Effects Of Near Fault Ground Motions On Frame Structures

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Effects of near-fault and far-fault ground motions on nonlinear dynamic response and seismic damage of concrete gravity dams 1. Introduction. Dams are important lifeline engineering which have contributed to the development of civilization for a... 2. Characteristics of near-fault ground motions. It ...

Effects of near-fault and far-fault ground motions on ...

Ground motions close to a fault can be significantly influenced by directivity effects. When the rupture and slip direction relative to a site coincide, and a significant portion of the fault ruptures towards the site, the ground motion can exhibit the effects of forward-directivity.

Effects of near-fault ground motions and equivalent pulses ...
Near-fault ground motion includes the characteristics of forward directivity and fling step. In addition to ground motion, the aspect ratio of the pier, as a representative factor of a structural system, influences the seismic behavior of bridges. Thus, this study assessed the seismic response of bridges with various aspect ratios under the near-fault and far-fault ground motion conditions. Nonlinear static analysis was first performed to evaluate the seismic capacity of the

pier.

Special Issue "Effects of Near-Fault Ground Motions on ...
The latter is described with idealized pulses and near-fault seismic records strongly influenced by forward-directivity or fling-step effects (from Northridge, Kobe, Kocaeli, Chi-Chi, Aegion). In addition to the well known dependence of the resulting block slippage on variables such as the peak base velocity, the peak base acceleration, and the critical acceleration ratio, our study has consistently and repeatedly revealed a profound sensitivity of both maximum and residual slippage: (1) on ...

Effects of Near-Fault Ground Shaking on Sliding Systems ...
Near-fault ground motions have caused much damage in the

vicinity of seismic sources during recent earthquakes. These ground motions come in large varieties and impose high demands on structures compared to “ordinary” ground motions. Recordings suggest that near-fault ground motions are characterized by a large high-energy pulse.

Effects of Near-Fault Ground Motions on Frame Structures ...

Conclusions 1) The long-period pulse has a significant effect on the tunnel, which makes the near-fault ground motions more damaging... 2) For a given pulse period, the pulse with larger amplitude brings more energy and leads to higher strains in rock and... 3) The period of the pulse can ...

Effect of near-fault ground motions with long-period ...

Effects of Near-Fault Ground Motion and Fault-Rupture on the Seismic Response of Reinforced Concrete Bridges

Effects of Near-Fault Ground Motion and Fault-Rupture on ...
Closure to "Effect of Near-Fault Vertical Ground Motions on Seismic Response of Highway Overcrossings" by Sashi K. Kunnath, Emrah Erduran, Y. H. Chai, and Mark Yashinsky Discussion of "Effect of Near-Fault Vertical Ground Motions on Seismic Response of Highway Overcrossings" by Sashi K. Kunnath, Emrah Erduran, Y. H. Chai, and Mark Yashinsky

Effect of Near-Fault Vertical Ground Motions on Seismic ...
Abstract. Near-fault ground motions exhibiting forward directivity effects are critical for seismic design because they impose very

large seismic demands on buildings due to their large-amplitude pulselike waveforms. The current challenge in seismic design codes is to recommend simple (easy-to-apply) yet proper rules to explain the near-fault forward directivity (NFFD) phenomenon for seismic demands.

Implementation of Near-Fault Forward Directivity Effects ...

On Topography: One of the main effects of the faults on topography is that they very often result in the development of distinct types of steep slopes which are aptly called fault scarps. Three types of fault associated scarps are often recognized- fault scarps, fault-line scarps and composite-fault scarps.

Faults: Meaning, Causes and Effects | Rocks | Geology step effect is the outcome of the tectonic permanent deformation of the earth in the proximity of the fault. It manifests itself in the record with a static residual displacement, oriented parallel to the fault strike with strike-slip earthquakes and perpendicular to the fault with purely dip-slip normal or thrust earthquakes Abraha-mson 2001 .

Effects of Near-Fault Ground Shaking on Sliding Systems

of severe, long-period pulses in near-fault ground motions may be a key factor in causing damages. Thus, it is necessary to investigate the effect of the long-period pulse on tunnels in order to interpret the observed damages. At present, there are two approaches to account for near-fault ground motions.

