US 20090094934A1

(19) **United States**
(12) **Patent Application Publication**
ESMAEILI

(10) **Pub. No.: US 2009/0094934 A1**
(43) **Pub. Date: Apr. 16, 2009**

(54) **METHOD FOR MAKING NON-LINEARLY ELASTIC COMPOSITE SYSTEMS**

(76) Inventor: **KAMYAR ESMAEILI**, Tehran (IR)

Correspondence Address:
BARRY CHOOBIN
193 SUITE #18, TALEGHANI, BAHARE SHOMALI
TEHRAN 1563714311 (IR)

(21) Appl. No.: **11/872,054**

(22) Filed: **Oct. 15, 2007**

Publication Classification

(51) **Int. Cl.**
E04B 1/00 (2006.01)

(52) **U.S. Cl.** **52/745.19**

(57) **ABSTRACT**

The present invention discloses a method for making and use Non-linearly Elastic Composite Systems wherein said non-linearly elastic composite systems comprises non-linearly strain changes in beam height during bending.

b) An Instance of the Above said Fibered Flexible Lightweight Concrete (as a Certain Example in the Mentioned Case) after in Compressing Loading.

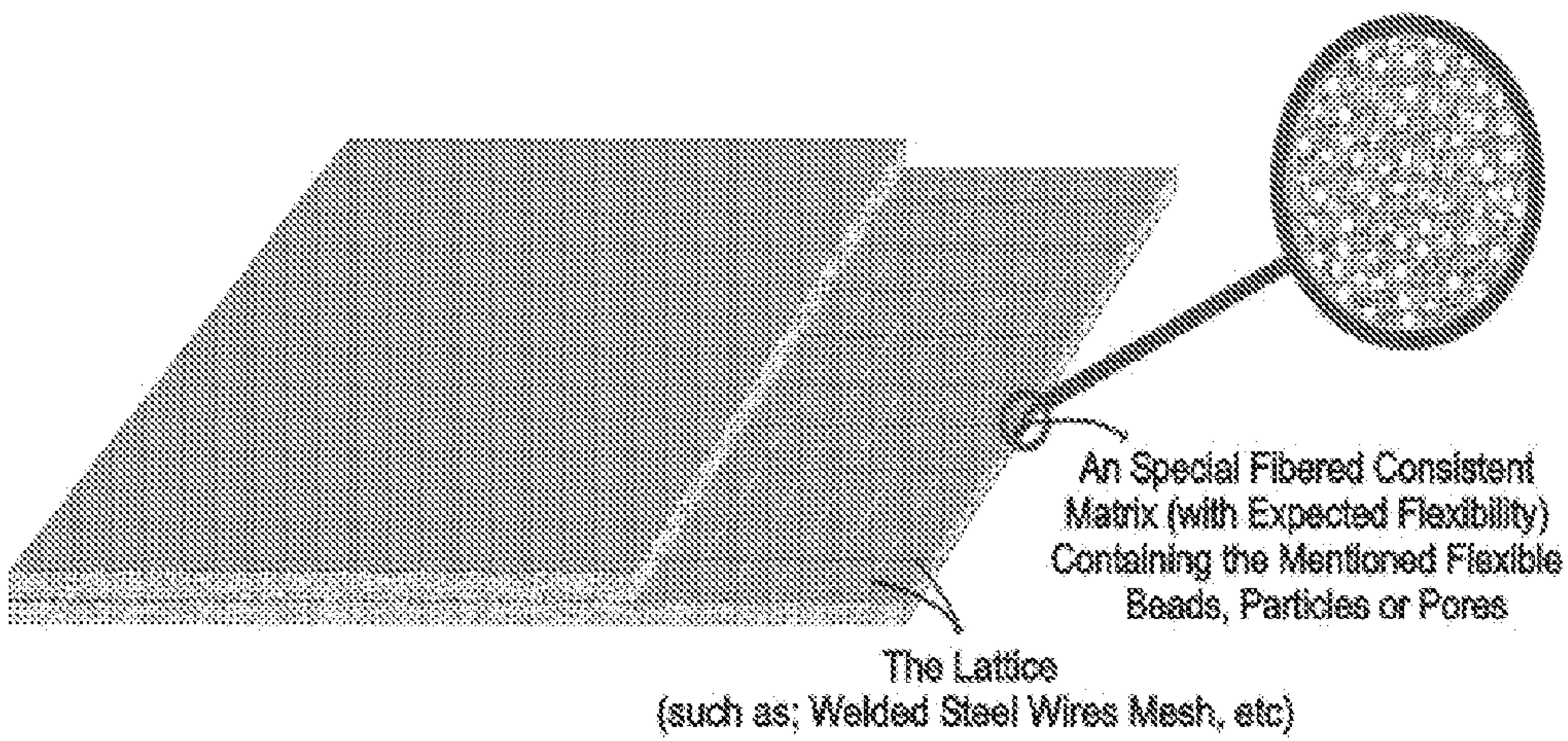


Fig.1) A Simple Instance of a Type of Resilient Composite System; R.C.S., Having Non-linearly Strain Changes during Bending (as a Non-"linearly Elastic Material)

