Earthquake Isolation In Steel Structures With Base Isolators

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The Damping Factor In Earthquake Design

- Earthquake load acting on a structure, which plays a big role on the cost and design method, depends on many parameters
- To decrease the effects of possible earthquakes
- The base shear magnitude affecting on the structure is defined by both the internal forces on the structural system and total damping capacity

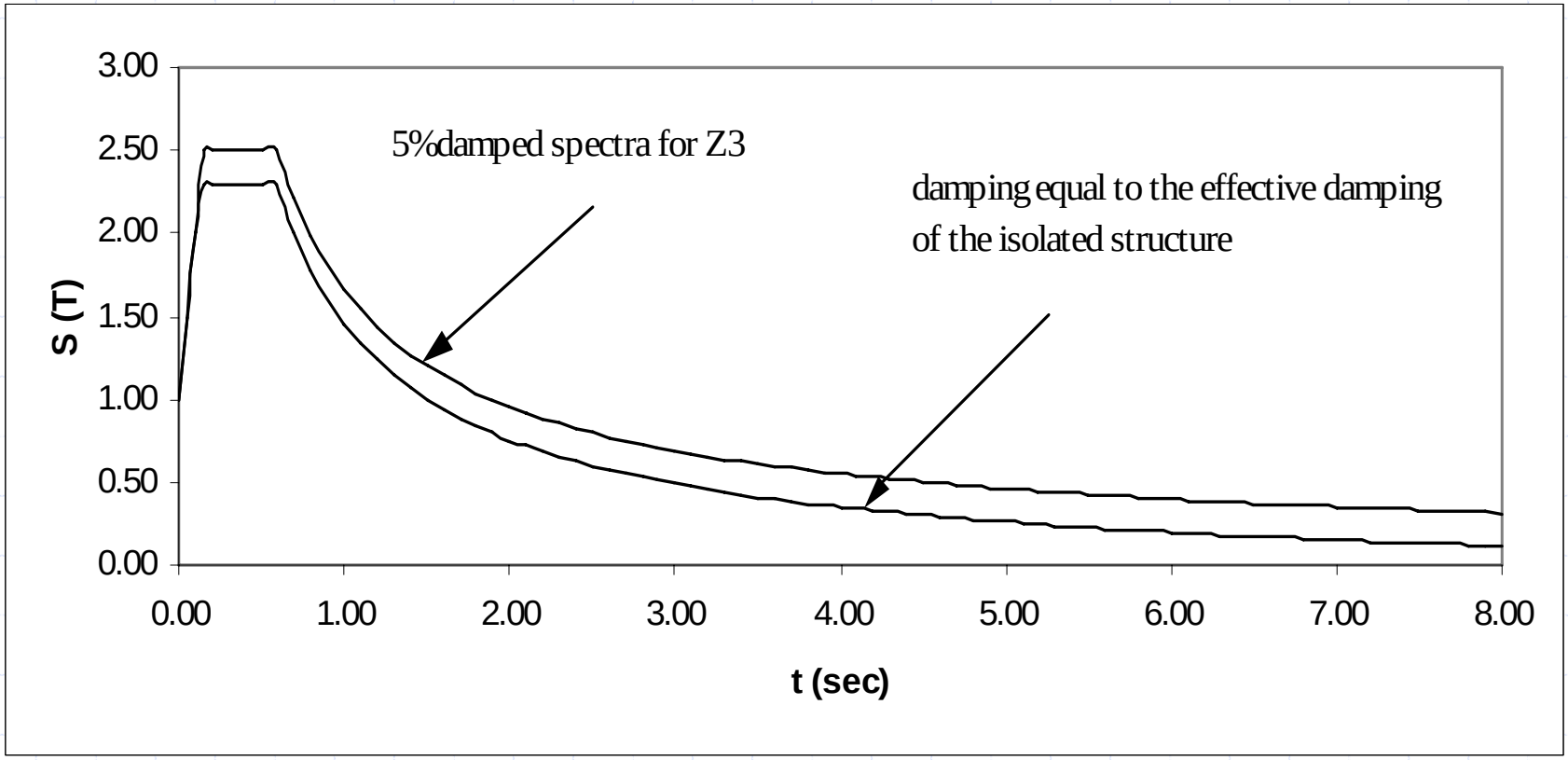
Base Isolators

- The elements to increase the damping ratio of a system
- Can be used for both new and existing structures
- Decrease the inertial forces acting on the structure and increase the damping capacity
- Affect the roof-foundation displacements, elastic base shear values and design forces

