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# Cosmetically Repaired Welded Steel Moment Frames: A Clear Risk of Disaster

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## Introduction

If an owner negotiates with a car dealer for the purchase of a new passenger vehicle with airbags, he can safely assume that in a head on collision the air bags will inflate and protect the passengers from serious injury or death. If an owner buys a recently constructed steel frame high rise, or a residential owner buys a condominium in a steel frame high rise, the new owner will similarly assume that the steel construction will provide adequate resistance to a normal earthquake. The owner may also assume that a "moderate," Northridge type earthquake, will not result in serious injury or death to the occupants, and that the structure will not collapse or partially collapse. This is because steel frame construction has been widely considered to be among the most earthquake resistant types of construction. If the owner of the new passenger vehicle discovered that the air bags were ruptured and could not function in a head on collision, he would return the vehicle to the dealer and the dealer would replace the air bags with new ones. If it turned out that the original batch of airbags was defective, the dealer would take steps to assure that the replacement air bags were from a non-defective batch. Once they were installed, they would function as expected in the head on collision. If the owner of the steel moment frame building discovered that the weld metal in the critical moment frame connection suffered "brittle fractures" during the Northridge Earthquake and the building would not resist moderate earthquake loads, he would notify the seller, general contractor and design professionals and ask for the replacement of the defective welds. Unfortunately, the air bag analogy breaks down here because throughout the southland, defective brittle welds are not being replaced but only repaired. Undoubtedly, the replacement cost of \$8,000 to \$30,000 each for defective welds is a substantial reason for this ongoing practice. But, just as it would be inappropriate to "tape over" a tear in an airbag, it should be equally inappropriate to repair defective brittle welds by welding over the brittle weld metal fractures. This is because the brittle welds themselves are the defect and the fractures are manifestations of their inability to transfer earthquake loads. Repairing brittle welds by re-welding fractures in the brittle weld metal ignores the root problem of the brittle welds and leaves them in place to fail again in the next earthquake. Such repairs cannot be considered structural repairs, and are cosmetic at best, yet they are passed off as

structural and permanent repairs.

## STEEL MOMENT FRAME CONSTRUCTION

The seismic design philosophy for steel moment frames assumes that in earthquakes the steel frame elements will be stressed beyond their elastic range but will not fracture. Ductility (flexibility) is the property that enables steel to distort without fracturing. This article will focus on Type I rigid or continuous frame construction. Analytically, Type I construction has connections that transmit loads to beams and columns. The connections between the beams and columns are full penetration welds on the critical path for the transfer of earthquake loads. It is critical that the welds also be ductile and of comparable strength to the beams and columns so that a lateral load will find its path from the beam, to the connection, to the column and down to the foundation without encountering an element that is too weak to resist the load. The role of the connection is to maintain its strength while adjacent beams yield and deform inelastically. Uniform Building Code Requirements

The weld connections deposited with E70T-4 do not meet the criteria of either Chapter 22 or Chapter 16 of the *Uniform Building Code* (1994). The UBC defines a moment frame as a frame in which members and joints are capable of resisting forces primarily by flexure. *Id.* at §1625. The UBC further defines a special moment-resisting frame as a "moment-resisting frame specially detailed to provide ductile behavior and comply with the requirements given in Chapter 16 or 22." Chapter 22 relating to steel construction provides as follows:

*2211.7.1.1 Required strength. The girder-to-column connection shall be adequate to develop the lesser of the following: 1. The strength of the girder in flexure. 2. The moment corresponding to development of the panel zone shear strength as determined from Formula (11-1).*

*2211.7.1.2 Connection strength. Connection configurations utilizing welds or high-strength bolts shall demonstrate, by approved cyclic test results or calculation, the ability to sustain inelastic rotation and develop the strength criteria in Section 2211.7.1 considering the effect of steel overstrength and strain hardening.*

The one exception is found in UBC §1631.2.4.2 regarding exterior nonbearing, nonshear connections. These connections "[s]hall have sufficient ductility and rotation capacity so as to preclude fracture of the concrete or brittle failures at or near welds. Although the UBC specifies the required connection strength, the UBC does not quantify an inelastic rotation capacity. Cal. Dept. of Conservation, *The Northridge, California, Earthquake of 17 January 1994*, Special Publication 116 (1995), p. 149 ("CDC"). Investigations after the Northridge Earthquake established that weld connections deposited with E70T-4 electrodes had a very low fracture resistance and developed fractures. Thus, the weld connections do not provide the ductile behavior required by the UBC.

## Damage to Steel Frame Structures in the Northridge Earthquake

Following the Northridge Earthquake, the California State Seismic Safety Commission prepared its "Report To The Governor - Turning Loss To Gain," published in 1995.

*The magnitude 6.7 Northridge earthquake occurred at 4:31 in the morning of January 17, 1994, on a national holiday, when most Californians were at home asleep. Fifty - seven people lost their lives, nearly 9,000 were injured, and damage exceeded \$20 billion. The summary of the Northridge earthquake's impact is 'It could have been a lot worse.' In fact it would have been a lot worse if the earthquake had occurred later in the day and if its duration and intensity had been of the nature anticipated for most of California.*

(California Seismic Safety Comm., *Northridge Earthquake, Turning Loss to Gain*, x (1995).

