CHAPTER 1: EXISTING DESIGN

1.1 INTRODUCTION

The original design of National Harbor Building M was examined in great detail through the compilation of technical reports 1, 2 and 3. The results of those structural investigations were analyzed and used to propose what has become the basis of this final report. This section gives a general outline of the existing structural systems as present in the existing design of Building M. The information presented will serve as a reference point during the discussion of the redesign, seeing that great efforts were made to maintain the integrity of the original building's character. Additionally, these results can be compared to those of the redesigned building and be used to evaluate the effectiveness of the changes. This section presents pertinent conclusions drawn in technical reports 1, 2 and 3. If more detailed information of the analysis of the original design is required, the original reports themselves should be referenced.

1.2 STRUCTURAL SYSTEM OVERVIEW

1.2.1 Floor System:

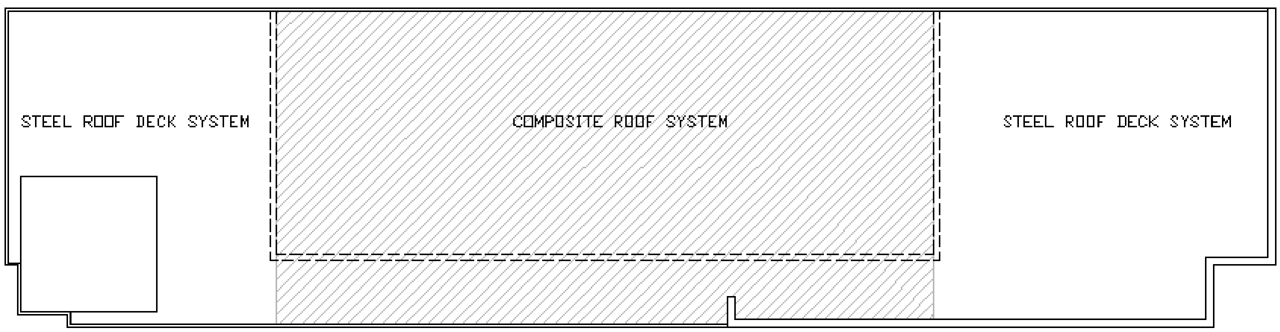
The typical floor is a 6-1/4" thick composite concrete system. It is comprised of a 3-1/4" light weight concrete slab with 3000 psi compressive strength and a 3"-20 gauge A992 (50 ksi) composite steel deck. The slab is reinforced with 6x6-10/10 draped welded wire mesh (WWM) and gains its composite properties from ¾" diameter 5-1/4" long steel studs. This composite floor system is supported by A992 wide-flange beams which are typically spaced at 10' on center, span 30'-5-1/2" in a normal bay, and have a 1" camber. These beams range in size from W14-22 to W16x26 and are in turn supported by a grid of wide flange girders. The girders typically are spaced at 30'-5-1/2" with a 30'-0" span ranging from W18x50 to W24x84 with a 1" camber.

1.2.2 Column System:

The columns are ASTM 572, grade 50 or A992 steel wide flanges, and are laid out in fairly square bays (30'x30'-5-1/2" typ.) forming a mostly rectangular grid of 9 bays by 2 bays. They are the main gravity resisting members of the structure as well as a portion of the lateral resisting system. These major gravity resisting columns range from W12x65 to W14x109 at the bottom level and are spliced 4' above the third floor level. There are lateral force resisting columns in both moment and braced frames which range from W14x99 to W14x211 at the bottom level, however, they tend to be on the order of W14x150s. These columns are also spliced at a distance 4' above the third floor level.

1.2.3 Roof System:

The roof of this structure is constructed in two different systems: typical flat roof steel deck and a composite slab roof construction (See Figure 1.1). The main roof is 3” 18 gauge wide rib, type N galvanized steel roof deck, which is uniformly sloped. The other roof system is a 4-1/2” normal weight composite concrete slab with 3000 psi compressive strength, and reinforced by 6x6-10/10 draped WWM supported by 3” 18 gauge composite steel deck. The composite action in this slab, as in the standard floor slabs, comes from ¾” diameter 5-1/4” long equally spaced studs.



