TingWall Inc.
505 A McKnight Park Drive
Pittsburgh, Pennsylvania 15237
Phone: (412) 367-2808
Fax: (412) 367-7193
www.tingwall.com

TingWall Bulletin No. 126

TINGWALL TOLERANCE FLEXIBILITY

1. Tolerance Problems in a Conventional System

The mullions of a curtain wall system are secured to the edges of floor slabs or spandrel beams. Once the curtain wall has been erected, it is expected to be very close to the theoretical position as intended. Therefore, how to absorb the following tolerances without impairing the intended curtain wall functions in the erection procedures is very critical for a successful curtain wall installation.

a. Tolerance for Slab Edge or Spandrel Beam Location (T1): This tolerance includes three directional components (i.e. in-and-out; left-to-right; and up-and-down). Since the mullion connection must be located very close to the theoretical position, a three-way adjustment capability is necessary for a pre-fabricated curtain wall system. The generally acceptable construction tolerances are listed below.
   (1). In-and-Out: $\pm$ 0.75" for low-rise and up to $\pm$ 2" for high-rise.
   (2). Left-to-Right: $\pm$ 0.75".
   (3). Up-and-Down: $\pm$ 0.75" to $\pm$ 1.0".

b. Shop Fabrication Tolerance (T2): This tolerance includes two directional components (i.e. length of vertical member and length of horizontal member). The generally acceptable tolerance ranges from $\pm$ 0.0625" to $\pm$0.125". The problem is how to prevent the accumulation of this tolerance in the worst condition (e.g. for a 20 story building with one mullion length per story, the accumulated tolerance could reach $\pm$ 2.5" for a mullion length tolerance of $\pm$ 0.125".).

c. Wall Erection Tolerance (T3): The generally acceptable wall erection tolerance ranges from $\pm$ 0.0625" to $\pm$ 0.125" in all three directions. Again, the problem is how to prevent the accumulation of the tolerance.

In a conventional pre-fabricated system, it is typical to have one mullion length per floor and the mullion splice joint is designed for absorbing the differential inter-floor deflection. The other intermediate horizontal mullions within one floor height is fixed in a fixed position relative to the vertical mullion (i.e. no relative adjustability in between). Normally, the adjustments for in-and-out and left-to-right can be executed without significantly impairing the curtain wall functions. Since there is only one movable mullion splice joint and the associated single movable horizontal panel joint available for up-and-down tolerance adjustments (i.e. T1 + T2 + T3) while allowing for absorbing the differential inter-floor deflection, the major problem is how to do that without impairing the major curtain wall functions (e.g. connection strength and water-tightness).

2. TingWall Solutions to Tolerance Problems

TingWall is designed with the most advanced curtain wall technology known as Functional Isolation Concept (FIC). As a result, the various tolerance problems for a conventional system can be independently and individually solved easily as explained below.

a. T1 Problem: The patented mullion connection system allows three-way adjustments without welding. The biggest difference is the potential structural problems caused by the requirement of adjusting for a large up-and-down tolerance in a conventional system are totally eliminated in TingWall system.

b. T2 Problem: Based on FIC, TingWall panel frame is independent of the supporting vertical mullion and each facing panel is an independent pre-fabricated unit. The vertical mullions are erected first independent of the panels. Each panels are then independently secured to the vertical mullions in the field forming the horizontal and vertical panel joints. In this manner, the filed formed mullion joint location is independent of the field formed panel joint location, therefore, the possible accumulation of the mullion length problem can be easily and independently adjusted on the top mullion by providing a mullion with a length larger than the theoretical length for field cutting to the required length. As long as the accumulated mullion length tolerance can be adjusted at the top mullion, the length tolerance of an individual mullion is not critical at all. In the capping design of TingWall, a differential level tolerance of ¼" at the top of two adjacent mullions is acceptable and among all completed TingWall projects in USA, Japan, and Taiwan, only two top mullions for the first Taiwan job required this simple field adjustment. This type of simple tolerance adjustment is not available in a conventional system.

c. Combined T2 & T3 Problem: On a typical TingWall elevation, there are at least one vision panel and at least one spandrel panel per floor height forming a movable horizontal panel joint located right under the splice joint of mullion and at least one intermediate horizontal panel joint. Using FIC in TingWall design, the movable joint is exclusively used for absorbing the inter-floor differential deflection only and the fixed joint is exclusively used for tolerance adjustment only. This type of functional separation is not available in a conventional system. Each fixed joint has a tolerance adjustability of up to $\pm$ ¼". In erecting TingWall panel, before applying the panel screws, it is required to temporarily support the weight of the panel using two joint spacer blocks at the joint gap. This method of erection results in minimum erection tolerance on the joint gap (normally less than 0.0625"). It is normally intended to hold the panel fabrication tolerance to 0.0625" on the panel height dimension, however, due to the field tolerance adjustability, except visual concern, there is no critical tolerance for functional performances. Based on the experience on the completed TingWall projects, position check on the horizontal panel joint for adjusting the accumulation of tolerances is only required after erecting every three floors of panels with few minor adjustments. In the horizontal

direction, TingWall has an automatic safeguard feature on unacceptable tolerance dictated by the sole fact of unable to be erected as explained as follows. If the panel is too wide and the column spacing is too small, the panel will be difficult to place the panel into the final engaged position with the mullions on both sides. However, hand tools to force the panel into engagement have been successfully used in the completed TingWall project. TingWall mullions are normally erected with a spacer bar to gage the mullion spacing and an erection tolerance of $\pm$ 0.0625" on the mullion spacing is achievable, however, additional tolerance will occur between the mullion supporting points due to the side bow of the mullion. It is normally intended to hold the panel fabrication tolerance to 0.0625" on the panel width dimension. If the panel is too narrow and the mullion spacing to too large, the pre-fabricated panel screw holes will be outside of the panel seating flange of the mullion and thus, the screws can not be applied and the panel will be rejected as out of tolerance. However, hand tools to squeeze the mullion spacing to allow the screw application have been successfully used for minor variance. As long as the panel can be erected, there is no critical tolerance that will affect the functional performances.

3. Conclusion

Due to the application of the most advanced curtain wall technology known as Functional Isolation Concept, TingWall offers the best solutions to the problems caused by various intertwined tolerances by simplest method for absorbing or adjusting each tolerance component independently. Even though it is intended to hold TingWall fabrication and erection to the highest standard with minimum tolerances, it must be recognized that practically TingWall has no rigid critical tolerance requirement for the concern of curtain wall performances. This is a major contributing factor to the unusual erection speed and field labor savings of TingWall system.