01-INTRODUCTION:

Sky scraping column buildings of Megacity Urban Development has created a deathtrap apparently to end up the Global Human Civilization.

FIGURE－01 (Thailand disaster－2016)

Take it or not as the best indication of how would the great human civilization fall with all of the Technologies too, at the forthcoming disastrous Geo Magnetic Reversal.

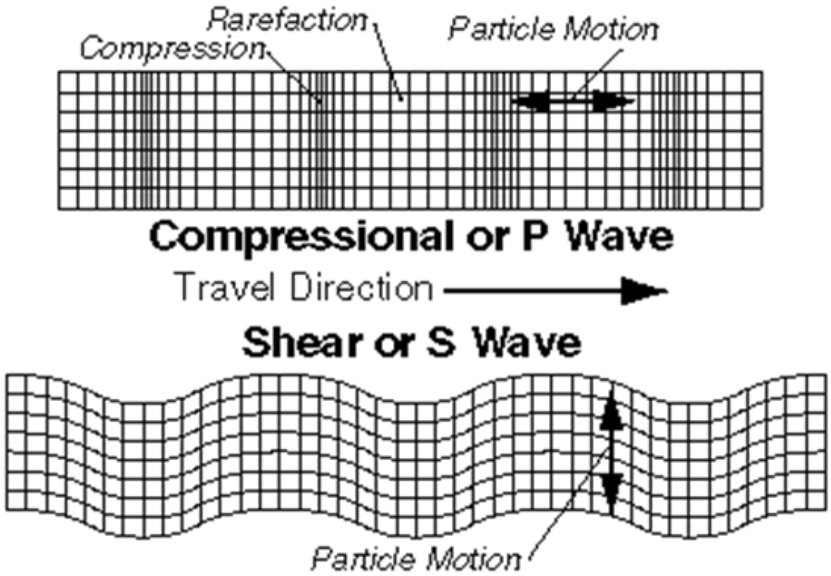
But till then, doesn’ t it look a failure in Structural engineering too, where causation undetected as yet and designing aspects remained without safety measures against earthquakes?

Therefore Structural Engineers have got to make a decision at this stage whether to avoid the high rise column pattern of Megacity buildings or unless to analyze the problem for possible safety measures against the disastrous seismic impulse.

02-BACKGROUND:

Seismic waves are accepted as born by some explosion takes place generally at where; tectonic plates collide, volcano activate, and at where rocky faults

collapse. Earthquakes are brought to our notice mainly by two types of seismic waves such as; P−waves and S−waves.



1. Primary waves (P-waves):

They are frequency modulated (FM) compressional energy waves transmitted through soil and rocky layers as well by oscillating of the medium mass forward and backward in the same direction of the wave propagation. The wave speed is generally around 5 to15km/s.

2. Secondary waves (S-waves):

'S−wave' is amplitude modulated−(AM) shear energy wave of which the velocity is almost half of the P−wave'. Medium matter is moved oscillating perpendicular to the direction of S−wave propagation.

The amplitude decides the size of the earthquake and it is between 1mm to 70mm for an ordinary level of an earthquake. Between 100−200mm of the amplitude at a certain locality means an earthquake of moderate level and above 200m means a big one in general concern.

03-TECHNICAL FIELDS:

Seismology and Geology are the related fields should account for the causation behind probability of earthquakes but what more could Geologists or Seismologists do when they can't predict earthquakes? But the blame is however ultimately loaded upon Engineers and therefore Structural Engineers

have got to decide whether to continue of the same building pattern or to take alternative safety measures under strategic disaster mitigation aspects.

FIGURE−02 (What has happened to the safety factors of Designers?)

04-PROBLEM ANALYSIS:

❖ **ERRONEOUS THEORIZATIONS IN ACCEPTANCE:**

However much the knowledge has been developed by the 21st century, we often observe that, there are many lapses in other scientific fields except from the overdeveloped field of Information Technology.

The background sciences related to this particular phenomenon earthquake too, look to have some areas vaguely explained or unexplained as yet or unless how could such disasters strike upon human civilization, all at once giving no chance to escape?

But Structural Engineering needs clear facts and figures for designing of alternative solutions to safeguard the civilization from this disaster. Therefor bellow furnished maters have to get clear, through an analytical approach at first.

1. How could such disastrous seismic waves initiated and probably at what depth?
2. What is the exact dynamic medium organization behind a Seismic Wave?
3. What are the governing factors to decide the path of a Seismic Wave?
4. What is the character wise difference between P−waves and S−waves?
5. What is the **Force of Seismic Impulse** upon structural buildings?

❖ **PROBLEMS TO BE SOLVED:**

1. Structural Engineers have not yet provided with sufficient knowledge of **amplitude** of a seismic wave of disastrous level. **Direction** of ground oscillation and **Intensity of Energy Flux** that pass through the ground too are essential factors need for designing of safe building foundations.

2. The impulsive lateral force 'Seismic Impulse' applied upon structural buildings and its direction has not yet been identified in Structural Engineering.

3. Architects have not yet provided with sufficient knowledge of the 'Climate Change' due 'Global Environment Potential Threats' to be considered in their planning of Megacity urban settlements and related infrastructure.

05-THEORETICAL ANALYSIS:

1. How could a seismic wave initiated and probably at what depth?

The hard crust of Earth could be vibrated due to interior geo dynamics, more possibly to take place at releasing of inner geothermal pressure out, from time to time.

