San Francisco's Octavia Boulevard

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Abstract. San Francisco, California's Octavia Boulevard was opened to traffic on September 2005. This five-block project (Hayes to Market Streets) replaced the terminal portion of the former Central Freeway. Rather than build a traditional four or six-lane arterial roadway in its place, the City chose a classic boulevard design. The design was guided by the research of University of California, Berkeley, Professors Allan Jacobs and Elizabeth McDonald. Octavia Boulevard was designed to have two one-lane frontage roads serving local residences and on-street parking, separated by a landscaped buffer from two median-divided lanes of through traffic. While the roadway received regional design awards, it was criticized by some as having confusing right-of-way rules. The paper describes the operation of frontage and main street traffic lanes. While the context of Octavia Boulevard is unique, this paper concludes with general challenges and lessons from the building of Octavia Boulevard for cities that may be contemplating a similar type of street design.

FIGURE 1: Octavia Boulevard Area

1. Historical Background

Octavia Boulevard is the latest chapter in San Francisco's rejection of the network of urban freeways planned in the first half of the 20th Century. Figure 1 (CSAA 1987) shows the freeway system that existed in the Civic Center area prior to 1989. The Central Freeway was the name given to the remnants of two planned highways that had been halted due to public opposition. The northernmost ramps that connected with Gough and Franklin Streets were demolished after the 1989 Loma Prieta earthquake. The remaining on and off-ramps at Oak and Fell Streets were closed for seismic work in 1996. After the seismic work was completed only the off-ramp was reopened. Motorists were then forced to use alternative means of transportation, including street detours to the remaining freeway ramps in the area.

The debate over the future of the freeway resulted in a series of ballot propositions in 1997, 1998 and 1999. The boulevard design was championed early in the process by the Hayes Valley neighborhood. The boulevard concept was based on the work of

University of California, Berkeley, Professors Allan Jacobs and Elizabeth Macdonald. The 1998 voter handbook included a draft design similar to what ended being approved by the city (Figure 2). San Francisco voters disapproved the Boulevard in 1998, but a year later a majority supported removing the elevated portion of the Central Freeway north of Market Street and replacing it with a surface street. The replacement touchdown ramps at Market Street and Octavia Boulevard were completed on September 9, 2005. Part of the goal of the Octavia Boulevard was to provide higher capacity connectivity to Oak and Fell Streets (one-way arterials that connect to the western neighborhoods) as well as to Franklin and Gough Streets (principal north-south arterials) without the negative social and aesthetic impacts of the overhead freeway structure.

