

# New inventions in Civil Engineering

Academician Oleg Figovsky

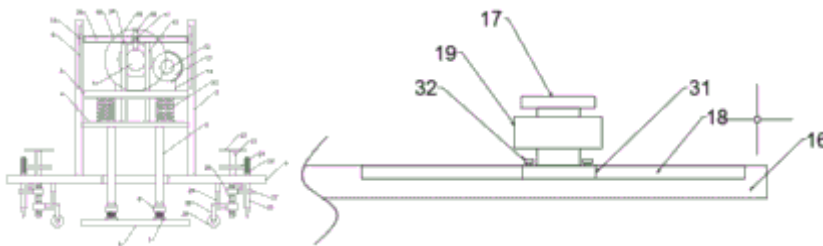
The field of civil engineering has always been at the forefront of innovation, and 2023 is no exception. As the world faces unprecedented challenges, including the need for sustainable infrastructure, civil engineers are being called upon to find new solutions to old problems. From smarter construction techniques to cutting-edge materials and innovative designs, the latest advances in civil engineering promise to transform the industry and help build a more resilient, efficient, and sustainable future. Cement is the most widely used material in construction, but also one of the biggest contributors to harmful carbon emissions, said to be responsible for around 7 percent of annual global emissions. One major problem is cracking in construction, usually caused by exposure to water and chemicals. Bath University researchers are looking to develop a self-healing concrete, using a mix containing bacteria within microcapsules. which will germinate when water enters a crack in the concrete, which exact limestone, plugging the crack before water and oxygen has a chance to corrode the steel reinforcement. The demand for efficient insulation material is becoming crucially important throughout the construction industry.

The heat through walls tends to cross directly through the building envelope, be it masonry, block, or stud frame, to the internal fascia such as drywall. This process is called “thermal bridging”. Aerogel, the Nasa technology developed for cryogenic insulation, is considered one of the most effective thermal insulation materials, and US spin-off. The rmablok has adapted it using a proprietary aerogel in a fiberglass matrix. This can be used to insulate studs, which can considerably increase the overall wall R-value (an industry measure of thermal resistance) by more than 40 percent. **Glazing integrated photovoltaic (BIPV)** can help buildings generate their own electricity, by turning the whole building envelope into a solar panel. **Polysolar** is a company is to provide transparent photovoltaic glass as a structural building material, forming windows, façades, and roofs. The grazing material of Polysolar is efficient at producing energy even on north-facing, vertical walls. It is high performance at raised temperatures means it can be double-glazed or insulated directly. It includes the building constructed off-site using the same materials and designed to the same standards as conventional on-site construction. It also helps in limiting environmental disruption, delivering components as and when needed, and turning construction into a logistics exercise. It also offers strong sustainability benefits, from fewer vehicle movements to less waste. By using this method with up to 70 percent of a building produced as components, it allows a move towards “just in time” manufacturing and delivery. This method is currently popular in the United States and the UK, Chinese developer Broad Sustainable Building recently completed a 57-story skyscraper.

USA and China are leading patent owners in the field of Civil Engineering. The last patents in Civil Engineering are presented below. The invention CN 107704703B discloses a kind of construction methods of civil engineering BIM project amount model, first obtain or construct BIM initial model, all parametrization components in the initial

model are created by layered modeling. Then according to project amount statistical requirements and demand, in BIM initial model all secondary structures and prefabricated preburied component carry out modeling inspection, and unmodeled secondary structure and prefabricated preburied component are modeled. Processing finally is reduced according to preset rules execution to all superimposed structures, obtains civil engineering BIM project amount model. Using the embodiment of the present invention, by the standardization and normalization procedure that execute civil engineering BIM project amount model construction, support BIM designs a model to execute the output requirement of preset rules with BIM engineering model to meet, without carrying out two modelings to go out project amount, or avoid between design and calculation amount software repeatedly in association process caused by data degradation, improve the integrated degree and efficiency of construction overall process project amount statistics.

The invention CN 201810286034 discloses a disc-drive-based pavement tamping device for civil engineering construction, which comprises a supporting transverse plate, wherein a fixed rod frame is arranged on the supporting transverse plate, a pushing transverse plate with the side connected with the rod wall in a sliding manner and a fixed transverse plate fixedly connected with the rod wall are arranged on the inner side of the fixed rod frame, the upper end surface of the pushing transverse plate is connected with the lower end surface of the fixed transverse plate through a tamping spring, the upper end of an adjusting slide block is connected and fixed with a poking convex column, the lower end wall of the pushing transverse plate penetrates through the fixed transverse plate through a plurality of connecting pull rods to be connected and fixed with the upper end surface of the pushing transverse plate, the spiral directions of two ends of the lower side of an adjusting screw rod are opposite, two spiral connecting sleeves matched with the adjusting screw rod are arranged on the lower side of the adjusting screw rod, moving rollers are. The device makes things convenient for the road surface to tamp, and is easy and simple to handle, can change application of force intensity adaptation different road surfaces, stable in structure during the tamping, and convenient the removal, and the practicality is stronger.

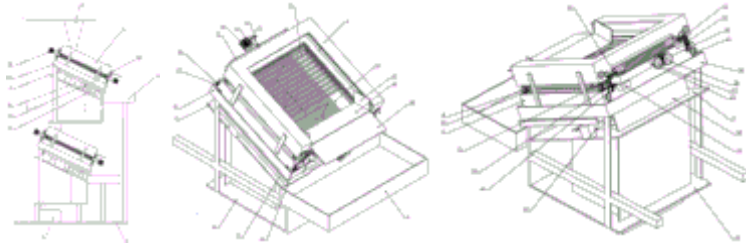


The utility model, according to CN 20152107440, provides a civil engineering building construction material smashes and mixes integrated device, includes the casing, be equipped with first pivot in the casing, first pivot is connected with the inverter motor who is located the casing top, be equipped with a plurality of support columns in the first pivot, the on -fixed end of support column is equipped with

first recess, is equipped with the spring in the first recess, spring one end and first recess bottom fixed connection, the other end and rod for crushing fixed connection, rod for crushing is last evenly to be equipped with a plurality of crushing blades, the bottom of first pivot is equipped with the disturbance pole, and the disturbance pole is circular - arcly, and disturbance pole below is equipped with arresting barrier, and arresting barrier is circular -arcly, the arresting barrier below is equipped with mixing arrangement, mixing arrangement includes second pivot, motor and helical blade. The beneficial effect of the utility model can come to change to smash radius, convenient to use as required, smash and the mixed phase combination, effectively practiced thrift the plenty of time for the construction progress.