The Report, expressed shock at the performance of steel moment frame buildings which had previously been believed to be the most earthquake resistant construction.

*The biggest surprise in the terms of building performance from the Northridge earthquake, at least to professionals who deal with seismic design regularly, was the poor performance of steel buildings with moment - resisting frames. Steel buildings have long been viewed as among the most reliable structural systems for resisting earthquakes. They are common for modern high-rises, not only in California but throughout the world. Id. at 65.*

The Northridge Earthquake raised serious questions about the design and construction of steel moment frame systems.

*"Fortunately none of the failures resulted in building collapse or loss of life. However, since the earthquake shaking was of short duration, it is an open question as to how the damaged buildings would have performed if the shaking had lasted substantially longer or of stronger intensity." Id.*

SAC, a joint venture of agencies (Structural Engineers Association of California, Applied Technological Council, and the California Universities for Research in Earthquake Engineering) has issued advisories and interim guidelines for the repair, retrofit and design of steel moment frame structures. (See SAC Joint Venture, *Steel Moment Frame Connection*, Advisory No. 3, SAC 95-01 (SAC Joint Venture Partnership 1995.)) The Northridge Earthquake challenged the assumption that welded steel moment frame connections were automatically capable of extensive yielding without a loss of strength. SAC 1.2. Thousands of welded steel moment frame connections fractured during the earthquake. SAC 1.2. Once such a fracture formed, the beam-column connection experienced a significant loss of flexural rigidity in capacity. SAC 1.2. In effect, the fractured connection turned out to be a pin connection all along rather than a

connection with moment resistive capacity. It fractured when its strength was needed most.

#### Building Inspections after the Northridge Earthquake:

Many initial inspections of steel frame buildings found only minor damage. After reports of steel moment frame damage began to circulate, engineers and owners revisited buildings to perform more complete inspections. In time, these inspections revealed damage types that had been observed in earlier testing programs. [Popov & Stephen, 1972; Popov & Bertero, 1973; Popov et al, 1985; Popov & Tsai, 1987; Englehardt & Husain, 1993.] It was revealed that an astonishing 99% of the brittle weld failures occurred with "self-shielded flux-core" weld metal. (National Institute of Standards and Technology, NISTIR 5625 *A Survey of Steel Moment-Resisting Frame Buildings Affected by the 1994 Northridge Earthquake*) In response, the City of Los Angeles passed an ordinance that required the inspection of all beams to column welded moment connections. Los Angeles Cal. Mun. Code §91.8908(a). Technical Studies have confirmed that self-shielded flux-core electrodes were a primary cause for brittle weld failures during the Northridge Earthquake. The Center for Advanced Technology for Large Structural Systems at Lehigh University examined the seismic performance of moment frame connections with specimens from the Northridge earthquake. Eric J. Kaufmann, Ming Xue, Le-Wu Lu and John W. Fisher, *Achieving Ductile Behavior of Moment Connections*, *Modern Steel Construction*, January 1996, p. 30. Lehigh's published findings concluded that the welds deposited with E70T-4 electrodes (self shielded flux-cored arc welding electrodes) had very low fracture resistance to moderate earthquakes (less than 10 foot-pounds at 70 degrees Fahrenheit) and are likely candidates for brittle fracture. *Id.* at 31. The Lehigh study found that brittle weld fractures developed in installations that used E70T-4 welding electrodes with backup bars. The fracture origins were identified at the weld root adjacent to the notch introduced by the backup bar at a location with inadequate root penetration. *Kaufmann* at 33. In contrast, when a ductile weld metal was used to fabricate a joint (such as E7018 stick electrode), no weld metal cracking occurred and the ultimate strength of the beam plate was developed, that is, it became a moment frame. *Id.* 36. Dynamic testing showed a much improved performance in strength and ductility (toughness) when the E7018 stick electrode was used. Lehigh, thus, concluded that acceptable connection performance is obtainable by using a higher toughness weld metal, such as E7018, with the removal of backup bars. *Id.* at 39. The E70T-4 that failed in the Northridge Earthquake was deemed "pre-qualified" by manufacturers and approved for use *without performing procedure qualification tests using the weld metal.* AWS 1.3.1. The "pre-qualification" assumption continues to this day. While E70T-4 may perform in a reasonable manner in non-moment frame applications, the Lehigh study has demonstrated that the use of E70T-4 weld metal causes brittle welds in critical moment frame connections: a catastrophe waiting to occur.

#### THEORIES OF RECOVERY

Remedies in tort and contract are available to pay for the repairs to the defective welds. If the welds have not cracked or shown any other manifestations of physical damage,

the doctrine of strict liability is not available as a remedy. *Huang v. Garner*, 157 Cal.App.3d 404, 419-420; 203 Cal.Rptr. 800 (1984) held that although economic damages are not recoverable based upon a theory of products liability, a plaintiff could recover such damages on a negligence theory. (Defects that do not cause actual physical damage are classified as economic damages.) Contract remedies are available whether or not the welds have fractured or shown any other manifestation of physical damage. Economic damages are recoverable under both breach of contract and express warranty theories. However, such damages would likely be excluded from insurance coverage under standard CGL policies as "economic losses." This is because the definition of property damage requires "physical injury to or destruction of tangible property." *Maryland Casualty Co. v. Reeder*, 221 Cal.App.3d 961, 968-971; 270 Cal.Rptr. 719 (1990).

