

## TOY BUILDING UNIT

### Technical Field

[0001] The present disclosure relates to novel toy building units which provide for a range of play and learning experiences.

### Background Art

[0002] Toys, in all shapes and sizes, are enjoyed by many children (and adults) around the world. Playing with toys entertains children and can also positively contribute to their physical and mental development. Providing novel toys for children, particularly those that have potential to increase the variety of play possibilities and/or improve the child's tactile engagement and learning, would be a beneficial contribution to the art.

### Summary of Invention

[0003] In a first aspect, the present invention provides a building unit of a toy building set. The building unit comprises a sheet of a material that defines a net of a polyhedron, the sheet having a plurality of sections, each section being connected to another section with a hinge. The building unit is configured to fold at the hinges from a flat configuration into a polyhedron with a hollow interior. The building unit also comprises a plurality of joins on outer edges of the building unit, each join comprising one or more teeth configured to interleave with teeth of another join and releasably connect the sections of the building unit to form edges of the polyhedron. The sections, hinges and joins are all provided on one piece of the same material.

[0004] The present invention relates to building units for use with a toy building set and which are provided in the form of a sheet of a material that can be folded by users including children into a three dimensional polyhedron. Such toys may advantageously provide a user with a tactile learning experience gained during the formation of a three dimensional structure from a flat structure and, conversely, during the reformation of the flat structure. The polyhedron may subsequently be used in further play, both on its own and in combination with other toy elements disclosed herein.

[0005] In some embodiments, the or each hinge may comprise a groove on one surface of the building unit in the flat position and a ridge on an opposite surface of the building unit in the flat

position. Such a hinge structure may enable users (particularly children) to perform the necessary folding actions more easily.

[0006] Alternatively, the or each hinge may comprise a first groove on one surface of the building unit in the flat position and a second groove on an opposite surface of the building unit in the flat position.

[0007] Alternatively, the or each hinge may comprise a partial cut through the sheet of material. Such a hinge structure is simpler and hence easier to form than more complicated hinges.

[0008] Each of these hinge structures will be described in further detail below.

[0009] In some embodiments, the teeth of connected joins may be configured to interleave to form a closed edge of the building unit, with friction between the surfaces of interleaved teeth holding the building unit together in the closed position. In such embodiments, the friction fit edge may be configured to unpair by a pulling apart one or more interleaved teeth, enabling a user to readily close, open and flatten the building unit. In some embodiments, indicia, physical features or other marking on the building unit may be provided in order to indicate a join opposite a hinge on one or more of the sections.

[0010] In some embodiments, the joins may comprise curved, angled or straight teeth. In some embodiments, the joins may comprise teeth having one or more compressible projections. For example, at least one tooth may be configured to compress or deform in the closed position, such a deformation increasing the friction holding an edge of the building unit together and hence providing for a more secure closure.

[0011] In some embodiments, a gap or edge adapted to receive a user's fingertip may be provided in at least one section (e.g. in the form of a gap between interleaved teeth of a join, typically the join opposite the hinge of a given section), in order to make it easier for the user to break the friction fit and to reduce the likelihood of damage occurring to the teeth during repeated opening and closing of the building unit. In some embodiments, unpairing a friction fit edge may be easier to perform by applying a finger pull, or other force, on particular teeth or portions of the unit.

[0012] In some embodiments, at least one outer surface of the polyhedron may be receptive to hand-colouring with ink, pencil, crayon, chalk or water colour. Enabling a user to personalise the building unit however they like is expected to even further increase the available play opportunities.

[0013] In some embodiments, the building unit may comprise (or be formed of) cardstock, cardboard, bagasse, wood, laminate, plastic, vellum, rubber, foam, plasticized pulp, or pulp, or any combination thereof.

[0014] In some embodiments, one or more of the sections of the building unit may have a dimension that is  $N \times$  about 8mm, where  $N$  is a whole number. Building units having such a size are compatible with other toy systems, which enables yet more play opportunities as the building units can be co-mingled with parts of other toy systems.

[0015] In a second aspect, the present invention provides a building unit of a toy building set. The building unit comprises:

- at least four polygonal sections, wherein each section is connected to another section with at least one integral hinge,
- wherein the building unit is configured to fold and unfold over multiple cycles at the hinges from a flat position into a closed position which is a polyhedron with a hollow interior; wherein the tips and sides of at least two integral teeth comprise outer edges of the building unit in the flat position,
- wherein friction between the sides of the integral teeth holds the building unit in the closed position,
- wherein the tips of the one or more integral teeth are visible on the exterior of the building unit in a closed position.

[0016] In some embodiments, sides of teeth configured to engage in friction fit are configured with a design overlap which causes the sides to compress or deform in the closed position.

[0017] In some embodiments, the building unit (in the flat position) has an exterior surface, an interior surface and an outer edge, wherein the exterior surface is visible on the exterior of the building unit in the closed position, and wherein the exterior surface is a material receptive to a sticker or a pencil, crayon or ink drawing.

[0018] Additional features and embodiments of the second aspect of the present invention may be as described herein in the context of the first aspect of the invention.

[0019] Additional features and advantages of the building units of a toy building set will be described below in the context of specific embodiments. It is to be appreciated, however, that such additional features may have a more general applicability than that described in the context of these specific embodiments.

**Brief Description of Drawings**

[0020] Embodiments of the building units for a toy building set of the present invention will be described in further detail below with reference to the following drawings, in which:

[0021] Figure 1A illustrates a toy building unit in a flat configuration, according to some aspects of the disclosure;

[0022] Figure 1B illustrates the toy building unit of Figure 1A partially folded into a three-dimensional hollow unit;

[0023] Figure 1C illustrates the toy building unit of Figure 1A in a closed configuration;

[0024] Figure 2A illustrates a hinge of toy building unit, according to some aspects of the disclosure;

[0025] Figure 2B illustrates a hinge of toy building unit, according to some aspects of the disclosure;

[0026] Figure 3A illustrates joins of a toy building unit, according to some aspects of the disclosure;

[0027] Figure 3B illustrates joins of a toy building unit, according to some aspects of the disclosure;

[0028] Figure 3C illustrates joins of a toy building unit connecting to form a three-dimensional hollow unit, according to some aspects of the disclosure;

[0029] Figure 4A illustrates a toy building unit that is a cuboid in a flat configuration, according to some aspects of the disclosure;

[0030] Figure 4B illustrates the toy building unit of Figure 4A that is partially constructed as a cuboid in a three-dimensional hollow unit;

[0031] Figure 5A illustrates a toy building unit that is a square based pyramid in a flat configuration, according to some aspects of the disclosure;

[0032] Figure 5B illustrates the toy building unit of Figure 5A that is partially constructed as a square based pyramid in a three-dimensional hollow unit;

[0033] Figure 6A illustrates a toy building unit that is a triangular prism in a flat configuration, according to some aspects of the disclosure;

[0034] Figure 6B illustrates the toy building unit of Figure 6A that is partially constructed as a triangular prism in a three-dimensional hollow unit;

[0035] Figure 7A illustrates a toy building unit that is a domed cuboid in a flat configuration, according to some aspects of the disclosure;

[0036] Figure 7B illustrates the toy building unit of Figure 7A that is partially constructed as a domed cuboid in a three-dimensional hollow unit;

[0037] Figure 8A illustrates a toy building unit that is a half cylinder in a flat configuration, according to some aspects of the disclosure;

[0038] Figure 8B illustrates the toy building unit of Figure 8A that is partially constructed as a half cylinder in a three-dimensional hollow unit;

[0039] Figure 9A illustrates a toy building unit that is a quarter cylinder in a flat configuration, according to some aspects of the disclosure;

[0040] Figure 9B illustrates the toy building unit of Figure 9A that is partially constructed as a quarter cylinder in a three-dimensional hollow unit;

[0041] Figure 10A illustrates interleaving teeth of two joins from the view of an outside surface of a toy building unit in a three-dimensional hollow position, according to some aspects of the disclosure;

[0042] Figure 10B illustrates a partial front view of joined joins, according to some aspects of the disclosure;

[0043] Figure 10C illustrates an isometric view of un-joined join with two teeth, according to some aspects of the disclosure;

[0044] Figure 10D illustrates interleaving teeth of two joins from the view of a top outside surface of the toy building unit in a three-dimensional hollow position, according to some aspects of the disclosure;

[0045] Figure 11A illustrates interleaving two joins with a plurality of spike teeth from the view of an outside surface of the toy building unit in a three-dimensional hollow position, according to some aspects of the disclosure;

[0046] Figure 11B illustrates a partial front view of two joined joins with a plurality of spike teeth, according to some aspects of the disclosure;

[0047] Figure 11C illustrates an isometric view of un-joined join with a plurality of spike teeth, according to some aspects of the disclosure;

[0048] Figure 11D illustrates two joined joins with a plurality of spike teeth interleaving from the view of a top surface of the toy building unit in a three-dimensional hollow position, according to some aspects of the disclosure;

[0049] Figure 11E illustrates detailed interleaving of spike teeth, according to some aspects of the disclosure;

[0050] Figure 12A illustrates two joined ridge joins from the view of an outside surface of the toy building unit in a three-dimensional hollow position, according to some aspects of the disclosure;

[0051] Figure 12B illustrates a partial front view of two joined ridge joins, according to some aspects of the disclosure;

[0052] Figure 12C illustrates an isometric view of un-joined ridge join with curved ridge instead of teeth, according to some aspects of the disclosure;

