A backpack including an external frame is provided. The external frame may include a pair of upright members and a pair of cross members. The cross members may extend transversely to, and may be attached to, the pair of upright members. The upright members and the cross members may be constructed of a laminate structure having layers of carbon fiber and wood, resulting in a lightweight, yet strong, frame.
BACKPACK EXTERNAL FRAME AND SUSPENSION SYSTEM

FIELD

[0001] The present disclosure relates to an external frame and suspension system for a backpack.

BACKGROUND

[0002] Backpacks generally fall into one of three categories: frameless, external frame, and internal frame. External and internal frames generally serve to support a load and distribute the weight of the load across the wearer's body. External frames generally are designed to carry heavier loads and thus provide the wearer more support and better weight distribution than internal frames or frameless packs. However, the increased strength of external frames generally increases the weight of external frames.

SUMMARY

[0003] Examples of the disclosure may include a backpack. In some examples, the backpack includes an external frame. The external frame may include a pair of upright members (or stays) and a pair of cross members (or stays). The pair of cross members may extend transversely to, and may be attached to, the pair of upright members. The pair of upright members and the pair of cross members may be constructed of a laminate structure having layers of carbon fiber and wood. The laminate structure of the pair of upright members and the pair of cross members may provide advantages relative to conventional external frames. For example, the laminate structure of the upright members and the cross members may result in significant weight savings relative to conventional external frames, without sacrificing strength.

[0004] The backpack may include a sleeve positioned around each upright member of the pair of upright members. The pair of sleeves may extend along a majority of the length of the pair of upright members. Each sleeve may be attached to a respective upright member by the attachment of the pair of cross members to the pair of upright members.

[0005] The backpack may include a torso pad attached to each sleeve. Each torso pad may be moveable relative to the pair of upright members. For example, each torso pad may be pivotable, laterally translateable, or both relative to the pair of upright members.

[0006] The backpack may include a shoulder strap attached to each sleeve. A portion of each shoulder strap may be slidably retained between a respective torso pad and sleeve. Each shoulder strap may include padded section for contact against a shoulder of a wearer.

[0007] The backpack may include a waist belt moveably attached to the pair of upright members. The waist belt may include an intermediate segment and a pair of padded end segments extending outwardly from the intermediate segment. The intermediate segment may define a pair of pockets that receive lower ends of the pair of upright members.

[0008] The backpack may include a lumbar pad attached to one of the pair of cross members. The lumbar pad may be folded around the intermediate segment of the waist belt and may be attached to the pair of upright members to vertically restrain the waist belt relative to the external frame. The lumbar pad may laterally restrain the waist belt relative to the external frame by maintaining lower ends of the pair of upright members in the pair of pockets. The lumbar pad may be thicker than the pair of padded end segments of the waist belt.

[0009] The pair of cross members may include an upper cross member and a lower cross member spaced apart from the upper cross member. The pair of upright members may converge toward one another as the pair of upright members extends downwardly from the upper cross member to the lower cross member. The pair of upright members may extend above the upper cross member to facilitate attachment of a bag to the external frame. The pair of upright members may extend below the lower cross member to facilitate attachment of a waist belt to the external frame. The external frame may be narrower in width than a wearer's back. The pair of upright members may have curved profiles. The pair of upright members and the pair of cross members may have rectangular cross sections and may be referred to as bars. The pair of upright members and the pair of cross members may be attached together by four, one-degree-of-freedom joints to permit relative lateral movement of the external frame.

[0010] Examples of the disclosure may include a method of assembling a backpack having an external frame and a suspension system. In some examples, the method includes positioning a sleeve having a closed end and an open end over an upright member of the external frame, positioning a cross member of the external frame transversely to the upright member such that a portion of the sleeve extends between the cross member and the upright member, and attaching the cross member to the upright member such that the sleeve is trapped between the cross member and the upright member. The upright member and the cross member may be constructed of a laminate structure having layers of carbon fiber and wood. The method may include attaching a torso pad to the sleeve such that the torso pad is pivotable relative to the upright member.