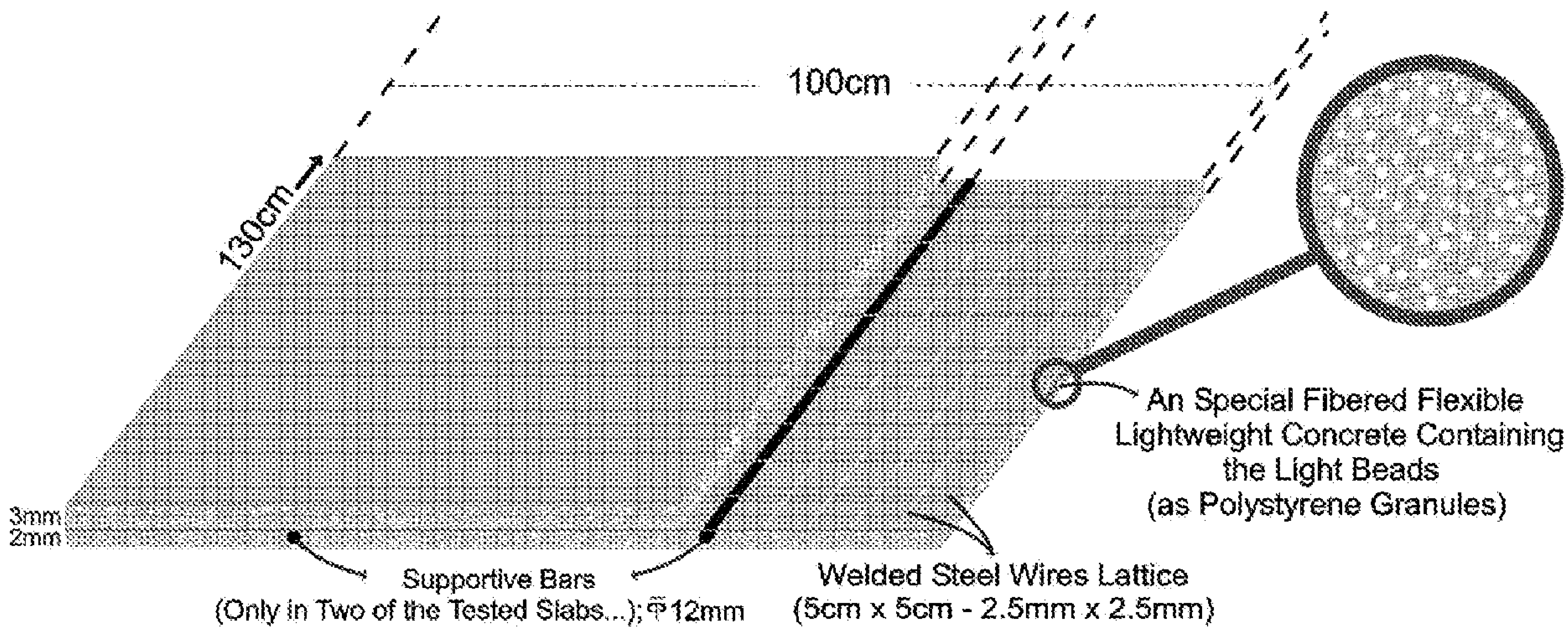


Fig. 2) An *example* of the Elastic Composite, Reinforced Lightweight Concrete.

Fig. 3-a) The Stress-Strain Diagram of in Compressing Loading of a similar Instance of the Above said Fibered Flexible Lightweight Concrete, Which Could Be Used in the Mentioned System, *"as a Certain Example"* (Oven-dry Density ≈ 600kg/m^3, f'_c ≈ 29.5kg/cm^2 in 28 days, Monofilament Polypropylene Fiber; about 1.1% of Volume Concrete) [ε_{cu} ↑](?)

