Gus Sirakis

From: Bhol, Saroj [sbhol@panynj.gov]
Sent: Thursday, December 14, 2006 4:06 PM
To: Fatma Amer
Cc: Palmieri, Mario; Passeri, Carl; Palmieri, Mario; Vadi, Hamir; angelo.arzano@som.com; carl.galioto@som.com; Bonacci, Carla; Pietropaolo, Paul; Gus Sirakis
Subject: RE: MINUTES OF MEETING 10/5/06
Attachments: Progressive R.doc

Fatma,

The attached write-up should clarify the progressive collapse issue. Sorry for being so late in responding; there was some delay in getting the information from the structural engineer. Should you have any further question on this, please let me know.

Thanks to you and your staff and wish everyone a wonderful Holiday season.

Saroj

-----Original Message-----
From: Fatma Amer [mailto:fatmaa@buildings.nyc.gov]
Sent: Monday, November 06, 2006 10:03 AM
To: Bhol, Saroj
Cc: Palmieri, Mario
Subject: RE: MINUTES OF MEETING 10/5/06

Thank you. I'll see you soon.

From: Bhol, Saroj [mailto:sbhol@panynj.gov]
Sent: Mon 11/6/2006 9:36 AM
To: Fatma Amer
Cc: Palmieri, Mario
Subject: RE: MINUTES OF MEETING 10/5/06

Fatma,

One of the slides in SOM's PowerPoint presentation had a list of the NIST recommendations that are being implemented in the Freedom Tower. Carl Galioto from SOM also mentioned about these during the presentation. I have asked SOM to have the structural engineer provide for you some specifics of the design to resist progressive collapse.

I really appreciate all the help the Port authority is getting from you in spite of your busy schedule.

Thank you so much.

Saroj

-----Original Message-----
From: Fatma Amer [mailto:fatmaa@buildings.nyc.gov]

Sent: Sunday, November 05, 2006 4:09 PM
To: Bhol, Saroj; Passeri, Carl; Palmieri, Mario; Vadi, Hamir; angelo.arzano@som.com; carl.galioto@som.com; Gus Sirakis
Cc: Lombardi, Frank; Zipf, Peter; Lin, C. John
Subject: RE: MINUTES OF MEETING 10/5/06

Saroj, I am in agreement with the minutes. However, I don't recall a specific discussion outlining the compliance with the NIST report except for the alternate sprinkler risers. In particular, I am interested to know the issue regarding progressive collapse. I know that you have the right to present me only with issues that may require code interpretation, but I would appreciate it if you can clarify this issue for me. Thanks a lot

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From: Krzykowski, Claire on behalf of Bhol, Saroj
Sent: Tue 10/31/2006 10:23 AM
To: Fatma Amer; Passeri, Carl; Palmieri, Mario; Vadi, Hamir; angelo.arzano@som.com; carl.galioto@som.com; Gus Sirakis
Cc: Lombardi, Frank; Zipf, Peter; Lin, C. John
Subject: MINUTES OF MEETING 10/5/06

Attached are the minutes of the October 5, 2006 meeting.

<<10-5 MS.pdf>>

Freedom Tower
Progressive Collapse Analysis & Design

Introduction

GSA Progressive Collapse Analysis and Design Guidelines (June 2003) define progressive collapse as "a situation where local failure of a primary structural component leads to the collapse of adjoining members which, in turn, leads to additional collapse. Hence the total damage is disproportionate to the original cause".

ASCE 7–02 defines progressive collapse as "the spread of an initial local failure from element to element that eventually results in the collapse of an entire structure or a disproportionately large part of it."

The analysis and design procedure is to ascertain the performance of a structure when a specific primary load path is disrupted. The elimination of a primary structural element would be as a result of an extreme event. A satisfactory outcome requires that the structure remains stable under sustained gravity load after removal of a primary structural element.

The basic philosophy is to provide an "Alternate Load Path" with sufficient strength to ensure adequate redundancy, enabling the overall structure to remain stable after the removal of a primary structural element.

Criteria

GSA criteria are used for the overall analysis.

- As per GSA Guideline, alternate load path based on a single column removal concept is provided
- The column removal is considered to be instantaneous; therefore, the dynamic amplification factor is considered in the analysis.
- The expected sustained load based on GSA guideline is considered in the analysis, and demands based on the load effects are compared with the expected component capacities.

Methods of Analysis

GSA's Equivalent Linear Static Procedure is used. The Nonlinear Dynamic Procedure is used for moment frame beams.

Structural System

The primary structural system is based on a Tube-in-Tube structural concept, utilizing a robust centrally located reinforced concrete core shear walls as the inner tube and a redundant steel moment-frame system at the perimeter of the tower as the outer tube. The concrete walls forming the center core function as the main spine of the tower resisting the majority of the wind and seismic shear forces as well as the tower gravity load. The perimeter moment-frame system provides additional strength and stiffness for the tower which reduces the lateral load imposed on the core walls. The thickness of the concrete core walls are gradually reduced from a maximum of 48" at the foundation level to 24" at the top of the enclosed building. Several shear walls at below grade levels are increased in thickness by 12" to accommodate the additional horizontal loads from the slurry walls. The concrete strength varies from 12000 psi at the base to 8000 psi at the roof.

The perimeter columns are typically W14 wide flange steel members. At lower levels, they are reinforced by additional steel plates for added strength and rigidity. The centerline of the structure at the base of the building is a 200 foot square. From the first office floor at the 20th floor (Ht. 167'-8"), the corners chamfer at a constant slope to the top of the building where the corners meet the central column. The columns are typically spaced at 30 foot on center and connect with the sloped columns on the chamfered face at floor levels to create structural nodes with the floor beams. The tower floor construction is comprised of composite steel metal deck with concrete slabs supported on steel framing. The steel floor beams are connected by shear connectors to the concrete slab for composite action. The steel beams span from the internal concrete core walls to the perimeter spandrel beams and steel columns.