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The anti-plane surface motion of valleys in coastal cities induced by earthquakes

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INTRODUCTION & AIMS

INTRODUCTION

Valleys are a common topographical feature of coastal cities, and some coastal cities are located within the Circum-Pacific and Eurasian earthquake belts. In addition, anti-plane surface motion can damage engineering structures and threaten human safety during an earthquake. Figure 1 and 2 separately show the ocean park and cable car, and the beautiful coast and buildings in coastal cities.

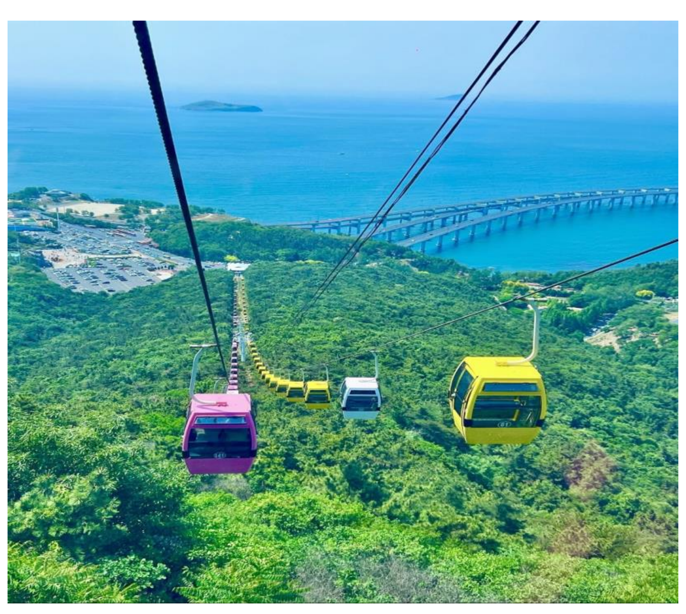

Figure 1 The ocean park and cable car.

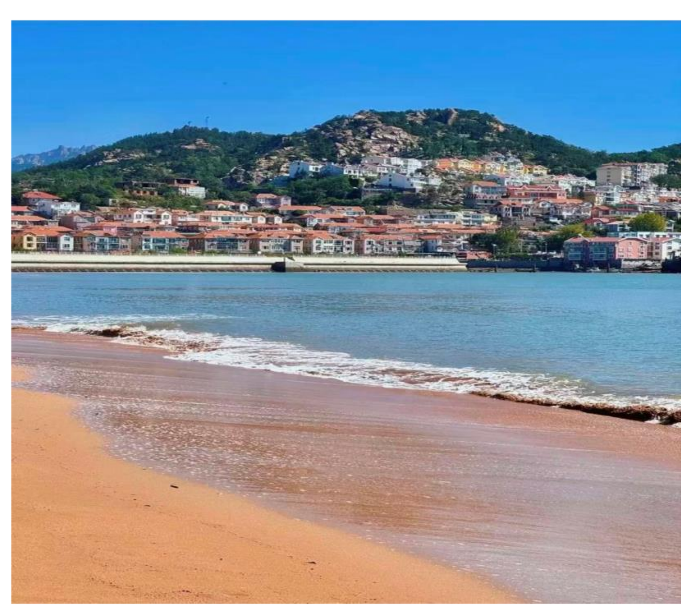

Figure 2 The beautiful coast and buildings in coastal cities.

AIMS

A novel and significant framework is therefore proposed for computing anti-plane surface motion of valleys induced by earthquakes in order to enhance the resilience of coastal cities against earthquakes.

THE METHOD

1. A valley under earthquake excitation is simplified as an arc-shaped mathematical model for incident SH waves. Figure 3 shows the arc-shaped valley mathematical model.

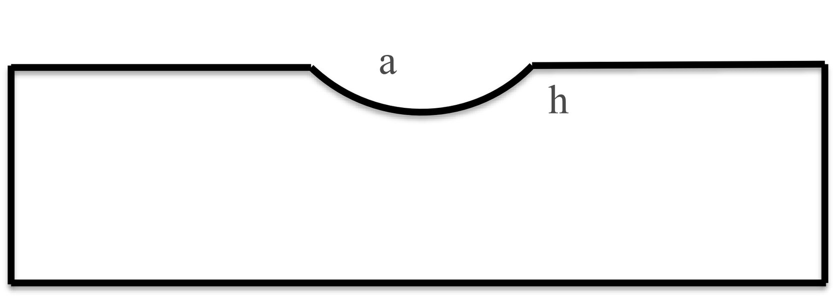

Figure 3 The arc-shaped valley mathematical model. a represents the half width, and h represents the height.