The utility model, according to CN 20527015U, discloses a novel shale shaker for civil engineering, including base, left support plate, right branch fagging, roof, feeder hopper, connecting the sand table, the inner wall of left support plate and right branch fagging all is provided with a set of spring, and the spring is fixed with the screen cloth of a horizontal setting, is provided with on the screen cloth to extend to the outer body of rod of right branch fagging, follows vertical direction on the right branch fagging and is provided with the slot hole that matches with the body of rod, and the outer wall of right branch fagging is provided with the mounting panel, is provided with first motor on the mounting panel, is provided with the cam on the output shaft of first motor, cam and body of rod contact, the preceding both sides of base are provided with a front wheel respectively, and both sides are provided with a rear wheel respectively at the back, and the front wheel passes through first round hub connection, and the rear wheel passes through second wheel hub connection, is provided with the second motor in the base, is provided with first gear on the output shaft of second motor, the first round is epaxial be provided with with a gear engagement's second gear. The beneficial effects are that: work efficiency is high, remove laborsaving convenience.

The invention CN 201910546708 relates to a civil engineering sand screening device, which utilizes a cross-shaped structure consisting of transverse rods and a longitudinal rod to form a screen structure, enables the transverse rods and the longitudinal rods to be adjusted at equal intervals according to requirements through a transverse interval adjusting device and a longitudinal interval adjusting device, simultaneously utilizes the locking function of a hydraulic telescopic rod in a hydraulic cylinder and the self-locking function of threads to realize the position locking after adjustment, enables the transverse rods and the longitudinal rods in the screen structure to be stable and reliable in the screening process, can be suitable for fine sand or gravel with different particle sizes, avoids the replacement of a screen, simultaneously drives the transverse rods and the longitudinal rods which are mutually matched to be separated when screen holes are blocked or the screen needs to be cleaned by a power device, and then realizes the cleaning effect through adjusting the interval, the invention has simple operation and ingenious structure, the replacement of the screen is avoided, and meanwhile, the screen can be cleaned in time, so that the screening efficiency and quality are greatly improved.



Method for the construction of a hybrid foundation structure, according to ES 2671930T3, providing an upper support layer (10) and a lower support layer (20) with different cross-sectional sizes from each other, and located vertically, wherein the upper support layer (10) and the lower support layer (20) are vertically installed on a ground, and comprising the upper support layer (10) formed on the ground in the vertical direction; the lower support layer (20) extending downwardly from the upper support layer (10) to have a narrower width compared to the width of the upper support layer (10), and the upper support layer (10) and the lower support layer (20) are formed by injection of solidified soil, which is a mixture of earth, sand and a soil solidifying agent, including the method: a drilling step to form a hole (1) of drilling on the ground to form the upper support layer (10) and the lower support layer (20); a basic formation step to inject the mixture of earth, sand and a soil solidifying agent into the drilling hole (1) to form the upper support layer (10) and the lower support layer (20), characterized in that earth and sand are a mixture of the silt produced in the drilling stage and aggregates, and the drilling stage and the basic formation stage consist of using a part of the silt produced in the drilling stage and injecting the mixture of remaining silt, aggregate and a soil solidifying agent.

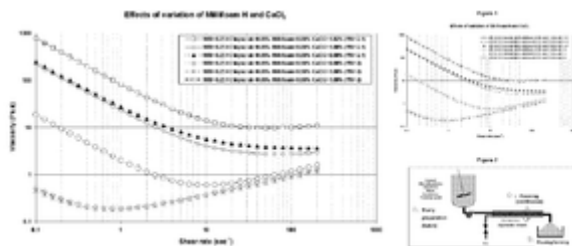
The invention US 972966557 B relates to a composition comprising, based on the dry weight of said composition, (A) 10 to 70% by weight of one or more hydraulic binder and (B) 20 to 85% by weight of one or more filler, wherein the composition contains 0.05 to 5% by weight, based on the amount of the hydraulic binder, of at least one terpenoid alcohol, wherein the terpenoid alcohol is not terpineol or borneol. Additionally disclosed is a hardened product made by the composition and the use of at least one terpenoid alcohol in a composition, comprising hydraulic binder and filler, to reduce the shrinkage of the wet composition during curing.

The invention KR 101724062 B, relates to a mortar composite to maintain and reinforce a concrete structure suppressing an in-depth fine crack of a damaged concrete structure, and a concrete structure maintaining and reinforcing method using the same. More specifically, when maintaining and reinforcing a damaged part of a deteriorated concrete structure; the present invention has excellent maintaining effect for an internal in-depth fine crack and improves a bonding strength and durability to maintain the effects of maintaining and reinforcing for a long time while at the same time stably completing maintaining and reinforcing construction for a short time; thereby having excellent economic feasibility, have excellent user convenience by being directly used in a site, and have excellent resistance to the damage and fusion of the concrete structure while at the same time having excellent effect of suppressing the growth and

proliferation of microorganisms. As such, the present invention is capable of having excellent tolerance to an acidic action caused by the action of the microorganisms.