ROOF CONSTRUCTION PLAN

Fig. 1.1

1.2.4 Foundation System:

The ground floor is constructed of a 4” thick slab on grade with a compressive strength of 3000 psi and reinforced with 6x6-10/10 WWM. The columns are supported by concrete footings, compressive strength of 4000 psi, which are in turn supported by driven 14” square precast prestressed concrete piles. The piles, which have an axial capacity of 110 tons, uplift capacity of 55 tons, and a lateral capacity of 7.5 tons, are typically arranged in three pile groups under the exterior columns. These pile groups and footing combinations are connected by reinforced concrete gradebeams running around the exterior of the foundation system. The columns, which form the braced frames around the elevator core, are additionally supported by a reinforced concrete pedestal and a 43 pile mat-pile group footing. The mat supporting these piles, 18 of which are uplift piles, is approximately 21’x 48’ x 64” deep.

1.2.5 Masonry Wall System:

The eastern wall of the structure is backed up by a full height 8” CMU masonry wall running the length of the building, 243’-8” (See Figure 1.2). The wall acts as a barrier between the office building and an adjacent parking garage being concurrently constructed. It separates the two with a 4” expansion joint on the parking garage side and ties into the structure at every floor level with a standard bent plate connection every 32” on center. The wall is reinforced with one or two #6 bars at a spacing of 8"-24" on center depending on the location. It is additionally reinforced with bond beams for impact loads from the parking garage of 6000lbs at a height of 1'-6" above the floor levels. In addition to being a barrier section of the CMU wall, it also acts as (4) 30'-0" masonry shear walls to aid in the lateral force resisting system.

1.2.6 Lateral System:

This building's lateral force resisting system is a combination of multiple system types which act together to laterally support the building (See Figure 1.2). It contains (6) 2-bay moment frames which run in the east-west or transverse direction of the building. Of the (6) moment frames, only two (MF #3 and MF #4) occur at the first two levels, while the other (4) frames extend to the top of the structure. They are arranged symmetrically with (2) moment frames at each end of the grid and another at one full bay in from each end. The structure also has (2) 1-bay braced frames running in the transverse direction centrally located flanking the elevator core. These braced frames are comprised of wide flange columns, beams, and diagonal members, with the diagonal resisting members ranging from W12x79 – W12x190. Typical moment and braced frame elevations can be seen in figure 0.3 and 0.4 respectively. The final components of the system are (4) 30'-0" reinforced masonry shear walls located in the 8" CMU wall running in the north- south or long direction of the building. The connection between the masonry walls, including the shear walls, is designed to allow the steel frames and shear walls to act independently when resisting lateral forces. Where the columns of the steel frames meet the adjacent wall, the masonry is notched back to 6" from 8". The typical connection made between the concrete slab and masonry shear wall consists of a 3/8" bent plate that is vertically slotted at the shear wall face (See Figure 1.5). The vertical slots allow for slabs, columns, and beams working in the transverse direction to deflect without adding out of plane stiffness to the frames. The connection, not slotted in the horizontal direction, is still able to provide lateral bracing for the masonry wall. Also, it engages the shear walls longitudinally as they resist the majority of lateral forces in that direction.

