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Seismic response study on a multi-span cable-stayed bridge scale model under multi-support excitations. Part II: numerical analysis

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Zhejiang University, China

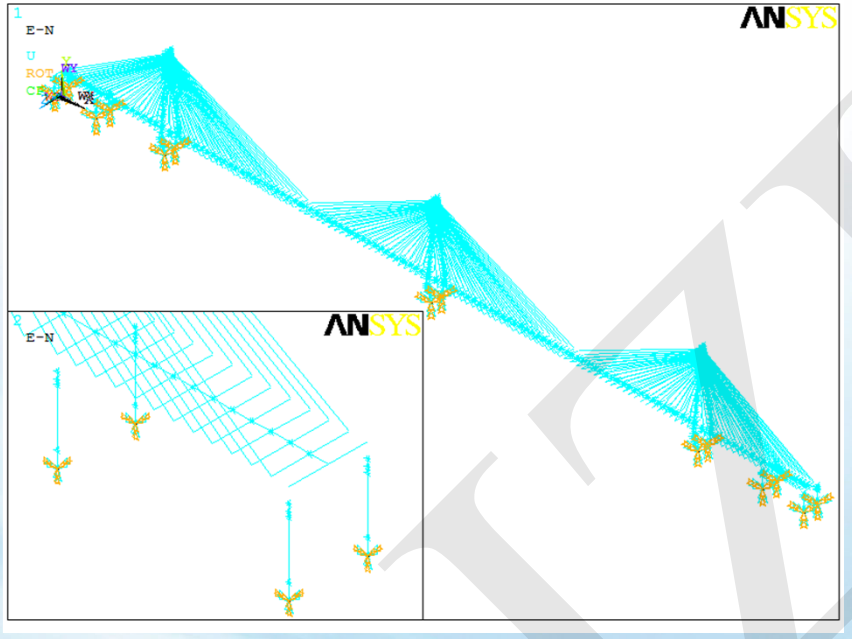
Scaled multi-span cable-stayed bridges

Prototype of a three-tower cable-stayed bridge

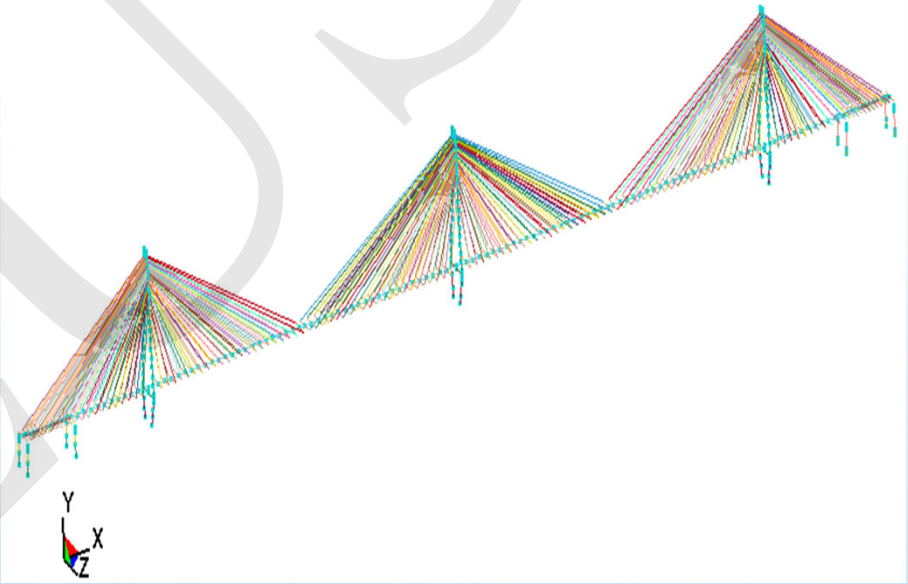
Scale model of the whole bridge with the ratio of 1:100