[0011] This summary of the disclosure is given to aid understanding, and one of skill in the art will understand that each of the various aspects and features of the disclosure may advantageously be used separately in some instances, or in combination with other aspects and features of the disclosure in other instances. Accordingly, while the disclosure is presented in terms of examples, it should be appreciated that individual aspects of any example can be claimed separately or in combination with aspects and features of that example or any other example. The present disclosure is set forth in various levels of detail in this application and no limitation as to the scope of the claimed subject matter is intended by either the inclusion or non-inclusion of elements, components, or the like in this summary.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate examples of the disclosure and, together with the general description given above and the detailed description given below, serve to explain the principles of these examples.

[0013] FIG. 1 is a perspective view of an example backpack.

[0014] FIG. 2 is a side elevation view of the backpack of FIG. 1.

[0015] FIG. 3 is an exploded view of the backpack of FIG. 1.
FIG. 4 is a perspective view of an example external frame with sleeves positioned around the upright members of the frame.

FIG. 5 is an enlarged view of an intersection of an upright member and a cross member of the external frame of FIG. 4 taken along the detail line 5-5 illustrated in FIG. 4.

FIG. 6 is a cross-section view of the intersection of the upright member and the cross member of FIG. 5 taken along the line 6-6 illustrated in FIG. 5.

FIG. 7 is a schematic view of a laminate structure of the upright members, the cross members, or both of the external frame FIG. 3.

FIG. 8 is a cross-section view of a torso pad of the backpack of FIG. 1 taken along the line 8-8 illustrated in FIG. 2.

FIG. 9 is a schematic cross-sectional view of the torso pads of the backpack of FIG. 1 pivoted into alignment with a contour of a wearer’s back.

FIG. 10 is a partial cross-sectional view of a lumbar pad of the backpack of FIG. 1.

FIG. 11 is a cross-section view of the lumbar pad of FIG. 10 taken along the line 11-11 illustrated in FIG. 15.

FIG. 12 is a perspective view of the backpack of FIG. 1 with a chair removable attached to the upright members and to the lumbar pad.

FIG. 13A is a schematic view of a common loop and a three-bar slider prior to attachment to another.

FIG. 13B is a schematic view of the common loop and the three-bar slider of FIG. 15 removeably attached to one another.

FIG. 14 is a fragmentary, perspective view of a bag positioned onto upper ends of the external frame of FIG. 4.

FIG. 15 is a rear elevation view of the backpack of FIG. 1 situated on a wearer’s back.

In certain instances, details that are not necessary for an understanding of the disclosure or that render other details difficult to perceive may have been omitted. In the appended drawings, similar components and/or features may have the same reference label. It should be understood that the claimed subject matter is not necessarily limited to the particular examples or arrangements illustrated herein.

DETAILED DESCRIPTION

Referring to FIGS. 1-3, a backpack 100 including an external frame 102 and a suspension system 104 is provided.

The external frame 102 generally serves to support a load and, along with the suspension system 104, to distribute most of the weight of the load to the wearer’s hips and legs, thereby improving the wearer’s ability to carry heavy loads and increasing the agility and balance of the wearer when carrying the load. The external frame 102 and suspension system 104 generally dispense the load onto the skeletal structure of the wearer in a balanced way, thereby reducing or eliminating forward, aft, right, or left forces on the wearer’s body so as to not disturb the wearer’s natural posture, balance, and movement.

Referring to FIGS. 3 and 4, the external frame 102 may include four frame members or stays: a pair of upright members 106, 108 and a pair of cross members 110, 112. The upright members 106, 108, also referred to as upright stays, may be spaced laterally apart from one another and may extend upwardly along a wearer’s back 114 (see FIG. 15). The cross members 110, 112, also referred to as cross stays, may be spaced vertically apart from one another and may extend laterally across a wearer’s back 114. The cross members 110, 112 may extend transversely to the upright members 106, 108 and may be positioned rearwardly of the upright members 106, 108 relative to the wearer. An upper cross member 110 may be positioned proximate to upper ends 106a, 108a of the upright members 106, 108 (see FIG. 4). A lower cross member 112 may be positioned proximate to the lower ends 106b, 108b of the upright members 106, 108. As shown in FIG. 4, the lower cross member 112 may be spaced vertically above the lower ends 106b, 108b of the upright members 106, 108 such that the upright members 106, 108 extend below the lower cross member 112 for attachment to a waist belt, which will be discussed in more detail below.

