

英文名：Two Stage Lateral Force Procedure

In the Japanese regulation for seismic design which is called as “Japanese Building Code” or “Building Standard Law of Japan” in English, the authorized seismic design method for regular building is categorized to force-based design, force-and-displacement-based design, energy-based design and peer review. The three methods except for peer review are applicable only for low-to-middle rise and small-to-middle span buildings. The force-based seismic design method is subdivided to Route 1, Route 2 and Route 3. Route 1 and Route 2 belong to prescription based design method and Route 3 belongs to performance based design method. The another name of Route 3 is “保有水平耐力計算法” in Japanese, which is temporally called as “Two stage lateral force procedure” in this book because there is no exact English equivalent of this Japanese expression. Note that the force-and-displacement based design and energy-based design are rarely used. Two stage lateral force procedure is Japanese equivalent of U.S. and European equivalent lateral force procedure which checks seismic performance using static lateral force determined by seismic design factors (base shear ratio, elastic design spectra, area factor, importance factor and response modification factor) and force distribution equation. However, the detail of the design procedure is different from U.S. and European design procedure. The difference is as follows: The Japanese design procedure has two stages compared with that only one stage design is required in U.S. and European design procedure. The 1st stage design (called as “Level 1 design” in Japan) corresponds to allowable strength design for service limit state against moderate earthquake with a recurrence interval between 43 years, and requires a structural engineer to perform stress analysis and to confirm that a building remains elastic against the lateral force with more than 0.2 of the base shear ratio and to check all of the peak story drift and the stiffness eccentricity ratio is under the code requirement. The 2nd stage design (called as “Level 2 design” in Japan) corresponds to ultimate strength design for ultimate state against severe earthquake with a recurrence interval between about 475 years (i.e. DBE level) and requires the structural engineer to perform nonlinear pushover analysis and check that the ultimate (nominal) horizontal strength in each story is over than the demand lateral force with more than 1.0 of the base shear ratio. Two stage lateral force procedure has no coefficients like overstrength factor and deflection amplification factor because the structural engineer is required to ensure that the building has sufficient ultimate strength and sufficient deformation capacity and to check the building collapse mechanism. Nonlinear analysis is naturally difficult for almost structural engineer, therefore (good or bad) special commercial software to make this nonlinear analysis mindless routine work is developed in Japan. Note that it is allowed that energy dissipation device for more severe earthquake is added to the building designed by two stage lateral force procedure. On the other hand, response modification factor denoted as D_s is not explicitly specified for the base shear ratio and is calculated for each story-based structural system.