Where the Rubble Went

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The massive earthquake that struck San Francisco on April 18, 1906 destroyed hundreds of buildings in a little over a minute. When the shaking stopped, most of the city was intact, though damaged. That would soon change as one of history's greatest urban firestorms swept over San Francisco. In the course of three days, 28,188 buildings burned.[1] Virtually all of these buildings were totally destroyed. Nearly 25,000 wood buildings burned to the ground. Fire gutted the interiors of brick buildings. Many of these buildings collapsed completely. Others were reduced to burned-out shells. Although a great many brick buildings came through the earthquake relatively unscathed, losing perhaps cornices or parts of their facades, when fire burned through their floors and internal framing, their walls fractured and fell. Only the most stoutly constructed brick buildings remained structurally intact. Some of the city's steel-frame and supposedly fireproof buildings also succumbed to the fire. They suffered severe structural damage as under-fireproofed steel buckled and deformed in the intense heat. When the fire finally burned itself out, the commercial, financial, and residential core of the West Coast's leading city was in ruins.

What happened to the ruins? Where did all the rubble go? It did not go into the Marina district. I debunked that myth in *What Lies Beneath the Marina?*[2] This article redeems a promise made there, but before I give a detailed account of where the rubble went, I want to say something about *how* it was cleared away. This bit of history will eliminate some of the misconceptions surrounding the great janitorial effort. The unsung heroes of this story are men and animals, not machines. For practical purposes no mechanical equipment aided men in excavating the ruins. Aside from derricks and cranes used to lift steel beams, safes, and other heavy loads, and the power of steam or dynamite applied to wall demolition, men with picks, shovels, and wheelbarrows did the work. No motorized trucks existed in 1906 San Francisco. Wagons and carts drawn by teams of horses hauled away almost everything the men excavated. According to some estimates, thousands of horses were worked to death during the cleanup and reconstruction of San Francisco.[3]

The swath of destruction caused by the 1906 earthquake extended far beyond San Francisco. Out on the San Mateo coast, cliffs crumbled and slid into the ocean. Unfortunately for the Ocean Shore Railway, under construction at that time, some of those cliffs held its roadbed, most of its construction equipment, and part of its rolling stock. C. E. Loss, a well known "Eastern" contractor building the Ocean Shore, quickly realized two things: The Ocean Shore project would not be resumed any time soon, if at all,[4] and there was money to be made in San Francisco. Accordingly, Loss called off construction of the railroad and marched his men to the city. Some of his men would work in conjunction with the Board of Public Works, he declared, while others would work clearing debris, starting on Market Street. The men would camp in San Francisco and remain "until the city has been brought out of the chaos that reigns in the streets."[5]

Building a Debris Railroad

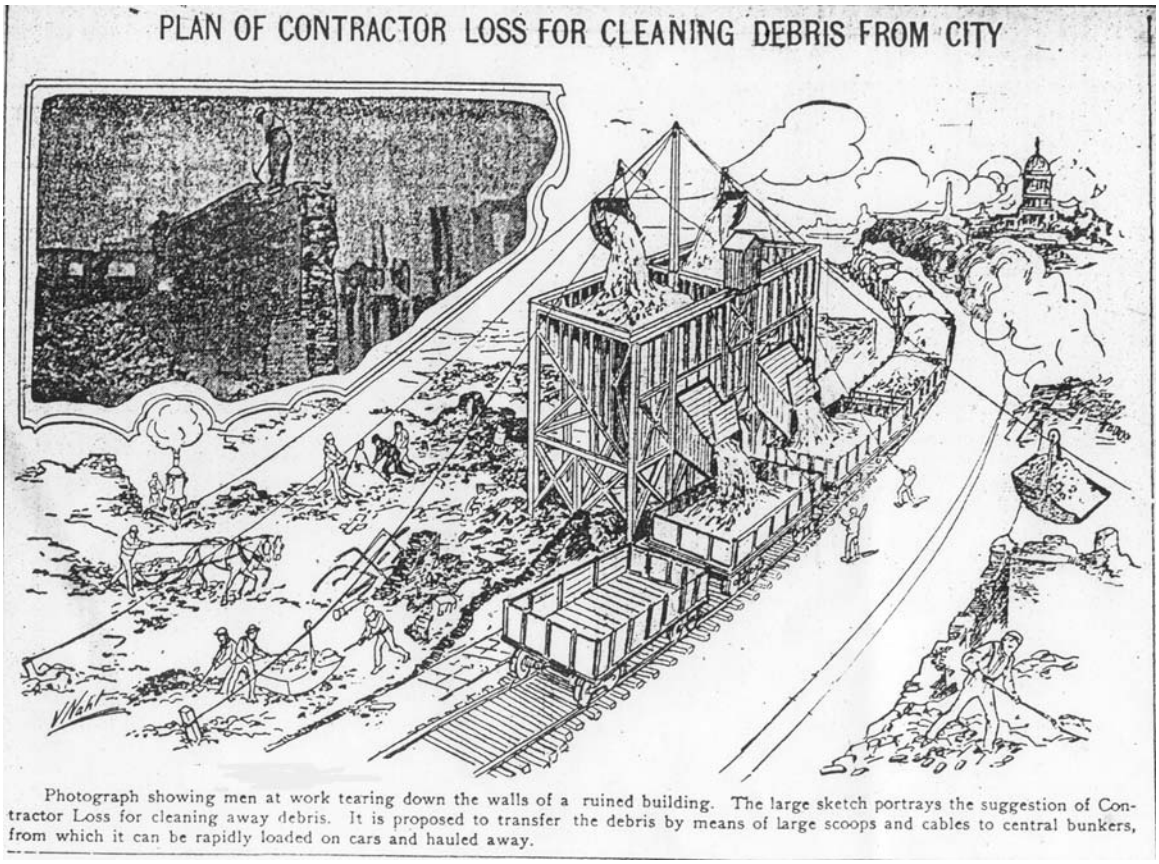
But repairing sewers and opening debris-clogged streets were not uppermost in C. E. Loss's mind. Although many dangerous hulks were dynamited in the days following the fire, just as standing buildings had been dynamited during the fire in vain attempts to establish firebreaks, hundreds of substantial ruins remained. Loss knew that contracts to demolish these buildings and clear their sites would be lucrative and contracts to rebuild perhaps grander structures even more so. Loss also knew that despite the salvage potential in the ruins—he believed 50%-70% of all bricks could be cleaned up and reused[6]—a huge amount of unsalvageable rubble would have to be hauled away and disposed of. Loss thought he could apply his railroad construction expertise to this peculiar transportation problem.

Executive officers of the Southern Pacific Company shared his vision. The railroad men proposed laying temporary track throughout the burned district to allow debris to be loaded on freight cars and transported out of town. Loss claimed it would take years to clean up the city using teams (horses and wagons) to transport the rubble. Hauling it away in carload lots would be far more efficient. Although it is hard to imagine today, in 1906 a plan envisioning steam engines hauling long trains of rubble-laden cars out of the ruins was a high-tech solution to San Francisco's problem. Promises by railroad spokesmen to clear rubble from the streets without charge only enhanced the plan's appeal. The Transportation Committee of the Committee of Fifty,[7] charged with coordinating rubble removal, approved the plan and authorized the Ocean Shore and Southern Pacific to construct temporary spur tracks in the city's burned district. Mayor Eugene Schmitz formally codified and extended this authorization following a meeting of the Committee of Fifty held at Fort Mason April 25, 1906. On April 27 Schmitz granted permits to the Ocean Shore, Southern Pacific, and Santa Fe,[8] giving the railroads what amounted to a blanket franchise to lay temporary track.

Southern Pacific and the Ocean Shore began laying track as soon as the permits were granted,[9] and by the first week of May, 850 men were at work in the burned district. Most tracks were laid right on top of the street. Southern Pacific laid track on Battery from Market to a waterfront connection with the Belt Line[10] and on Fourth Street from its own yards on Townsend to Everett (now Natoma) and from there to Third Street. The Ocean Shore laid track around City Hall and on Eleventh Street. These tracks were outfitted with removable sections to limit interference with traffic. The Ocean Shore also laid track on Capp and Howard, but most of its track-laying effort was wasted: Only the track on Howard Street ever carried rubble.[11]

United Railroads, the city's principal street railway operator, joined in the frenzy of track laying in early May, soon after its trolleys began running on Market Street. The company laid temporary track on the south side of Market and agreed to clean Market from curb to curb free of charge.[12] Southern Pacific and Santa Fe laid new track on streets near the waterfront. All this temporary track-laying went on without anyone's having a definite idea where the rubble would go. Had Southern Pacific's "Bay Shore cutoff"[13] been open, several arms of the bay along that route would have been obvious choices. The Ocean Shore's right-of-way ran along Islais Creek, and some property owners there, notably Western Pacific, wanted to fill in their otherwise "worthless" marshland. Likewise, water lots in North Beach behind the jetty at Fisherman's wharf lay just beyond the reach of the Belt Line. Southern Pacific spur lines ran near low-lying lots south of Channel Street—the remains of Mission Bay. Fortunately, the city did not appear to lack dumping grounds.

The railroads also laid temporary track without knowing how rubble would be loaded onto their freight cars. The railroads insisted loading was not their problem, even though the whole rationale for debris trains would collapse if an efficient way of loading cars was not designed. Only a few steam shovels existed in the city at the time, and these bulky machines, which moved on tracks themselves, would have to be positioned adjacent to the cars in order to load them.[14] With their range thus limited, the steam shovels would not be able to reach into the heart of ruined buildings to scoop up debris. Men could not simply shovel debris onto waiting cars either. Shoveling onto a four-foot tall flatcar would be problematic at best—into an eight-foot tall gondola impossible. Besides, cars—unlike wagons or dump carts—could rarely be spotted a shovel's throw away from significant amounts of rubble even when temporary track was laid on private property. A long sturdy plank laid up to a flatcar could function as a loading ramp for a man pushing a wheelbarrow full of rubble, but the effectiveness of this humble method would be limited by the distance a man could (profitably) push a wheelbarrow. The debris-car loading problem needed a solution, and C. E. Loss stepped forward with one—if not a particularly practical one.



An artist's conception of C. E. Loss's bunker plan. The ***Examiner***, May 3, 1906.

Loss envisioned large debris bunkers (huge storage bins) situated around the city. Debris loaded on wagons or wheelbarrows would be transported to the vicinity of a bunker and dumped into an oversized bucket, which would then be conveyed to the bunker by cables. Long trains of debris cars would pass under the bunkers to receive their loads. Loss apparently modeled his plan on the operation of an open-pit mine, which was a singularly inappropriate model for the ruined city. Debris "mining" would have to coexist with reviving commerce and reconstruction, but the scope and scale of Loss's plan virtually prohibited that. The Rube Goldberg complexity of the buckets and cables guaranteed breakdowns. No local contractors supported Loss's plan. Perhaps they resented an Eastern contractor's attempt to monopolize debris removal—Loss intended to build the bunkers himself and charge for their use. Nonetheless, the Transportation Committee of the Committee of Fifty, apparently desperate for a solution to the debris-car loading problem, approved Loss's plan in principle and granted him the right to construct bunkers at suitable locations in the burned district. Loss began constructing his first bunker on Howard near Third Street.

By mid-May 1906 a "gridiron" of temporary track lay over the burned district, but no rubble-laden trains were rolling over it. Patrick Calhoun, president of United Railroads, urged cooperation in debris hauling. All debris track should be unified into one system, he argued, and a uniform rate set for debris removal. He wanted all contractors involved in debris removal to coordinate their actions. He also wanted them to reveal the location and capacity of their proposed dumps, arguing that the railroads needed the information to plan sidings and set rates. Local contractors refused to cooperate. Perhaps their collective attitude was summed up by Charles Warren, head of the Warren Improvement Company and chief contractor in the 1890s for James Fair's massive reclamation project on the city's

north end, who accused the railroads of scheming to create a monopoly over debris removal by gaining control over the available dumps.[15]

The railroads finally hammered out a joint operating agreement on May 24, embodying many of Calhoun's ideas. The agreement authorized United Railroads to operate the debris railroad as if it were one of its own divisions. The chief engineer of the Ocean Shore Railway became the general manager of this division. All temporary track, existing or to be laid, and certain specified permanent track of the Ocean Shore, Santa Fe, and United Railroads became part of the debris railroad. The agreement set uniform shipping rates for any point as far south of downtown as Islais Creek and even specified demurrage charges for any car requiring more than two hours to unload. All rates and charges would remain in force until June 1, 1907. In presenting this agreement to the Transportation Committee, the railroads committed themselves to hauling debris as long as their right to construct and operate temporary tracks remained in force. The debris railroad was ready to roll.

Opening streets for traffic. Men shovel debris from the center of Bush Street to clear a way for pedestrians and horses and wagons. California Historical Society, FN-13107.

Clearing the Ruins—the First Three Months

While the debris railroad slowly took shape, both the city and its citizens energetically pursued rubble clearing on their own. The Board of Public Works began clearing streets as soon as the fire burned out. Although much of this work consisted of moving debris from the center of streets to the sides (and sidewalks), a lot of rubble was hauled away nonetheless. During the first week of May 7,500 debris cleaners worked on Market Street alone. Clearing the streets of earthquake and fire rubble and repairing damaged pavement would preoccupy the Board of Public Works for over a year. Owners of structurally sound but fire-damaged structures rushed to remove the ruined interiors of their buildings. For example, the May 4 *Chronicle* reported the closure of Ellis between Powell and Market so that workers gutting every floor in the Flood Building could throw brick, plaster, and remnants of furniture out the windows. All this debris was quickly hauled away. Some owners of destroyed buildings, eager

to resume business, set to work clearing their lots for reconstruction as soon as the bricks cooled.[16] Wagons of all types were pressed into service to haul away rubble, but a shortage of teams hampered the effort. This would be a chronic problem for many months. The principal dump for this rubble lay at the foot of King Street behind the new Pacific Mail Docks. This area, roughly bounded by Second Street, Townsend, Berry, and section 13 of the seawall, received most of the rubble removed from the city during the first three months of cleanup and reconstruction. North Beach water lots at the foot of Jones near North Point Street got a fair share of that rubble as well.