Finite element modeling of the scale model

1. Single girder model



2. Explicit dynamic model

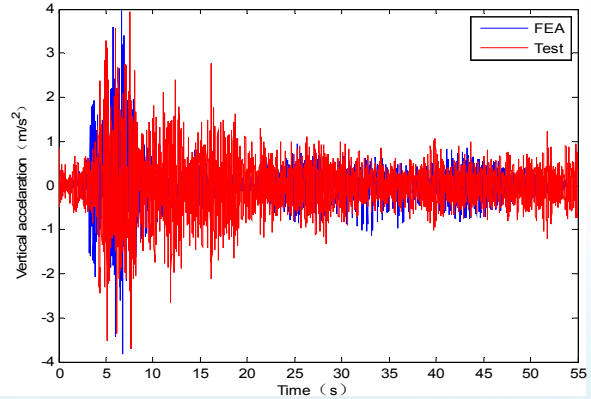


→ **Seismic response analysis**

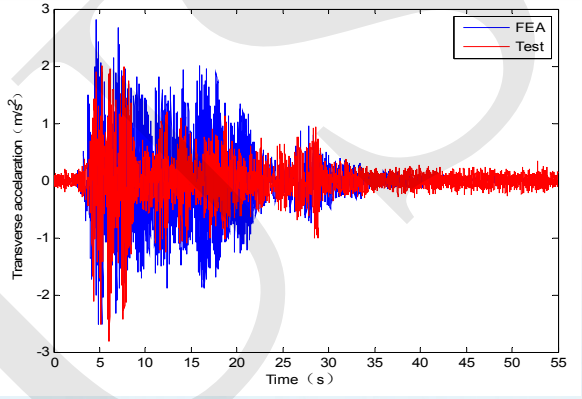
→ **Collapse and failure analysis**

Seismic response analysis of the single girder model

Uniform excitations under four seismic excitations