The invention KR 101614725 B, relates to a shrinkage-reducing type rapid hardening cement concrete composition with excellent durability and a road pavement maintenance construction method using the same. The present invention includes: 5-45 wt% of rapid hardening binder; 10-75 wt% of fine aggregate; 10-65 wt% of coarse aggregate; 0.01-25 wt% of reforming admixture; and 0.1-25 wt% of water. The rapid hardening binder includes: 10-60 wt% of normal granular Portland cement which has fineness of 4,000-8,500  $\text{cm}^2/\text{g}$ ; 5-50 wt% of calcium sulfoaluminate; 1-40 wt% of calcium aluminate cement; 1-40 wt% of sericite; 1-40 wt% of blast furnace slag powder which has fineness of 4,500-8,500  $\text{cm}^2/\text{g}$ ; 0.1-20 wt% of gypsum; 0.01-20 wt% of bauxite; 0.01-10 wt% of cyclohexylamine nitrite; 0.01-10 wt% of lithium carbonate; and 0.01-10 wt% of sodium carbonate. The shrinkage-reducing type rapid hardening cement concrete composition according to the present invention can improve the strength, durability, and especially waterproofing and soundproofing properties of concrete by forming dense concrete by promoting the initial hydration and densification of the cement. The present invention can obtain an effect of preventing surface crack and expansion failure phenomenon by drying shrinkage by using an expanding agent and a shrinkage reducing agent.

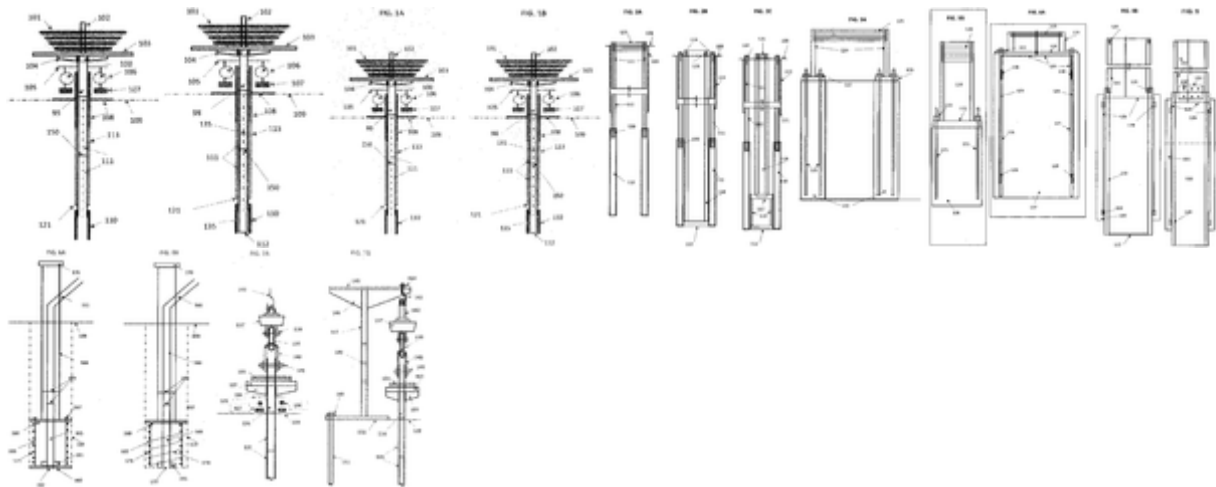
A foamed concrete, according to US 88001851 B, having a density from 100 to 800  $\text{kg}/\text{m}^3$  including by mass relative to the total mass of the concrete: a cement; water; from 0.01 to 5% of a water-reducing agent, plasticizer or superplasticizer; from 0.45 to 5% of a foaming agent relative to the amount of water; from 0.01 to 5% of a water-soluble calcium salt; inorganic particles from 0.1 to 300  $\mu\text{m}$  in size; the ratio of foaming agent to calcium salt being from 0.3 to 0.8; excluding foamed concretes including 10% or more by mass of slag.



A method of manufacturing a building block, according to ES 2808117 T3, comprising providing a granular material and a binder including steel slag; combining the granular material and the binder with water at a first water / slag ratio; compacting the combined granular material, binder and water at a compaction pressure of less than 20 MPa; reducing the amount of water in the combined granular material, binder and water to a second water / slag ratio that is less than the first water / slag ratio; hardening

said combined granular material, binder and water having said second water / slag ratio with carbon dioxide.

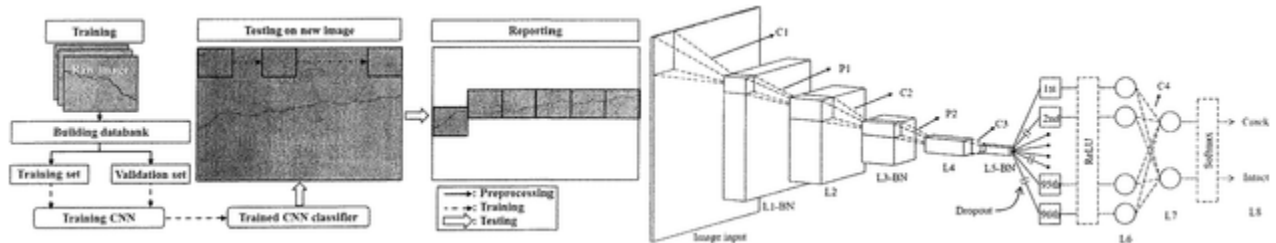
Subsurface exploration by patent US 10823880 B1 using In-Situ tests such as SPT, CPT, CPTu, DMT, and PMT predicts inaccurately engineering properties of soils and intermediate geomaterials and thereby predicts incorrect load-settlement relationship of piles; variations or errors in engineering properties predicted by one empirical correlation to another correlation could be up to 50% or greater. For soft to very soft soils, engineering properties cannot be predicted as the SPT only provides information such as WOR and WOH. To overcome this problem, the invention of the application consists of performing subsurface exploration using load tests on short model piles with or without instrumentation at various depths of a soil deposit for determining accurately the above-mentioned properties. For very soft soils, a hung balance is used to hang drill rods and short model pile from a drill rig boom or from a platform with soil anchors to prevent its overturning, and then perform the load test.



