

## E02 HYDRAULIC ENGINEERING; FOUNDATIONS; SOIL-SHIFTING

**E02D FOUNDATIONS; EXCAVATIONS; EMBANKMENTS** (specially adapted for hydraulic engineering E02B); **UNDERGROUND OR UNDERWATER STRUCTURES** [6]

- (1) This subclass covers underground structures made by foundation engineering, i.e. involving disturbance of the ground surface. [6]
- (2) This subclass does not cover underground spaces, made by underground mining methods only, i.e. not involving disturbance of the ground surface, which are covered by subclass E21D. [6]

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|---------------------------------------------------------------------------|-----------------------------|------------------------------------------------------------------------------------------------|--------------|
| INVESTIGATING, IMPROVING OR<br>PRESERVING FOUNDATION SOIL OR<br>ROCK..... | 1/00, 3/00                  | EXCAVATIONS, MAKING<br>EMBANKMENTS .....                                                       | 17/00        |
| STRUCTURAL ELEMENTS AND<br>TECHNIQUES THEREFOR                            |                             | KEEPING DRY FOUNDATION SITES .....                                                             | 19/00        |
| Structural elements .....                                                 | 5/00                        | CAISSONS .....                                                                                 | 23/00, 25/00 |
| Placing; removing; placing and<br>removing; accessories.....              | 7/00; 9/00;<br>11/00; 13/00 | FOUNDATIONS AS SUBSTRUCTURES;<br>UNDERGROUND OR UNDERWATER<br>STRUCTURES, RETAINING WALLS..... | 27/00; 29/00 |
| HANDLING MATERIALS .....                                                  | 15/00                       | PROTECTING, TESTING,<br>STRAIGHTENING, LIFTING, REPAIRING .....                                | 31/00 37/00  |

|       |                                                                                                                                                                                                                                                                                                                                                          |       |                                                                                                                                                                                                                                    |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1/00  | <b>Investigation of foundation soil <u>in situ</u></b> (investigation involving boring or specially adapted to earth drilling E21B 25/00, E21B 49/00; investigating or analysing materials by determining their chemical or physical properties, in general G01N, e.g. sampling G01N 1/00)                                                               | 3/074 | . . . Vibrating apparatus operating with systems involving rotary unbalanced masses (E02D 3/054 takes precedence) [3]                                                                                                              |
| 1/02  | . before construction work                                                                                                                                                                                                                                                                                                                               | 3/08  | . . by inserting stones or lost bodies, e.g. compaction piles (sand drains for soil compaction E02D 3/10; stressing soil while forming foundations E02D 27/28)                                                                     |
| 1/04  | . . Sampling of soil                                                                                                                                                                                                                                                                                                                                     | 3/10  | . . by watering, draining, de-aerating or blasting, e.g. by installing sand or wick drains (E02D 3/11 takes precedence; soil-penetrating vibrators with auxiliary watering E02D 3/054; drainage of soil in general E02B 11/00) [3] |
| 1/06  | . . Sampling of ground water                                                                                                                                                                                                                                                                                                                             | 3/11  | . by thermal, electrical or electro-chemical means (freezing soil for interrupting passage of underground water E02D 19/14) [3]                                                                                                    |
| 1/08  | . after finishing the foundation structure                                                                                                                                                                                                                                                                                                               | 3/115 | . . by freezing [3]                                                                                                                                                                                                                |
| 3/00  | <b>Improving or preserving soil or rock, e.g. preserving permafrost soil</b> (securing of slopes or inclines E02D 17/20; damming or interrupting passage of underground water E02D 19/12; improving soil for agricultural purposes A01; soil stabilisation for road building or like purposes E01C 21/00, E01C 23/10; setting rock anchoring bolts E21D) | 3/12  | . Consolidating by placing solidifying or pore-filling substances in the soil (making piles E02D 5/46; soil-conditioning or soil-stabilising materials C09K 17/00)                                                                 |