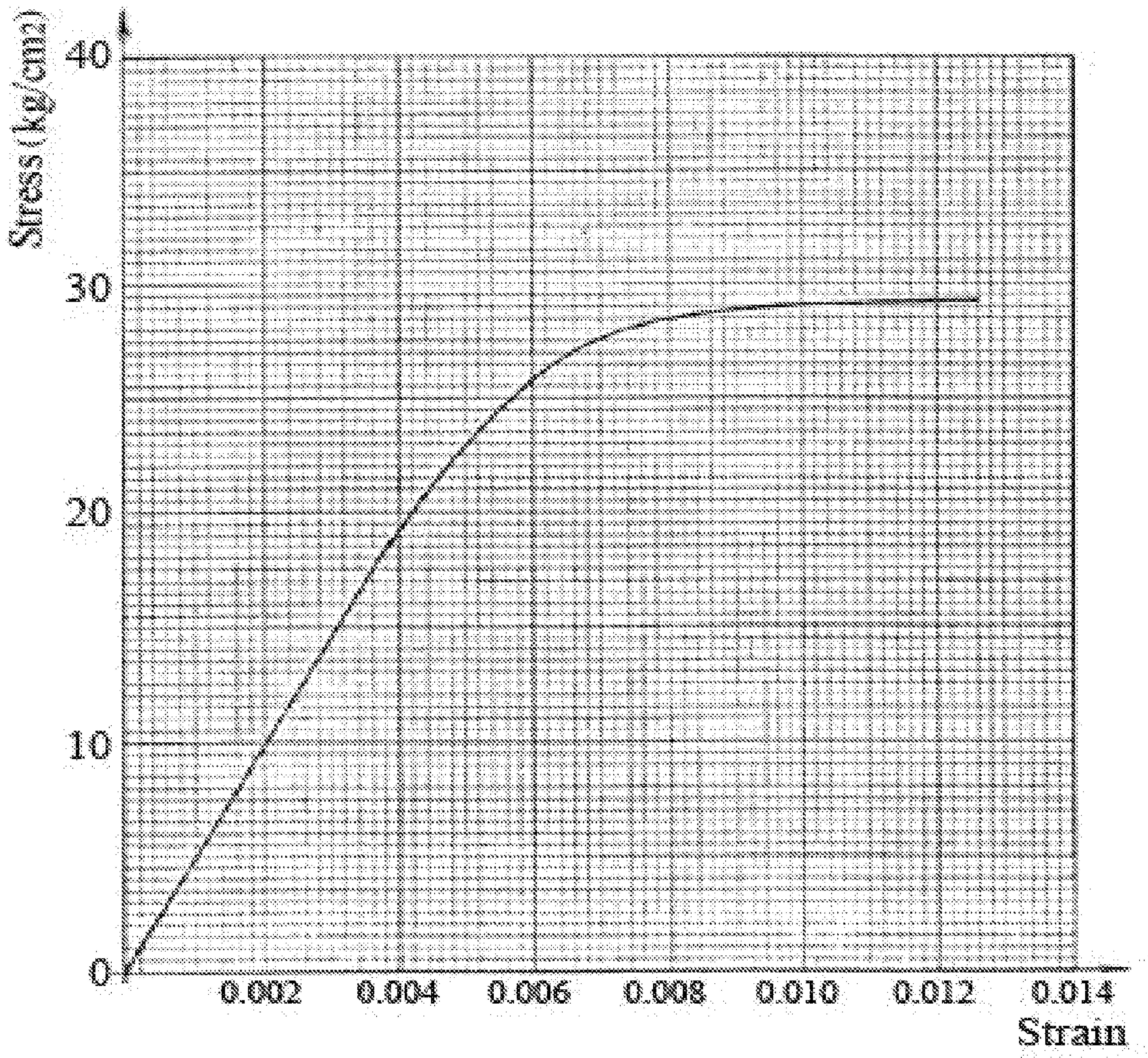
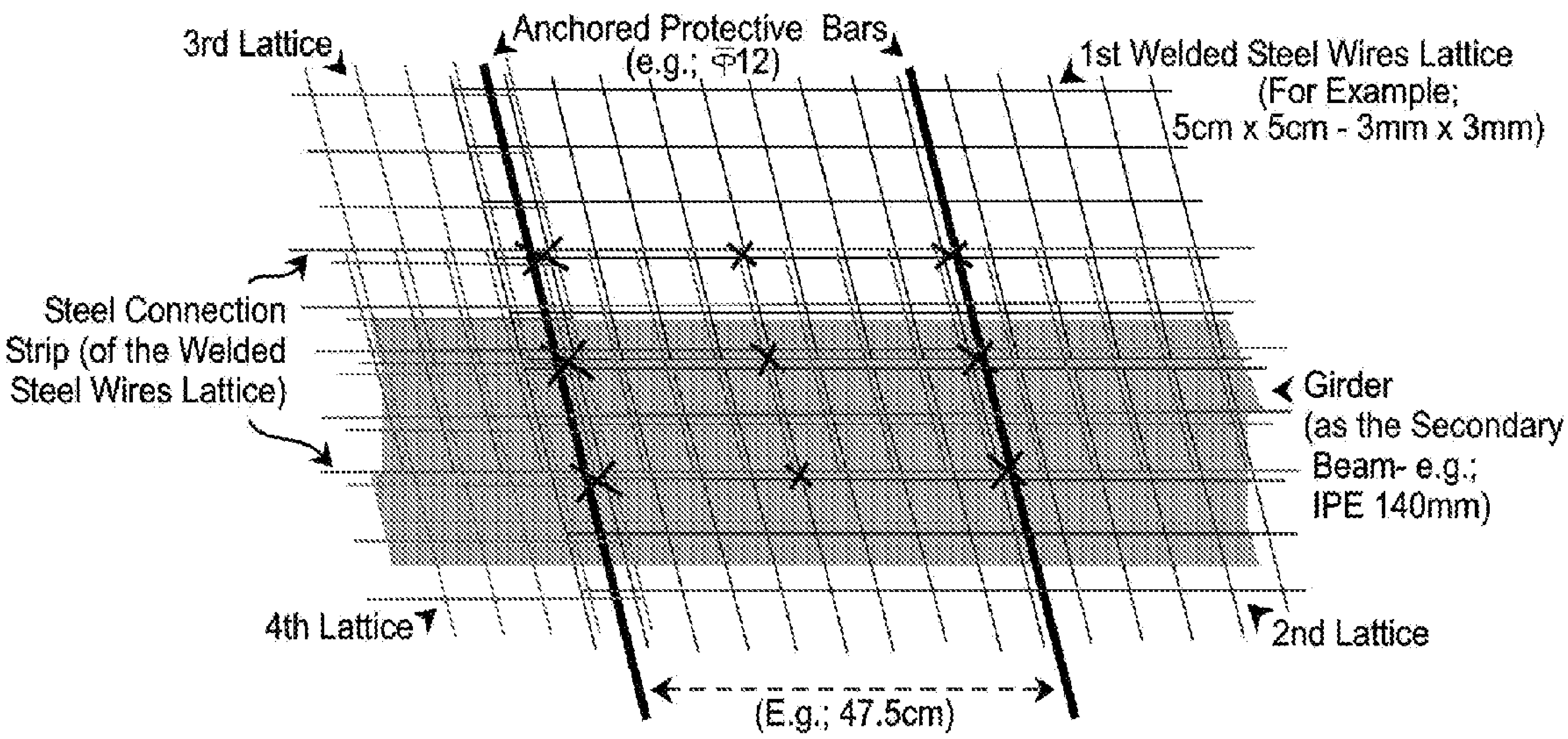


Fig. 3-b) An Instance of the Above said Fibered Flexible Lightweight Concrete (as a Certain Example in the Mentioned Case) after in Compressing Loading.

Fig. 4a) An Instance of the Execution Manner of a Type of the Mentioned Ceiling
with Using the Said Elements and Components…
(In Form of the Usual Ceilings, Called as Composite...)