## PRODUCTS LIABILITY

What Is a Defect? Although California courts separate manufacturing defects from design defects, they have refused to limit the definition of a defect. *Barker v. Lull Engineering Co.*, 20 Cal.3d 413; 143 Cal.Rptr. 225 (1978). Manufacturing defects are those defects which deviate from the manufacturer's intended result. For example, a broken gear tooth constituted a manufacturing defect in *Montez v. Ford Motor Co.*, 101 Cal.App.3d 315; 161 Cal.Rptr. 578 (1980). Design defects involve either products that fail to perform as safely as the ordinary consumer would expect (consumer expectation test) or products as to which the risk of danger inherent in the design outweighs the benefits of the design (risk / benefit test). If a product is something that an ordinary consumer would use, the consumer expectation test is the proper test to determine whether a design defect exists. For example, an ordinary consumer would not expect air bag inflation in a low speed collision to break the driver's arm. *Bresnahan v. Chrysler Corp.*, 32 Cal.App.4th 1559; 38 Cal.Rptr. 2d 446 (1995). But, not all products are subject to ordinary consumer expectations. As explained in *Soule v. General Motors Corp.*, 8 Cal. 4th 548; 34 Cal.Rptr. 2d 607 (1994), the Supreme Court noted that some products are so complex that a consumer may not have any minimum assumptions about its safe performance. In such a case, the jury should be instructed on a risk benefit analysis (determination whether the risk inherent in the design outweighs the benefits of the design). *Id.* at 568-570. Construction defects fall into categories described below.

### Poor Materials Selection and Faulty Construction Techniques:

A developer can be strictly liable for poor materials selection and faulty construction techniques. In *Kriegler v. Eichler Homes, Inc.*, 269 Cal.App.2d 224; 74 Cal.Rptr. 749 (1969), the defect was an incorrectly installed radiant heating system in the building's cement floor. In *Ault v. International Harvester Co.*, 13 Cal. 3d 113; 117 Cal.Rptr. 812 (1974); the plaintiff, injured in an auto accident, alleged that the vehicle's gearbox was made of 'aluminum 380', a material that was defective for that purpose and that malleable iron was stronger and less likely to fail. Plaintiff sought to introduce evidence that three years after the accident defendant substituted malleable iron for aluminum 380. The appellate court held that the evidence of the substitution was admissible. E70T-4 presents a very similar situation. The flux core material may function well for

other uses, but is not up to the task of fastening steel moment frame connections.

#### Non Defective Building or Component Placed in Wrong Location

A developer can also be strictly liable for placing a nondefective product in the wrong place. In *Del Mar Beach Club Owners Ass'n v. Imperial Contracting Co.*, 123 Cal.App.3d 898; 176 Cal.Rptr. 886 (1991) neither the condominiums themselves nor their component parts were defective. The developer, however, placed the condominiums on unstable soils. The court found the improper location to constitute a "defect." Thus, a product may function safely in one location or use but the product, though faultlessly made, may not function safely in another location or use and therefore be defective. See, *Hyman v. Gordon*, 35 Cal.App.3d 769; 111 Cal.Rptr. 262 (1973).

In a report entitled *The Right to Know*, dated 1992, the California Seismic Safety Commission stated:

*However, given the frequent occurrence – 105 times since 1849 magnitude 6 and greater earthquakes in California, and our ability to anticipate with reasonable accuracy the affected geographical areas and intensity of ground shaking, as well as the growing body of knowledge regarding how specific types of buildings and soils perform in such events, the Commission believes that a rational person can only conclude that the occurrence of damaging earthquakes is not speculative but foreseeable in every context of that term.*

*(The Right to Know, California Seismic Safety Commission, 1992.)*

While E70T-4 may perform well in other applications, the Lehigh study demonstrated that its use causes brittle welds in critical moment frame connections.

#### Deviations from the Plans and Specifications

Another type of "defect" is described in *Raven's Cove Townhomes, Inc. v. Knuppe Development Co.*, 114 Cal.App.3d 783; 171 Cal.Rptr. 334, (1981). Again, even if the product is not inherently defective, the manner of installation can be defective. The court noted that the drainage and irrigation system installed varied from the plans and specifications because the wrong sprinkler heads were installed resulting in inadequate watering in some areas and too much in others. The sprinklers also watered the buildings, sidewalks and streets. *Id.* at 789. The court found that the deviation from the plans and specifications constituted a defect and awarded the homeowner's association cost of repairs. The self shielded flux-cored electrode (E70T-4) is an improper material to use in critical moment frame connections because of the foreseeability of earthquakes in California. Substituting E70T-4 flux core for a ductile electrode required by the structural engineer in the plans and specifications is an improper choice of material.

