Chilean Base Isolated Hospital Design Examples

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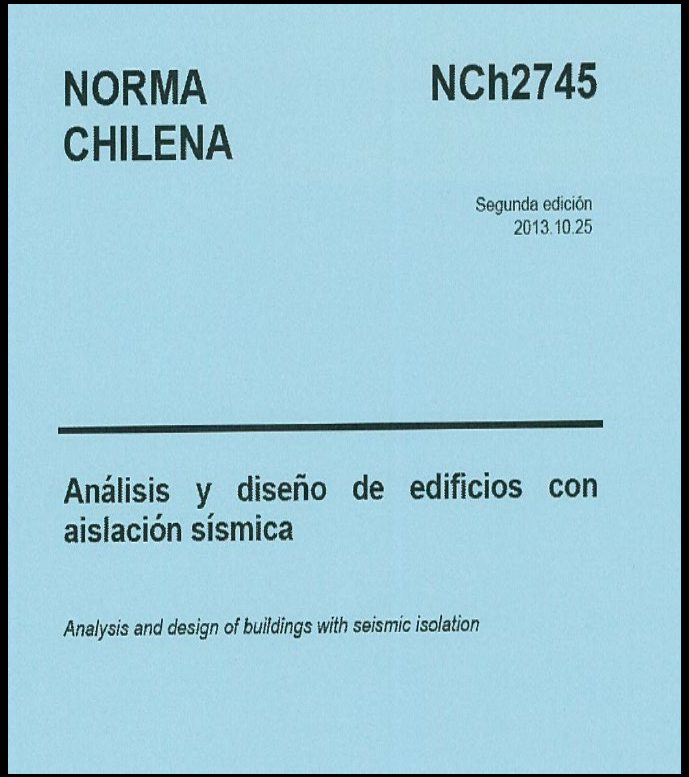
Code Design Basis

- NCh2745: Analysis and Design of Buildings with Seismic Isolation
- First version 2003
- Updated in 2013
- Currently under review
- Based on ASCE7 Chapter 17


NORMA CHILENA

NCh2745

Segunda edición
2013.10.25

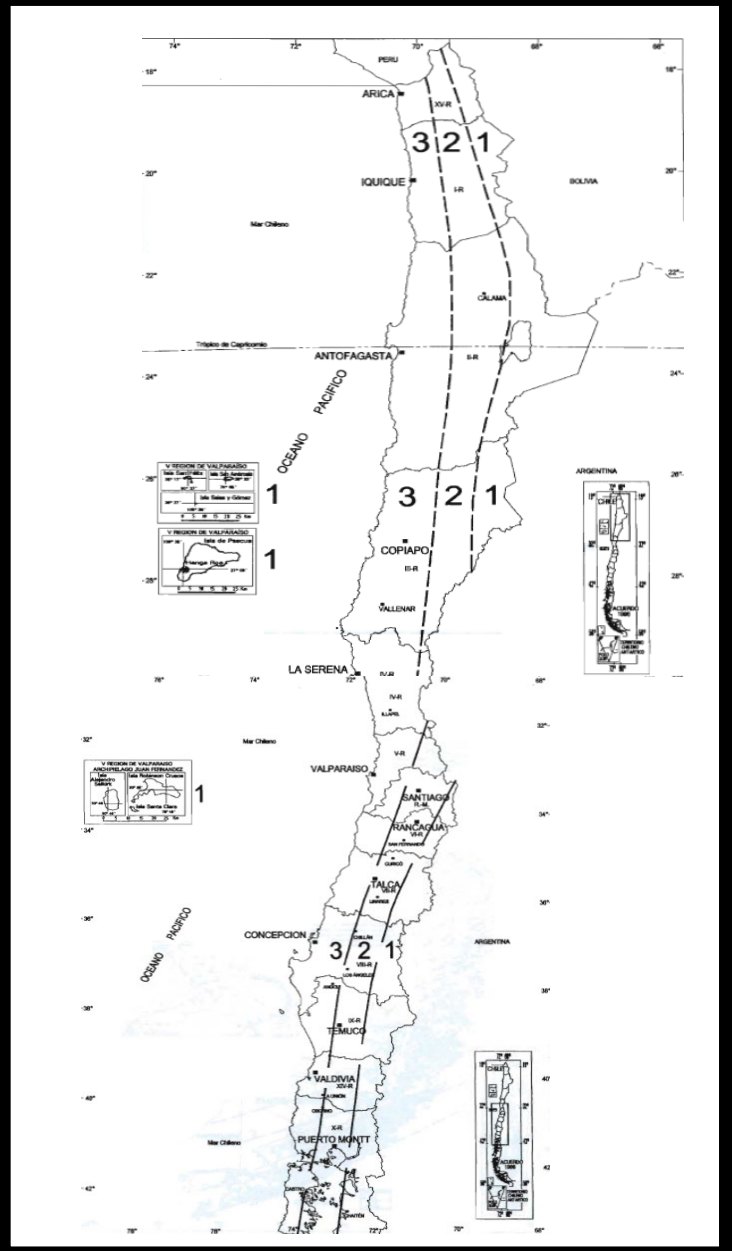
Análisis y diseño de edificios con aislación sísmica