| 3/02  | . Improving by compacting (E02D 3/11 takes precedence; compacting soil locally before or while forming foundations E02D 27/26, E02D 27/28) [3]                                                                                                                                                                                                           | 5/00  | <b>Bulkheads, piles, or other structural elements specially adapted to foundation engineering</b> (engineering elements in general F16)                                                                                            |
| 3/026 | . . by rolling with rollers usable only for or specially adapted for soil compaction, e.g. sheepfoot rollers (rollers for soil working in agriculture A01B 29/00; rollers for road paving, such rollers usable also for compacting soil E01C 19/23) [3]                                                                                                  | 5/02  | . Sheet piles or sheet pile bulkheads                                                                                                                                                                                              |
| 3/032 | . . . Trench rollers [3]                                                                                                                                                                                                                                                                                                                                 | 5/03  | . . Prefabricated parts                                                                                                                                                                                                            |
| 3/039 | . . . Slope rollers [3]                                                                                                                                                                                                                                                                                                                                  | 5/04  | . . . made of steel                                                                                                                                                                                                                |
| 3/046 | . . by tamping or vibrating, e.g. with auxiliary watering of the soil (E02D 3/026, E02D 3/08 take precedence; tamping or vibrating apparatus for working ballast on railways E01B 27/00, for consolidating paving materials E01C 19/30, for consolidating concrete in general E04G 21/06) [3]                                                            | 5/06  | . . . . Fitted piles or other elements specially adapted for closing gaps between two sheet piles or between two walls of sheet piles                                                                                              |
| 3/054 | . . . involving penetration of the soil, e.g. vibroflotation [3]                                                                                                                                                                                                                                                                                         | 5/08  | . . . . Locking forms; Edge joints; Pile crossings; Branch pieces                                                                                                                                                                  |
| 3/061 | . . . Tampers with directly acting explosion chambers (pile drivers with explosion chambers E02D 7/12) [3]                                                                                                                                                                                                                                               | 5/10  | . . . . made of concrete or reinforced concrete                                                                                                                                                                                    |
| 3/068 | . . . Vibrating apparatus operating with systems involving reciprocating masses (E02D 3/054, E02D 3/061 take precedence) [3]                                                                                                                                                                                                                             | 5/12  | . . . . Locking forms; Edge joints; Pile crossings; Branch pieces                                                                                                                                                                  |
|       |                                                                                                                                                                                                                                                                                                                                                          | 5/14  | . . Sealing joints between adjacent piles (sealing joints not restricted to foundation piles E04B 1/68)                                                                                                                            |
|       |                                                                                                                                                                                                                                                                                                                                                          | 5/16  | . . Auxiliary devices rigidly or detachably arranged on sheet piles for facilitating assembly                                                                                                                                      |
|       |                                                                                                                                                                                                                                                                                                                                                          | 5/18  | . Bulkheads or similar walls made solely of concrete <u>in situ</u>                                                                                                                                                                |