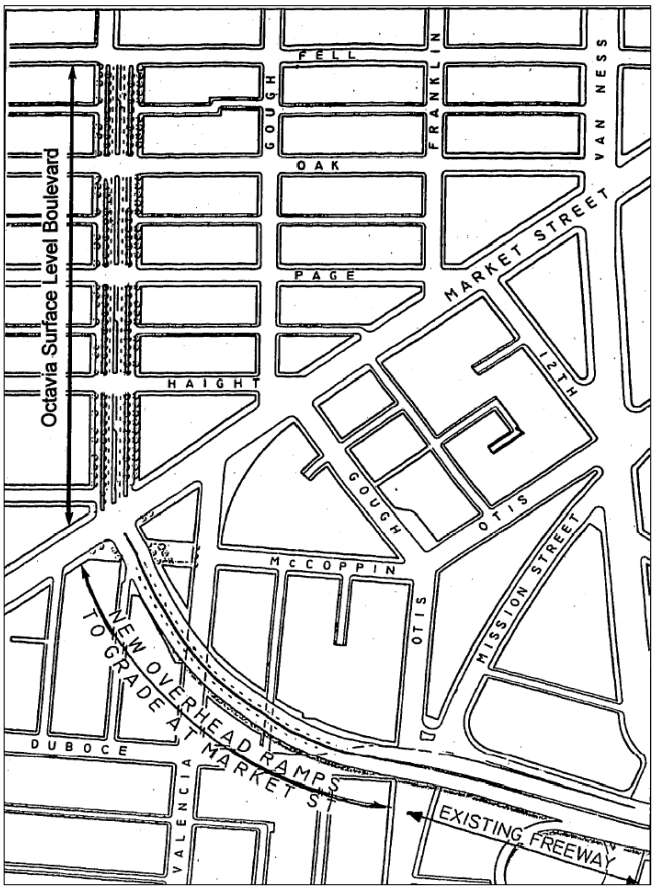

FIGURE 2: CONCEPT SHOWN TO VOTERS IN 1998 OCTAVIA BOULEVARD PROPOSITION

2. Issues with Octavia Boulevard Not Related to the Boulevard Design

The original freeway ramps carried about 90,000 vehicles a day. Octavia Boulevard has an average daily traffic flow of about half that amount and is often at capacity during peak hours. It is not in the scope of this paper to discuss in detail all the Octavia Boulevard traffic management issues that were more related to how this facility fit into the local arterial street network than to the multiway boulevard concept itself. Three problems that will not be discussed in this paper were congestion on various streets leading to Octavia Boulevard, transit delay on some of these cross streets, and

compliance issues with the prohibition of right turns into the freeway on-ramp from Market Street (1).

3. Octavia Boulevard Design Issues

In its brief existence Octavia Boulevard has received a number of design awards, including those from the California Transportation Foundation, the Northern California Chapter American Public Works Association, the American Planning Association, Caltrans, the Metropolitan Transportation Commission and San Francisco Beautiful. John King, writing in *The San Francisco Chronicle*, summarizes the general feeling that:

> The thoroughfare that replaced the elevated Central Freeway feels like it belongs. It's not perfect, but it keeps cars moving while making the neighborhood around it a better place to be (2).

