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(54) **SKI CORE**

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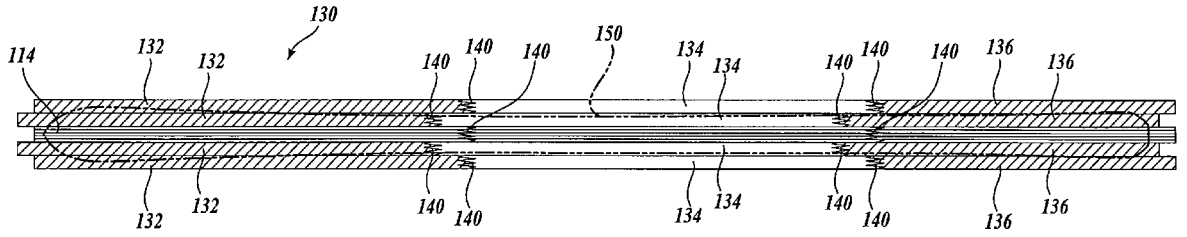
(57) **ABSTRACT**

A core (**130, 230**) for a gliding board (**100**) is disclosed having a forward shovel section (**132**), a middle waist section (**134**), and a rearward heel section (**136**). The shovel section and heel section are formed from a lower-density material than the waist section. In a particular embodiment, the core is formed from a plurality of elongate members (**112**) made by joining low-density wood sections (**132, 136**) to high-density middle sections (**134**). The sections may be joined using finger joints (**140**). A reinforcing member, such as an elongate bamboo member (**114**), may attach to the elongate members (**112**). The invention also encompasses skis (**100**) having such variable density cores (**130**).



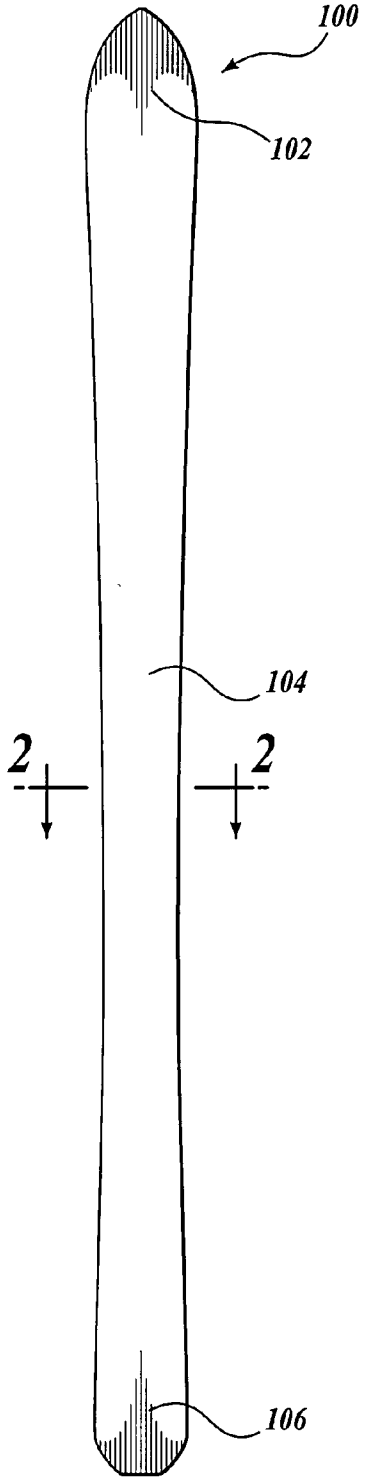


Fig. 1.