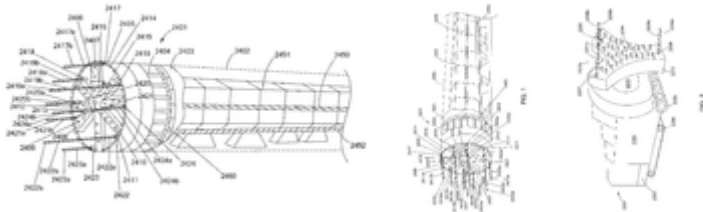
This invention CN 197510927 B relates to a set of elements or parts that make up an adjustable metal formwork system for concrete structures in civil engineering works that is intended to enable the formwork system to be assembled, joined and adjusted as efficiently as possible. Using the adjustable formwork system is intended to minimise the number of metal panels and accessories during execution of a project. It is also noteworthy that the shape, size and function of each element are especially designed to obtain a rigid structure, making it possible to construct the mould into which the concrete is poured while retaining its characteristics and to perform said functions more quickly, efficiently and safely.

Structure defect detection by US patent 11144814 B is performed using computer-implemented arrangements employing machine learning algorithms in the form of neural networks. In one arrangement, a convolutional neural network is trained using a database of images formed to optimize accuracy of the convolutional neural network to

detect, for example, a crack in a concrete surface. A two-stage scanning process each performing a plurality of scans of a test image is incorporated in the foregoing arrangement of convolutional neural network, with the two-stages forming overlapping capture areas to reduce likelihood of a crack lying on a boundary of the individual scans going undetected. Also, region-based convolutional neural networks are trained to detect various types of defects.



The patent US 10195687 B2 is provided high power laser and laser mechanical earth removing equipment, and operations using laser cutting tools having stand off distances. These equipment provide high power laser beams, greater than 1 kW to cut and volumetrically remove targeted materials and to remove laser affected material with gravity assistance, mechanical cutters, fluid jets, scrapers and wheels. There is also provided a method of using this equipment in mining, road resurfacing and other earth removing or working activities.



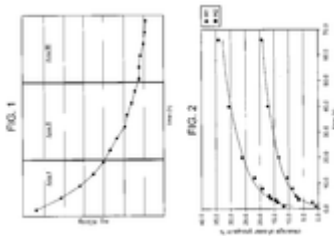
The invention CN 103136626 B relates to a kind of online management method of engineering project, the method is based on a remote interaction platform, pass budgets end computer installation, multiple contract enterprises end computer installation, multiple evaluation end computer installations, application end computer installation, multiple end computer installations of submitting to a higher level for approval or revision, multiple examination & verification end computer installations, data transmission and data between multiple examination & verification end computer installations and server-side computer system process, achieve online bidding and the assessment of bids of engineering project, the on-line evaluation contracting enterprise of engineering project, work out an engineering project schedule online, the online tracing of engineering project progress performance, engineering project progress abnormal response and process, the online engineering project quality that generates checks and accepts form, the online application of engineering project progress payment, material and labour cost analysis generates project estimates online.

The invention CN 107355509 B provides a kind of current vortex vibration absorber using lever principle, which includes cabinet (1), connecting screw hole (2), fixed copper sheet (3), permanent magnet (4), permanent magnet guide rail (5), support

rod (6), mobile copper sheet (7), mass block (8), mass block guide rail (9), spring (10), connecting rod (11), hinged screw hole (12), driving bearing pin (13). When structure is vibrated, energy transfer is carried out by TMD damper first, reduces structural vibration. Then the movement for moving permanent magnet generation and mass block opposite direction by lever body frenulum by mass block, increases the speed of related movement of copper sheet and permanent magnet, carries out non-contact type energy dissipation by eddy current damper. The device utilizes lever principle, effectively increases the speed of related movement of copper sheet and permanent magnet, improves damper energy dissipation capacity. Simultaneously by adjusting balance pivot and torque arm length, adjustable TMD damper parameters, it is more extensive that device is applicable in frequency range.

Polymers for cement dispersing admixtures, according to patent US 6855752 B2, which show different performing properties in concrete are described. All polymers are based on a composition of reactants, namely

