Sendai Mediatheque

Toyo Ito

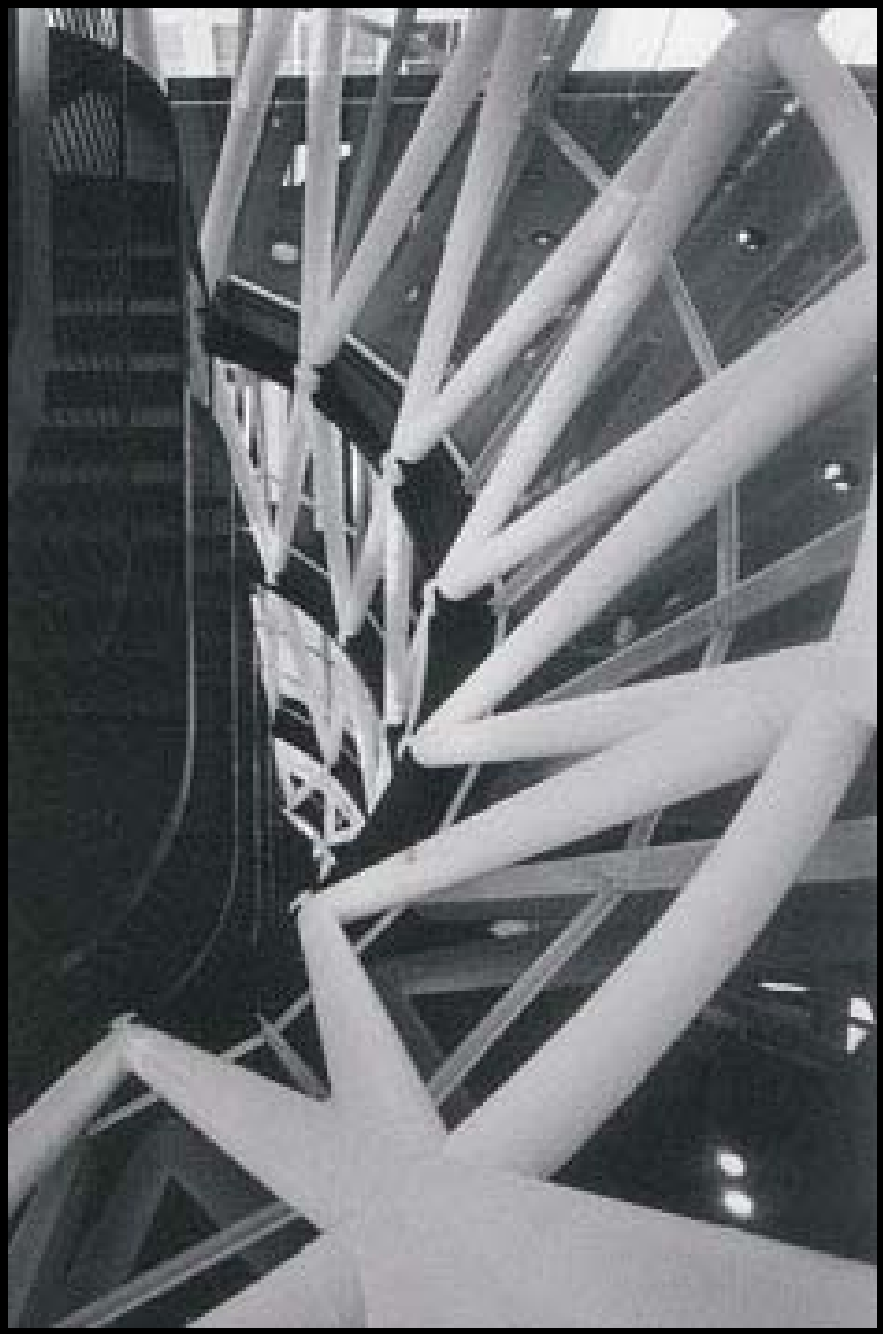
Structural Analysis

Jennifer Wong
Lisa Teters
Regina Stamatiou
Georgina Davis
Stephanie Fleming


せんだいメディアテーク
2001年1月26日オープン
sendai mediatheque
grand opening 26 jan 2001


TUBE
PLATE

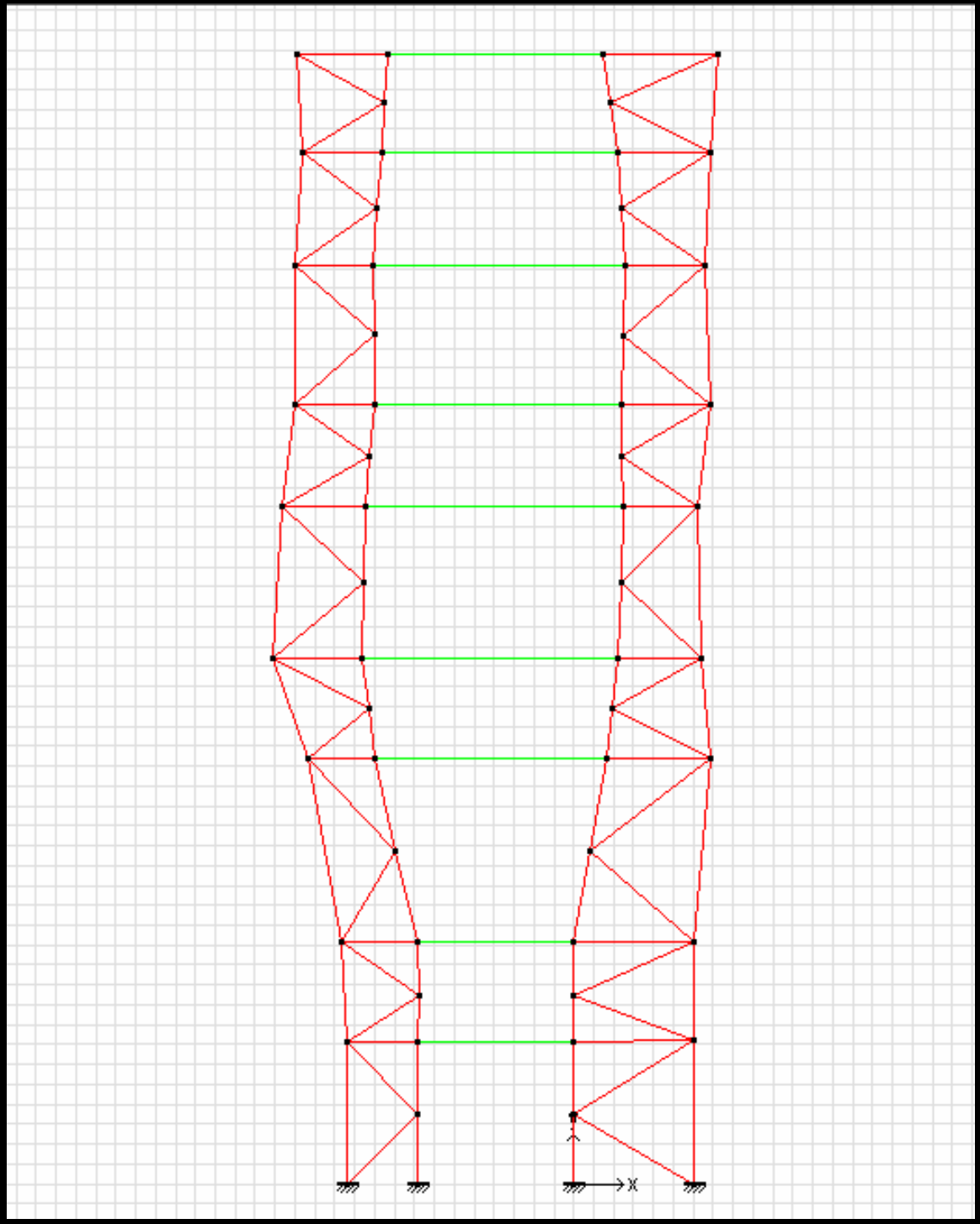
Building Skin

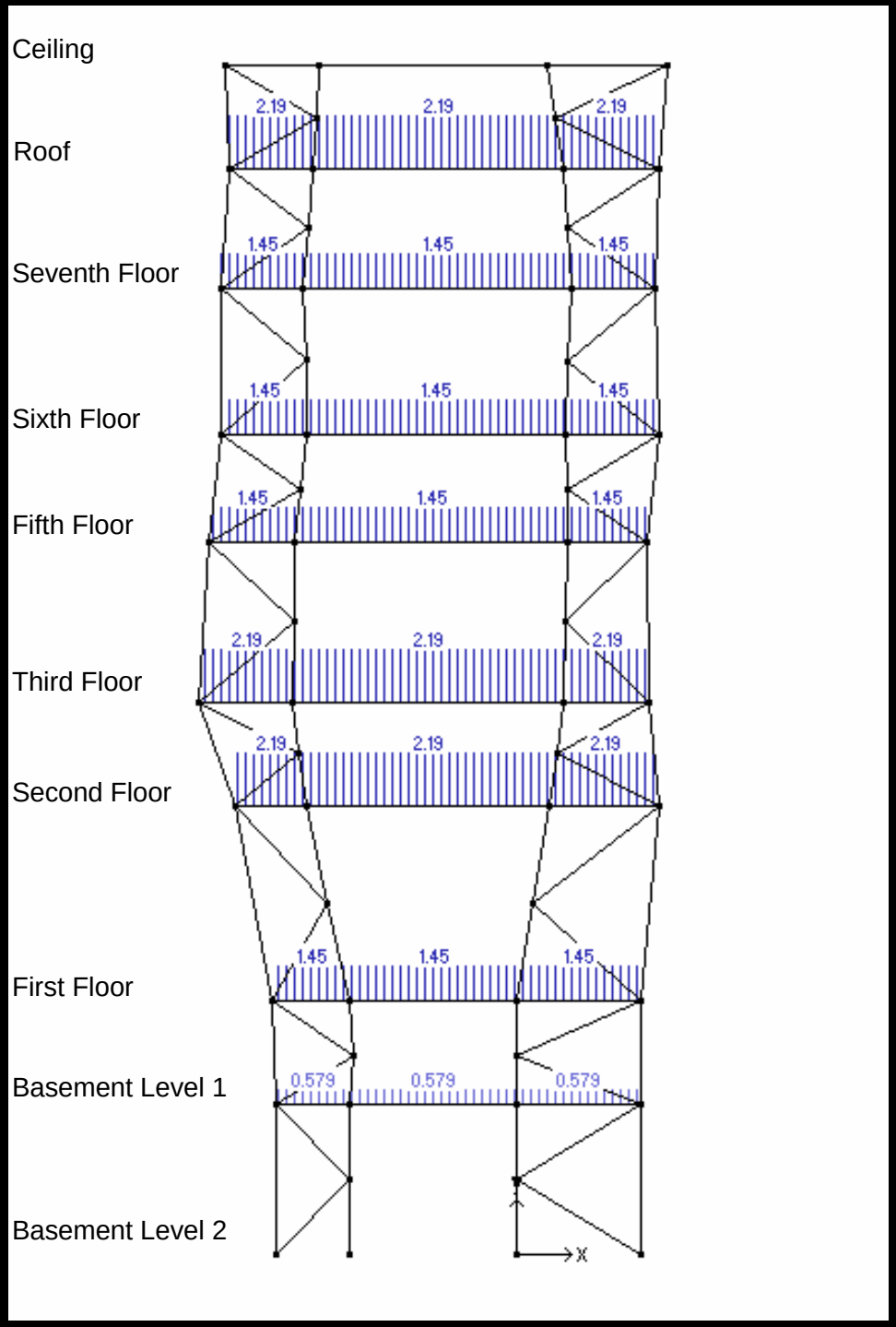


Rigid Structure

Connections

- Rigid connections throughout
- During construction the plates were placed on top of the ring beam of the tubes. This pin connection reduced bending stresses from the reaction of the plate with the tubes. Once the structure was in place the connections of the ring beam to the plate were welded.