The explosion could take place most probably at;
1)−Expanding of gaps between tectonic plates to release magma pressure
2)−Activation of volcano to release magma pressure
3)−Pressure collapsing of faults in rocks etc.

Then what is the most **probable depth** in Earth for a seismic wave to born?

Man has not drilled so far beyond some **12−15km** deep in to the body of Earth due to reason of high temperature growth which could melt even the diamond

drill bit. (Geothermal gradient in Earth is 25° C per one km with increasing depth)

As it is recorded, even the dense rocky substance had just started melting due to the increased heat in depths. (Kola Super Deep Project–12.26 km/USSR/ 1970–1993).

By the findings, we can come in to the conclusion that, ***solidity*** *&* ***elastic modulus*** *of earth materials (the essential factors required to create a strong vibration) are weakened beyond some* ***15–20km*** *in depth due to initiation of melting condition.*

Any vibration for a seismic wave of moderately high frequency, could not be born at all, under high viscos melting state of matter. To the best of our experience, **elastic modulus** of any substance is highly dropped under red heated melting phase and therefore it is reasonable to deduce that seismic waves must be generated at a shallow level, not deeper than **15–20km** in depth **at most.**

2. *What is a Seismic Wave?*

It is observed that properties of P–waves and S–waves are not properly defined in the background science of Seismology.

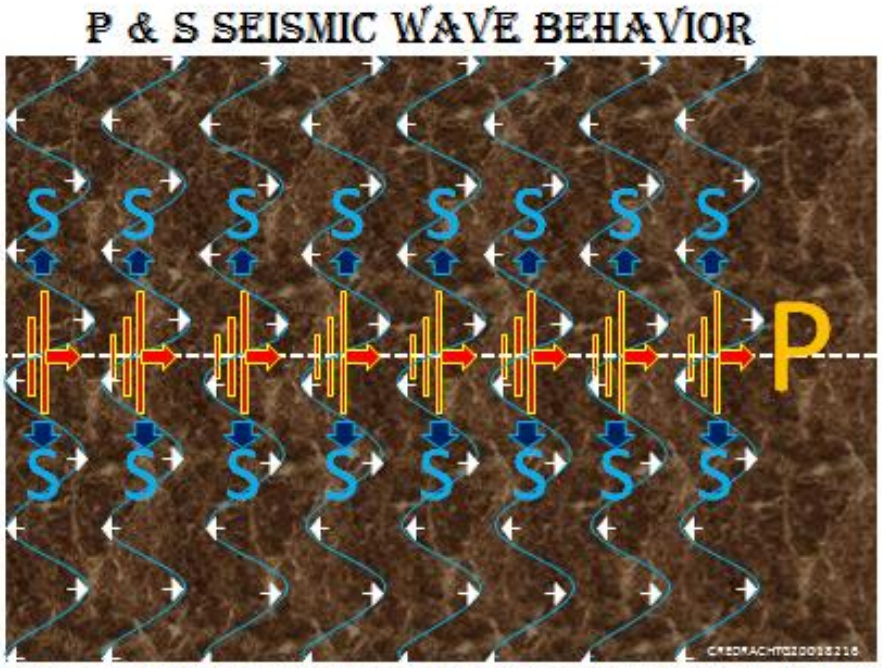
S–waves could not be born alone, without presence of a P–wave. That is mainly because the **origin** of a seismic wave should be due to an **explosion like pressure releasing** and hence the rocky medium must be compressed out and returned immediately back due to high elastic modulus. This forward and backward **oscillation of medium matter** is spread far throughout the medium as **P–waves,** propagating all the outward directions from the explosion.

This **commotion** of the medium should repeat several times until fading off the energy of the explosion. The origin therefore doesn't support for separate generation of S–waves of **amplitude modulation** due to the explosion. But instead where there the P–waves propagate, S–waves are also originated in perpendicular directions. Therefore it can be concluded that S–waves are originated only from P–waves but not from the explosion as a hole.

Amplitude modulated (AM) radio waves in the atmosphere are produced by a different transmission technology in Electromagnetism. But any impulsive pressure releasing explosion in the rocky substance cannot transmit out medium waves of Amplitude Modulation such as S–waves.

Alternative Definition for Seismic Waves:

A seismic wave is a dynamic medium organization to transmit a huge bulk of energy, which makes medium matter oscillate within the elastic limit. Forward motion of the seismic wave is recognized as a P−wave, while the spread of the same oscillation in perpendicular directions are identified as S−waves.



FIGURE−03

As shown in the figure−03, the bulk energy generation by any geo explosion is distributed far by the dynamic medium organization identified as a Seismic Wave.

What are Surface Waves?

If we throw a stone in to calm water, origin and spreading of surface waves could be observed. Structural Engineers know well that, moist soil too exhibits a fluidic behavior. Similarly waves could therefore be expected through the outermost soil medium to spread outwards from the explosion and they must be very slow and short lasting. The slow oscillation ought to be vertical and buildings are undergone a bit of ascending and descending effect only which is not so dangerous.

3. *What are the factors to decide the size and path of a Seismic Wave?*

The properties which decide the **speed** and **path** of a seismic wave belong to the medium such as;

- Density
- Modulus of Elasticity
- Pressure

3.1 What is the size of an Earthquake?

Size of the explosion cannot decide the **speed** or **path** of the seismic wave because it is a matter entirely related to the **medium qualities**. It denotes that, a **bigger** explosion cannot create a **speeder** wave.