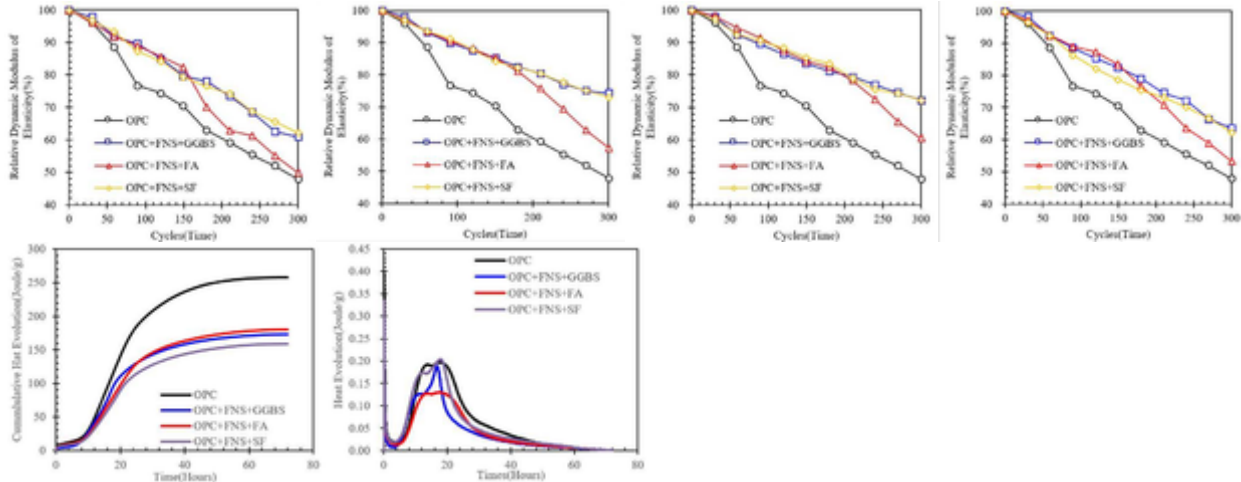
- a) a poly(acrylic acid), b) a polyalkyleneglycol-monoalkylether and, optionally c) a  $\alpha$ -amino-polyalkylene-glycol- $\omega$ -alkylether and/or d) a primary or secondary amine. By keeping the composition of reactants constant and varying only the reaction time, polymers with different properties can easily be achieved. Such polymers are suitable for pre-cast, readymix or for increasing workability over time, just depending on reaction time. Polymers of the invention can be used as single polymer or in polymer blends. For this, the kinetics of the used polymer analogous condensation reaction was intensively studied. Additionally, the benefit of amines as reactant regarding stability and hydrolysis velocity of cleavable side groups was investigated.



The present invention relates to a three-component concrete composition using fine ferronickel slag powder and a concrete structure manufactured using the same. More particularly, the present invention relates to a technology for forming a concrete composition using a three-component binder to which fly ash (FA), blast furnace slag (GGBS) fine powder, fine ferronickel slag (FNS) powder which are industrial by-products other than cement as a binder for concrete and also for manufacturing a concrete structure using the same. According to the present invention, the three-component concrete composition using fine ferronickel slag powder can prevent infiltration of harmful chemicals or chlorides through pores since the pores between cements can be densely filled, thereby significantly extending the life of the concrete structure, extending the repair period, and significantly reducing costs and manpower due to repair. By recycling ferronickel slag, blast furnace slag fine powder, fly ash, etc.,



which are by-products generated in large quantities in industrial sites, it is possible to increase the recyclability of resources and reduce the amount of waste by-products, thereby improving eco-friendliness by preventing secondary environmental pollution due to waste.

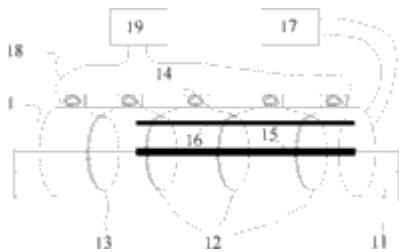


The invention US 103556225 B belongs to the field of civil engineering and relates to a complex squeezed pile forming construction method and a complex squeezed pile forming device. The complex squeezed pile forming construction method comprises the steps of utilizing a complex squeezing drill tool of the complex squeezed pile forming device to perform squeezing and hole forming, enabling an expansion body of the complex squeezing drill tool to expand and squeeze during upward spiral lifting, meanwhile starting a concrete pump to press and fill a pile material into a pile hole till the pile top elevation is reached, and obtaining the a complex squeezed pile. The complex squeezed pile forming device comprises the complex squeezing drill tool and a control system of the complex squeezing drill tool, wherein the complex squeezing drill tool comprises a drill rod, and multiple expansion bodies are arranged at a drill bit threaded section of the drill rod. The complex squeezed pile forming construction method has the advantages of being high in bearing capacity, small in settling volume, good in quality, low in cost, low in energy consumption, high in work efficiency, environment-friendly and the like, and the complex squeezed pile forming device can perform construction operation under the complicated geological condition/

The invention CN 109095836 B provides a recycled powder concrete material for 3D printing construction. The invention further provides a preparation method of the recycled powder concrete material for 3D printing construction. The invention also provides a recycled powder concrete member for 3D printing construction and a preparation method and application thereof. The recycled powder concrete for 3D printing construction and the preparation method thereof provided by the invention combine the construction waste recycling recycled powder technology with the 3D printing construction technology; the safety, the applicability and the durability of the 3D

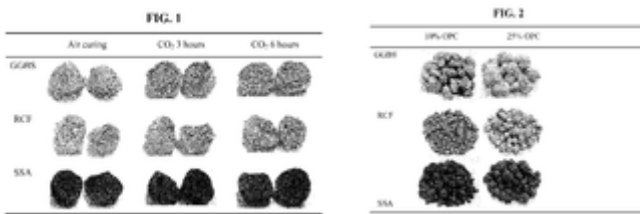
printing recycled powder concrete material are further improved through optimization of the recycled powder concrete formula, and the self-cleaning function is achieved. The invention has higher environmental benefit and social benefit by considering the development of unmanned construction technology and resource regeneration technology in civil engineering in the future.

The invention CN 10209677 B disclose a method for monitoring the corrosion cracks of reinforced concrete based on distributed optical fiber sensing technique. The method comprises the following steps: periodically detecting the polarization current of a steel bar and a stainless steel segment embedded in a sensor by an electrochemical work station to determine the initial corrosion time of the steel bar; monitoring the optical fiber strain by the distributed optical fiber sensing technique in real time through using sensing optical fibers surrounding the steel bar and laid in the sensor to deduce the corrosion expansion or corrosion crack stage of the reinforced concrete; and determining the corrosion expansion or corrosion crack degree by a calibration curve. The invention also discloses a sensor for executing the above method. The sensor can be used for monitoring the total corrosion cracking process of reinforced concrete at any position without damaging the structure of the concrete by monitoring the polarization current and the sensing optical fiber strain of the corroded steel bar, and can determine the corrosion crack stage and the degree of the reinforced concrete. The sensor is used for monitoring and evaluating the durability of reinforced concrete structure in the field of civil engineering.