#### Owner/Developer/liability

Under California law, a seller (developer) is liable for injuries proximately caused by a product which is adjudged defective. *Cronin v. J.B.E. Olson Corp.*, 8 Cal. 3d 121, 133;

104 Cal.Rptr. 433 (1972). Strict liability attaches for an injury proximately caused by a design or manufacturing defect which existed when the article left possession of the seller, provided that the injury resulted from a use of the article that was reasonably foreseeable by the seller. *BAJI Jury Instruction No. 9.00* (7<sup>th</sup> ed., 1994). In *Kriegler v. Eichler Homes, Inc.*, *supra*, 269 Cal.App.2d 224, the court extended the doctrine of strict liability to builders and developers of mass-produced single family residences. *Del Mar Beach Club Owners Ass'n v. Imperial Contracting Co.*, *supra*, 123 Cal.App.3d 898 extended the doctrine further to multi-unit, residential, planned development complexes. As the *Del Mar* court explained, the purchaser of a condominium is relying on the developer's skill and implied representation that the project was built in a workmanlike manner and is reasonably fit for habitation. Home buyers do not participate in or observe the design and construction. *Id.* at 911-912. California courts have not yet had occasion to apply the doctrine of strict liability to developers or builders of commercial structures. The same rationale would appear to apply, since the buyer relies on the developer's skill and expertise to insure that the project is built in a workmanlike manner and is reasonably fit for its intended purpose, and the buyer did not participate in or observe the design and construction.

#### Manufacturer's Liability

Under traditional tort law, a manufacturer may be strictly liable if it places a defective product into the stream of commerce. *Greenman v. Yuba Power Products, Inc.*, 59 Cal.2d 57, 62; 27 Cal.Rptr. 697(1963). A year later, the Supreme Court extended the strict liability doctrine to retailers, because retailers are an integral part of the overall commercial enterprise and are in a position to enhance product safety. *Vandermark v. Ford Motor Co.*, 61 Cal.2d 256, 262-263; 37 Cal.Rptr. 896 (1964). The courts have since applied strict liability to others in the vertical distribution of consumer goods, although these defendants were not necessarily involved in the manufacture or design of the product. *Price v. Shell Oil Co.*, 2 Cal.3d 245; 85 Cal.Rptr. 178 (1970). While numerous cases have applied strict liability to the developer or owner of a building, the first California case to apply strict liability to a manufacturer of a plumbing component (polybutylene resin) is *Bay Summit Community Association v. Shell Oil Co., et al.*, 96 Daily Journal D.A.R. 15041 (12/18/96). After installation of polybutylene plumbing in a condominium project, the homeowners began to experience leaks in the plumbing system. The homeowners association sued the developer, the two manufacturers of the plumbing system and Shell, the supplier of the resin. The pipes made from polybutylene resin were supplied in pellet form by Shell. There was no evidence that the polybutylene resin supplied by Shell was defective. *Id.* at 15041. At trial, plaintiffs showed that the plumbing system leaked because of the defective Celcon fittings, made from a different material. *Id.* at 15042. However, plaintiffs demonstrated that Shell was aware of the problems with the fittings in polybutylene plumbing systems but did not disclose the defects because the disclosure would frustrate their efforts to extend the penetration of the plumbing system into the marketplace. Shell also played a prominent role in the marketing of both the pipes and the polybutylene plumbing system. This included direct marketing assistance to manufacturers, homebuilders and plumbers. Shell also committed substantial resources to getting the system approved by the

Uniform Plumbing Code. *Id.* at 15042-43. Although there was no evidence of a defect in the resin pellets manufactured by Shell, the Court of Appeal held that Shell could be strictly liable if "(1) the defendant received a direct financial benefit from its activities and from the sale of the product, (2) the defendant's role was integral to the business enterprise such that defendant's conduct was a necessary factor in bringing the product to the initial consumer, and (3) the defendant had control over, or a substantial ability to influence, the manufacturing or distribution process." *Id.* at 15045. Similarly, the manufacturers of E70T-4 may face imposition of strict liability by California courts, if the manufacturer is shown to receive a direct financial benefit from the sale of the product, the manufacturer's conduct was a necessary factor in bringing the product to the initial consumer market, and the manufacturer had either direct control over or substantial ability to influence the manufacturing or distribution process of E70T-4 welding electrode.

#### BREACH OF IMPLIED WARRANTY

*Pollard v. Saxe & Yolles Development Co.*, 12 Cal. 3d 374; 115 Cal.Rptr. 648 (1974) was the first California case to apply the Uniform Commercial Code doctrine of implied warranties of quality and fitness to commercially owned property. In *Pollard*, apartment units in a complex suffered physical damage caused by the contractor's removal of center posts and installation of undersized headers and inadequate support beams. The trial court held that implied warranties do not attach to the sale of real property. In its reversal, the appellate court held that if timely notice is given, "a contract to build an entire building is essentially a contract for material and labor, and there is an implied warranty protecting the owner from defective construction." *Green v. Superior Court*, 10 Cal. 3d 616; 111 Cal.Rptr. 704 (1974); *Kuitens v. Covell*, 104 Cal. App. 2d 482; 231 P.2d 552 (1951). Since *Pollard*, California courts have applied both U.C.C. and common law implied warranty concepts to the construction and sale of residential and commercial real property. An important limitation is that the implied warranties may only apply to new construction. *East Hilton Drive Homeowners' Ass'n v. Western Real Estate Exchange*, 136 Cal. App. 3d 630; 186 Cal.Rptr. 267 (1982).

