength of the beam is much greater when it is calculated in the upright position than when calculated in the horizontal position. A beam used in this configuration will flex, if allowed to do so, before a catastrophic failure occurs (See FIG. GL-1).

[0010] When using this standard production glulam beam for the manufacture of a rig mat, the glulam beam (that is designed to be used in the vertical position) must be laid over on its side and used in the ground mat or its horizontal position. This design is not the best possible design to manufacture a strong, durable yet flexible ground mat (see FIG. GL-2).

[0011] Almost all of the rig mats manufactured in the oil and gas industry are 6 inches thick. It is the standard in the industry and without doing a scientific survey it would be safe to assume that 95% of the rig mats in existence today are made with 6 inch steel beams and are therefore 6 inches thick. Some rig mats are not flush decked with 6 inches of wood inserted in the frame and have instead a 2x6 board that is actually 5.5 inches thick fitted neatly inside the flanges of the W6×15 beams and this is referred to as an inset mat. Another solution is to “crowd up” the 5.5 inch boards to where they are rabbed flush with the top side of the rig mat frame, but are essentially 0.5 inches off the ground on the bottom side of the rig mat. These are the less expensive, lower end mats. The industry wants flush decked rig mats so the equipment is not just sitting on the steel beam frames, but rather sitting for the most part on the wooden portion of the rig mats. This reduces stress fracturing of the heavy machinery and provides for a more stable and less slippery deck for staging heavy machinery. Therefore, the flush decked steel and wood rig mat is the preferred and safest rig mat design. In order to achieve this 6 inch dimension the vast majority of rig mats are manufactured using the 2x8 board, therefore wasting much of the lumber.

SUMMARY OF THE INVENTION

[0012] This current provisional patent design is an improvement on Non-Provisional Patents 13/065,532 and 13/0005,365 and specifically deals with improving the design of the glulam beams used in manufacturing the Protective Hybrid Steel-Glulam Rig Mat found in US 13/0005,365 and the Structural Composite Glulam-Steel Rig Mat described in 13/065,532.

[0013] Lumber dimensions will change depending on the varying size of the rig mats to be manufactured using these engineered glulam beams, but for practical reasons we are using random length boards that are approximately 1.5 inches thick and 5.5 inches wide to build these glulam beam. The length of these boards varies because we are using excess cutoff ends and random length boards to manufacture these beams. We are using the standard 2x6 board, which is actually more approximately 1.5 inches thick and 5.5 inches wide, because it is this board that if used correctly, is the most efficient board to use in the manufacture of the typical oil field industry rig mat.

[0014] Therefore, I have designed a glulam beam that is made up of 2x6 lams stacked, glued and pressed together on
their flat horizontal sides to the desired depth of the beam, but in smaller groups, or billets (See FIG. GL-3). By using the boards in their horizontal position it is not necessary to use 2x8 boards to achieve a full 6 inch thick beam and waste is greatly reduced.

These smaller beam elements or billets are then glued to each other, side by side with the lams widest flat sides parallel to the ground to achieve the required dimensions of the finished glulam beam. The width of the glulam beam is controlled by the number of billets employed in the beam and by the width of the boards employed in each billet (See FIG. GL-4). If the required width of the resulting glulam beam does not equal the sum of whole numbers of billets, then a billet is sawn to the required width before cutting the tongue and grooves or rabbets into this billet and therefore any required dimension can be achieved in this manner. The vertical dimension of the glulam beam is controlled by the thickness of the lams that make up the billets and the number of lams stacked in each billet. After curing, the individual billets are tongue and grooved on their vertical sides (See FIG. GL-5) and then they are glued and pressed horizontally together into the final glulam beam (See FIG. GL-6). In this way, the billets are glued not only in the X and Y axis, but in the Z axis also.

Because the boards in the beams are arranged horizontally they are a unique design of glulam beam and they will be able to flex appropriately if they are sitting on uneven ground and loaded with weight. The downward force on the rig mat is now perpendicular to the wide flat side of the lam and parallel to the narrow edge of the lams which is the same configuration of forces on a typical architectural structural glulam beam. The tongue and grooved glue joint is much stronger than a simple butt joint and is an important design characteristic of this new glulam beam. Just as significantly, by using the more common and smaller 2x6 boards, this new glulam design utilizes approximately 36% less wood product than the current method of cutting down 2x8 boards in manufacturing the preferred full 6 inch thick flush decked rig mat.

FIG. RM-2 is a perspective view, looking from above and from outside, of a Corner Insert with Lifting Slots, which is a part of the rig mat of FIG. 12.

FIG. RM-3 is a perspective view, looking from above and from inside, of a Corner Insert with Lifting Slots, which is a part of the rig mat of FIG. 12.