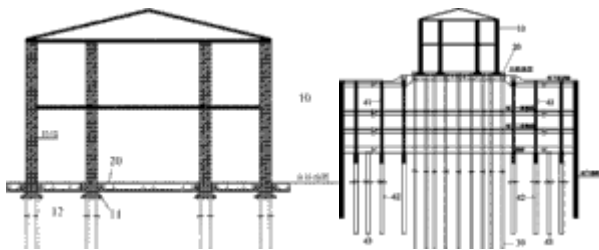


A kind of concrete material, comprise the following component of corresponding proportion: cement, fine aggregate, coarse aggregate, flyash, silicon ash, carbon nanotube, nano silicon, haydite, granular polystyrene, steel fiber, nano kaoline particle, ultra-fine natural zeolite powder, gypsum, polymer emulsion, dibastic alcohol compound, modified lignin mahogany sulfonate, sheet silicate minerals material, polysiloxane, oxalic acid, benzene emulsion, crystalloid hydrous magnesium aluminium silicate mineral, water, mould agent by force, the naphthalene series high-efficiency water-reducing agent of baric, organic polymer class plasticity-retention agent, compound retarder and air entrapment agent. The invention still further relates to the preparation method of this concrete material. Concrete material of the present invention CN 104291749 B is than it existing concrete, and various performance improves all greatly. It is applied widely, has great engineering practical value and significant Technological Economy meaning.

Synthetic aggregates by patent US 10207954 B2 are fabricated from greater than approximately 70 wt % waste starting materials. Starting materials may be selected from granulated ground blast furnace slag, waste concrete fines, or sewage sludge ash, and mixtures thereof. The starting materials are bound together by a hydraulic cementitious binder either added to the starting materials or formed in situ. The waste starting materials, binder, and water are formed into pellets and subjected to a hydraulic reaction and carbonation in an atmosphere of greater than approximately 50% carbon dioxide at temperatures less than approximately 100° C. The resulting synthetic aggregate has a crush strength after a period of hardening equal to or greater than approximately 0.5 MPa.

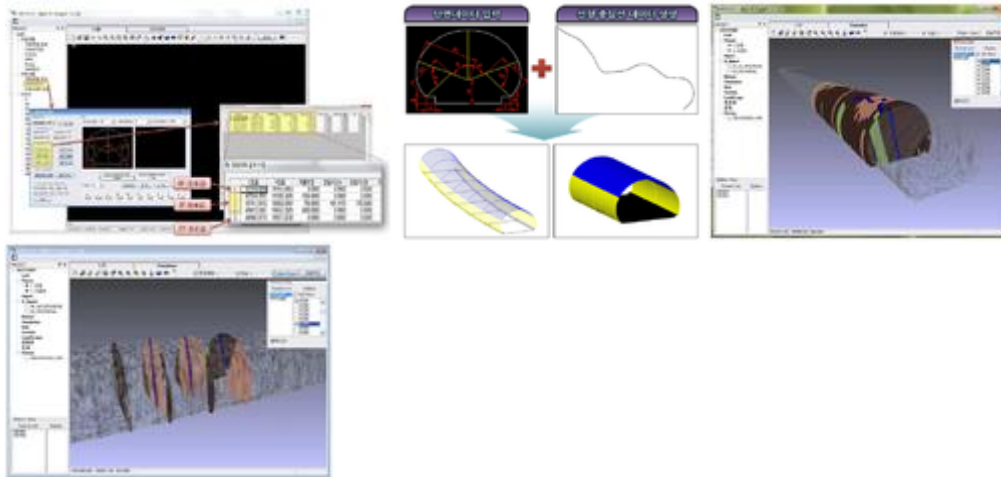


The invention CN 102127974 B provides a design and construction method of an additional cellar under an existing building, applied to the development and the application of an underground space under an existing building on a soft soil foundation. The method comprises the following steps of: (1) temporarily processing and reinforcing an existing building; (2) arranging an underpinning base carrier for wholly underpinning the foundation of the existing building; (3) designing and constructing an underpinning pile foundation under the existing building; (4) carrying out the engineering design and the construction of a foundation pit combined with the cellar structure; and (5) carrying out the structural design and the construction of a sequential part of the cellar structure to achieve the aim of adding a cellar under the building. The design and construction method provided by the invention can provide a complete and reliable design and construction technology for developing and utilizing the underground space under the existing building and can provide a new ideal for solving the problem of parking difficulty in a central metropolitan area, old towns, and the like.

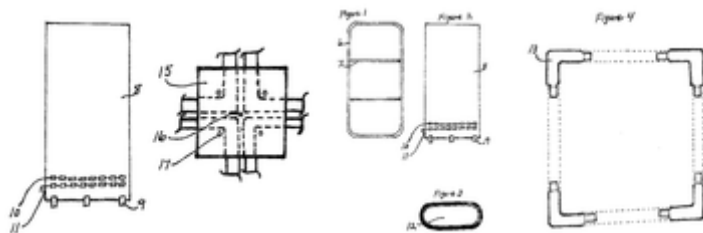


A tunnel BIM simulation system and method based on tunnel design data and excavation surface data is disclosed. The tunnel BIM simulation system by patent KP 101650480 B1 includes a two-dimensional centerline data generation unit, a three-dimensional centerline data generation unit, a tunnel cross-sectional configuration unit, a BIM model generation unit, and a data plane setting unit. The two-dimensional center linear data generator generates plane linear data and longitudinal linear data of the tunnel from the design data of the tunnel, and the three-dimensional center linear data generator generates three-dimensional central linear data of the tunnel from the plane linear data and the longitudinal linear data. The BIM model generator sets up a three-

dimensional BIM model of the tunnel using the three-dimensional centerline data of the tunnel and the cross-sectional shape of each section of the tunnel from the design data of the tunnel cross section. And the paved surface data setting unit sets the paved surface data of the tunnel to the cross section on the corresponding three-dimensional BIM model of the tunnel.