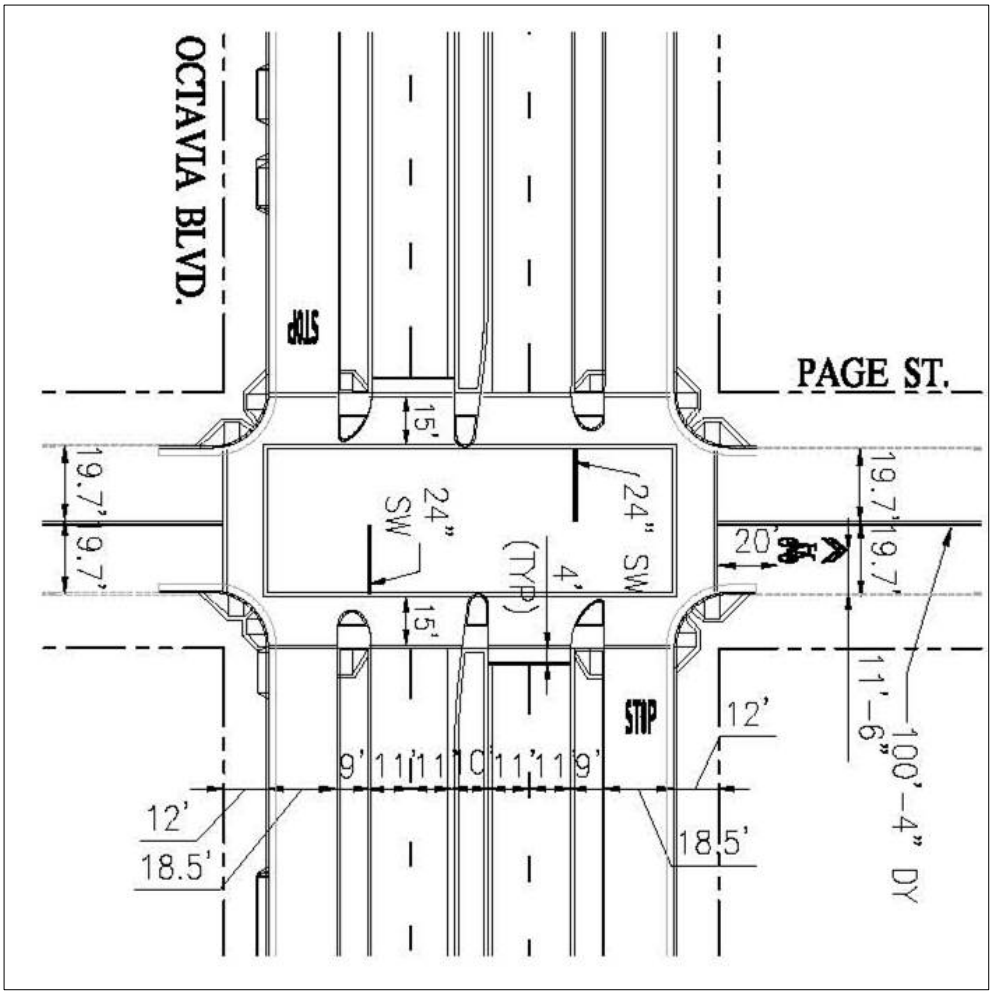

FIGURE 3: SECTION OF OCTAVIA BOULEVARD STRIPING DRAWING AT PAGE STREET

One of the main appeals of classic boulevards is that they segregate through traffic from local traffic. This is done by adding a narrower side road that is divided from through traffic by a landscaped median (Figure 3). At intersections, the side frontage roads and main roads are controlled as one intersection. By that definition Octavia is one of the

few urban boulevards built in the United States in recent years. The main questions that have arisen since the opening of Octavia Boulevard deal with how to treat the side road traffic at intersections and the design of the side roads themselves.

Traffic Controls Facing Side Roads at Intersections

The five Octavia Boulevard intersections between Market and Fell Streets are controlled by traffic signals facing the Octavia main traffic lanes and the cross streets. At Page and Haight Streets the Octavia side roads face a STOP sign (Figure 4). With the STOP sign a side road motorist can legally proceed into the intersection after stopping, regardless of the signal indications facing cross or parallel main lane traffic. The 2009 *Manual on Uniform Traffic Control Devices* Section 2B.04 does allow the use of STOP signs at signalized intersections where "an extremely low potential for conflict exists."

FIGURE 4: NORTHBOUND OCTAVIA BOULEVARD, SIDE ROAD STOP AT HAIGHT STREET

An alternative to STOP signs is the use of flashing red signals, which are present at the two heavier cross streets to Octavia Boulevard of Oak and Fell Streets. Here the Octavia side roads face a solid red light when the cross street has a green, then a flashing red light when Octavia Boulevard has a green light. The flashing red light allows traffic to proceed into the intersection as it would under a STOP sign, but during the solid red light motorists can only make a right turn on red. Boulevard experts Allan Jacobs and Elizabeth Macdonald, who worked with the City on the original Octavia Boulevard concept, prefer using STOP signs for the side roads:

> The side lanes ought to be controlled by stop signs and the central lanes by traffic signals. Concern over this unusual arrangement (which has been shown to work just fine on Chico's Esplanade) prompted the installation of flashing red lights at the access road intersections, which drivers have difficulty interpreting (3).

San Francisco's experience has been that the right-of-way rules appear to be understood by the vast majority of motorists whether STOP signs or flashing red signals are used. However, in either case side road traffic may have a tendency to not come to complete stops when the main roadway has a green light. To minimize this problem, signals, signs, and stop lines should be designed with attention to minimizing confusion between side and main approaches, particularly when median separating main and side road vehicles are narrow (in San Francisco's case these are 9 feet wide).

Intersection Turning Movements from Side Roads

With a couple of exceptions, Octavia Boulevard side road traffic is generally allowed to turn in all directions at intersections, except where these turns conflict with one-way regulations. During the design stage traffic engineers considered the possibility of collisions happening from vehicles making certain movements from or to the side roads while cross movements faced a green light. The concern that adding complexity to an intersection leads to decreased safety was "one of the reasons" that led Professors Jacobs and McDonald undertake the research contained in *The Boulevard Book:*

> The sheer number of possible conflicting movements—weaves from side access roads to the central lanes or from the central lanes to the access roads, possible right turns from the central lanes across straight-moving traffic on the access roads, to name only a few of many examples—suggests logically that boulevards must not be as safe as other streets. Our research shows otherwise (4).