The earthquake knocked out the city's "sanitary reduction works" at Fifteenth and De Haro, which incinerated the city's garbage. At first, accumulating garbage was piled on vacant lots and burned, but soon it was being dumped at sea. The Board of Public Works constructed an elevated driveway along the north side of Mission Street wharf No. 2. Planks attached to the edge of the driveway allowed garbage dumped from wagons to slide down to waiting scows and barges.[17] For the entire month of May San Francisco's garbage, including the manure from thousands of horses, was hauled to the waterfront, loaded on barges, and transported out to sea beyond the Golden Gate.

Once the Board of Public Works ceased dumping garbage onto barges at Mission Street wharf No. 2, the contractor Gilchrist & Co. took over the operation and began dumping rubble. The concept of a wharf dump was appealing. It would never fill up, and it was close to downtown. The plank slides proved ill suited to efficient rubble handling, so in July Gilchrist & Co. began renovating the facility to remedy the deficiencies. The contractor remodeled the driveway and installed two patented dumping machines. Each machine included an adjustable chute that could direct the flow of rubble to a barge's deck, eliminating the need to even the load by hand. Rubble dumping would resume at Mission Street wharf No. 2 in late August.

On May 28, 1906 Southern Pacific hauled away San Francisco's first carloads of rubble from a property on Minna near Third. Plank catwalks were laid up to and around the rims of gondola cars so men could roll wheelbarrows up, dump their loads, and descend by a separate path. The system worked, albeit slowly, as long as debris cars could be spotted on track near the property being cleared. The rubble probably ended up in the aforementioned cove at the foot of King Street. A Southern Pacific spur track to the old Pacific Mail Docks at the foot of First Street already served this area.

Locomotive No. 2 of the Ocean Shore Railway turns from Howard onto Fourth Street to retrieve a string of loaded debris cars. Courtesy of the California History Room, California State Library, Sacramento, California.

Debris cars were loaded in a few other locations as May turned to June. Cranes aided in the loading of some of these cars, but the going was slow, limited by the speed of shovel and wheelbarrow. Contractors were simply not securing enough debris-removal contracts to support large scale rubble transport. Insurance companies and property owners were contending with each other over the salvage value of buildings and the so-called fallen building clause.[18] Nor were there anywhere near enough proof-of-loss forms to go around. Even the decree signed at the end of May by 81 of 117 fire underwriters releasing policy holders to clear their property did little to spur demand for debris cars. The temporary track network was not extensive enough to reach all potential customers, yet the debris railroad refused to lay track unless the way was clear. Many streets were now blocked not by rubble knocked off buildings by "an act of God" but by rubble dumped there by workers excavating building cellars seeking buried safes and other valuables. The debris railroad balked at removing this rubble, arguing that someone "owned" the rubble and should pay to have it removed. As might be expected, no one stepped up to pay.

Despite these limitations, by mid-June the debris railroad was hauling thirty carloads of debris out of the burned district each day. Many of the blocks south of Market and along the waterfront were rapidly being cleared of rubble. Cars unloaded debris at the foot of King Street, near the Union Iron Works, and in the vicinity of the Sanitary Reduction Works where the rubble was used to grade streets and fill lots. The thirty carloads amounted to less than 1,000 cubic yards of rubble. The operators of the debris railroad hoped to carry far more than that—up to 400 carloads and more than 10,000 cubic yards a day. That quantity of rubble could not all come from properties adjacent to track. It would be impractical to lay temporary track everywhere and debris cars could not block track used by an active streetcar line. The debris railroad still needed a way to mate rubble hauling teams with debris cars. C. E. Loss had stopped work on his bunker at Third and Howard, which he would never resume. Finally a group of local contractors took matters into their own hands and incorporated the Bunker Company.[19] The

company secured permission to erect twenty-seven bunkers at various locations throughout the burned district. The bunkers would be loading platforms only, requiring no cumbersome storage machinery. Cars would be spotted near the platforms each night, filled during the day, and hauled away after normal business hours. This would minimize interference with the growing traffic of a reviving city. Construction of a bunker on First Street between Market and Mission began immediately.

Many property owners had serious misgivings about the railroad rubble-hauling plan. They resented paying to have debris removed from their lots that then became valuable landfill for someone else. At least split the shipping cost, they pleaded to no avail. The cost of hauling rubble by teams was competitive with railroad hauling, some property owners asserted, so why wait for the latest wrinkle in the railroad plan to unfold? Teamsters were pouring into the city to haul debris as well as lumber and other building materials. Huge stables were going up around town, particularly in the Mission between Sixteenth and Nineteenth streets. The recovering city's chronic shortage of teams might soon be alleviated. Teams would be competitive with trains, however, only as long as dumping grounds near downtown remained open. When those dumps filled up, the equation would change. The cost of sending teams out to, say, Western Pacific's free dump near Twenty-fifth and Illinois would not be competitive with shipping debris by rail.

North Beach dump. Rubble eventually will reach nearly all the way to Fisherman's Wharf. Courtesy of the Bancroft Library, University of California, Berkeley BANC PIC 19xx.112:075.

The First Street bunker opened at the end of June. The San Francisco Bunker Company deemed the bunker a success but did not rush to construct more. The slow pace of insurance claims adjustment kept demand for debris cars low. Even price cuts did little to spur business. Although prices were lower than before, for some contractors they were still not low enough. For example, the First Street bunker charged forty-eight cents to deposit and transport one wagonload (one and one-half cubic

yards) of rubble: 30 cents for hauling, 6 cents for switching, and 12 cents for bunker use. Such charges galled contractors, particularly since landfill generally cost about fifty cents a cubic yard,[20] and the railroads were using most of what they hauled away for improvements to their own properties. Contractor resentment helped to suppress demand for debris cars.

The debris railroad faced another, more serious problem. All debris trains were now leaving the city over the Howard Street temporary track, and the Howard Street Protective and Improvement Association was lobbying to have it removed. The track was an obstruction to traffic and a general nuisance, the Association argued, and nine tenths of all rubble was being hauled by teams anyway. The Association did not want to compromise debris removal, so it suggested that the streetcar tracks be rebuilt on Howard so that debris trains could use them each day after business hours. The Board of Public Works supported the Association and on July 25 the Board of Supervisors ordered that all temporary track laid on the surface of city streets be removed within 48 hours. Henceforth, temporary track had to be laid flush with the pavement.

This decision killed whatever chance the debris railroad had to dominate rubble removal. By late July insurance companies had begun to settle claims at a healthy pace. The Board of Public Works was pressuring property owners to remove all debris from the sidewalk and street in front of their properties, threatening to place liens on properties that did not comply. Demand for debris hauling had picked up, and the First Street bunker was running at full capacity. More than forty cars a day were dumping loads in the vicinity of Islais Creek. The debris railroad seemed primed for expansion. The supervisors' decision halted all that. Customers were turned away from the First Street bunker, and the debris railroad suspended all operations while United Railroads rebuilt the streetcar tracks on Howard. Surprisingly, no other temporary track was removed at this time. The supervisors' order was enforced on Howard Street only.

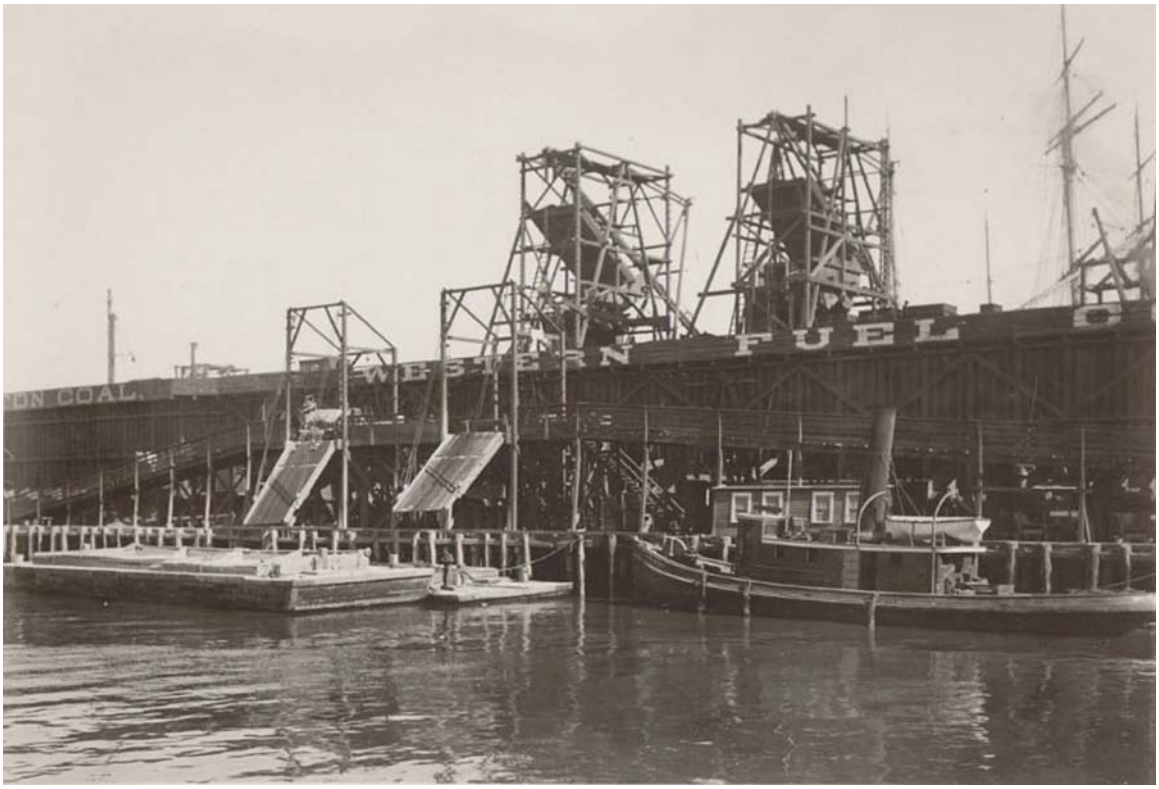
The Dump Crunch

At the beginning of August debris removal was in a crisis. The debris railroad was not hauling anything. Large dumps close to downtown were either full or limited in some way. The area behind seawall section 13, near the new Pacific Mail Docks, was all filled in, and the North Beach dump, while still accepting loads, was tightly controlled and closely monitored by the chief engineer of the Harbor Commission. Most teams hauling debris now faced long journeys to dumping grounds. This put pressure on contractors who had bid jobs assuming shorter hauls—shorter hauls meant more trips per day. According to the August 7, 1906 *Chronicle*, every contractor in the city was losing money on the long haul, and some were going broke. Dumps on the waterfront promised some relief. Renovation of the dumping platform at Mission Street wharf No. 2 was underway, and the contractor and building wrecker Healy-Tibbitts, doing business as the San Francisco Rapid Transit Excavation Co.,[21] began construction of its own dumping platform on the south side of the Vallejo Street wharf. At the end of the month, a specially designed, 1,000-ton, bottom-dump barge began accepting wagonloads of rubble at the foot of Mission Street wharf No. 2.[22] Barges would take on rubble at Mission No. 2 for over a year.

Brick cleaners with hatchets chip mortar off bricks which are then stacked for removal or reuse. In the background wagons are being loaded with rubble. California Historical Society, FN-33928.

The slowdown in debris removal did nothing to slow down activity in the city's ruins. Over 20,000 men were at work tearing down walls, loading wagons, and cleaning and stacking bricks for resale or reuse. Steel and cast iron from the ruins were cut up and shipped to smelters, then melted down and recast into beams and girders. Salvaging metals, especially brass and copper, was a lucrative business, so lucrative that thievery was common. Unguarded piles of valuable metals often vanished overnight. Ruined buildings were sometimes looted of their salvageable metals. Cleaned up bricks were stacked all over town. San Francisco's notoriously poor mortar (not reinforced with Portland cement) enabled wall demolition to proceed without undue damage to bricks. Broken brick was often crushed and used as aggregate for concrete. For example, all the brick, tile, stonework, and flooring removed from the fire-gutted Crocker building were recycled in this way. Broken brick from the Palace Hotel was fed into a rock crusher and sold to the railroads for track ballast.[23] The brick-cleaning process generated copious amounts of old mortar as a waste product. A small mountain of it stood at the corner of Geary and Kearny all through the summer and early fall. Mortar was typically hauled away in leaky wagons, which frustrated the efforts of the Board of Public Works to clean the city's streets. That board ordered all debris wagons to be "sand tight" on August 11, but leaky wagons plagued the cleanup effort for months to come.

The chief engineer for the Board of Harbor Commissioners eased the city's dump crunch by granting permission to a number of contractors to dump debris in an area north of Center (Sixteenth) Street and east of Illinois in the Central Basin. The round trip to this dump was about two miles shorter than the ruinous one to the free Western Pacific dump on the north shore of Islais Creek. The chief engineer also gave his blessing to the construction of a bulkhead of brick debris along the south line of Jefferson west of Taylor. With the bulkhead in place, the area south of it could be filled with rubble without displacing sand and mud into Fisherman's wharf. The chief engineer allowed California Fruit Canneries to fill part of Jefferson fronting its property between Hyde and Leavenworth as well.