Analysis and design of buildings with seismic isolation

Code Design Basis

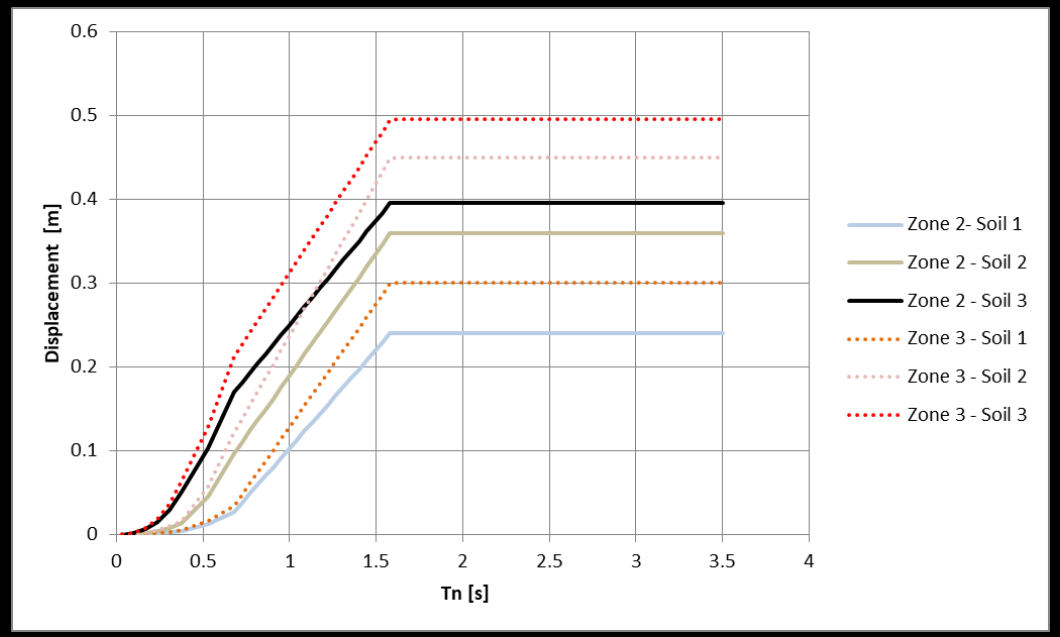
- Two seismic intensities
  - DBE → Tr=475 yrs → Structure Design
  - MCE → Tr=950 yrs → Seismic Isolation Design

- Three seismic Zones (1, 2, 3)



Code Design Basis

- Spectral Displacement Demand for MCE (5% Damping)
  - 24 to 50 cms in usual range of period (Td> 2.5s)
  - From Tm>3.5s, site specific demand study is required



Code Design Basis

- Seismic Forces Reduction Factors
  - Rs ≤ 2.0 (Superstructure)
  - Rb ≤ 1.5 (Substructure)

- Superstructure Design Strength
  - 0.070 W (seismic Zone 2)
  - 0.095 W (seismic Zone 3)

- Interstory Drift limited to 2.5 ‰ – 3.0 ‰ for DBE design forces (without Cd)
  - Approximately 5 ‰ elastic drift for typical effective Rs values

- Intermediate Moment Frame (IMF) detailing required for superstructure as per ACI318-08