For an instant, a supersonic concord jet can overtake the velocity of sound in the sky but it cannot create a sound wave speeder than the limit of sound.

Therefore seismic waves exhibit same speed in spite of the size of the explosion but slight differences could be observed due to change of **medium properties** from layer to layer.

Product of **wave length** and **frequency** is the wave **speed** mathematically and therefore if the wave length is high then frequency becomes low to keep the wave speed constant.

Thence the size of ***wave length*** *of a P−wave or size of* ***amplitude*** *of a S−wave only are the best measures of* ***strength (size)*** *of the seismic wave that identified at the* ***locality*** *of the seismographic station. Richter meter reading is the logarithmic representation of the amplitude and it is a good indicator of size of the wave at the station. But as yet, we cannot deduce real size of the explosion.*

3.2 How do we analyze the path of a P−wave?

P−wave is a compressional wave which pushes the medium matter forward and release to return back in accordance with a frequency.

Suppose the wave comes to propagate along the boundary of two soil layers of different qualities.

Material of loose side is easily pushed by the wave stroke and therefore the wave is gradually turned to face the **denser** side. Similarly which side applies a

bigger pressure against the wave stroke thence, the wave turns towards **high pressure** side. If one side is elastic and other side is plastic against motion, then the face of the wave stroke moves forward easily in the plastic side and therein the wave face is turned gradually towards the side of high **elastic modulus**.

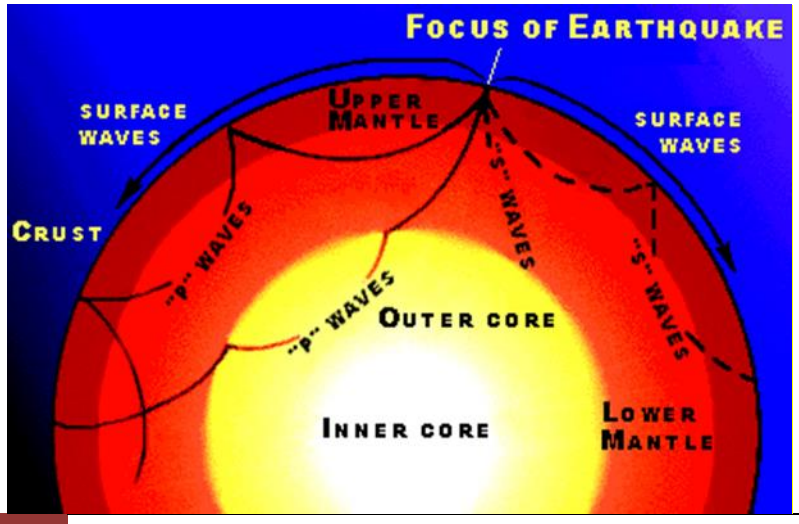
Conclusion:
P−wave is gradually turned towards the medium of high ***Density****, high* ***Pressure*** *and high* ***Elastic Modulus****.* ***Refraction*** *is the phenomenon behind bending of P−seismic waves and no reflection could be expected in Earth for earthquake originated seismic waves. P−wave is a medium wave of mighty strength but not an electromagnetic wave. Only electromagnetic seismic waves can be reflected back from bed rock or any other hard rocky boundary layer in Earth.*

3.3 The biggest problem with the Geological Model of Earth:

As per the accepted Geological model of Earth the density is rising towards the center starting from 2.4 g/cm^{3}at the ground level to end up with 13 g/cm^3 in the inner core.

Then the P−waves should always turn towards the center of the Globe. But in reality, seismic P−waves are reversed back towards the ground surface to be recorded in several distant seismographic stations. Therefore Seismologists at this stage should have challenged the Geological Model of Earth in acceptance by producing a better Seismological Model of Earth.

But instead, Seismologists seem to have made a big effort to support the conventional model by bending the P−waves in a queer manner, which is not acceptable at all.



What we have in against of this Model?

Question−01:− 'How could seismic P−waves bounced back at the free ground surface of Earth just like Ping−Pong balls?

Perhaps it might be the Richter meter at the seismographic stations which could have reflected back the waves of so mighty strength.

'What is the Physics behind this phenomenon, 'Refraction or Reflection'?

To **reflect** any energy wave or energy ray, there should be an **impenetrable** hard surface. It is similar to how a light ray is reflected back at a mirror. Earth surface just in touch with air or water is not hard enough at all, to reflect back a seismic wave of mighty power.

Question−02:− 'How could a deep penetrated seismic P−wave wave gently curved back again towards the ground level and what is the Physics behind it, Refraction or Reflection'?

It looks like in the demonstration that the wave is gently curved upward and therefore it ought to be refraction. Unless otherwise, there should exist a very hard layer beneath of the crust, to reflect the wave. In practical world we don't find any Earth layer denser than 2.7−3 g/cm^3 at most. It is not dense enough to reflect a strong P−wave back and therefore we have to conclude that the phenomenon should be **Refraction.**

If we can recollect our school day lessons, **illusion** is the result of refraction of light rays at a heated road surface. Air at the close proximity to the road surface is more heated and density is dropped. Then light rays that reach from above are diverted gradually back creating a mirror image for a distant observer. In that case rays are bent towards the denser layers of air.

Similarly P−waves should have bent towards the inner denser layers of Earth but not towards the outer surface like this.