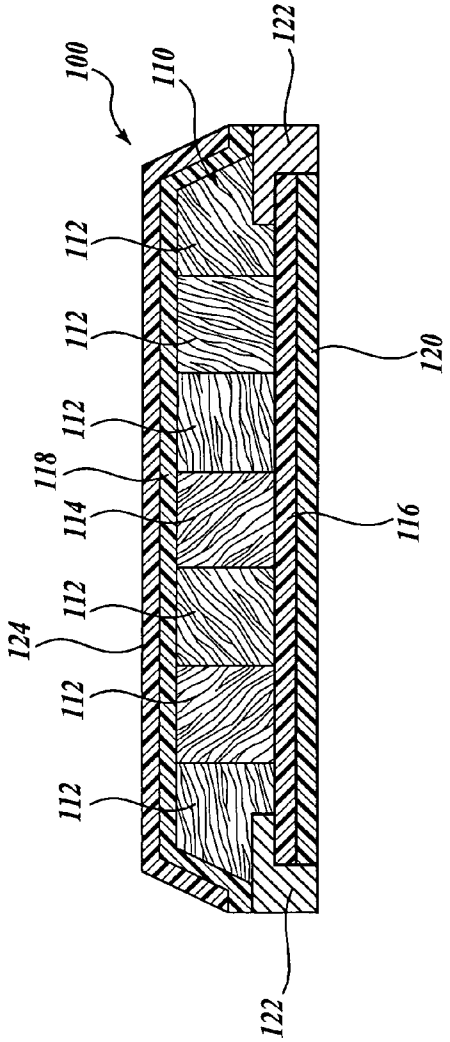

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Fig.2.

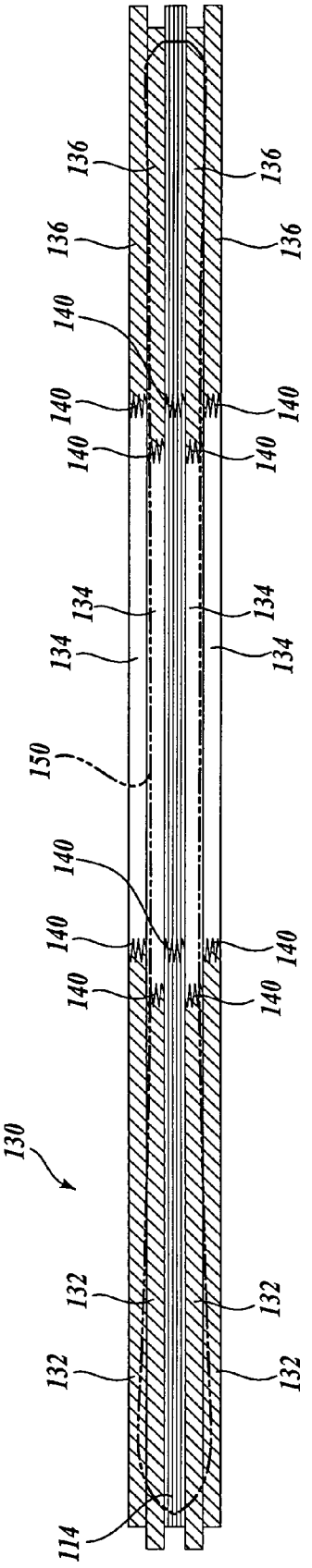
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Fig.3.

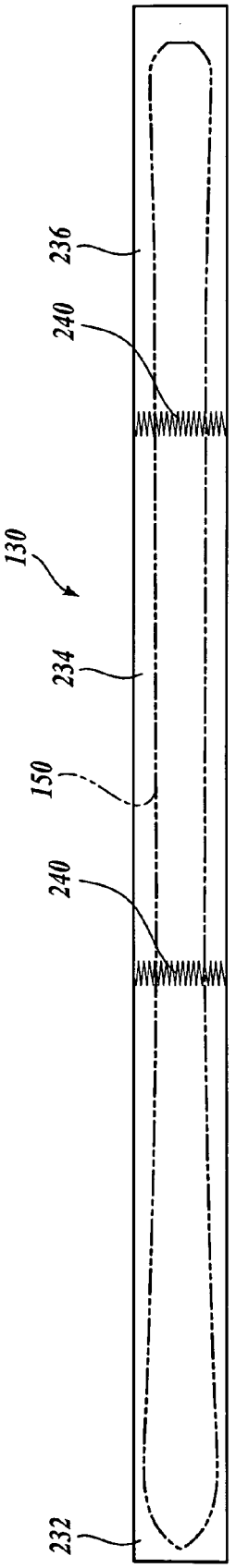

Fig. 4.

SKI CORE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application also claims the benefit of Provisional Application No. 60/527,508, filed Dec. 5, 2003, the benefit of which is hereby claimed under 35 U.S.C. § 119.

FIELD OF THE INVENTION

[0002] The present invention relates to snow skis and, in particular, to snow ski cores having spatially varying material properties.

BACKGROUND OF THE INVENTION

[0003] Snow skiing, including downhill skiing, cross-country skiing, and telemark skiing, is a popular and well-established winter sport in the United States and around the world. In recent years, snowboarding has also become very popular as an option to conventional downhill skiing. The design of skis and snowboards has evolved and continues to evolve to enhance the user's fun, safety, and capabilities in practicing the sport. For example, the planform shape, length, and edge design of skis have undergone continuing innovation and improvement. Also, the use of modern materials, including polymers and composite materials, has increased the ski artisan's options for designing skis that are sufficiently strong, flexible, and lightweight.