Method of Analysis

- For the first group of study an elastic response spectrum analysis is carried out using the 5% damped spectra of Turkish earthquake code for soil profile Z3.
- For the second group of study is used a composite spectra of total damping equal to the effective total damping ratio of the isolated structure
- The same steel profiles are used for non-isolated and isolated structures

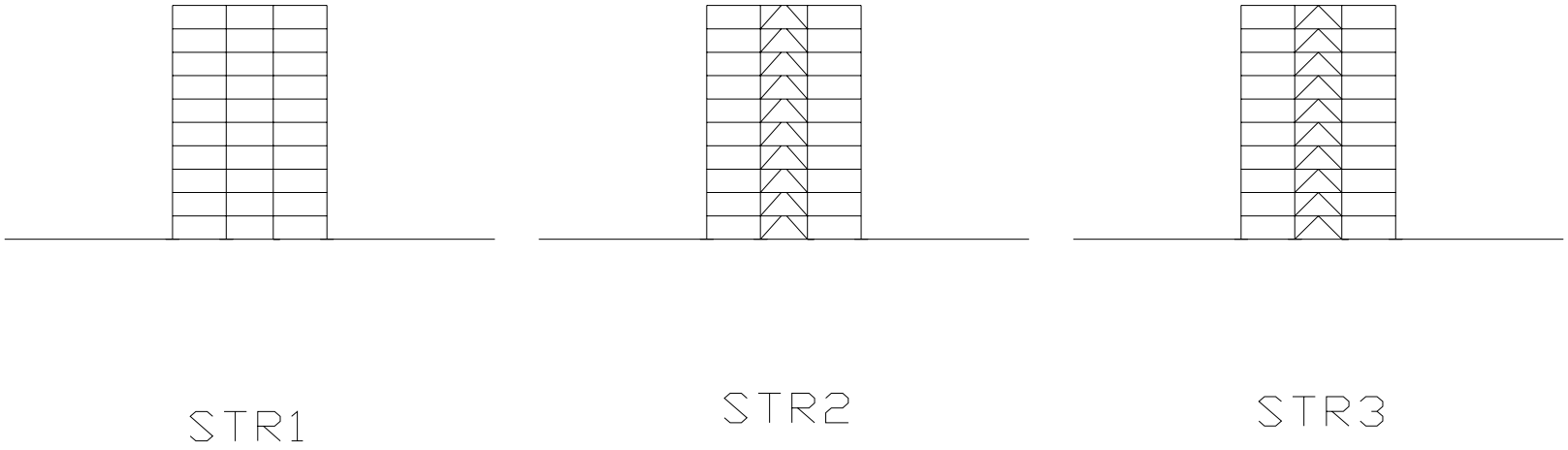
Figure 1 Composite spectra as defined in AASHTO specifications D1-A



Structural and Isolator Properties

- The analyses are based 3 types of structures with different lateral stiffness
- The frames analyzed in each group are a middle frame of a three bay, in plan symmetric structure
- Friction Pendulum System selected as the isolator
- The physical characteristics of the isolator are obtained from the manual of the product

Figure 3 Structural Properties



Analyses and Results

- To identify the structural behaviour of the isolated and non-isolated structural systems, tables compare the elastic base shear values, periods and storey drifts

Table 1- Elastic base shear values

V (t)	ISOLATED (0.20 DAMPING)	ISOLATED (0.05 DAMPING)	NON-ISOLATED
Str1	174.00	332.00	479.00
Str2	176.00	338.00	662.00
Str3	180.00	340.00	675.00

Table 2- First vibration mode periods

T (sec)	ISOLATED	NON-ISOLATED
Str1	4.00	2.10
Str2	4.00	1.31
Str3	4.00	1.26

Table 3- Structural displacements between roof & isolator

∆=Top-Bottom (m)	**ISOLATED (0.05 Damping)**	NON-ISOLATED
Str1	0.037	0.119
Str2	0.019	0.133
Str3	0.018	0.136

Table 4-Design elastic base shear values for non-isolated structures

V (t)	NON-ISOLATED
Str1 (R=8)	60.00
Str2 (R=7)	94.00
Str3 (R=6)	112.00

Table 5-Design elastic base shear values for isolated structures

V (t)	ISOLATED (0.05 Damping)	ISOLATED (0.20 Damping)
Str1 (R=2)	166.00	87.00
Str2 (R=2)	169.00	88.00
Str3 (R=2)	170.00	90.00

Conclusions

- The structural period for the first vibration mode is increased, which leads to lower elastic base shear values
- As a result of the increasing total structural damping, the elastic base shear values drop down significantly
- With base isolation for steel structures, large elastic displacements will be less because of the internal force reduction
- The comfort in the structure increases as in the storey drifts and the total structural displacements decrease