Therefore we have to accept that, the practical Seismographic records give us the message of immense importance that, there exists a **'Geo Transition Zone'** in side of Earth probably some **30−40km** in depth by the end of the solid crust.

The properties such as; **Density, Pressure** and **Temperature** are increased up to that special zone but beyond, they starts falling. **Gravity** is the main agent of all those changes and it is certain to be **inverted** at this special zone.

However it is quite away from the Structural Engineers scope under the topic but the conventional Geological model of Earth is challenged by practical Seismology unless the results are not **misinterpreted**. The P–wave behavior is explicitly explained by the alternative model as described under the figure–04.

Question–03:– How could S–waves travel far without presence of a P–wave?

In the atmosphere only electromagnetic AM waves could travel far alone. But seismic S–waves doesn' t have an electromagnetic origin and they cannot travel far alone. S–wave is only the lateral propagation of a P–wave. Therefore S type dynamics of a seismic wave cannot exist without having a mighty P–wave passing closely.

Question–04:– Why is that P or S–waves are not shown at the region of close proximity of the explosion?

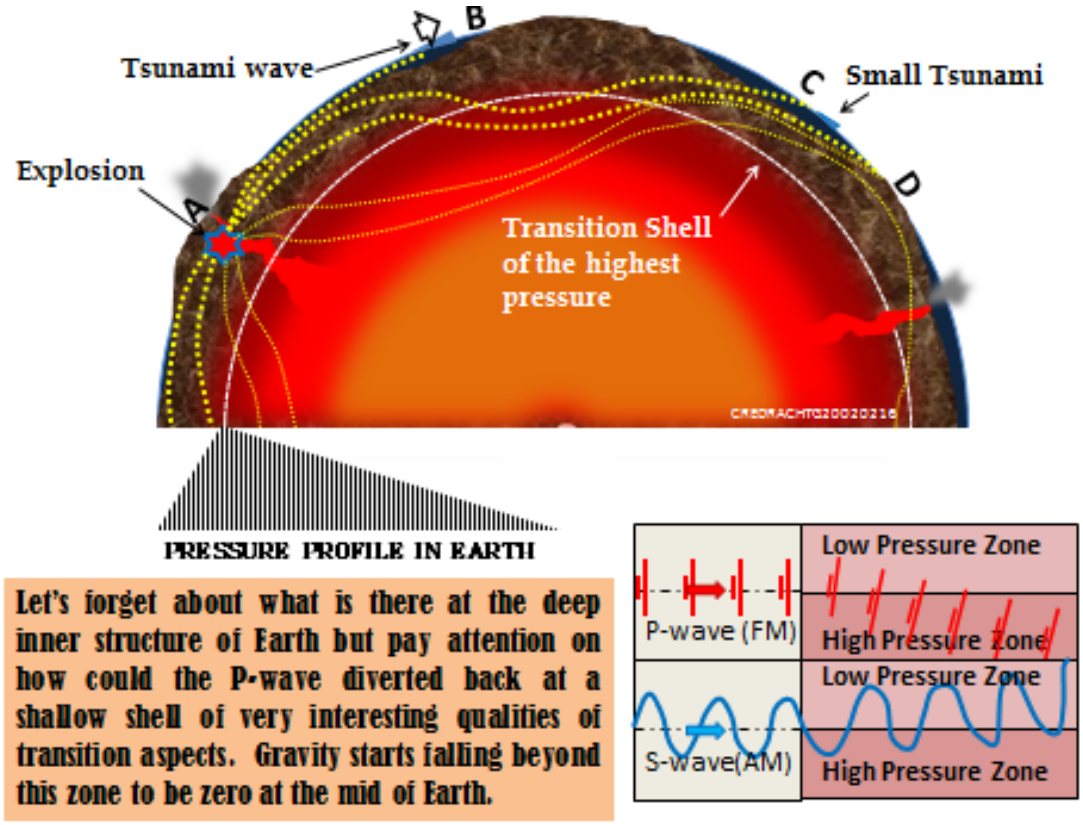
We have the problem that why P–waves are not drawn in lateral directions at the explosion? that in the problematic seismic wave model? If so, P–waves should have emerged at even very closer proximity of the explosion. But practically there exists a certain shadow areal region around the explosion for P–waves. It proves that P–waves are curved down towards the transition zone at first and beyond the transition zone they are curved up again to emerge at a considerable distance away from the explosion as shown in the figure–04.

Conclusion:

Therefore the model explained in the background science is contradictory and seismic wave path is not exhibited well. Perhaps the Seismologists might have mistaken the P–waves as same as electromagnetic seismic waves which reflects back at hard strata boundaries in Earth.

3.4 The Alternative Model of Seismic Medium Wave Behavior:

The P–wave is bent towards the medium of which **Density**, **Pressure** & **Elasticity** are rich, while the S–wave is bent towards the medium of which the above qualities are poor. The physics behind the phenomenon is **Refraction** but not reflection at all. Earthquake originated seismic waves are medium waves of mighty strength but they should not be treated as same as the weak electromagnetic seismic waves which are reflected back from hard boundaries of material density discontinuation.