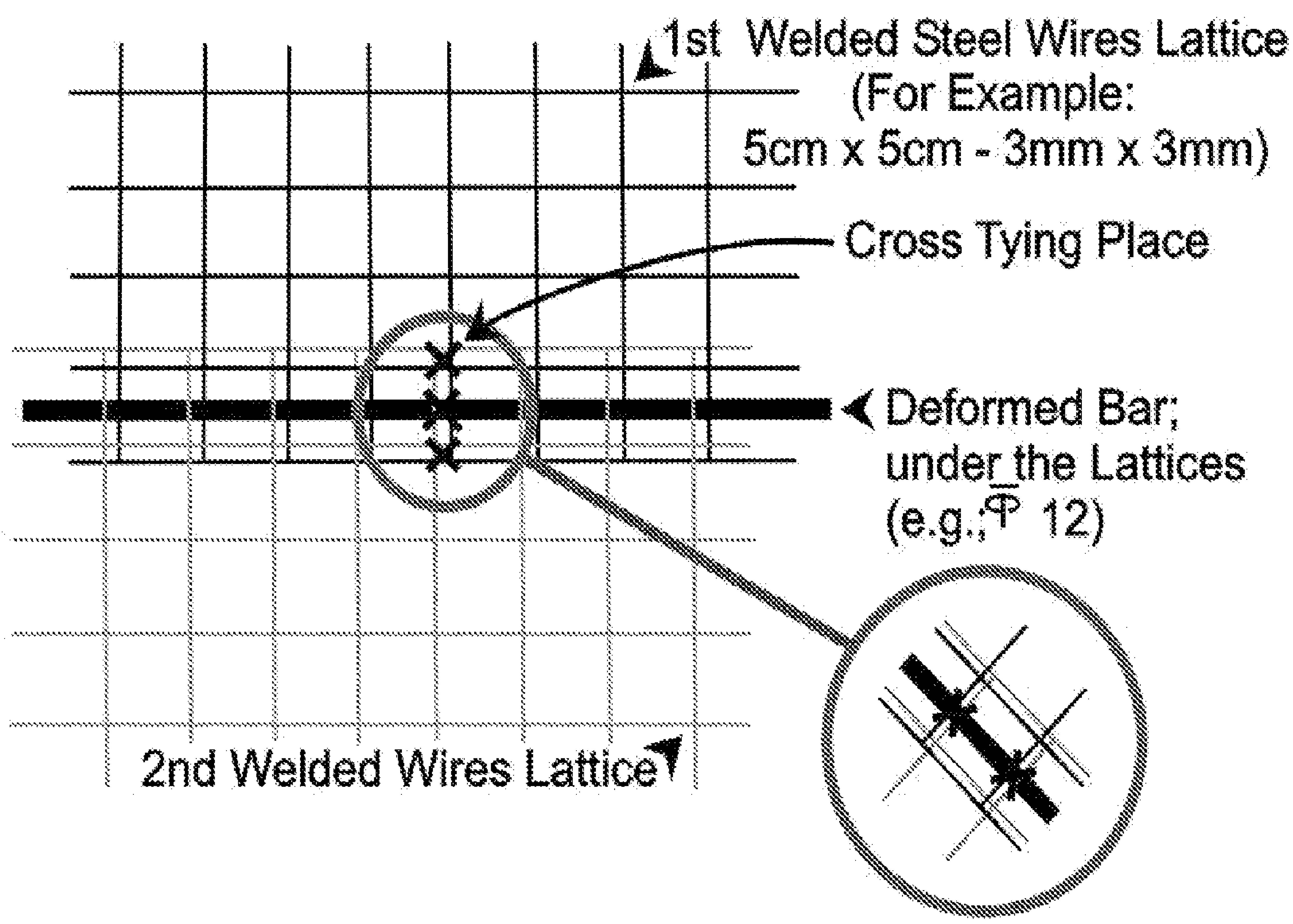


Fig. 4b) detailed illustration of an Instance of the Execution Manner of a Type of the Mentioned Ceiling with Using the Said Elements and Components. (In Form of the Usual Ceilings, Called as Composite...)

METHOD FOR MAKING NON-LINEARLY ELASTIC COMPOSITE SYSTEMS

BACKGROUND OF THE INVENTION

[0001] It is well known that, the imperative advantages of composite systems, as lightness and good specific strength, wherein said "specific strength" in Composite Materials is defined as ratio of the strength to the density.

[0002] Generally, in some specific composite systems, the main components are Lattice, fibers and/or strands, and matrix. These components' combination and interaction in the mentioned arrangement leads to an integrated operator unit having its particulars.

[0003] Meanwhile, in some Non-linearly Elastic Materials (such as, plastics and woods), strain changes in beam height during bending, is mainly non-linear, wherein said strain changes could cause high modulus of resilience (energy absorbing capacity) and resistivity (specific strength) in bending.

[0004] High modulus of resilience and significant strength in bending, particularly when they accompany with weight and dimensions reduction, are crucial. Moreover, the mentioned specifics could lead to better behavior and ultimate strength against in bending forces, disseminated impacts, shock and vibration. For instance, these characteristics are important in constructing load-bearing, lightweight pieces and slabs (in bending), elements exposed to vibration, impact, shock and in bending force, in building, bridge, road, and "Railroad & Subway" structures.

[0005] Therefore, it would be advantageous to increase the modulus of resilience and specific strength in bending. The present invention discloses a method for making composite systems with non-linearly strain changes in beam height during bending.

SUMMARY OF THE INVENTION

[0006] The present invention discloses a method for making and use Non-linearly Elastic Composite Systems wherein said non-linearly elastic composite systems comprises non-linearly strain changes in beam height during bending, wherein said method further comprises steps of:

[0007] Creating dispersed suitable pores, and/or appropriately distributing suitable materials and particles, wherein said suitable material and particles characterized in that lower strength comparing with context matrix;

[0008] obtaining resilient composite systems wherein said resilient composite systems is a type of composite arrangements and materials, in which, strain changes in beam height during bending is non-linear, and wherein said resilient composite systems consist at least of; a) Suitable lattice or lattices with expedient shapes and directions; b) Fibers or strands with expedient flexibility; c) Conjoined suitable matrix having dispersed pores and/or disseminated expediently flexible beads or particles;

[0009] combing and interacting said a) Suitable lattice or lattices with expedient shapes and directions; b) Fibers or strands with expedient flexibility; and c) Conjoined suitable matrix having dispersed pores and/or disseminated expediently flexible beads or particles, thereby leading to non-linear changes in beam height during bending.

