

Technical Bulletin- Control Joints on Building Wall

The new Honolulu Ford Dealership is a \$9 million 52,000 square foot multi-function facility.

Because of the large quantity (and long length) of CMU walls on this project, one of the primary concerns was crack control. Cracks in CMU buildings typically occur as a result of restrained movement. Movements in CMU walls are induced by changes in temperature, moisture, elastic deformations, creep and other factors. If the CMU is restrained from moving, these stresses may be large enough to cause the wall to develop cracks. A method of controlling cracking is to provide vertical CMU control joints.

Unfortunately, the proper placement and detailing of CMU control joints is a design issue that is often overlooked for several reasons. One reason is the underestimated importance of having sufficient control joints in CMU walls. Another reason is that the responsibility for the layout of CMU control joints does not fall solely into the domain of any one individual. To some degree, the Architect, Structural Engineer and Contractor are all responsible for coordinating the joint placement. Because so many parties are involved, this critical design issue often gets overlooked.

Control joint spacing is based on a myriad of factors and, as with many aspects of engineering, may be more of an art than a science. Although shrinkage cracking may not impact the structural integrity of the building, it detracts from the aesthetics of the façade and can give the impression of being “unsafe.” If left un-repaired, shrinkage cracking can ultimately become a structural concern.

In order to minimize the potential for shrinkage cracking on the Honolulu Ford project, the design-build team addressed the control joint issue from an early stage. Structural Engineer, Baldrige & Associates Structural Engineering Inc. (BASE), and project Architect, Richard Matsunaga & Associates (RMA), spent considerable effort on coordinating the locations of the vertical control joints. The challenge was providing a layout that was sufficient for controlling cracking without adversely impacting the architectural “look” of the building or the structural integrity.

To achieve this goal BASE provided RMA with a “first pass” of the control joint layout. This preliminary plan was based on providing a control joint layout that met the National Concrete Masonry Association (NCMA) recommendations for control joint placement and spacing. BASE insured that the control joints were placed in locations that worked well with the structural system. For example, joints were located so that they did not occur within the bearing width of the structural steel framing. The “first pass” layout was sent to the Architect for their comments and modifications. This iterative process continued until the Design Team had a satisfactory solution. As this was a design-build project, the Contractor was also solicited for input on potential constructability concerns.

The control joint layout for the Honolulu Ford project was based on general recommendations provided by the NCMA. Table 9-1 from the Reinforced Masonry

Engineering Handbook (James Amrhein – Fifth Edition) was used as a general “starting point” for the control joint spacing. This table is reproduced below:

TABLE 9-1 Spacing of Control Joints for Type I Concrete Masonry Units with Horizontal Reinforcing^{1,2}

| Recommended Spacing of Control Joints | Vertical Spacing of Joint or Horizontal Reinforcement (Inches) | | | |
|---|--|-------|-------|-------|
| | 48 | 24 | 16 | 8 |
| Expressed as Ratio of Panel Length to Height, L/H | 2 | 2½ | 3 | 4 |
| With Panel Length (L) Not to Exceed: | 40 ft | 45 ft | 50 ft | 60 ft |

1. The spacing of control joints should be reduced for Type II non-moisture controlled units. It may be reduced by one-half or an amount based on experience or practice in the area where the project is located.
2. Based on NCMA TEK Note 3, Table 1.

The most current data on CMU control joints is contained in **NCMA TEK 10-2B: Control Joints for Concrete Masonry Walls – Empirical Method (2003)** and **NCMA TEK 10-3: Control Joints for Concrete Masonry Walls – Alternative Engineered Method (2003)**. Both of the above methods focus on controlling cracking resulting from internal volume changes due to environmental forces such as temperature changes and moisture loss. TEK 10-2B is an empirical method based on historical performance over many years in various geographical conditions. For most conventional buildings, this approach has proven satisfactory.

TEK 10-3, on the other hand, presents an engineered approach to controlling shrinkage cracking. The effectiveness of this approach is highly dependent on having detailed knowledge of the particular masonry characteristics and insuring that the construction is in accordance with the project specifications. With this method, highly reinforced walls (typical of Seismic Performance Categories D and E) can have greater joint spacing or potentially no joints at all.

The approach presented in **TEK 10-3 can possibly be more attractive to architects and contractors since it has the potential of reducing (or possibly eliminating) control joints. It is important to remember, however, that this method not only requires a larger quantity of reinforcing steel, but it can be very sensitive to variations in masonry material and construction quality.** For the Honolulu Ford project, our office believed that the “empirical” method was both a more economical and reliable way of minimizing the potential for shrinkage cracking. In this case, the architect also realized the value in this approach and was able to successfully incorporate the control joints into the overall design.

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