[0053] Figure 12D illustrates a front view of an un-joined join with curved ridge instead of teeth, according to some aspects of the disclosure;

[0054] Figure 12E illustrates joined curved ridge joins from a top outside view of the toy building unit in a three-dimensional hollow position, according to some aspects of the disclosure;

[0055] Figure 13A illustrates a front view of an un-joined join with angled ridge instead of teeth, according to some aspects of the disclosure;

[0056] Figure 13B illustrates a partial front view of joined joins with angled ridges, according to some aspects of the disclosure;

[0057] Figure 13C illustrates an isometric view of un-joined join with angled ridge instead of teeth, according to some aspects of the disclosure;

[0058] Figure 14A illustrates teeth of two joins with design overlap, from the view of an outside surface of a toy building unit in a three-dimensional hollow position, according to some aspects of the disclosure;

[0059] Figure 14B illustrates a partial cross section view of the joins of Figure 14A;

[0060] Figure 14C illustrates a close-up view of the teeth and recess with design overlap of the joins of Figure 14A;

[0061] Figure 15 illustrates a close-up view of teeth and a recess with design overlap, according to some aspects of the disclosure;

[0062] Figure 16 illustrates a close-up view of tapered teeth and a recess with design overlap, according to some aspects of the disclosure;

[0063] Figure 17A illustrates a toy building unit in a flat configuration, according to some aspects of the disclosure;

[0064] Figure 17B illustrates an opposite side of the toy building unit of Figure 17A;

[0065] Figure 17C illustrates a partial cross section view of one of the hinges of the toy building unit of Figure 17B in a flat configuration;

[0066] Figure 17D illustrates a partial cross section view of the join of Figure 17C in a folded configuration;

[0067] Figure 17E illustrates the toy building unit of Figure 17A in a closed configuration;

[0068] Figure 18 illustrates a toy building unit in a closed configuration and including indicia, according to some aspects of the disclosure;

[0069] Figure 19 illustrates co-mingling of toy building unit, according to some aspects of the disclosure, with another toy system;

[0070] Figure 20 illustrates an example method of manufacturing the toy building unit, according to aspects of the disclosure.

[0071] Figure 21 illustrates an example method of manufacturing the toy building unit, according to aspects of the disclosure.

### **Description of Embodiments**

[0072] The overarching aim of the building units of the present invention is to provide users such as children with new toys and play opportunities, and preferably ones that can contribute to the children's tactile engagement and learning. In this regard, disclosed herein are building units of a toy building set. Each building unit comprises a sheet of a material that defines a net of a polyhedron, the sheet having a plurality of sections, each section being connected to another section with a hinge. The sheet of material is configured to fold at the hinges from a flat configuration into a polyhedron with a hollow interior. The building unit also comprises a plurality of joins on outer edges of the sheet of material, each join comprising one or more teeth configured to interleave with teeth of another join and releasably connect the sections of the building unit to form edges of the polyhedron. The sections, hinges and joins are all provided on one piece of the same material.

[0073] The building unit is initially provided in the form of flat sheet of material, which can be folded into a three dimensional shape for subsequent use. Such toys may advantageously provide a user with a tactile learning experience, gained during the formation of a polyhedron from its planar net shape. The product may subsequently be used in further play, both on its own and in combination with other toy elements disclosed herein.

[0074] As will be described in further detail below, these toy building units also contain a number of surfaces on which a user can draw or personalise in the manner described in further detail below. Furthermore, by having a hollow interior in the closed configuration, these toy building units may be used to contain other toys.

[0075] The building unit (more specifically the sheet of material) may be manufactured using a cutting process, a molding process, or combinations thereof. The building unit may comprise or be formed from cardstock, cardboard, bagasse, wood, laminate, plastic, extruded foam sheet, vellum, rubber, plasticized pulp, moulded pulp, pulp, or any combination thereof.

[0076] A wide variety of sheet material is suitable for cut units with cut hinges, and crimped hinges may also be suitable for some materials. For example, pulp (such as bagasse) is tray molded (not injection molded) and may be molded or pressed into sheets and cut, or may be molded into building units with integral hinges. White boxboard sheet and thermally pressed, tray molded pulp currently offers the highest quality/price combination of which the inventor is currently aware. Other suitable sheet materials include styrene sheets, polylactic acid (PLA) sheets or PLA foam which may be extruded into sheets.

[0077] Examples of plastic materials which may be used include poly(methyl methacrylate) (PMMA), nylons (e.g. polyamide), polycarbonate (PC), polyethylenes (e.g. PE, HDPE), polyoxymethylene (POM), polystyrene (PS), polybutylene adipate terephthalate (PBAT), polycaprolactone (PCL), polyhydroxyalkanoates (PHAs), polypropylene (PP), thermoplastic elastomers (e.g. TPS) and polylactic acid (PLA). Such plastics should be suitable for producing building units via injection moulding. Acrylonitrile butadiene styrene (ABS) is another plastic that has been used for other plastic toy blocks and is also likely to be useful in the present invention.

[0078] Bio-plastics, which are designed to substitute plant-based inputs for the petroleum inputs in polyethylene, polypropylene, polylactic acid and other plastics, may be a suitable long term sustainable alternative for building units which are injection molded or cut from sheeting. Composites of starch and bioplastic, wood and bioplastic, and other biomass and plastic composites are emerging materials that may also be suitable for building units.

[0079] As described above, the building unit includes a plurality of sections, each of which is connected to another section via a hinge. The hinges are foldable, thereby enabling the building unit to be folded by a user from its flat configuration into its three-dimensional polyhedron configuration.

[0080] The hinges may, for example, include (or be defined by) a groove on one surface of the building unit in the flat position and a ridge on an opposite surface of the building unit in the flat position. Such a hinge structure may enable users (particularly children) to perform the necessary folding actions more easily. Alternatively, the hinges may include (or be defined by) a first groove on one surface of the building unit in the flat position and a second groove on an opposite surface of the building unit in the flat position. Alternatively, the hinges may include (or be defined by) a partial cut through the sheet of material. Such a hinge structure is simpler and hence easier to form than more complicated hinges.

[0081] A groove which comprises a hinge structure may be formed by molding, cutting or applying pressure to the material.

[0082] The building unit also comprises a plurality of joins on outer edges of the building unit. Each join comprises one or more teeth configured to interleave with teeth of another join and thus releasably connect the sections of the building unit to form edges of the polyhedron.

[0083] The joins of the building unit may comprise curved or straight teeth. The joins may be configured to interlock with or without a design overlap, which requires teeth sides to compress to interleave and which may increase static friction to help retain the building unit in a closed position during play.

[0084] The teeth are an integral extension of the sections, where the one or more integral teeth, joins, and sections may have the same thickness and be configured so that the building unit in the flat position may be formed by a die cutting through a sheet of material. A building unit may be cut from a sheet of material by a laser cutter or a digital blade cutter.

[0085] The building unit is held in the closed position (i.e. in its polyhedron shape) by paired joins. The joins connect the sections of the building unit forming edge connections without adhesive to create the three-dimensional hollow building unit. The one or more interleaved teeth in a paired join may be configured to be visible on an exterior of the building unit in the closed position, in which configuration they can readily be opened by a user wanting to access an interior of the unit.

[0086] The closed position of the building unit is a predetermined polyhedron. In the building unit, the one or more interleaved teeth of the paired joins may be configured to engage with each other to form the predetermined polyhedron in response to a fold at the at least one hinge from the flat position into the closed position.

[0087] The building unit may for example comprise or be a cuboid unit. A cuboid unit comprises five hinges and fourteen joins. The fourteen joins, when closed, may form seven edges of the cuboid; and the five hinges form five edges of the cuboid. Other polyhedrons may be formed from the building units of the present invention, examples of which will be described below.

[0088] The building unit may also be a three-dimensional hollow building unit which may comprise a curved surface, for example, one created by a series of hinges in close proximity, or by a flexible sheet of material being constrained in a curved configuration.

[0089] In some embodiments, one or more of the sections of the building unit may have a dimension that is  $N \times$  about 8mm, where  $N$  is a whole number. As used herein, the term “about” is to be understood as meaning  $\pm 10\%$  of the recited value. Building units having such a size are compatible with other toy systems, such as those described below, thereby enabling additional play opportunities as the building units can be co-mingled with parts of other toy systems.

[0090] Also disclosed herein is a building unit of a toy building set, the building unit comprising at least two sections, wherein each section is connected to another section with at least one hinge, wherein a number of sections is equal to one plus a number of hinges, wherein the building unit is configured to fold over multiple cycles at the at least one hinge from a flat position into a at least one open position or a closed position, wherein the closed position is a three-dimensional position with a hollow interior.

[0091] The hinges may be configured as a groove on one surface of the building unit in the flat position and as ridges on an opposite surface of the building unit in the flat position.

Alternatively, the hinges may be provided as partial cuts through a sheet of material configured to be visible on an exterior of the building unit in the closed position. Alternatively, the hinges may be configured as a first groove on one surface of the building unit in the flat position and as a second groove on an opposite surface of the building unit in the flat position.

[0092] At least two joins integral to outer edges of the building unit in the flat position may be configured to be brought together in pairs to form edges of the building unit in the closed position.

[0093] The at least two joins may have one or more integral teeth.

[0094] The at least two sections, the at least one hinge, the at least two joins, and the one or more integral teeth may be in one piece.

[0095] The one or more integral teeth of paired joins may be configured to interleave to form a closed edge of the building unit in the closed position such that friction between surfaces of one or more interleaved teeth holds the building unit together in the closed position.