Code Design Basis

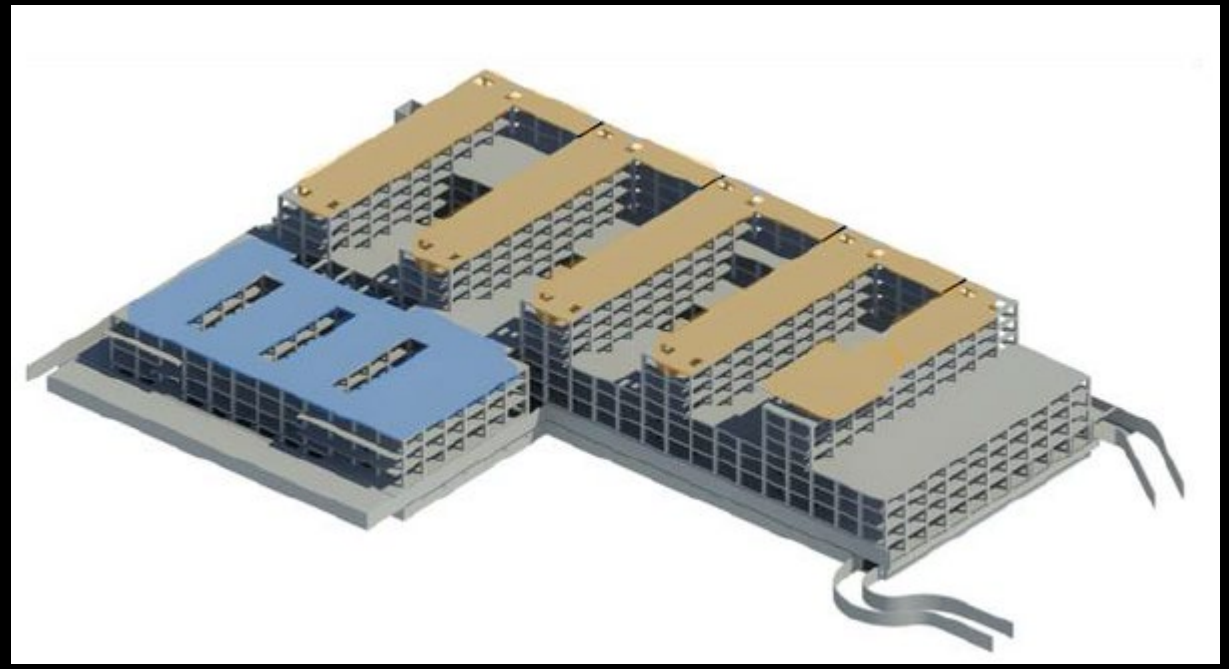
- Code doesn’t include specific isolator design basis

- Only requires stability for maximum Load and Displacement

- RLE Criteria
  - Two Limit States: Rubber deformation, min SF = 1.5
    Buckling of the isolator in the deformated position, min SF =1.5

Design Example #1: Ñuble Hospital

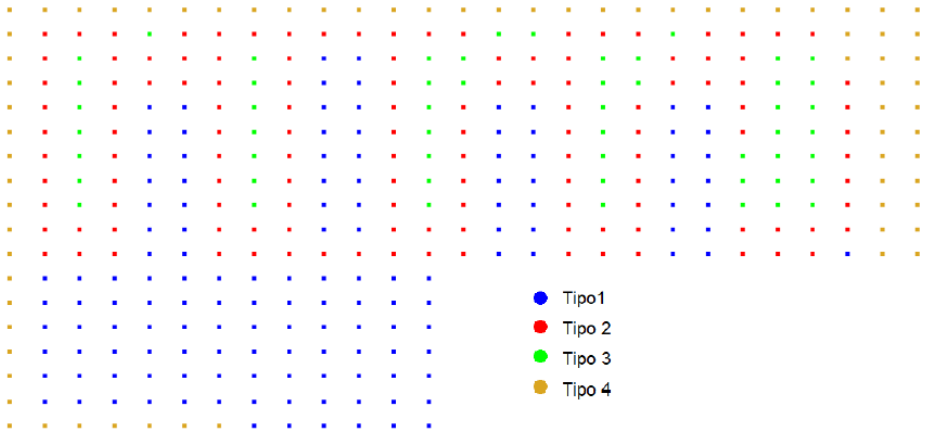
- L shaped Building with one single isolation system
  → Avoid a large displacement joint between the two buildings
- Six stories, two underground levels
- RC Moment Frame (f'c=35 MPa)
- Seismic Zone 3
- Soil Type 3 (T=2.2s)