FIGURE–04

Point 'A' in figure–04, indicates the locality at where the explosion takes place. There is a small shadow area around A, because P–waves are curved a bit downward due to refraction. Beyond that shadow radial up to B is the most vulnerable region for structural failures and even a Tsunami could be expected if the P–wave happen to travel in the seabed. The wave is then attached to the deep seabed due to high water pressure and could not be even noticed from the surface during traveling in the deep sea. But when it reaches the shallow depths near to the beaches, the total wave energy is transferred in to water by the raised bed friction. Then water level is raised high like a huge hump to build up potential energy and then spread slowly as a Tsunami tide.

There is an earthquake neutral area in between the points B&C as shown in the picture. The physics behind the phenomenon is **refraction** and a vacant area is created when P–waves beneath of the surface, are gradually bent towards the inner shell of high pressure.

But how could P–waves return again to the surface, emerging at a far distant point 'C' ?

That is because a different region of different qualities exists beyond the highest pressure shell in the Earth. Modulus of Elasticity, Density and Pressure as well start dropping towards further beneath from this shell of the highest pressure. That is why a P−wave is refracted back towards the surface.

However above definition is a challenge to the Geological Earth Model in the so far acceptance because in the conventional model as you know, density is rising towards the mid to become 12−13g/cm^3 ultimately at the inner core.

Let us consider how Gravity behaves inside of Earth. Every physicist living on Earth accepts that Gravity at the center of Earth is zero. Then the deduction is so simple such as;

I. Can we talk of any Gravitational **Force** (weight) without Gravity?
No we cannot.
II. Then can we talk of **Pressure** without referring of **Force**?
No we cannot.

Then we are inclined to conclude that, the highest pressure region in Earth must exist at the exact depth where Gravity starts falling and it is named herein as the 'Transition Shell'.

As Pressure, Density and Elasticity of materials are dropping beyond the Transition Shell, the seismic P−wave is refracted back towards the Earth surface again to emerge at a distant locality. But this deduction challenges the so far accepted Geological Earth Model of which density is grown highly up to 13g/cm^3 towards the Earth center.

4. *What is the 'Ground Energy Intensity' by a Seismic Wave?*

This is the most important parameter for Structural Engineers to design safety measures for their buildings. However Engineers cannot address the ultimate limit states in this regard because the biggest size of earthquakes could never be helped by them. But it is something great if their buildings could stand without falling down at least against a wave of moderately big size.

4.1 What is the appropriate size of a seismic medium wave to be addressed by Engineers?

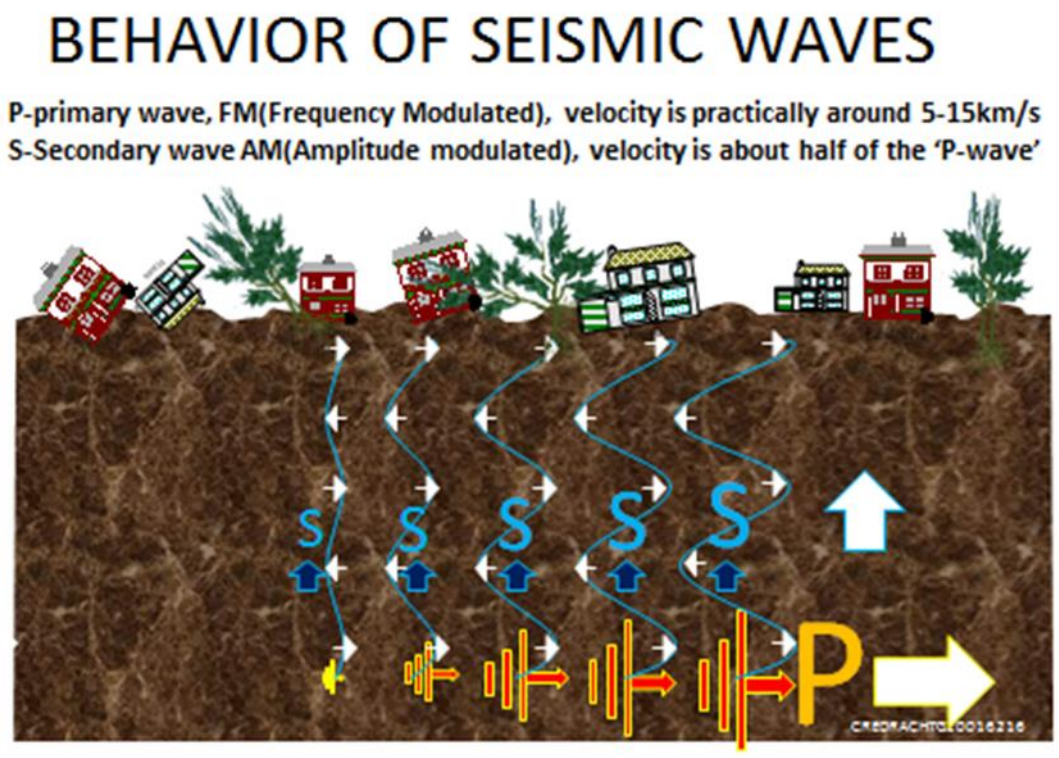
The amplitude decides the size of the earthquake and it is between 1mm to 70mm for an ordinary level of an earthquake. Between 100–200mm of the amplitude at a locality means an earthquake of moderate level and above 200mm means a seismic wave of big size.

Amplitude of the horizontal oscillation must be the best indicator for Engineers to decide the size of a seismic wave to be addressed in their designs and 200mm must be the most appropriate ultimate state to be addressed.