[0096] A friction fit edge may be configured to unpair by a pulling apart one or more interleaved teeth.

[0097] In all positions of the building unit, the one or more integral teeth may be configured to retain a fixed orientation relative to their integral join and their integral section.

[0098] The building unit in the flat position may have at least one point where two hinges meet two joins of a join pair; and wherein the one or more integral teeth of each join of the join pair are configured to interleave in a predetermined position. For example, the predetermined position may be a cuboid and a perimeter of the building unit in the flat position has at least one point where two hinges meet two joins at four right angles.

[0099] The one or more interleaved teeth in a paired join may be configured to be visible on an exterior of the building unit in the closed position.

[0100] The outer edges of the building unit in the flat position may be surfaces perpendicular to a top surface of the building unit in the flat position and perpendicular to a bottom surface of the building unit in the flat position.

[0101] Also disclosed herein is a building unit of a toy building set, the building unit comprising:

- at least four polygonal sections, wherein each section is connected to another section with at least one integral hinge,

- wherein the building unit is configured to fold and unfold over multiple cycles at the hinges from a flat position into a closed position which is a polyhedron with a hollow interior; wherein the tips and sides of at least two integral teeth comprise outer edges of the building unit in the flat position,

- wherein friction between the sides of the integral teeth holds the building unit in the closed position, and

- wherein the tips of the one or more integral teeth are visible on the exterior of the building unit in a closed position.

[0102] In all positions of the building unit, the tips of the one or more integral teeth may be configured to retain a fixed orientation relative to their integral section.

[0103] In the closed position, sides of teeth engaged in friction fit may be configured with design overlap which causes the sides to compress or deform.

[0104] The building unit in the flat position may have has an exterior surface, an interior surface, and an outer edge; wherein the exterior surface is visible on the exterior of the building unit in the closed position; wherein the exterior surface is a material receptive to pencil, crayon or ink drawing.

[0105] Specific forms of the building unit will be described below with reference to Figures 1 to 19.

[0106] Provided herein is a toy building unit for playing capable of folding from a flat configuration or position into a three-dimensional hollow configuration or position, held together only by friction. Methods of manufacturing the same are also described.

[0107] In some embodiments, the building unit 100 can be in a flat position 102, a partially constructed position, a three-dimensional hollow position 108, a closed position, or an open position. In some embodiments, the building unit 100 in a closed position can be the building unit in a three-dimensional hollow position 108. In some embodiments, the building unit 100 in an open position can be the building unit 100 in a partially constructed position such that at least one section 104 has an edge which is a join 110 that is not paired with (e.g., not connected with) another join 110. In some embodiments, closure of the building unit 100 (e.g., the building unit in a partially constructed position or a three-dimensional hollow position 108), can provide structural rigidity.

[0108] The building unit 100 includes a plurality of sections 104. In some embodiments, the building unit 100 can include 3 to tens, or any value or range between, or more sections 104. In some embodiments, the sections 104 can be, but are not limited to, square, rectangular, semicircular, triangular, oblong, pentagonal, hexagonal, diamond, trapezoidal, octagonal, or any other suitable shape. In some embodiments, the sections 104 can be rigid, flexible, or pliable, or capable of forming an arc. In some embodiments, the plurality of sections 104 can be delineated from and connected to at least one other section 104. In some embodiments, a section 104 can be connected to another section 104 by at least one hinge 106, the at least one hinge 106 being integral to the building unit 100. In some embodiments, integral can mean that the sections and the hinges are one piece of a same material. In some embodiments, integral can mean that the building unit 100 can be made such that all of the sections and all of the hinges are made of one

material that can start in a flat or two-dimensional position and fold into a three-dimensional hollow position 108. In some embodiments, integral can mean that hinges 106 can be part of the building unit 100 and can be manufactured in one piece of a same material, as shown in FIGS. 1-2, 3C, 4-9. In some embodiments, a section 104 can have an edge. In some embodiments, the edge of a section 104 can be on an outside perimeter of the toy building unit 100. In some embodiments, at least one edge of a section 104 can be a join 110.

[0109] The building unit 100 also includes a plurality of hinges 106. In some embodiments, the hinge 106 can be integral to the building unit 100. In some embodiments, the hinge 110 can be a living hinge. In some embodiments, the hinge 110 can be a partial cut. In some embodiments, the hinge 110 can be a small indent at a stress point aligned collinearly on the building unit 100 rather than cutting the thickness of the building unit 100. In some embodiments, the hinge can appear as a groove viewing one surface of the building unit 100 and a ridge when viewing the opposite surface of the building unit 100. In some embodiments, a hinge 106 can connect two sections 104 of the building unit 100. In some embodiments, the hinge 106 can bend to an angle when the building unit is in a three-dimensional hollow position 108. In some embodiments, the angle of the hinge 106 when the building unit is in a closed position 108 can be about a 15° angle to about a 200° angle or any range or value between. In some embodiments, one or more hinge 106 can be removed.

[0110] The building unit 100 also includes a plurality of joins 110 that include one or more teeth. Other joins envisaged include zip joins, finger joins or any other suitable join. In some embodiments, the joins 110 may be along the perimeter of the building unit 100. In some embodiments, the edges of a section 104 of a building unit 100 can include one or more joins 110 corresponding to one or more edges of the section. In some embodiments two joins 110 may be interleaved. In some embodiments, two joins 110 interleaved can hold together two or more sections 104 of the building unit 100. In some embodiments, two or more joins 110 can be reversibly opened and closed. In some embodiments, joins 110 enable closure of building unit in a three-dimensional hollow position 108. In some embodiments, joins 110 enable partial closure of building unit 100. In some embodiments, two or more joins 110 can be held together by friction. In some embodiments, closure of building unit 100 is enabled by friction among joins 110. In some embodiments, closure of building unit 100 is reversable and repeatable. In some embodiments, joins have one or more teeth 112.

[0111] In some embodiments, hinges 106 and joins 110 are features of the building unit 100 in a flat position 102 and of the building unit in a three-dimensional hollow position 108.

[0112] The building unit 100 includes one or more teeth 112 at each join 110 outlining the outer edges of sections 104 of the building unit. In some embodiments, teeth 112 can be integral to joins 110 and grip one or more opposing teeth 112 (e.g., teeth integral to another join 110 on another different section 104 such that the two joins are paired to form an edge of the building unit in a three-dimensional hollow position 108). In some embodiments a join 110 can include up to about 100 teeth 112 or any range or value between. In some embodiments the teeth 112 can be curved, angled, and / or straight. In some embodiments, teeth 112 can include ridges, grooves, spikes, protrusions, cavities, or other suitable shapes to enable paired joins to remain paired when the building unit is in a three-dimensional hollow position 108. In some embodiments, teeth 112 can have a thickness 113, a depth 114, and a width 115 (see Figure 10C).

[0113] In some embodiments, teeth have various widths and / or dimensions. In some embodiments, teeth 112 can be uniform or of different widths and depths. In some embodiments, teeth 112 can be rectangular. In some embodiments, teeth 112 can be rectangular rounded. In some embodiments, teeth 112 can be waves. In some embodiments, teeth 112 can be spikes. In some embodiments, teeth 112 can be protrusions. In some embodiments, teeth 112 can be latches. In some embodiments, joins 110 can comprise one or more angle-edge teeth 112, which function as a finger pull for ease of opening. In some embodiments the teeth 112 of the join 110 are rounded on two axes for smooth interleaving and reduced friction. In some embodiments the teeth 112 of the join 110 are rounded on one axis, which creates more friction than when teeth 112 are rounded on two axes. In some embodiments, there is friction where the teeth 112 of two joins 110 come together, with the inner teeth 112 along the join edge providing more friction.

[0114] In some embodiments, the thickness of joins 110 and depth of the teeth 112 can vary for each material of the building unit 100. In some embodiments the joins 110 can be about 0.2 mm to tens mm thick, or any range or value between. In some embodiments, teeth 112 can be the same thickness as the joins 110. In some embodiments, the width 115 of teeth 112 can range from about 2 mm to tens mm wide, or any range or value between (e.g. between about 2-25mm, such as about 5, 10, 15, 20 or 25 mm). In some embodiments, the depth 114 of teeth 112 can be about 0.2 mm to about 10 mm, or any range or value between (e.g. about 0.2, 0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10 mm). In some embodiments, the thickness 113 of teeth 112 can be about 0.2 mm to about 10 mm, or any range or value between (e.g. about 0.2, 0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10 mm).

[0115] In some embodiments, the thickness 113 of one or more of the teeth 112 of a join 110 on one section 104 can be the same as the depth 114 of one or more of the teeth 112 of another join 110 on another section 104 which, in a right angled join, presents a substantially continuous

surface across the interleaved teeth for the entirety of the join. In some embodiments, the depth and thickness of the teeth can vary relative to the thickness of the material (e.g., sheeting or molded material) of the toy building unit 100, whereas the width 115 of the teeth 112 can be a fraction of the entire length of an edge of a section. In some embodiments, the minimum and / or maximum thickness of joins 110 and / or teeth 112, depth of teeth 112, and width of teeth 112 can vary for each material. In some embodiments, the minimum and / or maximum thickness of joins and depth of teeth varies for each material of the building unit 100 such that the dimensions allow the building unit in a three-dimensional hollow position 108 to close properly and reversibly open.