A patented dumping machine unloads a wagon at Mission Street wharf No. 2. Courtesy of the California History Room, California State Library, Sacramento, California.

The debris railroad started removing rubble again during the last week of August. United Railroads purchased the steeple-cab electric locomotive *Electra* from the North Shore Railroad and dedicated it to debris removal. Wires went back up on Howard Street. The *Electra* hauled debris trains out to the vicinity of Islais Creek via Howard either by a connection with the Ocean Shore's line on Twelfth Street or along streetcar tracks on Fourth and Kentucky (now Third).[24] Steam engines provided supplemental power and switched cars over track that was not electrified. The Ocean Shore filled land on the north shore of Islais Creek for its repair shops.[25] Rubble may have been dumped along its spur line near Army Street (now Cesar Chavez) that ran east to Illinois Street. Temporary wire strung along Battery Street and on First Street allowed the *Electra* to work there. Once Howard Street was open to debris trains again, the First Street bunker reopened.

Dumping at Mission Street wharf No. 2 was going strong by September. Barges were supposed to dump their loads only in locations approved by the federal government's chief engineer for the region. Some barges probably dumped in the vicinity of Mile Rock, which was in relatively deep water and outside the shipping lanes. Others may have dumped in the Central Basin or in shallow water near the mouth of Islais Creek. But some contractors could not resist "midnight dumping." Under cover of darkness, when no state wharfinger (wharf manager) was around to ask questions or collect tolls, wagons would dump into a waiting barge. Then the barge would slip out and dump its load, illegally, into the bay. Telephone cables beneath the bay were soon found to be covered in debris. On September 19, in response to this illegal dumping, the federal government's chief engineer placed all barges engaged in debris removal under military supervision. Soldiers were posted at every place along the waterfront where debris barges were loaded. Several individuals were arrested and convicted for illegally dumping into the bay. The illegal activity ceased but legal barge dumping boomed. Soon there was a severe shortage of lighters[26] around the waterfront. In October it seemed that every vessel that could carry debris did.

Debris clearing reached its zenith in the fall of 1906. Many insurance claims had been adjusted and the rate of claims adjustment was increasing. Demand for the services of building wreckers soared. A bunker was constructed on New Montgomery between Market and Jessie, opposite the Palace Hotel. Demolition of the Palace commenced in late September, and the New Montgomery bunker was designed specifically to serve that project. However, wagons hauling debris from other sites could dump there as well. The San Francisco Rapid Transit Excavation Co. initiated provisional dumping at the Vallejo Street wharf in October and commenced full-scale operations there in December. The company also took over the 1,000-ton bottom-dump barge, which had been working at Mission Street wharf No. 2, and began operating it from the bulkhead between Howard Street wharves No. 1 and No. 2. Three wharf dumps were now in operation. More new landfill opportunities opened up in and near downtown. A large fill was started on Sansome Street, and Southern Pacific began filling in a huge area of ponds and low-lying land that would become its Mission Bay freight yards. Five thousand debris teams now worked in the burned district. Teams hauled cut-up cast iron and steel to local smelters, who had cornered the scrap market by virtue of their low shipping costs. Countless teams hauled cleaned bricks to storage yards and construction sites. For a few months there was something like a "brick rush" going on amidst San Francisco's ruins. There was so much work cleaning bricks that soldiers were deserting their posts at the Presidio to earn five or six dollars a day chipping off mortar or loading wagons. Five dollars a day was a princely sum to a soldier earning fifteen dollars a month.[27]

The New Montgomery bunker. Wagons dump their loads on the bunker platform, and the rubble is shoveled onto flatcars waiting below. Originally the bunker possessed two platforms. Track next to the Palace Hotel will carry flatcars full of crushed brick. The machinery is being assembled at the corner of Jessie and New Montgomery. Note the two debris bunkers for loading wagons. California Historical Society, FN-18759.

Duffy's Crusades

In mid-October George Duffy, the new president of the Board of Public Works, launched a street cleaning crusade to enforce the order handed down by the Board of Supervisors in July mandating that streets and sidewalks be cleared of debris. Property owners complained that the demand for teams and the call for debris cars made it impossible to comply with his order. Duffy was unmoved. He assigned 500 men to the job of clearing Market Street. Anything piled on the street or sidewalk would be thrown back onto the lot behind it. Property owners were incensed since the "debris" was often scrap metal, construction material, or bricks cleaned and stacked for reuse. One contractor, whose crew had cleaned and stacked 100,000 bricks on the street and sidewalk, pulled a revolver on a gang of Duffy's street cleaners who had thrown several thousand bricks back into the excavation they had been salvaged from. Duffy refused to cut property owners any more slack—they had already enjoyed three months' grace—but his street cleaners would not interfere with anyone actually removing debris from public thoroughfares and would even lend a hand loading wagons. Property owners got the message and scrambled to hire teams. Duffy took on United Railroads too, browbeating its management into removing all the rails lying around loose on Market Street. Duffy's crusade succeeded as debris was cleared from property line to property line along Market, Mission, and many other major streets. This success came at a price. By December the Board of Public Works was $70,000 in debt due to street-cleaning projects.

On October 20 high winds caused several brick walls to collapse. Five people were killed. Damaged walls, though still standing, were widely recognized as a menace to life. George Duffy sent out notices to property owners ordering them to remove dangerous walls immediately. The notices were ignored. Then, on November 30, high winds dislodged a large chunk of masonry from a window of the Palace Hotel above Market Street. Part of this mass struck Edward Cuneo, 14, killing him instantly. This tragedy seemed to inspire Duffy to launch his second crusade—against dangerous walls. Duffy's work gangs used fire department ladders to scale walls. Once ropes were fastened around the top of a wall, men would use brute force to pull it down. Soon Duffy secured the use of a traction locomotive for greater pulling power. A serious storm on December 12 caused numerous walls to collapse around town, thus adding urgency to Duffy's crusade. Many property owners suddenly became motivated to remove dangerous walls themselves, often erecting scaffolding and tearing walls down by hand. Walls continued to collapse without warning through January of 1907, but soon afterward the last dangerous wall was demolished.

The traction locomotive leased by the Board of Public Works tears down the remains of the Auzerais Building on the southwest corner of Ellis and Powell. California Historical Society, FN-33837.

By January 1907 the debris railroad was in decline. Track to the New Montgomery bunker was the last temporary track laid. Lack of new track limited the railroad's ability to haul debris. Only so many cars could be spotted at the bunkers, and the cars could not be moved out and replaced during the day. Debris cars not serving bunkers needed to be spotted on track near the rubble they would be hauling. Revived streetcar service kept the cars off major streets. As lots adjoining temporary tracks were cleared of rubble, demand for direct "curbside" loading of debris cars evaporated.

Temporary track was nothing but a traffic-obstructing nuisance to teamsters, draymen, and merchants. In January 1907 these groups joined forces to form the Street Repair Association. Although its primary goal was raising money for street repair, it also lobbied the Board of Public Works for removal of the irksome temporary tracks. On January 14 George Duffy launched his third crusade. He ordered the railroads to remove temporary track, except that actually in use, from all city streets. For practical purposes, this meant all track in the system except the bit connecting the Palace Hotel site to the streetcar tracks on Howard. All the railroads complied with Duffy's order except Santa Fe, which had contributed almost nothing to the debris-hauling effort. Santa Fe tried to placate Duffy and hold on to its Spear Street track, which ran along Spear to Market from Harrison. At Harrison a switch connected it to Santa Fe's own spur track. Originally Santa Fe laid this "temporary" track on top of the pavement, but later replaced it (without permission) with mainline-railroad-quality track. The track was laid flush with the pavement and on one side of the street, which left room for a second track on the other side. Santa Fe's intentions were transparent to George Duffy. This was a permanent spur to a future depot on Market Street. Duffy would not accept this "street grab."[28] He carefully organized his response. His attack on Santa Fe's track on Sunday, February 3, 1907 caught the railroad by surprise. Courts were closed and no injunctions could be issued. Duffy and his gang of workers struck first at the switch connecting the Spear Street track to Santa Fe's own. Once the switch was ripped out Santa Fe could

not send cars over the Spear Street track to claim control of it. Santa Fe was outfoxed, and within two days the Spear Street track was no more. Another Duffy crusade had succeeded. The temporary track to the Palace Hotel site remained in service until most of the ruins of the hotel were hauled away. The debris railroad ceased regular operation in March of 1907.

The Ruins Disappear

As spring approached, the amazing progress made in clearing the city's ruins was apparent to all. A mere ten months earlier it had seemed that ruins would choke the city for years. Instead, a building boom was under way. Nearly one third of the city's burned district had been rebuilt! The Mission district from Market to Twentieth Street had been built up more densely than before. North Beach showed almost no traces of the fire. Dupont Street (now Grant Avenue) from California to Broadway was nearly reconstructed. In a five block radius from Market and Kearny 146 fireproof and semi-fireproof buildings were under construction or being rehabilitated.[29] Numerous lower quality brick buildings were also going up. Continuing demolition of ruined buildings eliminated the haunting reminders of the great cataclysm.

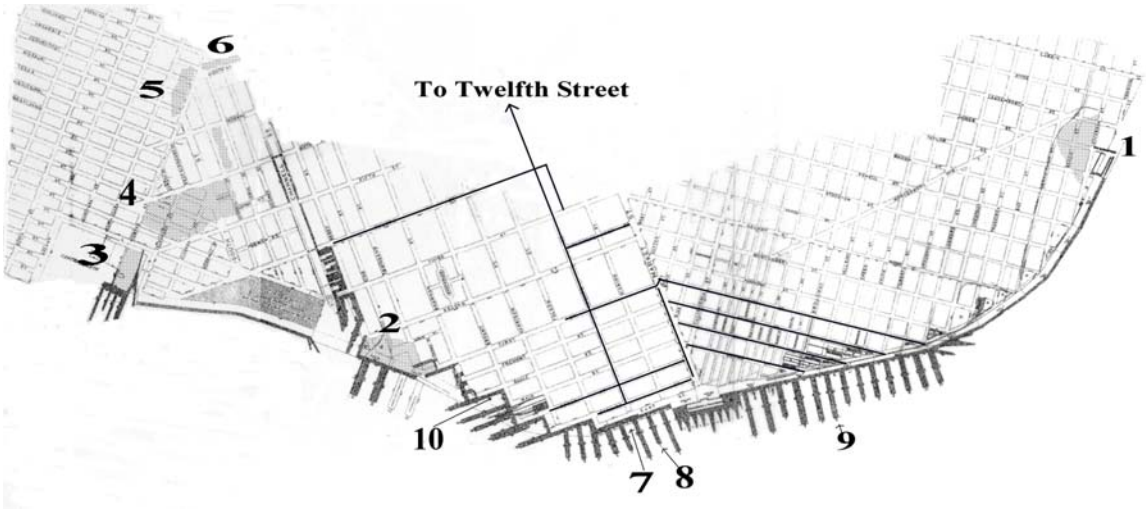
Building-demolition and reconstruction produced tremendous amounts of dust. Despite valiant efforts by the Board of Public Works, the streets were thick with sand mixed with lime from old plaster and mortar. The streets themselves were in deplorable condition. Both the earthquake and the heavy traffic associated with reconstruction had damaged pavement. Fortunately, money was available for street repair. The city pledged $150,000 to the cause, and private "improvement" associations raised funds through bond sales and special assessments.[30] Because thoroughly cleaning the streets was a prerequisite to repairing them, the Street Repair Association advocated a citywide volunteer housecleaning day to make a major dent in the mess. Major thoroughfares would be swept clean of dirt and debris and made ready for repair. The Board of Public Works wholeheartedly supported the idea, and the newspapers plugged it. The response was enormous. The city's largest contractors offered tools, teams, and men, and the railroads promised debris cars. On Sunday, March 3, 1907 at least 20,000[31] volunteers took broom and shovel to the streets of San Francisco. Individual contractors assumed responsibility for various sectors. Debris cars lined Main, First, and Howard. Three barges were moored at the waterfront. Newspapers reported that 3,500 teams worked all day. The army of volunteers piled up an estimated 50,000 cubic yards of dirt. Although 30,000 cubic yards of it were hauled away on housecleaning day, 20,000 cubic yards remained piled up in heaps all over town. George Duffy promised that the Board of Public Works would clean up all the heaps, but he had neither the money nor the manpower to do so. For several weeks heaps of dirt stood at curbs all over town, and during that time a lot of it blew back onto the streets and sidewalks. Nonetheless, after housecleaning day, most of the principal streets downtown and south of Market remained clean, and street repair proceeded apace.

Housecleaning day and the day after. The ***Call,*** March 4, 1907.

Although teams would haul away many more loads of sand and brick from the sites of ruined buildings, housecleaning day symbolized a change in San Francisco's recovery from the earthquake and fire. The city had emerged form the clean-up phase of its recovery and was now clearly rebuilding. The pace of rubble removal slowed. Construction of seawall section 12 beginning in June 1907 allowed dumping to resume near the foot of King Street. The North Beach dump remained open as well. The Rapid Transit Excavation Co. continued to load rubble on barges until mid-July 1907 and the Debris Transportation Co., which took over the dumping operation at Mission Street wharf No. 2 in December 1906, accepted loads until October 1907. By the time the Great White Fleet steamed into San Francisco Bay on May 6, 1908, the great janitorial effort to clear away San Francisco's ruins was essentially over.

Where the Rubble Went—Known Dumps

Three possible fates awaited the ruins of 1906. The rubble might remain where it was, be salvaged or recycled, or be dumped somewhere. If it was dumped, debris cars, barges, or teams—horses and wagons—hauled it away. Barges dumped rubble at sea or in the bay. Debris cars and teams dumped it within the city limits—in marshlands, water lots, or land that was below street level. What follows is a catalog of known and probable dumps for the rubble of 1906.