5.2 Analysis upon 'Ground Energy Intensity'

Definition:

Ground Energy Intensity is defined as, how much of energy is transmitted horizontally by the seismic wave, across a unit area [NM/M^2]at a considered depth in the ground.



FIGURE–05(a seismic wave attack)

As shown in the figure–05, a seismic wave attack could not exist for longer than a few seconds at most. Effective duration of the entire vibration could be

perhaps less than half a second in case of manmade geo nuclear explosions. In artificial cases the front most wave is the most powerful one of the biggest amplitude.

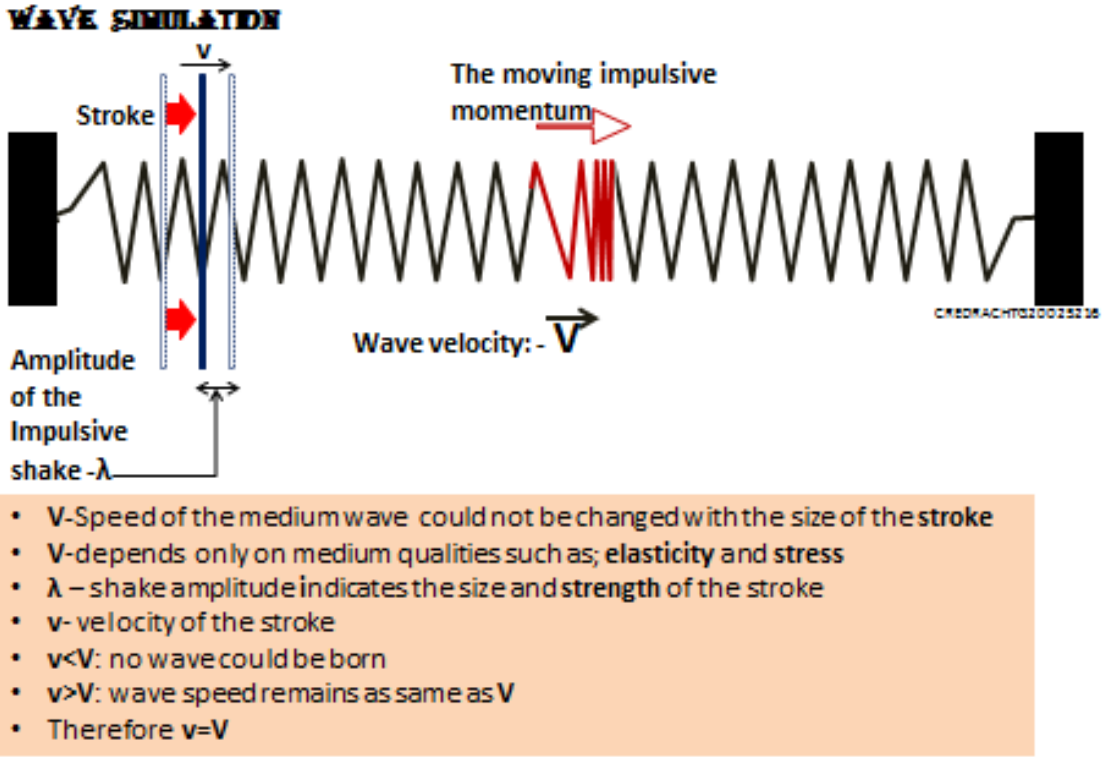
But in case of natural earthquakes the vibration could continue for some few seconds and could exist repeating during a certain period.

However Structural Engineers have got to deal with the biggest horizontal amplitude of the ground oscillation.

Deduction of the Force of Seismic Impulse:

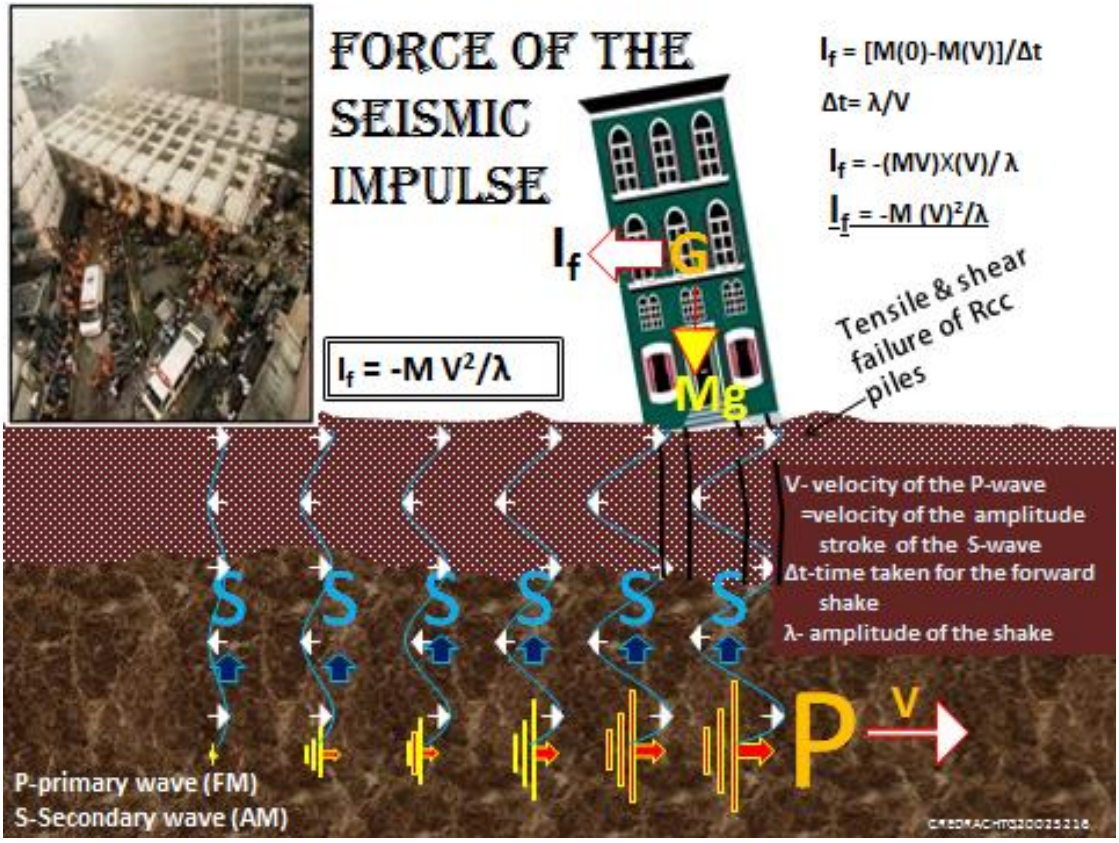
Let' s consider a spiral spring or a rubber band to deduce energy of a Frequency Modulated (AM) wave.