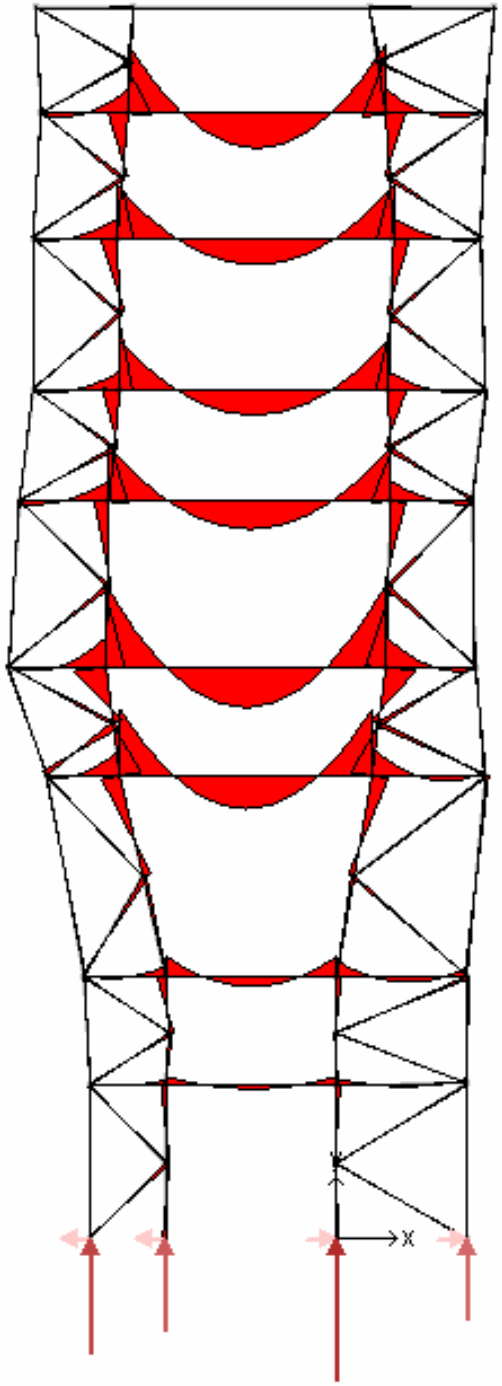


Live Loads

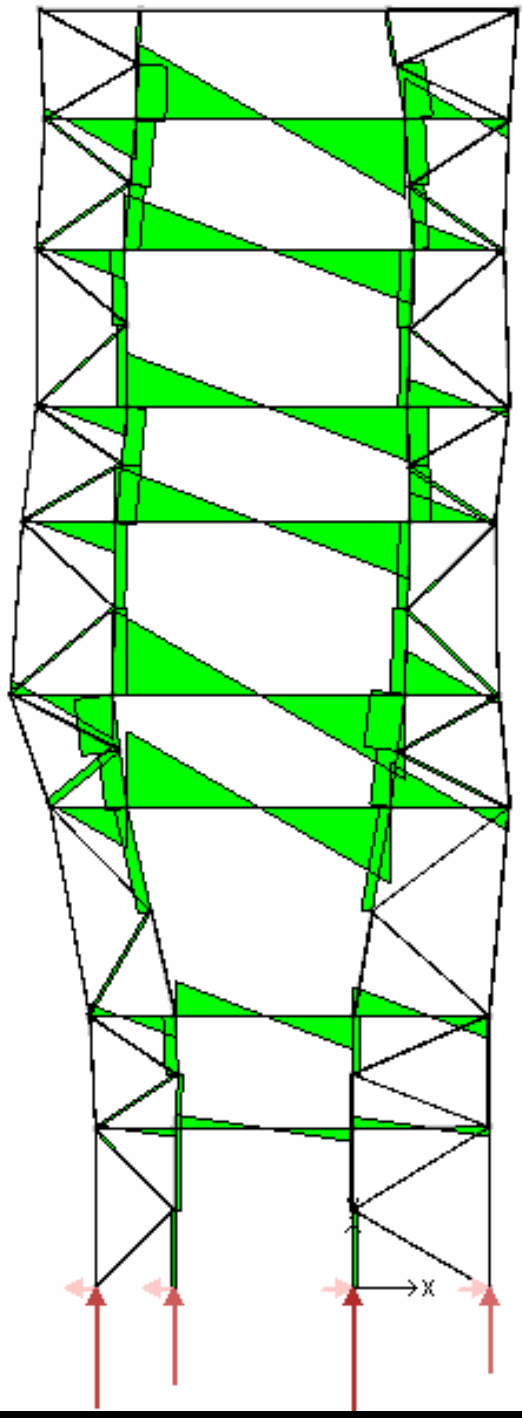
- Ceiling: steel lattice structure, non-load bearing
- Roof : 150 psf (2.03 kN/m)
- Seventh Floor: 100 psf (1.29 kN/m)
- Sixth Floor: 100 psf (1.29 kN/m)
- Fifth Floor: 100 psf (1.29 kN/m)
- Fourth Floor: open
- Third Floor: 150 psf (2.03 kN/m)
- Second Floor: 150 psf (2.03 kN/m)
- First Floor: 100 psf (1.29 kN/m)
- Basement: 40 psf (.419 kN/m)

