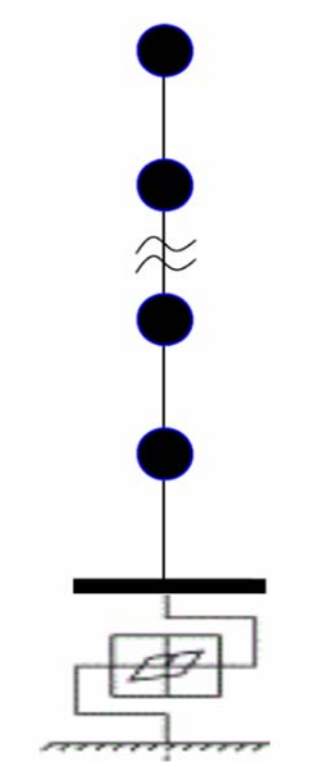
5-STORY MDOF BASE ISOLATED MODEL WITH ELASTIC STIFFNESS

5- Story LMM (Lumped Mass Model) base isolated model with elastic stiffness



Building Data		
$W_{(1st\ floor)}$ =	4500	KN
$W_{(upper\ floor)}$ =	3000	KN
No. of floors (N) =	5	
$W_{(Total)}$ =	19500	KN
$T_F = 0.1N$	0.5	sec
β =	4	
$T_B = \beta \times T_F$ (>=2.5s)	2.5	sec
$K_{eff} = m \times 4\pi^2 \times (1/T_B)^2$	12555.82701	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	12.57
ω^2	157.91

- Elastic Stiffness Values for superstructure floors:

N	K (KN/mm)	Assigned damper in Stera3D
5	241	D6
4	435	D5
3	579	D4
2	676	D3
1	724	D2

- Lateral force on super structure: -

Super Structure		
$Cs = 0.15/T_F$	**0.3**	
$Qs = Cs \times W_{(total)}$	5850.00	KN

- Lateral Force on sub-structure: -

Sub-Structure (Base isolation level)		
α=	**0.3**	
$Q_{hyst} = F_{y.} =$ **α x** Qs	1755	KN

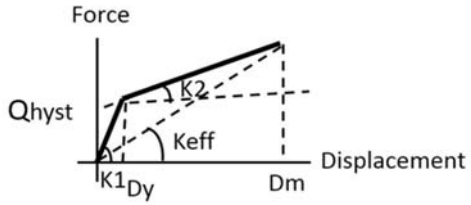
➢ To calculate Primary (K1) & secondary (K2) stiffness for LRB :

- 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} = 4986.775 KN

K1 = Q_{hyst} / D_y = 175.5 KN/mm

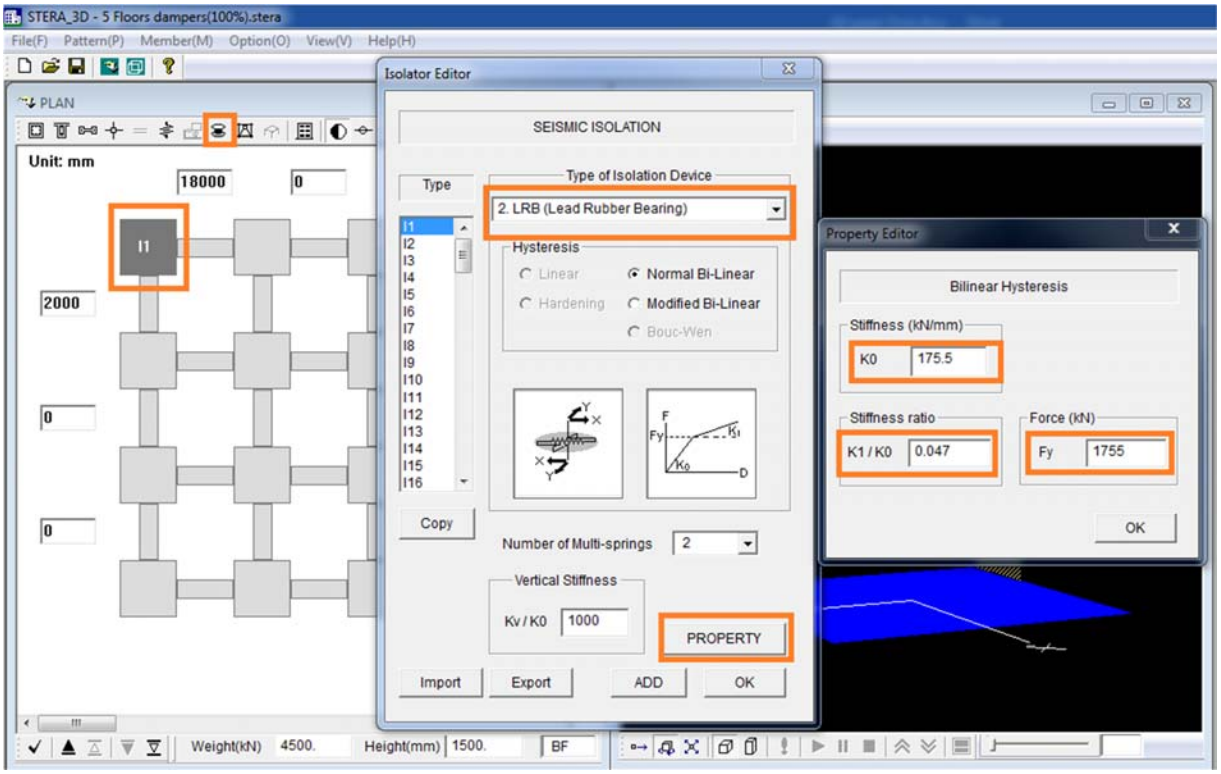
K2 = (F_m – Q_{hyst})/(D_m – D_y) = 8.055 KN/mm