The interaction of side road and intersection cross traffic has largely been uneventful in the southbound direction of Octavia. Because the majority of main southbound traffic is already coming from the west, there is little demand for through traffic to turn right at the cross streets of Haight and Page Streets (and it is not possible to do at Oak Street due to the one-way direction of the street). Also critical to the southbound side road's success has been not allowing this direction to have access to the freeway on-ramp at Market Street. If this had not been done it would have likely resulted in the side road being used more as a by-pass to the congestion present on the main road.

The northbound side road has proven to be more of a challenge. In the northbound direction there is more demand from main road traffic to turn right, which increases the use of the side road by through traffic and results in more side/main lane friction at intersections. Page Street is a local roadway and Haight Street is a one-way westbound street and thus both have had fewer side/main road conflict issues other than lack of compliance with STOP signs. More complaints from the public have come from conflicts at Oak Street and Octavia Boulevard (Figure 5). Here there are higher volumes on the northbound side road and higher number of vehicles making a turn from the northbound main road to Oak Street. This type of public complaint is summarized by a 2006 email from a driver:

> I am writing to document my displeasure with the setup of the intersection between Octavia Blvd. and Oak St. It is particularly confusing for motorists. Imagine this example:

> Auto 1 is headed northbound on Octavia. Auto 2 is likewise headed northbound, but is traveling on the frontage road to the right of the boulevard. At the intersection of Octavia and Oak, the light turns red. Auto 1 is preparing to turn right. Auto 2 would like to go straight. The light at Octavia turns green. Who goes first?

FIGURE 5: OAK STREET AT OCTAVIA BOULEVARD. VEHICLE ON THE RIGHT CAN PROCEED STRAIGHT AFTER STOP WHILE THE VEHICLE ON LEFT MAKES A RIGHT TURN ON GREEN LIGHT

Although it is clear that the side roadway has to stop and yield to pedestrians and cross traffic (facing either a solid or flashing red), what may be less evident is that vehicles from the main road can turn at the same time that side road traffic is allowed to proceed straight. It remains the obligation of main street motorists to signal when making a right turn and do so carefully, as they must yield to pedestrians who could be crossing the cross street at the same time. It remains the obligation of side street motorists to look over their left shoulders and ensure that no vehicles are turning right or weaving into the side road from the main road. During the design stages this issue had been discussed by San Francisco's City Traffic Engineer with the city of Chico, California, whose Esplanade had similar characteristics as those proposed for Octavia. In part based on Chico's experience, San Francisco decided that the design would work.

One option that was considered but not implemented would have been to force the vehicular side roads on Octavia Boulevard to make a right turn (except for bicycles) at every cross street. As suggested by a letter to *The San Francisco Chronicle*:

> The frontage lanes should be changed to right turn only at the end of each block. This simple change would help prevent some of the reckless driving and allow the frontage lanes to function as the boulevard's designers intended—as a shared realm for pedestrians, bikes and slower local traffic.(5)

Prior to completion of the roadway, proposals to install “right turn only” regulations or restrict weaving movements from the side roads back to the main lanes and vice versa were not pursued in order to implement and test a traditional multiway boulevard design. One problem with mandatory right turns, other than restricting local access, is that some motorists may decide not to comply with the new regulation. Though the city still hears occasional complaints about this aspect of Octavia Boulevard, there are no plans currently to require all the side roads to turn right.

