the general science journal

Antonio Ruggeri Dr. Ing.
modexp@iafrica.com

21 October 2010 (reviewed)

UDS spares lives (saves money) and protects the reputation of the Engineer

The development of the UDS eventually gives startling results when applied to engineering practice.

The fundamental conclusion is that a Contact Force $F_{CONTACT}$ or F_C of gravitational origin applied to a physical mass M (a column of volume $V=A_CL$, *resting over a solid foundation*) is still subjected to movement as an elastic deformation ΔL is affecting the volume of the column.

The gravitational energy (work) developed by the superstructure and pertaining to the elastic phenomenon:

$$\Delta F_{TOT} = F_C{}^*\Delta L \quad kJ$$

is preceded by almost instant establishment of presence of the contact Force F_C over M (F_C enters the column at the speed of sound c_S in the column), establishing over the unit of time t=1"[sec] presence of an amount of compression energy (ΔF_{ELAST}) and a displacement ΔL in the direction of the Force.

We then have that:

$$\Delta F_{ELAST} = F_C{}^*L = \sigma_C V$$

Is the measure of compression against the opposite Newtonian Force $-F_C$.

Presence of these two opposite forces is producing reduction ΔV of the volume V occupied by an amount of interstitial energy $\Delta M_I c^2$ ***(and by incompressible atomic entities), as consequence*** $\Delta M_I c^2$ ***is upgraded into m-e*** ΔM_I ***"occupying a volume*** $\Delta \overline{V} \geq 0$ ***"*** , inside V we have that (Hooke's Law):

$$1) \quad \boldsymbol{\sigma V} = \frac{\sigma V}{\Delta V}\Delta V = \boldsymbol{E_Y \Delta V} = \Delta M_I c^2$$

for contraction $\Delta V \rightarrow V \quad \sigma \rightarrow E_Y$

but due to the fact that presence of incompressible atoms limits the maximum contraction to ΔV_{MAX} , since we have equivalence of effects between σV and $E_Y \Delta V$ the maximum values are:

$$\sigma_{MAX} V = E_Y \Delta V_{MAX}$$

We obtain a relation which says that for a contraction ΔV_{MAX} (caused by σ_{MAX}) the maximum amount of interstitial energy $\Delta M_I c^2 = E_Y \Delta V_{MAX} = \sigma_{MAX} V$ contained

inside ΔV_{MAX} has been compressed to the point that we can assume it has been upgraded to the status of m-e $\Delta M_I = \rho \Delta \overline{V}$ which occupies with density ρ a volume:

$$\Delta \overline{V} = \frac{\sigma_{MAX} V}{\rho c^2} = \frac{E_Y \Delta V_{MAX}}{\rho c^2}$$

Note: $E_Y \Delta V_{MAX} = \sigma_{MAX} V$ is represented in units of energy [kJ] and is related to the portion of volume that can be compressed and assumed that energy is an indestructible substance it still will be there when under the effect of a compressing agent (the Force F_{CMAX} at which the physical mass faces collapse) a volume reduction ΔV_{MAX} gives presence of m-e ΔM_I inside $\overline{V}$.

Presentation of the phenomenon is then established through compaction of atomic masses inside a volume V-ΔV that keeps reducing with the increase of external Force until the interstitial m-e ΔM_I occupies the volume $\Delta \overline{V}$.

When this happens, all the interstitial energy $\sigma_{MAX} V = E_Y \Delta V_{MAX}$, which inside M was occupying the volume ΔV_{MAX} at density E_Y was not lost but was conserved and upgraded into m-e ΔM_I through contraction $(\Delta V_{MAX} - \Delta \overline{V}) \cong \Delta V_{MAX}$

At this point, the $\Delta M_I c^2$ which was present in the status of energy inside a volume ΔV_{MAX} was reduced by compression to the status of m-e but compressed inside a volume $\Delta \overline{V}$.

As can be seen the system under the influence of the opposite Newtonian Forces (F_C and $-F_C$) didn't receive m-e but was instead subjected to upgrade from energy to mass-energy only of the interstitial substance whereas through Hooke's Law the maximum energy of compression $\sigma_{MAX} V$ resulted already partially compressed at a density E_Y over a volume ΔV_{MAX} (whereas $E_Y = \rho c_S^2$ being c_S the speed of propagation of the sound in the same medium):

$$\Delta F_{ELAST-MAX} = \sigma_{MAX} V = E_Y \Delta V_{MAX} = \rho c_S^2 \Delta V_{MAX} = \Delta M_I c^2$$

The whole amount of interstitial energy transformed-upgraded results into presence of m-e inside a reduced volume (respects conservation) and is a phenomenon which is in simultaneity of existence with the gravitational phenomenon also associated with the same Force acting over the superstructure, (which is producing transformation-degradation of gravitational m-e into energy ,Work or $\Delta F_{TOT} = F_C \Delta L$, belonging to the superstructure and entering the column).

When we withdraw the Force compressing the physical mass of the column which *reduces V* of $\Delta V \leq \rightarrow \Delta V_{MAX}$, **the interstitial m-e ΔM_I returns into the status of energy whilst the physical mass recovers the volume** ΔV).

The *interstitial energy* in dependence of the time taken during the cycle of upgrade into m-e and the time of return to the status of energy can be subjected to partial degradation into Heat which is dissipated, and since presence of

interstitial bonds cannot be replaced, their disappearance affects the load bearing capacity of the column.

Simultaneously, during a full cycle of loading and unloading, the gravitational energy (Work or ΔF_{TOT} mentioned above) transmitted, inside the column by the superstructure, is lost trough degradation caused by internal frictions and dissipated.

The contact gravitational Force F_C is theoretically transmitted instantaneously, but the elastic movement ΔL of F_C generating (Work of gravitational origin as transformation-degradation affecting the superstructure and transmitted inside the column) depends from the elastic reaction of the column.

