CLAIMS

1. A support and drainage element comprising a frame comprising:

(a) at least one first section having a first major surface and a second major surface, the first major surface of the at least one first section and the second major surface of the at least one first section comprising rows of parallel flanges, the rows of parallel flanges being spaced apart from each other by apertures passing through the first major surface of the at least one first section and the second major surface of the at least one first section, the at least one first section further comprising a plurality of apertures and/or slots passing through the parallel flanges of the at least one first section, the at least one first section having a plurality of beams arranged in parallel and projecting upwardly from, and perpendicular to, the first major surface of the at least one first section, wherein each beam of the plurality of beams of the at least one first section includes at least one slot and/or aperture therethrough;

(b) at least one second section having a first major surface and a second major surface, the first major surface of the at least one second section and the second major surface of the at least one second section comprising rows of parallel flanges, the rows of parallel flanges of the at least one second section being spaced apart from each other by apertures passing through the first major surface of the at least one second section and the second major surface of the at least one second section, the at least one second section further comprising a plurality of apertures and/or slots passing through the parallel flanges of the at least one second section, the at least one second section having a plurality of beams arranged in parallel and projecting upwardly from, and perpendicular to, the first major surface of the at least one second section, wherein each beam of the plurality of beams of the at least one second section includes at least one slot and/or aperture therethrough; and

(c) a first foldable hinge having a first major surface and a second major surface and at least one aperture passing through the first major surface of the first foldable hinge and the second major surface of the first foldable hinge, wherein the at least one first section is connected to the second section by the first foldable hinge;

(i) wherein when the first foldable hinge is folded, the plurality of beams on the at least one first section and the plurality of beams on the at least one second section align side by side touching each other.

2. The support and drainage element of claim 1, further comprising

(d) at least one third section having a first major surface and a second major surface, the first major surface of the at least one third section and the second major surface of the at least one third section comprising rows of parallel flanges, the rows of parallel flanges of the at least one third section being spaced apart from each other by apertures passing through the first major surface of the at least one third section and the second major surface of the at least one third section, the at least one third section further comprising a plurality of apertures and/or slots passing through the parallel flanges of the at least one third section, the at least one third section having a plurality of beams arranged in parallel and projecting upwardly from, and perpendicular to, the first major surface of the at least one third section, wherein each beam of the plurality of beams of the at least one third section includes at least one slot and/or aperture therethrough;

(e) at least one fourth section having a first major surface and a second major surface, the first major surface of the at least one fourth section and the second major surface of the at least one fourth section comprising rows of parallel flanges, the rows of parallel flanges being spaced apart from each other by apertures passing through the first major surface of the at least one fourth section and the second major surface of the at least one fourth section, the at least one fourth section further comprising a plurality of apertures and/or slots passing through the parallel flanges of the at least one fourth section, the at least one fourth section having a plurality of beams arranged in parallel and projecting upwardly from, and perpendicular to, the first major surface of the at least one fourth section, wherein each beam of the plurality of beams of the at least one fourth section includes at least one slot and/or aperture therethrough; and

(f) a second foldable hinge having a first major surface and a second major surface and an aperture passing through the first major surface of the second foldable hinge and the second major surface of the second foldable hinge, wherein the at least one third section is connected to the at least one fourth section by the second foldable hinge, and

(g) a third foldable hinge having a first major surface and a second major surface and at least one aperture passing through the first major surface of the third foldable hinge and the second major surface of the third foldable hinge, wherein the

third section is connected to the at least one second section by the third foldable hinge;

(ii) wherein when the second foldable hinge is folded, the plurality of beams on the at least one third section and the plurality of beams on the at least one fourth section align side by side touching each other.

3. The support and drainage element of claim 2, wherein the at least one aperture in the third foldable hinge is larger than the at least one aperture in the first foldable hinge and in the second foldable hinge.

4. The support and drainage element of claim 2 or 3, wherein, when folded, the plurality of beams on the at least one first section contact the first major surface of the at least one second section, the plurality of beams on the at least one second section contact the first major surface of the at least one first section, the plurality of beams on the at least one third section contact the first major surface of the at least one fourth section, and the plurality of beams on the at least one fourth section contact the first major surface of the at least one third section.

5. The support and drainage element of any one of claims 2-4, including at least one additional first section, at least one additional second section, and at least one additional first foldable hinge connecting the at least one additional first section to the at least one additional second section, and at least one additional third foldable hinge, connecting the at least one additional first section to the at least one fourth section.