2. The elastic wave motion equation is generated without factors of time.
3. Based on the variable-separation method, wave functions satisfying the equation are derived.
4. Wave functions meeting boundary conditions can be obtained using zero-stress boundary conditions of the mathematical model.
5. Complex displacement of surface motion is obtained through wave functions' linear calculations.
6. Amplitudes and phases of surface motion are determined using complex-number calculative formulae.

Figure 4 shows the basis framework for computing anti-plane surface motion.

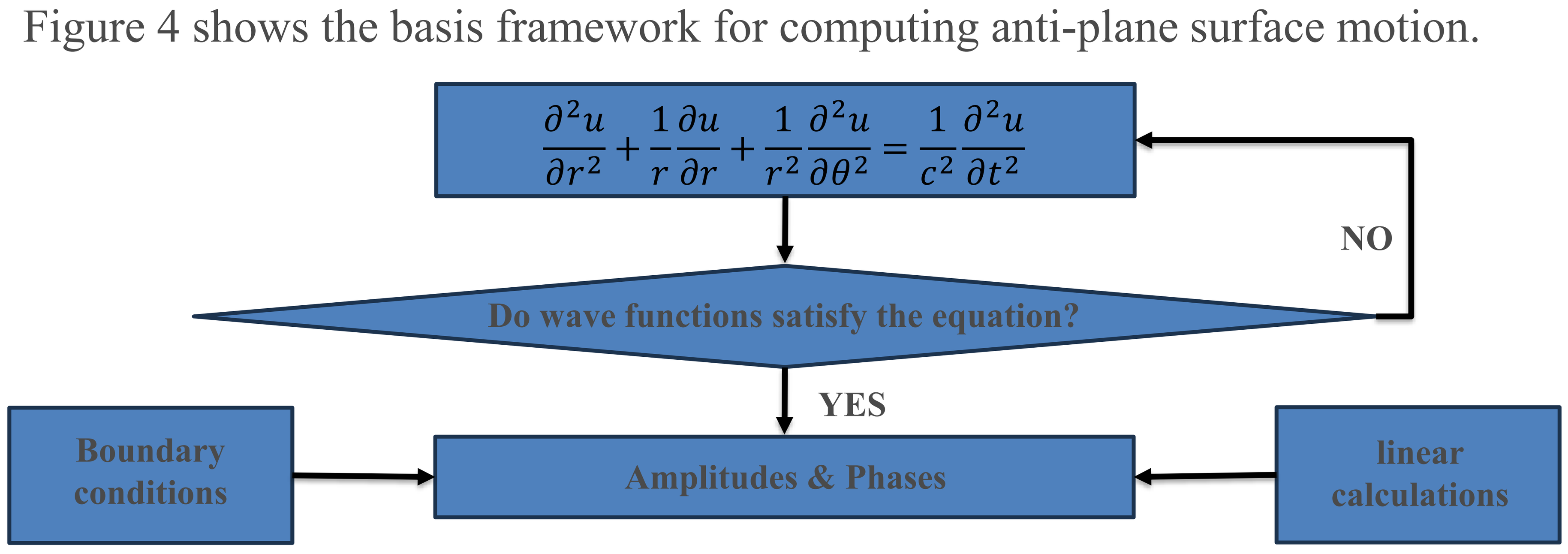

Figure 4 The basis framework for computing anti-plane surface motion of arc-shaped valleys induced by earthquakes.

RESULTS & DISCUSSION

As a result, anti-plane surface motion of valleys can be computed by the newly presented framework. In the next study, angles ranging from 30 to 60 degrees and frequencies ranging from 0 to 10 HZ will be evaluated. There employs the arc-shaped valley model with a=500m, h=250m. The frequency of incident SH waves is 5 HZ. Figure 5 shows amplitudes versus the dimensionless distances for incident SH waves angles equivalent to 30 and 60 degrees. Figure 6 shows phases versus the dimensionless distances for incident SH waves angles equivalent to 30 and 60 degrees.