The cross members 110, 112 may be attached to the upright members 106, 108 at the intersection of the cross members 110, 112 and the upright members 106, 108. With specific reference to FIGS. 4-6, a single fastener 116, e.g., a rivet, may be used at each intersection to attach the cross members 110, 112 to the upright members 106, 108, thus permitting slight angular movement between the upright members 106, 108 and the cross members 110, 112. As such, the frame 102 may be slightly skewed from side-to-side by a load attached to the external frame 102. Although not shown, more than one fastener may be used at each intersection to provide a more rigid connection between the cross members 110, 112 to the upright members 106, 108.

Referring to FIGS. 3 and 4, the external frame 102 may resemble an inverted trapezoid when viewed from the front or rear. The upright members 106, 108 may converge toward one another as the upright members 106, 108 extend downwardly from the upper cross member 110 to the lower cross member 112. In other words, the external frame 102 may taper in width from an upper end of the frame 102 to a lower end of the frame 102. With reference to FIG. 15, the uprights may be positioned closer apart from one another near the shoulder region of a wearer’s back and may be positioned closer to one another near the lumbar region of the wearer’s back. In other words, the upright members 106, 108 may converge toward one another as the upright members 106, 108 extend downwardly from the shoulder region toward the wearer’s hips, thereby transferring the load to the wearer’s hips and legs.

Although in FIGS. 3 and 4 the external frame 102 has a linear taper from the upper end of the frame to the lower end of the frame when viewed from the front or rear, in some implementations the external frame 102 may have a non-linear taper when viewed from the front or rear.

To accommodate the larger width of the upper end 102a of the frame 102, the upper cross member 110 may be longer than the lower cross member 112. The upper and lower cross members 110, 112 may extend parallel or substantially parallel to one another. The upper cross member 110 may form acute interior angles with the upright members 106, 108, and the lower cross member 112 may form obtuse interior angles with the upright members 106, 108.

Referring to FIGS. 4, 14, the external frame 102 may have a curvilinear profile when viewed from the side. The upright members 106, 108 may have an S-shaped profile that corresponds to a profile of the wearer’s back 114. The profile of the upright members 106, 108 may be customized to accommodate various back profiles, such as a flat back or a standard-curved back. The cross members 110, 112 may have a rectilinear profile and extend in a straight line between the upright members 106, 108.
The cross members 110, 112 and the upright members 106, 108 of the external frame 102 may be constructed of bars, rods, tubes, or other members having various cross-sectional profiles. With reference to FIGS. 5 and 6, the cross members 110, 112 and the upright members 106, 108 may be constructed of bars having rectangular cross-sections. In such examples, the cross members 110, 112 and the upright members 106, 108 may be referred to as cross bars and upright bars, respectively. The cross members 110, 112 and the upright members 106, 108 may have identical or substantially identical cross-sectional dimensions. In some implementations, the cross members 110, 112 and the upright members 106, 108 have cylindrical cross-sections, oval cross-sections, trapezoidal cross-sections, or other suitable cross-sectional shapes.

The cross members 110, 112 and the upright members 106, 108 of the external frame 102 may be constructed of carbon fiber, laminate, metal (e.g., aluminum), plastic, wood, or other suitable materials. Referring to FIG. 7, the external frame 102 may be constructed of a composite or laminate of carbon fiber and wood that is lightweight, yet provides high strength, thereby reducing the weight of the external frame 102 relative to conventional external frames 102 without sacrificing strength. The upright members 106, 108 and the cross members 110, 112 may be formed of the laminate structure. Referring to FIG. 7, the upright members 106, 108 and the cross members 110, 112 may include multiple layers of wood flanked by layers of carbon fiber. In some implementations, the upright members 106, 108 and the cross members 110, 112 include three layers of wood C, E, G stacked on top of one another and attached together with thermoplastic resin layers D, F. Carbon fiber layers A, I may be attached to outer surfaces of the outer wood layers C, G with thermoplastic resin layers B, H, which may be reinforced for increased stiffness. The thermoplastic resin layers B, H may include one ply of ninety-degree unidirectional fiberglass impregnated thermoplastic resin. The carbon fiber layers A, I may be constructed of two plies of unidirectional carbon fiber, which may be rotated ninety degrees relative to one another. The wood layers C, E, G may be formed of maple veneer or other suitable types of wood.

