19

REK SHOPPING CENTER

19.1 INTRODUCTION TO REK SHOPPING CENTER

19.1.1 Plans and Elevations

Figures 19.1-1 and 19.1-2 show the plan and elevations of a single-story, 16,000 square foot shopping center, assigned to Risk Category II and located in an area of moderate seismicity and moderate basic wind speed (similar to a locale such as Big Timber, Montana). The north, east, west and central shear walls are constructed of reinforced concrete masonry. The south wall is primarily a glass curtain wall with one masonry shear wall element and glass units around the entrance.

Nominal wall thicknesses are 8 in. Figures 19.1-1 and 19.1-2 are based on concrete masonry units, with a specified thickness of 7.63 in.

The roof framing system is typical of many low-rise masonry commercial buildings. It consists of a corrugated metal deck on open-web joists, supported on the concrete masonry walls and steel columns, with a five-foot roof overhang on the south side.

19.1.2 Example Problems

To illustrate the application of TMS 402 to this type of structure, example problems are presented in Section 19.3. An example problem index is included on the following page to assist the reader in correlating the design issues shown in the examples to the plans and elevations of the structure.

To help the reader identify which design approach and material type is addressed by each example, example numbers and "bleed tabs" are provided on the page edges. Allowable-stress design examples are designated with an "ASD" after the problem number in the "bleed tabs" and strength design examples are denoted with an "SD". In addition, so the reader can compare solutions from different design approaches, the example numbering remains consistent for the design of similar elements. For example, the problem addressing "Design of Exterior Reinforced CMU Nonloadbearing Wall for Out-of-plane Flexure and Shear" is denoted as REK-02 throughout the ASD and SD examples, with changes in suffix to denote which design method is addressed. For example, REK-02 ASD refers to the allowable-stress version of that example, and REK-02 SD refers to the strength version of that same example.

Example REK-01 is applicable for both the ASD and SD solutions and is not repeated in the SD examples. As such, the SD examples start on Example REK-02 SD and simply refer to REK-01.

