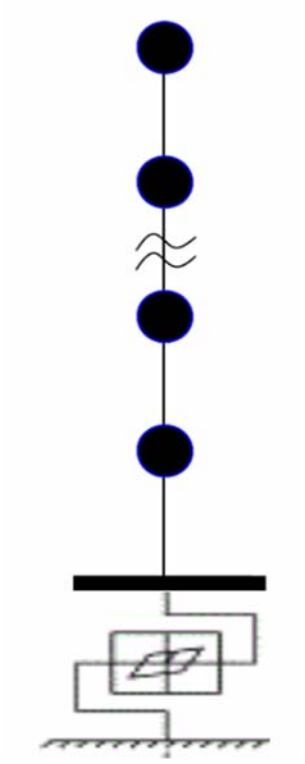
15-STORY MDOF BASE ISOLATED MODEL WITH ELASTIC STIFFNESS

15- Story MDOF (Multi-Degree of Freedom) base isolated model with elastic stiffness



Building Data		
$W_{(1st\ floor)}$ =	4500	KN
$W_{(1\ floor)}$ =	3000	KN
No. of floors (N) =	15	
$W_{(Total)}$ =	49500	KN
$T_F = 0.1N$	1.5	sec
β =	4	
$T_B = \beta \times T_F$ (>=2.5s)	6	sec
$K_{eff} = mx4\pi^2x(1/T_B)^2$	5533.41735	KN/m

K_{eff} = Effective stiffness W= Weight of floor

T_F=Fundamental period T_B= Isolation period

- Superstructure floors will be modeled as elastic shear springs whose elastic stiffness is calculated so that the first mode shape becomes a triangular shape using the following equation:

$$K_i = (1/2)\left(N(N+1) - i(i-1)\right) m_s \omega_s^2$$

Where: (Ki) is the stiffness of i-th story , m_s = mass of the i-th story

N= number of floors , $\omega_s = 2\pi/T_F$

W(KN)	3000
m_s(kN)	0.3058104
ω	4.19
ω^2	17.55

- Elastic Stiffness Values for superstructure floors equals:

N	K (KN/mm)	Assigned damper in Stera3D
15	80	D16
14	156	D15
13	225	D14
12	290	D13
11	349	D12
10	402	D11
9	451	D10
8	494	D9
7	531	D8
6	563	D7
5	590	D6
4	612	D5
3	628	D4
2	639	D3
1	644	D2

- Lateral force on super structure: -

Super Structure		
$Cs = 0.15/T_F$	**0.15**	
$Qs = Cs \times W_{(total)}$	5175.00	KN

- Lateral Force on sub-structure: -

Sub-Structure (Base isolation level)		
α=	**0.25**	
$Q_{hyst} = F_{y.} =$ **α x** Qs	1293.75	KN

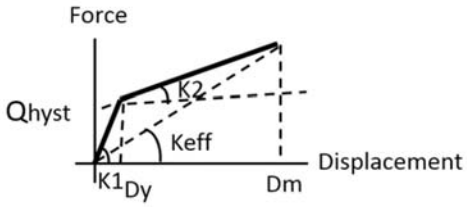
➢ To calculate Primary (K1) & secondary (K2) stiffness for LRB:

- Assume yielding displacement (D_y) = 10mm
- Assume Maximum displacement by isolator (D_m) = 400mm
- Calculate F @ maximum disp. (F_m) = (D_m–D_y) x K_{eff} = 2158 KN