1558. Effect of near-fault ground motions with long-period ...

Characteristics of Near-Fault Ground Motions. • F d Di ti it Eff tForward Directivity Effect: – Fault rupture propagates toward a site with Vr??(and slip vector points toward the site). – Appears in the form of two-sided velocity pulse. – Observed in the strike-normal directionfor strike-slip and dip-slip faults.

NEAR-FAULT GROUND MOTIONS:FAULT GROUND MOTIONS ...

To investigate the effects of earthquake characteristics, two categories of strong ground motions are assumed through IDA method, i.e. near and far-field sets. To study the extent of modification for various heights of structures, 4 – 6 and 10 stories moment-resisting concrete frames are considered as case studies.

Effects of Near-fault Strong Ground Motions on ...

The analyses results revealed that the seismic performance of the CBFs without FVDs is very poor and sensitive to the velocity pulse period and the intensity of the NF ground motion due to brace?buckling effects. Installing FVDs into the CBFs significantly improved their seismic performance by maintaining their elastic behaviour.

Effect of near?fault ground motion and damper ...

near-fault phenomenon requires consideration in the design process for structures that are located in the near-fault region, which is usually assumed to extend about 10 to 15 km from the seismic source (1996 SEAOC Blue Book). Aside from directivity effects, near-fault ground motions are more severe than “ordinary”

EFFECTS OF NEAR-FAULT GROUND MOTIONS ON FRAME STRUCTURES

Effects of Near Fault and Far Fault Ground Motions on Nonlinear Dynamic Response and Seismic Improvement of Bridges. Mohammad Hajali, Abdolrahim Jalali, Ahmad Maleki. Abstract. In this study, the dynamic response of bridges to earthquakes near and far from the fault has been investigated. With respect to available data and showing the effects ...

Effects of Near Fault and Far Fault Ground Motions on ...

Ground motions with velocity pulses caused by near-fault directivity have received a great deal of attention from engineers and seismologists because of their potential to cause severe damage to structures.

Growth of major population centers near seismically active faults has significantly increased the probability of a large earthquake striking close to a big city in the near future. This, coupled with the fact that near-fault ground motions are known to impose larger demands on structures than ground motions far from the fault, makes the quantitative study of near-fault seismic hazard and risk important. Directivity effects cause pulse-like ground motions that are known to increase the seismic hazard and risk in near-fault region. These effects depend on the source-to-site geometry parameters, which are not included in most ground-motion models used for probabilistic seismic hazard assessment computation. In this study, we develop a comprehensive framework to study near-fault ground motions, and account for their effects in seismic hazard assessment. The proposed framework is designed to be modular, with separate models to predict the probability of observing a pulse at a site, the probability distribution of the period of the observed pulse, and a narrow band amplification of the spectral ordinate conditioned on the period of the pulse. The framework also allows deaggregation of hazard with respect to probability of observing the pulse at the site and the period of the pulse. This deaggregation information can be used to aid in ground-motion selection at near fault sites. A database of recorded ground motions with each record classified as pulse-like or non-pulse-like is needed for an empirical study of directivity effects. Early studies of directivity effects used manually classified pulses. Manual classification of ground motions as pulse-like is labor intensive, slow, and has the possibility to introduce subjectivity into the classifications. To address these problems we propose an efficient algorithm to classify multi-component ground motions as pulse-like and non-pulse-like. The proposed algorithm uses the continuous wavelet transform of two orthogonal components of the ground motion to identify pulses in arbitrary orientations. The proposed algorithm was used to classify each record in the NGA-West2 database, which created the largest set of pulse-like motions ever used to study directivity effects. The framework to include directivity effects in seismic hazard assessment, as proposed in this study, requires a ground-motion model that accounts for directivity effects in its prediction. Most of the current directivity models were developed as a correction for already existing ground-motion models, and were fitted using ground-motion model residuals. Directivity effects are dependent on magnitude, distance, and the spectral acceleration period. This interaction of directivity effects with magnitude and distance makes separation of distance and magnitude scaling from directivity effects challenging. To properly account for directivity effects in a ground-motion model they need to be fitted as a part of the original model and not as a correction. We propose a method to include the effects of directivity in a ground-motion model and also develop models to make unbiased prediction of ground-motion intensity, even when the directivity parameters are not available. Finally, following the approach used to model directivity effects, we developed a modular framework to characterize ground-motion directionality, which causes the ground-motion intensity to vary with orientation. Using the expanded NGA-West2 database we developed new models to predict the ratio between maximum and median ground-motion intensity over all orientations. Other models to predict distribution of orientations of the maximum intensity relative to the fault and the relationship between this orientation at different periods are also presented. The models developed in this dissertation allow us to compute response spectra that are expected to be observed in a single orientation (e.g., fault normal, orientation of maximum intensity at a period). It is expected that the proposed spectra can be a more realistic representation of single orientation ground motion compared to the median or maximum spectra over all orientations that is currently used.