[0004] Skis and snowboards, sometimes referred to as gliding boards, are typically constructed with a wood core having a structural outer layer—for example fiberglass—laminated or otherwise attached to the core. Sometimes a synthetic core material may be used rather than wood—for example, a polymeric foam or honeycomb material, composite material, or the like. The structural outer layer may be formed from a reinforcing material—such as an epoxy fiberglass, molded polymer, or metal—and is disposed generally about the core material to achieve a ski that exhibits the desired strength, weight, flexion, and torsion characteristics. The reinforcing material may be formed from other materials, such as graphite, carbon, or the like. The base element or bottom portion of the ski, i.e., the portion that glides on the snow, is typically constructed of a sintered polyethylene material and may be laminated or molded to the bottom of the ski. Edges, typically made of metal such as steel or titanium, are secured to the lateral side edges, approximately coplanar with the bottom surface of the base element.

[0005] The structural outer layer may comprise upper and lower portions having sidewalls disposed therebetween wherein the upper and lower portions are bonded to the core and sidewalls, or the upper portion of the structural layer may be cap-shaped to include integral sidewalls and attach directly to the lower portion to form a box-beam type structure. The former method is commonly called "sandwich laminated construction"; the latter method is commonly called "cap construction" or "monocoque construction." Generally, cap construction provides certain aesthetic and structural advantages over sandwich laminated construction. Typically, a protective and/or decorative outer layer—that may be, for example, a transparent polyurethane—is attached over the top of the ski.

[0006] The performance, ease of use, and the feel of a ski in particular snow conditions are determined by certain physical properties of the ski. The length of a ski, its torsional and flexion properties, its weight and, in particular, its swing weight, its shape, the position and shape of the edges and the like, can all affect the user's experience using the ski. It will be appreciated that the selection of these various physical parameters involves design tradeoffs. For example, longer skis generally provide greater directional stability and generally provide a more stable gliding surface, but they are generally more difficult to use because they are more unwieldy to maneuver and have greater moment of inertia about the user's axis, i.e., a greater swing weight. In conventional skis, the swing weight may be reduced by shortening the length of the skis or by making the skis lighter. The length of the skis is important, however, for achieving good directional stability and a comfortable glide over the snow. For given materials, the minimum weight is typically limited by the need to provide sufficient strength and flexion in the ski. The swing weight of skis relates to how much energy or work is required to turn the skis about a pivot point—generally, the user's foot. It is therefore desirable to have a low swing weight to minimize the work associated with maneuvering the skis.

[0007] There remains a need for a ski having improved swing weight properties while maintaining desirable length, glide, strength, and flexibility characteristics.

SUMMARY OF THE INVENTION

[0008] A ski generally includes a forward shovel portion, a rearward heel portion, and a middle waist portion. The waist portion includes a binding mechanism for attaching to the user's boots and directly supports the user. The shovel and heel portions are disposed further away from the user and the pivot axis for the skis and, therefore, the weight in these sections contributes disproportionately to the swing weight of the ski. The present invention is directed to a gliding board, such as a ski and a core therefor, having relatively low-density shovel and heel portions and relatively high-density center sections.

[0009] In an embodiment of the invention, the core is made from laminated wood sections—for example, falcatta shovel and heel core sections and fir or aspen core sections in the waist portion.

[0010] In an embodiment of the invention, the core is made with a plurality of elongate members, each member having relatively low-density front and rearward sections and relatively high-density center sections, the elongate members being joined, for example, by bonding.

[0011] In an embodiment of the invention, the elongate members are formed by joining the low-density sections to the high-density section using finger joints and wherein the finger joints of adjacent elongate members are staggered.

