PERFORMANCE TARGET CHOICES BY OWNERS UNDER ASCE 7-10 AND ASCE 41-13: IMPROVING SEISMIC RESILIENCY AND REDUCING SEISMIC RISK IN THE LEGAL ARENA

（ASCE 7-10及びASCE 41-13に基づく耐震性能目標を達成するための選択肢:
耐震性を向上させ、法的観点からの地震リスクを低減するには）

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地震活動が活発な地域の都市中心部では、水平方向耐震性に対し（地震からの水平方向の負荷に対する耐性）一つの水平方向耐震システムのみ利用する新しい構造設計を選ぶデベロッパーが増えている。予見された地震での完成建造物の性能は、その設計により決まってくるが、性能が不十分な場合、物件所有者は多額の法的責任に直面することになる。最近の判例によれば、所有者は法定基準の順守だけでは、不十分な耐震性を原因とする死亡、破壊、ダウンタイムの法的クレームからの全面的な保護は期待できない。より良い方法は、新しい構造設計の完成前に、ASCE 7-10およびASCE 41-13に関連した一連の疑問点を、リスク・カテゴリーの選択も含めて、構造コンサルタントに相談することである。

例えば、所有者がRC建造物の賃貸面積を3倍に拡大したい場合を考えてみよう。所有者は、まず、既存建造物のどの部分をそのまま残すか、改造するか、取り壊して建て替えるかの決断を下さなければならない。賢明なアプローチとしては、まず、構造コンサルタントに少なくとも安全レベル地震（SLE）、設計レベル地震（DBE）、考慮すべき最大地震（MCE）という３つの想定状況で当該建造物が発揮すると思われる性能について相談することである。それによって、所有者は予測性能が目標性能にマッチしているかどうかの判断ができる。このプロセスを経ることで、法的観点からの地震のリスク管理が向上する。

WHEN NEW STRUCTURES FAIL

MOMENT MAGNITUDE 5.3 EARTHQUAKE

Photo Credit: Eduardo Fierro, BFP Engineers, Inc.

Photo Credit: Alvin Jornada, courtesy of The San Francisco Chronicle. www.sfgate.com

FIRST TRICK QUESTION

As a matter of law, is a building owner automatically immune from legal liability if it chooses to design, build or operate a structure in accordance with minimum building code standards?

質問　1

法律論として、建造物の設計、建設、運用で最低限の法定基準を順守すれば、所有者は自動的に法的責任から免れるか？

ANSWER TO FIRST TRICK QUESTION

NO! In the published court opinion entitled ***Myrick v. Mastagni*** (2nd District 2010) 185 Cal. App. 4th 1082, the trial judge, the jury and the court of appeal all found that a building owner can have legal liability for the poor seismic performance of a structure even if its management and use is in accordance with the minimum standards of local ordinances and building codes.

質問１の回答

免れない！

ミリック対マッツァーニ(2010年第２連邦地方裁判区)(185 Cal. App. 4th 1082)と呼ばれる訴訟事件では、公判裁判官、陪審人、控訴審の判断として、建造物が地方自治体の条例及び建築基準法を最低限満たしていても、耐震性能が不十分であれば、その所有者は法的責任を負うことになる。


MOMENT MAGNITUDE
6.5 EARTHQUAKE,
EPICENTER LESS THAN 25 MILES AWAY.
Photo Credit: Joe Johnston. Photo courtesy of The Tribune. www.sanluisobispo.com

The general rule is that statutory compliance is not a complete defense in a lawsuit based upon poor performance of a structure during an earthquake.

A statute, ordinance or regulation ordinarily defines a minimum standard of conduct and mere adherence to that minimum standard "***does not*** preclude a finding that a reasonable person would have taken additional precautions under the circumstances."

不十分な耐震性能が争点となる訴訟では、一般に、法令を順守しているだけでは十分な抗弁にはならない。

制定法、条例、規制は一般に最低限の基準を定義しているのであり、最低限の基準を守っただけでは「常識ある通常人であれば同じ状況で用心のためさらなる予防策を実施していただろう」という、裁判所による認定を避けることはできない。

SECOND TRICK QUESTION

As a matter of law, is a design professional automatically immune from legal liability to a party with whom it has no contractual relationship, who claims he or she was injured by poor performance of designer's facility during an earthquake?

質問２

法律論として、設計業務のプロフェッショナルは、不十分な耐震性能で傷害を受けたと主張する契約当事者でない者に対する法的責任から自動的に免れるか？

ANSWER TO SECOND TRICK QUESTION

NO! In its opinion for the *Beacon* case (2014) 59 Cal.4th 568, the California Supreme Court held that design professionals can have a non-statutory duty to avoid design flaws that may harm third parties with whom they have no contractual relationship. Most courts will extend the logic of this rule to structural engineers whose flawed designs cause poor performance in a foreseeable earthquake.

質問２の回答

免れない！

ビーコン訴訟事件(2014) (59 Cal.4th 568)でのカリフォルニア州最高裁判所の判断では、契約関係のない第三者に損害を与える可能性のある設計欠陥を避ける非制定法上の義務が設計業務のプロフェッショナルにあるとした。大多数の裁判所は、この法理を予見可能な地震で十分な耐震性を発揮できない設計を行った構造設計士にも適用するであろう。

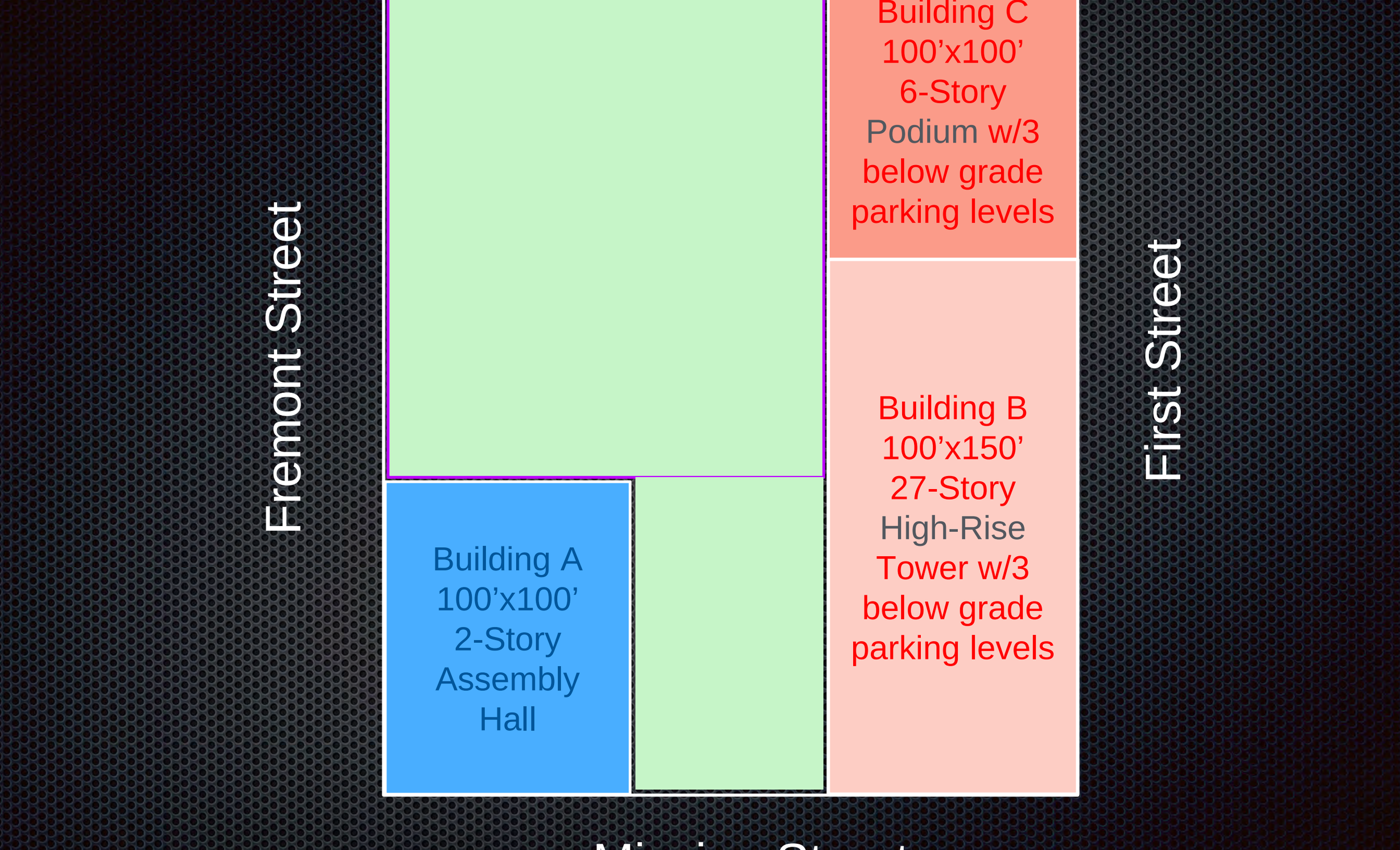
OUR SCENARIO

Developer wants to retrofit and reconfigure an existing urban campus in San Francisco. It plans to hire a structural engineer to design a new high-rise tower and at the same time, manage the seismic risk inherent in the project.