- Can we create a wave without tensioning of the band? No we cannot. Then we can conclude that, Tensile or Compressive **Stress** of any medium is the most essential factor for wave generations.



FIGURE–06

- The moving impulsive momentum, as shown in the figure–06, possesses a different mobility than the wave. It has a forward stroke and a backward stroke as well in it but the resultant commotion is running forward with the same speed of the FM wave.
- The above simulation proves that, The **compressive stress** or **pressure** of the earth layer through which the seismic wave is transmitted is of immense importance and it decides the **velocity** of the wave.
- It also proves that, sandy or muddy earth surface layer could not transmit any sort of seismic waves and therefore buildings of shallow floating foundations are hardly likely to be affected by earthquakes.



FIGURE–07

- Active earth pressure is increased with the depth of soil and therefore deep foundations are more affected than shallow foundations.
- Pile foundations for Megacity buildings are essentially driven in to the bedrock and they are the most vulnerable buildings because the most powerful P–wave is always attracted to the bed rock by the high **pressure**, high **density** and the high **elastic modulus.**
- Piles driven in to the hard strata are shaken vigorously with the bedrock by the strong wave strokes but the building above, being unable to pick

up the velocity, develops a negative impulsive force as shown in the figure−07.

- The **force of seismic impulse** is acting laterally upon the center of Gravity of the building and the piles are collapsed instantly under the massive shear stress and bending moment as well.
- Buildings are falling almost in a single direction and it is the exact direction from where the strong P−wave comes.
- S−waves are but just the lateral medium oscillation identified, when a strong P−wave is passing beneath.
- P−wave velocity in common rocky layers (could be varied with the pressure in the layer and if the pressure is high velocity too becomes high)

Velocity in Common Rock Types	Velocity [m/s]
Unconsolidated Sandstone	4600 - 5200
Consolidated Sandstone	5800
Shale	1800 - 4900
Limestone	5800 - 6400
Dolomite	6400 - 7300
Anhydrite	6100
Granite	5800 - 6100
Gabbro	7200

General size of the Seismic Impulse on Buildings:

Let' s workout the typical example for Seismic Impulse, applied upon a building of 20 floors and 10,000 metric tons in weight. If we consider a moderate size of an earthquake, with amplitude of 100mm and wave velocity of 10km/s, the force of Seismic Impulse;

$$I_f = -M\,V^2/\lambda$$

$$= -(10{,}000{,}000\text{kg})\,(10{,}000\text{m/s})^2/0.1\text{m}$$

$$= -\,1.0 \times 10^{13}\ \text{kN}$$

What a gigantic force is it and can Structural Engineers deal with the seismic impulse when it is acting from the center of gravity of the building, about 30m high in the sky?

