

*Lateral Load Increment Scheme Quantization For Use In
Push Over Analysis Scheme Generally Used In Multi-Storeyed Structural Analysis*

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Abstract

In this research manuscript, the author has detailed a *Lateral Load Increment Scheme Quantization For Use In Push Over Analysis Scheme Generally Used In Multi-Storeyed Structural Analysis*.

Theory

One can Note that Capturing the Mode Shapes of Displacement Accurately In Push Over Analysis Scheme Generally Used In Multi-Storeyed Structural Analysis is not an easy task. Various Schemes of Lateral Loading and the Increment Schemes used therein such as FEMA Load Distribution, Inverted Triangular Distribution, A Uniform Load Distribution, Kunnath's Load Distribution (Kunnath, 2004), Two-Phase Load Distribution (Jingjiang et al, 2003), Adaptive Force Patterns that are updated according to the instantaneous dynamic properties of the system under study (Bracci et al. 1997), (Lefort, 2000) are being used currently for Performing the Push Over Analysis.

One should centrally Note that according to the Inertia and/ or Energy Transference Phasing Theorem {see author's Literature on the Same}, the Loading must be in Phase with the Displacement and especially, this is necessary for the Load Function, i.e., the Load Increment Scheme. Hence, this calls for the Quantization of Load Increment of the form

New Concept 1

Condition 1:

$$P(sl) = P_0 + n\Delta P$$

$$P(sl) = P_0 + n\left(\frac{1}{T}\right)\int_0^T P_0 \sin(\omega t + \phi) dt$$

Where sl stands for Storey Level

P_0 = Average Amplitude of the Sinusoidal Earth Quake Simulating Load

T = Average Time Period of the Sinusoidal Earth Quake Simulating Load

$n = 0, 1, 2, \dots, \text{Max}(sl)$

ω = Average Angular Frequency of the Sinusoidal Earth Quake Simulating Load

$\Delta P = \text{Average Quantized Minimum Increment to the Sinusoidal Earth Quake Simulating Load}$

ϕ is the *Arbitrary Phase*.

Furthermore,

New Concept 2

Condition 2:

$$\langle P(sl) \rangle_{\omega} < \langle X_0(sl) \rangle_{\omega}$$

That is,

Where $\langle P(sl) \rangle_{\omega}$ is the *Angular Frequency of Average Energy* associated with the *Incremental Load*, $\langle X_0(sl) \rangle_{\omega}$ is the *Angular Frequency of Average Energy* associated with the *Sinusoidal Response Displacement*.

This condition is very *Critical* because to *Note* the *Higher Mode Shapes of Displacement*. If we do not *Enforce* this *Criterion*, we run the *Risk* of being *Unable to Observe All the Higher Mode Shapes of Displacement*. And this *Condition* can be *Enforced* by *Reverse Engineering* the *Design* of ω and ϕ , the *Arbitrary Phase*.

From the above, we Derive

$$\langle E(n\Delta P) \rangle < \langle nE(X_0 \sin(\omega t + \phi)) \rangle$$

wherein, $\langle E(\Delta P) \rangle$ is the *Average Energy* associated with the *Incremental Load* and $\langle nE(X_0 \sin(\omega t + \phi)) \rangle$ is the *Average Energy* associated with the *Sinusoidal Response Displacement*.

New Concept 3

Energy $E = \bar{F} \cdot \frac{d^m \bar{x}}{dt^m}$

{see author's *Definition Of Energy* at www.vixra.org/author/ramesh_chandra_bagadi}

New Concept 4

Inertia and/ or Energy Transference Phasing Theorem

We can note from the author's *Definition of Energy*

$$E = \bar{F} \cdot \frac{d^m \bar{x}}{dt^m}$$

that, for *Perfect Transference of Energy*, the *Load* and the *Displacement* and/ or

the Quantity $\frac{d^m \bar{x}}{dt^m}$

Must be in Perfect Phase.

Here, \bar{F} = Force

And $\frac{d^m \bar{x}}{dt^m}$ is the m^{th} Derivative of Displacement \bar{x} .