FIG. RM-4 is a perspective view, looking from above, showing the interchangability of the Lateral End Rails of the rig mat of FIG. 12.

FIG. RM-5 is a perspective view, looking from above, of the interchangeable Modular Oilfield Loading Hitch, which is a part of the rig mat of FIG. 13.

FIG. RM-6 is a perspective view, looking from the side, of the interchangeable Modular Oilfield Loading Hitch, which is a part of the rig mat of FIG. 13.

FIG. RM-7 is an exploded perspective view, looking from above, of the first stage of assembling the rig mat of FIG. 12.

FIG. RM-8 is a perspective view, looking from above, of the installation of the outside glulam beams in the rig mat of FIG. 12.

FIG. RM-9 is a perspective view, looking from above, of the installation of the Corner Inserts with Lifting Slots in the rig mat of FIG. 12.

FIG. RM-10 is a perspective view, looking from above, of the installation of the Longitudinal Side Rails in the rig mat of FIG. 12.

FIG. RM-11 is a plan view, looking from above, of the installation of the Fork Protection Plates in the rig mat of FIG. 12.

FIG. RM-12 is a perspective view, looking from above, of the finished Structural Composite Glulam-Steel Rig Mat with standard ends.

FIG. RM-13 is a perspective view, looking from above, of the finished Structural Composite Glulam-Steel Rig Mat with the optional Modular Oilfield Loading Hitch.

DESCRIPTION OF MANUFACTURE OF BILLETED TONGUE & GROOVE GLULAM BEAM

I will start the manufacturing process by describing how to build the unique billeted glulam beams to be used in the manufacture of this rig mat and then proceed to integrating the glulam beams and steel components into the finished rig mat product.

Sorter

The manufacturing process of the glulam beams begins with running random length boards through a Sorter to separate the lumber that is suitable for our purposes from those that are not suitable for our purposes. Boards that are thinner than the minimum requirement, narrower than the minimum requirement will be sorted out at this time.

Continuous RF Finger Jointer

Next, the appropriate lumber is run through an RF Finger Jointer machine that will cut the finger joints in the ends of the boards, glue these finger joints and crowd them together (or press them together) while the new finger jointed boards are passed through the radio frequency tunnel that cures the glue. The continuous board that is produced by this RF finger jointing machine is cut off at the required length for the project at hand and moved over to the next process. In certain instances the Finger Jointer will not be necessary and
instead the random length boards will be glued and laid up in the billet press with a butt jointed or scarfed interface between the random length ends.

[0041] Planer

[0042] The next process is to run these long finger jointed boards through a four sided planer to make the board’s width and thickness uniform so as to fit perfectly together creating flat even surfaces for gluing and pressing into the billets. In certain instances the board planer will not be necessary and instead the random length boards will be run through a glue spreader machine and then laid up in the billet press.

[0043] Continuous Feed RF Billet Press

[0044] The next process is to glue and stack the finger jointed boards into the required thickness for the billet and press the billet until the glue has cured. Billets will be pressed together in batches in large presses to increase production or the preferred method is to use an RF continuous feed or batch press to glue, stack and press these billets together. While not as efficient, this can also be accomplished with mechanical presses that may utilize hydraulic cylinders, pneumatic cylinders, pneumatic hoses or simply threaded rods and clamps.

[0045] Mokler

[0046] The next process is to run the glued billets through a molder machine, or a planer equipped with side molder heads that will tongue and groove the vertical sides of the billets. Billets that will make up the outside faces of the glulam beam are not tongue and grooved on the vertical outside two long faces of the beam. These outside faces are instead appropriately rabbed along the top and bottom outside corner edges to allow the glulam beams to fit close to the flanges of the steel beams, therefore enabling the rig mat to be flush decked. (see FIG. 4).

[0047] Second Press

[0048] The next process is to apply glue to the tongue and groove faces of the billets, move them into the second press and press the billets into the final form of the finished glulam beam. This creates a glulam beam that is glued in three dimensions and is made up of boards flat to the ground in a horizontal position. At this stage the glulam beam is a bit rough and has glue dried on its surfaces (see FIG. 5).

[0049] Surface Planer

[0050] The next process is to run the glulam beams through a beam surfacer or beam sizer to finish plane the glulam beam on all four surfaces to its desired dimensions. The glulam beam is now its required width and height and has the full length rabbets cut along the 4 longitudinal corner edges.