シナリオ

デベロッパーがサンフランシスコに現存するアーバン複合施設の改造・改築を考えている。新しく高層ビルを設計し、同時にそのプロジェクトに内在する地震リスクを管理するため、構造設計士を雇おうと考えている。

LAYOUT OF HYPOTHETICAL CAMPUS PROJECT IN SAN FRANCISCO


Fremont Street
First Street
Building C
100’x100’
6-Story
Podium w/3
below grade
parking levels
Building B
100’x150’
27-Story
High-Rise
Tower w/3
below grade
parking levels
Building A
100’x100’
2-Story
Assembly
Hall

THE ISSUES

What levels of seismic performance should Developer choose when directing its structural engineer to develop the design for a new podium and new high-rise tower, and how do they help demonstrate that Developer took reasonable steps under the circumstances to protect others? Same questions for retrofitting the Assembly Hall.

問題点

デベロッパーは、新しい高層ビルのポディアム部と高層タワー部の設計を担当する構造設計士に指示で、どのレベルの耐震性能を選ぶべきか？

本状況下で、デベロッパーが合理的な安全処置を講じたということを証明するには、どの耐震性能レベルを選ぶべきか？

人が集まる集会施設の改造・改築についても同じ質問。

ONE OPTION

Unless the Developer is an expert in seismic engineering, it should first receive cost and benefit information from its structural consultant, and then choose a seismic performance profile for its new high-rise consistent with ASCE 7 Risk Category II, Risk Category III, or higher, depending on occupancy and use.

Table One. Resiliency of a High-Rise Structure is a Function of the Risk Factor Chosen

	Risk Category II	*Risk Category III*	*Risk Category IV*	*Risk Category V*
Examples of characteristics determining the Risk Category for a High-Rise:				
In the event of failure during an earthquake, the high-rise . . .		. . . could pose a substantial risk to human life; or	. . . could pose a substantial hazard to the community.	[Not applicable because the high-rise would not fail in SLE, DBE or MCE earthquakes because it remains elastic in all three.]
		. . . has potential to cause "a substantial economic impact"; or		
		. . . has potential to cause "mass disruption of day-to-day civilian life."		
Other criteria:	It is outside I, III and IV.		It is an "essential facility."	It has national security characteristics.
The Risk Category Chosen corresponds to expected performance during an MCE, including "Maximum Probability" of the following:				
Total or partial structural collapse:	10%	6%	3%	~ 0%
Failure that could result in endangerment of individual lives	25%	15%	10%	~ 0%

Compiled from ASCE 7-10 section 1.5 and Tables 1.5-1 and 1.5-2; ASCE 7-10 Commentary section C1.5.1 ("The lives

Table Two. Performance Target Choices by Developer in Hypothetical San Francisco Campus Project

SF Campus Project		*Seismic Hazard and Performance Target Choices*		
Structures:	*Components:*	SLE	DBE	MCE
Two-Story Assembly Hall	*Structural*	Elastic	Damage Control	Limited Safety
	Non-Structural	Fully Operational	Position Retention	Position Retention
Corporate Headquarters (Podium/Garage)	*Structural*	Elastic	Elastic	Immediate Occupancy
	Non-Structural	Fully Operational	Fully Operational	Operational
Commercial and Residential 27-Story High-Rise Tower	*Structural*	Elastic	Immediate Occupancy	Damage Control
	Non-Structural	Fully Operational	Operational	Position Retention

MANAGING RISKS AND DEVELOPING BENEFITS

Investment in the new high-rise is at risk.

Commercial relationships are at risk.

Poor performance in earthquake can trigger legal claims by contract partners, visitors and neighbors.

Short-term costs to exceed minimal seismic performance can yield substantial long-term benefits.

リスク管理と効果の拡大

新高層ビルへの投資リスク。

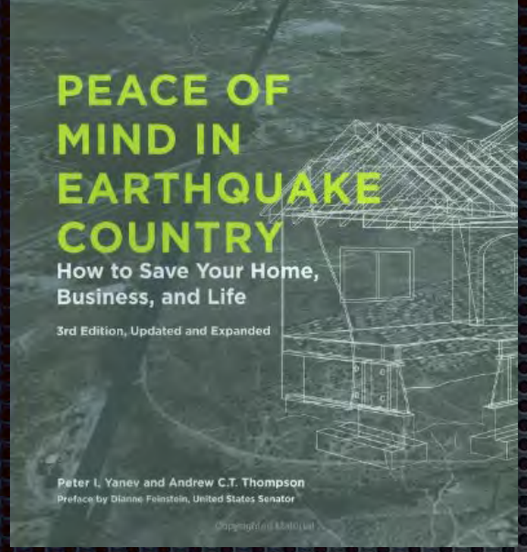
ビジネス関係上のリスク。

不十分な耐震性能による契約パートナー、来客者、隣人からの訴訟リスク。

最低限以上の耐震性能を得るための短期コストは、長期的な経済効果を生み得る。

Applying these concepts to a subset of new high-rises currently being built along the Pacific Rim:

Concrete Ductile Core Towers




Seismic Performance and Design Requirements for High-Rise Concrete Buildings

By Joe Maffei, S.E., Ph.D. & Nicole Turo, S.E.

Code Acceptance of Non-Prescriptive Designs

STRUCTURE magazine 28 April 2007

The Concrete Ductile Core approach raises three commercial concerns:

- No second line of defense in an EQ
- No field tests of completed towers—untested in a strong earthquake
- Performance based design, with peer review, is required because the tower height takes it out of the prescriptive design provisions of the IBC

DEVELOPER'S CHOICE OF A SEISMIC PERFORMANCE PROFILE

When its structural consultant starts to develop the performance based structural design, Developer should consider choosing Risk Category III as the design starting point for its new high-rise.

デベロッパーの
耐震性能の選択

構造設計コンサルタントが性能レベルをもとに高層ビルの構造設計を始める際、デベロッパーは、まず、リスクカテゴリーⅢの選択を考えるべきである。

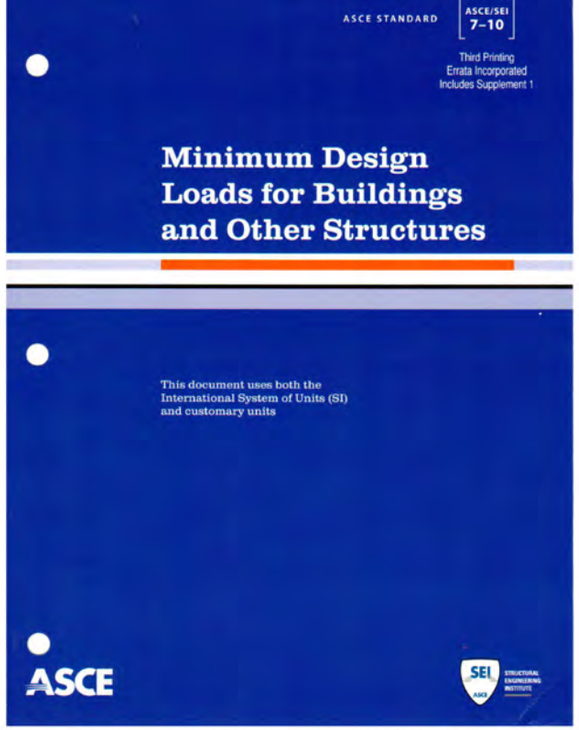
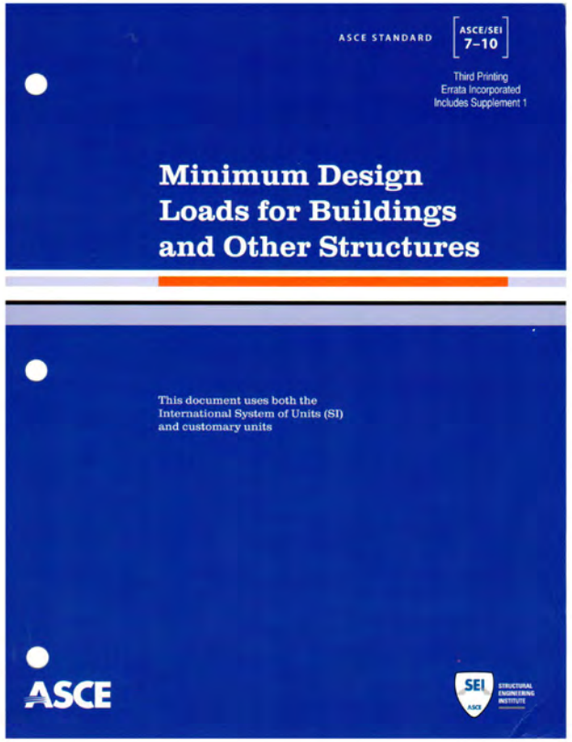


Table C.1.3.1b Anticipated Reliability (Maximum Probability of Failure) for Earthquake[1]

Risk Category I and II	
Total or partial structural collapse	10% conditioned on the occurrence of maximum considered earthquake shaking
Failure that could result in endangerment of individual lives	25% conditioned on the occurrence of maximum considered effects
Risk Category III	
Total or partial structural collapse	6% conditioned on the occurrence of maximum considered earthquake shaking
Failure that could result in endangerment of individual lives	15% conditioned on the occurrence of maximum considered earthquake shaking
Risk Category IV	
Total or partial structural collapse	3% conditioned on the occurrence of maximum considered earthquake shaking
Failure that could result in endangerment of individual lives	10% conditioned on the occurrence of maximum considered earthquake shaking

[1]Refer to the NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Strucures, FEMA (1997), for discussion of the basis of seismic reliabilities.