#### BREACH OF CONTRACT

The language of a construction contract may impose liability on a general contractor for substituting materials that are not equal to or better than materials called for in the plans or specifications. Thus, breach of contract liability may exist on the basis that inferior materials were substituted. In *Shell v. Schmidt*, 164 Cal.App.2d 350; 330 P.2d 817 (1958), the general contractor was found to have made "material" deviations from the plans and specifications by substituting lath paper and chicken wire for wood sheathing on the exterior walls, by substituting one 35,000 B.T.U. capacity furnace for two 30,000 B.T.U. unit furnaces, and by substituting sheet rock with tape joints on interior walls for gypsum lath and plaster. *Id.* at 358. The court rejected the contractor's argument that it had substantially performed the contract. In *Idaho State University v. Mitchell*, 97 Idaho 724, 552 P.2d 776 (1976), the Supreme Court of Idaho reviewed A.I.A. Document 201. Noting that Article 13.2.2 deals with work *not in accordance with the contract*

*documents*, the court remarked that the contract "appears to impose liability without fault in claims arising under this provision." *Id.* at 728 (emphasis added.). Thus, the owner needs not prove negligence of the contractor. The contractor is liable for damages incurred because of work that does not conform to the contract documents. Washington and Oregon courts have held that substitutions that were not equal to or better than the materials specified in the contract constituted a material breach of contract. In *Beik, et al. v. American Plaza Co., et al.*, 280 Or. 547; 572 P.2d 305 (1977), the sales agreement provided that the condominiums would be built according to the plans and specifications. The developer substituted sliding glass doors and air conditioning units, and also failed to install a putting green, roof garden and skylight. Finally, windows leaked air and water. The court found that the sliding glass doors as installed did not perform up to SGD-A3HP specifications, and that the Carrier air conditioning units did not meet the standards of the specified Remington EK units. *Id.* at 552-555. The court ordered the developer to replace the sliding glass doors and air conditioners according to the specifications. *Id.* at 559. The contractor substituted Perlite light-weight aggregate in place of the specified sand. In *City of Seattle v. Kuney, et al.*, 50 Wash.2d 299; 311 P.2d 420 (1957), the court held that although the architect approved the substitution, the material was nevertheless improper, because the contractor guaranteed that the substitute material was equal or better in all respects than the material specified and it was not. *Id.* at 302-303. In New York, a contractor was ordered to pay the cost of installing styrofoam insulation and footing drains called for by the contract but which the contractor thought were unnecessary and did not install. *Roudis v. Hubbard*, 176 A.D. 2d 388, 389; 574 N.Y.S. 2d 95 (1991). In *Midland Motels, Inc. v. Central Plumbing & Heating Company*, 252 So.2d 729 (La. App. 3d Cir 1971), the Louisiana Court of Appeal held that the evidence supported liability where the plans and specifications had called for the outside sewer piping to be cast iron and the contractor had installed a clay pipe that sagged and collapsed in the area of a motel driveway. *Id.* at 731. The Colorado Court of Appeal held that the contractor's construction of a roof and floor failed to comply with plans and specifications, where the contractor installed a 15 year roof instead of the specified 20 year roof; the expansion joints were not installed as provided in the plans; roof joists were not constructed as shown on the plans; the floor was not constructed to the thickness specified in the plans; the contractor had not installed stone or gravel under the floor; and the wire mesh was not properly imbedded in the concrete. *Summit Construction Co. v. Yeager Garden Acres, Inc.*, 28 Colo. App. 110, 118-119; 470 P.2d 870 (1970).

## EXPRESS WARRANTY

### Contract Documents

Contract documents often warrant how the work will be performed. A.I.A. General Conditions, Art. 4.5.1 (1976 edition) is an example of a generally-accepted provision:

*The Contractor warrants to the Owner and the Architect that all materials and equipment furnished under this Contract will be new unless otherwise specified, and that all Work will be of good quality, free from faults and*

*defects and in conformance with the Contract Documents. All Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. This warranty is not limited by the provisions of Paragraph 13.2.*

In *Smith v. Erftmier*, 210 Neb. 486; 315 N.W.2d 445 (1982), the contractor installed the grain bins with inadequate foundations and the concrete work was poor. The contractor had warranted that it would repair or replace those portions of the building rendered defective because of poor workmanship. The court held that the "[m]anufacturer may not on the one hand reap the benefits of the glowing descriptions and promises it puts into the stream of commerce, and on the other hand avoid legal responsibility for them when they prove unfounded." *Id.* at 483. An Illinois appellate court held that a contractor's warranty that the repairs would result in a leak-proof roof was breached when the roof leaked. *Miller v. Racine Trust*, 65 Ill.App.3d 207, 214-215; 382 N.E. 2d 41 (1978).

#### Manufacturer Warranties

Liability on a theory of express warranty may be based upon brochures supplied by the manufacturer. In *Herman v. Bonanza Buildings, Inc.*, 223 Neb. 474; 390 N.W.2d 536 (1986), a manufacturer had prepared a brochure given to the owner extolling the virtues of the steel building and expressly promising that the manufacturer "would replace or repair defects resulting from poor workmanship." The brochure created an express warranty, such that the statements became part of the basis of the bargain. *Id.* at 483-484. In *Little Rock School District of Pulaski County v. Celotex*, 264 Ark. 757; 574 S.W.2d 669 (1979), an architect prepared the plans and specifications based upon information supplied to the architect by the manufacturer regarding the ability of a two-ply roofing system to meet the needs of the District. The manufacturer represented that the two-ply system was the equivalent of a four-ply conventional system, would be bonded for up to 20 years, and provided excellent weather protection. *Id.* at 763. The roof began leaking almost immediately. The Court held that these representations were sufficient to submit the issue of breach of express warranty to a jury. *Id.* at 766-767.