BREIF DESCRIPTION OF THE DRAWINGS

[0010] FIG. **1**) Shows a simple Instance of a Type of Resilient Composite System; R.C.S., Having Non-linearly Strain Changes during Bending (as a Non-"linearly Elastic Material).

[0011] FIG. **2**) shows an example of the Elastic Composite, Reinforced Lightweight Concrete.

[0012] FIG. **3**-*a*) Shows as an Example of the Stress-Strain Diagram of in Compressing Loading of a Similar Instance of above said Fibered Flexible Lightweight Concrete, Which Used as a component of mentioned Elastic Composite, Reinforced Lightweight Concrete (Oven-dry Density≈600 kg/m3, f'c≈29.5 kg/cm2 in 28 days, Monofilament Polypropylene Fiber; about 1.1% of Volume Concrete).

[0013] FIG. **3**-*b*) an Instance of the Fibered Flexible Lightweight Concrete after Compressing Loading.

[0014] FIG. **4***a*) An Instance of the Execution Manner of a Type of the Ceiling Using Said Elements and Components. (In Form of the Usual Ceilings, Called as Composite.)

[0015] FIG. **4***b*) Detailed illustration of an Instance of the Execution Manner of a Type of the Ceiling Using the Elements and Components. (In Form of the Usual Ceilings, Called as Composite.)

DETAILED DESCRIPTION OF THE INVENTION

[0016] In preferred embodiment, the present invention discloses a method for making Non-linearly Elastic Materials in framework of disclosed composite arrangement ("Resilient Composite Systems; R.C.S.).

[0017] As shown in FIG. **1**, the Resilient Composite Systems consist of at least; a) Suitable lattice or lattices with expedient shapes and directions; b) Fibers or strands with expedient flexibility; c) Conjoined (consistent) suitable matrix having dispersed pores and/or disseminated expediently flexible beads or particles. The particular components' combination and interaction in the system leads to non-linear changes in beam height during bending in practice, as the specific functional character of these systems.

[0018] Thus, the disclosed composite systems is made by creating dispersed suitable pores, and/or by appropriately distributing suitable materials and particles (with lower strength comparing to the context matrix) in the reinforced, fibered matrix, which could have expedient elasticity. The purpose is to achieve a specific functional character with non-linear strain changes in beam height during bending in the systems with reticular arrangement, as integrated operator units. An example of making R.C.S implementing the method of the present invention:

[0019] Generally, "Elastic Composite, Reinforced Lightweight Concrete", having non-linear strain changes in beam height during bending, high modulus of resilience and bearing capacity "in bending", is also a type of Resilient Composite Systems; R.C.S.).

[0020] Said "Elastic Composite, Reinforced Lightweight Concrete" (named also as Resilient Composite Concrete; R.C.C.) is a particular fibro-elastic, reinforced lightweight concrete with a kind of reticular arrangement, having the said functional character during bending.

[0021] In this special composite system, the matrix is a particular type of lightweight concrete (or cement paste). The disclosed lightweight concrete (or cement paste) has dispersed pores and/or flexible aggregates (for instance, Polystyrene Granules, etc) in the consistent cement material in suitable content (which leads to providing expedient behavior). Thus, said "Elastic Composite, Reinforced Lightweight Concrete" has been consisted of the said lightweight concrete (or cement paste), appropriate lattice or lattices (for example, welded steel wires meshes, etc) and fibers (such as partially elastic Polymer fibers like Polypropylene fibers, etc), in an expedient arrangement for achieving said specific functional character (non-linear strain changes in beam height during bending). It is worth stating that in the usual reinforced concrete beams, strain changes in beam height during bending, are assumed "linear", and the current applied relations and calculations are based on this basic assumption.

[0022] In said composite, reticular arrangement, the existed pores and/or lightweight flexible aggregates or beads, accompanied by the appropriate roles of the other components in the system lead to the required flexibility, resilience and ductility in the system, whereas in conventional lightweight concretes pores and/or lightweight flexible aggregates or beads tends to brittleness. Nevertheless, the general objective of employing fibers and lattices in said composite structure is substantially similar to the one in conventional concretes (such as fibered concretes, Ferro cements, etc).

[0023] Said structure, in view of its texture and special pattern of strain during bending, has more specific strain capability (particularly in elastic range), energy absorbing and load bearing specific capacities in bending comparing to the usual reinforced concrete beams.

[0024] In under-bending sections of said elastic composite, reinforced lightweight concrete, the established deformities in conjoined and perpendicular to load applying direction layers during bending, the initially plane and perpendicular to beam axis sections are removed from plane and vertical state to curve shape during bending (||) Thus, the basic geometrical assumption of bending in the usual reinforced concrete beams based upon linear being of strain changes in beam height during bending, and its resulted trigonometric equations & equalities are being overshadowed.

[0025] The present invention provides better distribution of internal stresses and reduction of their partial concentration in certain areas of the section during bending course. For instance, increasing compressive stresses particularly in the upper part of compressive block in the section during bending significantly decrease. Meanwhile, the employed mesh and fibers, in their turns increase the elasticity and tensile strength of the reticular structure. The disclosed strain pattern and behavior in bending in present system in its turn increases absorption, and control capabilities of applied stresses, and increases endurance against the stresses, and further increases elastic strain capability and modulus of resilience of the system in bending.