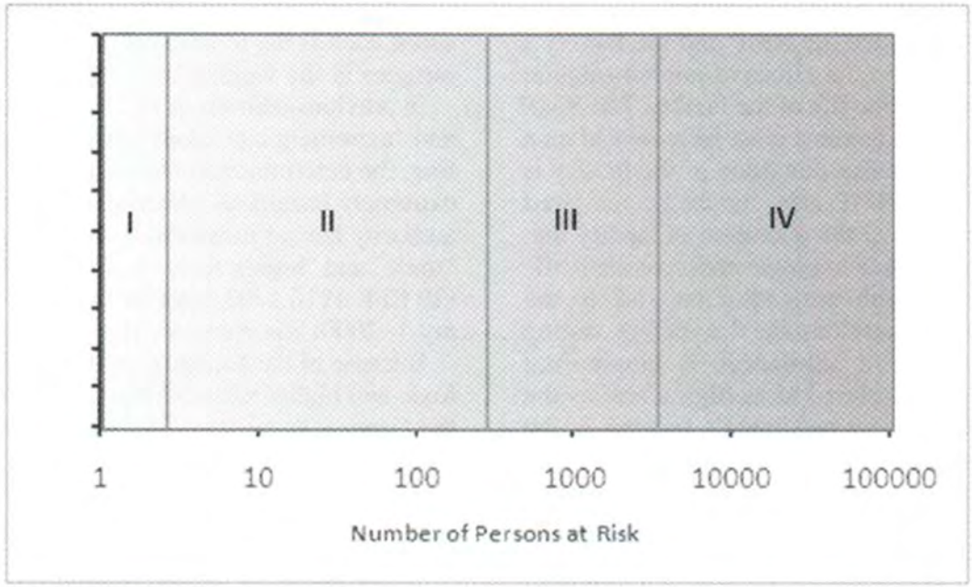


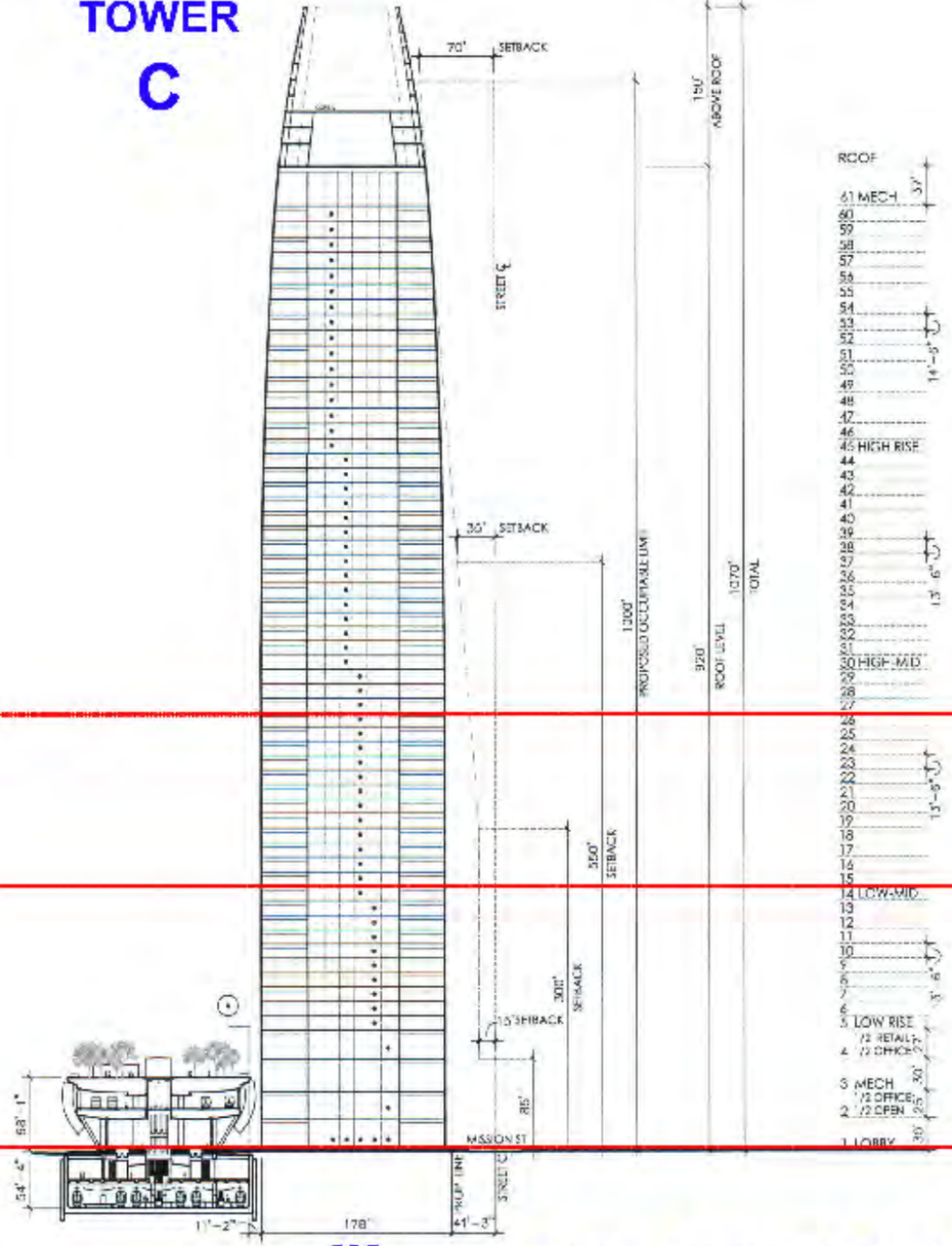
FIGURE C1-1 Approximate Relationship between Number of Lives Placed at Risk by a Failure and Occupancy Category.

SHORT-TERM EXTRA COSTS OF CHOOSING RISK CATEGORY III AND LONG-TERM IMPROVED SEISMIC PERFORMANCE

Short-term costs to exceed minimal seismic performance are expected to average between 3% and 5% of total project costs, and can yield substantial long- and term benefits, including improved seismic resiliency and reduced repair costs.

