CLAIMS

1. A geogrid in the form of an integral, mesh structure comprising molecularly orientated polymeric material, the mesh structure formed of interconnecting mesh defining elements including elongate tensile elements wherein the molecular orientation of the mesh structure is uniform throughout the extent thereof.

2. A geogrid in the form of an integral, mesh structure comprising polymeric material, the mesh structure comprising elongate tensile elements interconnected by junctions in the mesh structure wherein the junctions and the elongate tensile elements have the same mean thickness

3. The geogrid as claimed in claim 2 wherein the polymeric material of the geogrid is uniformly molecularly oriented throughout the extent thereof.

4. A geogrid in the form of an integral, mesh structure comprising molecularly orientated polymeric material, the mesh structure comprising elongate tensile elements interconnected by junctions in the mesh structure wherein there is no thickening of the junctions caused by stretching of the polymeric material.

5. The geogrid as claimed in any one of claims 1 to 4 wherein the cross-section of the tensile elements is uniform along their length.

6. The geogrid as claimed in claim 5 wherein the cross-section of the elongate tensile elements is rectangular.

7. The geogrid as claimed in any one of claims 1 to 3 in which the polymeric material is uniaxially oriented.

8. The uniax geogrid as claimed in claim 7 having a Creep Reduction Factor (RF_{CR}) of at least 55%, more preferably at least 60%, even more preferably at least 65%, and most preferably at least 70%.

9. A uniax geogrid in the form of an integral, mesh structure comprising polymeric material which is uniaxially oriented and where the geogrid has a Creep Reduction Factor (RF_{CR}) of at least 55%, more preferably at least 60%, even more preferably at least 65%, and most preferably at least 70%.

10. The uniax geogrid as claimed in any one of claims 7 to 9 having a thickness of 0.1 to 3 mm.

11. The uniax geogrid as claimed in any one of claims 7 to 10 having a stretch ratio of at least 4:1.

12. The uniax geogrid as claimed in any one of claims 7 to 11 having a tensile strength of at least 30 kN / m.

13. The uniax geogrid as claimed in any one of claims 7 to 12 comprising:

(i) a plurality of the elongate tensile elements extending parallel to each other in the direction of orientation, and

(ii) a plurality of connector elements integral with the tensile elements and each serving to connect adjacent rib structures together, the connector elements connecting any two tensile elements together being spaced from each other in the direction of orientation thereby defining, with the tensile elements, elongate apertures extending parallel to the tensile elements.

14. The uniax geogrid as claimed in claim 13 wherein the tensile elements have a width of 2 to 50mm, the apertures have a length of 40 to 400 mm and a width of 5 to 100 mm and the connector elements have a width of 2 to 20 mm

15. The uniax geogrid as claimed in claim 14 wherein the tensile elements have a width of 5 to 40 mm, the apertures have a length of 40 to 250 mm and a width of 10 to 80 mm and the connector elements have a width of 6 to 18 mm.

16. The uniax geogrid as claimed in any of claims 11 to 15 wherein the connector elements are arranged as a plurality of sets in which the connectors of any one set are aligned with each other in a direction transverse to the rib structures and the sets are spaced from each other in the longitudinal direction of the rib structures.

17. The uniax geogrid as claimed in any one of claims 7 to 16 comprising:
(a) a plurality of generally parallel rib structures extending in the direction of uniaxial orientation, and (b) a plurality of spaced, generally parallel bar structures extending transversely to the rib structures, said rib structures and said bar structures being interconnected by junctions at spaced locations along their respective lengths whereby the rib structures are sub-divided along their lengths into alternating junctions and rib segments and the bar structures are sub-divided along their lengths into alternating bar segments and junctions.

18. The uniax geogrid as claimed in claim 17 wherein the rib structures have a width of 2 to 50 mm the apertures have a length of 40 to 400 mm and a width of 5 to 100 mm and the bar structures have a width of 2 to 20 mm.

19. The uniax geogrid as claimed in claim 18 wherein the rib structures have a width of 5 to 40 mm, the apertures have a length of 40 to 250 mm and a width of 10 to 80 mm and the bar structures have a width of 6 to 18 mm.

20. The uniax geogrid as claimed in any one of claims 7 to 19 wherein the geogrid has integral beads of the polymeric material on a face of the geogrid at least partly around peripheral edges of the apertures.

21. The uniax geogrid as claimed in claim 20 wherein the beads are formed along the ends of the apertures and reduce to zero height along the elongate edges thereof.

22. The geogrid as claimed in any one of claims 1 to 6 in which the polymeric material is biaxially orientated, optionally the biax geogrid having a stretch ratio of at least 1.5:1 and/or further optionally the biax geogrid having a tensile strength of at least 10 kN / m.

23. A method of producing a geogrid comprising the steps of:

(a) stretching an elongate polymeric starting sheet to form a geogrid precursor comprising molecularly orientated polymer, the geogrid precursor being of essentially uniform thickness, and

(b) converting the geogrid precursor into a geogrid by forming apertures in the geogrid precursor to define an integral mesh structure formed of interconnecting mesh defining elements including elongate tensile elements.

24. The method as claimed in claim 23 wherein the polymeric starting sheet has a mean thickness of 2 to 12mm.

25. The method as claimed in claim 24 wherein the polymeric starting sheet has a mean thickness of 4 to 10mm.

26. The method as claimed in any one of claims 23 to 25 wherein the apertures are formed such that the elongate tensile elements are generally rectangular as seen in cross-section at right angles to the longitudinal extent of the elongate tensile elements, the length sides of the rectangular cross-section being along the faces of the geogrid.

27. The method as claimed in claim 26 wherein the apertures are formed such that the tensile elements have a width on opposite sides of the geogrid of 2 to 20 mm.