REK SHOPPING CENTER EXAMPLE PROBLEM INDEX

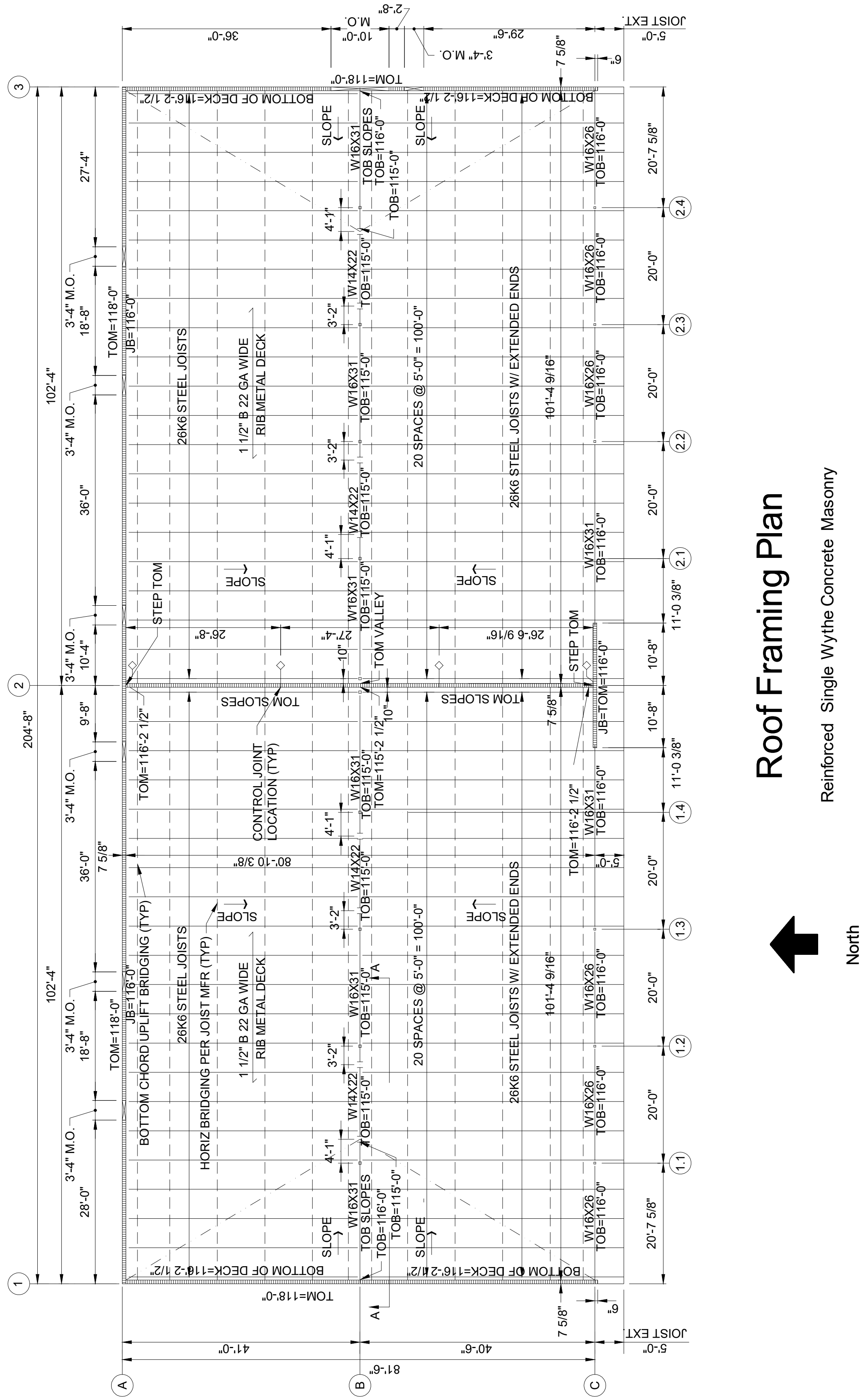

Figure 19.1-1: REK Shopping Center Plan

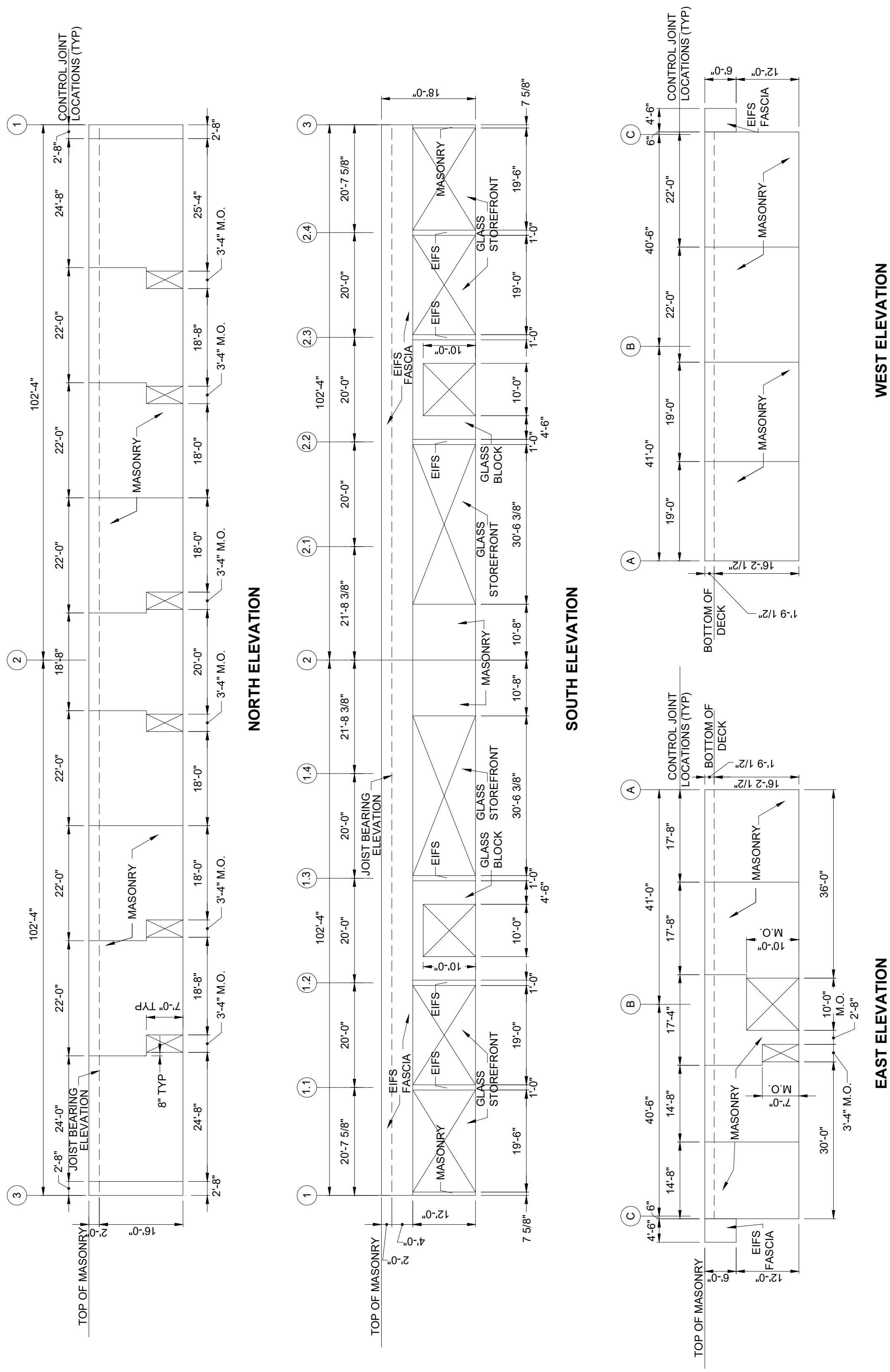

Figure 19.1-2 : REK Shopping Center Elevations

20

JHM BOX RETAIL STORE

20.1 INTRODUCTION TO JHM BOX

The JHM Box Retail Store (here after referred to as the JHM Box) is a typical single story, high bay structure that is commonly designed using both loadbearing and non-loadbearing masonry walls. To show how masonry wall systems can be designed to resist high loading levels over relatively large heights, the example structure was purposely located in an area that produces both high wind and seismic loads.

The designs developed for the Big Box structure can be modified and applied to other high bay applications such as gymnasiums, warehouses, and industrial/commercial structures.

20.2 PLANS AND ELEVATIONS

Figures 20.2-1 and 20.2-2 show the roof framing plan and elevations of a 44,000 square foot, single-story retail building identified as the JHM Box building. It is assumed that this structure can be evaluated as a Risk Category II building as defined in ASCE/SEI 7-22. As is typical of these types of buildings, the walls are reinforced concrete masonry. In addition, the south elevation of the building has a 4 in. clay masonry veneer.