A comprehensive parameterized stochastic model of near-fault ground motions in two orthogonal horizontal directions is developed. The proposed model uniquely combines several existing and new sub-models to represent major characteristics of recorded near-fault ground motions. These characteristics include near-fault effects of directivity and fling step; temporal and spectral non-stationarity; intensity, duration and frequency content characteristics; directionality of components, as well as the natural variability of motions for a given earthquake and site scenario. By fitting the model to a database of recorded near-fault ground motions with known earthquake source and site characteristics, empirical "observations" of the model parameters are obtained. These observations are used to develop predictive equations for the model parameters in terms of a small number of earthquake source and site characteristics. Functional forms for the predictive equations that are consistent with seismological theory are employed. A site-based simulation procedure that employs the proposed stochastic model and predictive equations is developed to generate synthetic near-fault ground motions at a site. The procedure is formulated in terms of information about the earthquake design scenario that is normally available to a design engineer. Not all near-fault ground motions contain a forward directivity pulse, even when the conditions for such a pulse are favorable. The proposed procedure produces pulselike and non-pulselike motions in the same proportions as they naturally occur among recorded near-fault ground motions for a given design scenario. The proposed models and simulation procedure are validated by several means. Synthetic ground motion time series with fitted parameter values are compared with the corresponding recorded motions. The proposed empirical predictive relations are compared to similar relations available in the literature. The overall simulation procedure is validated by comparing suites of synthetic ground motions generated for given earthquake source and site characteristics to the ground motion prediction equations (GMPEs) developed as part of phase 2 of the Next Generation Attenuation (NGA) program, (NGA-West2, see, e.g., Campbell and Bozorgnia, 2014). Comparison is made in terms of the estimated median level and variability of elastic ground motion response spectra. The use of synthetic motions in addition to or in place of recorded motions is desirable in performance-based earthquake engineering (PBEE) applications, particularly when recorded motions are scarce or when they are unavailable for a specified design scenario. As a demonstrative application, synthetic motions from the proposed simulation procedure are used to perform probabilistic seismic hazard analysis (PSHA) for a near-fault site. The analysis shows that the hazard at a near-fault site is underestimated when the ground motion model used does not properly account for the possibility of pulselike motions due to the directivity effect.

Rotational components of ground motions, torsion about the vertical axis and rocking about the horizontal axes, have caused significant damage to engineering structures and failures to bridges. Several analytical and experimental studies have been conducted to investigate the effect of these components on structures. Rotational components of ground motions cannot be measured directly and have been measured by rotational sensors only for explosions and by strong motion arrays only for far-field seismic events. Therefore, in the absence of near-fault records of differential ground motions, the characterization, parameterization, modeling and simulation of strain, rocking, and torsional ground motions in the vicinity of the fault, as well as the systematic investigation of their effects on the dynamic response of engineering structures becomes an important issue. In this study, the dynamic ground deformations generated by Mavroeidis and Papageorgiou (2010a) for two well-documented seismic events (i.e. 1979 Imperial Valley and 1999 Izmit earthquakes) based on the discrete wavenumber representation method (Bouchon and Aki, 1977; Bouchon, 1979a) are utilized to obtain torsional and rocking ground motions and their associated distributions on the gridded region in the vicinity of each earthquake. These synthetic ground deformations are used in this study to investigate the effect of the biaxial action of recorded translational ground motions and synthetic torsional ground motions on the response of symmetric and asymmetric structures. In the current seismic deign codes and standards, this torsional ground motion accounts by the shifting of the center of mass to produce the desired results. In order to investigate the effects of torsional motions on the structural responses, a software has been developed to study the linear and nonlinear response of buildings under biaxial and torsional seismic ground excitation. The program is able to perform nonlinear time history analysis based on the force- and displacement-based formulation methods developed by Spacone (1992). The biaxial and uniaxial Smooth Hysteresis Models developed Simeonov et al. (2000) are employed to model the hysteresis behavior of elements in the context of the moment-curvature relationship. The uniaxial and biaxial smooth hysteresis behaviors of the material, similar to the widely used Bouc-Wen model are employed in this research. Various numerical approaches such as the implicit Runge-Kutta, Newton-Raphson and Newmark methods are used to solve the differential equations that govern the dynamic response of the system. Finally, parametric linear and nonlinear analyses are performed for a series of symmetric and asymmetric single-story buildings to investigate the influence of the natural and accidental torsional eccentricity on the response of structures. The structural models are subjected to bidirectional recorded translational motions and synthetic low-frequency angular accelerations from the 1979 Imperial Valley and 1999 Izmit earthquakes. In order to examine the response of structures subjected to synthetic torsional motions containing high-frequency components, the bidirectional translational records from the 1986 Taiwan earthquake at FAT-1 station and the associated synthetic torsional motion, generated by the Surface Distribution Method, are also used to conduct parametric nonlinear analysis. The equivalent accidental eccentricity is developed through the mathematical formula for structures subjected to the combination of the bidirectional translational motions and torsional ground motions. The torsional amplifications developed in structures either by accidental torsion or by synthetic ground differential deformations are not significant for the lower periods. The nonlinear behavior of the structure imposed by strength eccentricity is also explored, while the results are displayed in the biaxial Base Shear and Torque (BST) Surface, inferred for the possible collapse mechanisms regardless of the analysis results.