[0116] The building unit 100 includes one or more edges. In some embodiments, the edges can be the edges of the sections 104. In some embodiments, the edges of the sections 104 of the building unit 100 can be a join 110. In some embodiments, the edges of the section 104 are un-joined joins 110. In some embodiments, the edges of the building unit 100 are un-joined joins 110. In some embodiments, the edges can be the edges of the three-dimensional hollow building unit 114. In some embodiments, the edges of the three-dimensional hollow building unit 114 can be a hinge 106 that connects two sections 104 of the building unit. In some embodiments, the edges of the three-dimensional hollow building unit 114 can be two joins 110 that come together (e.g., interleaved, paired, clicked in place, removably attached, held together by friction, and the like) to form an edge of the three-dimensional hollow building unit 114.

[0117] The closed joins 110 hold the building unit in a three-dimensional hollow position 108. In some embodiments, the closed joins 110 connect the sections 104 of the building unit 100 to each other predominantly by static friction so that the resulting polyhedron remains closed during play. In other words, in some embodiments, the building unit in a three-dimensional hollow position 108 remains closed by the static friction force in the closed joins 110 and thus there is no need for glue, tucking, magnets, or any other means. In some embodiments, the closed joins 110 may be pulled open by an intentional manual force to return the building unit 100 unit to a flat position 102. In some embodiments, the transition between the building unit 100 in a flat position 102 with open joins to the building unit in a three-dimensional hollow position 108 with closed joins 110 is reversible and repeatable. In some embodiments, the transition between the building unit 100 in a flat position 102 with open joins to the building unit in a three-dimensional hollow position 108 with closed joins 110 is partially reversible and repeatable such that some sections 104 feature joins 110 that can be opened and closed in a reversible and repeatable manner, while other sections 104 feature joins 110 that cannot be opened and closed in a reversible and repeatable manner.

## Shapes

[0118] The building unit 100 is foldable from a flat position 102 into a three-dimensional hollow position 108. The building unit in a flat position 102 can be described using the mathematical concept of a two-dimensional (2D) net, where the building unit can be described as a net, a 2D net, a net of a solid, a net of a polyhedron, a cut-out, a stencil, a paper sheet, or the like. A net is an arrangement of non-overlapping edge-joined polygons in the plane which can be folded (along edges) to become the faces of the polyhedron. Many different nets can exist for a given polyhedron, depending on the choices of which edges are joined and which are folded. Nets are known. For example, there are eleven nets of a cube, wherein each net is a unique arrangement of sections 104 of the net.

[0119] In some embodiments, the building unit 100 can be a cuboid, square based pyramid, triangular prism, domed cuboid, half cylinder, quarter cylinder, or any other three-dimensional shape (e.g., any polyhedron). In some embodiments, a three-dimensional hollow position 108 of the building unit 100 can be a cuboid, square based pyramid, triangular prism, domed cuboid, half cylinder, quarter cylinder, or any other three-dimensional shape (e.g., any polyhedron).

[0120] In some embodiments, the building unit 100 can be a cuboid. In some embodiments, the cuboid can be a cube where the ratio of width:length:height is equal. For example, in some embodiments that cuboid can be about 10 to about 1000 mm in width, length, and height. In some embodiments a cuboid can be an extended cube where one dimension of the width:length:height ratio is extended. In some embodiments, a cuboid can be a rectangular prism where one or more dimension of the width:length:height ratio is extended. In some embodiments, the cuboid unit can include five hinges 106 and fourteen joins 110. In some embodiments, the building unit 100 of the cuboid unit can include six sections 104. In some embodiments, the fourteen joins 110, when closed, form seven edges of the cuboid (e.g., edge of the three-dimensional hollow building unit 114) and the five hinges 106 form five edges of the cuboid (e.g., edge of the three-dimensional hollow building unit 114). In some embodiments, the width of the cuboid can be about 10 mm to about 1000 mm. In some embodiments, the length of the cuboid can be about 10 mm to about 1000 mm. In some embodiments, the height of the cuboid can be about 10 mm to about 1000 mm.

[0121] In some embodiments, the building unit 100 can be a square based pyramid which can, for example, include four hinges 106, eight joins 110 and five sections 104. In such embodiments, the eight joins 110, when closed, form four edges of the square based pyramid (e.g., edge of the three-dimensional hollow building unit 114), and the four hinges 106 form four

edges of the square based pyramid (e.g., edge of the three-dimensional hollow building unit 114).

[0122] In some embodiments, the building unit 100 can be a triangular prism which can, for example, include four hinges 106, ten joins 110 and five sections 104. In such embodiments, the ten joins 110, when closed, form five edges of the triangular prism (e.g., edge of the three-dimensional hollow building unit 114), and the four hinges 106 form four edges of the triangular prism (e.g., edge of the three-dimensional hollow building unit 114).

[0123] In some embodiments, the building unit in a three-dimensional hollow position 108 can include a volume with a cylindrically curved surface, with one section that curves into a three-dimensional position by flexing the material of the building unit 100 to connect to an adjoining section 104 on which the join 110 is curved. The flexibility of the curved section 104 can be enabled by the use of a flexible material to make the building unit 100, or by adding features such as ribbing or cuts into a rigid material.

[0124] In some embodiments, the building unit 100 can be a domed cuboid which can, for example, include five hinges 106, fourteen joins 110 and six sections 104. In some embodiments, the fourteen joins 110, when closed, form seven edges of the domed cuboid (e.g., edge of the three-dimensional hollow building unit 114), and the five hinges 106 form five edges of the domed cuboid (e.g., edge of the three-dimensional hollow building unit 114).

[0125] In some embodiments, the building unit 100 can be a half cylinder which can, for example, include three hinges 106, six joins 110 and four sections 104. In such embodiments, the six joins 110, when closed, form three edges of the half cylinder (e.g., edge of the three-dimensional hollow building unit 114), and the three hinges 106 form three edges of the half cylinder (e.g., edge of the three-dimensional hollow building unit 114).

[0126] In some embodiments, the building unit 100 can be a quarter cylinder which can, for example, include four hinges 106, ten joins 110 and five sections 104. In such embodiments, the ten joins 110, when closed, form five edges of the quarter cylinder (e.g., edge of the three-dimensional hollow building unit 114), and the four hinges 106 form four edges of the quarter cylinder (e.g., edge of the three-dimensional hollow building unit 114).

[0127] In some embodiments, any shape or configuration could be used.

### Materials

[0128] The toy building unit 100 can be made of a material suitable for method of manufacturing a toy building unit 100 that is capable of folding from a flat position 102 into a three-dimensional

hollow position 108 wherein the building unit 100 can include a plurality of sections 104, wherein the plurality of sections 104 can be delineated from and connected to at least one other section 104 with a hinge 106 that is integral to the building unit, a plurality of joins 110 (which are the outer edges of the building unit) outlining the building unit 100, wherein the joins 110 can connect the sections 104 of the building unit 100 forming edges of the closed three-dimensional hollow building unit 108.

[0129] In some embodiments, the building unit 100 can be made of a material selected from cardstock, cardboard, bagasse, wood, wood sheeting, particle board, laminate, plastic, plastic sheeting, vellum, vellum paper, rubber, foam sheeting, vinyl sheeting, rubber sheeting, plasticized pulp, pulp, recycled pulp, or any combination thereof. In some embodiments, a pulp can be, for example, paper pulp, bagasse pulp, hemp pulp, bamboo pulp, wood pulp, or any combination thereof. In some embodiments, the building unit 100 can be made of a material that further includes a resin. In some embodiments, a resin can be, for example, polyester resin, phenolic resin, alkyd resin, polycarbonate resin, polyamide resin, polyurethane resin, silicone resin, epoxy resin, UV resin, or combinations thereof. In some embodiments, the building unit 100 can be made of a material that includes coatings. In some embodiments, coatings can include wax, plastic, bioplastic, or combinations thereof. In some embodiments, the building material 100 can be made of a material that includes one or more additives. In some embodiments, the building unit 100 can include a laminate of one or more material. In some embodiments, a laminate can be two or more layers of different materials, often with a plastic being the outer layer, e.g., laminated paper can be a plastic layer bonded to a paper layer, and laminated wood is generally a plastic layer bonded to a wood layer (could be three layers chip board, wood veneer, then plastic). In some embodiments, one or more additives can include resin, coatings, colorants, stabilizers, a laminate, and the like.

[0130] In some embodiments, the building unit 100 can include material, or a coating applied therein, that is receptive to a marking. Example markings can include pencil, crayon, chalk, paint, or ink drawing. In some embodiments, the building unit 100 can be configured to be washable or erasable after certain markings are applied. In further embodiments, the building unit 100 can be configured to be resistant to the application of certain markings. In some embodiments, a marking can be applied to the building unit 100 at manufacture. In further embodiments, the applied marking can be invisible until chemically activated. For example, the building unit 100 can include a surface configured to activate normally invisible ink. In another example, the building unit 100 can depict an image, color, or pattern when wet.

Manufacturing

[0131] Provided herein in some embodiments are methods of manufacturing the toy building unit 100 disclosed herein.