Principal track of the debris railroad indicated by dark lines. Shaded areas indicate approximate extent of dumps. Dump key: 1, North Beach; 2, foot of King Street; 3, Central Basin; 4, Southern Pacific lands in Mission Bay; 5, foot of Seventh and Eighth Streets; 6, Fifteenth Street and De Haro; 7, bulkhead between Howard Street wharf No. 1 and Howard Street wharf No. 2; 8, Mission Street wharf No. 2; 9. Vallejo Street wharf; 10, Beale Street wharf roadway. Not shown: dumps on north shore of Islais Creek. Map derived from the 1908 Board of State Harbor Commissioners map.

The Debris Railroad: Electric and steam locomotives hauled rubble in both flatcars and gondola cars. Flatcars, also called ballast cars, were more common. Planks surrounding the flatcar's surface often helped retain the load. The capacity of such a car ranged from twenty to more than thirty cubic yards, depending on how high the load was heaped. Gondola cars had a greater capacity—forty to fifty cubic yards.[32]

The debris railroad hauled rubble in two distinct phases, punctuated by the suspension of all activity during reconstruction of the Howard Street tracks. The first phase lasted two months starting with the first load hauled on May 28, 1906. By early June thirty cars were leaving the burned district each day; by July the number was up to forty or more. I will assume an average of thirty-six cars for the period, evenly divided between gondolas and flatcars. Twenty-four cars dumped daily at the foot of King Street, while the others dumped near the Sanitary Reduction Works and near the Union Iron Works.[33] I estimate there were fifty-three working days in this phase (a six-day week). Debris cars dumped about 50,000 cubic yards at the foot of King Street and about 20,000 cubic yards elsewhere.

When the debris railroad resumed operation in late August 1906, gondola cars had been withdrawn from service and flatcars substituted for them. The bunkers at both First and New Montgomery streets were designed to serve flatcars, not gondolas. The capacity of these bunkers was limited by the number of cars that could be spotted on the street. Each bunker could handle about 300 cubic yards of rubble a day—200 wagonloads. It is hard to say how successful the bunkers were. Both were running at capacity soon after opening, according to the *Chronicle*, but the paper did not follow their progress.[34] The United Railroads archives at the California State Railroad Museum Library suggest the bunkers

were not so successful. United Railroads, the corporate parent of the debris railroad, took over operation of the First Street bunker in July 1906[35] and almost certainly operated the New Montgomery bunker as well. It sold 19,946 five-cent "debris tickets" from August 1906 through March 1907. It is only logical to assume that each ticket represents one wagonload—one and one-half cubic yards—dumped at a bunker. (The debris ticket was not the full cost as I indicated above.) Thus, if debris tickets represent all the loads dumped at the bunkers, then the debris railroad hauled away about 30,000 cubic yards of rubble from the two bunkers during its second phase of operation. This was less than half of the bunkers' theoretical capacity.[36] It is possible that debris tickets may not tell the whole story. Some contractors, such as the original investors in the San Francisco Bunker Company, may have had special privileges at the bunkers, and the New Montgomery bunker might have been independent of United Railroads, but I will not factor these speculations into my calculation.

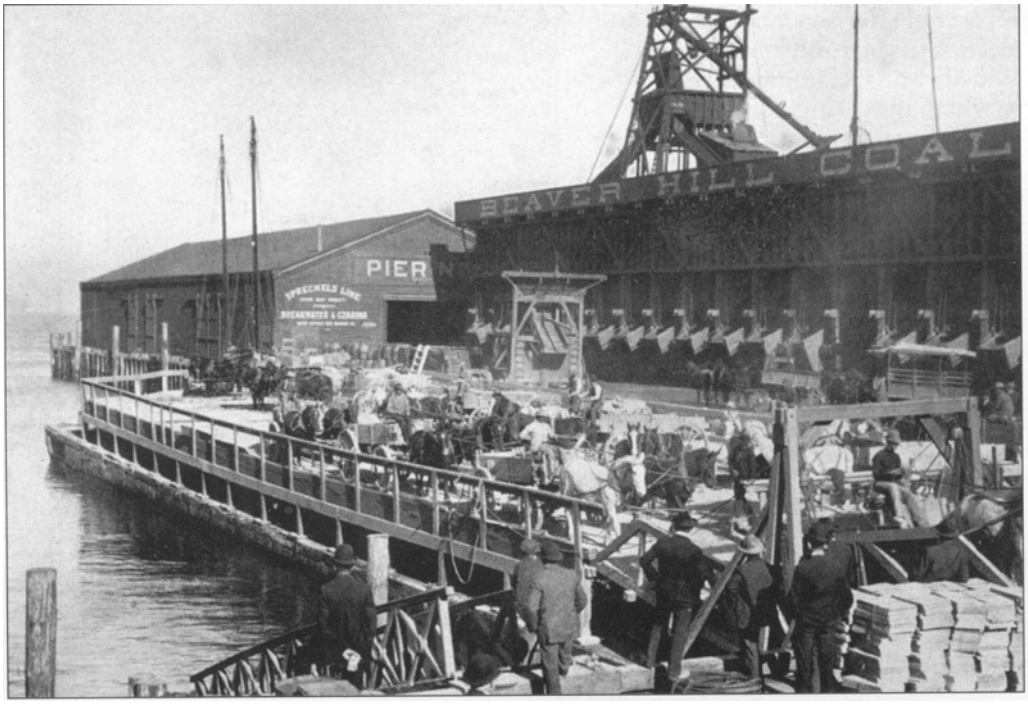
Electra at Battery and Market. The basic elements of debris clearing are depicted here: the brick cleaner with his hatchet; men pushing wheelbarrows of rubble up a plank to dump into a debris car; cleaned bricks stacked; a team ready to haul bricks or rubble. California Historical Society, FN-33849.

Cars were directly loaded (that is, not from bunkers) at many locations during the debris railroad's second phase of operation, but this activity was concentrated along Battery Street and at the Palace Hotel. Most of the city's debris tracks lay in the waterfront area east of Battery and First streets. When the debris railroad resumed service, that area had been largely cleared of rubble. Battery Street was the notable exception. I estimate that an average of twenty-four cars worked for 110 days on Battery and other streets. Those cars carried away 66,000 cubic yards of rubble. Additional flatcars carried scrap steel and cast iron, but this rubble was recycled and not used as landfill. After January 1907 only cars spotted at the Palace were being directly loaded with debris. Temporary track was laid right next to the Palace, probably in December 1906. I estimate that cars were directly loaded at the Palace for about 100 working days. Rock crushers pulverized bricks and dumped the remains into some of the cars. It is

difficult to estimate how many debris cars were directly loaded at the Palace. Cars may have been spotted and removed during normal business hours, contrary to the prevailing practice.[37] Many cars carried away steel and cast iron. I will assume that, on average, ten debris cars were directly loaded at the site each day. Thus, 25,000 cubic yards of rubble was directly loaded onto cars at the Palace Hotel site. During the debris railroad's second phase of operation, about 90,000 cubic yards of rubble was directly loaded onto flatcars. Nearly all of this rubble, plus the 30,000 cubic yards loaded at the bunkers, was hauled to the vicinity of Islais Creek (see below). Over the two phases of its operation, the debris railroad hauled no more than 200,000 cubic yards of rubble.

Dumps on the Waterfront: In 1906 the State of California's harbor commissioners had jurisdiction over San Francisco's waterfront. The harbor commissioners tightly controlled all activity on the wharves and the adjoining bay and tidelands. Earthquake and fire damage along the waterfront was comparatively light. The major casualty was the huge grain shed on the northern waterfront. It burned to the ground. A couple of freight sheds also collapsed, but in general, the wharves emerged from the catastrophe intact and ready for business. Relief supplies, then building supplies, poured into the city. Lumber in particular arrived in tremendous quantities. Business on the waterfront boomed, so there was not a lot of space available to erect facilities for handling debris. Wharf records and newspaper accounts agree there were only three sites where rubble was dumped onto barges and hauled out to sea—at the Vallejo Street wharf, at Mission Street wharf No. 2, and from the bulkhead between Howard Street wharf No. 1 and Howard Street wharf No. 2. The dump at Mission No. 2 opened first, and by August 1906 was in regular operation. It remained open until October 1907. The other two dumps opened in mid-October 1906 and closed before mid-July 1907.

Tolls are the clue to the amount of rubble loaded at Mission No. 2 and from the bulkhead between Howard No. 1 and Howard No. 2. Records for Mission No. 2 have a ledger line marked "debris" and a figure for the tolls assessed. Barge No. 5—a 1,000-ton, bottom-dump barge constructed for the sole purpose of hauling debris—loaded at Mission No. 2 for two months. Tolls were assessed to it separately. When Barge No. 5 moved to the bulkhead between Howard No. 1 and Howard No. 2—it was the only barge to take on rubble at this location—tolls were assessed to it on the ledger of Howard No. 1. A five-cent toll was levied on each wagonload of debris.[38] Tolls at Mission No. 2 were assessed to Gilchrist & Co. ($419.50), the Debris Transportation Co. ($1,180.10), and Barge No. 5 ($345.30). Barges at Mission No. 2 thus carried away 58,347 cubic yards of rubble. Tolls on Barge No. 5, when it was loading on the bulkhead between Howard No. 1 and Howard No. 2, amounted to $1,857.80. Barge No. 5 carried away 55,734 cubic yards of rubble from that location.

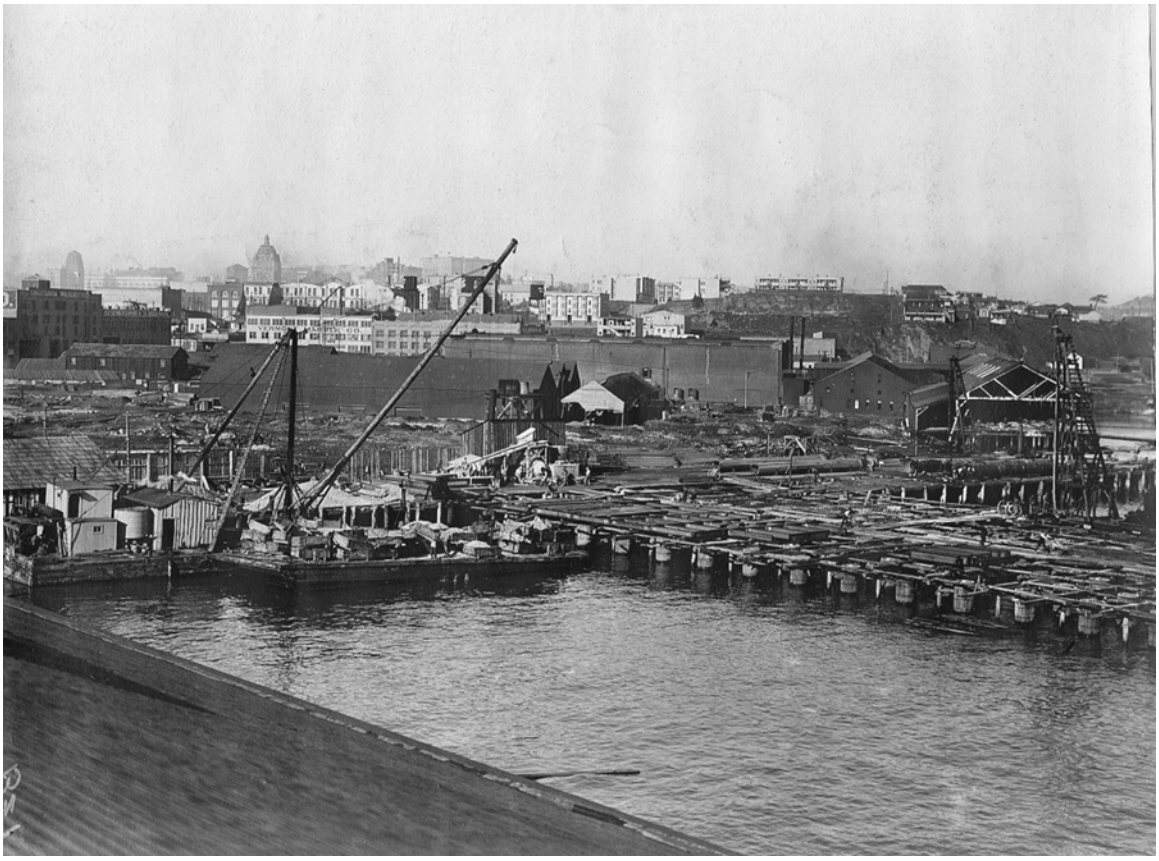


Barge No. 5 takes on rubble from the bulkhead between Howard Street wharf No. 1 and Howard Street wharf No. 2. Wagons dump into the barge's hold after planks on its deck are moved aside. Courtesy of the California History Room, California State Library, Sacramento, California.

No tolls were levied on the barges at the Vallejo Street wharf. Perhaps the terms of its lease allowed the San Francisco Rapid Transit Excavation Company to load barges without paying tolls. A 400-ton lighter, No. 4, and a 120-ton lighter, No. 1, provided the bulk of rubble service at Vallejo Street. A ship's tonnage is a measure of volume, not weight. Still there is a correlation between a ship's volume (tonnage) and the amount of weight (in tons) it can carry. A 400-ton lighter, for example, could carry about 555 cubic yards of rubble.[39] If all the lighters working at Vallejo Street were loaded to capacity each day wharf records show them loading, they could have carried away 142,870 cubic yards of rubble. I believe it is unlikely the operation was that efficient. It took a long time for the Vallejo Street operation to get under way, suggesting that its conveyor-belt technology was cranky and prone to breakdown. Lighters were probably not loaded to capacity either. The records for Barge No. 5 at Mission No. 2, which show its arrivals and departures, indicate that it was loaded, on average, to about 75% capacity. These records show it took two days to load the barge. If it took a little less than that, say, one and three-quarters days, to load the lighters used at Vallejo Street to 75% of their capacity, those lighters could have carried 61,230 cubic yards of rubble.