CONCRETE DUCTILE CORE HIGH RISES IN SAN FRANCISCO: EXAMPLES

TOWER
C



III

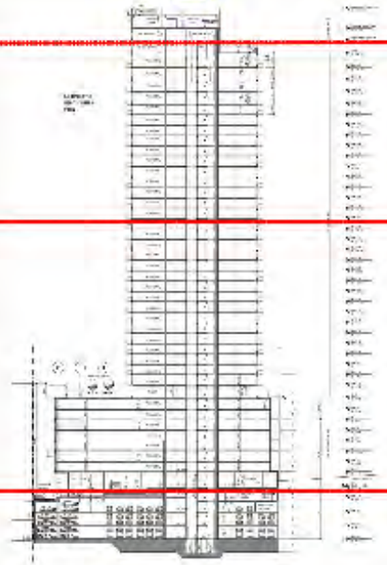
400+ FEET

240+ FEET

GROUND FLOOR

TOWER
A

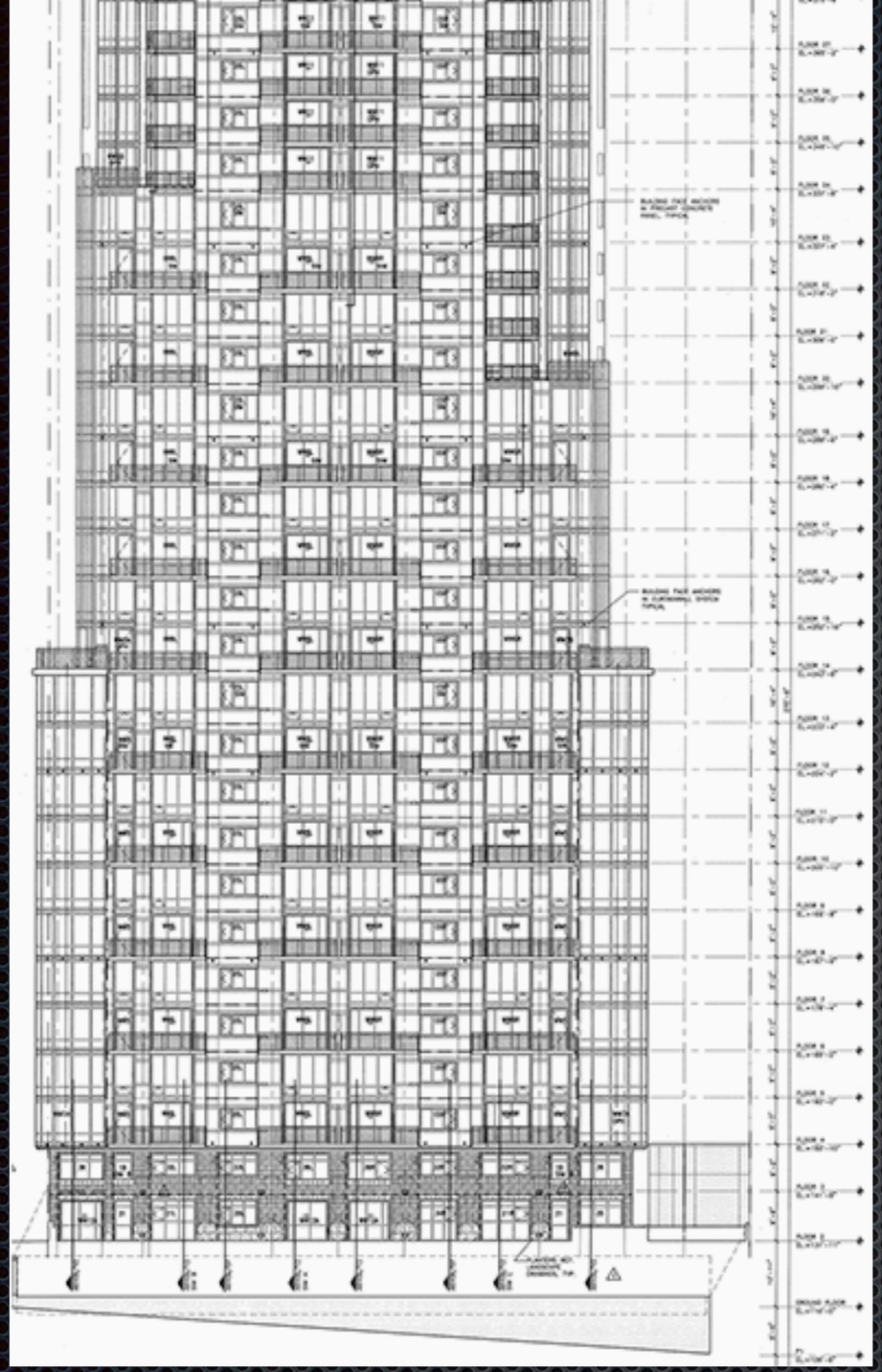
TOWER
B



II

ASCE 7 RISK CATEGORY CHOSEN: II

SOURCES:
Pelli Clarke Pelli Architects;
Magnusson Klemencic Associates