[0132] In some embodiments, the toy building unit 100 can be manufactured from a single sheet of material. In some embodiments, the method can include cutting a building unit 100 from a single sheeting material; forming a plurality of hinges 106; and forming from the edge of a segment of the building unit, a plurality of joins. In some embodiments, the cutting process can be die cutting, blade cutting, laser-cutting, or combinations thereof. In some embodiments, the hinges 106 can be formed by crease scoring the material. In some embodiments, the hinges 106 can be formed by cut scoring the material. In some embodiments, the building unit 100 manufactured by die cutting, laser-cutting, crease scoring, cut scoring, and combinations thereof can be made of cardstock, plastic sheeting, wood sheeting, bagasse sheeting, foam sheeting, particle board, vellum paper, cardboard, paper, vinyl sheeting, rubber sheeting and laminates of any of these materials. In some embodiments, the method can include cutting a plurality of teeth 112 from the edge of a section 104 of the building unit 100. In some embodiments, the method can include a straight edge. In some embodiments, the straight edge can crease score or cut score the building unit 100 to form the hinges 106. In some embodiments, the method can be digital.

[0133] In some embodiments, the method of manufacturing a toy building unit 100 can include forming, by a molding process of a material, a building unit that can include a plurality of sections 104, wherein the plurality of sections 104 can be delineated from and connected to at least one other section with a hinge that is integral to the building unit 100; and a plurality of joins 110 along the outer edges of the building unit 100. In some embodiments, the joins 110 can comprise one or more, or a plurality of teeth 112. In some embodiments, the molding process of the material can include injection molding (see e.g., [https://en.wikipedia.org/wiki/Injection moulding](https://en.wikipedia.org/wiki/Injection_moulding)). Suitable materials for injection molding can include plastic, bioplastic, rubber, or combinations thereof.

[0134] In some embodiments, the molding process of material can include wet pressing, dry pressing, transfer molding, thermoforming, or combinations thereof (see e.g., *Moulded Pulp Manufacturing: Overview and Prospects for the Process Technology Article in Packaging Technology and Science*, February 2017). Suitable materials for wet pressing, dry pressing, transfer molding, thermoforming, or combinations thereof can include paper pulp, bagasse pulp, hemp pulp, bamboo pulp, wood pulp, recycled pulp, or combinations thereof. Suitable materials

for wet pressing, dry pressing, transfer molding, thermoforming, or combinations thereof can further include resins, wax, plastic, bioplastic, or combinations thereof.

[0135] In some embodiments the method can include a waterproofing step.

[0136] In some embodiments the method can be three-dimensional printing.

## EXAMPLES

[0137] The figures provided herein illustrate the toy building unit 100 and features thereof according to some embodiments of the present disclosure. The figures show combination with hinges 106 and joins 110, but any combination of joins 110 and hinges 106 can be used.

[0138] FIG. 1 illustrates a cuboid toy building unit 100 in the flat position 102, partially constructed position, in the three-dimensional hollow building unit 108, according to some embodiments of the present disclosure. FIG. 1A illustrates a toy building unit in a flat position 102, where the toy building unit 100 includes five hinges 106. The toy building unit 100 also includes six sections 104 and fourteen joins 110, which outline the sections 104 of the building unit in a flat position 102. The join 110 includes teeth 112 as shown in FIG. 1. FIG. 1B illustrates a toy building unit 100 partially folded into a three-dimensional hollow unit, according to some aspects of the disclosure. Joins 110 of the building unit 100 can come together (e.g., interleave) and form an edge of the three-dimensional hollow building unit 114 as shown in FIG. 1B-C. FIG. 1C illustrates a toy building unit in a closed position.

[0139] FIG. 2 illustrates hinge 106 of the toy building unit 100. In some embodiments, the hinge 106 can be recessed such that a 45° angle can be formed when the building unit is in a flat position 102 as shown in FIG. 2A. In some embodiments, the hinge 106 can form a 90° angle when the building unit 100 is in a partially constructed position or in a three-dimensional hollow position 108 as shown in FIG. 2A. In some embodiments, the hinge 106 can be recessed such that a 22.5° angle can be formed when the building unit is in a flat position 102 as shown in FIG. 2B. In some embodiments, the hinge 106 can form a 45° angle when the building unit 100 is in a partially constructed position or in a three-dimensional hollow position 108 as shown in FIG. 2B. In some embodiments, the hinge 106 can form an angle that can be about a 15° angle up to a 150° angle or any range or value between when the building unit 100 is partially constructed position or in a three-dimensional hollow position 108.

[0140] FIG. 3 illustrates various join 110 designs on the toy building unit 100 according to some embodiments. FIG. 3A illustrates a close-up view of joins and teeth with 1.5mm thick side walls

which may be die cut from plastic sheeting, cardstock, wood, laminate, for example. In some embodiments, the toy building unit 100 can include one or more sections 104 with one or more joins 110, which can include one or more teeth 112 as shown in FIG. 3A. In some embodiments, the join 110 can have four or five teeth 112 as shown in FIG. 3A. In some embodiments, the teeth 112 can be cut perpendicular to the surface 104 as shown in FIG. 3A. FIG. 3B illustrates a close-up view of molded joins with teeth 112 of lower granularity, 3mm thick side walls which may be implemented in injection molded plastic, tray molded bagasse pulp, injection molded rubber, for example. FIG. 3B also illustrates an angled-edge teeth 112 design that functions as a finger pull for ease of opening, according to some embodiments. FIG. 3B illustrates rounded edges along two directions of the teeth 112 to enable smooth interleaving and reduce friction. In some embodiments, rounded edges can be along one edge of the teeth 112 (not shown) to decrease friction over the embodiment depicted in FIG. 3B.

[0141] FIG. 3C illustrates joins 112 of a toy building unit connecting to form a three-dimensional hollow unit 108, according to some aspects of the disclosure. FIG. 3C shows a view of the building unit in three-dimensional hollow position 108, the building unit 100 has hinges 106, sections 104, joins 110, teeth 112, and edges of the three-dimensional hollow building unit 114. Two or more sections 104 of the building unit 100 can connect, where the edge of the three-dimensional hollow building unit 114 is connected by joins as shown by Edge(AB) 114 in FIG. 3C. In some embodiments, the edge of the three-dimensional hollow building unit 108 can be a hinge 106 between two sections 104. In some embodiments, Edge(AB) 114 can connect two sections 104. One section can be, for example, Section A 104 and another section can be, for example, Section B 104, as shown in FIG. 3C. In some embodiments, Edge(AB) 114 can connect Section A 104 and Section B 104, as shown in FIG. 3C. In some embodiments, an edge of the three-dimensional hollow building unit 114 can be formed by the pairing of two joins 110. In some embodiments, the edge of the three-dimensional hollow building unit 114 can be Edge(AB). In some embodiments, the two joins 110 can be Join A 110 and Join B 110, as shown in FIG. 3C. In some embodiments, Edge(AB) 114 can be formed by the pairing of Join A 110 and Join B 110, as shown in FIG. 3C. In some embodiments, the width of the teeth 112 of one join 110 can be longer than the width of the teeth 112 of another join 110. In some embodiments, the thickness of the teeth 112 of one join 110 can be equal and / or about equal to the depth of the teeth 112 of another join 110. In some embodiments, the width of the teeth 112 in Join A 110 can be longer than the width of the teeth in Join B 110, and the thickness of the teeth 112 in Join A can be equal and / or about equal to the depth of the teeth 112 in Join B 110, as shown in FIG. 3C. In some embodiments, two teeth 112 on section A 104 can be about 15 mm wide, about 2

mm thickness, and about 2 mm depth. In some embodiments, three teeth 112 on section B 104 can be about 5 mm wide, about 2 mm thick, and about 2 mm depth. In some embodiments, teeth have various widths and / or dimensions.

[0142] FIG. 4 illustrates a cuboid toy building unit 100 in the flat position 102 and in a partially constructed position, according to some embodiments of the present disclosure. FIG. 4A illustrates a toy building unit in a flat position 102, which includes five hinges 106, as illustrated in dotted lines in FIG. 4. In some embodiments, the toy building unit 100 can include six sections 104 as shown in FIG. 4. In some embodiments, the toy building unit 100 can include fourteen joins 110 as shown in FIG. 4. In some embodiments, the joins can outline the sections 104 of the building unit in a flat position 102. In some embodiments, the join 110 can include teeth 112 as shown in FIG. 4. FIG. 4B illustrates a toy building unit 100 partially folded into a three-dimensional hollow unit. In some embodiments, joins 110 of the building unit 100 can come together (e.g., interleave) and form an edge of the three-dimensional hollow building unit 114 as shown in FIG. 4B.

[0143] FIG. 5 illustrates a square based pyramid building unit 100 in the flat position 102 and in a partially constructed position, according to some embodiments of the present disclosure. FIG. 5A illustrates a toy building unit in a flat position 102, which includes four hinges 106, as illustrated by dotted lines in FIG. 5. In some embodiments, the toy building unit 100 can include five sections 104 as shown in FIG. 5. In some embodiments, the toy building unit 100 can include eight joins 110 as shown in FIG. 5A. In some embodiments, the joins can outline the sections 104 of the building unit in a flat position 102. In some embodiments, the join 110 can include teeth 112 as shown in FIG. 5. FIG. 5B illustrates a toy building unit 100 partially folded into a three-dimensional hollow unit. In some embodiments, joins 110 of the building unit 100 can come together (e.g., interleave) and form an edge of the three-dimensional hollow building unit 114 as shown in FIG. 5B.

[0144] FIG. 6 illustrates a triangular prism building unit 100 in the flat position 102 and in a partially constructed position, according to some embodiments of the present disclosure. FIG. 6A illustrates a toy building unit in a flat position 102, which includes four hinges 106, as illustrated by dotted lines in FIG. 6. In some embodiments, the toy building unit 100 can include five sections 104 as shown in FIG. 6A. In some embodiments, the toy building unit 100 can include ten joins 110 as shown in FIG. 6A. In some embodiments, the joins can outline the sections 104 of the building unit in a flat position 102. In some embodiments, the join 110 can include teeth 112 as shown in FIG. 6. FIG. 6B illustrates a toy building unit 100 partially folded into a three-dimensional hollow unit. In some embodiments, joins 110 of the building unit 100 can come

together (e.g., interleave) and form an edge of the three-dimensional hollow building unit 114 as shown in FIG. 6B.

