B.2 Beam Element Model of Storage Rack

Beam Element Model

Dynamic models of new and spent fuel storage rack share the same basic form. Only components of element (length, mass, moment of inertia, etc) are differently input according to dynamic characteristics of each. Typical shape of beam element model is shown at Figure B.4.
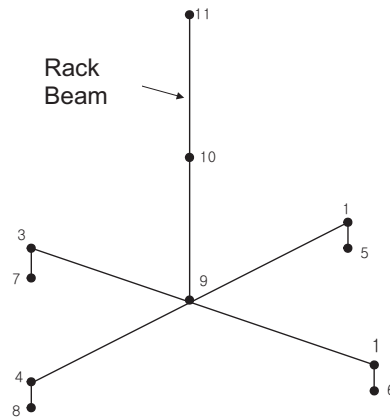

Figure B.4 Beam Element Model for Rack

Total eleven nodes were used in order to create above model and elements used are as below.

Linear elastic beam element was used to describe base plate, cells and pedestal. Base plate and pedestal have four nodes at each corner. Cells were composed of three node elements, including a node of center.
Lengths of base element and rack element were decided based on the outermost corner cell and height of rack respectively.
And structural mass element was used to describe mass of rack at three nodes.

Tuning of Dynamic Model

Beam model was developed in ways to have similar dynamic characteristics with full model and generated by repetitive change in moment of inertia (Iyy, Izz) for rack element so that square natural frequency of dynamic model in each direction is identical to that of full model.

Modal Analysis Result of Storage Rack

When comparing natural frequency of beam model with natural frequency of full model, beam model well reflecting the dynamic characteristics of full model has been developed. Primary dynamic characteristics of each model are summarized as follows.

1) New Fuel Storage Rack

Module Type	FEM Model	Total Mass(lbs)	Natural Frequency (Hz)	Remark
7 x 8	Full Model	84.26	22.88	
	Beam Model	84.28	22.87	

2) Spent Fuel Storage Rack

Region I :

Module Type	FEM Model	Total Mass(lbs)	Natural Frequency (Hz)	Remark
8 x 8	Full Model	53.41	41.61	
	Beam Model	53.93	41.34	
6 x 8	Full Model	41.48	34.34	
	Beam Model	41.48	34.45	

Region II :

Module Type	FEM Model	Total Mass(lbs)	Natural Frequency (Hz)	Remark
8 x 8	Full Model	31.10	38.26	
	Beam Model	32.54	38.38	
8 x 7	Full Model	28.13	36.07	
	Beam Model	28.80	36.35	