New Concept 5

Inertia and/ or Energy Transference Phasing Theorem {Fractional Order Derivative Based}

We can note from the author's *Fractional Order Derivative Based Definition of Energy*

$$E = \bar{F} \cdot \frac{d^{m+\alpha} \bar{x}}{dt^{m+\alpha}}$$

that, for *Perfect Transference of Energy*, the *Load* and the *Displacement* and/ or

the Quantity $\frac{d^{m+\alpha} \bar{x}}{dt^{m+\alpha}}$

Must be in Perfect Phase.

Here, \bar{F} = Force

And $\frac{d^{m+\alpha} \bar{x}}{dt^{m+\alpha}}$ is the $(m + \alpha)^{th}$ Fractional Derivative of Displacement \bar{x} and

m is a Positive Integer and α is a Constant such that $0 < \alpha < 1$. {For more on *Fractional Derivative*, see author's *Research Literature on Fractional Calculus in the References*}

The reason, why we are *Resorting* to the use of *Fractional Derivative* for *Slating* the *Energy Term*, is because, sometimes, it is possible that the *Obscureness of Loading Function Aspect* can possibly make our aforementioned *Conditions Un-Enforceable*, however this situation can easily be *Overcome* by *Resorting* to the use of *Fractional Derivative* for *Slating* the *Energy Term* helps us to finely make our *Problem Solvable*.

New Concept 6

The above two *Conditions* can be used *Constructively* for *Re-Designing* the *Building For Possible New LoadingFunction* with respect to *Allowable Possible Loading Function* using the advocated '*Lateral Load Increment Scheme Quantization For Use In Push Over Analysis Scheme Generally Used In Multi-Storeyed Structural Analysis*' as useful *Constraints*.

New Concept 7

Condition 3:

$$P(sl) = P_0 + n\Delta P$$

$$P(sl) = P_0 + [M]n \left(\frac{1}{T} \right) \int_0^T \left\{ \frac{d^2 \{X_0 \sin(\omega t + \phi)\}}{dt^2} \right\} dt$$

where *sl* stands for *Storey Level*

P_0 = *Average Amplitude of the Sinusoidal Earth Quake Simulating Load*

T = *Average Time Period of the Sinusoidal Earth Quake Simulating Load*

$n = 0, 1, 2, \dots, \text{Max}(sl)$

ω = *Average Angular Frequency of the Sinusoidal Earth Quake Simulating Load*

ΔP = *Average Quantized Minimum Increment to the Sinusoidal Earth Quake Simulating Load*

ϕ is the *Arbitrary Phase*

$[M]$ is the *Mass (Matrix)*

m is a *Positive Integer* and α is a *Constant* such that $0 < \alpha < 1$.

New Concept 8

Condition 3:

$$P(sl) = P_0 + n\Delta P$$

$$P(sl) = P_0 + [M]n \left(\frac{1}{T} \right) \int_0^T \left\{ \frac{d^{m+\alpha} \{X_0 \sin(\omega t + \phi)\}}{dt^\alpha} \right\} dt$$

where *sl* stands for *Storey Level*

P_0 = *Average Amplitude of the Sinusoidal Earth Quake Simulating Load*

T = *Average Time Period of the Sinusoidal Earth Quake Simulating Load*

$n = 0, 1, 2, \dots, \text{Max}(sl)$

ω = *Average Angular Frequency of the Sinusoidal Earth Quake Simulating Load*

ΔP = *Average Quantized Minimum Increment to the Sinusoidal Earth Quake Simulating Load*

ϕ is the *Arbitrary Phase*

$[M]$ is the *Mass (Matrix)*

m is a *Positive Integer* and α is a *Constant* such that $0 < \alpha < 1$.

New Concept 9

We choose the *Lower Value of Condition 1 (New Concept 1) and Condition 3 (New Concept 7) for our Final Load Quantization Scheme Design.*

Also, similarly, for the *Obscure Loading Function Condition*

We choose the *Lower Value of (New Concept 1) and (New Concept 8) for our Final Load Quantization Scheme Design.*

Conclusion

One can note that the afore-detailed *Load Quantization Scheme* will enable one to do *Optimal Re-Designing Of Structures For Acceptable Levels Of New Loading Function.*

Moral

Every Hand Has Its Own Glove.

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