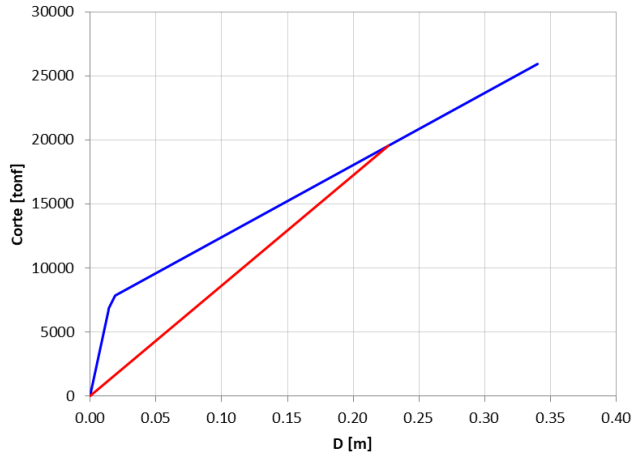


Design Example #1: Ñuble Hospital

- Four Types of Rubber Isolator
  - Type 1, 2, and 4: Lead Rubber Isolator
  - Type 3: Rubber Isolator

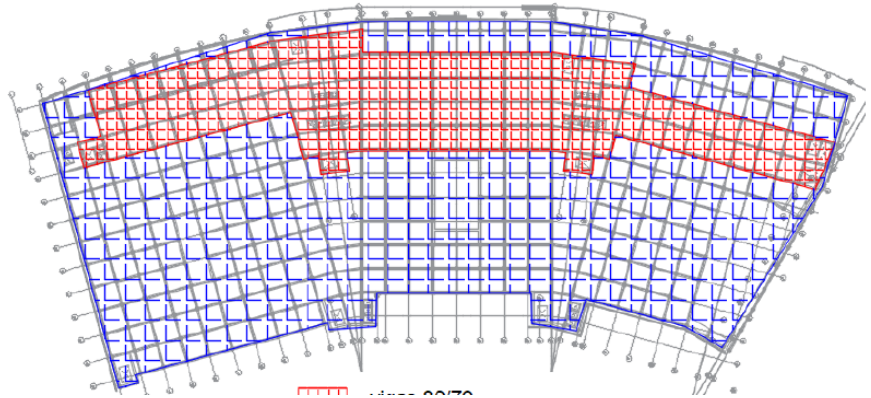
- Td= 3.5s (effective period for Dd)
- βd= 21% (effective damping for Dd)
- Fy/W = 3.5 %
- Dtm = 36.0 cms (includes 5 cms for static loads)
- Gap= 45 cms
- Dtm / Dm = 1.08 (good torsional behavior)
- Vs = 9.4% W (superstructure strength)
- Effective Rs factor = 1.2





Design Example #2: Sótero del Rio Hospital

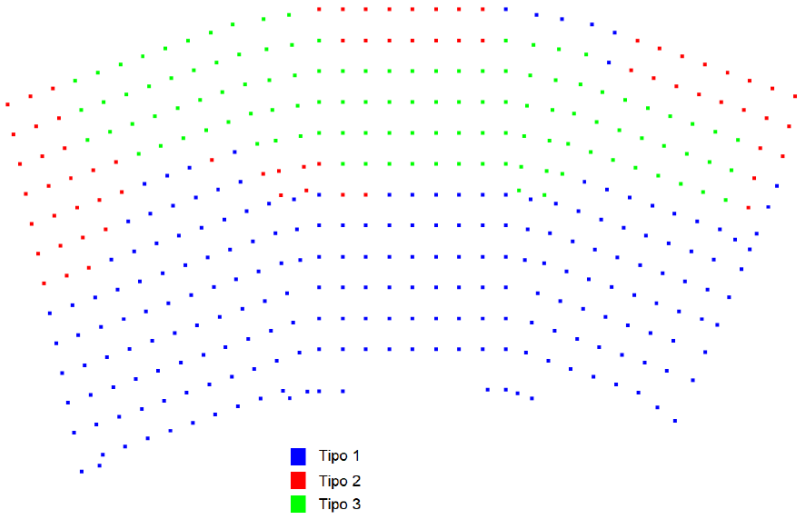
- Ten stories, two underground levels
- RC Moment Frame (f'c=35 MPa)
- Seismic Zone 2
- Soil Type 2
- Large Mass Eccentricity