The manufacturer of the self-shielded flux-cored arc welding electrode (E70T-4), publishes brochures stating that the electrodes are for "structural fabrication." The brochure also states that one of the eight reasons to select self shielded flux-cored electrodes, is that:

*[The electrode] resists weld cracking on heavy plate, restrained joints and medium carbon steel. Desulfurizes weld deposits so well that even high sulfur steels may be welded without incurring cracking due to hot shortness.*

The brochure further states that the self shielded flux-core electrode has been used in San Francisco specifically to withstand earthquakes:

*Thirty-eight out of thirty-nine buildings on the San Francisco skyline have been erected using . . . Innershield electrode. Where buildings must be designed to withstand seismic disturbances, Innershield is the architects' choice. Because of its great cost reduction potential more new buildings are on the way.*

Since virtually all of the brittle failures from the Northridge Earthquake occurred with self shielded flux- cored electrodes (E70T-4), a compelling case can be made that this welding electrode does not conform to the representation that it resists weld cracking or is designed for seismic disturbances.

### **DISCLOSURE LIABILITY**

As the dangers associated with "brittle fractures" become known, the duty to disclose such welds will arise. In a 1992 report, the California Seismic Safety Commission stated that "[a]lthough there is no definitive case law dealing with disclosing seismic hazards in buildings, recent legislation and the evolution of decisional case law lead to the conclusion that the duty to warn of known seismic hazards in a building already exists." *The Right to Know*, California Seismic Safety Commission, 1992. The open question is whether an adequate quantum of information exists to conclude that self shielded flux core E70T4 will suffer brittle fracture failures during moderate Northridge type earthquakes. If it does, it must be disclosed. The duty to disclose arises where the defendant has knowledge of material facts which are not reasonably accessible to the plaintiff. *Rothstein v. Janss Inv. Corp.*, 45 Cal. App. 2d 64; 113 P.2d 465 (1941). The steel frame inspections required by Los Angeles Ordinance No. 170406 will provide steel moment frame owners with material information that will have to be disclosed.

#### Common Law Duty Of Disclosure

It is settled law in California that where a seller knows of facts *materially affecting the value or desirability* of property and also knows that such facts are not known to, and cannot be discovered by diligent observation of the buyer, the seller has a duty to disclose these facts to the buyer. Failure to disclose is "negative fraud." *Herzog v. Capital Co.*, 27 Cal. 2d 349; 164 P.2d 8 (1945); *Barnhouse v. City of Pinole*, 133 Cal. App. 3d 171; 183 Cal.Rptr. 881 (1982). Normally, a seller of real property does not have an obligation to undertake complex investigations to discover potential problems. *Miller and Starr, California Real Estate 2d ed.*, §1:121 (Bancroft-Whitney 1975). However, when there are "red flags," the law imposes a duty to make further investigations or inspections to determine whether a problem exists. *Id.*

#### Public Awareness of Brittle Weld Defects

In the case of E70T-4 steel moment frame connections, the "red flags" are obvious. Los Angeles Ordinance No. 170406 requires owners of steel frame buildings to inspect the moment frame connections for damage and draft a repair plan. Since the Northridge Earthquake, dozens of newspaper articles have described the failure of steel moment frame connections. During the first week of October, 1996, for example, the Los Angeles Times printed two prominent stories about the steel moment frame failures. It is

reasonable to assert that owners of steel moment frame structures, as well as their brokers, attorneys and engineers should be aware of material problems with their buildings and that proper repairs may cost millions of dollars. In jurisdictions that have enacted steel frame inspection requirements, there is little likelihood that any owner will not have material information that should be disclosed. It is likely that potential buyers may not have reasonable access to such material facts. The real issue may be defining "spin control." If a building owner is advised by structural consultants that fractures in "brittle weld" surfaces have been repaired, disclosure of such information might not reveal current thinking in the engineering community that the "brittle welds" should be removed and replaced. Without complete disclosure, the building owner could be exposed to almost unlimited liability.

#### Brittle Welds As Material Facts

A fact is "material" if a party would not have entered into a contract had the true facts been known. *Wood v. Kalbaugh*, 39 Cal. App. 3d 926, 932; 114 Cal.Rptr. 673 (1974). Though "materiality" is a question of fact, potential collapse of a building is undoubtedly "material". Judicially determined "material" facts are: the existence of unstable soil or fill (*Hefferan v. Freebairn*, 34 Cal. 2d 715; 214 P.2d 386 (1950)); structural defects (*Herzog v. Capital Co.*, 27 Cal. 2d 349; 164 P.2d 8 (1945)); termites and dry rot (*Piazini v. Jessup*, 153 Cal. App. 2d 58; 314 P.2d 196 (1957)).