Given the short length of the column we assume that the phenomenon developing work takes 1" second:

$$\Delta F_{TOT}=F_C \Delta L$$

Note: the above formulation stresses the necessity to have a good foundation since subsidence of the foundation during loading can amplify many times the ΔF_{TOT}.

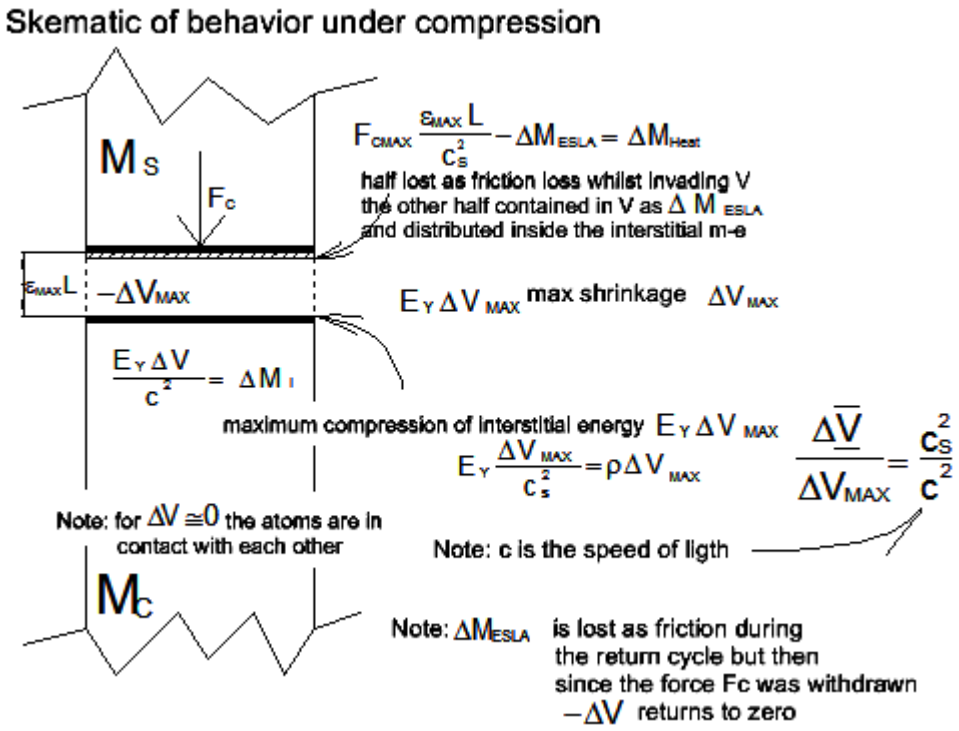

Figure 1

We have now that during that 1"sec, 50% of the gravitational energy:

$$½ \Delta F_{TOT} = ½ F_C \Delta L \text{ [kJ]}$$

entering the column, due to internal friction, is dissipated whilst the other half which retains the directional spin character, is compressed as m-e in a transient

status ΔM_{ESLA} against the interstitial ΔM_I residing between the atoms of the column.

Note: in touch with the UDS representation of m-e , I call ΔM_{ESLA} the m-e equivalent to the residual energy ½ ΔF_{TOT} stored inside the elastic interstitial m-e ΔM_I gluing together the atoms:

$$½\ \Delta F_{TOT}/\ c^2 = \Delta M_{ESLA}$$

Resuming: Hooke's Law is helping to explain the behavior of the interstitial energy, inside a column at rest, under the effect of Force applied along a direction and opposed by contact Force, and defines the elasticity character belonging to it, as reduction of volume due to presence of compressible interstitial energy under the hypothesis that the atoms are incompressible.

Hooke's interpretation says that the interstitial energy (which is the one defining the elastic character) can be compressed by external Force up to the point in which the volume it occupies can be considered almost null $\Delta \overline{V} > \cong 0$ (at that point the interstitial energy has became m-e).

For $\sigma_C \rightarrow E_Y$ and $\Delta V \rightarrow V$

$$\frac{\sigma_C}{E_Y} = \frac{\Delta V}{V}$$

This Law is general since is representing "conservation of energy" but must be adapted to the case treated (be it a column or be it a liquid under compression, here I will use it in this canonic form, assuming that the cross section A of the column remains constant (not subjected to expansion and therefore no Poisson coefficient) there is collapse at $\sigma_{CMAX} = E_Y\ \varepsilon_{MAX}$

This same Hooke's Law can be applied (mutatis mutandis) to compression of a volume V of liquid inside an absolutely rigid cylindrical container still assuming that the atoms are not affected by compression, but then σ_C is pressure , ε_{MAX} is representing a volumetric contraction and $E_Y = \rho c_S^2$ is unchanged:

$$\frac{\sigma_{CMAX}}{E_Y} = \frac{\Delta V_{MAX}}{V} = \varepsilon_{MAX}$$

Here disappearance of the volume ΔV is due to compression of interstitial energy $\Delta M_I c^2$ up to the point in which its character of fabric, gluing the atoms, disappears and becomes (for contraction ΔV_{MAX}) pure substance totally compressed or m-e (see fig 1).

Note: the increase of energy per unit of contracted volume is due to a **physical presence** of substance and is "the external Force" $\mathbf{F_C}$ which, as anybody can observe, squeezes the interstitial energy(substance) inside the whole mass M of the column, and since, for these types of phenomena, the incompressible atoms are to be considered "glued together by the highly compressible interstitial energy constituting the elastic bonds, as result of the application of F_C, the interstitial energy initially occupying the volume ΔV_{MAX} is compressed to near

zero value $\Delta \overline{V} > \cong 0$ (reached when the atoms are in contact with each other) at this point we say that the interstitial energy has became m-e.

The description of all these phenomena leads to the conclusion that the process of loading a structure of elastic character must be managed if we want it to be safe and the structure be undamaged at the end of it.