K2 / K1 = 0.046

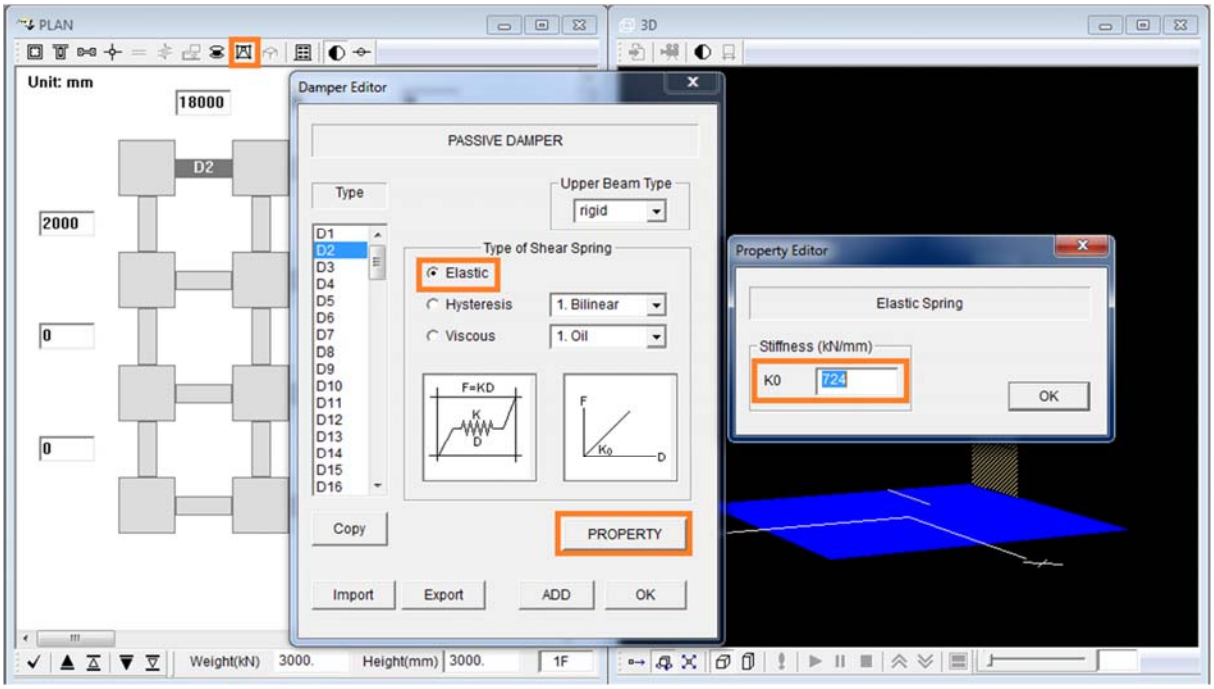


❖ Modelling in Stera3D

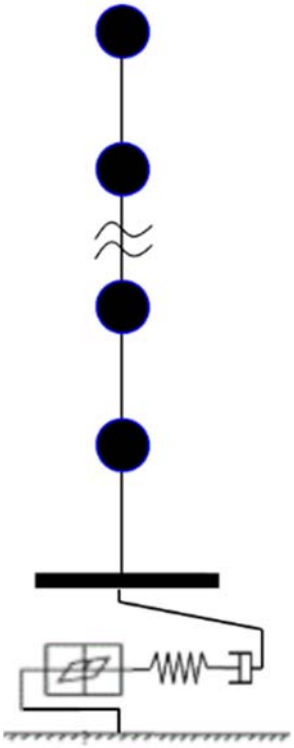
- Base isolation (LRB): -



- Superstructure (Elastic Shear springs):



5- 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}	702	KN
C1 = Q_{oil} / V_r =	2.19375	
C2/C1 =	0.067