- * Dead Load 10.96 psf (.16 kN/m) for steel tubes and sandwich slab per floor

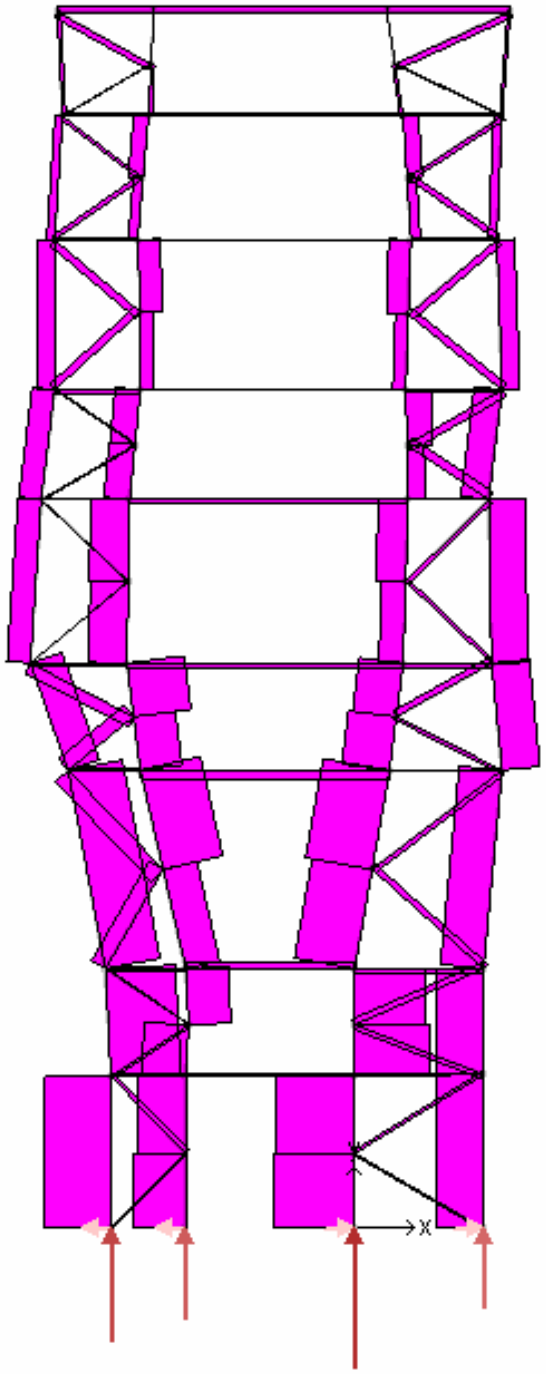
Moment Diagram



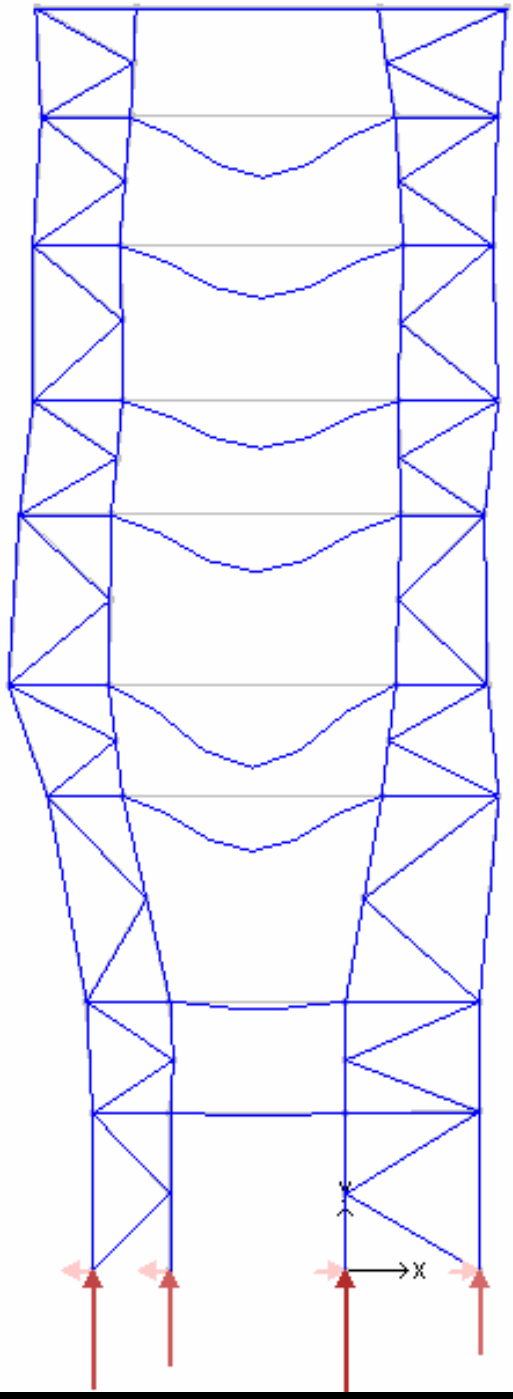
Shear Diagram