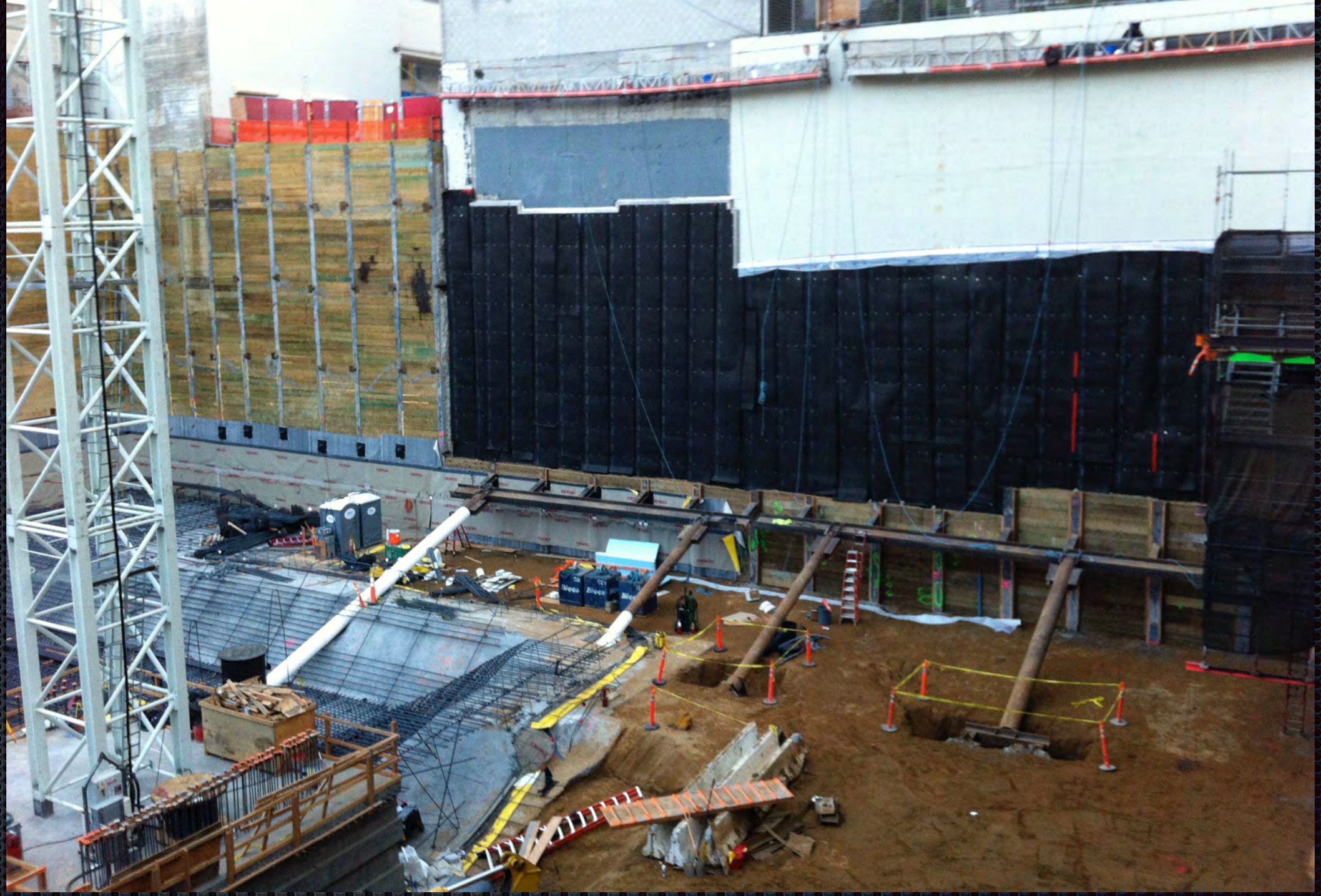
BUILDING A

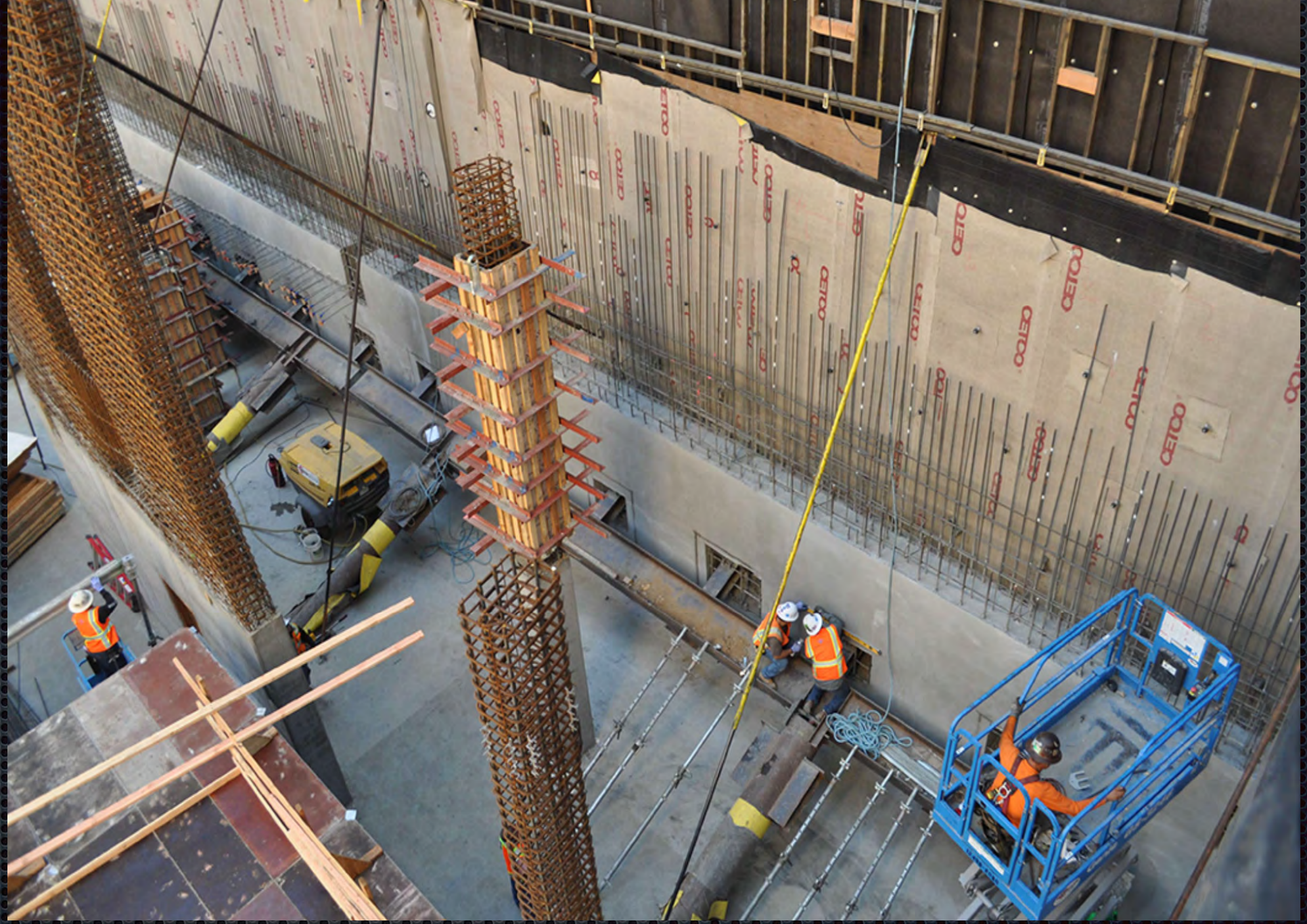
Field Status: Completed 2005

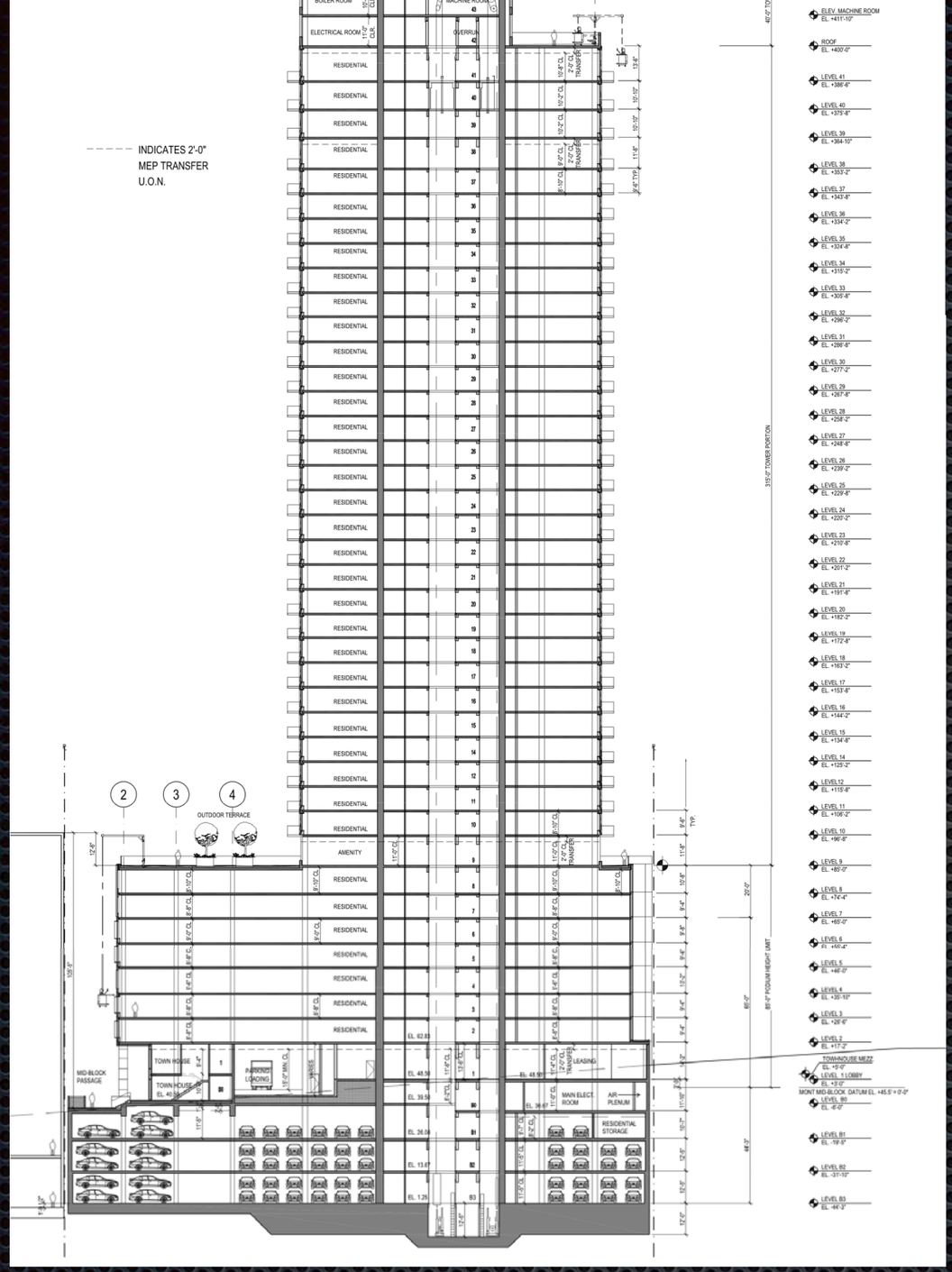
Tower Height (to roof in feet): 256

Stories: 26

Area (square feet): 530,000




CETCO



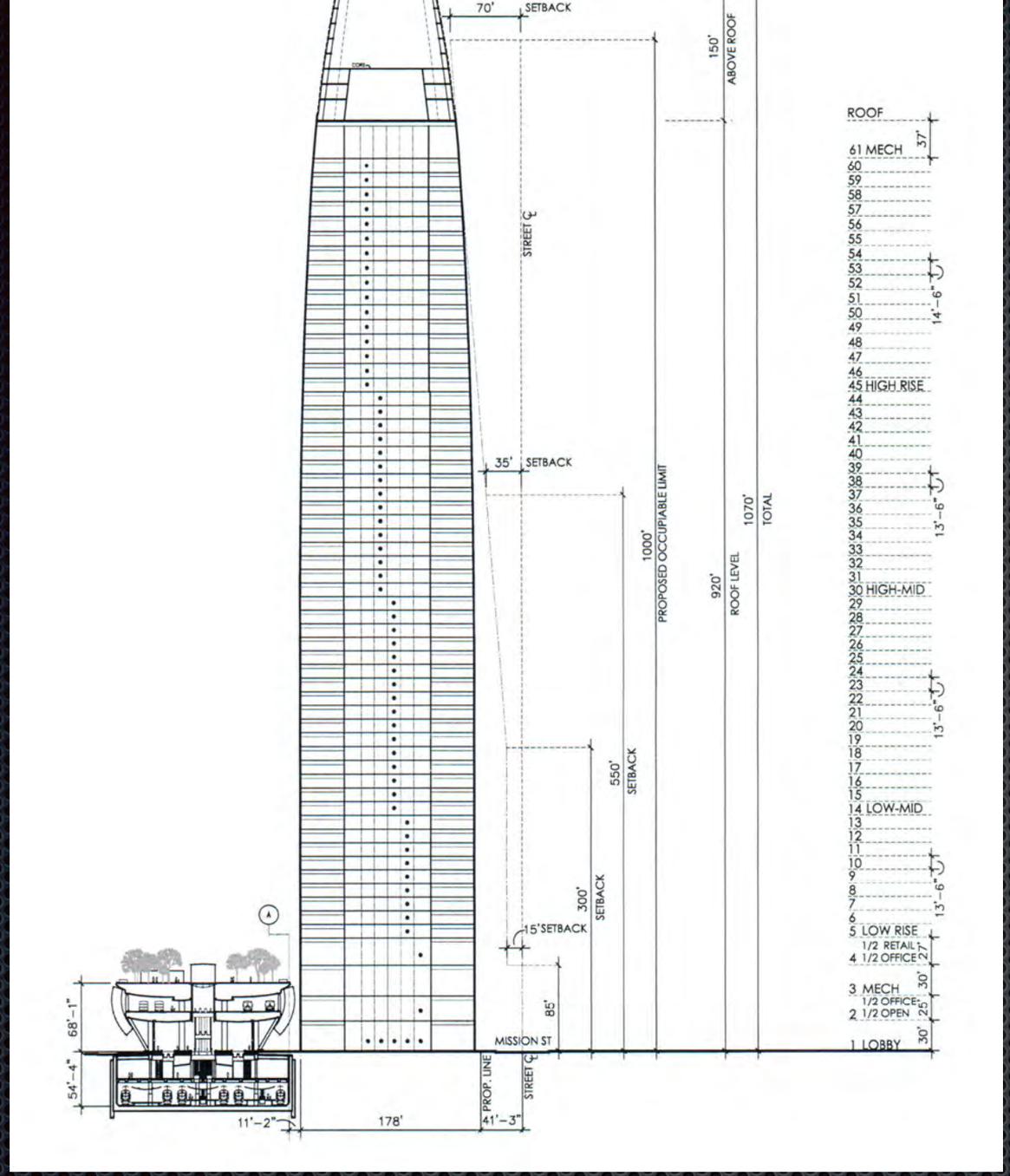
BUILDING B