The building has four wall openings, including a 32 ft. wide opening over the main front doors. All openings are assumed to have masonry lintels and movement joints are located as shown by the diamond symbols on the plans. As described in MDG Chapter 8, these joints are placed at corners, at the edge of openings, and at a spacing of 24 ft. This spacing fits the building module and is less than the 25 ft. maximum spacing of control joints that the empirical recommendations from the NCMA suggest for this building configuration. In addition, the movement joints at the edge of openings incorporate the opening edge and then jog away to provide a minimum 8 in. bearing for the lintels. Expansion joints are also assumed at the corresponding control joint locations in the clay masonry veneer, except that no jog is needed at the opening.

The flat roof framing is a simple one-way system of open web steel roof joists and joist girders supporting a metal roof deck, membrane roof system, and miscellaneous equipment. The north and south walls support the joists, and the east and west walls support the end reactions of the joist girders. The roof diaphragm elevation is 22 ft. above grade and the wall parapets extend beyond this level by 3 ft - 4 in. The roof will have a minimum ¼ in. per foot slope provided by tapered insulation and sloped roof elements. Ponding loading was not addressed in this example.

The northeast corner of the building has a loading dock area with a driveway flanked by a 4 ft - 8 in. retaining wall capped by a 4 ft - 8 in. screen wall.