Distribution of Forces Diagram

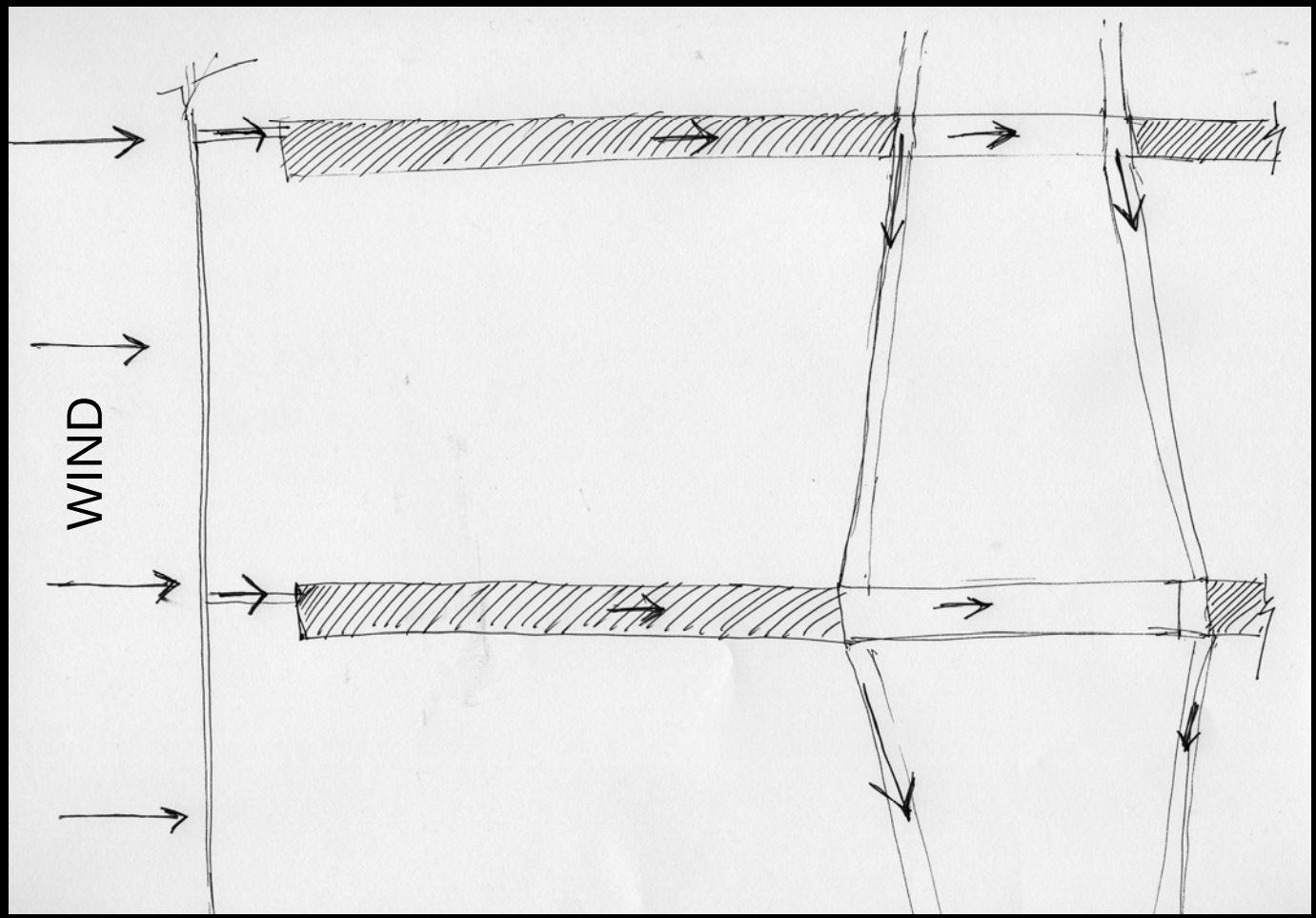


Deflection Diagram



Lateral Loads

- Lateral resisting system is tubes and slabs
- Building will twist in response to lateral loading