[0026] In said elastic composite, reinforced lightweight concrete, the usual calculation of equilibrium steel amount for attaining to low-steel bending sections with secure fracture pattern and its related limitations, do not become propounded due to the non-brittle being of fracture pattern and non-linear being of the strain changes during bending. Therefore, solutions for solving some important problems of lightweight concretes applications, such as deadlock of brittle and insecure fracture patterns in many of the usual reinforced lightweight concrete structures, is presented. Accordingly, achieving high bearing capacities in bending elements, and attaining qualitative development of capabilities of using lightweight concretes, especially lightweight concretes with oven-dry densities of <1350-1400 kg/m3 and compressive strengths of <14-17 mpa, and even with oven-dry densities of <800 kg/m3, are conceivable.

[0027] Thus, the present invention has numerous applications in Road and Building Industries too. For example, the present invention increases resistance and safety against earthquake by Lightweight & Integrated Construction.

[0028] Yet in another application, the present invention provides a system that is especially useful in seismic areas, and can also be employed in constructing vibration absorber non-bearing or bearing pieces and elements, which could also be used in Road Construction and "Railroad & Subway Structures" (such as Slab Tracks, Traverses, etc).

[0029] "Elastic Composite, Reinforced Lightweight Concrete", having "strain non-linear changes in beam height during bending", high modulus of resilience and appropriate flexibility in bending, is a fibro-elastic, reinforced lightweight concrete with reticular structure. In the present invention, strain changes in beam height during bending, similar to some Non-linearly Elastic Materials, and contrary to the usual reinforced concrete beams and so-called Linearly Elastic Materials, is particularly non-linear.

[0030] As disclosed, said structure is a type of particular composite systems called generally as "Resilient Composite Systems; R.C.S.". The components' combination and interaction in the Resilient Composite Systems with the mentioned reticular arrangement is so that, it leads to non-linear changes in beam height during bending, as the specific functional character of the present invention.

[0031] In Elastic Composite, Reinforced Lightweight Concrete, the matrix includes a type of flexible lightweight concrete. The lightweight concrete has pores and/or flexible aggregates (such as Polystyrene Granules, etc), and conjoined (consistent) cement material, in appropriate content, which leads to provide required bonding and adherence. The lightweight concretes containing the Polystyrene granules are also called as <<EPS concretes>>. Generally, the type of lightweight concretes having Polystyrene granules, and those called as cellular Lightweight concretes with net cement, etc, are partially well known. As well, these are being indicated also in ACI 523.IR-92, accompanied with other types of Lightweight concretes. (Generally, usual lightweight concretes in ACI 523; Ferrocements in ACI 544, and fibered concretes in ACI 549 are being discussed.)

[0032] In said structure, because of integrated, reticular arrangement, and utilized components behavior and proportion in interaction with each other, possibility of more appropriate distribution of stresses and strains is forgathered, and energy absorption and reserving capacities are high. Meanwhile, appropriate strain capability particularly in elastic extent brings about possibility of more appropriately attaining stresses and strains in steel and concrete simultaneously and also delay in establishment and out spreading of cracks and effective damage in the concrete (matrix). This means more benefiting from tension reinforcements potential capacities. Thus, besides providing suitable strength reserving and ductility, and fine (non-brittle) and disseminated being of fracture pattern, accessing to "high capacity of loading in bending", despite low weight and dimensions, is achieved.

[0033] The organized reticular structure in the context of the utilized lightweight concrete can also assist to control and accumulation of cement materials contractile stresses in piece; just as, this matter could in its turn and in appropriate conditions lead to partially increasing strength of the beam made with this system during tension and bending, and could effect on its ductility. (FIG. **2** & FIG. **3**)

[0034] As is illustrated in FIG. **2**, in an Example, at the time of in bending & in compressive loading tests (in the manners similar to ASTM E 72), f'c≈64 kg/cm2, fr≈34.5 kg/cm2, fct(Brazilian Method)≈14.5 kg/cm2; Es≈2×106 kg/cm2, Ec≈4×104 kg/cm2; (The lattice is made of cold-drawn steel wires) fyl(Mesh)≈4672 kg/cm2, As1(Mesh)≈0.98cm2 –fy2 (Bar)≈4400 kg/cm2, As2(Bar)≈2.26cm2; d1(Mesh)≈3 cm, d2(Bar)≈3.9cm, L≈120 cm, h≈5 cm, b≈100 cm. Portland cement (type II)+Silica fume (8.5% of cement materials) ≈675 kg/m3; W/C+S≈0.425 (with using Lignosulfonate as a common "plasticizer" and retardant); Fibers (Polypropylene, denier: 3, and in two different lengths: 2 portion in 12 mm & 1 portion in 6 mm)≈12.6 kg/m3; Expanded Polystyrene Granules (D50≈3.2 mm) up to 1 m3. Notes: No other materials, additives and aggregate are used in the lightweight concrete in said example; membranous curing has been performed in the related environmental conditions; the lightweight concrete oven-dry density≈835 kg/m3; drying shrinkage of the employed high fibered lightweight concrete (90 days)<0.015, and some loading tests have been done about 3 months after making the slabs.

[0035] As is illustrated in FIG. **3***a*, in said flexible lightweight concrete as an Example, Oven-dry Density≈600 kg/m3, f'c≈29.5 kg/cm2 in 28 days, Monofilament Polypropylene Fiber; about 1.1 % of Volume Concrete.