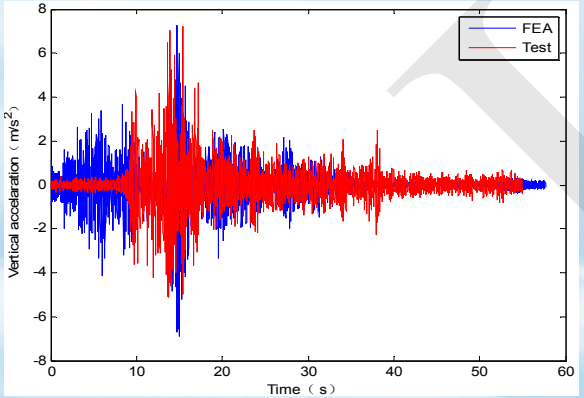


Vertical responses comparison of main girder

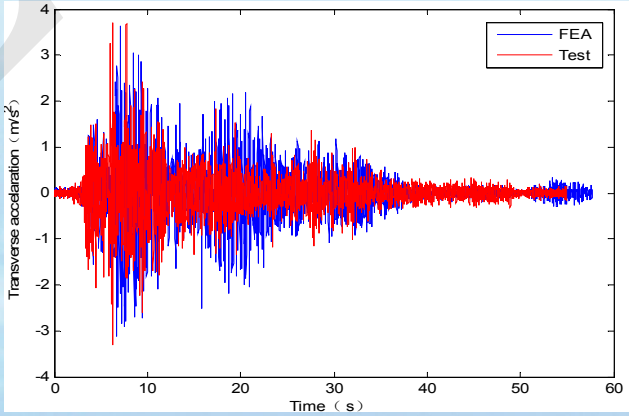


Transverse responses comparison of main girder

Non-uniform excitations by traveling wave effect



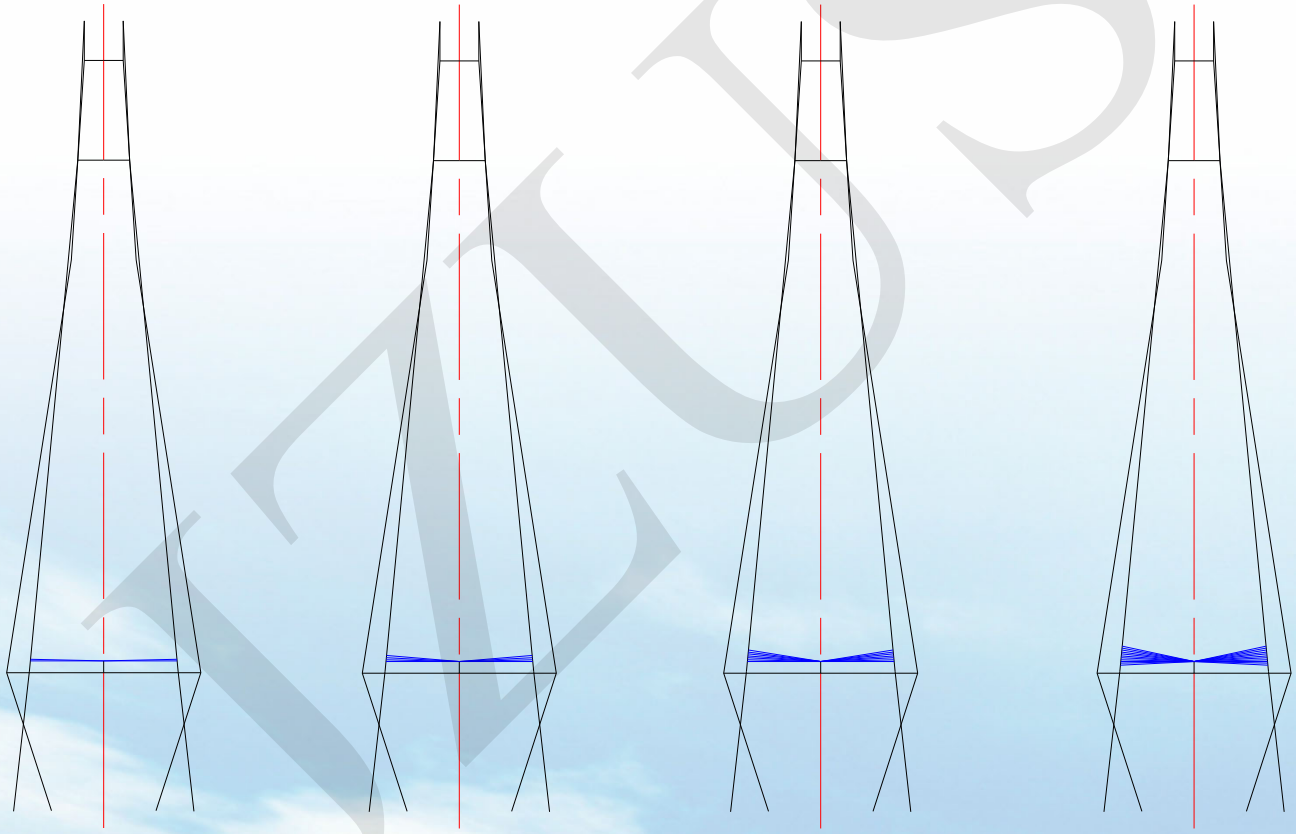
Vertical responses comparison of main girder