[0012] In an embodiment of the invention, at least one elongate bamboo stringer is also attached to the elongate wood members to enhance the strength of the core.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The foregoing aspects and many of the attendant advantages of this invention will become more readily appreciated as the same become better understood by ref-

erence to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

[0014] **FIG. 1** is a plan view of a ski made in accordance with the present invention;

[0015] **FIG. 2** is a front cross-sectional view of the ski shown in **FIG. 1**, taken along cut **2-2**;

[0016] **FIG. 3** is a plan view of a core blank for the ski shown in **FIG. 1**; and

[0017] **FIG. 4** is a plan view of an alternate core blank for a ski according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0018] Refer now to the figures, wherein like numbers indicate like parts throughout the various figures. **FIG. 1** shows a plan view of a snow ski **100** made in accordance with the present invention. The present invention provides a ski having a relatively low swing weight and is therefore particularly suited for snow skis used for backcountry skiing, such as cross-country and telemark skiing. It will be readily appreciated, however, that the present invention may also be utilized for all forms of skiing, including alpine skiing, snowboarding, and the like. The ski **100** shown in **FIG. 1** includes a relatively wide front shovel section **102**, a tapered waist section **104**, and a relatively wide rearward heel section **106**. The waist section **104** is adapted to receive a binding (not shown) for securing a user's boot to the ski **100**. The tapered planform shown in **FIG. 1** provides well-known performance advantages, particularly for turning. However, other planforms are also known and may alternatively be utilized, including, for example, skis wherein the shovel, waist, and heel sections all share a common, constant width.

[0019] A front cross-sectional view of the ski **100** through line **2-2** of **FIG. 1** is shown in **FIG. 2**. In this embodiment, the ski **100** is formed utilizing a cap construction, including a central core **110**, that is substantially enclosed between a lower structural panel **116** and an upper structural cap **118**. The lower structural panel **116** and upper structural cap **118** may typically be formed from a fiberglass matrix and epoxy. A conventional base element **120**, which may be made from a suitable ski base material such as P-Tex®, is affixed to the ski **100** beneath the lower structural panel **116**. Ski edges **122** are disposed on either side of the ski **100** and may be made from any suitable material, and are commonly made of steel or titanium. A decorative and/or protective layer **124** is affixed to the upper structural cap **1118**, generally laminated thereto.

[0020] In the present invention, the core **110** of the present invention is made from a plurality of materials to achieve design goals including suitable strength, light weight, and flexibility. In the currently preferred embodiment, the core **110** is made from a plurality of laminated longitudinal members, including laminated wood longitudinal members **112** and a central bamboo member **114**. The outboard wooden members **112** are multi-component or composite members, as discussed below.

[0021] **FIG. 3** shows a plan view of a core blank **130** from which the core **110** shown in **FIG. 2** may be produced. The core blank **130** of **FIG. 3** includes four laminated longitudinal members **112** and an optional central bamboo member **114**. In the disclosed embodiment, each of the laminated longitudinal members **112** may be approximately square in cross-section. The laminated longitudinal members **112** of the disclosed core blank **130** may each include three sections—a forward or shovel portion **132**, a center or waist portion **134**, and a rearward or heel portion **136**. The shovel portions **132** and the heel portions **136** are preferably made from a lighter, less dense wood, such as falcatta. Falcatta is a particularly suitable wood because of its light weight, workability, and tolerance to moisture. The waist portions **134** are preferably made from a relatively sturdier, more dense wood, such as fir or aspen.

[0022] The shovel portions **132** are joined to the waist portions **134** using a finger joint **140** and a suitable adhesive to form a longitudinal member **112**. Although finger-type joints **140** are currently preferred due to their strength and ease of production, it will be readily appreciated by the artisan that other joining arrangements may alternatively be utilized, including, for example, scarf joints, three-dimensional finger joints, and joints made utilizing joining hardware such as plates, pegs, and the like.

[0023] The longitudinal members **112** are formed and multiple longitudinal members **112** are placed side-by-side and jointed together, preferably by laminating, to complete a core blank **130**. As shown in **FIG. 3**, an optional bamboo member **114** may be incorporated into the core blank **130**. In the preferred embodiment, a single bamboo member **114** is disposed centrally in the core blank **130** and may be similarly formed with finger joints **140** to achieve the desired length. The bamboo member **114** may alternatively be formed as a single unitary member. It is also contemplated that more than one bamboo member **114** may be utilized—for example, narrow bamboo members may be interposed between each of the longitudinal members **112**.

[0024] The finger joints **140** may be staged or staggered as shown in **FIG. 3**. The staggering may be conveniently accomplished by merely shifting adjacent longitudinal members **112** longitudinally to achieve a desired staggering. Alternatively, the various longitudinal members **112** may be formed with different finger joint **140** locations and assembled to achieve a desired layout of staggered joints. It will be appreciated that staggering the finger joints **140** such that portions of the more dense waist portions **134** overlap portions of the less dense shovel portions **132** and heel portions **136** will produce a more gradual longitudinal variation in the aggregate material properties, such as the flexibility and strength of the resulting core **10**. Clearly, the length and position of the relatively dense waist portions **134** are strategically selected to achieve the desired strength for the load-carrying portions of the ski **100**.