The wood layers C, E, G may be thicker than the carbon fiber layers A, I. For example, in some implementations, the wood layers C, E, G are 0.0625 inches in thickness and the carbon fiber layers A, I are 0.009 inches in thickness. The thermoplastic resin layers B, D, F, H may be the same thickness as the carbon fiber layers A, I. For example, in the above-noted implementations, the thermoplastic resin layers B, D, F, H may have a thickness of 0.009 inches. Although two layers of carbon fiber A, I and three layers of wood C, E, G are illustrated, the frame 102 may include more or less layers of carbon fiber and wood based on the desired strength and weight characteristics of the frame 102.

The laminate structure of the upright members 106, 108 and the cross members 110, 112 of the external frame 102 may provide advantages relative to conventional external frames. For example, the laminate structure of the frame members 106, 108, 110, 112 may result in significant weight savings relative to conventional external frames, without sacrificing strength. In some implementations, the external frame 102 with the laminate structure has about ten percent reduced weight relative to conventional external frames, yet is capable of supporting as much or more load relative to conventional external frames.

Referring to FIGS. 1-3, a suspension system 104 may be attached to the external frame 102. The suspension system generally includes a system of straps and padding that softens the contact between the frame 102 and the wearer’s back and provides attachment points for a bag or other items. The suspension system 104 may include a pair of sleeves 118, 120, a pair of torso pads 122, 124, a pair of shoulder straps 126, 128, a lumbar pad 129, and a waist belt 130. The suspension system 104 generally transfers the load to the wearer through the waist belt 130, leaving the shoulder straps 126, 128 primarily for stabilizing the load. Most of the weight is therefore taken off the wearer’s shoulders, reducing the chance of injury from shoulder strap pressure, as well as being less restrictive of the wearer’s upper body range of motion.

The pair of sleeves 118, 120 may be positioned around the pair of upright members 106, 108 and extend along a majority of the length of the upright members 106, 108 continuously (see FIG. 4) or discontinuously. Referring to FIGS. 1-4, the sleeves 118, 120 may be snugly fit onto the upright members 106, 108. The sleeves 118, 120 may be closed at upper ends 118a, 120a and open at lower ends 118b, 120b. The sleeves 118, 120 may be positioned to over- or surround a majority of the length of the upright members 106, 108 (see FIG. 4). The sleeves 118, 120 may extend from the upper cross member 110 to the lower cross member 112 and may be securely attached to the upright members 106, 108 with the fasteners 116. As shown in FIGS. 6 and 11, a portion of the sleeves 118, 120 may be sandwiched between the cross members 110, 112 and the upright members 106, 108 at the intersection of the cross members 110, 112 and upright members 106, 108.

With reference to FIG. 4, various attachments (e.g., fabric loops, common loops, three-bar sliders, and slider locks) may be stitched or otherwise attached to the sleeves 118, 120 to provide attachment points for accessories, suspension components, or both. For example, the sleeves 118, 120 may provide attachment points for a bag and a chair, both of which are described in more detail below. Additionally, the torso pads 122, 124, the shoulder straps 126, 128, and the lumbar pad 129 may be attached to the sleeves 118, 120. By providing attachments on the sleeves 118, 120, the cost and complexity of manufacturing the external frame 102 may be reduced, since the attachments may be attached to the sleeves 118, 120 prior to fitting the sleeves 118, 120 onto the upright members 106, 108, and, after attachment of the sleeves to the upright members, various accessories and suspension components may be interchangeably attached to the sleeves 118, 120 via the attachment points.

The sleeves 118, 120 may be constructed of various types of material. In some implementations, the sleeves 118, 120 are constructed of webbing. The webbing may be formed of nylon, polypropylene, or other suitable materials. The webbing may be formed as a flat strip or a tube. In implementations using flat strip webbing, the webbing may be folded over onto itself and opposing, longitudinally-extending edges of the strip may be stitched together to form a shroud having an internal cavity with cross-sectional dimensions sufficient to receive the upright members 106, 108, and in some examples the sleeves 118, 120 have a tight fit. The shroud may be closed at one end and open at the other end, thus permitting the shroud to be snugly slid onto a respective upright member 106, 108 until the upper end 106a, 108a of the respective upright member 106, 108 abuts against the closed end of the shroud. The attachment points of the suspension system 104
and accessories may be stitched into the seams of the folded-over strip of webbing or attached to the face of the webbing strips. In implementations using tube webbing, one end of the tube webbing may be closed by stitching, for example, and then snugly fit onto a respective upright member in the same manner described above with respect to the folded-over strip of webbing. In the tube webbing implementations, the attachment points of the suspension system 104 and accessories may be attached, such as stitched, to the outer surface of the tube webbing.