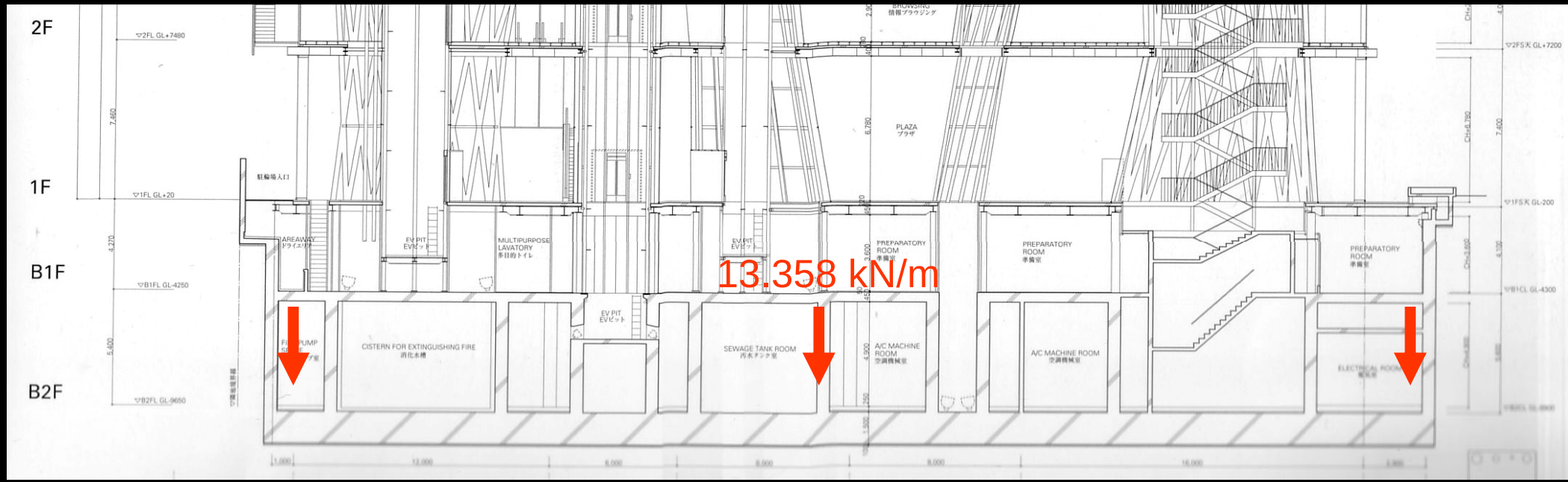


Soil Conditions

- Liquefaction Index
  - Calculated from the safety rate to liquefaction for every depth derived from sampling of the soil
- Soil Conditions in Sendai
  - Sand, silty sand, sand with clay, sand with gravel
  - Presumed bearing condition 200 kN/m^2