Field Status: Started 2014

Tower Height (to roof in feet): 400

Stories: 40

Area (square feet): 340,000



BUILDING C

Field Status: Started 2014

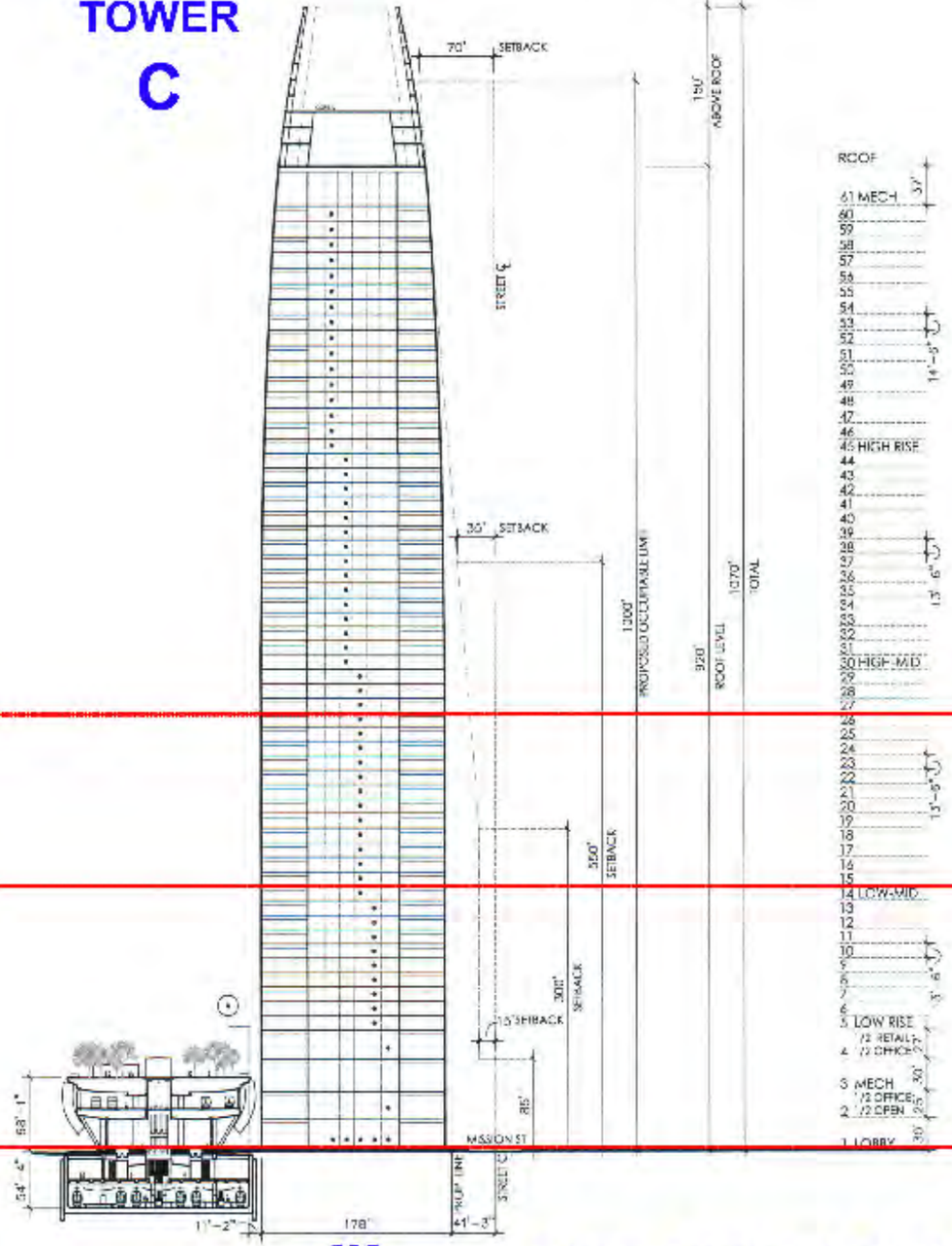
Tower Height (to roof in feet): 920

Stories: 60

Area (square feet): 1,400,000

CONCRETE DUCTILE CORE HIGH RISES IN SAN FRANCISCO: EXAMPLES