Referring to FIGS. 1-3, 8, 9, 12, and 15, the pair of torso pads 122, 124 may be attached to the upright members 106, 108 of the external frame 102. With reference to FIGS. 8 and 9, the torso pads 122, 124 each may include a foam pad 132 positioned within a housing 134. In some implementations, the foam pad is constructed from polyethylene terephthalate (PET) closed-cell foam and is 0.75" thick. The housing 134 may enclose the foam pad 132 and may include two strips of material, an outer strip 136 and an inner strip 138, attached to one another along opposing sides 132a, 132b of the foam pad 132. The outer strip of material 136 may be directed toward a wearer’s back 114, while the inner strip of material 138 may be directed toward the respective upright member 106, 108 (see FIG. 8). In some implementations, the outer strip of material 136 is constructed of a moisture-control fabric, such as the fabric marketed under the Dri-Lex® brand. In some implementations, the inner strip of material is constructed of a durable fabric material that is tear and abrasion resistant, such as the fabric marketed under the Cordura® brand.

With continued reference to FIGS. 8 and 9, the housing 134 may be attached to a respective sleeve 118, 120 with one or more strips of fabric material. In the depicted example, opposing side edges 140a, 140b of a single strip of material 140 are attached to the housing 134 at the junction of the outer and inner strips of material 136, 138 along opposing sides 132a, 132b of the foam pad 132. An intermediate section 140 of the single strip of material 140 may be attached to a respective sleeve 118, 120 so as to connect the housing 134 to the sleeve 118, 120 and thus to the associated upright member 106, 108. The inner strip of material 138 of the housing 134 and the single strip of material 140 may be joined together so as to define an open-ended, internal passage 142 peripherally-bounded by the strips 138, 140. In some implementations, the single strip of material 140 is constructed of a durable fabric material that is tear and abrasion resistant, such as the fabric marketed under the Cordura® brand.

Referring to FIG. 9, the pair of torso pads 122, 124 may be moveable relative to the pair of upright members 106, 108 to provide a customized, comfortable fit. As shown in FIG. 9, the free spans 144, 146 of the single strip of material 140 may permit the torso pads 122, 124 to pivot and/or laterally translate relative to the pair of upright members 106, 108, thereby allowing the torso pads 122, 124 to track the contour of a wearer’s back 114 for increased comfort. Additionally, the motion of the torso pads 122, 124 relative to the upright members 106, 108 may maintain the torso pads 122, 124 in contact with the wearer’s back 114 during relative movement between the wearer and the external frame 102, thereby providing flexibility to the backpack 100 and providing a more comfortable fit relative to conventional external frame back packs.

The pair of shoulder straps 126, 128 may be attached to the upright members of the external frame 102 and to the waist belt 130. Referring to FIGS. 1 and 12, one end 126a, 128a of the shoulder straps 126, 128 may be attached to a lower portion of the pair of sleeves 118, 120 and an opposing end 126b, 128b of the shoulder straps 126, 128 may be attached to the waist belt 130. From the ends 126a, 128a of the shoulder straps 126, 128 that are attached to the sleeves 118, 120, the shoulder straps 126, 128 may pass through the internal passage 142 defined between the torso pads 122, 124 and the upright members 106, 108 and extend upwardly along the upright members 106, 108 (see FIGS. 1 and 8). The shoulder straps 126, 128 may be moveable, e.g., slideable, within the internal passage 142 relative to the torso pads 122, 124 and the upright members 106, 108. Padded sections 148, 150 of the shoulder straps 126, 128 may define an apex of the shoulder straps 126, 128 and may extend forwardly and downwardly from the apex. Adjustable, shoulder-pad lift straps 152, 154 may attach at upper ends to the upper, closed end 118a, 120a of the sleeves 118, 120 and may attach at lower ends to the padded sections 148, 150 of the shoulder straps 126, 128. The lift straps 152, 154 may lift the padded sections 148, 150 of the shoulder straps 126, 128 off of the top of a wearer’s shoulder to prevent the weight of the backpack 100 and its supported load from pulling down on the top of the wearer’s shoulders, thereby transferring the load primarily to the waist belt 130 through the external frame 102 and allowing the shoulder straps 126, 128 to stabilize the load. The padded sections 148, 150 of the shoulder straps 126, 128 may be attached to one another with a buckle 156 (see FIG. 1). From the padded sections 148, 150, the shoulder straps 126, 128 may extend downwardly and attach at terminal ends 158, 160 to the waist belt 130 outwardly of the lower ends 106a, 108b of the upright members 106, 108. These lower extensions 158, 160 of the shoulder straps 126, 128 defined between the padded sections 148, 150 and the waist belt 130 may be adjustable in length to accommodate differently-sized wearers.

