

Determining the risk level of the structure against the phenomenon of earthquake intensification with the FMEA method

The safety level of a structure depends on the two factors of structure resistance R and the amount of load on the structure S .

Capacity=Structural resistance= R

Demand = load entering the structure = S

An exception should be made in the case that the earthquake load on the structure is such that the phenomenon of amplification occurs. Using the method of failure modes and analysis of its factors (FMEA), the phenomenon of resonance in the structure can be analyzed.

MATLAB program to determine the values of mass matrix and stiffness matrix in three degrees of freedom mode using single objective genetic algorithm method by taking the value of earthquake frequency at the beginning of the program so that the frequency of the structure is equal to the frequency of the incoming load which is the earthquake. Some of its implementations, the results of which are different values of mass and stiffness matrices, while the frequency of the load and the structure are equal, are given below.

Each of these modes is a failure mode that must be analyzed using the FMEA method.

First run:

Enter load frequency= 5

Iter = 1 BEST = 0.17

Iter = 2 BEST = 0.17

Iter = 3 BEST = 0.09

Iter = 4 BEST = 0.04

Iter = 5 BEST = 0.01

Iter = 6 BEST = 0.01

Iter = 7 BEST = 0.01

Iter = 8 BEST = 0.01

Iter = 9 BEST = 0

Best par = 9.2415 4.9893 5.8516 1.4164 0.48615 9.4986

Best fitness = 0

Time = 0.1334

M =

1.4164	0	0
0	0.4861	0
0	0	9.4986

K =

14.2308	-4.9893	0
-4.9893	10.8409	-5.8516
0	-5.8516	5.8516

omega =

5.0000

2.7800

0.4600

Second run:

Enter load frequency= 5

Iter = 1 BEST = 0.05

Iter = 2 BEST = 0.03

Iter = 3 BEST = 0

Best par = 0.54188 1.6534 7.6279 1.4444 0.38663 8.5032

Best fitness = 0

Time = 0.031041

M =

1.4444 0 0

0 0.3866 0

0 0 8.5032

K =

2.1953 -1.6534 0

-1.6534 9.2813 -7.6279

0 -7.6279 7.6279

omega =

5.0000

1.2000

0.2000

Third run:

Enter load frequency= 5

Iter = 1 BEST = 0.07

Iter = 2 BEST = 0.04

Iter = 3 BEST = 0.04

Iter = 4 BEST = 0.02

Iter = 5 BEST = 0.01

Iter = 6 BEST = 0

Best par = 5.3439 9.0607 7.6169 8.6044 0.70091 6.0498

Best fitness = 0

Time = 0.047228

M =

8.6044	0	0
0	0.7009	0
0	0	6.0498

K =

14.4046	-9.0607	0
-9.0607	16.6777	-7.6169
0	-7.6169	7.6169

$\omega =$

5.0000

1.2300

0.5200