#### Duty Of Disclosure To Subsequent Purchasers

Privity of contract is not required for a duty of disclosure to exist. An action for fraudulent concealment or deceit does not require privity of contract. *Lingsch v. Savage*, 213 Cal. App. 2d 729, 736; 29 Cal.Rptr. 201 (1963). §533 of the Restatement of Torts, 2d states:

*[t]he maker of a fraudulent misrepresentation is subject to liability . . . to another who acts in justifiable reliance upon it if the misrepresentation, although not made directly to the other, is made to a third person and the maker intends or has reason to expect that its terms will be repeated or its substance communicated to the other, and that it will influence his conduct."*

In *Barnhouse v. City of Pinole*, *supra*, 133 Cal. App. 3d 171, the First District Court of Appeal held that "[h]ere, the jury could have inferred that Smith failed to make the initial disclosures with the intention that subsequent purchasers would also act in ignorance. *Id.* at 192. The Court further held that "[w]hile an affirmative misrepresentation might not be repeated, a nondisclosure must necessarily be passed on." *Id.* From *Barnhouse*, it is clear that future grantees can hold valid claims based on past non-disclosures.

#### Statutory Duty Of Disclosure

Statutory duties of disclosure are completely independent of the common-law duties discussed above: compliance with one does not relieve a person from compliance with the other. *Government Code* §8893.2 requires the seller of a commercial building utilizing unreinforced masonry walls to deliver a pamphlet entitled "*The Commercial Property Owner's Guide to Earthquake Safety*." The pamphlet describes, in detail, the

problems associated with unreinforced masonry construction and their vulnerability to earthquakes. Because of the peril associated with deficient steel moment frame connections, the Legislature is likely to require disclosure of inspections and repairs and whether brittle weld metal has been left in place.

#### Brokers' - Agents' Duties Of Disclosure

The real estate broker is held to a greater standard of care than an ordinary seller of real estate. In *Easton v. Strassburger*, 152 Cal. App. 3d 90; 199 Cal.Rptr. 383 (1984), the appellant was the listing broker for a residence. The driveway was destroyed because fill had not been properly engineered and compacted. The broker had inspected the property and was aware of "red flags" indicating potential soil problems, but did not request further testing and did not inform respondent of the potential soil problems. The court said that "[I]f a broker were required to disclose only known defects, but not also those that are reasonably discoverable, he would be shielded by his ignorance on that which he holds himself out to know." *Id.* at 100. The court cited the Code of Ethics of the National Association of Realtors, which states that "a broker must not only avoid concealment of material facts, but must also discover adverse factors that a reasonably competent and diligent investigation would disclose." National Assn. of Realtors, Interpretations of the Code of Ethics, art. 9 (7<sup>th</sup> ed. 1978).

Miller and Starr state that the authorities:

*"lead inevitably to the conclusion that the seller of commercial property has the same duty of disclosure as the seller of residential property. The general statutory and common law rules require disclosure in all transactions, not just real property, and the rule is stated as being applicable to all sellers of real property without distinction between commercial and residential." Miller and Starr, supra, at §1:121.*

A broker must determine what information would materially influence the principal's decisions. Thus, the seller's broker may be liable to the seller, and the buyer's broker may be liable to the buyer, for not explaining the ramifications (actual and potential) of buying or selling structures with unrepaired moment frame damage or structures with brittle weld metal (E70T-4) left in place. A seller's broker also has the same duty as the principal to disclose all facts to the buyer which materially affect the value of the property. On the one hand, a broker generally is not required to examine inaccessible areas (moment frame connections are clearly inaccessible). On the other hand, a duty may exist to at least inquire whether the seller performed an inspection and obtain the results of any inspection.

#### Seller's Attorney Has A Duty To Disclose

It is conceivable that a seller's attorney may have a duty to disclose. In *Heliotis v. Schuman*, 181 Cal. App. 3d 646; 226 Cal.Rptr. 509 (1986), the buyer, Heliotis, dealt primarily with a residential property owner's attorney, Berger, in negotiating the purchase of the house. Though Heliotis inspected the home, he did not notice the

abandoned foundations of homes nearby. After Heliotis purchased the property, a friend informed him that the land was unstable. In an action against the sellers and Berger, the trial court granted summary judgment on the basis that Berger owed no duty to Heliotis. (In the unpublished portion of the opinion, the court recognizes that whether the seller's attorney owes duties to the buyer is a question of first impression. *Id.* at 650.) The court noted that the attorney made no attempt to persuade Heliotis to purchase the property, that Heliotis conducted his own investigation, and that imposition of a duty on the attorney who merely acts as a conduit for sellers could potentially compromise the attorney-client relationship. The court then held that the attorney owed no duty to Heliotis. *Id.* at 650-651. (It is important to note that only the factual summary portion of the opinion was certified for publication.)

In his concurring opinion, Associate Justice Poche agreed with the majority's holding "because only the legislature could assign such a third party duty to attorneys. The concurring opinion also states that "[a]ny lawyers who believe that today's decision creates a new field of employment representing sellers who have something to hide should read with care Civil Code sections 1102-1102.13 which become operative January 1, 1987." Concurring opinion at 651. For example, SAC Advisory No. 3 provides: ". . . *those buildings which are repaired, under the above definition, may still have significant vulnerability and could be expected to experience 'brittle fracture damage' again, affected by strong ground motion.*" (*Emphasis added.*)

#### SHOULD BRITTLE WELD FRACTURES BE REPAIRED OR REPLACED?

Owners, contractors and engineers face the decision of either replacing or simply repairing the defective welds. While *repairing* the defective welds is relatively inexpensive, replacing the welds with ductile ones can cost \$8,000 to \$30,000, per weld. The high cost of replacing non-ductile welds has led to the cosmetic repair of many defective welds. A repaired weld does not produce the requisite continuity in the fractured connection that is needed to create a ductile frame. As such, this repair can only be considered cosmetic. The brittle connection would act as a fuse in an electrical circuit, unable to transmit load through the system, thus breaking under lateral earthquake forces. It would represent the proverbial weak link serving to destroy the performance of the greater assembly.

