The Type 3 vertical irregularity concerns the extent of difference between the horizontal dimensions of adjacent levels. A typical scenario is that the lower level is wider than the upper level (the opposite situation is generally uncommon) such that there can be significant disparity between the stiffnesses of the two levels (the width disparity could also trigger a weight/mass irregularity, depending on the magnitudes of masses supported at the two levels). A significantly uneven stiffness distribution can result in a different (first) mode shape than the one(s) assumed in the development of the equivalent lateral force procedure. Given that the concern stems from uneven stiffness distribution, one needs to look at whether the lower story indeed has greater lateral stiffness. It may be possible that the added bay at the lower level(s) does not provide additional lateral stiffness (and strength) because it does not involve a lateral force resisting element (e.g., additional bracing, shear wall, moment frame, etc.).

2. Arrangement of supported masses: Despite their potential building-like appearance, not all nonbuilding structures are building-like in terms of how the attached masses are supported. For example, the response of nonbuilding structures composed of suspended vessels and boilers cannot be reliably determined using the equivalent lateral force procedure because of the pendulum mode shape(s) associated with the significant mass of the vessel/boiler. The resulting pendulum mode shape(s), while beneficial in terms of reducing the demand for story shears and base shear, may pose a problem in terms of providing sufficient clearances to allow pendulum motion of the supported vessel/boiler or piping. Dynamic analysis should be performed in such cases, with consideration for appropriate impact forces in the absence of adequate clearances.
3. Relative rigidity of beams and girders: Even when a classic shear building model may seem appropriate, the use of the equivalent lateral force procedure results in an underestimation of the total response if the girders are flexible relative to the columns (in case of moment frame systems) or relative to braces (in case of braced systems). This is because increase in the flexibility of girders results in diminution of the modal contribution factor associated with the first mode so that the higher modes may contribute more significantly to the total response. The reason for this increased contribution of higher modes is different in this case than the standard provision requiring dynamic analysis when the first mode period is larger than $3.50T_s$ in that flexible girders increase the higher mode contributions regardless of how much larger the first mode period is compared to T_s. The situation of flexible girders can be pertinent to nonbuilding structures due to the potential absence of "normal" floors common to buildings. Therefore, the dynamic analysis procedures are recommended for building-like nonbuilding structures with flexible beams and girders. Alternatively, the equivalent lateral force procedure may be used in these situations if the shape of the design response spectrum (see Fig 11-1) is modified past period T_s by using the relationship $S_a = S_{D1}/T^{2/3}$ (instead of $S_a = S_{D1}/T$). This ad hoc adjustment accounts for the expected increase in higher mode contributions associated with the presence of flexible beams and girders.

Nonbuilding Structures Not Similar to Buildings. The equivalent lateral force procedure is based on the assumption of a classic shear building model. By their very nature, many nonbuilding structures not similar to buildings cannot be idealized with a shear building model for characterization of their dynamic behavior. The following discussion is intended to illustrate the type of issues that should be considered for selecting an appropriate method for their dynamic analysis as well as for determining the nature of lateral force distribution if an equivalent static force method is deemed appropriate.

1. Structural geometry: Nonbuilding structures, such as bottom-supported vertical vessels, stacks, and chimneys (i.e., structures with a fixed base and a relatively uniform distribution of their mass and stiffness), can be adequately represented by a cantilever model (e.g., the shear building model) so that they can be satisfactorily analyzed using the equivalent lateral force procedure provided in this standard. The procedure described in this standard is a special application (for cantilever/shear building models) of the more general Equivalent Static Method, which treats the response as being dominated by the first mode.

   A generalized version of the equivalent static method may be suitable for other simple nonbuilding structures with uniform mass and stiffness distribution. In such cases, it is necessary to identify the first mode shape (from classic literature and/or from use of the Rayleigh–Ritz method) for distribution of the dynamic forces.