6. A filter arrangement comprising:

a pleated porous filter medium having a plurality of pleats, each pleat having an upstream surface and a downstream surface; and,

a support and drainage system comprising

a support and drainage element comprising a frame comprising:

(a) at least one first section having a first major surface and a second major surface, the first major surface of the at least one first section and the second major surface of the at least one first section comprising rows of parallel flanges, the rows of parallel flanges of the at least one first section being spaced apart from each other by apertures passing through the first major surface of the at least one first section and the second major surface of the at least one first section, the at least one first section further comprising a plurality of

apertures and/or slots passing through the parallel flanges of the at least one first section, the at least one first section having a plurality of beams arranged in parallel and projecting upwardly from, and perpendicular to, the first major surface of the at least one first section, wherein each beam of the plurality of beams of the at least one first section includes at least one slot and/or aperture therethrough; and

(b) at least one second section having a first major surface and a second major surface, the first major surface of the at least one second section and the second major surface of the at least one second section comprising rows of parallel flanges, the rows of parallel flanges of the at least one second section being spaced apart from each other by apertures passing through the first major surface of the at least one second section and the second major surface of the at least one second section, the at least one second section further comprising a plurality of apertures and/or slots passing through the parallel flanges of the at least one second section, the at least one second section having a plurality of beams arranged in parallel and projecting upwardly from, and perpendicular to, the first major surface of the at least one second section, wherein each beam of the plurality of beams of the at least one second section includes at least one slot and/or aperture therethrough;

wherein the at least one first section or the at least one second section contacts the upstream surface or the downstream surface of a pleat, and the plurality of beams on the at least one first section and the plurality of beams on the at least one second section align side by side touching each other.

7. A filter arrangement comprising:

a pleated porous filter medium having a plurality of pleats, each pleat having an upstream surface and a downstream surface; and,

at least one support and drainage element comprising a frame comprising:

(a) at least one first section having a first major surface and a second major surface, the first major surface and the second major surface comprising rows of parallel flanges, the rows of parallel flanges of the at least one first section being spaced apart from each other by apertures passing through the first major surface of the at least one first section and the second major surface of the at least one first section, the at least one first section further comprising a plurality of apertures and/or slots passing through the parallel flanges of the at least one first section, the at least one first section having a plurality of beams arranged in parallel and projecting upwardly from, and perpendicular to, the first major surface, wherein each beam of

the plurality of beams of the at least one first section includes at least one slot and/or aperture therethrough;

(b) at least one second section having a first major surface and a second major surface, the first major surface of the at least one second section and the second major surface of the at least one second section comprising rows of parallel flanges, the rows of parallel flanges of the at least one second section being spaced apart from each other by apertures passing through the first major surface of the at least one second section and the second major surface of the at least one second section, the at least one second section further comprising a plurality of apertures and/or slots passing through the parallel flanges of the at least one second section, the at least one second section having a plurality of beams arranged in parallel and projecting upwardly from, and perpendicular to, the first major surface of the at least one second section, wherein each beam of the plurality of beams of the at least one second section includes at least one slot and/or aperture therethrough; and

(c) a first foldable hinge having a first major surface and a second major surface and at least one aperture passing through the first major surface of the first foldable hinge and the second major surface of the first foldable hinge, wherein the at least one first section is connected to the at least one second section by the first foldable hinge;

(i) wherein when the first foldable hinge is folded, the plurality of beams on the at least one first section and the plurality of beams on the at least one second section align side by side touching each other;

wherein the first foldable hinge is folded and the upstream surface or the downstream surface of a pleat is in contact with the second major surface of the at least one first section and the second major surface of the at least one second section.

8. The filter arrangement of claim 7, further comprising an additional support and drainage element comprising a frame comprising:

(a) at least one first section of the additional support and drainage element having a first major surface and a second major surface, the first major surface and the second major surface comprising rows of parallel flanges, the rows of parallel flanges of the at least one first section of the additional support and drainage element being spaced apart from each other by apertures passing through the first major surface of the at least one first section of the additional support and drainage element and the second major surface of the at least one first section of the additional support and

drainage element, the at least one first section of the additional support and drainage element further comprising a plurality of apertures and/or slots passing through the parallel flanges of the at least one first section of the additional support and drainage element, the at least one first section of the additional support and drainage element having a plurality of beams arranged in parallel and projecting upwardly from, and perpendicular to, the first major surface, wherein each beam of the plurality of beams of the at least one first section of the additional support and drainage element includes at least one slot and/or aperture therethrough;

(b) at least one second section of the additional support and drainage element having a first major surface and a second major surface, the first major surface of the at least one second section of the additional support and drainage element and the second major surface of the at least one second section of the additional support and drainage element comprising rows of parallel flanges, the rows of parallel flanges of the at least one second section of the additional support and drainage element being spaced apart from each other by apertures passing through the first major surface of the at least one second section of the additional support and drainage element and the second major surface of the at least one second section of the additional support and drainage element, the at least one second section of the additional support and drainage element further comprising a plurality of apertures and/or slots passing through the parallel flanges of the at least one second section of the additional support and drainage element, the at least one second section having a plurality of beams arranged in parallel and projecting upwardly from, and perpendicular to, the first major surface of the at least one second section of the additional support and drainage element, wherein each beam of the plurality of beams of the at least one second section of the additional support and drainage element includes at least one slot and/or aperture therethrough; and