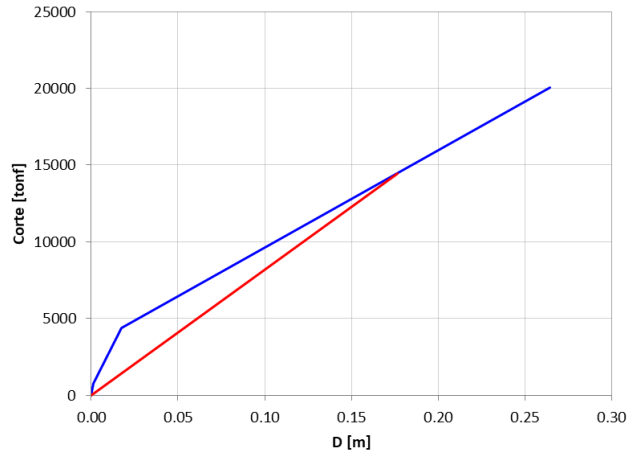


Design Example #2: Sótero del Río Hospital

- Three Types of Rubber Isolator
  - Type 1, and 3: Rubber Isolator
  - Type 2: Lead Rubber Isolator

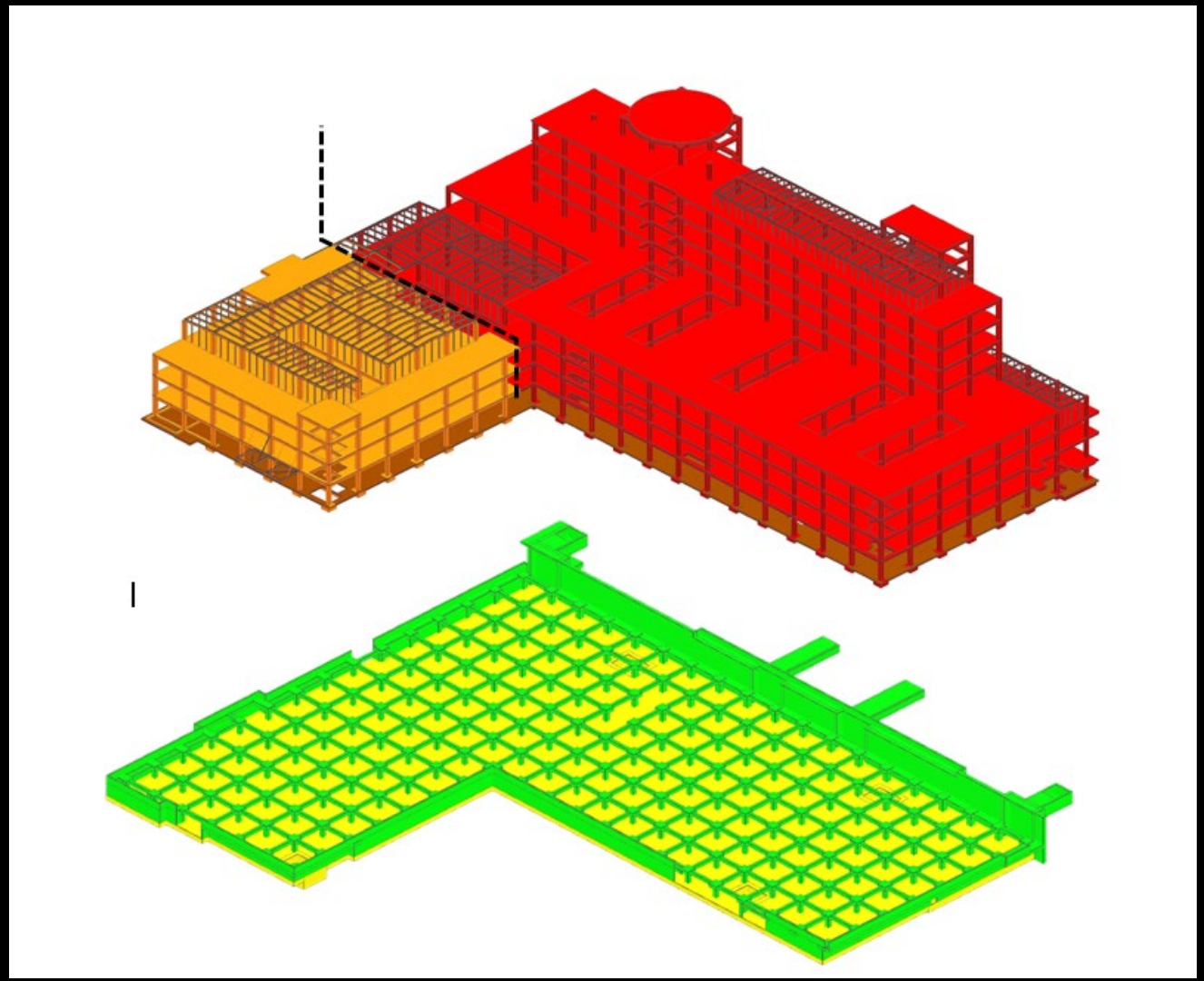
- Td= 3.5s (effective period for Dd)
- βd= 13% (effective damping for Dd)
- Fy/W = 1.7 %
- Dtm = 32.5 cms (includes 5 cms for static loads)
- Gap= 40 cms
- Dtm / Dm = 1.14 (good torsional behavior)
- Vs = 7.0% W (superstructure strength)
- Effective Rs factor = 1.3