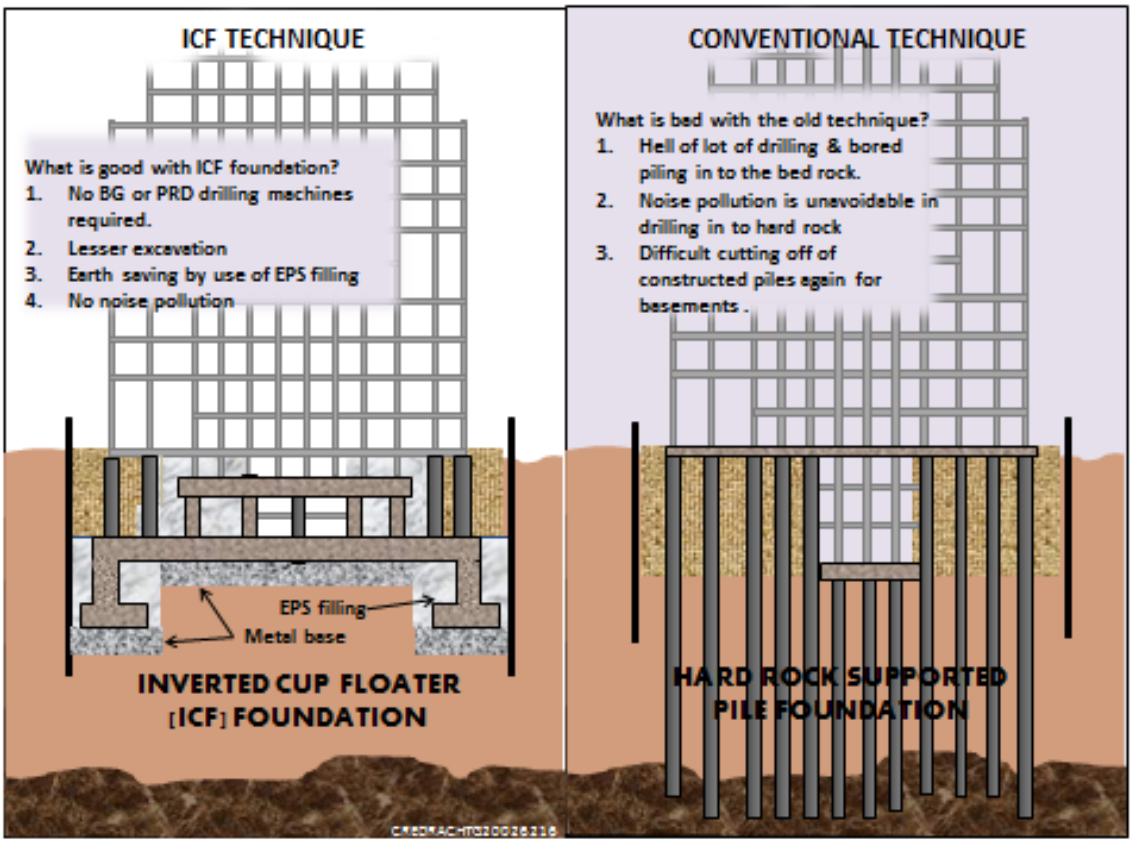
No, it is useless even to try. Therefore the best strategy is to avoid pile foundations and to go for alternative models of floating foundations in aim of avoiding the bed rock through which the most powerful P−wave is running.

06-PROBLEM SOLVING MEASURES:

Inverted Cup Floater (ICF) Foundation

The ICF model introduced herein doesn't touch the bed rock in the purpose to avoid the stronger seismic stroke.

Besides that, the floating foundation structure has allocated a sufficient gap for any lateral movements so that the building doesn't face the impulsive seismic stroke directly.



FIGURE−08

Also the load bearing Rcc cup is placed upon a thick metal layer in order to minimize the shearing strength of the seismic wave through frictional dissipation of energy by slipping.

Engineers can also try different slippery bases allowing some 200–300mm of a lateral slip between the cup footing and the base, in order to minimize the impulsive lateral seismic impulse upon the building.

The EPS filling shall provide the required space 300mm maximum and designing of the load bearing slippery base is the challenge for the Structural Engineers of innovative thinking. If the base is made slippery with introduction of highly clayish soil layer(entrapped mud) or unless a layer of desert dust, the disastrous seismic wave should spare the building above with no impulsive shaking.

07-ECOLOGICAL ASPECTS UPON SUSTAINABILITY:

a. Global Human Civilization seems to march rapidly in to the deathtrap from earthquakes due to wrong human dimension in over urbanization and the trend for sky rising **Megacity Column structures.**
b. In that respect all the efforts are made to centralize the World Economy around Megacities but developing countries should comprehend that **decentralized economy** is long lasting and Sustainable.
c. A high–risen column building creates a deathtrap not only for the inhabitants in it but also upon the innocent citizens living in the circle of the **height radius.**
d. The Global Environmental Organizations, who made a so big noise over use of DDT, seem silent in this regard but they have to limit the height of Megacity building columns at least, through an **International Environmental Convention.**

08– **SUMMARIZATION:**

01. Force of Seismic Impulse, that is applied by seismic medium wave strokes to fail high raised column structures is deduced in this technical paper as; $I_f = -M\ V^2/\lambda$ where 'V' is velocity of the P–wave, 'λ' is the stroke length of the horizontal ground oscillation (amplitude of the related S–wave) and 'M' is the weight of the building.

02. The impulsive force is deduced such as;

If the entire building could gain the same velocity of the wave stroke, within the short time gap, thence there is no building failure at all. Then the impulsive force is the change of momentum of the building during the short time gap. But if the building is unable to move with the stroke, then the same force is acting in negative direction, upon the center of gravity to fail the building structure.

03. The impulsive force is so high that Structural Engineers had better to go for optional aspects of foundations avoiding bored piling in to the bed rock because bed rock is the best medium which facilitate for the P–wave of mighty strength.

04. Instead the technique of 'Inverted Cup Floater(ICF)' foundation is suggested herein allowing for a lateral shifting space of 200mm at least, upon a frictional or slippery base in order to avoid the impulsive force of the wave stroke.

05. In this analytical study however we observed that there are some lapses or gaps in the background sciences and therefore the Scientists of the 21st century have got to open their conserved stocks of knowledge for new challenges on behalf of Improvements.

06. This analytical monograph also delivers the important message for attention of the Global Knowledge Departments that, Earth is not solid but a **Hollow Globe.**

EARLY DETECTION

FORECASTING

SAFETY MEASURES

NO DANGER

LATE DETECTION

EARLY WARNING

MITIGATION MEASURES

LESS DANGER

UNDETECTED

NO ALARM

CHECKMATE

DISASTER

END

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