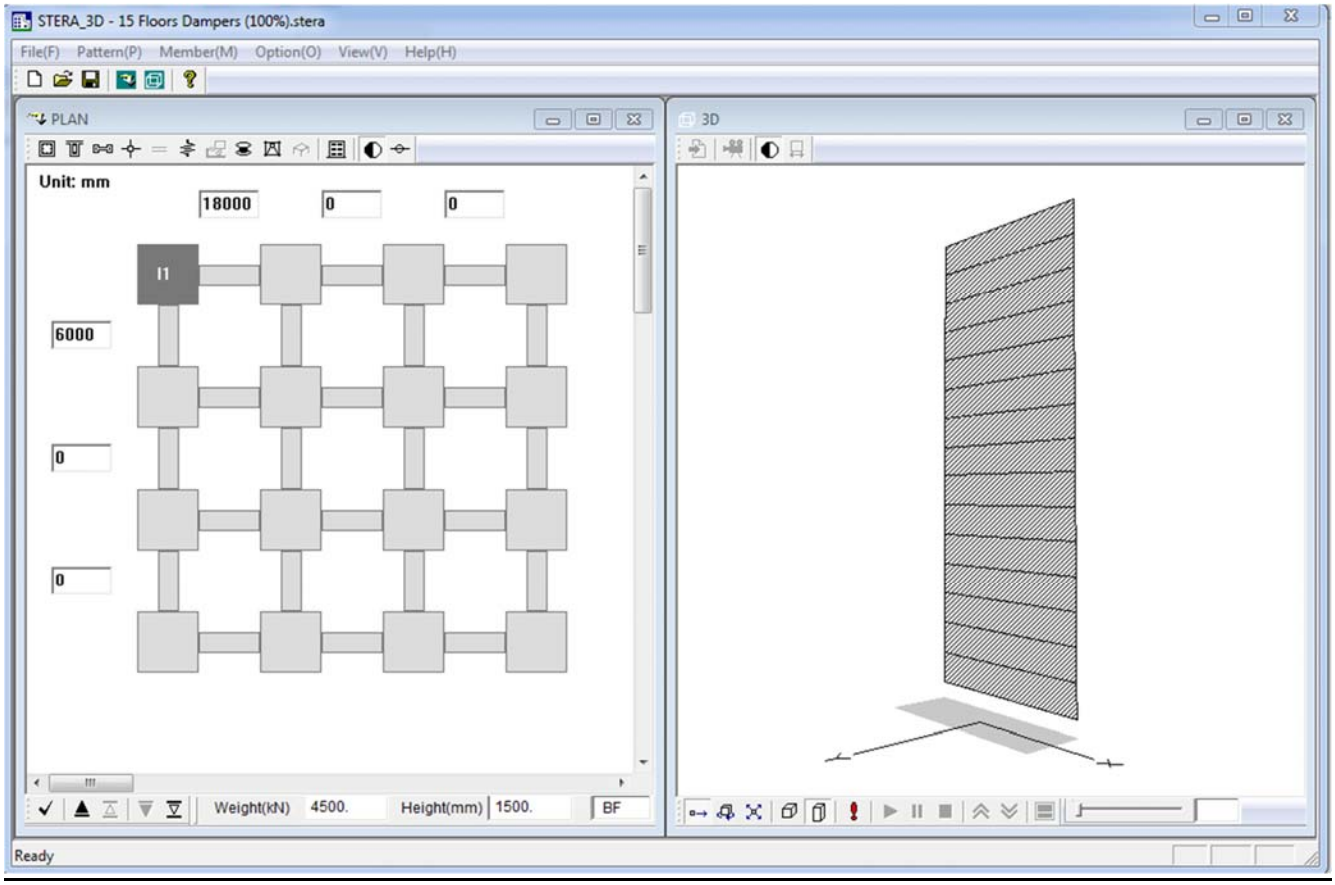
$K1 = Q_{hyst} / D_y$ = 99 KN/mm

$K2 = (F_m - Q_{hyst})/(D_m - D_y)$ = 3 KN/mm

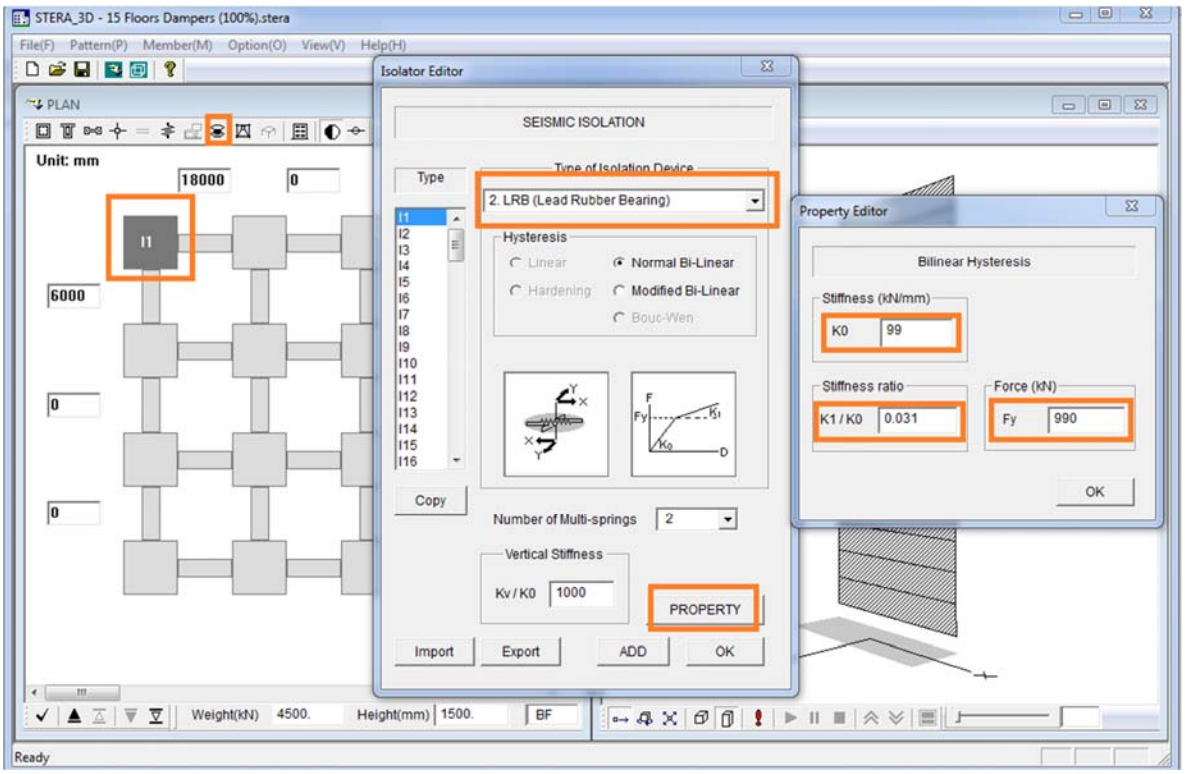
$K2 / K1$ = 0.031



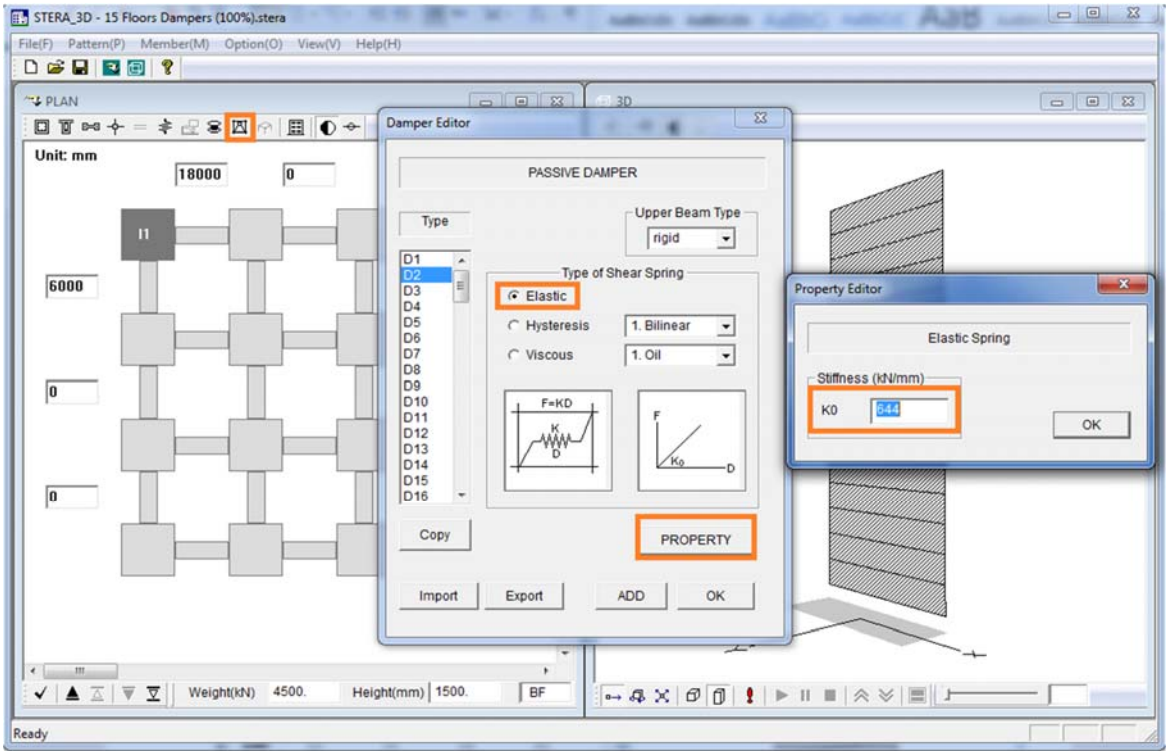
❖ <u>Modelling in Stera3D</u>



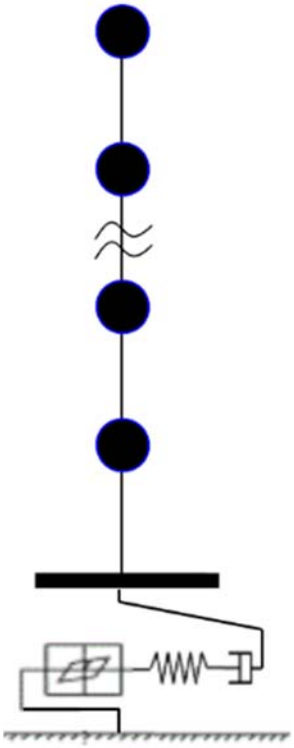
- Base isolation (LRB):



- Superstructure (Elastic Shear springs):-



15- Story MDOF (Multi-Degree of Freedom) base isolated model with oil damper.



Oil Damper		
ɣ =	0.40	
Vr =	320	mm/s
Q_{oil} = ɣ x Q_{hyst}	396	KN
C1 = Q_{oil} / V_r =	1.2375	
C2/C1 =	0.067