Design Example #3: Puerto Varas Hospital

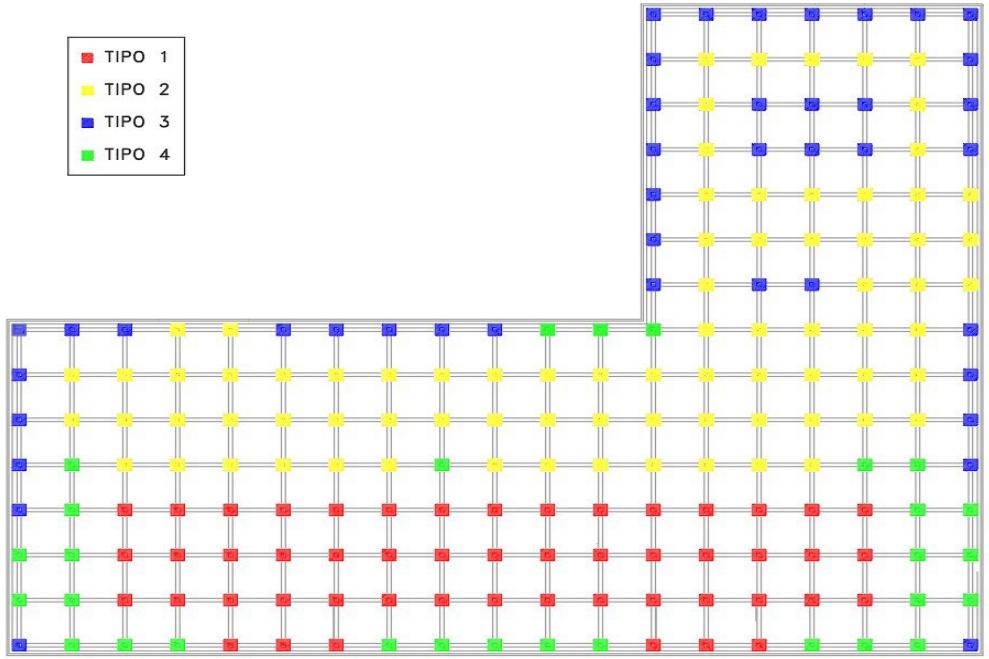
- Two independent superstructures on a single isolated system
  - → Avoid torsion in superestructure
  - → Avoid a large displacement joint between the two buildings
- Eight stories, one underground level
- RC Moment Frame (f'c=35 MPa)
- Seismic Zone 2
- Soil Type 3

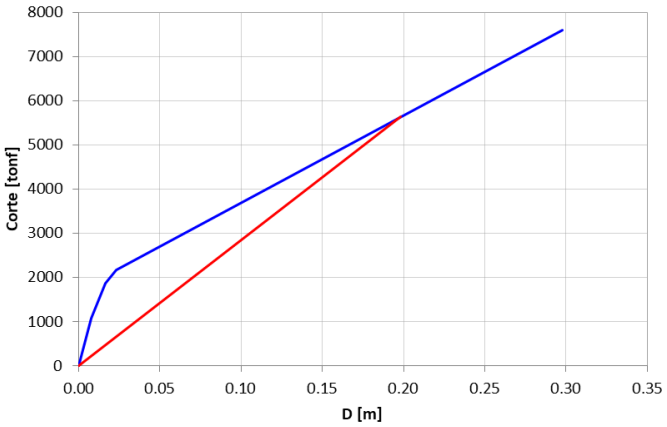


Design Example #3: Puerto Varas Hospital

- Four Types of Rubber Isolator
  - Type 1, 3 and 4: Lead Rubber Isolator
  - Type 2: Rubber Isolator

- Td= 3.7s (effective period for Dd)
- βd= 17% (effective damping for Dd)
- Fy/W = 2.7 %
- Dtm = 33.6 cms (includes 5 cms for static loads)
- Gap= 55 cms
- Dtm / Dm = 1.06 (good torsional behavior)
- Vs = 7% W (superstructure strength)
- Effective Rs factor = 1.7





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