Below is a diagram intended to show the effect of the gravitational transformation-degradation over the superstructure transmitted inside the column under observation:

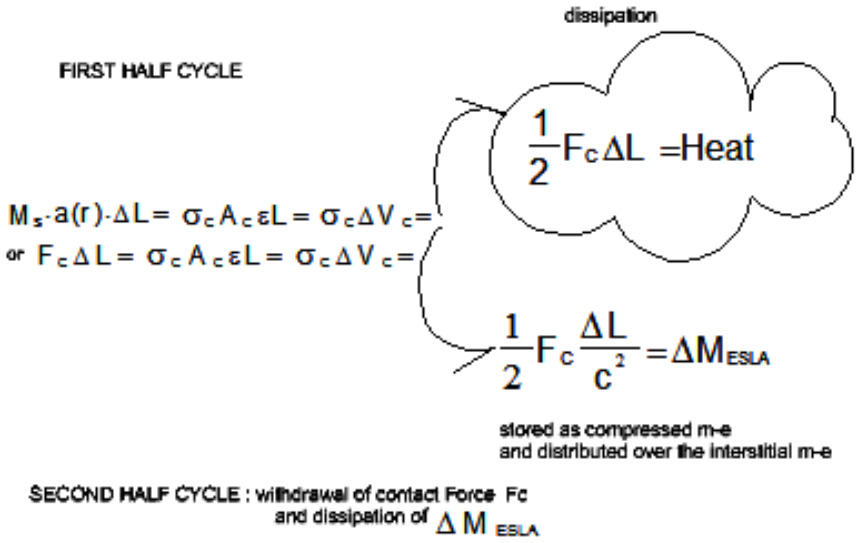

Figure 2

Note: the above expressions are not completely describing the status of the column of mass M inside the volume V, since:

The effect of gravity over M (the mass of the column) is overlooked.

The above justification represents a necessary clarification, pointing to the physical fact that the Euclidean space is involved only because is occupied by substance, it shows that the Force impinges over the mass M modifying the volume occupied by it, further based over Hooke's Law is:

$$2) \quad F \Delta L = \sigma_C A_C \varepsilon L = \sigma_C A_C \frac{\sigma_C}{E} L = \frac{\sigma_C^2}{E} V \quad [kN \cdot m] \text{ or } [kJ]$$

Showing how the elastic movement is controlling the transformation of m-e gravitational in the superstructure M_S and makes it available to the column M_C in

(Fig 1) whilst the associated variation of volume of the column, generated by Force alone concentrates the interstitial energy present in it into the equivalent status of m-e, when the Force is withdrawn the m-e is free to return to its initial status of interstitial energy.

The Static Force due to gravity acting over the superstructure is associated to a real dynamic phenomenon internal to the physical mass of the underlying column, which finds its equilibrium after a volume reduction $\Delta V \rightarrow \leq \Delta V_{MAX}$ has occurred (see fig 1).
Note: in these formulae when we refer to a column we always consider A=constant overlooking the Poisson's coefficient.

Note: the understanding of the fundamental properties of the elastic characters of a physical mass, where the velocity of dissipation of the energy as sound happens at c_S speed and the phenomenon associated to presence of Force causes contraction of substance that here is named elastic energy up to a maximum condition of existence that we call m-e, was followed by the discovery that the basic velocity of dissipation of Heat (another form of energy) into a medium (the Ether/ESF) was c.
The Ether/ESF should then be explained as a form of interstitial energy, but this will be treated elsewhere using analogies.
All this was followed by the formulation by Einstein of his, "very successful", "Law of equivalence" valid for the Ether as a form of interstitial energy of density $\rho=1$ and for the physical mass:

$$E_{TOT} = M\, c^2$$

a multifaceted basic Universal Law that with Newton's ULG permits further advances if the field of knowledge.
Note: the above analogy between Hooke's Law and the Law of equivalence of Einstein if accepted for what it is puts in the right perspective the fact that in Science the achievement by an individual is always following the groundwork laid by predecessors.

Note: in the above definitions of transmission of compression (Force) by the superstructure M_S the occurrence of the phenomena in time has been totally ignored and this is a fault of representation since time determines the value of the Dominant Force (Power) ruling the phenomenon inserting the ΔF_{TOTAL} (energy) originated by gravitational transformation or by external device and acting over the column and the manner in which the Force compresses the column causing inside the elastic energy, bonding its atoms, passage from the status of energy to the status of m-e.
If for example the time interval is Δt = 1sec, it will result numerically that the Force developed by gravitational energy will reduce the volume of the underlying column of a ΔV over 1" sec:

$$\Delta F_{TOTAL} = F_{DOMINANT} * 1" = F_C \Delta L$$

And due to presence of incompressible atoms according to Hooke's Law the whole effect of the Force alone is distributed inside a volume ΔV occupied by interstitial energy which can stand a max of compression at which will exist in the status of m-e.

Note: we must make a distinction regarding the velocity of transmission of Force "c_S" that for short values of L can be considered infinite (instant transmission) and the time interval during which the deformation ΔL takes place which in gravitational cases is assumed to be 1" second.

This means that if the application (release) of the gravitational energy generated by the superstructure (if the transfer proceeds from a device it will need to be dealt apart) to an elastic member (a column long L in our example, see fig 1) is taking place during 1" second, the consequence will be that the value of ΔF_{TOT} inserted over 1" sec of time as F_D, represents compression released inside the volume V through the contact surface A_C half of which ($½\ \Delta F_{TOT} = \Delta M_{ESLA}\ c^2$) is stored as m-e (since the other half is lost by internal friction) against the interstitial bonds contained inside the column.

Note: the compression of **the interstitial bonds** is causing a reduction of Volume $\Delta V = A_C * \Delta L$ of the physical mass M (the column), since inside M the atoms are to be considered rigid and incompressible the volume $V-\Delta V_{MAX}$ which they occupy excludes that they can be compressed (they do not partake the weak elastic phenomenon presented here, which happens at Earth surface).

Note: the phenomenon is a lot more complex but my purpose now is to reach a conclusion based on a theory permitting to establish the safety of operations on site (staggering them along time intervals) through control of the application over a physical mass of Force exclusively of gravitational origin.