The three wharf dumps received about 175,000 cubic yards of rubble.[40] The debris railroad and the wharf dumps combined disposed of less than 400,000 cubic yards of rubble. Teams carried all the rest. Thus the distance a team hauling a load of rubble could economically travel—about three miles[41]—limited where dumps could be located. San Francisco's topography also limited dump location. For example, no dumps were located on hillsides. Sizable dumps could be located only on water lots, marshes, or low-lying lands. In the San Francisco of 1906 such sites could be found along the waterfront from North Beach to Islais Creek, along Islais Creek, and in the former tidelands of Mission Bay. The estimates of dump capacity given below derive from several cartographic sources: Sanborn maps from 1899 and 1913, 1903 (corrected to 1905) U. S. Coast and Geodetic Survey, 1911 Chevalier map of San Francisco, and the 1908 Harbor Commissioners map.

The foot of King Street: Construction of San Francisco's great seawall began on the northern waterfront in 1878. Construction on the first section south of the Ferry Building—section 13—did not begin until 1904. This 600 by 60 foot seawall, oriented at about a forty-five degree angle to Second Street, ran almost due north from slightly south of Berry Street to the south line of King Street. A 400 by 50 foot bulkhead constructed around the same time connected the seawall to the foot of Second Street. These structures created a nearly rectangular cove whose open end looked across water toward the Pacific Mail dock, which extended along the east side of First Street from Brannan nearly to Berry Street. Filling the cove took place in two phases. The first lasted from May through July of 1906, during which time the area behind seawall section 13 was filled back to the shore. The second phase started in late 1907. Fill followed along with the construction of seawall section 12, which was completed in 1908. By the end of 1908 the cove had been filled as far north as First Street. Some rubble may have been added to the earlier fill during this phase as well. The principal fill area covered nearly eleven acres. Water was fairly deep here, even close to shore. I estimate the average depth of water over this entire area at two fathoms (twelve feet), measured to the lowest low water level. In San Francisco, an elevation of zero (City Base) is about thirteen feet above the lowest low water level.[42] Thus, the average distance from City Base to the bay floor was twenty-five feet. Fill of this magnitude would not just rest on the bay floor—it would sink in a bit. Based on these considerations, I estimate the capacity of this dump at about 500,000 cubic yards. About 10% of it was transported in debris cars. The chief engineer of the Harbor Commission endorsed rubble as a fill material, and quite a bit wound up behind seawall section 12 between First Street and Beale,[43] but I did not include it in this estimate.



King Street dump. Pier 40 is under construction in late 1908. The Oriental warehouse is at the center of the picture. In front of it is the Occidental warehouse. To their right are the remains of the Pacific Mail dock at First and Brannan. Fill extends from the seawall to the warehouses and the Pacific Mail dock as well as beyond the picture's left margin to Second Street. Courtesy of the San Francisco Maritime Museum Library.

North Beach: In 1906 the shoreline between Taylor and Leavenworth curved south as far as North Point. The water lots between the shore and Jefferson were subsequently filled with rubble. Dumping began here as soon as the fire burned out. Some of this dumping pushed sand and mud into Fisherman's wharf (located at the west end of seawall section B between Taylor and Jones). The Harbor Commission halted it. The Harbor Commission approved dumping in other locations, however, and eventually approved construction of a rubble breakwater along the south line of Jefferson. This breakwater enclosed about three and three-quarters blocks of water lots. The blocks between Beach and Jefferson were under seven to eight feet of water. Water lots between Beach and the shoreline were shallower. About fifteen acres were filled in this area. I estimate the capacity of this dump at about 500,000 cubic yards. This figure includes the section of Jefferson between Leavenworth and Hyde filled by California Fruit Canneries and a similarly sized area south of Jefferson filled by that company as well. Only wagons served this dump. Most of the area south of Jefferson was filled in by May of 1908.[44] By 1913 another four acres north of Jefferson between Jones and Hyde had also been filled, perhaps with rubble that was not cleared away until after the spring of 1908.

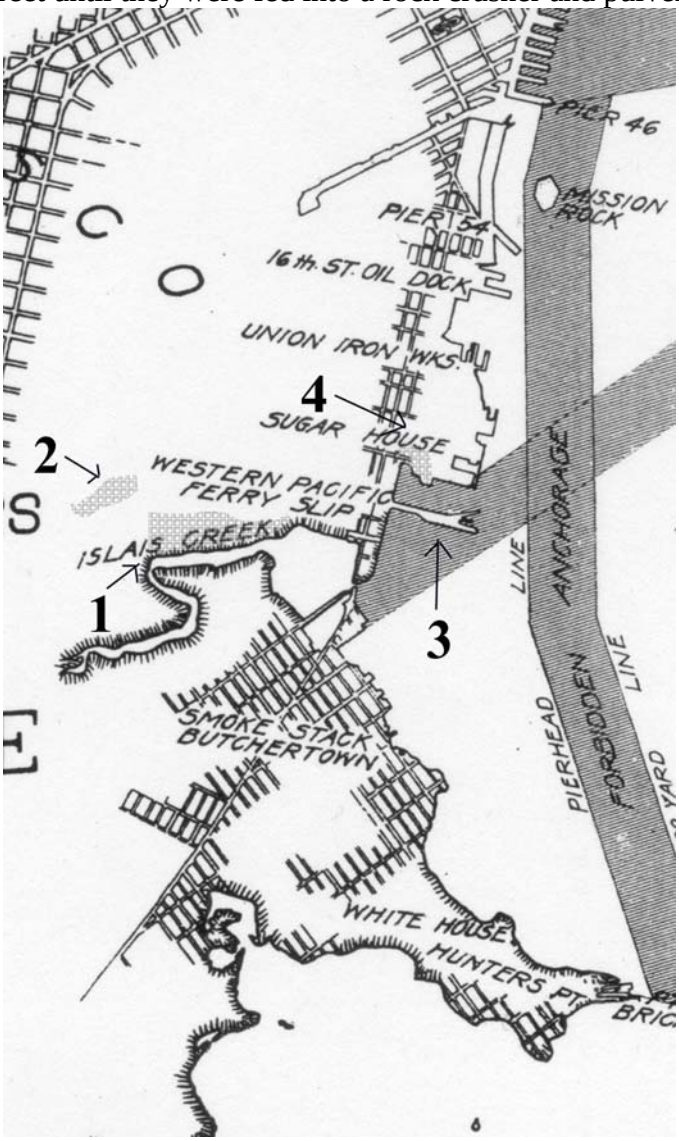
Southern Pacific lands in Mission Bay: The December 21, 1906 *Call* reported that Southern Pacific was filling land along the "southern approaches to the wharves along Channel Street." This area became the vast Mission Bay freight yards. The principal fill area lay between the lines of Fifth and Sixth streets in the southern part of Mission Bay near Kentucky (Third Street) and Sixteenth Street. In 1899 over twenty-five acres of shallow ponds and low-lying areas filled with garbage covered this area. The garbage-strewn areas were soft and in need of stabilization to accommodate the weight of heavy trains. About fifteen feet of fill would have brought the shallow ponds up to City Base. Low-lying lands south of Sixteenth Street between Sixth and Seventh streets might also have been filled at this time. Unfortunately, there is no public record of any of Southern Pacific's filling operation, and it is not clear how much land was filled in that area between 1899 and 1906.[45] Nevertheless, I conservatively estimate the capacity of this dump at 500,000 yards. Although it was filled by a railroad company to provide stable ground for railroad yards, it is likely that wagons dumped all the rubble at this site.

Fifteenth Street and De Haro: Debris cars dumped rubble from a Southern Pacific spur track near the Sanitary Reduction Works at Fifteenth Street and De Haro. Marshes lined the west side of Eighth Street from the Mission Creek Channel to Sixteenth Street. A section of these marshes lay directly opposite the reduction works. Streets in the area were graded with rubble as well.[46] Debris cars dumped about 10,000 cubic yards here and on Sixteenth Street (see below). Wagons used this dump too. The area around the Sanitary Reduction Works also functioned as a public dump into 1907 and was used during housecleaning day. It was tightly controlled. In 1899 the marsh in this area covered about four acres. If half of that remained to be filled in 1906 and if the depth of fill was twelve feet, the capacity of this dump would have been 40,000 cubic yards. In addition, 10,000 cubic yards of rubble or more may have been used in nearby street-grading projects.

Former dumps at the foot of both Seventh and Eighth streets (near Sixteenth): This area was once part of Mission Bay, and pools of water dotted the area in 1906.[47] In 1899 about five acres of marshes extended along the south side of Sixteenth Street between Seventh and Eighth streets. If half this marshland remained in 1906 and the depth of fill was twelve feet, the capacity of this dump would have been 50,000 cubic yards. Wagons dumped most of the rubble used as fill here.

Central Basin: The chief engineer for the Harbor Commissioners granted several contractors the right to fill an area of shallow water in Central Basin east of Illinois between the Arctic Oil Works on Sixteenth Street and Southern Pacific's freight ferry wharf to the north.[48] The area was about fifteen

feet below City Base. The contractors dumped around 120,000 cubic yards of debris into this four and three-quarters acre water lot beginning in August 1906 and continuing through May 1907. Wagons probably dumped all the rubble here, although barges may have dumped here too. Much of this area was excavated in the summer of 2005. A stratum of brick was exposed, and piles of brick, stone, and old mortar lined Third Street until they were fed into a rock crusher and pulverized.



Dumps in the Islais Creek area. Shaded areas represent approximate dump extent. Dump key: 1, shops and yards of the Ocean Shore Railway; 2, Precita Valley swamp; 3, Western Pacific's mole; 4, Western Sugar Refinery on Potrero Point; 5, Union Iron Works. Map derived from 1918 Board of State Harbor Commissioners map of Forbidden Anchorage.

Islais Creek north shore: The debris railroad carried rubble to the vicinity of Army Street and dumped most of it on tidelands owned by the Ocean Shore Railway. In my discussion of the debris railroad I estimated the amount of rubble dumped in the Islais Creek area at about 120,000 cubic yards. Western Pacific Railroad, which was planning a freight ferry slip at the foot of Twenty-fifth Street, offered the public a free dumping ground there, and it is possible that the debris railroad served that area as well. Barges could have dumped there too. Teams hauling rubble could make only two trips a day to the tidelands of Islais Creek.[49] A contractor dumping in this area would find it hard to underbid a contractor dumping closer to downtown. Western Pacific eventually constructed a mole just south of Twenty-fifth Street, but I do not know how much of that landfill was 1906 rubble. The railroad's water lots were under about two feet of water—fifteen feet to City Base. I calculate that the mole, as depicted

in the 1913 Sanborn maps of the area, required about 160,000 cubic yards of fill. Additional fill for Western Pacific's right-of-way in the area consumed about 60,000 cubic yards. Promoters of the debris railroad envisioned millions of cubic yards of rubble reclaiming the tidelands of Islais Creek. *It never happened. In 1913 the north shore of Islais Creek was still mostly water and mud flats.*

If all the fill around Western Pacific's mole was 1906 rubble, then the dumps along Islais Creek received 340,000 cubic yards. Teams would have carried 220,000 cubic yards of it, unless barges also served the area.

Near Union Iron Works: A Southern Pacific spur track served the Union Iron Works,[50] and debris cars dumped about 10,000 cubic yards of rubble there. Wagons may have used this dump too.

Dumps along the northern waterfront: Low-lying areas along Sansome and in a triangular lot bounded by Bay, Kearny, and The Embarcadero were filled with rubble.[51] Wagons dumped about 35,000 cubic yards of rubble in these and other low-lying areas along the northern waterfront.

Beale Street wharf roadway: In 1906 Beale Street between Bryant and Brannan was planked on piles. Debris was dumped into the bay at this location. There was no proper bulkhead in the area, so the chief engineer for the State Harbor Commissioners sought to curtail the dumping. For housecleaning day he allowed the Street Repair Association to dump street cleaning debris through the wharf roadway.[52] This was a small, little-used dump; probably no more than 5,000 cubic yards of rubble ended up there.

Where the Rubble Went—Probable Dumps

Precita Valley Swamp: In 1906 marshlands covered the area roughly bounded by Army, Twenty-sixth, Bryant, and Potrero. San Francisco's Board of Supervisors wanted the Ocean Shore Railway to extend temporary tracks to the swamp, which they viewed as an unsanitary nuisance, then fill it with rubble from the burned district. The Ocean Shore never did this, although the railroad's main line ran along Potrero Street adjacent to the swamp. The Board of Supervisors awarded Western Construction Co. a contract to fill the swamp. But the contractor never started the job, and the city finally washed its hands of the matter. The city engineer recommended that the owners of the swampland take charge of filling it.[53] Sanborn maps show that Precita Valley Swamp was filled in by 1913, and I think it is fair to assume that property owners availed themselves of 1906 rubble to do so. The swamp covered about five and three-quarters acres and was probably filled to an average depth of two to three yards. I estimate that 70,000 cubic yards of rubble could have been dumped here.

North of the Southern Pacific freight ferry in Central Basin: One and one-half acres of mudflats and shallow water lay between the China Basin yards of the Atchison Topeka and Santa Fe Railroad and Southern Pacific's freight ferry wharf. By 1913 this area was filled to City Base, which would have required about fifteen feet of fill. Thus I estimate that about 35,000 cubic yards of 1906 rubble could have been dumped here.