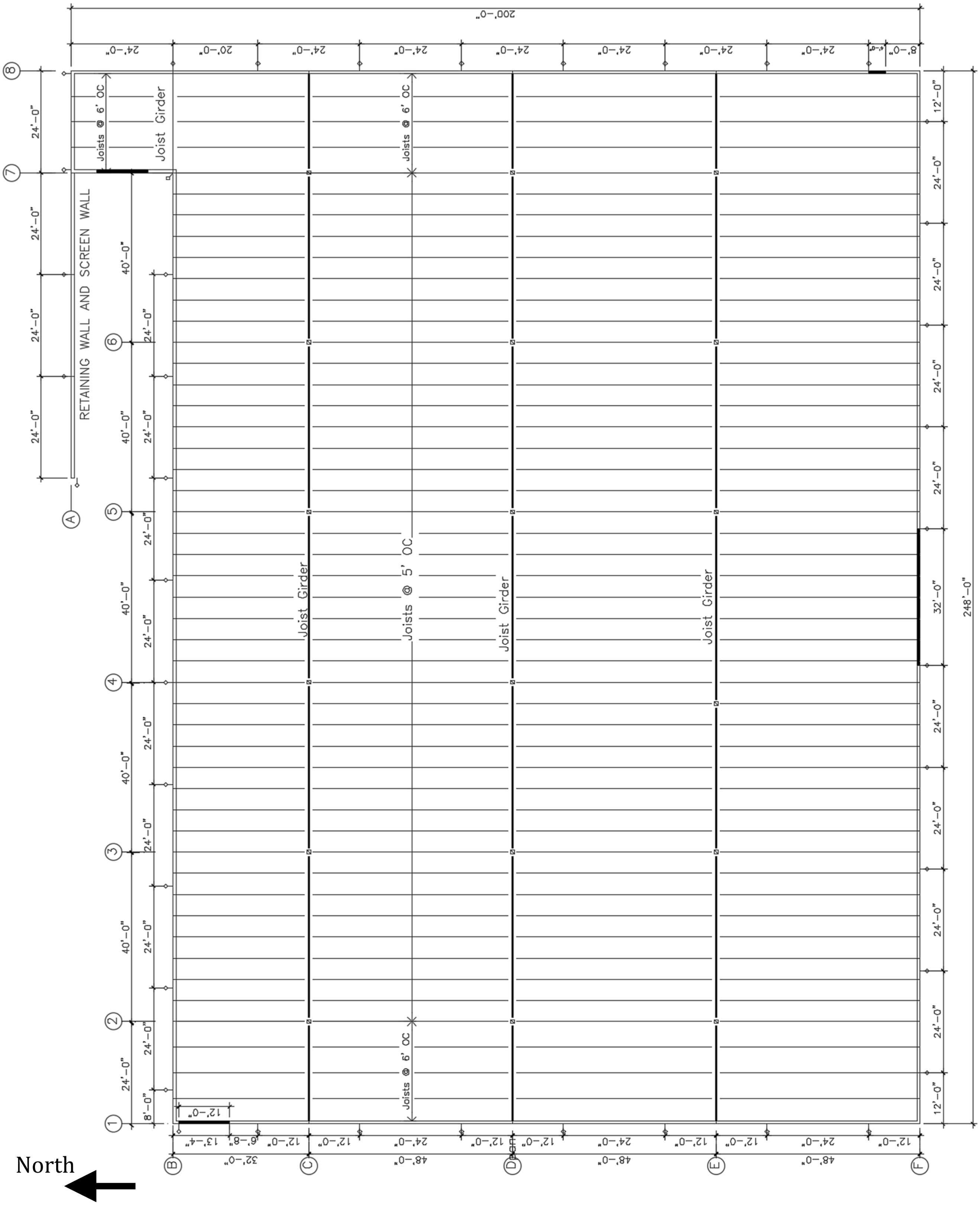

Figure 20.2-1 JHM Box Building Roof Framing Plan and Layout

JHM BOX Store

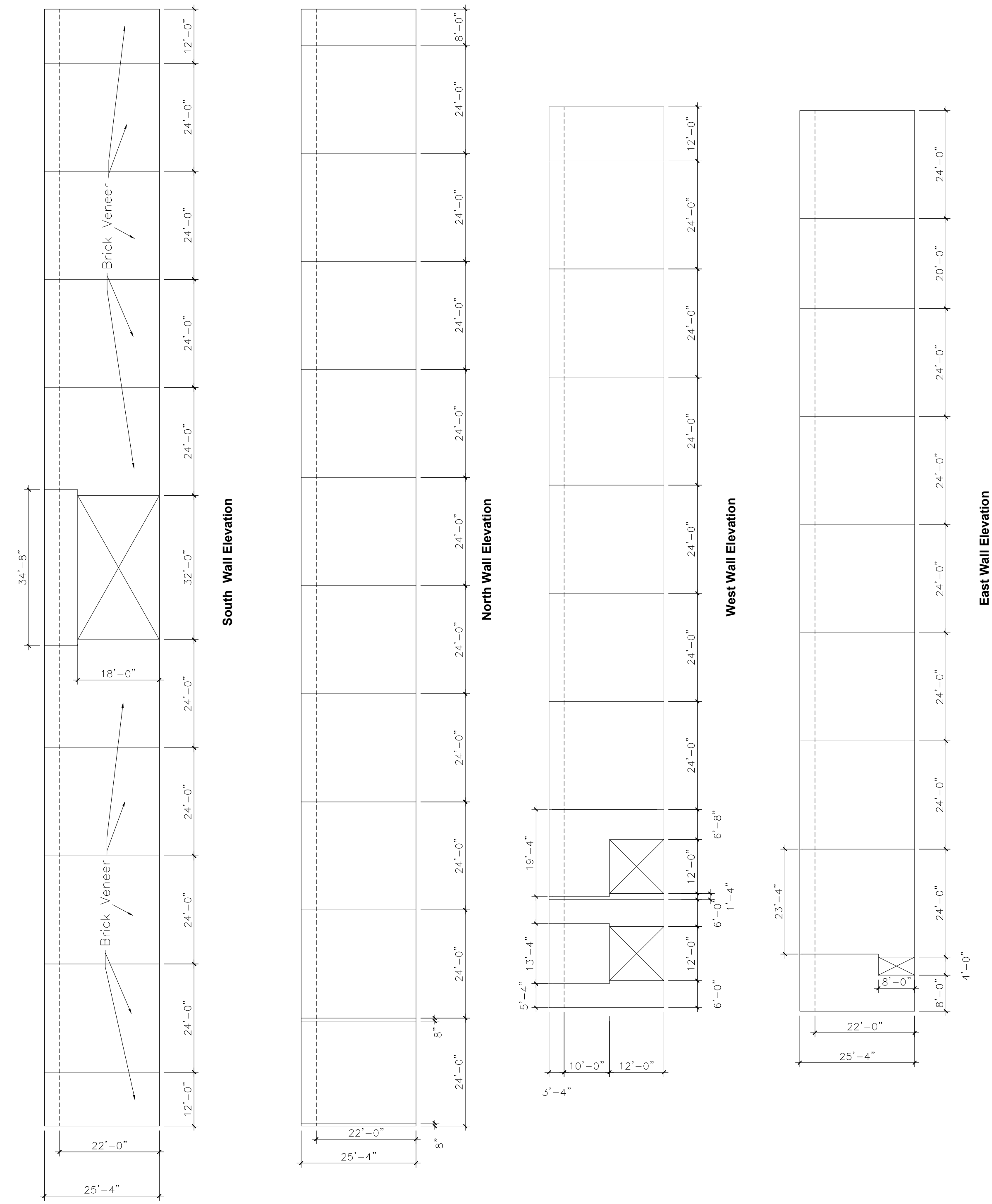

Figure 20.2-2 JHM Box Building Elevations and Control Joint Layout

20.3 DESIGN EXAMPLES

To illustrate the application of TMS 402 to the structural design of such a building, example problems are presented in this chapter. The JHM BOX Example Problem Index describes the examples presented, along with a page number where each example starts. Following the calculation of loadings on the system (Example JHM Box 01), various elements of the building are designed using the Allowable Stress Design (ASD) provisions of TMS 402 Chapter 8 and then using the Strength Design (SD) provisions of TMS 402 Chapter 9. As noted previously, the building is composed of reinforced concrete masonry.

The material properties used in the design examples related to the JHM Box examples are shown in Table 20.3.1.

ASTM C 90 requires a minimum unit compressive strength of 2,000 psi. This will result in an f'_m of 2,000 psi for Type S mortar using the unit strength method (TMS 602 Table 2). Type S mortar was specified for this building as it is located in Seismic Design Category D. TMS 402 Section 7.4.4.2.2 would thus require that Type S mortar be used.

Many manufacturers routinely produce CMUs with strengths in excess of 2,800 psi which would result in an f'_m of well in excess of 2,000 psi. In highly loaded walls this added strength may be advantageous. The grout is specified to meet the provisions of ASTM C476 with a minimum compressive strength, f'_g , of 2,000 psi.