28. The method as claimed in claim 27 wherein the tensile elements width is from 6 to 18 mm.

29. The method as claimed in claim 27 or 28 wherein the apertures are formed to have a length of 40 to 250 mm and a width of 5 to 80 mm.

30. The method as claimed in claim 29 wherein the apertures have a length of 50 to 200 mm and a width of 5 to 50 mm.

31. The method as claimed in any one of claims 23 to 30 wherein the stretching in step (a) is effected in a single direction to provide a geogrid precursor where the polymeric material is uniaxially orientated.

32. The method as claimed in claim 31 wherein, in step (a), polymeric starting sheet is stretched to a stretch ratio of at least 4:1.

33. The method as claimed in claim 32 wherein said stretch ratio is at least 7:1.

34. The method as claimed in claim 33 wherein said stretch ratio is from 7:1 to 12:1.

35. The method as claimed in any one of claims 31 to 34 wherein the apertures are formed such that the tensile elements extend parallel to the stretching direction and the apertures are elongate and also extend parallel to that direction.

36. The method as claimed in claim 35 wherein the apertures are formed such that the mesh structure produced in step (b) comprises:

(i) a plurality of the elongate tensile elements extending parallel to each other, and

(ii) a plurality of connector elements integral with the tensile elements and each serving to connect adjacent rib structures together, the connector elements connecting any two tensile elements being spaced from each other in the stretching direction thereby defining, with the tensile element, the elongate apertures.

37. The method as claimed in claim 36 wherein the apertures are formed such that the connector elements are arranged as a plurality of sets in which the connector elements of any one set are aligned with each other in a direction traverse to the elongate tensile elements, and wherein the sets are spaced from each other in the longitudinal direction of the tensile elements.

38. The method as claimed in claim 36 or 37 wherein the apertures are formed such that the tensile elements have a width of 2 to 50 mm, the apertures have a length 40 to 400 mm and a width of 5 to 100 mm and the connector elements have a width of 2 to 20 mm.

39. The method as claimed in claim 38 wherein the tensile elements have a width of 5 to 40 mm, the apertures have a length of 40 to 250 mm and a width of 10 to 80 mm and the connector elements have a width of 6 to 18 mm.

40. The method as claimed in claim 35 wherein the apertures are formed such that the mesh structure produced in step (b) comprises:

(i) a plurality of generally parallel rib structures extending in the direction of uniaxial orientation, and a plurality of spaced, generally parallel bar structures extending transversely to the rib structures, said rib structures and said bar structures being interconnected by junctions at spaced locations along their respective lengths whereby the rib structures are sub-divided along their lengths

into alternating junctions and rib segments and the bar structures are sub-divided along their lengths into alternating bar segments and junctions.

41. The method as claimed in claim 40 wherein the apertures are formed such that the rib structures have a width of 2 to 50 mm, the apertures have a length of 40 to 400 mm and a width to 5 to 100 mm, and the bar structures have a width of 2 to 20 mm.

42. The method as claimed in claim 41 wherein the rib structures have a width of 5 to 40 mm, the apertures have a length of 40 to 250 mm and a width of 10 to 80 mm and the bar structures have a width of 6 to 18 mm.

43. The method as claimed in any one of claims 35 to 42 wherein the apertures are provided by a punching operation.

44. The method as claimed in claim 43 wherein the punching operation forms integral beads of the polymeric material on a face of the geogrid and at least partly around peripheral edges of the apertures.

45. The method as claimed in claim 44 wherein the beads are formed along the ends of the apertures and reduce to zero height along the elongate edges thereof.

46. The method as claimed in any one of claims 23 to 25 wherein the sheet starting material is stretched in two mutually perpendicular directions to produce a geogrid precursor where the polymeric material is biaxially orientated.

47. A method of producing a geogrid comprising the steps of:

(a) providing a geogrid precursor in the form of a polymeric starting sheet comprising polymeric material uniformly molecularly orientated throughout the extent of the sheet, and

(b) converting the geogrid precursor into a geogrid by forming apertures in the geogrid precursor to define an integral mesh structure formed of interconnecting mesh defining elements including elongate tensile elements.

48. The method as claimed in claim 47 wherein the geogrid formed in step (b) is as claimed in any one of claims 1 to 22.

49. A geogrid obtained and/or obtainable by a method as claimed in any one of claims 23 to 48.

50. A method of strengthening a particulate material, comprising embedding in the particulate material a geogrid as claimed in any one of claims 1 to 22 or 49.

51. A particulate material strengthened by the method of claim 50.

52. A geoengineering construction comprising a mass of particulate material having embedded therein a geogrid as claimed in any one of claims 1 to 22 or 49.

53 The geoengineering construction as claimed in claim 52 selected from the group consisting of: embankment foundation, railway track ballast and/or sub ballast; road bed foundation, bridge abutment, retaining wall, steep slope, slip repair, steel mesh face, wraparound face, terraced wall, wall and slope, vegetated face, non-vegetated face, modular blocks, concrete panel, marine unit and/or gabion face.

54. The geoengineering construction as claimed in claim 52 or 53 where the geogrid imparts to the geoengineering construction an improvement in at least one property selected from:

strength; stabilization, reduced layer thickness; increased life; increased bearing capacity; control of differential settlement; ability to cap weak deposits, and/or ability to span voids of and/or beneath the particulate material and/or geoengineering construction.

55. Use of a geogrid as claimed in any one of claims 1 to 22 or 49 with a particulate material to form a geoengineering construction for at least one purpose selected from the group consisting of:

strengthening; stabilizing, reducing layer thickness; increasing the life of; increasing bearing capacity; controlling differential settlement; capping weak deposits, and/or spanning voids of and/or beneath the particulate material and/or geoengineering construction.