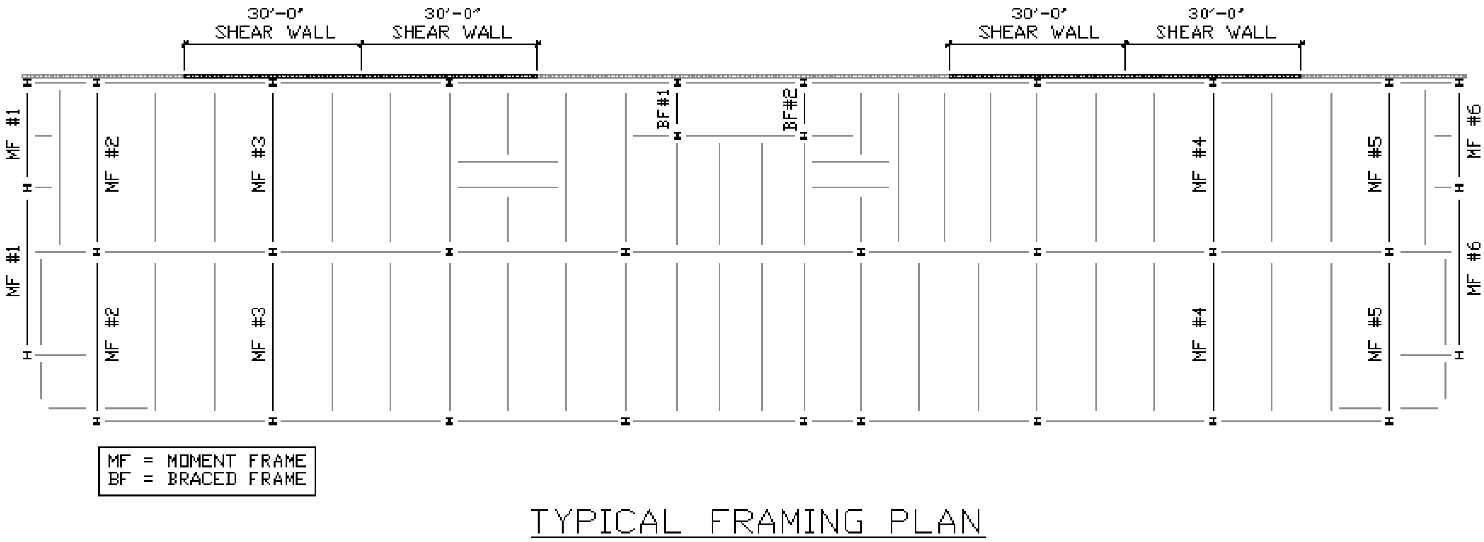


Fig. 1.2

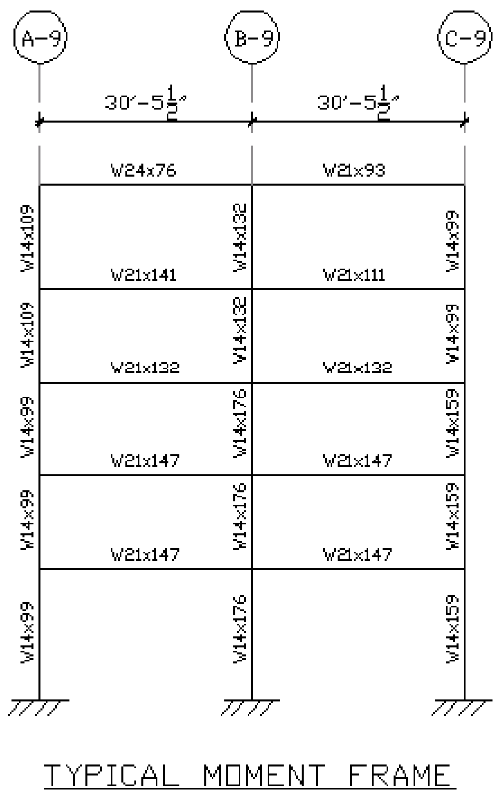


Fig. 1.3

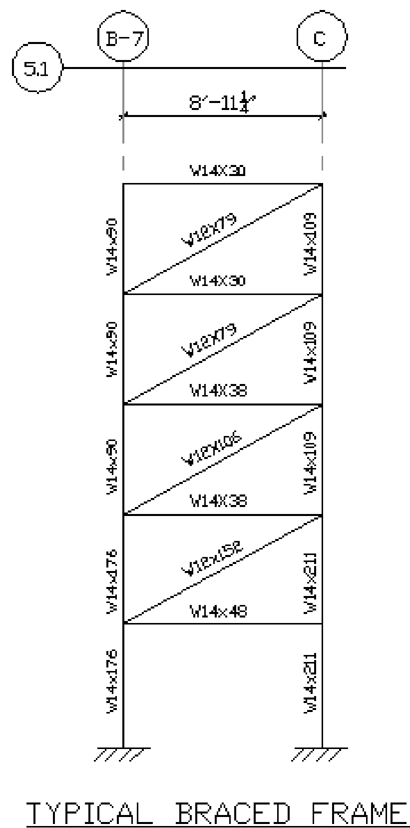


Fig. 1.4

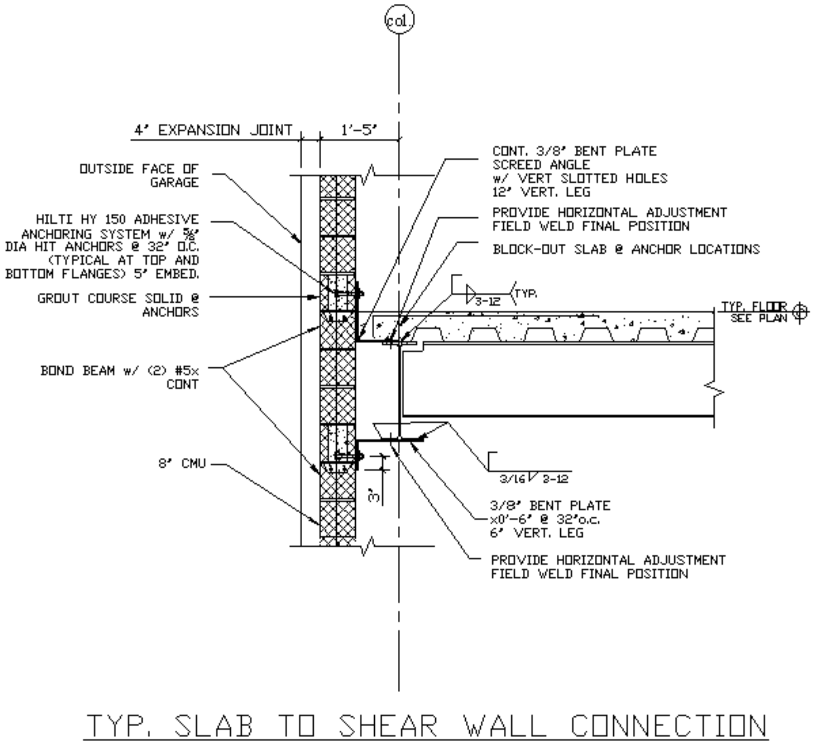

col.
4" EXPANSION JOINT
1'-5"
OUTSIDE FACE OF GARAGE
HILTI HY 150 ADHESIVE ANCHORING SYSTEM w/ 5/8" DIA HIT ANCHORS @ 32" O.C. (TYPICAL AT TOP AND BOTTOM FLANGES) 5" EMBED.
GROUT COURSE SOLID @ ANCHORS
BOND BEAM w/ (2) #5x CONT
8" CMU
CONT. 3/8" BENT PLATE SCREED ANGLE w/ VERT SLOTTED HOLES 12" VERT. LEG
PROVIDE HORIZONTAL ADJUSTMENT FIELD WELD FINAL POSITION
BLOCK-OUT SLAB @ ANCHOR LOCATIONS
3-12
TYP.
TYP. FLOOR SEE PLAN
3/16 3-12
3"
3/8" BENT PLATE x0'-6" @ 32"o.c. 6" VERT. LEG
PROVIDE HORIZONTAL ADJUSTMENT FIELD WELD FINAL POSITION
TYP. SLAB TO SHEAR WALL CONNECTION

Fig. 1.5