Transverse responses comparison of main girder

Collapse and failure analysis of the explicit dynamic model

1. Failure mode of the scale model under the El Centro (EC) wave



Time: 0s

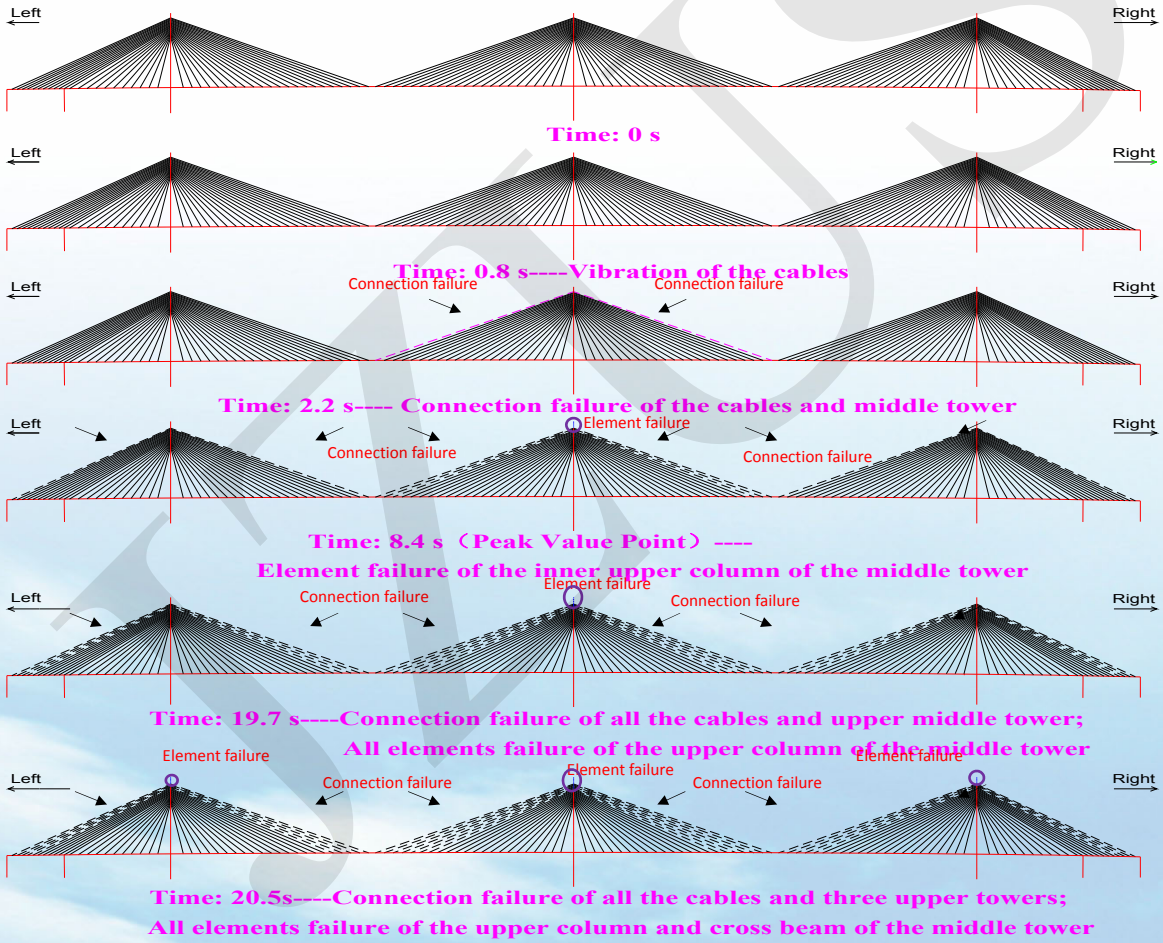
Time: 2.2s(Peak Value Point)
--- Slight vibration of the cables

Time: 20.5s---Failure of the bearing at the middle tower

Time: 53.7s----Torsional vibration of the cables

Collapse and failure analysis of the explicit dynamic model

2. Failure mode of the scale model under the Jiangxin (JX) wave



Conclusions

▽ The acceleration responses results of the numerical simulation are consistent with those from the shaking table tests, which indicates that the established single girder model can predict the seismic response of the scale bridge model under uniform excitations and non-uniform excitations.

▽ The constructed explicit dynamic model can predict the failure modes and collapse process of the scaled bridge model by using the explicit dynamic model.