[0025] The broken line **150** shown in **FIG. 3** on the core blank **130** is an exemplary outline of a ski core **110** that may be cut from the core blank **130**. It will be appreciated that the denser waist portions **134** are located near the center of the ski **100**—the portion of the ski that must directly support the user's weight. The lighter, less dense shovel portions **132** and heel portions **136** are disposed at locations of the ski **100** that are furthest away from the user. Therefore, the overall weight of the ski may be reduced by utilizing a less dense core material for portions of the core **110**. It will be readily apparent to the artisan that by using a less dense material at

the ends of the ski, the swing weight of the ski is preferentially reduced, thereby reducing the torque that must be applied by a user to rotate the ski **100** during use.

[**0026**] It will also be appreciated that the optional bamboo section **114** increases the overall strength of the core **110** and therefore the ski **100**. In particular, bamboo has a very good strength-to-weight ratio that is similar to that of steel. The bamboo section **114**, therefore, will enhance the responsiveness of the ski **100** and its ability to withstand the forces exerted during use, and may permit the upper structural cap **118** and lower structural panel **116** to be of lighter construction. In particular, the bamboo section **114** advantageously provides additional support for the relatively low-density portions **132**, **136** of the core **130**.

[**0027**] A plan view of an alternative ski core blank **230** is shown in **FIG. 4**, wherein a shovel portion **232**, waist portion **234**, and a heel portion **236** are each formed as unitary sections that are joined together with finger joints **240**. The shovel portion **232** and heel portion **236** are preferably formed from a relatively less dense material, such as a low-density wood or foam, and the waist portion **234** is formed from a relatively high-density material such as a higher-density wood or foam. In this embodiment, there is no reinforcing bamboo section and the fabrication step of joining separate elongate portions may be eliminated. It will also be appreciated that, although the finger joints **240** are shown as transverse and perpendicular to the longitudinal axis of the blank, the finger joints **240** may be alternatively shaped and/or oriented. For example, the finger joints **240** may be angled or cut along a generally V-shaped profile. Of course, the core blank **230** may alternatively be sectioned down the middle and a bamboo member or other reinforcing member interposed therebetween.

[**0028**] Although the preferred embodiment is shown in the context of a ski made using cap construction techniques, the invention is equally applicable to other ski construction techniques, such as sandwich laminated construction. Alternatively, the invention may be practiced by first constructing the structural box beam comprising the lower structural panel **116** and upper structural cap **118** (**FIG. 2**) and injecting different density foams to form the waist, heel, and shovel core portions in situ, allowing the foams to set.

[**0029**] It will also be appreciated by one skilled in the art that other suitable materials may be used to form a ski core having a relatively higher-density waist section and relatively lower-density heel and/or shovel sections. For example, a variety of polymeric foams are known in the art that are suitable for ski cores. It is contemplated by the present invention, for example, that the ski core may be formed from one or more polymeric foams, such as polyurethane foam or a phenolic foam, and wherein the shovel and heel sections of the core are made (at least in part) from a lower-density foam and the waist section of the core is made from a higher-density foam or, alternatively, that portions of the ski core may be formed in whole or in part from relatively low-density foam materials and the waist section formed from a relatively dense wood.

[**0030**] It will be readily appreciated that, although the preferred embodiments discussed above utilizes a less dense core material for both the shovel portion **132** and the heel portion **136** of the ski **100**, it is contemplated by the present invention that alternatively, only the shovel portion **132** or only the heel portion **136** may be constructed utilizing the lower-density material, or that the shovel portion **132** may include a low-density material that is different from a low-density material used for the heel portion **136**.

[**0031**] Similarly, it is contemplated that the reinforcing bamboo center member **114** (**FIG. 3**) alternatively may be made from a different material having desirable strength, flexibility, and weight properties, including, for example, a metal member or a denser wood member.

