Soil Dynamics and Earthquake Engineering 31 (2011) 1724–1731

Contents lists available at ScienceDirect

Soil Dynamics and Earthquake Engineering

journal homepage: www.elsevier.com/locate/soildyn

Structure–soil–structure interaction: Literature review

Lou Menglin[a], Wang Huaifeng[a,*], Chen Xi[b], Zhai Yongmei[c]

[a] State Key Laboratory for Disaster Reduction in Civil Engineering, TongJi University, Shanghai 200092, China
[b] Department of Civil Engineering, TongJi University, Shanghai 200092, China
[c] Shanghai Institute of Disaster Prevention and Relief, TongJi University, Shanghai 200092, China

ARTICLE INFO

Article history:
Received 27 February 2011
Received in revised form
26 April 2011
Accepted 24 July 2011
Available online 11 August 2011

ABSTRACT

The concept of structure–soil–structure dynamic interaction was introduced, and the research methods were discussed. Based on several documents, a systematic summary of the history and status of the structure–soil–structure dynamic interaction research that considers adjacent structures was proposed as a reference for researchers. This study is in the initial stage, given its complexity and excessive simplification of the model for soil and structures, and should be carried forward for its significance. An attempt was made to summarize the common major computer programs in this area of study. Furthermore, the advantages, disadvantages, and applicability of such programs were discussed. The existing problems and the future research trend in this field were also examined.

1. Introduction

With the rapid development of society and economy and the global explosion of population, the construction of the cluster of high buildings is on the rise gradually due to the lack of space in cities. Thus, numerous high-rise buildings are emerging in cities, as shown in Fig. 1.

As in the metropolitans, such as Kobe in Japan, the building structures are built closely to each other over the soft soil deposit. Under such circumstances, the dynamic interaction among building structures must occur through the radiation energy emitted from a vibrating structure to other structures. Hence, the dynamical characteristics as well as the earthquake response characteristics of a structure are unable to be independent of those of the adjacent structures. In accordance with the parameterized study of Jiang and Yan [1] in 1998, those two buildings with distance less than 2.5 times of width of foundation are interacting with each other. And when the distance was less than one time of width of foundation, the response of structures may increase or decrease tens of percent. Thus, the interactions between neighboring buildings have to be investigated.

Soil–structure interaction, one of the most major subjects in the domain of earthquake engineering, has been paid comprehensive attention by international in recent decades. Soil–structure interaction phenomena concern the wave propagation in a coupled system: buildings erected on the soil surface. Its origins trace back to the late 19th century, evolved and matured gradually in the ensuing decades and during the first half of the 20th century, and progressed rapidly in the second half stimulated mainly by the needs of the nuclear power and offshore industries, by the debut of powerful computers and simulation tools such as finite elements, and by the needs for improvements in seismic safety.

Investigations of soil–structure interaction have shown that the dynamic response of a structure supported on flexible soil may differ significantly from the response of the same structure when supported on a rigid base [2–4]. One of the important reasons for this difference is that part of the vibrational energy of the flexibly mounted structure is dissipated by radiation of stress waves in the supporting medium and by hysteretic action in the medium itself. Analytical methods to calculate the dynamic soil–structure interaction effects are well established [5]. When there is more than one structure in the medium, because of interference of the structural responses through the soil, the soil–structure problem evolves to a cross-interaction problem between multiple structures.

Structure–soil–structure interaction (SSSI), put forward in recent decades, means the dynamic interaction problem among the multi-structure system through soil-ground. To the writer's knowledge, it is Luco and Contesse [6] in 1973 to come up first with the Structure–soil–structure interaction designation for this area of study. Its additional name is dynamic cross interaction (DCI), derived from several publications about nuclear power plant (NPP). And owing to those previous studies were just confined to consider foundations placed on soil without superstructures, SSSI was also call foundation–soil–foundation interaction (FSFI). SSSI studies the influence of the presence of adjacent structures to the others further through the interaction effect of

* Corresponding author.
E-mail address: forgotten.wang@yahoo.com.cn (Wang).

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doi:10.1016/j.soildyn.2011.07.008