[0145] FIG. 7 illustrates a domed cuboid building unit 100 in the flat position 102 and in a partially constructed position, according to some embodiments of the present disclosure. FIG. 7A illustrates a toy building unit in a flat position 102, which includes five hinges 106, as illustrated by dotted lines in FIG. 7A. In some embodiments, the toy building unit 100 can include six sections 104 as shown in FIG. 7A. In some embodiments, the toy building unit 100 can include fourteen joins 110 as shown in FIG. 7A. In some embodiments, the joins can outline the sections 104 of the building unit in a flat position 102. In some embodiments, the join 110 can include teeth 112 as shown in FIG. 7. FIG. 7B illustrates a toy building unit 100 partially folded into a three-dimensional hollow unit. In some embodiments, joins 110 of the building unit 100 can come together (e.g., interleave) and form an edge of the three-dimensional hollow building unit 114 as shown in FIG. 7B.

[0146] FIG. 8 illustrates a half cylinder building unit 100 in the flat position 102 and in a partially constructed position, according to some embodiments of the present disclosure. FIG. 8A illustrates a toy building unit in a flat position 102, which includes three hinges 106, as illustrated by dotted lines in FIG. 8A. In some embodiments, the toy building unit 100 can include four sections 104 as shown in FIG. 8A. In some embodiments, the toy building unit 100 can include six joins 110 as shown in FIG. 8A. In some embodiments, the joins can outline the sections 104 of the building unit in a flat position 102. In some embodiments, the join 110 can include teeth 112 as shown in FIG. 8. FIG. 8B illustrates a toy building unit 100 partially folded into a three-dimensional hollow unit. In some embodiments, joins 110 of the building unit 100 can come together (e.g., interleave) and form an edge of the three-dimensional hollow building unit 114 as shown in FIG. 8B.

[0147] FIG. 9 illustrates a quarter cylinder building unit 100 in the flat position 102 and in a partially constructed position, according to some embodiments of the present disclosure. FIG. 9A illustrates a toy building unit in a flat position 102, which includes four hinges 106, as illustrated by dotted lines in FIG. 9A. In some embodiments, the toy building unit 100 can include five sections 104 as shown in FIG. 9A. In some embodiments, the toy building unit 100 can include ten joins 110 as shown in FIG. 9A. In some embodiments, the joins can outline the sections 104 of the building unit in a flat position 102. In some embodiments, the join 110 can include teeth 112 as shown in FIG. 9. FIG. 9B illustrates a toy building unit 100 partially folded into a three-dimensional hollow unit. In some embodiments, joins 110 of the building unit 100 can come

together (e.g., interleave) and form an edge of the three-dimensional hollow building unit 114 as shown in FIG. 9B.

[0148] FIG. 10 illustrates example joins 110, for which the static friction can hold the building unit 100 together in a three-dimensional hollow position 108, according to some embodiments. FIG. 10A illustrates interleaving teeth 112 of two joins 110 from the view of an outside surface of the toy building 100 unit in a three-dimensional hollow position 108, according to some aspects of the disclosure. FIG. 10B illustrates a partial front view of joined joins 110, according to some aspects of the disclosure. In some embodiments, joins 110 can meet at right angles ( $90^\circ$  angle), as shown in FIG. 10A-B and FIG. 10C. In some embodiments, the joins can meet at angles other than  $90^\circ$  angle (e.g., from about a  $15^\circ$  angle up to a  $150^\circ$  angle or any range or value between). FIG. 10C illustrates an isometric view of un-joined join 110 with two teeth 112. FIG. 10D illustrates interleaving teeth 112 of two joins 110 from the view of a top outside surface of the toy building unit in a three-dimensional hollow position 108. The interleaving teeth 112 are formed by one or more tips 112a, sides 112c and recesses 112b. The recesses 112b can be configured to interface with some portion of another interleaving tooth. In some embodiments, interleaving teeth 112 can enable friction to retain joins 110 such that the building unit 100 remains in a closed position, as shown partially in FIG. 10A and FIG. 10D. In some embodiments, the toy building unit 100 shown in FIGs. 10A-D can be manufactured using cutting or molding processes described herein and known in the art.

[0149] FIG. 11 illustrates example views of the toy building unit 100 with joins 110 that include a plurality of spike teeth 112 according to some embodiments of the present disclosure. FIG. 11A illustrates interleaving two joins 110 with a plurality of spike teeth 112 from the view of an outside surface of the toy building unit in a three-dimensional hollow position 108. FIG. 11B illustrates a partial front view of two joined joins 110 with a plurality of spike teeth 112. In some embodiments, interleaving teeth 112 are not visible from the view of the outside surface of the toy building unit in a three-dimensional hollow position 108, as shown in FIG. 11A. In some embodiments, the teeth 112 of two joins 110 of the building unit 100 can come together at multiple points, such that the interleaving teeth 112 are visible from a front view of interleaving joins 110, as illustrated in FIG. 11B. FIG. 11C illustrates an isometric view of un-joined join 110 with a plurality of spike teeth 112. In some embodiments, the teeth 112 of the join 110 of the building unit 100 can be spikes, protrusions, jagged edges, barbs, catches, and the like (as shown in FIG. 11C and FIG. 11E), which can enable friction to retain joins 110 in a closed position. In some embodiments, styles of teeth 112 that include spikes, protrusions, jagged edges, barbs, catches, and the like can be manufactured using molding processes described herein and known

in the art. FIG. 11D illustrates two joined joins 110 with a plurality of spike teeth interleaving from the view of a top surface of the toy building unit in a three-dimensional hollow position 108. In some embodiments, interleaving teeth 112 are not visible from the top view of the toy building unit in a three-dimensional hollow position 108, as shown in FIG. 11D. FIG. 11E illustrates detailed interleaving of spike teeth 112. Three interleaving spike designs are shown in cutout according to some non-limiting examples (Fig. 11E). In some embodiments, the teeth 112 may enable friction to retain joins 110 such that the building unit 100 remains in a closed position, as shown partially in FIG. 11A-B and FIG. 11D-E. In some embodiments, the toy building unit 100 shown in FIG. 11 can be manufactured using molding processes described herein and known in the art.

[0150] FIG. 12 illustrates a join with a curved ridge, which may enable joins 110 to be retained in a closed position by friction, by latching of overlapped ridges, or by a combination of friction and latching of overlapped ridges, according to some embodiments. In some embodiments, the join 110 of the building unit 100 can include an integral interleaving mechanism and no teeth 112, as shown in FIG. 12. In some embodiments, the join 110 of the building unit 100 can include an integral interleaving mechanism and teeth 112 (not shown). In some embodiments, an integral interleaving mechanism of a join 110 can include a ridge, as shown in FIG. 12. In some embodiments, the ridge can be curved as shown in FIG. 12. FIG. 12A illustrates two joined ridge joins 110 from the view of an outside surface of the toy building unit in a three-dimensional hollow position 108. In some embodiments, interleaving joins 110 are not visible from the view of the outside surface of the toy building unit in a three-dimensional hollow position 108, as shown in FIG. 12A. FIG. 12B illustrates a partial front view of two joined ridge joins 110. In some embodiments, the joins 110 with an integral interleaving mechanism can enable latching of opposing ridges which may retain joins in a closed position, as shown in FIG. 12B. FIG. 12C illustrates an isometric view of un-joined ridge join 110 with curved ridge instead of teeth 112. In some embodiments, the curved ridge can be the integral interleaving mechanism. In some embodiments, the integral interleaving mechanism can include a first lip 116 and a second lip 118. In some embodiments, the space between the first lip 116 and the second lip 118 can be curved, as shown in FIG. 12C. FIG. 12D illustrates a front view of an un-joined join 110 with curved ridge instead of teeth 112. In some embodiments, the curved ridge can be the integral interleaving mechanism. In some embodiments, the integral interleaving mechanism can include a first lip 116 and a second lip 118. In some embodiments, the first lip 116 can be slightly obscured when looking at the section 104 from a front view, as shown in FIG. 12D. In some embodiments, the second lip can be viewed when looking at the section 104 from a front view,

as shown in FIG. 12D. FIG. 12E illustrates joined curved ridge joins 110 from a top outside view of the toy building unit in a three-dimensional hollow position 108. In some embodiments, interleaving joins 110 are not visible from the top view of the toy building unit in a three-dimensional hollow position 108, as shown in FIG. 12E. In some embodiments, the toy building unit 100 shown in FIG.12 can be manufactured using molding processes described herein and known in the art.