Aquatic Park area: The small strip of land north of the centerline of Beach Street between Hyde and Polk was reclaimed from the bay between 1899 and 1913. Less than an acre was filled to a depth of five to six yards. About 20,000 cubic yards of 1906 rubble could have been dumped here.[54]

Foot of Webster in the Marina: In *What Lies Beneath the Marina?* I showed that no significant amount of 1906 rubble found its way to the Marina district. However, San Francisco Gas & Electric

Co. offered free dumping for fire debris (no metal) in water lots between its own mole and James Fair's seawall on Webster Street.[55] This area later became a public dump. Fill here extended from a bit north of North Point Street to around the line of Beach Street. The fill did not reach all the way up to City Base. Around 20,000 cubic yards of 1906 rubble may have been dumped here.

Near Western Sugar Refinery on Potrero Point: In 1906 a Southern Pacific spur track ran out to the Western Sugar Refinery on the south shore of Potrero Point, so debris cars may have dumped there. Barges may have dumped here as well. About two and a half acres of shallow water in the area southeast of Twenty-third and Illinois were filled between 1899 and 1913. If the fill was fifteen feet deep, about 60,000 cubic yards of 1906 rubble may have been dumped there.

In areas of subsidence: The earthquake caused ground to subside in many places. The Transportation Committee recommended that debris be used to fill in subsided streets and to bring streets up to newly established grades. Contractors used rubble, especially the remains of plaster and mortar, to fill in areas of subsidence. For example, Van Ness Avenue sank nearly two feet from Vallejo to Union, and Vallejo sank nearly as much between Polk and Franklin.[56] The area of subsidence covered more than two acres. At least 5,000 cubic yards of fill was required to bring these streets back up to grade. Other major areas of street subsidence were on lower Market, East Street between Pacific and Vallejo, Harrison (which sank four feet in some places), Valencia near Eighteenth, Dore Street, Capp, Union between Steiner and Pierce, and an area near Ninth and Brannan. Other, minor areas of subsidence were scattered throughout the city. I estimate that 50,000 cubic yards of rubble restored subsided areas to their previous levels and raised the grade on several streets, including lower Market.

I estimate that known 1906 dumps received between 2,065,000 to 2,285,000 cubic yards of rubble. (The range reflects my uncertainty about the origin of the fill for Western Pacific's Twenty-fifth Street mole, as well as my attempt to avoid double-counting rubble that barges dumped along the southern waterfront, e.g., for Western Pacific's mole.) Probable dumps could hold about 250,000 cubic yards. Was this enough capacity for the ruins of 1906?

Quantifying 1906 Rubble

The usual estimate of the amount of rubble left behind by the disaster of 1906 is 10,000,000 to 11,000,000 cubic yards. This estimate originated with C. E. Loss[57]. Newspapers of the day reported the figure but not the method he used to calculate it. Other contractors estimated considerably less. Loss, eager to play a major role in debris removal, may have exaggerated somewhat in order to sell his schemes to a skeptical public. I estimate that San Francisco's ruins contained less than 7,500,000 cubic yards of rubble. (Readers may evaluate my calculations in the Appendix.) This means that about two-thirds of 1906 rubble was not hauled away to a dump. Is this a realistic figure?

In 1906, 24,704 frame (wood) buildings burned to the ground.[58] Frame buildings accounted for nearly half the city's rubble. Ashes, the remains of interior plaster, and mortar accounted for about half of all frame building rubble. More than one third was brick from chimneys and foundations, and the rest was a melange of metal, terra cotta, tile, ceramics, stone, concrete, and glass. The interiors of brick buildings were consumed by fire just as thoroughly as the interiors of frame buildings, but the walls of brick buildings—standing or not—remained behind. 50% of 1906 rubble consisted of bricks, whole or broken, and over 40% consisted of ashes and the remains of plaster and mortar—principally sand and lime.

Most frame building rubble was not dumped anywhere. Brick and metal were salvaged. The remainder, mostly ashes and dust, was simply left in place.[59] Building new structures over the ashes of old ones is a time-honored tradition. Ashes and dust quickly become part of the soil, and it is cheaper to leave the stuff in place than to haul it away. A great many lots were not redeveloped during San Francisco's reconstruction boom, and old foundations and other architectural remnants dotted the cityscape for many years. For example, many blocks between Nob Hill and City Hall west of the Union Square area that had been covered with wooden residences in 1906 were sparsely rebuilt by 1913, though the large brick buildings erected there housed more people than the 1906 buildings had. At least 15% of lots that had lost buildings in 1906 were vacant in 1913. Based on these considerations, I estimate that 75% of all the ashes, plaster, mortar, and miscellaneous small bits of metal, tile, etc. left behind as frame building rubble remained on site either merged with the soil or locked up in masonry. This amounts to about 1,600,000 cubic yards. Most of the bricks in the chimneys and foundations of frame buildings were salvaged. Few were damaged by collapse or demolition. It is likely that many foundations were repaired and reused. I estimate that 90% of all bricks in frame buildings were salvaged whole. This amounts to nearly 1,100,000 cubic yards of bricks. I conclude, conservatively, that about 2,700,000 cubic yards of frame building rubble did not have to be carried off to a dump.

"Patent cleaner at work in a debris brick mine" proclaimed the caption on this photograph when it appeared in *Sunset* for October, 1906. Bricks may have been brought to this site, near Ellis and Mason, for rapid cleaning. Powered grinding wheels made short work of mortar adhering to brick. California Historical Society, FN-12385.

Rubble remained on the sites of brick buildings too. Many businesses eager to reestablish themselves in their old locations rushed to build the one-story "temporary" structures that after the fire required no building permit. These structures were often built right over below-ground cellars filled with brick, mortar, stone, and steel. Many bricks were left behind in short walls, basements, or foundations on lots

that were not redeveloped immediately. 50% to 75% were salvaged whole from most brick buildings. Poor quality mortar aided brick salvaging—it gave way under relatively light pressure.[60] Even where the mortar was strong and reinforced with steel, as in the Palace Hotel, 25% of bricks were salvaged whole. In the aftermath of all this brick salvage, vacant lots around town were piled high with bricks awaiting reuse.[61] Bricks were crushed for use as aggregate in concrete, a practice approved by the chief engineer of the Board of Harbor Commissioners. Railroads bought crushed brick for track ballast. Crushed brick was also used in street repair. I estimate that 75% of all bricks in the ruins of San Francisco's brick buildings were not hauled away to dumps. This amounts to about 1,900,000 cubic yards of bricks.

Nearly all the steel and cast iron from the ruins was salvaged, including pipes and cast-iron fixtures such as bathtubs and sinks. At dump sites pipes and other metal products were often separated from the nonmetallic rubble and recycled. Proportionally more ashes and dust were hauled away from brick buildings than from frame buildings. The brick cleaning process left behind a great mass of mortar dust. Some of that dust, especially if it was on bare ground and not in a cellar, was left behind. Even dust in cellars was left behind on lots that were not redeveloped immediately. Some dust found its way into repaired streets and small local fills. Paving contractors may well have stockpiled this material in anticipation of street repair jobs. Stone and terra cotta, like brick, were crushed and used for aggregate in concrete. Some stone, especially marble, calcined (turned to powder) in the fire's intense heat. I estimate that 25%, or more than 400,000 cubic yards, of the ashes, dust, metal, stone, terra cotta, and miscellaneous rubble from San Francisco's brick buildings was not hauled away to dumps.

About 5,000,000 cubic yards of 1906 rubble was salvaged, recycled, or left in place. Less than 2,500,000 cubic yards needed to be hauled away—a total which nearly matches the capacity of known and probable dumps. I ask those readers who find this all a bit too pat to reflect on a point I made above: Barges and debris cars carried away only about 400,000 cubic yards of 1906 rubble. Teams carried away the rest of it. No team carried debris south of Islais Creek, and the 70-acre lake behind the seawall in the Marina District, which would accept over 1,300,000 cubic yards of fill in 1912, was not used as a dump. Both geography and economics limited possible dumps for 1906 rubble. Aside from what barges dumped at sea, all 1906 rubble went into water lots, marshes, and low-lying land within a three mile radius of Lotta's Fountain. This is why I am certain my list of dumps is virtually complete. Moreover, I noted above that completion of seawall section 12 in 1908 opened up a large dump between First Street and Beale. This excess capacity provides a cushion for my claim that I have shown where all the rubble went.

In round numbers, teams hauled 2,000,000 cubic yards of rubble to dumps. This required 1,333,333 trips, assuming a wagon capacity of one-and-one-half cubic yards. If these teams averaged three trips per day, a single team would need 444,444 days to haul away all the rubble. 1,500 teams could accomplish the task in about 300 days or one year of six day workweeks. 7,000 teams were licensed to haul debris by early 1907.[62] Not all of these teams were working at the same time, and not all hauled rubble to dumps. Many hauled salvaged brick and steel. Others hauled construction material. Nonetheless, there were more than enough teams available to haul the rubble.

Between eight hundred million and one billion bricks were salvaged whole from the ruins of San Francisco's brick buildings. Brick cleaners using hatchets to chip off mortar cleaned most of these bricks, although a number of engine-powered grinding wheels were deployed to speed up the process. If a brick cleaner could clean a brick in ninety seconds, he could clean 320 bricks in an eight-hour day. In 350 days 9,000 brick cleaners could clean over a billion bricks by hand. That may sound like a lot of brick cleaners, but it amounted to less than half of the work force that cleaned up San Francisco's

ruins. If a brick cleaner could clean a brick in a minute, 7,000 brick cleaners could clean a billion bricks in less than 300 days.

In this article I have focused on 1906 rubble that was disposed of and have, for the most part, ignored rubble that was salvaged. A lot of that rubble is still with us, standing in brick walls in Chinatown, the financial district, the Tenderloin, and South of Market. Some is in the steel frames of buildings constructed in 1907 or 1908, and crushed brick lies hidden in the aggregate in some of the concrete poured at that time. The ruins of the great city that was are around us today, transformed.

Appendix: Estimating Rubble

An accurate estimate of the amount of 1906 rubble requires knowing something about the size and construction of the 28,188 buildings destroyed by the earthquake and fire. The 1899 Sanborn fire insurance maps provide much of this information. Most of what the fire destroyed in 1906 had already been built by 1899, despite something of a building boom in the intervening years. I derived my estimate of 1906 rubble by extrapolation from my analysis of the 1899 Sanborn maps.

San Francisco buildings fall into two classes: frame (wooden) buildings and everything else. In 1906 24,671 wooden buildings burned to the ground. Thirty-three corrugated iron buildings (on wooden frames) were also destroyed. For simplicity I refer to these 24,704 structures as "frame buildings." The earthquake and fire destroyed 3,484 buildings from the "everything else" class: 3,168 brick buildings, 259 structures that were a combination of brick and wood, 15 stone buildings, and 42 supposedly "fireproof" buildings. I refer to this class as "brick buildings." The numerical figures I present below are all rounded. Most are rounded up.

Frame Building Rubble

When a 1906 frame building burned to the ground, its wood, in terms of its original volume, practically disappeared. Only about 10% of that original volume remained as ash. Although the largest component of 1906 frame building rubble was the brick and mortar from foundations and chimneys, interior plaster made a big contribution as well. In order to estimate the volumes of brick and mortar, plaster dust, and ashes, I decided to distill a profile of the typical frame building from the 1899 Sanborn maps. Many large frame buildings existed in 1899, but the vast majority were smallish buildings erected on small lots. Even though sheds, stables, and workshops were counted as buildings, single story frame buildings were still relatively rare. The typical frame building was two or three stories tall. I make no pretense of statistical rigor here, but, based on my analysis, I have concluded that the average 1906 frame building had a 27 x 66 footprint. I believe a more thorough analysis of 1899 frame buildings than mine might well show I have exaggerated the size of the average 1906 frame building.

The amount of plaster a building contains is determined partially by the building's volume and partially by the number of partitions in its interior. I assumed plaster was applied at a one-inch thickness on the inside of exterior walls, on ceilings, and on both sides of interior partitions.[63] I figured the average frame building had eight rooms per floor, a hall of some kind, and eleven-foot ceilings. After taking into account windows, doors, built-in cabinets, and woodwork, I calculated that this average 1906 frame building contained twenty-one cubic yards of plaster per floor and fifty-two yards per building. (Two and one-half floors worth of plaster.)[64] Not all of this plaster remained behind as rubble. Air increases plaster's volume during mixing. The 1906 firestorm's extreme temperature drove water out of plaster, causing it to disintegrate and thus lose volume. Lightweight lime also wafted away along with ashes in the firestorm's tremendous updraft. About 3% of 1906 plaster was animal hair, which burned up. After weighing these factors, I estimated that the plaster in the average frame building lost 12.5% of its original volume. Thus the average 1906 frame building left behind about forty-six yards of disintegrated plaster. As a rule, sheds, stables, workshops, and other outbuildings were not plastered. I assumed 1,704 (about 7%) fell into this category. Twenty-three thousand plastered frame buildings left behind about 1,060,000 cubic yards of plaster dust. Nearly two-thirds of that was sand.

Sources of wood in a typical 1906 frame building included exterior siding and framing, interior partition framing, lath, flooring and floor joists, ceiling joists, rafters and shakes, posts and beams,

doors, windows, and their framing, interior woodwork, cabinets, and furniture. In 1906 wood was milled to actual dimensions. This means a 2 x 4 actually measured 2 inches by 4 inches. Such a 2 x 4 stud is equivalent in volume to a sixteen-inch plank one half-inch thick. I used equivalencies like this to estimate the volume of wood for the average 1906 frame building. Such a building contained about 120 cubic yards of wood. Complete combustion of this wood left about 12 cubic yards of ash per building or about 300,000 cubic yards for all the frame buildings destroyed.