The specialty section Earthquake Engineering is one branch of Frontiers in Built Environment and welcomes critical and in-depth submissions on earthquake ground motions and their effects on buildings and infrastructures. Manuscripts should yield new insights and ultimately contribute to a safer and more reliable design of building structures and infrastructures. The scope includes the characterization of earthquake ground motions (e.g. near-fault, far-fault, short-period, long-period), their underlying properties, their intrinsic relationship with structural responses, and the true behaviors of building structures and infrastructures under risky and uncertain ground motions. More specific topics include recorded ground motions, generated ground motions, response spectra, stochastic modeling of ground motion, critical excitation, geotechnical aspects, soil mechanics, soil liquefaction, soil-structure interactions, pile foundations, earthquake input energy, structural control, passive control, active control, base-isolation, steel structures, reinforced concrete structures, wood structures, building retrofit, structural optimization, uncertainty analysis, robustness analysis, and redundancy analysis. This eBook includes four original research papers, in addition to the Specialty Grand Challenge article, on the critical earthquake response of elastic-plastic structures under near-fault or long-duration ground motions which were published in the specialty section Earthquake Engineering. In the early stage of dynamic nonlinear response analysis of structures around 1960s, a simple hysteretic structural model and a simple sinusoidal earthquake ground motion input were dealt with together with random inputs. The steady-state response was tackled by an equivalent linearization method developed by Caughey, Iwan and others. In fact, the resonance plays a key role in the earthquake-resistant design and it has a strong effect even in case of near-fault ground motions. In order to draw the steady-state response curve and investigate the resonant property, two kinds of repetition have to be introduced. One is a cycle, for one forced input frequency, of the initial guess of the steady-state response amplitude, the construction of the equivalent linear model, the analysis of the steady-state response amplitude using the equivalent linear model and the update of the equivalent linear model based on the computed steady-state response amplitude. The other is the sweeping over a range of forced input frequencies. This process is quite tedious. Four original research papers included in this eBook propose a new approach to overcome this difficulty. Kojima and Takewaki demonstrated that the elastic-plastic response as continuation of free-vibrations under impulse input can be derived in a closed form by a sophisticated energy approach without solving directly the equations of motion as differential equations. While, as pointed out above, the approach based on the equivalent linearization method requires the repetition of application of the linearized equations, the method by Kojima and Takewaki does not need any repetition. The double impulse, triple impulse and multiple impulses enable us to describe directly the critical timing of impulses (resonant frequency) which is not easy for the sinusoidal and other inputs without a repetitive procedure. It is important to note that, while most of the previous methods employ the equivalent linearization of the structural model with the input unchanged, the method treated in this eBook transforms the input into a series of impulses with the structural model unchanged. This characteristic guarantees high accuracy and reliability even in the large plastic deformation range. The approach presented in this eBook is an epoch-making accomplishment to open the door for simpler and deeper understanding of structural reliability of built environments in the elastic-plastic range