Note: intermittent exchange of ΔF_{TOTAL} obtained, for example hitting the top of the column with a large hammer, or detonating a properly prepared explosive charge inside a physical mass, are part of phenomena not treated in this paper.

Unhindered transformation-degradation only ruled by gravity, being a natural event dependent from Newton's Law, can be reduced to a phenomenon (the Dominant Force) happening during 1" sec of time in the case the *gravitational mass M_S of the superstructure* is suddenly unloaded over the elastic mass of *the column/s with whom the gravitational mass (the superstructure) is in contact.*

This happens only if the props holding the superstructure are suddenly released and the superstructure is suddenly subjecting to compression F_C and to internal transmission of a gravitational $\Delta F_{TOTAL} = F_D\ 1" = F_C * \Delta L$ [kJ] (sudden application of F_C causing the elastic deformation ΔL of the mass M of the column/s underneath which is reacting to the F_C applied to it producing upgrading the interstitial energy as per Hooke's).

I intend to show here what could be the consequences of gravitational Force originated inside a superstructure and unloaded over the physical mass of a column whilst a simultaneous gravitational transformation-degradation of m-e originated inside the same superstructure is entering as energy of movement the

physical mass of the column/s, since presently if sudden release of a superstructure over a column/s is followed by a collapse, *justified by an excessive release, of Force at the surface of contact A_C and of Dominant Force (during a small Δt >~1")*, no one will accept an explanation based on the fact that a structure perceived solid sound and durable, can be subjected to failure through fast un-propping, under the combined effect of sudden loading and to minor extent of internal frictions (*and possibly by presence of elastic movements over the foundation surface which here are not considered)*.

Note: the effects observed here are those due to sudden unloading of Force, cause of the elastic deformation affecting the interstitial bonds between the atoms and the absorption of gravitational energy ΔF_{TOT} (work, which affects the whole mass and though in this case is much reduced and can be overlooked, is becoming a very important dynamic phenomenon when there is a cyclical repetition).

Indeed, my purpose in the following exercise is to point out that, a very fast release of Force was more than once, the cause of collapse of a whole structure and although very experienced old builders may have an empirical knowledge of the phenomenon, presently, in the building industry, the engineers and the contractors ignore the problem whilst the number of "unexplainable" failures is growing.

In the past, masonry was relatively exempt from sudden release of supports (with the exception of arched structures built in stone or in bricks, or as mixture of both, in which fast release at the key of the arc was a necessary operation and for which the high rate of success has to be attributed to awareness, acquired through experience etc…concerning the dangers presented by sudden release of props).

Presently with the use of mechanical plant and adoption in building construction of frames of reinforced concrete, there is a dangerous tendency to fast release of weight over the single columns, removing in matter of minutes the props supporting the decks over which the superstructures have been cast.

This activity in appearance is innocent, but in reality, can be highly destructive and, in few extreme cases, produces collapse of the structure or can start a chain of events causing a series of successive deteriorations (*cracks that can be ultimately followed by failure*) of what was in origin a basically sound and well built structure.

The outcome of an unwise sudden or too fast un-propping operation releasing a superstructure over a structural member/s subjects the concerned member/s to a small (low grade) internal explosion, which when does not produces collapse may leave the builders unaware of the internal damage suffered and of the possible consequences.

The above formula (1) is fundamental and properly interpreted has lots of applications, it comprises and extends the bare formulation of the theory of elasticity $\sigma/E_Y=\varepsilon$ (basically correct since is an expression of energy conservation)

to the little understood manner in which the contact Force enters the structural element under scrutiny and compresses the interstitial mass.

The following conclusions are an attempt to show the way forward, and they use concepts and definitions derived from the UNIVERSAL DYNAMIC SCIENCE (UDS) developed by me.

The phenomena of elastic nature encountered in structures and in machines, in which substance in a degraded status of existence (in respect to the status it occupies in the universe as ESF) binds (as interstitial m-e) atoms that are to be considered rigid and incompressible, are in analogical correspondence (mutatis mutandis) with the elastic behavior of the atomic masses under high compression inside the Large Gravitational Masses M_{LGM} present in the Universe.

In the theory of elasticity, we can assume that the atoms present in the physical mass are rigid entities (non-deformable and incompressible) and this hypothesis in regard of engineering applications is acceptable, in it we assume that inside a physical mass there is a minimal amount of interstitial substance between the atoms holding them together through a network of molecular and crystalline bonds and this interstitial substance can be assumed to be energy in a status of existence which can be subjected to compression induced by introduction and presence of an external contact Force a σ_C over the top cross sectional area A_C (of a column, see fig3 below) opposed by a contact F_C at the foundation.

Note: the case on study is gravitational and regards the effect of the flow of ESF over the superstructure that causes the establishment of a gravitational Force inducing over a structural member (a column in our case), the internal dynamisms (volume variation) in time and is a phenomenon in which if to the superstructure is added presence of mobile gravitational loads or cyclical loadings originated by devices, there will be necessity to study not only the extra elastic variations of volume but also the introduction of work energy associated to elastic movements and subjected to dissipation.