[0151] FIG.13 illustrates a join with an angled ridge, which may enable latching ridges to retain joins 110 in a closed position according to some embodiments. In some embodiments, the join 110 of the building unit 100 can include an integral interleaving mechanism and no teeth 112, as shown in FIG. 13. In some embodiments, the join 110 of the building unit 100 can include an integral interleaving mechanism and teeth 112 (not shown). In some embodiments, an integral interleaving mechanism of a join 110 can include a ridge, as shown in FIG. 13. FIG. 13A illustrates a front view of an un-joined join 110 with angled ridge joins instead of teeth. In some embodiments, the ridge can be angled as shown in FIG. 13. In some embodiments, the angled ridge can be the integral interleaving mechanism. In some embodiments, the integral interleaving mechanism can include a first lip 116 and a second lip 118. In some embodiments, the first lip 116 can be viewed when looking at the section 104 from a front view, as shown in FIG. 13A. In some embodiments, the second lip can be viewed when looking at the section 104 from a front view, as shown in FIG. 13A. FIG. 13B illustrates a partial front view of joined joins 110 with angled ridges. In some embodiments, the joins 110 with an integral interleaving mechanism can enable latching of ridges which may retain joins in a closed position, as shown in FIG. 13B. FIG. 13C illustrates an isometric view of un-joined join 110 with angled ridge instead of teeth 112. In some embodiments, the angled ridge can be the integral interleaving mechanism. In some embodiments, the integral interleaving mechanism can include a first lip 116 and a second lip 118. In some embodiments, the space between the first lip 116 and the second lip 118 can be angled, as shown in FIG. 13C. In some embodiments, the toy building unit 100 shown in FIG.13 can be manufactured using molding processes described herein and known in the art.

[0152] FIG. 14A illustrates teeth of two joins having a design overlap, designed to interleave by joining a first 131 and second 132 section, from the view of an outside surface of the toy building unit, according to some aspects of the disclosure. FIG. 14B illustrates a partial cross section view of the joins of FIG. 14A. FIG. 14C illustrates a close-up view of the teeth and recess which are circled in FIG. 14A. In some embodiments, at least a portion of the teeth 112 can include regions 120 with design overlap which extend dimensionally beyond the volume of the recess provided between teeth of the other join. The teeth 112 and/or recesses can be

configured to deform based on the joining to accommodate the regions 120. In some embodiments, the deformation can be temporary while the first 131 and second 132 sections are joined. In some embodiments, the deformation can partially revert after the first 131 and second 132 sections are separated. In other embodiments, the deformation can be permanent for at least a portion of the region 120 or for a portion of the opposing side which friction fits with region 120. The region 120 can be formed by angling the sides 112c of the teeth 112 along a different axis than that of a joining recess 112b. In some embodiments, the tip 112a of the teeth 112 can be wider than the widest width of the recess 112b. In some embodiments, the tip 112a of the teeth may be narrower than the widest width of the recess. In some embodiments, the structure of the deformation can enhance the friction-fit between the first 131 and second 132 sections. In some embodiments, active decompression of the region 120 can enhance the friction-fit between the first 131 and second 132 sections.

[0153] FIG. 15 illustrates a close up view of a recess and teeth 112 which is configured to join section 141 and section 142, and which has an alternative overlapping design to the one shown in Figures 14A and 14C and wherein the region 120 is designed to deform.

[0154] FIG. 16 illustrates a close up view of a recess and teeth 112 which is configured to join section 151 and section 152, and which has an alternative overlapping design to those shown in Figures 14A, 14C and 15 and wherein the region 120 is designed to deform. In this embodiment, teeth 112 are inwardly tapered, with the tip of the tooth being narrower than the base of the tooth. In alternative embodiments however (see, for example, Figure 14C), the tip of the tooth may be wider than the base of the tooth. The tip-to-side angle 153 is the angle of incidence between two planes that approximate two surfaces: tips of teeth and a side of the same teeth. The tip-to-side angle 153 may be varied to achieve different friction fit outcomes. The tip-to-side angle 153 shown in Figure 16 is greater than 90 degrees, but may be acute (e.g. less than 90 degrees) in alternative embodiments, such as is shown in Figure 14C. A tip-to-side angle of greater than 90 degrees may improve the usability of a pair of joins by making it easier for the user to pair the joins and interleave teeth. A tip-to-side angle of less than 90 degrees may improve the friction fit of a closed unit by making it more difficult for a joined join to be pulled apart when a pull force is applied at a tip of teeth.

[0155] The compressible designs in Figures 14-16 are illustrative and other embodiments are possible in keeping with the invention. In some embodiments, the integral teeth 112 and/or recess can include compressible regions with a variety of shapes, angles, curves or projections configured to enhance the friction-fit between the teeth 112 and recesses when a portion of material deforms.

[0156] FIG. 17 illustrates a toy building unit 200 according to another aspect of the disclosure. In FIGS. 17A and 17B, the unit is shown in its flat configuration, one side of which has hinges in the form of lateral cuts 202 that extend partially through the material and between adjacent sections 204, 204, as shown in FIG. 17C. This configuration of hinge is readily foldable by a user between the positions shown in Figures FIG. 17C and FIG. 17D when forming the three-dimensional shape. Figure 17E illustrates the toy building unit of Figure 17A in a closed configuration. As can be seen, the cut hinges define a neat groove on the outside of the polyhedron in the closed position. Hinges which appear as grooves on the outside of the polyhedron may provide stackability benefits for the blocks due to them having a hinge geometry which does not protrude and interfere with the planar structure of the exterior sides of the polyhedron. Stackability may also benefit from cut hinges that are configured to cause minimal or no warping on the exterior side of sections. Stackability of closed building units may be impaired when material strain occurring from a folded hinge causes adjacent material to warp sections, which may include rounded edges and bowed sections.

[0157] Toy building units with cut hinges and cut teeth may benefit from ease of manufacturing by virtue of being compatible with the installed base of high volume die cutting equipment which is prevalent in the art. A die configured to cut a toy building unit may cut the building unit, joins, hinges and teeth in a single press of a die press machine or in a single pass of a rolling die cutting machine. Similarly, a die configured to cut a building unit may press-form the hinges and cut the building unit, joins and teeth in a single die press or in a single pass of a rolling die cutting machine. A wide range of material may be suitable for die cut units, including cardstock, cardboard, rubber, foam sheeting, plastic sheeting, bagasse sheeting, and laminates.

[0158] Toy building units having such a structure (e.g. having an integral hinge, interleaving teeth, a consistent single layer of material having a thickness of about 1.5mm) are configured to enable small forces (e.g. as would be the case for forces applied by children) to easily transform the unit from a closed 3D to flat 2D net.

[0159] FIG. 18 illustrates a toy building unit 300 in a closed configuration and which includes indicia 302, according to some aspects of the disclosure. In the illustrated embodiment, the indicia 302 is shown in the form of a finger symbol, printed on the side of the unit 300 adjacent the join 310 on the opposite side of the section 304 to the hinge 306. Whilst a user could access the interior of the unit 300 by opening any of the three joins on that section, opening the unit at the indicated join would be easiest for the user and would place the least amount of stress on the section 304, thus enhancing the unit's lifespan. Although not shown in Figure 18, the unit may also include a notch, or the like, adjacent or integral to the teeth and configured to receive a

user's fingertip. Such a notch may help to enhance usability and the unit's durability, through its use in the opening operation which may reduce forces and strains on teeth or hinges.

[0160] FIG. 19 illustrates co-mingling of toy building units, according to some aspects of the disclosure, with another toy system, in this case a Lego® toy system or Lego® compatible toy system. In this aspect of the disclosure, the toy building unit is either a cube or a rectangular prism with edge lengths of  $N \times$  about 8mm, where  $N = 6, 12$  or  $18$ . This dimension results in the units being of a size that can be snugly received between Lego® bricks that are positioned 6, 12 or 18 studs apart. As can be seen from the photograph, toy building units in accordance with the present invention can readily be incorporated into structures built out of Lego® bricks (or Lego® compatible bricks), thereby providing additional play opportunities for the user.

[0161] The units shown in Figure 19 have a number of differentially wide recesses 450 in the centre of joins opposite hinges which are configured to serve as both a visible indicator of preferred opening locations and as a functional surface to facilitate finger-pull opening. The added gap for finger pulls is about 3mm in Figure 19, although may range from about 3mm to 30mm on larger blocks. A gap of about 3mm may, for example be formed by enlarging a recess by a few mm and/or by removing a tooth.

[0162] FIG. 20 illustrates an example method of manufacturing the toy building unit, according to aspects of the disclosure. The method can include obtaining a single sheeting material (e.g., cardstock, plastic sheeting, wood sheeting, bagasse, foam sheeting, particle board, vellum paper, cardboard, paper, vinyl sheeting, rubber sheeting, or laminates, or any combination thereof) 402. The method can include cutting a plurality of teeth 112 from the edge of a section 104 of the building unit 100 using die cutting, laser-cutting, or combinations thereof 404. The method can include forming a plurality of hinges 106 by crease scoring the material and / or forming a plurality of hinges 106 by cut scoring the material using a straight edge 406. The method can include forming, from the edge of a section 104 of the building unit 100, a plurality of joins 110 using die cutting, laser-cutting, or combinations thereof 408. The method can include cutting a building unit 100 from the single sheeting material using die cutting, laser-cutting, or combinations thereof 410. The method can include applying a waterproofing surface 412 to the building 100.

[0163] FIG. 21 illustrates an example method of manufacturing the toy building unit, according to aspects of the disclosure. The method can include obtaining for injection molding a material (e.g., plastic, bioplastic, rubber, or combinations thereof) 416. The method can include obtaining for wet pressing, dry pressing, transfer molding, thermoforming, or combinations thereof, a

material (e.g., paper pulp, bagasse pulp, hemp pulp, bamboo pulp, wood pulp, recycles pulp, resins, wax, plastic, bioplastic, or combinations thereof) 418. The method can include forming 420, by a molding process of a material, a building unit 100 that can include a plurality of sections 104, wherein the plurality of sections 104 can be delineated from and connected to at least one other section 104 with a hinge 106 that is integral to the building unit 100; and a plurality of joins 110 along the outer edges of the building unit 100. The method can include forming 422 one or more, or a plurality of teeth 112 of a join 110 using injection molding, wet pressing, dry pressing, transfer molding, thermoforming, or combinations thereof. The method can include applying a waterproofing surface 412 to the building 100.