1906 frame buildings typically rested on brick foundations. Concrete was little used due to opposition from the powerful masons union. I estimated the typical foundation at 2- to 3- feet high and 2- to 3- feet wide. Thus the foundation of a 27 x 66 frame building contained about forty-five cubic yards of brick and mortar. Some 1906 frame buildings had wood (timber) foundations.[65] I assumed the unplastered sheds, stables, and workshops mentioned above were members of this class. More substantial buildings probably had timber foundations as well, but I assumed that 23,000 frame buildings had masonry foundations. The brick and mortar from these foundations amounted to 1,035,000 cubic yards.

Most 1906 frame building had brick chimneys, although many had tin or terra cotta flues instead. Sheds, barns, and out-buildings, as well as some buildings used for industrial purposes, had no chimneys at all. I estimated that 23,000 buildings averaged two brick chimneys a piece and that each chimney had a one square yard cross section minus a one square foot “flue” and was thirty-nine feet high. Thus, the chimneys of 23,000 frame buildings contained about 550,000 cubic yards of brick and mortar. The remainder of 1906 frame building rubble consisted of metal, tile, stone, glass, terra cotta, and ceramics. A typical frame building contained about fifteen cubic yards of this stuff. All the frame buildings destroyed left behind 370,000 cubic yards of it.

Here, then, is my estimate of the total rubble from 24,704 frame buildings destroyed by the great fire of 1906 in cubic yards: plaster dust, 1,060,000; ash, 300,000; foundations, 1,035,000; chimneys, 550,000; miscellaneous rubble, 370,000. The total: 3,315,000 cubic yards.

Brick Building Rubble

Fire reduced the walls of frames buildings to ash. It did not do the same to the walls of brick buildings. To determine the volume of this rubble I consulted the 1899 Sanborn maps. Among other details, these maps indicate a brick building’s height as well as the thickness of its walls. The thickness of a brick wall is typically a multiple of four inches (a “course”), the nominal width of a standard brick and its surrounding mortar. The walls of an 1899 three-story brick building might be represented on a Sanborn map as: 161612. This means that the first two floors had sixteen-inch walls, while the top floor had a twelve-inch wall. Assume this building had a 30 x 80 footprint and was 42 feet tall. The total wall area (ignoring openings) would be 9,240 square feet. To derive the wall volume, express the wall thickness in terms of one-foot thick walls. A 161612 wall is one and two-ninths (11/9) feet thick, assuming, for simplicity, stories of equal height. Thus the wall volume of the hypothetical three-story brick building would be 11,293 cubic feet or 418 cubic yards.

The actual wall volume would be higher than this, however. A “standard” brick is three and three-quarters inches wide.[66] A nominal sixteen-inch wall requires four four-inch brick courses. There is mortar between the courses. If that mortar is three eighths of an inch wide, the actual wall thickness will be sixteen and one-eighth inches; if the mortar is a half-inch wide, the wall thickness will be sixteen and one-half inches. If the bricks are wider than standard bricks, the wall thickness will be greater still. To reflect this possibility I will raise my final wall volume totals by 7%.

The earthquake and fire destroyed approximately 2,800 of the brick buildings depicted on the 1899 Sanborn maps. About 2,000 of these buildings were one- to three-stories tall with wall volumes more or less evenly distributed between 200 and 650 cubic yards. The hypothetical three-story building discussed above would be near the midpoint of this range. The total wall volume of these relatively small buildings was 850,000 cubic yards. In 1906, buildings of this type predominated in certain areas of downtown and Chinatown. To this day, parts of Chinatown, with its reconstructed brick buildings, have the look and feel of the early 1900s. At the other extreme of the wall-volume spectrum were 242 "super" buildings with wall volumes greater than 1200 cubic yards. I estimated the wall volumes of super buildings by hand and came up with 655,000 cubic yards. The queen of this class was the Palace Hotel with her twenty-eight inch exterior walls. Her internal partitions were all brick too and twenty-inches thick. All told, her walls held about 30,000 cubic yards of brick and mortar. Of the remaining 558 brick buildings from the 1899 Sanborn maps, 146 were one- to three-story buildings with an average wall volume of 935 cubic yards and a total wall volume of 137,000 cubic yards. These were fairly large footprint buildings. A typical member of this class was the Pacific Fringe factory—a three-story 170 x 90 x 44 foot building with 161212 brick walls and a wall volume of 942 cubic yards. The remaining 412 buildings were four or more stories tall.[67] Among these buildings 32 had an average wall volume of 375 cubic yards and a total wall volume of 12,000 cubic yards, 190 had an average wall volume of 700 cubic yards and a total wall volume of 133,000 cubic yards, and 190 had an average wall volume of 1,030 cubic yards and a total wall volume of 196,000 cubic yards. The total wall volume of the 2800 brick buildings depicted on the 1899 Sanborn maps was about 2,000,000 cubic yards.

I assumed that two thirds of 1906 brick buildings had below ground basements. I estimated basement wall volume this way: It would be half the wall volume of a two-story building, one-third the wall volume of a three-story building, and one-quarter the wall volume of a building four stories or taller. Using this rule of thumb I estimated the total basement wall volume for the 2,800 brick buildings analyzed above at 460,000 cubic yards. I did not account for brick chimneys in brick buildings. They were rare and typically built into the walls. Sanborn maps indicated that in Chinatown, for example, flues were tin and terra cotta, not brick. Steam heated many buildings, and factories and warehouses were typically unheated. I did not account for wall openings like windows and doors either. The volume of these openings more than balances out the volume of any "missing" chimneys. I should deduct something for wall openings, however. Many of the largest brick buildings stood on corner or gore lots and had numerous windows. The Palace Hotel had windows on all four sides. Therefore, I will subtract 3% from my wall volume totals to account for this.

The earthquake and fire destroyed 3,225 buildings of brick, stone, or "fireproof" construction.[68] Four-hundred twenty-five of these buildings went up in the burned district between 1899 and April 18, 1906. (I ignored the fact that some of the 1899 buildings I counted were torn down before 1906.) Some data exists on the nature of this construction.[69] Brick buildings constructed during this period were on the large side. I assumed these numbers: 101 super buildings with an average wall volume of 2,600 cubic yards, 162 large buildings with an average wall volume of 1,030 cubic yards, and 162 medium buildings with an average wall volume of 650 cubic yards. Total wall volume for these buildings was about 535,000 cubic yards. Total basement wall volume was about 100,000 cubic yards.

Combination brick and wood buildings typically had the first story or two constructed out of brick. The brick wall volume in a combination building was equivalent to that of a small brick building. These buildings were often found on hillside lots and basements were fairly common. The 259 buildings that were destroyed had a total wall volume of about 115,000 cubic yards. Basement wall volume was about 40,000 cubic yards.

The calculated total wall volume for the 3,484 brick and combination brick and wood buildings destroyed in 1906 was 2,650,000 cubic yards. The walls in the basements of these buildings held an additional 600,000 cubic yards. If the actual wall volume was 4% greater (combining my two adjustments noted above), then the brick buildings destroyed in 1906 contained about 3,400,000 cubic yards of brick and mortar and over 1.6 billion bricks.[70]

Brick buildings destroyed in 1906 contained quantities of stone, concrete, and terra cotta. Small buildings contained no more than ten to fifteen cubic yards; larger buildings contained proportionally more. I estimate that super buildings averaged 150 cubic yards of stone, concrete, and terra cotta and large buildings half that amount. Brick building rubble contained about 150,000 cubic yards of stone, concrete, and terra cotta. I estimate that about 250,000 tons of large-sized steel and cast iron lay in these ruins, consisting for the most part of posts, beams, girders, and machinery. By volume this amounted to about 40,000 cubic yards.[71] The ruins also contained quantities of glass, small metal (tin cans, tin roofing material, silverware, hardware, metal fixtures, tools, and pipes), tile, and ceramics. I estimate the volume of this rubble at about 100,000 cubic yards.

Nearly all the brick buildings destroyed in 1906 had wooden interior floors and framing. Plenty of interior woodwork existed as well, although there was almost none in factories, stables, and warehouses. All this wood burned to ash. The 2,259 small brick and brick and wood combination buildings were not much larger than the typical frame building described above. They averaged less than ten cubic yards of ash per building. The larger buildings averaged about forty cubic yards. Ash from the burned out interiors of brick buildings amounted to about 75,000 cubic yards. Brick building rubble contained about 400,000 cubic yards of plaster. Hotels and office buildings were heavily plastered since they contained many rooms. Factories, warehouses, retail stores, and stables were less heavily plastered. These buildings had few partitions and featured large open spaces.

Here, then, is my estimate of the total cubic yards of rubble from 3,484 brick and combination brick and wood buildings destroyed in 1906: brick walls, 2,760,000; brick basements, 625,000; stone, concrete, and terra cotta, 150,000; miscellaneous rubble, 100,000; steel and cast iron, 40,000; ash, 75,000; plaster dust, 400,000. The total: 4,150,000 cubic yards.

The 28,188 buildings destroyed in 1906 left behind approximately 7,465,000 cubic yards of rubble. About 2,700,000 million cubic yards of this was mortar or plaster which itself was mostly sand. Brick, whole or broken, accounted for about 3,700,000 cubic yards of 1906 rubble.

Footnotes

1. All figures pertaining to buildings destroyed come from *Report of the Sub-Committee on Statistics to the Chairman and Committee on Reconstruction,* San Francisco, 1907.

2. *The Argonaut,* Volume 14 No. 2, Winter 2003, and Volume 15 No. 1, Summer 2004.

3. The January 11, 1907 *Call*, p. 9, reported that the SPCA was carting away thirty dead horses a day, compared with only nine a day before the fire. Rufus Steele in *The City That Is, the Story of the Rebuilding of San Francisco in 3 Years* claimed 15,000 horses were worked to death during San Francisco's cleanup and reconstruction.

4. The financial backers of the Ocean Shore Railway (Railroad after 1909) planned a double-track electric railroad connecting San Francisco and Santa Cruz via the San Mateo coastline. The disaster of

1906 forced them to rethink their plans. A single-track line was eventually constructed, but it never linked San Francisco and Santa Cruz. A twenty-six mile gap in the track between Tunitas and Swanton on the coast was never closed. Passengers traveling between San Francisco and Santa Cruz on the Ocean Shore traversed this gap in a Stanley Steamer. Revenue service from San Francisco south began October 2, 1907. The Ocean Shore ceased operation on August 16, 1920.

5. *Chronicle* April 21, 1906, p. 2.

6. *Chronicle* May 5, 1906, p. 1.

7. Mayor Schmitz appointed the Committee of Fifty, which actually had more than fifty members, on April 18, 1906 to coordinate relief and the restoration of services and utilities. On May 3, 1906 Schmitz formed the Committee of Forty on Reconstruction. On May 5, 1906 this committee succeeded the Committee of Fifty.

8. The Atchison, Topeka, and Santa Fe Railway ran a freight terminal operation in San Francisco. Barges transported freight cars between Richmond and the railroad's China Basin yards. On May 12, 1906 Schmitz even granted a temporary track permit to Western Pacific, which had no track of its own in San Francisco at the time. Western Pacific laid no track under this permit and did not participate in the debris railroad.

9. Southern Pacific laid track on Third Street before getting a permit and was forced to remove it.

10. The State Belt Railroad of California (the Belt Line) served only that part of the waterfront north of Jackson Street in 1906. It was undamaged by the earthquake and fire.

11. The Ocean Shore laid track on Capp from Twenty-fourth Street, where a connection was made to Southern Pacific's main line, down to Fifteenth Street. There the track curved across private property until it reached Howard Street. It continued down Howard toward the waterfront. This ill-considered line, laid in haste, immediately ran into trouble. The Howard Street track covered the water mains of the Spring Valley Water Company, San Francisco's water supplier. The mains needed repair, so the Ocean Shore had to shift its temporary track to the center of the street. There it covered streetcar tracks. The section of temporary track curving across private property drew the wrath of two property owners. These women and their families actually tore up some of the track and faced down an Ocean Shore work crew. Their action effectively forced the abandonment of the Capp Street trackage. The Howard Street temporary track was eventually connected to the Ocean Shore's own track on Twelfth Street. See the *Chronicle* May 24, 1906, p. 8 and June 15, 1906, p. 14.

12. United Railroads originally laid track on the north side of Market, but it was judged hazardous to traffic and removed.

13. Southern Pacific's Bay Shore cutoff (the route Caltrain uses today) did not open for service until December 8, 1907. The original route to the Peninsula through the Bernal Cut and Ocean View opened in 1864.

14. At least one steam shovel loaded cars on Battery Street. (See http://www.oac.cdlib.org/ark:/13030/hb1s20051z/?brand=oac4) The sidewalks there were covered with rubble, and there was room in the street to lay the steam shovel's own track. Excavators, as we

know them today, are descendants of Benjamin Holt's "crawler tractors" invented in Stockton in 1904. It would take decades for this technology to be applied to general construction equipment.

15. *Chronicle* May 20, 1906, p. 14.

16. Since in all likelihood such precipitate actions would have voided any insurance coverage, these properties may have been uninsured. Fire insurance was not universal in 1906. For example, Virginia Vanderbilt lost 400 houses in the Mission District to fire. None was insured. St. Ignatius Catholic Church on Van Ness between Hayes and Grove was not insured. A few property owners may have defied their insurers by demolishing their buildings before their claims were adjusted.

17. San Francisco Municipal Reports for 1906-07, p. 741. Also see http://sunsite.berkeley.edu/FindingAids/dynaweb/calher/graves/figures/I0014395A.jpg and http://cdn.calisphere.org/data/13030/s0/hb1w1005s0/files/hb1w1005s0-FID4.jpg. The latter picture was taken on May 28, 1906.