TOWER
C



III

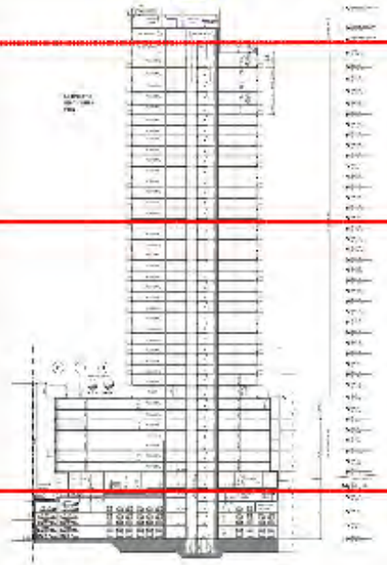
400+ FEET

240+ FEET

GROUND FLOOR

TOWER
A

TOWER
B



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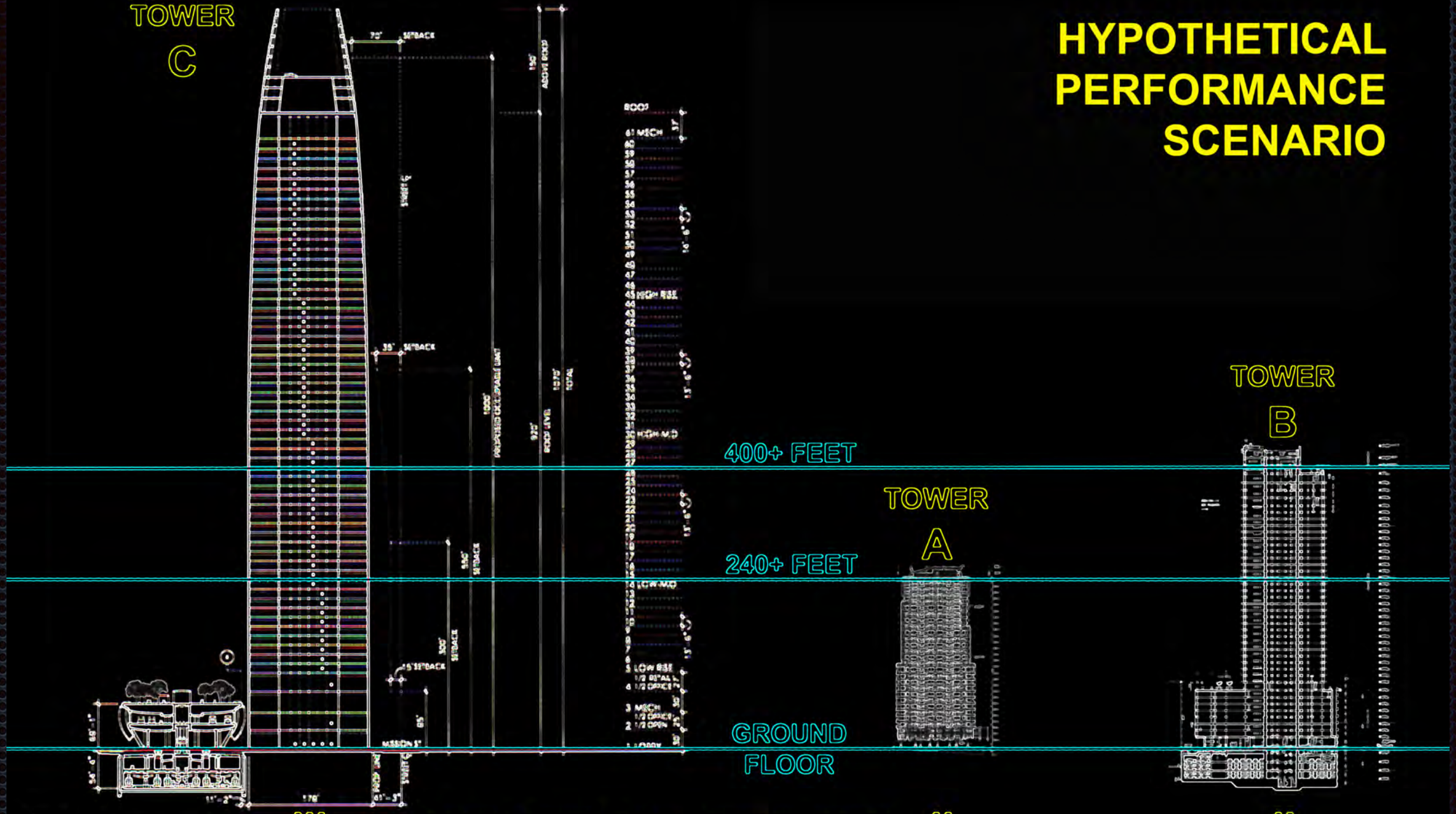
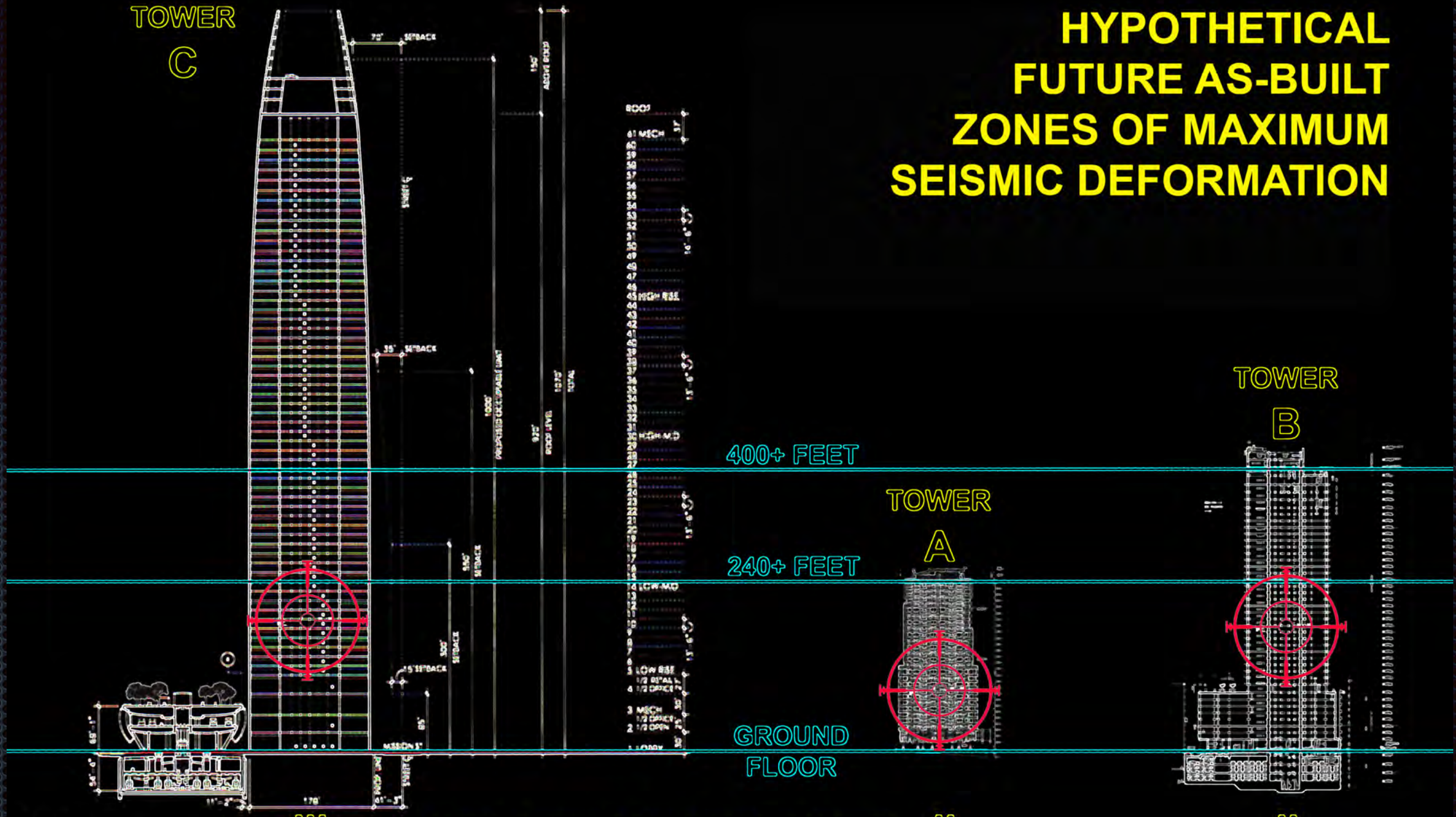
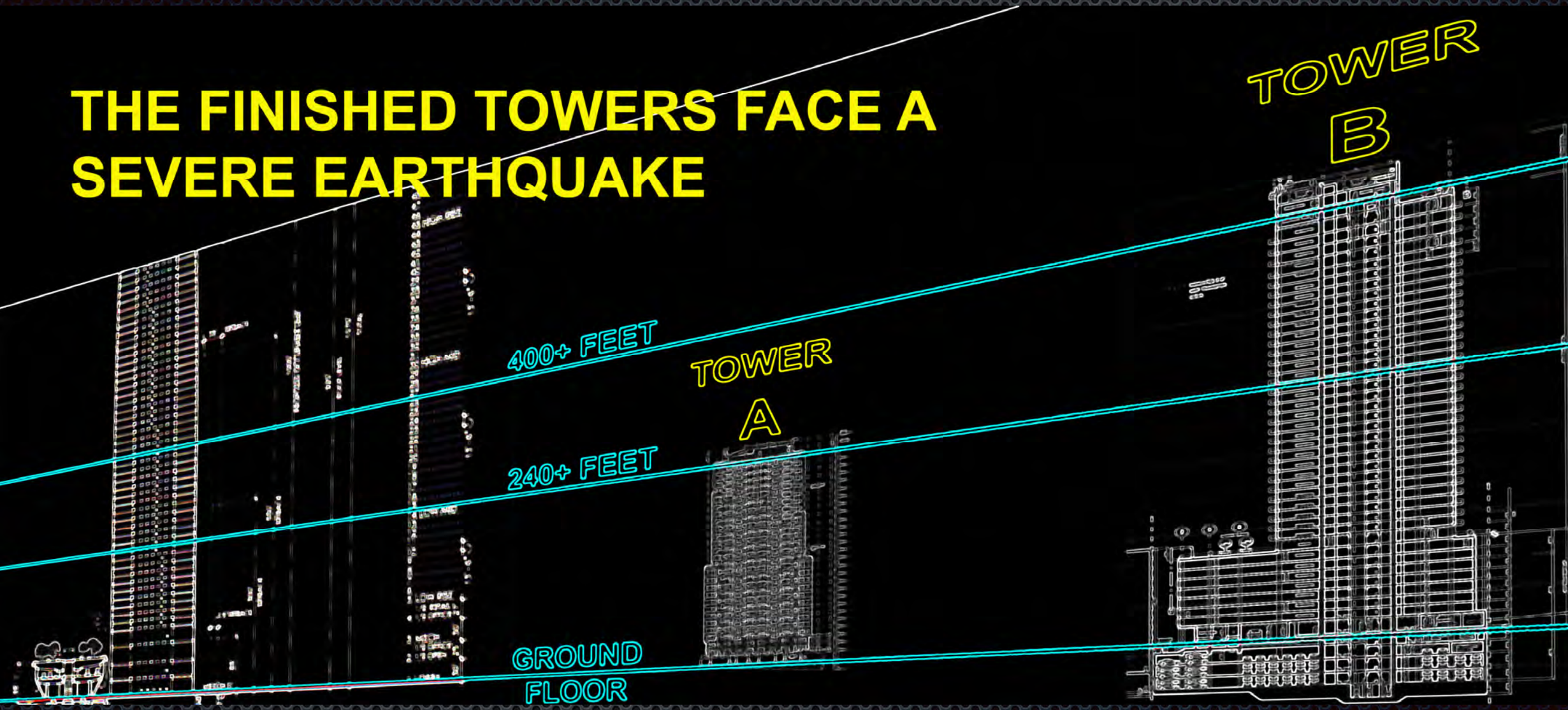
HYPOTHETICAL PERFORMANCE SCENARIO