(c) a first foldable hinge having a first major surface and a second major surface and at least one aperture passing through the first major surface of the first foldable hinge and the second major surface of the first foldable hinge, wherein the at least one first section of the additional support and drainage element is connected to the at least one second section of the additional support and drainage element by the first foldable hinge;

(i) wherein when the first foldable hinge is folded, the plurality of beams on the at least one first section of the additional support and drainage element and the

plurality of beams on the at least one second section of the additional support and drainage element align side by side touching each other;

wherein the upstream surface of a pleat is in contact with the second major surface of the at least one first section of the additional support and drainage element and the second major surface of the at least one second section of the additional support and drainage element of the at least one support and drainage element, and the downstream surface of a pleat is in contact with the second major surface of the at least one first section of the additional support and drainage element and the second major surface of the at least one second section of the additional support and drainage element.

8. The filter arrangement of claim 7 or 8, comprising a plurality of separate support and drainage elements, the plurality of separate support and drainage elements each comprising a frame comprising:

(a) at least one first section of the plurality of separate support and drainage elements having a first major surface and a second major surface, the first major surface and the second major surface comprising rows of parallel flanges, the rows of parallel flanges of the at least one first section of the plurality of separate support and drainage elements being spaced apart from each other by apertures passing through the first major surface of the at least one first section of the plurality of separate support and drainage elements and the second major surface of the plurality of separate support and drainage elements, the at least one first section of the plurality of separate support and drainage elements further comprising a plurality of apertures and/or slots passing through the parallel flanges of the at least one first section of the plurality of separate support and drainage elements, the at least one first section of the plurality of separate support and drainage elements having a plurality of beams arranged in parallel and projecting upwardly from, and perpendicular to, the first major surface, wherein each beam of the plurality of beams of the at least one first section of the plurality of separate support and drainage elements includes at least one slot and/or aperture therethrough;

(b) at least one second section of the plurality of separate support and drainage elements having a first major surface and a second major surface, the first major surface of the at least one second section of the plurality of separate support and drainage elements and the second major surface of the at least one second section of the plurality of separate support and drainage elements comprising rows of parallel

flanges, the rows of parallel flanges of the at least one second section of the additional support and drainage element being spaced apart from each other by apertures passing through the first major surface of the at least one second section of the plurality of separate support and drainage elements and the second major surface of the plurality of separate support and drainage elements, the at least one second section of the plurality of separate support and drainage elements further comprising a plurality of apertures and/or slots passing through the parallel flanges of the at least one second section of the plurality of separate support and drainage elements, the at least one second section of the plurality of separate support and drainage elements having a plurality of beams arranged in parallel and projecting upwardly from, and perpendicular to, the first major surface of the at least one second section of the plurality of separate support and drainage elements, wherein each beam of the plurality of beams of the at least one second section of the plurality of separate support and drainage elements includes at least one slot and/or aperture therethrough; and

(c) a first foldable hinge having a first major surface and a second major surface and at least one aperture passing through the first major surface of the first foldable hinge and the second major surface of the first foldable hinge, wherein the at least one first section of the plurality of separate support and drainage elements is connected to the second section of the plurality of separate support and drainage elements by the first foldable hinge;

(i) wherein when the first foldable hinge is folded, the plurality of beams on the at least one first section of the plurality of separate support and drainage elements and the plurality of beams on the at least one second section of the plurality of separate support and drainage elements align side by side touching each other;

each of the plurality of separate support and drainage elements comprising an insert upstream and/or downstream of a pleat.

9. A support and drainage element system, comprising first and second separate support and drainage elements of any one of claims 1-5, the first separate support and drainage element comprising an upstream support and drainage element, the second separate support and drainage elements comprising a downstream support and drainage element.

10. A support and drainage element system, comprising a plurality of first and second separate support and drainage elements of claim 1, each of the plurality of first and second separate support and drainage elements comprising a separate insert suitable for use upstream and/or downstream of an individual pleat of a pleated porous filter medium having a plurality of pleats.

11. A filter system comprising a pleated porous filter comprising at least one pleated porous filter medium having a plurality of pleats, and the support and drainage element system of claim 9, wherein the pleated porous filter is arranged between the upstream support and drainage element and the downstream support and drainage element.

12. A filter system comprising a pleated porous filter comprising a pleated porous filter medium having a plurality of pleats, and the support and drainage element system of claim 10, wherein each pleat has a separate support and drainage element comprising an insert arranged upstream and downstream of the pleat.

13. The filter system of claim 11 or 12, wherein the pleated porous filter comprises a laid-over-pleat filter.

14. A method of filtering fluid, the method comprising passing a fluid through the filter system of claim 11, including passing fluid through the upstream support and drainage element, the pleated porous filter, and the downstream support and drainage element.

15. A method of filtering fluid, the method comprising passing a fluid through the filter system of claim 12, including passing fluid through the upstream support and drainage element inserts, the pleats, and the downstream support and drainage element inserts.