[0036] As is illustrated in FIG. **3***b*, some noticeable particulars of said instance of the mentioned fibered flexible lightweight concrete (as an example) are: appropriate ratios of elasticity modulus and tensile and shearing strengths to compressive strength; suitable ratios of the surface under stress-strain diagram and strength in "elastic limit" to ultimate strength (especially, "noticing the concrete density"); expedient ductility, and high being of the strain correspondent with strength peak, the strain correspondent with failure (εcu) and fracture toughness (high α and β stress block indices), and non-fragile being and occurrence of a type of being compressed (in high compressive loadings). [In this case, it is worth mentioning that in the view of the considerable failure toughness, and occurrence of a type of gradually crashed being in the lightweight concrete pointed here as an example (especially of fibered type) instead of the typical outspreading shattering occurred failure about some usual lightweight concretes, here, the subject of "the strain correspondent with failure (ϵ_{cu})" (in its current, as a certain, exact quantity) loses its particular point.]

[0037] Considering the results of accomplished actual loading the above elastic composite, reinforced lightweight concrete, analysis of the mentioned "in bending" structures upon assumptions and equations related to the usual reinforced concretes in calculating nominal ultimate strength moment (Mn) with the method called as "ultimate strength", the obtain numbers have been much less than the attained actual amounts of in practice (M_e). Even when concrete's compressive strength in the related equations, from mathematical point of view is tended towards <<∞>>, and have considered the strain block height equal to zero, the M_e has been obviously higher than M_n. Particularly, "actual amounts of strain in bending in elastic limit" and therefore, "modulus of resilience" (u=½ σy.εy) have been considerably higher than the expected amount based upon relations related to the usual reinforced concrete beams (with basic assumption of strain linear changes in beam height during bending). In fact, in view of the certain manner of strain changes in beam height during bending, despite considerable increase of applied tensile forces in the slab in bending course from what is usually called compressive block strength in the usual reinforced concrete beams, strain is yet being continued up to reaching to higher strains. Meanwhile, occurrence of bending fracture in the slab has been resulted from gradual incidence and deepening of cracks in under grater stretch layers in the beam, after passing from elastic and plastic stage, with a non-brittle pattern. Furthermore, despite significantly higher being of the utilized tensile steel amount in the mentioned slab of equilibrium steel (calculated <<pb>>according to common relations related to the usual reinforced concrete beams (εcu=0.003)), still the fracture pattern in the loaded pieces has not become "primary compressive" type and brittle.

[0038] The bending pattern in this system differs from the usual reinforced concrete beams. Thus, in these structures, the logical necessity of equivalence of computable compressive and tensile forces resultants in the structure during bending ("when the resultants calculated with the usual equations related to the usual reinforced concrete beams"), and its certain resulted trigonometric similarities and the related restrictions, are insubstantial. As well, also considering the non-brittle being of fracture pattern in the said loaded pieces, even of primary compressive type in some of axial loadings, the usual calculations of equilibrium steel amount to attain low-steel bending sections with non-brittle fracture pattern (of secondary compressive type) and its related limitations have no indication of being propounded. Thus, the usual serious restriction in benefiting tensile reinforcements in beams and slabs, has been eliminated. Meanwhile, the usual relations for calculating in bending beam nominal capacity (Mn) will result much lesser amounts of in practice actual amount (Me)—particularly that cracking moment (Mcr) and stress amount and especially, "actual amount of strain in elastic extent" (σy & εy) are considerably higher than calculated amounts based upon the usual equations related to usual reinforced concrete beams.

[0039] It should be mentioned that even in some of compressive (column-like) loading of the tested pieces, which steel lattices and additional supportive bars positions in them have been towards convex surface in the axial loading, and also regarding the concrete compressive strength, the related slenderness ratio, and load exertion amount and method, fracture of "primary compressive" type has been occurred, because of the certain lightweight concrete's texture and behavior, yet the fracture pattern has been significantly fine (non-brittle).

[0040] Thus, in the above mentioned system, which is behaving as an integrated beam in its major strain during bending, in addition to appropriate ductility, the Elastic Strain Energy and Modulus of Resilience are considerably increased, and regarding comparatively high being of Strain Energy Density, specific capacities of energy reserving and absorption are high.

[0041] Moreover, the reticular structure role on rising strength reserving and confronting with formation, development, deepening and changing of vertical and diagonal cracks, the special manners of strain and elasticity, diminish of the accumulating effect of bending moment and tensile force in the beam, and expedient strength against piece length alteration, could be in their turns effective on partially increasing this system strength also against shearing and torsion.

[0042] Furthermore, if necessary, simultaneously employing some methods and accompanying elements such as supportive reinforcements, connection strips, foam pieces, reinforcing in different levels in proportion with this system could be according to the case taken into consideration. For instance, in addition to the afore-said impressions of the probably employed supportive reinforcements, the supportive bars placed near the final tensile strands in the slab, in case of having suitable embedment and anchor from two directions (e.g., on the accessory or secondary beams), could accordingly improve the construction's totality integration, by assisting in combined function of the mentioned piece with some other construction elements such as probable so-called secondary beams utilized in ceiling. For instance, possibly employing supportive bars under the used lattice in the mentioned slab can naturally be impressive on all parts of stress-strain diagram, such as ascending branch slope (as "rigidity" and modulus of elasticity) and energy absorbing capacity, ductility, strength, fracture toughness, and ultimate strength energy, in bending [$Uu=(\sigma y.\sigma u/2)\epsilon u$].

[0043] Moreover, fibered being of the said flexible lightweight concrete and its adhesive matrix bonding (considering the used components type and amount in that example), and extensive surface of the utilized reinforcements in shape of lattice with connected, perpendicular longitudinal and transverse components, are altogether impressive on increasing involvement of reinforcements in the mentioned lightweight concrete. Meanwhile, in the view of mixture plan of the above said flexible lightweight concrete, particularly, the utilized fibers with suitable involvement in the concrete's bonding and adhesive context matrix, and the system reticular structure, result in useful control of shrinkage effect and the like. The controlled shrinkage could in its turn assist to increase of fibers and lattice involvement in the context matrix. [According to used components and composition of the above said fibered flexible lightweight concrete in its mixture plan, and considering the texture and qualities of this integrated structure and its conjoined (consistent) matrix, it could have suitable durability against some of destructive agents in long-term.]