Foundation Section

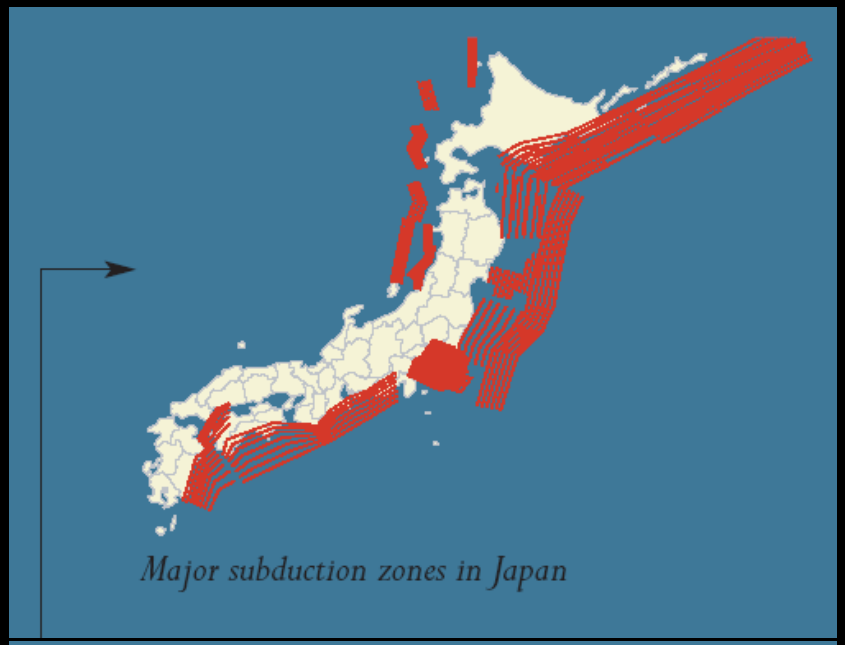
•Foundation: flat slab below grade

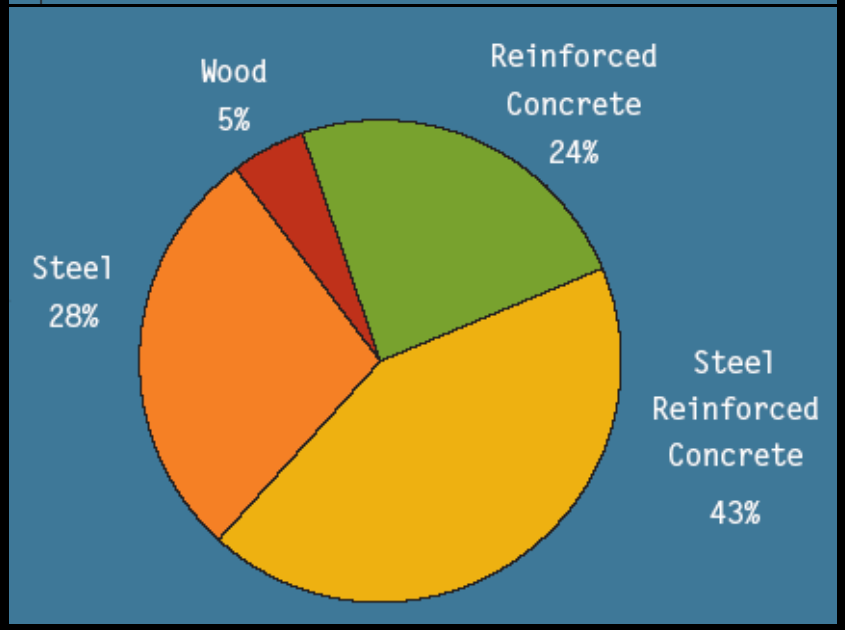


200 kN/m

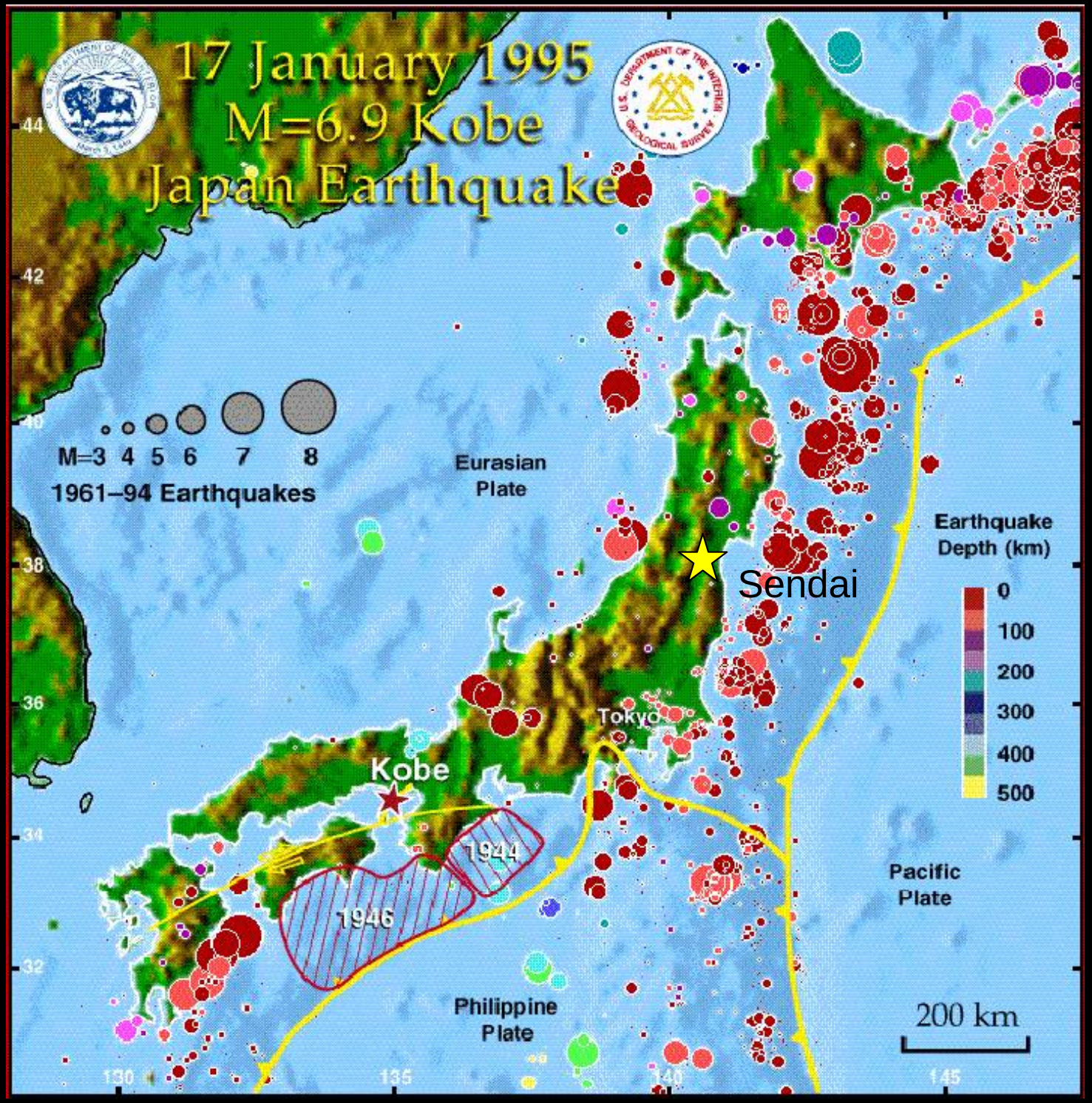
*Loads above are for 1’ strip section

Seismic Forces





- 1915: V=CW
  - V is lateral force for seismic design
  - C is seismic coefficient
  - W is structure weight
- 2000:
  - Allowable stress design
    - $Q_i=C_t \times W_i$
  - Lateral shear capacity design
    - $C_i=Z \times R_t \times A_i \times C_0$


17 January 1995
M=6.9 Kobe
Japan Earthquake
M=3 4 5 6 7 8
1961–94 Earthquakes
Eurasian
Plate
Sendai
Earthquake
Depth (km)
0
100
200
300
400
500
Tokyo
Kobe
1944
1946
Pacific
Plate
Philippine
Plate
200 km
44
42
40
38
36
34
32
130
135
140
145

Reaction to Seismic Forces

•A damping mechanism for absorbing energy is used within the main structure on the first basement floor.

•The first floor framing is structurally separated from the basement's external wall. So, the first basement floor is the level where seismic energy is transferred into the ductile steel shafts that support the upper level steel tubes. Therefore, the upper levels see little of the seismic forces.