- 5/20 . Bulkheads or similar walls made of prefabricated parts and concrete, including reinforced concrete, in situ
- 5/22 . Piles (sheet piles E02D 5/02)
- 5/24 . . Prefabricated piles
- 5/26 . . . made of timber with or without reinforcement; Means affording protection against spoiling of the wood (cases E02D 5/60; impregnating agents B27K 3/16); Self-cleaning of piles placed in water
- 5/28 . . . made of steel
- 5/30 . . . made of concrete or reinforced concrete or made of steel and concrete
- 5/32 . . . with arrangements for setting in position by fluid jets
- 5/34 . . Concrete or concrete-like piles cast in position
- 5/36 . . . making without use of mould-pipes or other moulds
- 5/38 . . . making by use of mould-pipes or other moulds
- 5/40 . . . . in open water
- 5/42 . . . . by making use of pressure liquid or pressure gas for compacting the concrete
- 5/44 . . . . with enlarged footing or enlargements at the bottom of the pile
- 5/46 . . . making in situ by forcing bonding agents into gravel fillings or the soil (consolidating soil in general E02D 3/12)
- 5/48 . . Piles varying in construction along their length
- 5/50 . . Piles comprising both precast concrete portions and concrete portions cast in situ
- 5/52 . . Piles composed of separable parts, e.g. telescopic tubes
- 5/54 . . Piles with prefabricated supports or anchoring parts; Anchoring piles
- 5/56 . . Screw piles
- 5/58 . . Prestressed concrete piles
- 5/60 . . Piles with protecting cases
- 5/62 . . Compacting the soil at the footing or in a casing by forcing cement or like material through tubes
- 5/64 . . Repairing piles
- 5/66 . Mould-pipes or other moulds
- 5/68 . . for making bulkheads
- 5/70 . . for making sheet piles
- 5/72 . Pile shoes
- 5/74 . Means for anchoring structural elements or bulkheads (anchoring piles E02D 5/54)
- 5/76 . . Anchorings for bulkheads or sections thereof
- 5/80 . . Ground anchors
- 7/00 Methods or apparatus for placing sheet pile bulkheads, piles, mould-pipes, or other moulds** (for both placing and removing E02D 11/00)
- 7/02 . Placing by driving
- 7/04 . . Hand pile-drivers
- 7/06 . . Power-driven drivers
- 7/08 . . . Drop drivers with free-falling hammer
- 7/10 . . . with pressure-operated hammer
- 7/12 . . . Drivers with explosion chambers
- 7/14 . . . Components for drivers
- 7/16 . . . . Scaffolds for drivers
- 7/18 . Placing by vibrating
- 7/20 . Placing by pressure or pulling power
- 7/22 . Placing by screwing down
- 7/24 . Placing by using fluid jets
- 7/26 . Placing by using several means simultaneously
- 7/28 . Placing of hollow piles or mould-pipes by means arranged inside the piles or pipes
- 7/30 . . by driving cores
- 9/00 Removing sheet pile bulkheads, piles, mould-pipes, or other moulds** (for both placing and removing E02D 11/00)
- 9/02 . by withdrawing
- 9/04 . by cutting-off under water
- 11/00 Methods or apparatus for both placing and removing sheet pile bulkheads, piles, or mould-pipes** (features relating to placing only E02D 7/00, to removing only E02D 9/00)
- 13/00 Accessories for placing or removing piles or bulkheads**
- 13/02 . specially adapted for placing or removing bulkheads
- 13/04 . Guide devices; Guide frames
- 13/06 . for observation while placing
- 13/08 . Removing obstacles
- 13/10 . Follow-blocks of pile-drivers or like devices
- 15/00 Handling building or like materials for hydraulic engineering or foundations** (conveying or working-up concrete or similar masses in general E04G 21/02)
- 15/02 . Handling of bulk concrete specially for foundation purposes
- 15/04 . . Placing concrete in mould-pipes, pile tubes, boreholes, or narrow shafts
- 15/06 . . Placing concrete under water
- 15/08 . Sinking workpieces into water or soil
- 15/10 . Placing gravel or like material under water
- 17/00 Excavations; Bordering of excavations; Making embankments** (soil shifting apparatus E02F; earth drilling E21)
- 17/02 . Foundation pits
- 17/04 . . Bordering or stiffening the sides of foundation pits
- 17/06 . Foundation ditches or narrow shafts
- 17/08 . . Bordering or stiffening the sides of ditches or narrow shafts for foundations
- 17/10 . . Covering trenches for foundations
- 17/12 . . Back-filling of foundation trenches or ditches
- 17/13 . Foundation slots; Implements for making these slots
- 17/16 . Loosening of soil or rock, under water (for correcting streams E02B 3/02; by dredgers or excavators E02F)
- 17/18 . Making embankments (E02D 17/20 takes precedence)
- 17/20 . Securing of slopes or inclines
- 19/00 Keeping dry foundation sites or other areas in the ground** (sheet piles or bulkheads E02D 5/02)
- 19/02 . Restraining of open water
- 19/04 . . by coffer-dams
- 19/06 . Restraining of underground water
- 19/08 . . by employing open ditches arranged below the level of the water
- 19/10 . . by lowering level of ground water
- 19/12 . . by damming or interrupting the passage of underground water
- 19/14 . . . by freezing the soil (in connection with sinking shafts E21D 1/12)
- 19/16 . . . by placing or applying sealing substances (consolidating by placing solidifying or pore-filling substances in the soil E02D 3/12)
- 19/18 . . . by making use of sealing aprons (sealings or joints for engineering work E02B 3/16)