A structural element of physical mass M (a column/s in our case of volume V=AL) is made up by atoms as spheres suspended in a network of interstitial bonds and the physical mass inside the volume of the structural element (under the effect of contact force F_C generated by the flow of ESF over the mass belonging to the superstructure M_S above it) originates the Force field of compression ($\sigma_C = F_C/A$ [kJ/m^3]) distributed over its entire volume $V=A*L$ giving a Total Force:

$$\Delta F_{ELAST} = \sigma_C * A * L \text{ [kJ]} \quad \text{(see Fig. 3)}$$

Nevertheless the ΔF_{ELAST}, only represents compression of the interstitial energy extending over a range of volume reduction) $0 \le \Delta V \le \Delta V_{MAX}$ since the rigid incompressible atomic entities are occupying the volume:

$$\overline{\overline{V}} = V - \Delta V_{MAX}$$

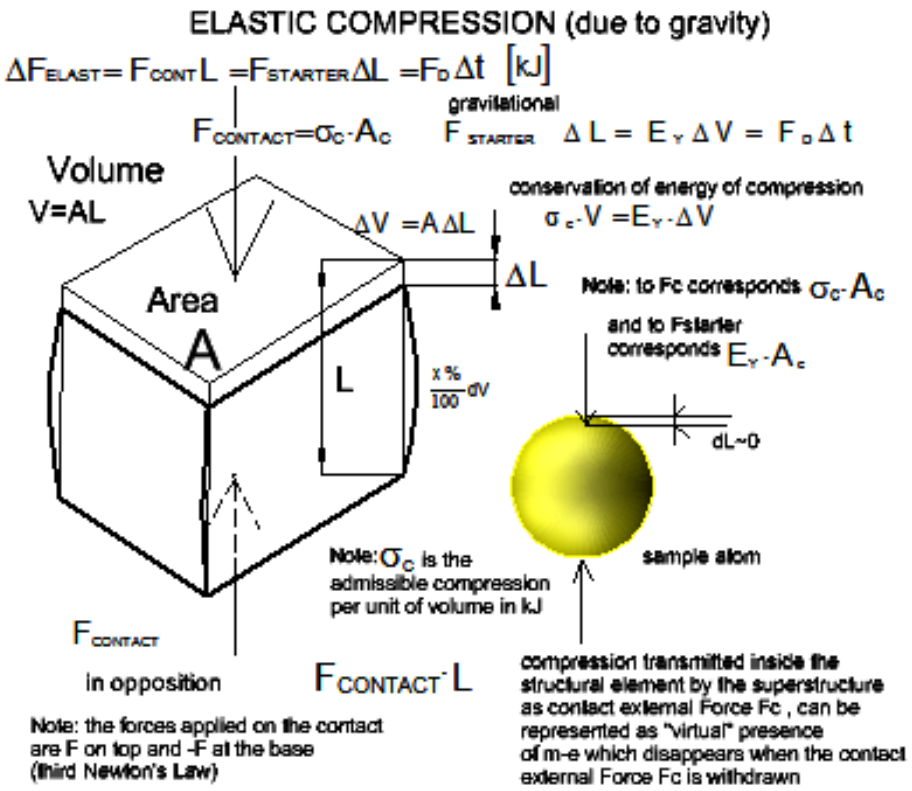

Figure 3

Since ΔV_{MAX} is a minimal fraction of V the concentration of compression is high and the molecular and crystalline bonds are subjected to extreme solicitation since the phenomenon tends to gradually transform them from the status of elastic energy to the extreme status of m-e as result of maximum contraction ΔV_{MAX} (they are upgraded into m-e).

It results that to respect the conditions of conservation it must be:

$$F_{C^*}L = \sigma_{C^*}V = = E_{Y^*}\Delta V = E_{Y^*}A^*\Delta L = F_{STARTER\ *}\ \Delta L = \Delta F_{ELAST}$$

The gravitational F_C transmitted through the superstructure compresses the whole structural element and the level of compression is expressed by a ΔF_{ELAST} whilst the structural element undergoes a reduction of volume which can be represented as $-\Delta V = -A\ \Delta L$ followed by lateral bulging (lateral expansion) measured through lateral increase of a percent of ΔV, (see Fig 1) reducing the total volume reduction to:

$$\Delta \overline{V} = \Delta V \frac{(100 - x\%)}{100}$$

As consequence of the hypothesis of rigidity and incompressibility of the atoms but deformability of a physical mass due to presence of the interstitial substance between the atoms, a linear elastic medium (a column of concrete or a column of

steel, both of undefined length) invariably respond to sudden introduction of compression with a deformation which affects only the interstitial volume (up to a maximum contraction ΔV_{MAX} , assumed to be the value at which collapse and breakage occurs).

Now we have a situation in which the physical mass M_C under compression loses a volume ΔV forcing us to assume that whilst under the effect of a Force (and its opposite) external to M_C, the compression that these Forces exercise in real fact is cause of upgrade of energy into mass-energy trough loss of volume.
$\Delta F_{ELAST} = \sigma V$ [kJ] means that the *specific amount of compression* is:

$$\frac{\Delta F_{ELAST}}{V} = \sigma \quad \left[\frac{kJ}{m^3}\right]$$

σ then is interstitial energy per unit of volume that being reduced only in a portion of the unit of volume $\Delta V/V = \varepsilon$ results to be over it:

$$E_Y \quad \left[\frac{kJ}{m^3}\right]$$

At this point we are witnessing volume contraction whilst introducing nothing since the two opposite forces acting on the column (F_C and $-F_C$) are contact Forces and the only answer to this conundrum is that we are in front of a live demonstration of the Law of equivalence, (the interstitial energy existing between the atoms under the volume reduction caused by external Force, which apparently annihilates the volume which it occupies is upgraded into m-e).
Energy not only is equivalent to m-e but in this case is upgraded and becomes m-e inside a volume too small to be measured, whilst presence of m-e is understandable only with the use of reason.
Note: compression ΔF_{ELAST} enters the volume V and the manner in which it happens is important since the mass, due to the particular status of existence of energy inside its small interstitial volume is sensitive to sudden compression and the crystal and molecular internal bonds tend to break and be transformed-degraded into Heat in inverse proportionality to the time of application of compression (sudden compression causing internal deformation of the bonds made of energy, instead of compressing them can cause their breakage which is followed by dissipation).

The exercise

A bloc of RC, a superstructure, subjected to gravity, of height $r_2 - r_1 = H$, having a transversal section of area Ω (with $V_S = \Omega H$)will generate a Static Force, $F_{CONTACT}$ (F_C):

$$F_C = \rho V_S a(r) \quad [kN]$$

Where F_C for a superstructure of mass M_S and density $\rho = 2.2$ Ton/m^3 is:

$$F_C = \rho \cdot V_S \cdot a(r) \cong 22 \cdot V_S \quad [kN]$$

F_C is the total gravitational contact Force generated by the flow of pure pristine energy ESF caused by Earth's gravity "$v_{ESF} = a(r)/c^2$" acting over the bloc of RC and transmitted by contact to the column underneath of cross section A_C, of mass M and volume V.