SAC Emergency Advisory on Steel Moment Frame Connections.

In 1995, SAC issued advisories and interim guidelines for the repair, retrofit and design of steel moment frame structures. One key issue addressed was the determination of what repairs need to be performed to correct brittle weld fractures and moment frame damage.

Would owners have to remove all of the brittle welds or only repair the ones that were cracked? SAC Advisory No.3, provides only equivocal guidance.

***Majority Opinion:*** *Structural repair is the restoration of the building to its*

*pre-earthquake performance capability. It does not include modifications intended to improve the performance capability of the building beyond what existed prior to the earthquake.*

**Commentary:** *Much of the damage which occurred in the Northridge Earthquake has been attributed to initial poor quality construction, particularly with regard to welding. This definition of repair should not be interpreted to mean that damaged workmanship of poor quality would be replaced with new repair workmanship of similar poor quality. It is presumed that all repair work will be conducted in strict conformance with the applicable standards, such as AWS D1.1.*

*As demonstrated by the post - Northridge testing program at the University of Texas at Austin, poor construction quality was not the only cause for the damage experienced by welded steel moment frame structures. Therefore, those buildings which are repaired, under the above definition, may still have significant vulnerability and could be expected to experience 'brittle fracture damage' again, if affected by strong ground motion." [SAC 95-10 Advisory no.3, p 4-13]*

It can be argued that restoration of "the building" means a repair which finally provides the intended ductile capability of a steel moment frame building rather than just repairing a welded connection to its pre-earthquake condition. The "performance capability" of a steel moment frame building must by definition have ductile moment frame connections. That is the unequivocal intent of welded steel moment frame connections: ductility. Advisory No. 3 plainly states that repairs undertaken pursuant to its Majority Opinion guidelines, "could be expected to experience brittle fracture damage again, if affected by strong ground motion." Whether a brittle weld fracture should be replaced or rebuilt depends ultimately on whether the repair would leave the building in a life threatening condition. A higher factor of safety is needed for a higher risk. If the brittle welding is life threatening, then the welds should be removed and replaced.

#### Retroactive Repair and /or Replacement in Commercial Buildings

The UBC does not allow a welded steel moment frame to be maintained with damaged connections. The L.A. ordinance imposes a duty to repair the damaged connections in an expeditious manner. California decisional law appears to support such an ordinance. In *Barenfeld v. City of Los Angeles*, 162 Cal.App.3d 1035; 209 Cal.Rptr. 8 (1984), the City of Los Angeles amended the Municipal Code to require that all buildings constructed prior to October 6, 1933, with unreinforced masonry bearing walls were to be demolished or be repaired. Each owner of a pre-1933 unreinforced masonry building received a compliance order informing the owner of the dates by which the owner had to comply with the structural repair work or the owner would have to demolish the building. Owners brought an action to enjoin enforcement of Division 68. The City's motion for summary judgment was granted.

The issue before the Court of Appeal was whether Division 68 was a valid exercise of

the City's police power. The Court of Appeal held that it was. Quoting *Ratkovich v. City of San Bruno*, 245 Cal.App.2d 870, 878-879; 54 Cal.Rptr. 333 (1966), the appellate court set out the factors a court considers in determining the validity of the exercise of a city's police power:

*'A determination by the legislative body of the facts warranting its action will not be set aside or disregarded by the courts unless the legislative decision is clearly and palpably wrong and such error appears beyond a rational doubt from facts or evidence which cannot be controverted. [Citations.] The court will not nullify laws enacted under the police power unless they are manifestly unreasonable, arbitrary or capricious, having no real or substantial relation to the public health, safety, morals or general welfare. [Citations.] A court is not concerned with the wisdom or policy of the law and cannot substitute its judgment for that of the legislative body if there is any reasonable justification for the latter's action. [Citations.] If reasonable minds might differ as to the reasonableness of the ordinance [citations] or if the reasonableness of the ordinance is fairly debatable [citations], the ordinance must be upheld.'* *Id.* at 1040.

## CONCLUSION

Repairing brittle welds by re-welding fractures in the brittle weld metal ignores the root problem and leaves the brittle welds in place to fail again in the next earthquake. This is because the brittle welds themselves are the defect and the fractures are manifestations of their inability to transfer earthquake loads. The bitter teaching of the Northridge Earthquake is that self shielded flux core (E70T-4) weld metals produce brittle welds that do not have the capacity to transfer lateral earthquake loads from beams to the columns. The information now available should put engineers and developers on notice that only ductile welded connections can produce an energy absorbing ductile moment frame, and owners that brittle welds must be replaced or disclosed. The reluctance to spend \$8,000 to \$30,000 per connection is understandable. However, short term benefits must be weighed against the potential costs. Potential liability for catastrophic losses faces owners, designers, contractors, manufacturers, sellers, brokers, lenders, consultants and attorneys involved in the development and sale of welded steel moment frame structures.

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