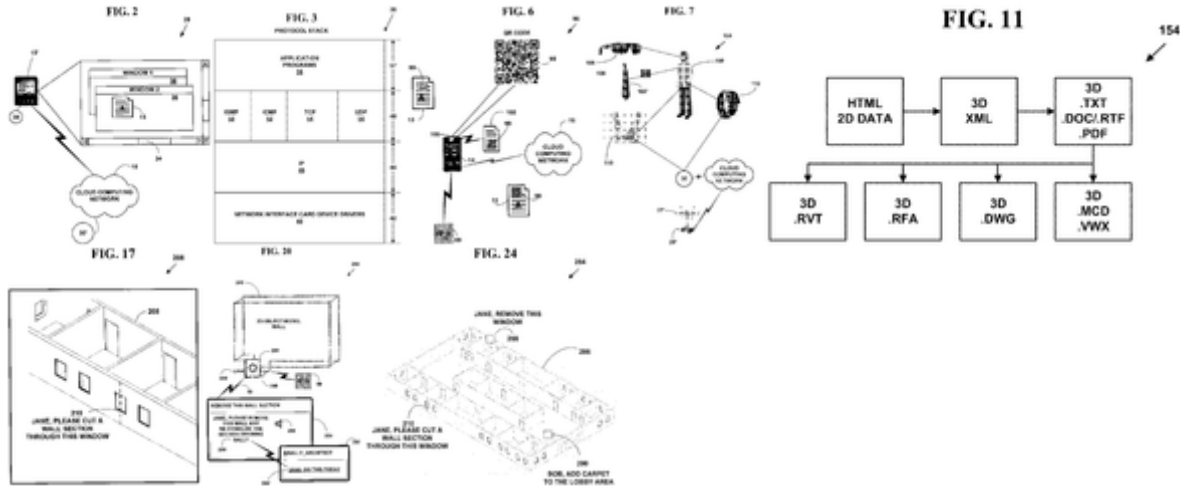


An innovative, low-density, highly-insulating modular panel for use in many applications and industries. The panel by patent US 9512670 B2 consists of a frame that may be preformed or bent and may be made of rigid or flexible material, and a panel covering comprising at least one pocket of thin, low-density shade fabric that has the capability of sufficiently stretching to surround the frame when the pocket is pulled onto it. The pocket may be then secured, along any previously open end where the frame was inserted, by various fastening devices. The panel covering pocket may have additional features added, as described herein. The panel is durable and cost-effective, and has good solar-control and insulating qualities. It is also a windbreak panel, a noise-reduction panel, an impact protection panel, a water-resistant panel, a fall protection panel, and a pollution-control panel. Two or more panels can be joined to create a structure-protecting panel assembly or system.

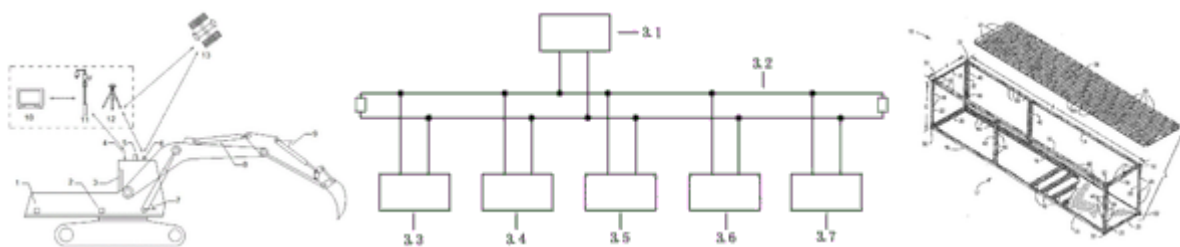


A method and system for native object collaboration, revision and analytics for Building Information Models (BIM) and other design platforms. The method and system by patent US 10949805 B2 provide X-dimensional (XD) models for building information modeling (BIM) with collaboration and analytics. The method and system allows real-

time and static collaboration on native and new composite XD (e.g., 3D, or lower or higher dimensional) object models from within existing 3D modeling BIM programs (e.g., AUTODESK REVIT, AUTOCAD, VECTORWORKS etc.). Collaboration analytics are collected and displayed.