18. By the terms of this clause a building was covered if it burned but not if it "fell."

19. The San Francisco Bunker Company, J. Rouse, A. E. Buchman, and C. A. Warren principals, was incorporated June 14, 1906 with a capitalization of $5,000. See http://content.cdlib.org/ark:/13030/hb9d5nb6th/?order=9&brand=eqf. The lower plate on this page, captioned "San Francisco, looking south across Market Street," shows the First Street bunker. The long, partially inclined, platform casts a significant shadow.

20. This was the price Santa Fe paid for fill taken from Potrero Hill to its new yards in China Basin. See the *Chronicle* August 7, 1906, p. 12 for the cost of dumping at the First Street bunker.

21. Wagons hauling rubble from excavations would make a rapid transit to the dump.

22. This barge had a checkered career carrying debris. Apparently it was poorly designed. While being towed to Mission Street Wharf No. 2 for the first time, the barge crashed into the end of the wharf, slightly damaging it. A few weeks later, while being towed, it crashed into the end of Howard Street wharf No. 1. On March 15, 1907 it collided with a mud scow and later in the day sank at the dock.

23. The April 18, 1907 *Engineering News* discusses recycling during reconstruction of the Crocker Building. See the *Chronicle* January 2, 1907, p. 5 for disposition of the Palace Hotel's remains.

24. San Francisco required the Ocean Shore to use electric locomotives on city streets north of Army (now Cesar Chavez).

25. See the *Examiner* September 21, 1906, p. 7 for a report on allegations that the Ocean Shore Railway had blocked the sewer at the foot of Kansas Street with landfill. Kansas extended south of Army in 1906. Ocean Shore constructed its shops at the foot of Kansas on land reclaimed with rubble. The site today is bounded roughly by Jerrold, Marin, Evans, and Napoleon streets.

26. A lighter is a large open barge, having neither power nor steering capability, used primarily to load or unload ships not docked at wharves.

27. See "Brick Piles Lure Soldier Boys," the *Call* September 24, 1906.

28. Duffy believed the San Mateo interurban line, which had a terminal at Fifth and Market, held a franchise on Spear to Market. He reasoned that Santa Fe could acquire the old franchise and overnight gain a direct route (across the bay via the new Dumbarton Bridge) to the heart of San Francisco.

29. See the *Call* January 12, 1907, p. 7 and the *Chronicle* April 18, 1907, p. 2.

30. Board of Public Works spent $148,919.86 on special street repairs in the fiscal year ending June 30, 1907. The Sutter Street Improvement Association sold bonds to repair and beautify Sutter Street, and merchants did the same on Geary.

31. This was the *Chronicle's* estimate. The *Call* claimed 20,000 worked in the burned area and 30,000 worked in outlying areas.

32. My estimates of debris-car capacity derive from two sources: a *Chronicle* May 25, 1906, p. 16 article about fixing rates for hauling debris and the car dimensions given in the 1905 Southern Pacific freight car roster available at the California State Railroad Museum Library.

33. See the *Chronicle* June 14, 1906, p. 12 and July 9, 1906, p. 11 for car movement figures. See the *Call* July 6, 1906, p. 7 for the number of cars dumping daily at King Street.

34. See the *Chronicle* September 19, 1906, p. 9 for the capacity of the New Montgomery bunker, and the *Chronicle* July 11, 1906, p. 8 for car movement at the First Street bunker. Only twelve cars a day could be spotted between Market Street and the First Street bunker's loading platform.

35. The company did not remain independent for long. The debris railroad soon took control of its operation. See the *Chronicle* July 11, 1906, p. 8 and July 26, p. 12. The B. P. Legare mentioned in the latter article was the superintendent of the debris railroad. Legare had succeeded J. B. Rogers, the original superintendent.

36. Calculating the theoretical capacity of the First Street and New Montgomery bunkers is complicated by uncertainty about when each bunker closed. I assume the First Street bunker closed before mid-January 1907, when all temporary track north of Market Street was removed, and thus conclude that the bunker was open for about 110 days during the debris railroad's second phase of operation. This assumes a six-day work week. I estimate the New Montgomery bunker was open for about 170 days from mid-September 1906 through March 1907, the last month in which United Railroads sold debris tickets. Since I am calculating the theoretical capacity of the New Montgomery bunker, I will ignore the distinct possibility that it was shut down during certain phases of the Palace Hotel's demolition. Thus the theoretical capacity of the two bunkers during the debris railroad's second phase of operation was 84,000 cubic yards.

37. The *Chronicle* January 2, 1907, p. 5 quoted a prediction from the contractor demolishing the Palace Hotel that once the walls of the hotel were torn down, the remains would be removed at the rate of forty carloads a day. Were those forty carloads all removed by debris cars? Not necessarily, since "forty carloads" only expresses a quantity. If forty cars a day were used to remove debris, those cars would have to be removed and replaced during the day, or else loaded by night as well as by day. Forty debris cars could not all fit at once on the New Montgomery temporary tracks.

38. Rates adopted by the Board of State Harbor Commissioners in 1906 do not mention debris, but crushed rock, sand, gypsum, paving stones, and ballast were all assessed a five cent toll per long ton (2,240 pounds). Alternatively, a five cent toll was assessed on a "ton," defined as one and one-half cubic yards of material. (See the Biennial Report of the Board of State Harbor Commissioners, 1906-1908, pps. 20-21. The one and one-half cubic yard "ton" is equivalent to the forty cubic foot figure mentioned in the report.) A 1906 wagon typically had a one and one-half cubic yard capacity. (See the *Chronicle* August 7, 1906, p. 12 article on debris removal.) I assume that a five cent toll was assessed per wagonload of debris, even though the load weighed more than one long ton. (Nine cents for a one and one-half cubic yard load would have been typical. See footnote 39 below.) This assumption is supported by the fact that figures for the tolls assessed on "debris" and on Barge No. 5 are all divisible by five.

39. I estimated the rubble-carrying capacity of the lighters working at Vallejo Street by extrapolating from the data on a small set of modern deck barges. These vessels can carry nearly twice (1.874) their tonnage in tons. (See http://www.canalbarge.com/WebPublic/Main.nsf/vwWebPages/RentalServices.) A cubic yard of rubble disposed of (in contrast to rubble in the ruins) was about 40% sand (from the remains of mortar and interior plaster), 30% brick, 15% lime, and 15% a mix of ashes, stone, terra cotta, concrete, tile, ceramics, metals, and glass. A cubic yard of 1906 rubble weighed about 2700 pounds or 1.35 tons. To estimate the cubic yards a barge can carry I multiply its tonnage by 1.874 and divide that figure by 1.35. (Http://www.reade.com/Particle_Briefings/spec_gra2.html gives weight to volume ratios for the substances making up 1906 rubble.)

40. This total fell far short of their advertised capacity. In the fall of 1906, newspapers predicted that the dumps at Mission No. 2 and Vallejo Street would receive 4,000 cubic yards of rubble a day. (The *Chronicle* September 19, 1906, p. 9 gives this optimistic projection.) What happened? Cost may have been a factor. The Debris Transportation Co. charged thirty cents a wagon to dump at Mission No. 2, and it is likely the other wharf dumps did the same. Mechanical problems probably beset the operation at Vallejo Street. The efficient unloading of wagons envisioned at Mission No. 2 required that wagon beds be modified with a patented device. Contractors may have balked at modifying their wagons. Loading Barge No. 5 was a relatively slow process.

41. Three miles is the approximate distance from Lotta's Fountain to Twenty-fifth and Illinois, the site of Western Pacific's free dump near the north shore of Islais creek.

42. The 1903 U. S. Coast and Geodetic Survey gives depths relative to lowest low water. Roger and Nancy Olmsted in *San Francisco Waterfront* pps. 157-158 note that the intersection of King and The Embarcadero was under three fathoms of water in 1853, although they suggest the water may have become shallower there by 1906 due to silting. The Olmsteds also note (p. 249) that City Base is 11.67 feet above mean low water. The 1903 U. S. Coast and Geodetic Survey cited above specifies depth relative to mean lower low water level. Mean lower low water is 1.3 feet below mean low water. Thus City Base is 13 feet above the soundings shown on the 1903 Coast Survey.

43. See the *Biennial Report of the Board of State Harbor Commissioners* 1908-1910 p. 18 for a photograph of rubble-filled land on the east side of the old Pacific Mail Docks.

44. For a revealing view of this area in 1906 see the photograph of Katherine and Dante Monaco on Telegraph Hill in Richard Dillon's *North Beach* in the section of photographs located between pages 153 and 154. Unfortunately, Katherine Monaco's hat blocks part of the cove. For a 1908 view showing

the progress of landfill in this area see page 179 in William Bronson's *The Earth Shook, the Sky Burned*.

45. In his magisterial masters thesis *Bay Fill in San Francisco*, Gerald Dow found no public record of Southern Pacific's landfill activity in Mission Bay (page 134). He claims two thirds of Southern Pacific's holdings there had been filled by 1903 and after debris removal operations in 1906 everything was filled.

46. The *Chronicle* June 25, 1906, p. 1 has pictures of rubble dumping in this area.

47. See the report on wholesalers locating on old dumps in the *Chronicle* May 30, 1906, p. 2.

48. Information on Central Basin dumping comes from a file of letters written by the chief engineer for the State Board of Harbor Commissioners preserved at the California State Archives.

49. See the Western Pacific ad in the *Chronicle* May 26, 1906 p. 10. The *Chronicle* October 3, 1906, p. 5 reported that Western Pacific was actively filling on the north shore there. Islais creek was the site of the "far away" dump mentioned in the *Chronicle* August 7, 1906, p. 12.

50. See the *Chronicle* July 9, 1906, p. 11.

51. The *Chronicle* September 19, 1906, p. 14 mentions the Sansome Street fill. The lot with water in it is visible at http://webbie1.sfpl.org/multimedia/sfphotos/AAC-3883.jpg.

52. This dump is discussed in letters written by the Chief Engineer of the State Board of Harbor Commissioners on October 19, 1906, October 22, 1906, and March 3, 1907.

53. The following *Chronicle* articles detail the rocky start to the filling of Precita swamp: June 15, 1906, p. 14; July 14, 1906, p. 11; September 12, 1906, p. 14.

54. The 1911 Chevalier map shows this area filled in.

55. The *Chronicle* July 13, 1906, p. 2 has an ad for this dump.

56. See the *Chronicle* May 29, 1906, p. 16 for the Transportation Committee's recommendation. See the *Call* June 9, 1906, p. 5, and the September 20, 1906 *Engineering News* for discussion of subsidence around Van Ness and Vallejo.

57. This estimate first appeared in the *Chronicle* May 5, 1906, p. 1.

58. I am counting 33 corrugated iron buildings on wooden frames as wood buildings. See the Appendix.

59. "On city blocks devastated by the fire, the resulting layer of ruins is an unmistakable black slash in the soil, usually visible about 12 inches below the present-day ground surface." (*Behind the Seawall*, p. 85.)

60. Reports by Charles Derleth and the sub-committee on statistics blame poor mortar and sloppy workmanship for the collapse of many brick walls.

61. The *Chronicle* April 3, 1907, p. 16 reported on a brick swindle in which someone who was not their lawful owner sold 300,000 bricks piled up on leased land at 250-252 Shipley.
62. An article on the preparations for Housecleaning Day in the *Chronicle* February 15, 1907, p. 5 is the source of this figure.

63. I know from personal experience replastering my 1885 home that this is something of an exaggeration.

64. Use of the tables presented in *Plastering Skills* pps. 496-500 leads to a similar result.

65. The report of the subcommittee on statistics (see footnote 1) discusses damage to buildings with timber foundations.

66. "The length of typical bricks, throughout all times, has been twice the short dimension plus the presumed width of the vertical joint between bricks." *Encyclopedia Britannica* 1960 edition, volume 4, page 119. In order for bricks to be brick bonded, two header lengths (brick width parallel to wall) plus joint width must equal stretcher length (length parallel to wall).

67. I counted all Sanborn 3B buildings (three stories over a basement) as four stories.

68. 3,168 were brick, 42 were fireproof steel-frame construction, and 15 were stone.

69. An article on building activity since 1900 in the *Call* April 28, 1906, p. 8 is the principal source for this estimate.

70. William Bronson in *The Earth Shook, the Sky Burned,* claimed "six and one-half billion bricks fell during the earthquake and fire." (page 168 in the paperback edition) Were his brick figure correct, the average brick building destroyed in 1906 would have contained nearly 1.9 million bricks *and been nearly as massive as the eight story Hearst Building—a manifest absurdity.*

71. According to the *San Francisco News* October 17, 1906, p. 4, William A. Doble of The Abner Doble Co. estimated that 30,000 tons of steel and cast iron would be salvaged from the ruins. Barton W. Currie, writing in the October, 1906 edition of *Sunset* estimated that 400,000 tons of steel and cast iron in the city's ruins possessed "an intrinsic value as scrap metal." (p. 314) Currie's estimates should be evaluated with some skepticism. He also estimated that a 45 by 110 foot four story building would have 5,000 cubic yards of plaster on its walls. (p. 317) If such a building were 56 feet high, its total volume would be 277,200 cubic feet or 10,267 cubic yards. Thus, nearly half the building's volume would be plaster! I will roughly split the difference between the estimates of Doble and Currie and say the city's ruins contained 250,000 tons of large-sized steel and cast iron. If cast steel weighs 490 pounds per cubic foot and cast iron weighs 450 pounds per cubic foot, 250,000 tons of steel and cast iron amounts to about 1,063,830 cubic feet or 40,000 cubic yards.

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