Note: in our case the block is cast and rests over a temporary flat deck (also of surface Ω) supported by props (see fig 4).

Once removed the props and the deck, the concrete block will rest over the top of the column of area A_C (see Fig 4).

What I suggest now is an ideal exercise which attributes to a block of height H=1.00 m, cross section Ω =25 m^2 and density ρ = 2.2 Ton/m^3 (belonging to an equivalent superstructure of ± 3 floors, and the accidental load here is overlooked as it is overlooked the gravitational Force acting over the mass of the column/s and the gravitational energy of transformation-degradation (work) transmitted by the superstructure inside the column), the F_C transmitted by it is intended to compress a ΔF_{ELAST} [kJ] inside the column on the terms described above.

Note: the term "Elastic" has been used to describe the fact that the interstitial energy is a constant presence and its status is determined by the application of the external contact Newtonian Forces (F_C and $-F_C$).

We then have that the gravitational Contact Force F_C acting in top of the said column over the area A_C has the following value:

$$F_C = 2.2 * 10 * 1 * 25 = 550 \text{ [kN]}$$

I am now using only energy values in physical units kJ to describe the establishment of presence of internal compression of Elastic energy, caused by the flow of ESF and defined as a total ΔF_{ELAST} inside the whole structural member (column/s) as in fig 4.

In particular I need to describe the loss under compression of a volume ΔV which can absorb a specific compression E_Y kJ/m^3 entering the column through contact Force as cause of elastic deformation $-\Delta V$ and concentration of the interstitial energy $\Delta M_I c^2$ between the atoms inside a increasingly restricted volume $\Delta V_{MAX} - \Delta V$, until can be assumed concentrated inside a volume $\Delta \overline{V} > \cong 0$ and transformed into m-e ΔM_I

Note: to describe the elastic phenomenon of compression the $F_{CONTACT}$ is a necessary presence that, depending from constant gravitational phenomenon (of flow in time of the ESF over the superstructure) is constant, and when applied is transmitted at c_S speed but we can assume that the F_C is almost instantaneously present in the column and in that free condition reaches full loading value inside the column over the time of 1" sec.

Note: the amount of energy of compression generated by the load F_C is:

3) $\Delta F_{ELAST} = F_C L = \sigma_C A_C L = E_Y A_C \Delta L = F_{STARTER} \Delta L = F_D$ 1" [kJ]

and causes the full shrinkage ΔV of volume over Δt=1" second

The above relation says that for A_C = const the ***amount of compression or ΔF_{ELAST}, caused by F_C depends linearly from the height L of the column***.

Supposing that the F_C is unloaded over a column of section: A_C=0.34 * 0.34 = 0.1156 m^2 and height L = 3m , the unit of surface at the top will result loaded with a specific load in kN/m^2 :

$$\sigma_C = F_C / A_C = 550/0.1156 = 4757 \text{ kN/m}^2 \sim 4.757 \text{ MPa}$$

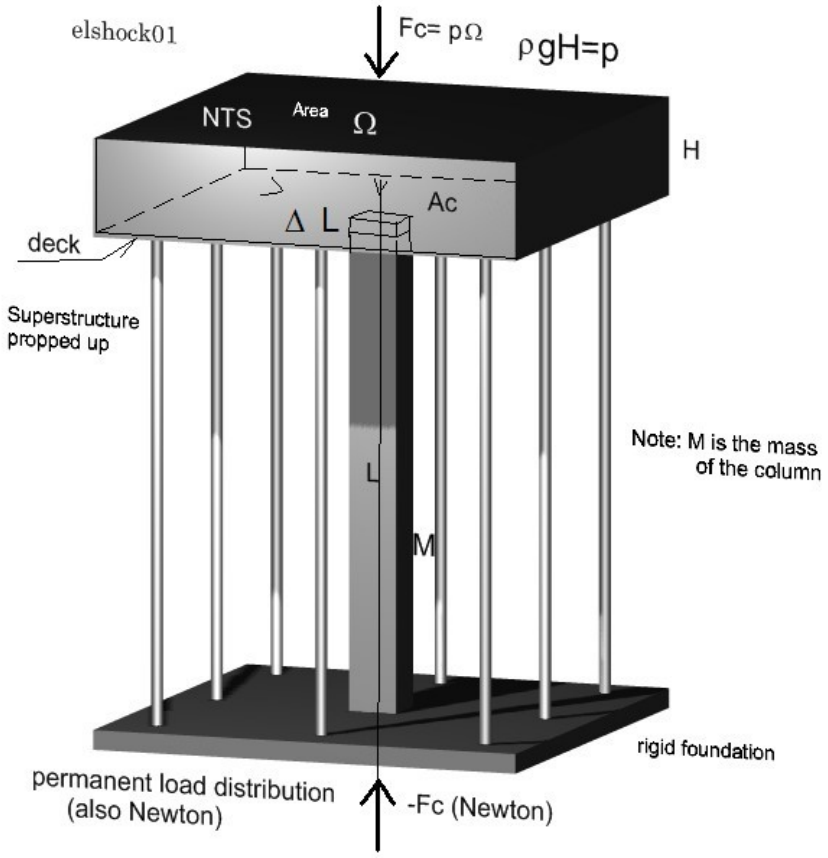

Figure 4

Which in terms of compression stores inside the unit of volume of the column the following amount of physical units of energy: σ_C = 4757 kJ/m^3 = 4.757 MJ/m^3 (the energy present inside the concrete columns in the conditions above mentioned of interstitial energy is subject to compression by external Forces changing its status of existence).