The waist belt 130 may extend transversely to, and may be attached to, the upright members 106, 108 of the external frame 102. Referring to FIGS. 1, 3, 10-12, and 15, the waist belt 130 may include an intermediate segment 162 and a pair of padded end segments or wings 164 extending outwardly from the intermediate segment 162. The intermediate segment 162 of the waist belt 130 may include a pair of cups 166, 167 that define pockets 168 having open upper ends and closed lower ends. The pockets 168 may snugly receive lower ends 106a, 108b of the upright members 106, 108, reducing or preventing lateral movement or slippage of the waist belt 130 relative to the frame 102. The cups 166, 167 may be constructed of a folded-over strip of material that is attached to a rear surface of the intermediate segment 162 of the waist belt 130. The cup material may be formed of chlorosulphonated polyethylene (CSPE) synthetic rubber (CSM), such as that marketed under the Hypalon® brand, ballistic cloth, such as ballistic nylon, or other types of durable materials. The padded wings 164 may be selectively positionable around a wearer’s hip or pelvic girdle, and ends of the padded wings 164 may be attached together with a releasable buckle 170 (see FIG. 1). The waist belt 130 may be attached to the sleeves 118, 120 and the lumbar pad 129 with adjustable straps.

The lumbar pad 129 may be attached to the lower cross member 112 and to the upright members 106, 108 of the external frame 102 with a fabric covering 172. Referring to FIGS. 10 and 11, the fabric covering 172 may include a rear flap 174 that includes a hemmed edge 175 that defines a...
passageway 176 that receives a portion of the lower cross member 112 spanning between the upright members 106, 108 to secure the lumbar pad 129 to the lower cross member 112. From the lower cross member 112, the fabric covering 172 may extend downwardly along a rear side of the upright members 106, 108, may wrap around lower ends 106b, 108b of the upright members 106, 108, may extend upwardly along a front side of the upright members 106, 108, and may be adjustably attached to the sleeves 118, 120 with hook and loop fasteners 178 threaded through a common loop 179, for example. The intermediate segment 162 of the waist belt 130 may be sandwiched between the upright members 106, 108 and the fabric covering 172 of the lumbar pad 129, thereby restraining vertical movement of the waist belt 130 relative to the external frame 102 by forcing the cups 166, 167 upwardly into engagement with the lower ends 106b, 108b of the upright members 106, 108.

One or more foam pads 180, 182 may be positioned along the front side of the upright members 106, 108 and may be enclosed within the fabric covering 172 of the lumbar pad 129. Referring to FIGS. 10 and 11, the lumbar pad 129 may include two foam pads 180, 182 positioned one in front of the other within the fabric covering 172. A rearwardly-positioned foam pad 180 may be thinner than a forwardly-positioned foam pad 182. In some implementations, the rearwardly-positioned foam pad 180 may be 0.75" thick, and the forwardly-positioned foam pad 182 may be 1.5" thick. The rearwardly-positioned foam pad 180 may be constructed of a different type of foam than the forwardly-positioned foam pad 182. In some implementations, the rearwardly-positioned foam pad 180 may be constructed of closed-cell foam, and the forwardly-positioned foam pad 182 may be constructed of open-cell foam for moisture-control purposes. For example, the open-cell foam may absorb moisture, e.g., sweat, from the lumbar region of the wearer during use. In some implementations, the rearwardly-positioned foam pad 180 may be formed of polyethylene terephthalate (PET) and may include a pressure-sensitive adhesive (PSA). In some implementations, the forwardly-positioned foam pad 182 may be formed of polyethersulfone (PES) with a UL temperature index.