Table 20.3.1 Default Material Properties for the JHM BOX Example Problems

Property	Concrete Masonry
Unit Compressive Strength, psi	2,000
Mortar Type	S
f'_m, psi; f'_g , psi	2,000
E_m, psi	$1.8{\times}10^6$
Modular ratio, n	16.1

JHM BOX EXAMPLE PROBLEM INDEX

21

RCJ Hotel

21.1 INTRODUCTION

The typical floor plans, elevations and details of a multistory hotel called the RCJ Hotel are shown in Figures 21.1-1 through 21.1-8. The vertical and lateral force resisting system for the hotel is masonry bearing and shear wall constructed from reinforced hollow clay units. The elevated floors and roof are constructed of precast planks with a cast-in-place topping. The north and south walls are nonstructural exterior glazing. Notes for the RCJ Hotel are given after the figures.

The RCJ hotel is located near Palm Springs, California. A basic wind speed of 97 mph was used for wind analysis in accordance with ASCE/SEI 7-22. Seismic ground motion parameters were taken from the ASCE 7 Hazard Tool.

Hollow clay units are available in nominal 4 inch, 5 inch, 6 inch and 8 inch thicknesses. Most of the masonry members in the RCJ hotel could be designed with reasonable levels of reinforcement using 6 inch units. However, it was determined that 8 inch units would better accommodate bearing of the precast floor planks, as shown in Figure 21.1-8. Hollow clay units are typically available in nominal 12 inch lengths and nominal 16 inch lengths, and various heights. The nominal 16 inch length, or a 8 inch module, was chosen for this based on the geometry of the building being more compatible with the 8 inch module. A nominal unit height of 4″ has been assumed. The geometry of these units is shown in Figure 21.1-9. On an actual project, it would be prudent to work with the architect and potential unit suppliers to determine availability of the appropriate unit sizes and the material properties associated with the clay unit color(s) under consideration by the designer.

The size and area of reinforcing that can be placed in these units is dependent on the nominal unit size and available gross grout space, which is illustrated on Figure 21.1-9. For an 8″ nominal units, TMS 402 6.1.3.2.3 limits the maximum bar diameter to one-eighth of the nominal unit thickness, or #8 for an 8 inch nominal unit. TMS 402 6.1.3.2.4 further limits the bar diameter to one-third of the least clear dimension of the gross grout space. This requirement does not affect the maximum size of the vertical bars, because the least dimension of the grout space exceeds 3″ in both directions. It does, however, restrict the maximum size of the horizontal reinforcement to a #5 bar when placed in a single bond beam, since one-third of 2-3/16 inch is 0.73 inch. Lastly, TMS 402 Table 6.1.3.2.5 limits the area of the reinforcement to 4% of the area of the gross grout space. For vertical bars, this would allow the use of (1) #8 in a cell or (2) #6. For horizontal bars either (1) #6 or (2) #4 could be placed in a single bond beam, and either (1) #8 or (2) #5 in a double bond beam. In general, this example will use only a single bar per grout space.

To illustrate the application of TMS 402 to a typical structural design for this type of building, example problems are presented in Section 21.5. A problem index is included below to assist the reader in correlating design issues with example problems.

RCJ HOTEL EXAMPLE PROBLEM INDEX

Example #	**Page #**	**Design Issue**
RCJ-01	21-29	Vertical Expansion Joint Size and Spacing
Allowable Stress Design (ASD) Examples		
RCJ-02 ASD	21-31	Reinforced Wall Loaded Out-of-Plane
RCJ-03 ASD	21-35	Exterior Bearing Wall
RCJ-04 ASD	21-43	Reinforced Loadbearing Shear Wall
RCJ-05 ASD	21-52	Reinforced Loadbearing Wall Segment
RCJ-06 ASD	21-60	Coupling Beams
RCJ-07 ASD	21-69	Connection of Rigid Roof Diaphragm to Exterior Loadbearing Wall
RCJ-08 ASD	21-76	Reinforced Retaining Wall
RCJ-09 ASD	21-81	Canopy Column
Strength Design (SD) Examples		
RCJ-02 SD	21-93	Reinforced Wall for Out-of-Plane Load
RCJ-03 SD	21-97	Exterior Bearing Wall
RCJ-04 SD	21-107	Reinforced Loadbearing Shear Wall
RCJ-05 SD	21-117	Reinforced Loadbearing Wall Segment
RCJ-06 SD	21-126	Coupling Beams
RCJ-07 SD	21-143	Connection of Rigid Roof Diaphragm to Exterior Loadbearing Wall
RCJ-08 SD	21-149	Reinforced Retaining Wall
RCJ-09 SD	21-153	Canopy Column