And the compression ΔF_{ELAST} present inside a column of length L will also be cause of an elastic movement that during the unit of time of 1" sec is reducing of ΔL the length L of the column:

$$\Delta F_{ELAST} = 4757 * 0.1156 * 3 = 1650 \ [kJ]$$

Note: we can compare the above ΔF_{ELAST} with the gravitational transformation-degradation or work $\Delta F_{TOT} = \sigma_C * \Delta V$ that takes place inside the superstructure but affects the whole physical mass of the column (atoms included), still taking into account that half of ΔF_{TOT} is dissipated during loading (see 2 above):

$$\Delta F_{TOT} = (4757^2 / 3e7) * 0.1156 * 3 = 0.261 \ [kJ]$$

Since inside a volume V the interstitial energy (amount of substance) is contained inside ΔV_{MAX} and the atomic entities not affected by compression occupy the volume $(V - \Delta V_{MAX})$ the Elasticity modulus E_Y represents the density of concentration over $\Delta V_{MAX} / V$ of the compression energy σ_{MAX} where ***σ_{MAX} is the measured value causing collapse of the mass in the unit of volume***:

$$E_Y \Delta V_{MAX} = \sigma_{MAX} V \ [kJ]$$

E_Y, then , is the value of specific compression that as external Force of compression σ , continuously increasing, would reduce to zero the unit of volume filled only of the interstitial mass in our case we obtain from physical measurements:

$$\sigma_{MAX} = E_Y \varepsilon_{MAX} \left[\frac{kJ}{m^3} \right]$$

that due to presence of atoms is valid only for $\sigma < \sigma_{MAX}$ and $\varepsilon < \varepsilon_{MAX}$, therefore

$E_Y = 3e7 \ kJ/m^3$

Note: the interstitial energy $\Delta M_I c^2$ is the one that under compression follows the Law of equivalence at elastic level becoming m-e when the compression has reached a maximum value (and in the case of a column of concrete maintaining constant the cross section A_C) the Law of compression is in linear relation with the contraction $\varepsilon = \Delta L / L$.

The column having cross sectional area A_C=constant subject to the specific compression $\sigma_C = 4757 \ kJ/m^3$, will then have a specific value of linear deformation:

$$\varepsilon = \Delta V / V = \Delta L / L = \sigma / E_Y = 4757 / 3 \text{ e } 7 = 0.0001585 \ m/m \ (meter/meter)$$

and a reduction of volume per unit of length:

$$\varepsilon * A_C = (4757 * 0.1156 * 1) / 3 \text{ e } 7 = 0.00001833 \ m^3/m$$

Note: For the column L=3 m high the total linear deformation is:

$$\Delta L = \varepsilon L = 0.0004755 \ m$$

Over the surface A_C in contact with the superstructure, the flow of ESF (generated by the effect of gravity of the Earth over M_S) is giving a value of contact force F_C [kN] and over the volume V the F_D reflecting the upgrading of energy into m-e within a time interval Δt = 1" second , is :

$$\Delta F_{ELAST} = F_{DOMINANT}\ 1" = F_{CONTACT}\ L$$

Dividing by Δt" [sec] all the terms of this expression, the phenomenon will result split into smaller similar ones and it will take Δt" seconds to obtain the above conditions.

Whilst due to presence of rigid incompressible atoms the unit of length of the column of volume $A_C * 1$ compressed by the Force generated in the superstructure is subjected to a loss of volume $\Delta V = A_C * \varepsilon$ along the line of gravity and this results in transformation of the interstitial energy into the equivalent status of m-e, as defined, and permits to write what is an application of Hooke's Law:

4) $$F_{STARTER} \cdot \varepsilon = E_Y A_C \cdot \varepsilon = 3e7 \cdot 0.34^2 \cdot 0.0001585 = 550 \left[\frac{kJ}{m}\right]$$

Since $F_{STARTER}$ (see the 3 above) is the upgrade causing *total volume reduction* per unit of length over the column of our exercise which is 3 m long we have:

$$\Delta F_{ELAST} = F_{STARTER} \cdot \varepsilon \cdot L = 1650 \ [kJ]$$

$F_{STARTER} = E_Y A_C \sim 3.470$ e 6 kJ/m of column of cross sectional area A_C (we must notice that $F_{STARTER}$ is a huge amount).

Note: **$F_{STARTER}$ is the specific amount of upgrade in kJ shrinking the length of our column of 1m, but for a shrinkage :**

$\Delta V/A = \Delta L$ the upgrade is $F_{STARTER}\ \Delta L = F_C L$

We suppose now that the column is only 1m high and when the contact Force is suddenly released over it the compression communicated to the interstitial m-e contained inside the unit of length of column takes 1" sec to perform the upgrade of interstitial energy into m-e during half a cycle of the elastic movement $\varepsilon = \Delta L/L$ which happens in absolute simultaneity and dependence with the real gravitational transformation-degradation in the superstructure (the work energy) half of which is dissipated as internal friction.

Note: passage of the interstitial energy into m-e and elastic return to energy (during a full cycle) does not happens without degradation of it, which depends from stretching of the molecular and crystal bonds, *it results that the said degradation is depending from the Force F_C applied and from the time it takes to the Dominant Force to perform the upgrade*.

Note: this last character of the elastic loading will be treated separately in case elastic cycles faster than 1"sec are affecting the column.

We overlook for the moment the transformation-degradation of gravitational origin due to the elastic movement and concentrate our attention over the upgrade value as ΔF_{ELAST} (mass-Force or internal compression) over the unit of length:

a) $\Delta F_{ELAST}/L = F_C * 1 = F_{STARTER} * \varepsilon = F_{DOMINANT}/L * 1" = \sigma_C * A_C * 1$

using the values of our exercise:

$\Delta F_{ELAST}/L = 550 * 1\ m = 3.470\ e\ 6 * 0.0001585 = 550 * 1"$ kJ/m

If now we modify the above multiplying each term by: $\varepsilon = 0.0001585$

b) $\Delta F_{ELAST}\varepsilon/L = (F_C * \varepsilon) * 1m = (F_{STARTER}\ \varepsilon) * \varepsilon = ((F_{DOMINANT}/L) * \varepsilon) * 1"$

$\Delta F_{ELAST} * \varepsilon /L = 0.087 * 1\ m = \mathbf{550} * \varepsilon = 0.087 * 1"$ kJ/m

Using this last transformation per each second of time we will need $\Delta t" = (1/\varepsilon)"$ sec to obtain the value in a) .