### **ADDITIONAL EMBODIMENTS**

[0164] An embodiment provides a toy building set that can include a building unit which is capable of folding from a flat position into a three-dimensional hollow position; the building unit can include a plurality of sections, wherein the plurality of sections can be delineated from and connected to at least one other section with a hinge that is integral to the building unit; a plurality of joins (which can be the outer edges of the building unit) outlining the building unit, wherein the joins can connect the sections of the building unit forming edges of the closed three-dimensional hollow building unit; and a closed position.

[0165] In some embodiments, the building unit can be cardboard. In some embodiments, the building unit can be bagasse. In some embodiments, the building unit can be wood. In some embodiments, the building unit can be laminate. In some embodiments, the building unit can be vellum. In some embodiments, the building unit can be rubber. In some embodiments, the building unit can be plasticized pulp. In some embodiments, the building unit can be a domed cuboid unit. In some embodiments, the domed cuboid unit can include five hinge and fourteen joins. In some embodiments, the fourteen joins, when closed, can form seven edges of the domed cuboid unit; and the five hinges can form five edges of the domed cuboid unit. In some embodiments, the building unit can be a half cylinder. In some embodiments, the half cylinder can include three hinge and six joins. In some embodiments, the six joins, when closed, can form three edges of the half cylinder; and the three hinges can form three edges of the half cylinder. In some embodiments, the building unit can be a quarter cylinder. In some embodiments, the quarter cylinder can include four hinge and ten joins. In some embodiments, the ten joins, when closed, can form five edges of the quarter cylinder; and the four hinges can form four edges of the quarter cylinder. In some embodiments, the closed position can include a flat surface created by a final closure. In some embodiments, the building unit can be laminated.

[0166] Another embodiment provides a method of manufacturing a toy building set, the method can include: cutting a building unit from a single sheeting material; forming, by a straight edge, a plurality of hinges whereby pressing the straight edge into the sheeting material forms the hinges; and forming, by cutting a plurality of joins.

[0167] In some embodiments, the building unit can be capable of folding from a flat position into a three-dimensional hollow position with the friction of connected joins. In some embodiments, the straight edge can crease score or cut score, the building unit to form the hinges. In some embodiments, the plurality of hinges can appear as a groove on one side of the building unit and a ridge on the opposite side of the building unit. In some embodiments, cutting can be die cutting, blade cutting, laser cutting, or combinations thereof. In some embodiments, the sheeting material can be cardstock, cardboard, plastic sheeting, bagasse sheeting, wood sheeting, pulp sheeting, plasticized pulp sheeting, laminates, and combinations thereof.

[0168] Another embodiment provides a method of manufacturing a toy building set, the method can include: forming, by a molding process of a material, a building unit comprising: a plurality of sections, wherein the plurality of sections are delineated from and connected to at least one other section with a hinge that is integral to the building unit; and a plurality of joins along the outer edges of the building unit, wherein each join comprises a plurality of teeth.

[0169] In some embodiments, the building unit can be capable of folding from a flat position into a three-dimensional hollow position with the friction of connected joins. In some embodiments, the molding process of a material can be injection molding. In some embodiments, the material can be a plastic, bioplastic, rubber, or combinations thereof. In some embodiments, the molding process of a material can be wet pressing, dry pressing, transfer molding, thermoforming, or combinations thereof. In some embodiments, the material can be paper pulp, bagasse pulp, hemp pulp, bamboo pulp, wood pulp, recycled pulp or combinations thereof. In some embodiments, the material can further comprise resins, wax, plastic, bioplastic, or combinations thereof.

[0170] As will be appreciated, the novel building unit of a toy building set described above afford numerous advantages, including:

- The novel combination of hinges and reversible friction joins increases play possibilities, tactile engagement and learning;
- Children enjoy folding and unfolding blocks;
- Items can be placed inside blocks during play;

- 2D to 3D transitions may provide kinaesthetic geometry learnings, including helping teach blind children geometry; and
- A building unit made from colour receptive material is easily hand-coloured in the flat position.

[0099] While various embodiments have been described above, it should be understood that they have been presented by way of example and not limitation. It will be apparent to persons skilled in the relevant art(s) that various changes in form and detail can be made therein without departing from the spirit and scope. In fact, after reading the above description, it will be apparent to one skilled in the relevant art(s) how to implement alternative embodiments. Thus, the present embodiments should not be limited by any of the above-described embodiments.

[0100] In addition, it should be understood that any figures which highlight the functionality and advantages are presented for example purposes only. The disclosed methodology and system are each sufficiently flexible and configurable such that they may be utilized in ways other than that shown. In particular, the elements of any flowchart or process figures may be performed in any order and any element of any figures may be optional.

[0101] Although the term “at least one” may often be used in the specification, claims and drawings, the terms “a”, “an”, “the”, “said”, etc. also signify “at least one” or “the at least one” in the specification, claims and drawings. The terms “including” and “comprising” and any similar terms should be interpreted as “including, but not limited to” in the specification, claims and drawings.

[0171] In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word “comprise” or variations such as “comprises” or “comprising” is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

[0172] It is to be understood that any prior art publication referred to herein does not constitute an admission that the publication forms part of the common general knowledge in the art.

**CLAIMS:**

1. A building unit of a toy building set, the building unit comprising:
  - a sheet of a material that defines a net of a polyhedron, the sheet comprising a plurality of sections, wherein each section is connected to another section with a hinge, wherein the building unit is configured to fold at the hinges from a flat configuration into a polyhedron with a hollow interior; and
  - a plurality of joins on outer edges of the building unit, wherein each join comprises one or more teeth configured to interleave with teeth of another join and releasably connect the sections to form edges of the polyhedron, wherein the sections, the hinges and the joins are one piece of the same material.
2. The building unit of claim 1, wherein the or each hinge comprises a groove on one surface of the building unit in the flat position and a ridge on an opposite surface of the building unit in the flat position.
3. The building unit of claim 1, wherein the or each hinge comprises a first groove on one surface of the building unit in the flat position and a second groove on an opposite surface of the building unit in the flat position.
4. The building unit of claim 1, wherein the or each hinge comprises a partial cut through the sheet of material.
5. The building unit of any one of claims 1 to 4, wherein the teeth of connected joins are configured to interleave to form a closed edge of the building unit wherein friction between surfaces of one or more interleaved teeth holds the building unit together in the closed position.
6. The building unit of claim 5 wherein a friction fit edge is configured to unpair by a pulling apart one or more interleaved teeth.
7. The building unit of claim 6, wherein indicia or other marking on the building unit indicates a join opposite a hinge on one or more of the sections.
8. The building unit of any one of claims 1 to 7, wherein the joins comprise teeth having one or more compressible sections.
9. The building unit of claim 8, wherein at least one of the one or more teeth is configured to compress or deform in the closed position, whereby the deformation increases the friction holding an edge of the building unit together.

10. The building unit of claim 9, wherein the at least one of the one or more teeth has tapered sides, where a tip of the tooth is narrower than a base of the tooth.
11. The building unit of any one of claims 1 to 10, wherein a gap adapted to receive a user's fingertip is provided in at least one section.
12. The building unit of claim 11, wherein the gap is provided in the form of a gap between the interleaved teeth of the join that is opposite the hinge of the at least one section.
13. The building unit of any one of claims 1 to 12, wherein at least one outer surface of the polyhedron is receptive to hand-colouring with ink, pencil, crayon, chalk or water colour.
14. The building unit of any one of claims 1 to 13, wherein the building unit comprises cardstock, cardboard, bagasse, wood, laminate, plastic, vellum, rubber, foam, plasticized pulp, or pulp, or any combination thereof.
15. The building unit of any one of claims 1 to 14, wherein the building unit is molded bagasse or molded plastic.
16. The building unit of any one of claims 1 to 15, wherein the polyhedron is a cuboid.
17. The building unit of any one of claims 1 to 14, wherein one or more of the sections of the building unit have a dimension that is  $N \times$  about 8mm, where  $N$  is a whole number.
18. A building unit of a toy building set, the building unit comprising:
  - at least four polygonal sections, wherein each section is connected to another section with at least one integral hinge,
  - wherein the building unit is configured to fold and unfold over multiple cycles at the hinges from a flat position into a closed position which is a polyhedron with a hollow interior; wherein the tips and sides of at least two integral teeth comprise outer edges of the building unit in the flat position,
  - wherein friction between the sides of the integral teeth holds the building unit in the closed position,
  - wherein the tips of the one or more integral teeth are visible on the exterior of the building unit in a closed position.
19. The building unit of claim 18, wherein, in all positions of the building unit, the tips of the one or more integral teeth are configured to retain a fixed orientation relative to their integral section.

20. The building unit of claim 18 or claim 19, wherein sides of teeth configured to engage in friction fit are configured with a design overlap which causes the sides to compress or deform in the closed position.
21. The building unit of any one of claims 18 to 20, wherein the building unit in the flat position has an exterior surface, an interior surface and an outer edge, wherein the exterior surface is visible on the exterior of the building unit in the closed position, and wherein the exterior surface is a material receptive to a sticker or a pencil, crayon or ink drawing.