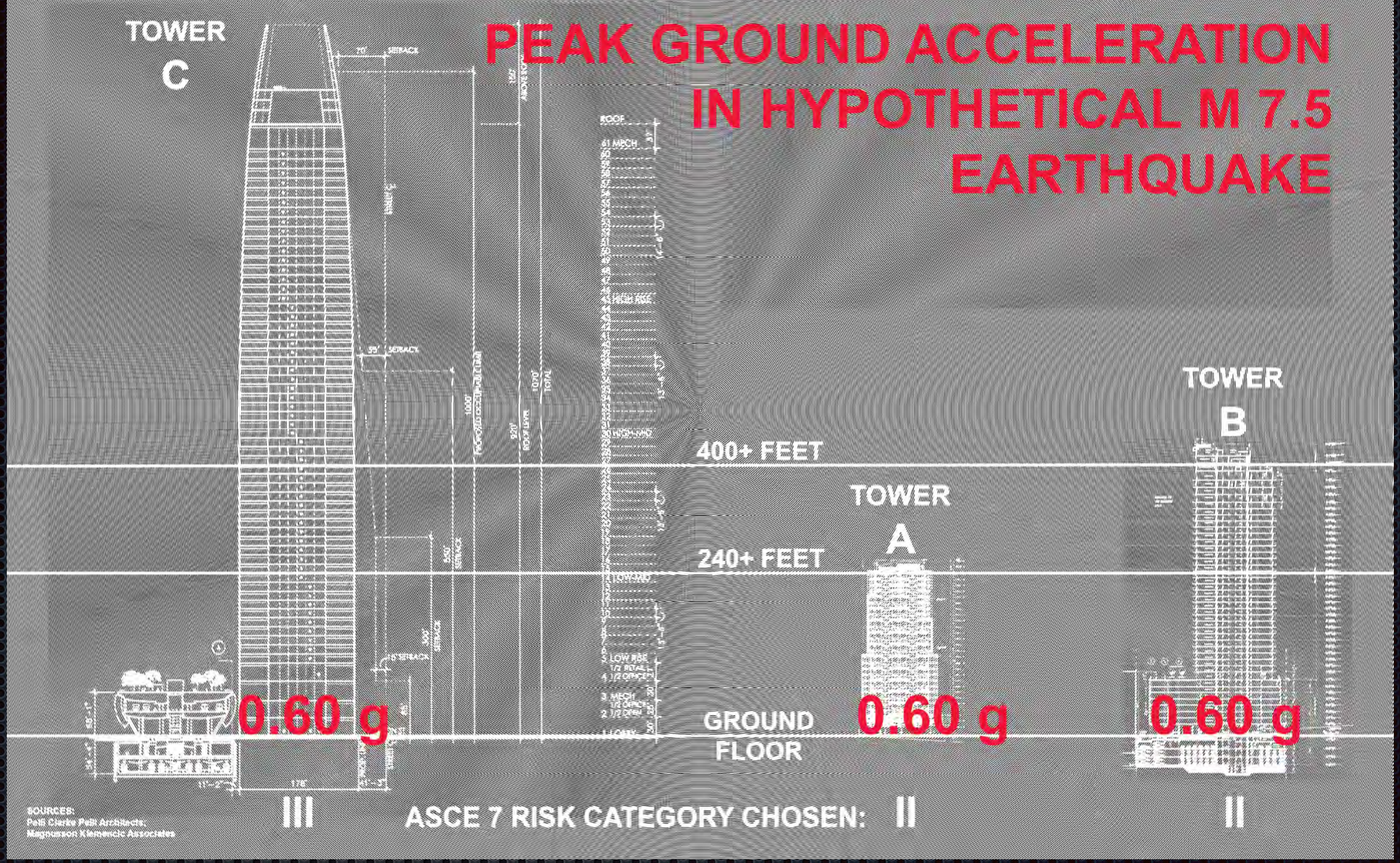


HYPOTHETICAL FUTURE AS-BUILT ZONES OF MAXIMUM SEISMIC DEFORMATION



THE FINISHED TOWERS FACE A SEVERE EARTHQUAKE




TOWER
C
PEAK GROUND ACCELERATION
IN HYPOTHETICAL M 7.5
EARTHQUAKE
TOWER
B
400+ FEET
TOWER
A
240+ FEET
0.60 g
GROUND
FLOOR
0.60 g
0.60 g
III
ASCE 7 RISK CATEGORY CHOSEN: II
II
SOURCES:
Pelli Clarke Pelli Architects;
Magnusson Klemencic Associates

HYPOTHETICAL DEATH, DAMAGE & DOWNTIME FOLLOWING M 7.5 EARTHQUAKE

TOWER C

(i) 3 Injuries;

(ii) Moderate;

(iii) 45 Days.

TOWER A

(i) 4 Injuries;

(ii) Moderate;

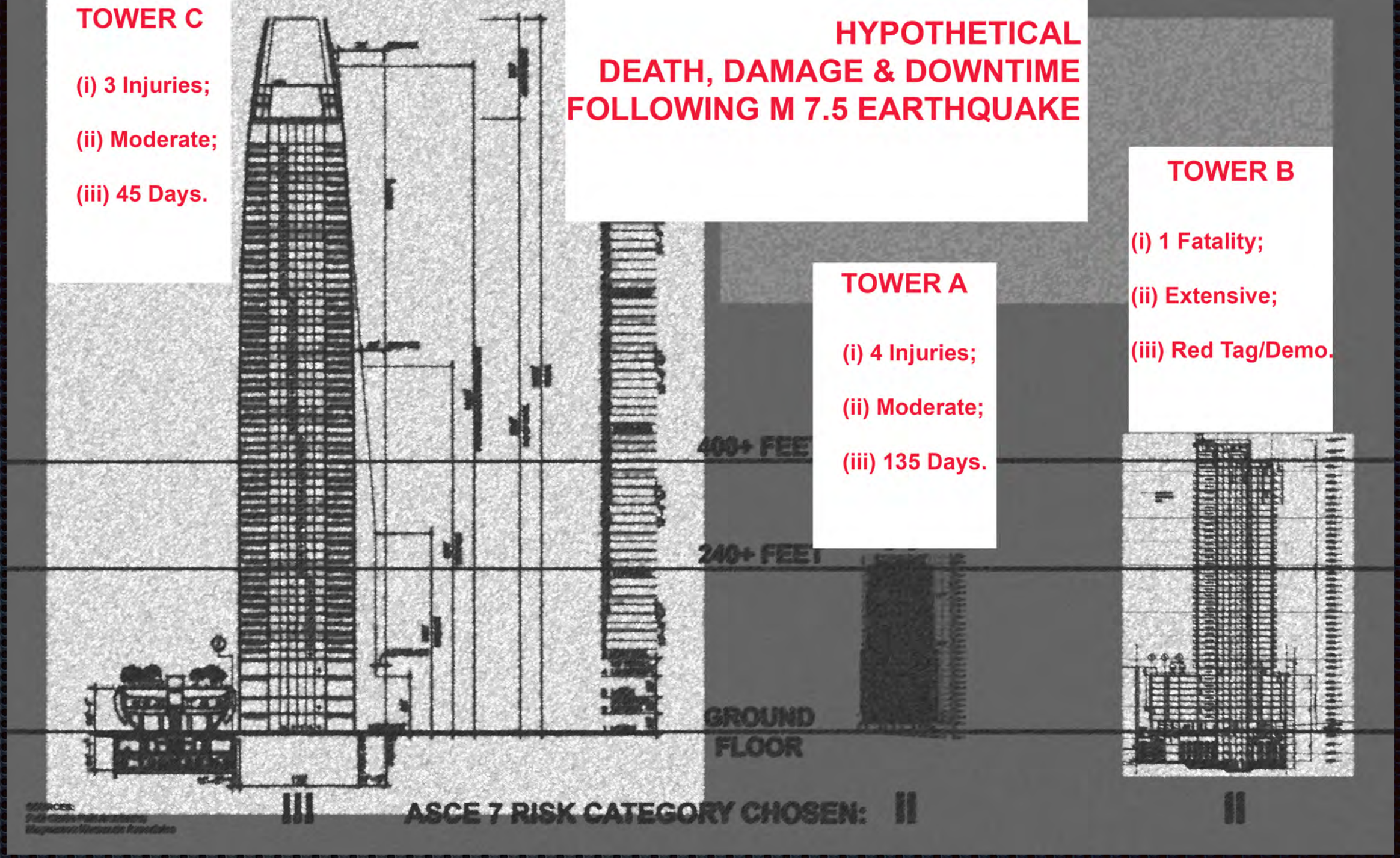
(iii) 135 Days.

TOWER B

(i) 1 Fatality;

(ii) Extensive;

(iii) Red Tag/Demo.



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