Then the time necessary to obtain the value in a), using the rate of transformation in b), will be $(1/\varepsilon)" = 1/0.0001585 = 6309"$ sec

or 1h 45' 9"

this is the time of transformation-degradation during which the $F_{STARTER}$ reaches the value abovementioned of compression in the 4) above if dynamic conditions of transformation over the elastic substance inside the mass ($F_{DOMINANT}$ or power of internal upgrade of energy into m-e *inside the unit of length of the column during 6309"* sec) is maintained at the same value of the safe static $F_{CONTACT}$ = 550 kJ/m, which is the safe value given by the Engineer for the column as a member of the structure, in a static permanent condition, and we have to conclude that a static condition reached through gradual increase of upgrade of the interstitial energy transforming it into m-e is tolerated a lot better than the one reached suddenly through loading instantaneously the superstructure (and consequently transforming the interstitial energy into m-e during the minimal interval of 1" second).

Note: for what regards the loss through internal compression of interstitial bonds due to application of F_C it is easy to speculate that a compression (F_C) acted in 1" second is far more disruptive than many F_C' whose cumulative sum is F_C each acting inside the column over 1"second, (see the conclusions in the above exercise) and what is more also the absorption of energy from the gravitational transformation-degradation which took place at the same time over the superstructure and its friction effect over the interstitial energy $\Delta M_I c^2$ (though here is a small phenomenon which is possible to overlook) is far better tolerated and,

on the whole, possibility of damage to $\Delta M_l c^2$ and therefore to the column is also greatly reduced.

Using this method the damages to the structure are decreasing, in respect to the ones that could result from sudden release of the superstructure, since if dismantling happens for $\Delta t<(1/\varepsilon)=6309$" in the b) above the second term will become:

$$\left(F_{STARTER} \frac{1}{\Delta t} \right) > \left(F_{STARTER} \varepsilon \right) = 550 \left[\frac{kJ}{m \cdot sec} \right]$$

and possibly, the operation of dismantling, due to the increasing values of Starter Force per unit of time, can become a catastrophe long before we reach the Olympic record of $\Delta t=1$" sec , for which $F_{STARTER}$ = 3.47 e 6 [kJ/(m·sec)] "see the a) above" since during fast dismantling the upgrade value (internal compression), which we call Starter Force corresponds to a direct effect over the molecular bonds and lattice of the crystals binding the atoms (as fast deforming and flattening the volume ΔV inside V, see fig 1)

Concluding: the crystalline structure of the column in concrete (and other building material of similar elastic characters) cannot *absorb rapidly a large Dominant Force developed by fast dismantling.*

Note: neither can safely absorb the gravitational work associated with the elastic transformation-degradation which although is representing a far lower amount of passage of energy is associated to internal friction and both phenomena (the one tied up to the Force F_C and the other tied up to the gravitational transformation-degradation absorbed from the superstructure) end up damaging on their own way the interstitial energy $\Delta M_l c^2$ of the physical mass of the column.

Note: in our case what is of major concern is the effect due to the sudden release of contact Force F_C.

In any case what should be accepted is that the Starter Force over the *unit of length of the column of concrete of our exercise*, due to the presence of incompressible atoms acts over an extremely limited volume:

$(\Delta V/L) = (\Delta L/L) * A_C = \varepsilon A_C = 0.0001585 * 0.1156 = 18.3$ e-6 m^3/m etc…

The relation c) below reflects a permanent internal condition of ***equilibrium of mass Forces*** trapped inside the volume of the column under scrutiny and respecting the principle of conservation once the whole effect of the gravitational flow over the superstructure has been transmitted inside the column of L length as a contact Force F_C:

c) $\Delta F_{ELAST} = F_C * L = \sigma_C * A_C * L = F_{STARTER} * \varepsilon L = F_D * 1$"

and now should be evident that is of advantage to obtain the above effect inside the column over a time interval Δt" sec through establishment of a reduced Dominant Force F_D of gravitational origin.

Note: if for now we exclude cyclical conditions of load, assuming a maximum capacity of production of internal compression of energy (upgrade) at σ_{MAX} = 24000 kJ/m^3 for a design value of σ_C = 4757 kJ/m^3 the safety factor used as norm of calculations would be $\eta=(\sigma_{MAX}/\sigma_C)\cong 5$, this would represent *some arguable protection (as shown in this paper)* against elastic collapse since in the worst conditions (Δt=1") as in c) the $\sigma_C = (1/5)\sigma_{MAX}$.

Note: this paper and the above exercises are only informative since my purpose was to point out that when a structure is built very fast, and a sizable superstructure has been cast over a structural element (a column/s, in our case), the release of the temporary supports and the loading of the column/s over which the structure will permanently rest, is an operation that requires accurate calculations and supervision by responsible person and mustn't be overlooked as I presume was done until now in most circumstances.

If we go back in history and examine the various disasters which took place, we can in many circumstances attribute failure to fast loading and fast un-propping (always associated with poor workmanship and poor choice of a safety factor).
The sad aftermath was usually followed by enquiries usually directed to find fault with the work of the Engineer, and currently, the Engineer, even if his design was correct, is blamed for failures which happen beyond his control.
Nowadays, in the practice of construction, failures and plain disasters are starting to be more frequent since with modern techniques buildings are growing fast and decks and propping are on occasions obtained using patented designs "easy efficient and very fast to dismantle" especially when the dismantling is made by specialized crews, machinery producing vibrations are made in increasing sizes and mobile transport devices are growing in number whilst carrying increasing loads .

4 November 2009
Reviewed on 26 October 2010

Ruggeri32 (reviewed)