Referring to FIGS. 1 and 15, the width of the lumbar pad 129 may be slightly larger than the separation distance between the lower ends 106b, 108b of the upright members 106, 108. The width of the lumbar pad 129 may provide a tighter wrap of the waist belt 130 around the wearer’s hip girdle, thereby providing a more comfortable attachment with reduced slippage of the external frame 102 relative to the wearer, especially under heavy loads. The lumbar pad 129 also may be thicker than the padded end segments 164 of the waist belt 130, thereby maintaining the external frame on the wearer’s waist for effective load transfer to the wearer’s hips and legs. The torso pads 122, 124 and the lumbar pad 129 may provide a standoff between the external frame 102 and the wearer’s back 114 to permit air flow between the frame 102 and the wearer’s back 114 for cooling purposes. Further, the torso pads 122, 124 and the lumbar pad 129 may prevent contact between the external frame 102 and the wearer’s back 114 to provide a comfortable packing experience.

The external frame 102 and suspension system 104 may provide for quick attachment and detachment of various accessories, for example, shelves or bags. Referring to FIG. 12, a chair or shelf 184 may be attached to the external frame 102 by attaching an inner end 184a of the chair 184 to a pair of common loops 186 stitched to the rear flap 174 of the lumbar pad 129. Support straps 188 may extend from the outer end 184b of the chair 184 and may be attached to the sleeves 118, 120 using triangular loops 190 stitched to the sleeves 118, 120. With reference to FIGS. 13A and 13B, an example of the connection of the inner end 184a of the chair 184 to the rear flap 174 of the lumbar pad 129 is provided. A three-bar slider 192 may be attached to the chair 184 with a strip of webbing 194. To attach the three-bar slider 192 to the common loop 186 (which is attached to the rear flap 174 of the lumbar pad 129 with a fabric loop 196), the three-bar slider 192 may be rotated ninety-degrees relative to the common loop 186 such that the smaller dimension of the three-bar slider 192 is aligned with the internal through-hole of the common loop 186. Once aligned, the three-bar slider 192 may be inserted through the through-hole of the common loop 186 and rotated back to its nominal orientation to interlock the three-bar slider 192 and the common loop 186, as shown in FIG. 13B. To detach the three-bar slider 192 from the common loops 186, thereby detaching the inner end 184a of the chair 184 from the lumbar pad 129, the above steps may be performed in reverse order.

Referring to FIG. 14, a bag 198 may be attached to the external frame 102 by positioning a cradile 200 of the bag 198 over the upper cross member 110, routing common loops 202, 204 attached to the upper ends 118a, 120a of the sleeves 118, 120 through openings 206 formed in the cradle 200 (a right-end portion of the cradle is a mirror image of the depicted left-end portion of the cradle and thus is not shown for clarity purposes), and extending the lift straps 152, 154 exteriorly of the cradle 200. Once exposed through the openings 206, the common loops 202, 204 may be attached to corresponding connectors attached to the bag 198 to secure the bag 198 to the external frame 102 (the corresponding bag connectors are not shown). In some implementations, three-bar sliders (such as that shown in FIGS. 13A and 13B) may be attached to the bag 198 and may be interlocked with the common loops 202, 204 in the manner described above. Although not shown, the bag 198 also may be attached to lower portions of the external frame 102 via fabric loops, common loops, three-bar sliders, ladder locks, or other suitable connectors generally known in the art that may be attached to the sleeves 118, 120 (see FIG. 4). The depicted bag 198 includes a restrictable opening 208 (such as a drawstring opening), although various types of bags may be attached to the external frame 102.

FIG. 15 is a rear elevation view of the backpack 100 of FIG. 1 situated on a wearer’s back 114. With reference to FIG. 15, the external frame 102 may be contained within the envelope of a wearer’s back 114. In other words, the upright members 106, 108 (hidden within the sleeves 118, 120) may be positioned closer to one another than the width of the wearer’s back, resulting in weight savings and less bulk based in part on the reduced length of the cross members 110, 112. The smaller size of the external frame 102 also reduces the likelihood of a wearer hitting their elbows into the frame 102 and facilitates movement through tight places when hiking through brush and trees, for example. The upright members 106, 108 may extend above the upper cross member 110 to facilitate attaching a bag to the external frame 102, and the upright members may extend below the lower cross member 112 to facilitate attaching the waist belt 130 to the external frame 102, thereby stabilizing the backpack 100. The waist belt 130 may wrap around the hip bones, pelvis structure, or
both of the wearer to facilitate load transfer from the external frame to the hips and legs of the wearer.