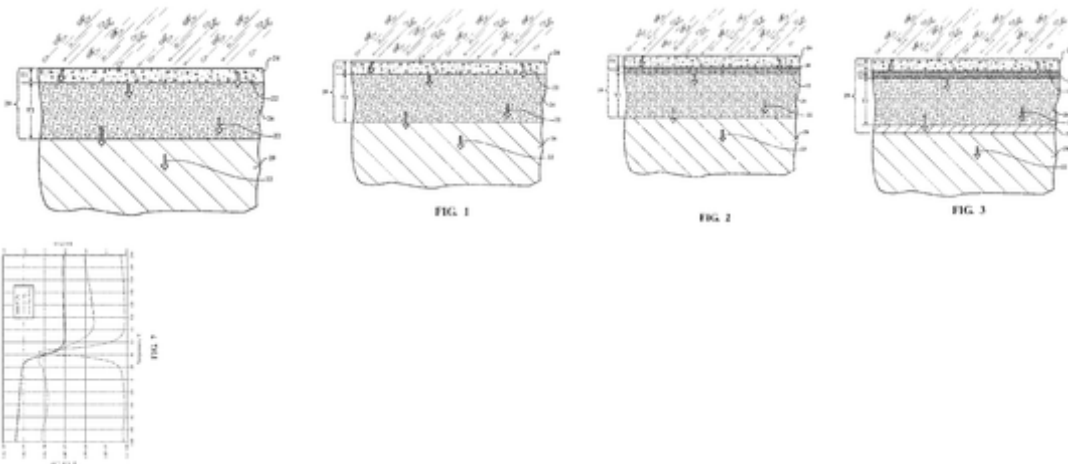


An autonomous 3D excavation construction robot by patent CN 201810829038 A utilizes machine vision, a satellite positioning and automatic control device, a 3D digital model and the like to realize automatic and intelligent 3D excavation construction operation, and in a specified unstructured area, a satellite positioning system is utilized to measure pose information, a machine vision system is utilized to sense and recognize operation environment information, and an autonomous decision is made to excavate a driving route, driving speed, a bucket operation pose and the like of the robot. The satellite positioning system senses the position and the posture of the excavating robot in real time by adopting a satellite positioning receiver set; the machine vision system adopts a fixed baseline camera to sense and excavate the surrounding environment of the robot and AR augmented reality capacity; the automatic control system is composed of an onboard upper control computer and a lower controller based on a CAN bus, wherein the lower controller comprises an engine controller, a running controller, a bucket operation controller, a fault diagnosis controller and the like. The autonomous 3D excavation construction robot can also be manually driven or remotely operated.



A kind of prefabricated beam column attachment means provided by the invention CN 105625570 B and preparation method thereof, are related to technical field of civil engineering, including the pre-buried steel member of prefabricated beam-column connection, styletable and the pre-buried steel member of beam-ends the prefabricated beam-column connection includes the first reinforcing bar connector and the second reinforcing bar connector, the first reinforcing bar connector and the second reinforcing bar connector agrees with across and integrated cast molding, the pre-buried steel member of styletable is connected with the end face of the first reinforcing bar connector, and the pre-buried steel member of beam-ends is connected with the end face of the second reinforcing bar connector. Said apparatus causes job site only lifting splicing process need to be used can be linked together in beam-ends and styletable, substantially increases construction speed, easy for construction; it is swift to operate, shorten the duration, be advantageous to environmental protection and noise control; it is readily transported, pacifies and tear open, and can be largely produced with the short time.

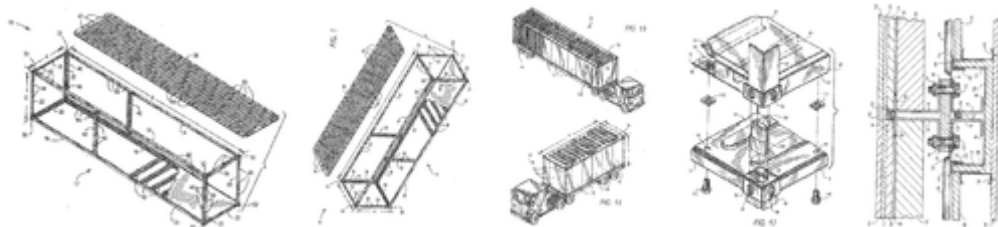
A composite pavement structure comprises a wearing course layer and a base course layer disposed below the wearing course layer. The wearing course layer comprises aggregate, e.g. glass and rock, and an elastomeric composition. The elastomeric composition comprises the reaction product of an isocyanate component and an isocyanate-reactive component. The isocyanate component comprises a polymeric isocyanate, and optionally, an isocyanate-prepolymer. The isocyanate-reactive component comprises a hydrophobic polyol and a chain extender having at least two hydroxyl groups and a molecular weight of from about 62 to about 220. The chain extender is present in the isocyanate-reactive component in an amount of from about 1 to about 20 parts by weight based on 100 parts by weight of the isocyanate-reactive component. The base course layer comprises aggregate which is the same or different than the aggregate of the wearing course layer. Methods of forming the composite pavement structure are also disclosed - see US 9850625 B2.



The invention CN 11572229 B discloses a preparation method of high-strength coral concrete. Weighing the following raw materials in parts by weight: 25-63 parts of

cementing materials, wherein the cementing materials comprise 20-45 parts of cement, 5-18 parts of mineral admixture, 45-58 parts of coral aggregate, 10-16 parts of mixing water and a water reducing agent with the weight being 2-5% of the total weight of the cementing materials. Placing the coral aggregate, seawater, a water reducing agent and 55-85% of cementing materials into a stirrer, stirring for 10-15 minutes, and adding the rest cementing materials into the stirrer in several times before initial setting to complete stirring, thus obtaining the high-strength coral aggregate concrete. The coral concrete has high mechanical performance index, high compactness, good impermeability and durability, is used for various concrete engineering in ocean island reef and coast construction, meets the requirements of civil engineering on greening and economy, and is beneficial to military defense facility construction and further development and utilization of ocean resources.

Construction systems for erecting budding structures comprise a plurality of prefabricated interconnectable modular budding units, each unit comprising framing members and a plurality of nodes, each node situated for selective interconnection with other units, the nodes and the exterior dimensions of the frame conforming to ISO shipping standards such that each unit is transportable using the ISO intermodal transportation system, and such that when the units are interconnected, a building structure is formed. The modular units are assembled at a remote location, and are there constructed to a semi-finished state, following which the semi-finished modular units are transported from the remote location to the job site, where they are secured to form the structure being erected, and the semi-finished modular units are thereafter constructed to a finished state. See US 20160160515A1.



A patented method and system for automatically ordering and fulfilling architecture (US 11475176 B2), design or construction product sample requests. Product sample request codes are added to 3D modeling programs, product pages, digital copies of standards books, product catalogs or product sheets. The product sample codes are used with artificial intelligence (AI) methods to automatically order and fulfill requests for architecture, design or construction product samples. The requested architecture, design or construction product samples are collected and shipped in a shipping container that includes graphical and other information that visually and consistently indicates the shipping container includes requested architecture, design or construction product samples. The shipping containers for the requested architecture, design or construction product samples may also include product branding for the manufactures

or product suppliers of the requested architecture, design or construction. product samples.