[0044] Some Applications of said system comprises:

[0045] Constructing various types of slabs, and flat, slope and dome-shaped ceilings, having high specific bearing capacity in bending with appropriate security. (FIG. **4**)

[0046] FIG. **4** is an illustration of an instance of the Execution Manner of a Type of the Mentioned Ceiling with Using the Said Elements and Components (In Form of the Usual Ceilings, Called as Composite.)

[0047] Meanwhile, some benefits of employing this system in constructing the bearing lightweight pieces and slab tracks under railways and subways are: increase of beneficial lifespan, decrease of structures' dimensions and weight, saving in spent expenses, time, and energy for repairs, maintenance, possibly replacement, foundation, transportation & implementation.

[0048] Producing "integrated, insulant, lightweight internal and external walls" with appropriate behavior against impact, shock and blast. For instance, the non-bearing walls, as the types of reinforced sandwich panels, could be constructed by easily executing the paste-form, adhesive, work-able type of this lightweight concrete (occasionally with less fibers) on with or without fire retarded foam tri-dimensional meshes having appropriate stability and flexibility. This practical implementation technique could easily spread, considering a partially similar and common existing method of constructing (as employing the combination of tri-dimensional panels with usual fine aggregate concrete). These walls and constructional technology could have the advantages such as: providing more rapidity & easiness in transportation and installation; little materials wasting in implementation and least required additional plasters (considering the suitable surface of the performed concrete); capabilities of cutting, nailing, and holding plaques & corpies, and having possibility of repair, installation transferring, and establishment of frames, doors & windows, and various coatings & paints; appropriate flexibility and having possibility of adaptation with diverse architectural designs (e.g. in curve surfaces and forms). Generally, there are considerable benefits in using this system and its components in buildings, especially in a wide view. At least comprising: significant reduction in construction weight (sometimes up to 3-6 times comparing with some usual heavy materials) and saving in the related expenses; improvement of resistance, safety and behavior against earthquake, shock and explosion; suitable thermal insulation, and sound intervening; increase of indoor useful space (owing to some components' dimensions reduction); perform-abilities and capabilities of the so-called in-place, precast and semi-precast implementations (according to the case); etc. These benefits could in their turns have imperative importance also in constructing high buildings and towers, constructing in seismic and/or far-reaching areas.

[0049] Strengthening and safe-making some constructional elements, for example in bending and shearing, and coiling the columns circumference for improving their ductility, fracture strength and bearing capacity. It is worth mentioning that according to the specified instruction, employing this composite structure in the columns circumference (with appropriate connection, extension and bonding), can be useful in confronting with crack formation, scaling and pitting in the circumference of high axial under-load columns, and buckling phenomenon in them. As well, appropriately using this system can in its turn increase ductility, fracture strength and bearing capacity in columns, also by applying effective radial stress from circumference to the center.

[0050] Employing in construction of road, bridge, and especially, Slab Tracks & Traverses and non-bearing or particularly, "bearing" vibration absorber, lightweight pieces under Railways and Subways.

[0051] Generally, referring to reticular system's specialties, as appropriate energy absorbing capacity, elastic strain capability and "Endurance Limit" in bending, and suitable behavior against dynamic loads and disseminated impacts and shocks, the present invention is beneficially employed for constructing vibration and shock absorber and exposed to continual dynamic loads pieces too.

[0052] It is understood that various changes or modifications can be made within the scope of the appended claims to the above Resilient Composite Systems without departing from the scope and the spirit of the invention. The principle of this invention is not limited to the particular embodiments described herein. Various embodiments can employ the present invention. This invention is not limited to the exact illustration as described; alternative methods can be used to form the intended Resilient Composite Systems and the method for making same of this invention.

1. A method for making and use Non-linearly Elastic Composite Systems, wherein said non-linearly elastic composite systems comprises non-linearly strain changes in beam height during bending, and wherein said method further comprises steps of:

Creating dispersed suitable pores, and/or appropriately distributing suitable materials and particles, wherein said suitable material and particles characterized by lower strength comparing with context matrix;

obtaining resilient composite systems wherein said resilient composite systems is a type of composite arrangements and materials, in which strain changes in beam height during bending is non-linear, and wherein said resilient composite systems consist of at least; a) Suitable lattice or lattices with expedient shapes and directions; b) Fibers or strands with expedient flexibility; c) Conjoined suitable matrix having dispersed pores and/or disseminated expediently flexible beads or particles;

Combining and interacting said a) Suitable lattice or lattices with expedient shapes and directions, b) Fibers or strands with expedient flexibility, and c) Conjoined suitable matrix having dispersed pores and/or disseminated expediently flexible beads or particles, thereby creating non-linear changes in beam height during bending.

2. The method as claimed in claim **1**, wherein said method further comprises step of; obtaining high modulus of resilience and resistivity in bending, thereby increasing capacity of bearing in bending.

3. The method as claimed in claim **1**, wherein said Resilient Composite Systems characterized in that Elastic concrete, Composite concrete, Reinforced concrete and lightweight concrete with non-linearly strain changes in beam height during bending.

4. The method as claimed in claim **1**, wherein said Resilient Composite Systems is employed in construction field, marine structures and floaters, rail roads, bridges, roads, highways, and vehicles.

5. The method as claimed in claim **1**, wherein said Resilient Composite Systems performs the act of shielding and absorbing shock resulting from an explosion.

6. The method as claimed in claim **1**, wherein said Resilient Composite Systems is employed in making objects, wherein said objects comprises facade covers, lumber, cabinet, counter, and pip and ducts.

7. The method as claimed in claim **1**, wherein said Resilient Composite Systems is employed in making wall partitions and covers in reservoirs.

* * * * *