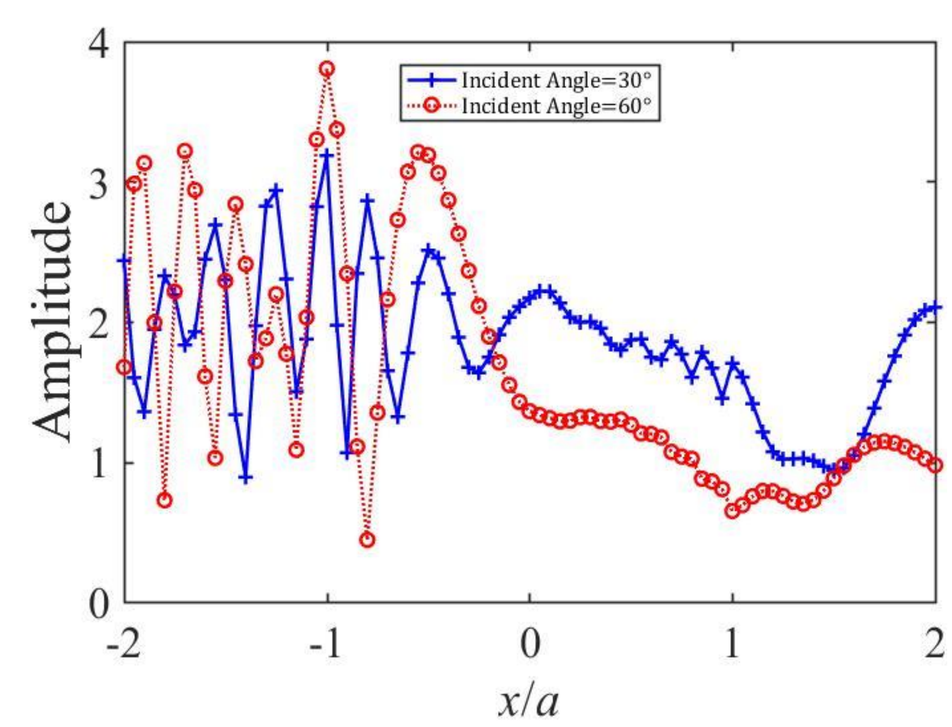

Figure 5 The amplitudes versus the dimensionless distances.

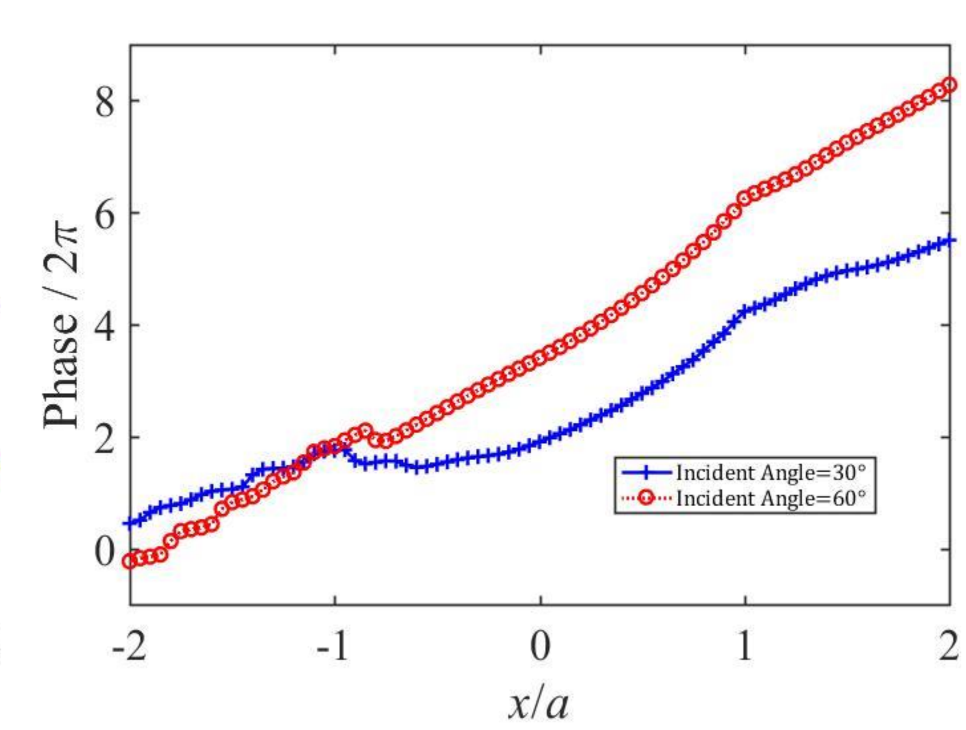

Figure 6 The phases versus the dimensionless distances.

Amplitudes and phases of surface motion are given as functions of various angles and frequencies of incident SH waves. It is found that amplitudes and phases of surface motion of valleys usually vary with angle and frequency.

CONCLUSIONS

a. For oblique incidence, displacement amplitudes on a surface facing waves are often higher than those on a shadow surface.

b. In addition, the number of oscillations of amplitudes on a surface facing waves is often greater than that on a shadow surface. However, regular patterns of phases are nearly consistent.

c. These findings suggest that important buildings, such as cable cars, bridges and railways, can be built better on shadow surfaces of valleys in coastal cities.

FUTURE WORK / REFERENCES

FUTURE WORK

1. Improve and complete this novel and significant framework proposed.
2. Focus on studying the influence of angles and frequencies of incident SH waves to anti-plane surface motion.

REFERENCES

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