[**0032**] Referring again to **FIG. 2**, it will be apparent that the core **110** may be produced by forming a plurality of variable-density, elongate members **112** by joining a section of relatively low-density first material, such as shovel portion **132** (**FIG. 3**), to the front of a section of relatively high-density second material, such as waist portion **134**, and joining another section of the relatively low-density first material, such as heel portion **136**, to the back of the section of the waist portion **134**, then forming a core blank **130** by laminating the plurality of variable-density, elongate members **112** together. The core **110** is then formed by cutting or otherwise shaping the core blank **130** to a desired core shape. The reinforcing elongate bamboo member **114** is preferably also included in the core blank **130**, as shown.

[**0033**] While the preferred embodiment of the invention has been illustrated and described, it will be appreciated that various changes can be made therein without departing from the spirit and scope of the invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A core for a gliding board comprising a front shovel section, a middle waist section and a rear heel section, wherein at least one of the core shovel section and the heel section is formed at least in part from a first material having a relatively low density and the middle waist section is formed at least in part from a second material having a relatively high density.

2. The core of claim 1, wherein the first and second materials are wood.

3. The core of claim 2, wherein the first material is falcatta and the second material is selected from fir and aspen.

4. The core of claim 2, wherein the core includes a plurality of elongate wood members, the elongate wood members comprising a relatively low-density wood front portion, a relatively low-density wood rear portion, and a relatively high-density wood middle portion, and wherein the front and rear portions are joined to the middle portion to form the elongate wood member.

5. The core of claim 4, wherein the front and rear portions are joined to the middle portion with a joint selected from finger joints, scarf joints, and three-dimensional finger joints.

6. The core of claim 5, wherein the plurality of elongate wood members is laminated together such that the joints of adjacent elongate wood members are staggered.

7. The core of claim 1, further comprising a central elongate strengthening member disposed substantially along the length of the core.

8. The core of claim 2, further comprising an elongate bamboo member that extends generally along the length of the core and comprises a portion of the front shovel section, the middle waist section, and the rear heel section.

9. The core of claim 4, further comprising an elongate bamboo member, wherein the plurality of elongate wood members and the elongate bamboo member are laminated together to form a core blank.

10. A ski comprising:

a core;

a lower structural member and an upper structural cap, the lower structural member and the upper structural cap substantially enclosing the core to define a reinforced core;

a base element attached to the reinforced core; and

an edge attached to the reinforced core, the edge having a lower surface that is substantially coplanar with the base element;

wherein the core comprises a front shovel section, a middle waist section, and a rear heel section, wherein the front shovel section and the rear heel sections are formed at least in part from a first material having a relatively low density and the waist section is formed at least in part from a second material having a relatively high density.

11. The ski of claim 10, wherein the first and second materials are wood.

12. The ski of claim 11, wherein the first material is falcatta and the second material is selected from fir and aspen.

13. The ski of claim 11, wherein the core includes a plurality of elongate wood members, wherein the elongate wood members comprise a relatively low-density wood front portion, a relatively low-density wood rear portion, and a relatively high-density wood middle portion, wherein the front and rear portions are joined to the middle portion to form the elongate wood member.

14. The ski of claim 13, wherein the plurality of elongate wood members is laminated together such that the finger joints of adjacent elongate wood members are staggered.

15. The ski of claim 10, further comprising an elongate strengthening member disposed substantially along the length of the core.

16. The ski of claim 15, wherein the elongate strengthening member is formed from bamboo, and comprises a portion of the front shovel section, the middle waist section, and the rear heel section.

17. The ski of claim 16 wherein the plurality of elongate wood members and the elongate strengthening member are laminated together to form a core blank.

18. A method of manufacturing a core for a gliding board comprising the steps of:

forming a plurality of variable-density elongate members by joining a section of relatively low-density first material to the front of a section of relatively high-density second material and joining another section of the relatively low-density first material to the back of the section of relatively high-density second material;

laminating the plurality of variable density elongate members together; and

cutting the blank to a desired core shape.

19. The method of claim 18, wherein the first material and second material are wood.

20. The method of claim 19, wherein the first material is falcatta and the second material is selected from fir and aspen.

21. The method of claim 19, wherein the sections of relatively low-density first material are joined to the section of relatively high-density second material with joints selected from finger joints, scarf joints, and three-dimensional finger joints.

22. The method of claim 21, wherein the joints of adjacent elongate members in the core blank are staggered.

23. The method of claim 19, further comprising the step of forming an elongate reinforcing member from a third material, and wherein the elongate reinforcing member is laminated to the plurality of variable density elongate members.

24. The method of claim 23, wherein the third material is bamboo.

* * * * *