The foregoing discussion has been presented for purposes of illustration and description and is not intended to limit the disclosure to the form or forms disclosed herein. For example, various features of the disclosure are grouped together in one or more aspects, embodiments, or configurations for the purpose of streamlining the disclosure. However, it should be understood that various features of the certain aspects, embodiments, or configurations of the disclosure may be combined in alternate aspects, embodiments, or configurations. For instance, although the sleeves are illustrated in association with the upright members, the sleeves may be used in association with the upright members and/or the cross members, which may be constructed of various materials. Moreover, the following claims are hereby incorporated into this Detailed Description by this reference, with each claim standing on its own as a separate embodiment of the present disclosure.

All directional references (e.g., proximal, distal, upper, lower, upward, downward, left, right, lateral, longitudinal, front, back, top, bottom, above, below, vertical, horizontal, radial, axial, clockwise, and counterclockwise) are only used for identification purposes to aid the reader’s understanding of the present disclosure, and do not create limitations, particularly as to the position, orientation, or use of this disclosure. Connection references (e.g., attached, coupled, connected, and joined) are to be construed broadly and may include intermediate members between a collection of elements and relative movement between elements unless otherwise indicated. As such, connection references do not necessarily infer that two elements are directly connected and in fixed relation to each other.

What is claimed is:

1. A backpack comprising:
   an external frame including a pair of upright members and a pair of cross members extending transversely to and attached to the pair of upright members; wherein the pair of upright members and the pair of cross members are constructed of a laminate structure having layers of carbon fiber and wood.

2. The backpack of claim 1, further comprising a sleeve positioned around each of the pair of upright members and extending along a majority of the length of the pair of upright members.

3. The backpack of claim 2, wherein each sleeve is attached to its respective upright member by the attachment of the pair of cross members to the pair of upright members.

4. The backpack of claim 2, further comprising a torso pad attached to each sleeve.

5. The backpack of claim 4, wherein each torso pad is pivotable relative to the pair of upright members.

6. The backpack of claim 4, further comprising a shoulder strap attached to each sleeve.

7. The backpack of claim 6, wherein a portion of each shoulder strap is slidably retained between a respective torso pad and sleeve.

8. The backpack of claim 1, further comprising a waist belt having an intermediate segment and a pair of padded end segments extending outwardly from the intermediate segment, wherein the intermediate segment defines a pair of pockets that receive lower ends of the pair of upright members.

9. The backpack of claim 8, further comprising a lumbar pad attached to one of the pair of cross members, folded around the intermediate segment of the waist belt, and attached to the pair of upright members to laterally and vertically restrain the waist belt relative to the external frame by maintaining the lower ends of the pair of upright members in the pair of pockets.

10. The backpack of claim 9, wherein the lumbar pad is thicker than the pair of padded end segments of the waist belt.

11. The backpack of claim 1, wherein:
   the pair of cross members comprises an upper cross member and a lower cross member spaced apart from the upper cross member; and
   the pair of upright members converge toward one another as the pair of upright members extend downwardly from the upper cross member to the lower cross member.

12. The backpack of claim 11, wherein the pair of upright members extend above the upper cross member to facilitate attachment of a bag to the external frame.

13. The backpack of claim 11, wherein the pair of upright members extend below the lower cross member to facilitate attachment of a waist belt to the external frame.

14. The backpack of claim 1, wherein the pair of upright members have curved profiles.

15. The backpack of claim 1, wherein the pair of upright members and the pair of cross members have rectangular cross sections.

16. The backpack of claim 1, wherein the pair of upright members and the pair of cross members are attached together by four one-degree-of-freedom joints to permit relative lateral movement of the external frame.

17. The backpack of claim 1, wherein the external frame is narrower in width than a wearer’s back.

18. A method of assembling a backpack having an external frame and a suspension system, the method comprising:
   positioning a sleeve having a closed end and an open end over an upright member of the external frame;
   positioning a cross member of the external frame transversely to the upright member such that a portion of the sleeve extends between the cross member and the upright member; and
   attaching the cross member to the upright member such that the sleeve is trapped between the cross member and the upright member.

19. The method of claim 18, wherein the upright member and the cross member are constructed of a laminate structure having layers of carbon fiber and wood.

20. The method of claim 18, further comprising attaching a torso pad to the sleeve such that the torso pad is pivotable relative to the upright member.

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