- 19/20 . . . by displacing the water, e.g. by compressed air
- 19/22 . Lining sumps in trenches
- 23/00 Caissons; Construction or placing of caissons** (tunnels submerged into or built in open water E02D 29/063) [6]
- 23/02 . Caissons able to be floated on water and to be lowered into water in situ
- 23/04 . Pneumatic caissons
- 23/06 . . Bringing persons or material into, or out of, compressed air caissons
- 23/08 . Lowering or sinking caissons
- 23/10 . . Caissons filled with compressed air
- 23/12 . . Inclined lowering
- 23/14 . . Decreasing the skin friction while lowering
- 23/16 . Jointing caissons to the foundation soil, specially to uneven foundation soil
- 25/00 Joining caissons or like sunk units to each other under water**
- 27/00 Foundations as substructures**
- 27/01 . Flat foundations
- 27/02 . . Flat foundations without substantial excavation (E02D 27/04, E02D 27/08 take precedence)
- 27/04 . . in water or on quicksand
- 27/06 . . . Floating caisson foundations
- 27/08 . . Reinforcements for flat foundations
- 27/10 . Deep foundations
- 27/12 . . Pile foundations
- 27/14 . . . Pile framings
- 27/16 . . . Foundations formed of separate piles
- 27/18 . . Foundations formed by making use of caissons
- 27/20 . . Caisson foundations combined with pile foundations
- 27/22 . . Caisson foundations made by starting from fixed or floating artificial islands by using protective bulkheads
- 27/24 . Foundations constructed by making use of diving-bells (equipment for dwelling or working under water B63C 11/00)
- 27/26 . Compacting soil locally before forming foundations; Construction of foundation structures by forcing binding substances into gravel fillings (consolidating foundation soil in general E02D 3/02 E02D 3/12)
- 27/28 . Stressing the soil or the foundation structure while forming foundations
- 27/30 . Foundations made with permanent use of sheet pile bulkheads, walls of planks, or sheet piling boxes
- 27/32 . Foundations for special purposes
- 27/34 . . Foundations for sinking or earthquake territories (building constructions with protection arrangements against earthquakes E04H 9/02)
- 27/35 . . Foundations formed in frozen ground, e.g. in permafrost soil [3]
- 27/36 . . Foundations formed in moors or bogs
- 27/38 . . Foundations for large tanks, e.g. oil tanks
- 27/40 . . Foundations for dams across valleys or for dam constructions
- 27/42 . . Foundations for poles, masts, or chimneys
- 27/44 . . Foundations for machines, engines, or ordnance (special layout of foundations with respect to machinery to be supported F16M 9/00)
- 27/46 . . Foundations for supply conduits or other canals
- 27/48 . . Foundations inserted underneath existing buildings or constructions
- 27/50 . . Anchored foundations
- 27/52 . . Submerged foundations
- 29/00 Underground or underwater structures** (underground tanks B65D 88/76; hydraulic engineering, e.g. sealings or joints, E02B; underground garages E04H 6/00; underground air-raid shelters E04H 9/12; burial vaults E04H 13/00); **Retaining walls** [6]
- 29/02 . Retaining or protecting walls (piers or quay walls E02B 3/06)
- 29/045 . Underground structures, e.g. tunnels or galleries, built in the open air or by methods involving disturbance of the ground surface all along the location line; Methods of making them [6]
- 29/05 . . at least part of the cross-section being constructed in an open excavation or from the ground surface, e.g. assembled in a trench [6]
- 29/055 . . . further excavation of the cross-section proceeding underneath an already installed part of the structure, e.g. the roof of a tunnel [6]
- 29/063 . Tunnels submerged into, or built in, open water (construction or placing of caissons in general E02D 23/00; joining caissons to each other under water, in general E02D 25/00) [6]
- 29/067 . . Floating tunnels; Submerged bridge-like tunnels, i.e. tunnels supported by piers or the like above the water-bed (pontoons or floating bridges E01D 15/14) [6]
- 29/07 . . Tunnels or shuttering therefor preconstructed as a whole or continuously made, and moved into place on the water-bed, e.g. into a preformed trench [6]
- 29/073 . . Tunnels or shuttering therefor assembled from sections individually sunk onto, or laid on, the water-bed, e.g. in a preformed trench (caisson-type sections lowered onto the water-bed E02D 29/077) [6]
- 29/077 . . Tunnels at least partially built beneath the water-bed characterised by being made by methods involving disturbance thereof all along the location line, e.g. by cut-and-cover or caisson methods [6]
- 29/09 . Constructions or methods of constructing, in water, not otherwise provided for [6]
- 29/12 . Manhole shafts; Other inspection or access chambers; Accessories therefor (for underground tanks B65D 90/10; for sewerage E03F 5/02) [6]
- 29/14 . . Covers for manholes or the like; Frames for covers [6]
- 29/16 . Arrangement or construction of joints in foundation structures (sealing joints not restricted to foundation structures E04B 1/68)
- 31/00 Protective arrangements for foundations or foundation structures; Ground foundation measures for protecting the soil or the subsoil water, e.g. preventing or counteracting oil pollution** (spillage retaining means for tanks B65D 90/24)
- 31/02 . against ground humidity or ground water
- 31/04 . . Watertight packings for use under hydraulic pressure
- 31/06 . against corrosion by soil or water
- 31/08 . against transmission of vibrations or movements in the foundation soil
- 31/10 . against soil pressure or hydraulic pressure
- 31/12 . . against upward hydraulic pressure
- 31/14 . . against frost heaves in soil [3]

**E02D**

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| <p><b>33/00</b>    <b>Testing foundations or foundation structures</b> (testing methods or apparatus, <u>see</u> the relevant subclasses of class G01; testing structures or apparatus as regards function, in general, G01M; investigating or analysing materials by determining their chemical or physical properties, in general G01N)</p> | <p><b>35/00</b>    <b>Straightening, lifting, or lowering of foundation structures or of constructions erected on foundations</b></p> <p><b>37/00</b>    <b>Repair of damaged foundations or foundation structures</b></p> |
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