[0051] Final Processing of Glulam Beams

[0052] The final process is to move the glulam beams to the final processing area where any required cutting of dados for fitting the protective forklift plating, cutting rabbets in the ends and/or corners of the beam and drilling any holes, if required to accommodate the through-pins that might anchor the fork plates to one another. After FINAL PROCESSING these double pressed tongue and grooved glulam beams are precisely trimmed and ready to move to the welding shop where they are assembled with the steel formed channel perimeter frame, the modular corners and the internal longitudinal wide flange beams into the final form of the rig mat.

Description of Manufacture: Assembly of Rig Mat

[0053] A 4Rail-3Beam Rig Mat (See FIG. 1) is used for the Description of Manufacture in this application and is the same model rig mat as described in the previous Provisional Patent for a Structural Composite Glulam-Steel Rig Mat that is number US 61/340,896 filed on Mar. 23, 2010. The Structural Composite Glulam-Steel Rig Mat is illustrated exploded beginning with FIG. 1. The rig mat outer frame, in this embodiment, is made with formed channel steel beams, running lengthwise as the two Longitudinal Side Rails (#12) and the two Lateral End Rails (#11) running crossways at each end of the rig mat. These four outer frame rails are connected at the four corners of the rig mat with the four Corner Inserts (#3). The two Longitudinal Internal Rails (#13) are connected to the Lateral End Rails (#11). The twelve steel Fork Protection Plates (#14) welded between all four of the longitudinal rails on both faces of the rig mat and installing and welding up the connection rods; complete the structural steel frame of the rig mat.

[0055] The first stage of assembling the rig mat, shown in FIG. 7, is to assemble the Longitudinal Internal Rails (#13) to the Lateral End Rails (#11) with the center glulam (#1), boxed in the center section (if the rig mat is to have more than two Glulam Beams). To install the glulam beams (#1 & #2) into the rig mat frames, the best method is employ a horizontal, table height jig; lay out the first Longitudinal Internal Rail (#13)in the proper position to accept the two Lateral End Rails (#11). Weld the two Lateral End Rails (#11) in place to this Internal Wide Flange Rail (#13) and then insert the Center Glulam Beam(#11) into the u-shaped slot formed by the 3 Rails. Next install the second Longitudinal Internal Rail (#13), which boxes in the Center Glulam Beam (#1) and weld them in place. This creates the “backbone” of the rig mat. While the backbone is still in place in the jig, illustrated in FIG. 8, install each of the two mitered Outside Glulam Beams (#2) into the short slots formed inside the protruding ends of the two Lateral End Rails (#11). Next, illustrated in FIG. 9, install the four Corner Inserts (#3) onto the outside ends of the Lateral Cross Rails (#11) and weld them in place. Finally, illustrated in FIG. 10, install the outside Longitudinal Side Rails (#12) into the space created inside the Corner Inserts (#3) and weld them in place. This operation has essentially assembled the main structural components of the rig mat and it is now ready for finish welding. Finally the installation of the Fork Protection Plates (#14) on both sides of the rig mat and the Steel Pins (#15) that anchor the Fork Protection Plates (#14) to each other on opposite sides of the rig mat completes the manufacturing process.

[0056] FIG. 12 illustrates the finished Structural Composite Glulam-Steel Rig Mat in 4Rail-3Beam Rig Mat configured to be handled by cranes and forklifts manufactured with the standard Lateral End Rails (#11).

[0057] FIG. 13 illustrates the finished Structural Composite Glulam-Steel Rig Mat in 4Rail-3Beam Rig Mat configured to be handled by cranes, forklifts and oilfield Bedtandems, Pole Trucks and Winch Trucks manufactured with the Modular Oilfield Loading Hitch (#10).

I/we claim:
1. A Structural Composite Glulam-Steel Rig Mat capable of carrying a load and comprising:
   a. A unique steel frame
   b. Full length wood glulam beams
   c. Is constructed in a modular design
   d. A unique laminated, tongue and groove glulam beam design
2. The mat of claim 1 wherein said steel frame incorporates a unique lifting eyes for cranes and other lifting equipment in the corners of the rig mat.
b. wide forklift protection plates that are inset flush with the horizontal surface of the rig mat frame and with the surface of the glulam wood beams

c. incorporates steel channeled beams for the perimeter of the rig mat with smooth radius corners to enable easy handling by forklifts and other lifting machinery

3. The mat of claim 1 wherein said glulam beams
   a. are full length beams and span the long length of the rig mat
   b. are engineered and certifiable wooden glulam beams
   c. are laminated tongue and grooved construction never before manufactured in the glulam industry

d. and are unique in this industry and have never been employed in the construction of steel framed rig mats.

4. The mat of claim 1 is constructed in a modular design
   a. and this unique modular design enables an efficient manufacturing process
   b. the modular design creates the ability to change the character of the rig mat by interchanging the lateral end rails between smooth end rails or the modular oilfield loading hitch.

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