Differentiation and Design of the Side Road

A final concern about the design of the Boulevard is the overall width and pavement treatment of the side roads. After its completion Professor Jacobs said that one of the things he would change about Octavia Boulevard would be to make the side roads narrower than 18 feet (6). Although *The Boulevard Book* mentions the 18 foot width of the then planned Octavia Boulevard as “narrow” (7) and gives examples of successful boulevards with much wider side roads, Professor Jacobs believes that the current width does not effectively slow down vehicles. Professor Macdonald adds that:

> The local access roads are too wide—for a through-lane next to a parking lane, they were made eighteen feet wide, rather than 16.5 feet. A narrower space would have contributed more to traffic calming. (8)

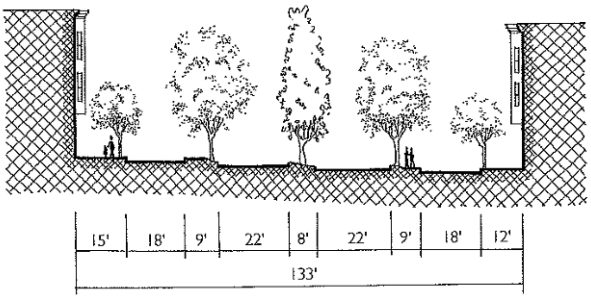

FIGURE 6: OCTAVIA BOULEVARD SECTION FROM *THE BOULEVARD BOOK* (9)

The 18.5 foot width was selected by the city as the narrowest width that would also accommodate the needs of larger vehicles, most importantly fire engines. This width is already below the San Francisco standard guidelines used for emergency vehicle access, which typically recommend 7 feet for parking adjacent to a 14 foot clear area, for a 21-foot desirable minimum street width. The narrower dimension used on Octavia was made possible in part by building mountable (gentler) curbs along the landscaped medians. The mountable curbs can also assist vehicles that are exiting or entering the narrow residential driveways already present on the west side of Octavia Boulevard.

The side roads are signed for a speed limit of 15 MPH, the slowest speed limit allowed by local law for this roadway dimension (main road is signed for 30 MPH). According to a one day speed survey taken in 2006, 85 percent of motorists traveled at speeds of 27 MPH of lower on the northbound side roads (Table 1). While higher than the posted speed limit, overall these would be good results for a typical residential street in San Francisco, where measured speeds tend to be higher (and lanes much wider).

Table 1: Octavia Boulevard Side Road Volumes and Speed
Surveyed June 2006 and January 2010 between Haight and Page Streets

	Daily Vehicles	Median Speed	85th Percentile
2006 Northbound	3,223	21 MPH	27 MPH
2006 Southbound	646	19 MPH	26 MPH
2010 Northbound	1,721	17 MPH	22 MPH
2010 Southbound	456	17 MPH	24 MPH

What was more significant was that northbound side road carried almost five times the traffic than the southbound side road (3,200 to 650 vehicles). Due to a combination of factors the northbound side roads were attracting through traffic that should have been using the main lanes. In 2009 speed humps were added to the northbound side road segments. Traffic volumes dropped by almost half and 85th percentile speeds dropped from 27 to 22 MPH (Table 1). The traffic calming devices appear to have helped control the number of through vehicles on the side streets.

Professors Jacobs and Macdonald also would have preferred that the side road have a different pavement texture than the rest of the street in order to emphasize its different function, but cost and maintenance considerations favored an asphalt paving surface. While using different paving textures is an effective way to provide additional driving clues to motorists, the use of special pavement surfaces and materials can be difficult to maintain in the long-run, particularly in San Francisco's case where resources for routine pavement maintenance are already limited. The crosswalks crossing the side road were paved in concrete at their junction with other cross streets, but this treatment may have been too subtle to affect driver behavior.

4. Reported Collisions: Page Street and Octavia Boulevard

When discussing Octavia Boulevard's operational history, it should be emphasized that the boulevard portion is only four blocks long and has two intersections at each end that do not offer traditional boulevard designs. At the intersection of Market Street there is no northbound side road, while the southbound one is forced to turn right away from the intersection. On the block between Hayes and Fell Streets, the space occupied by the main roadway is replaced by a popular new park, resulting in an unusual T-intersection configuration at Fell Street unlikely to be replicated elsewhere. Two of the remaining three intersections have one-way streets (Haight and Oak), leaving only Page Street (a local street) as the single intersection from which the full range of multiway boulevard side and main lane movements can be made (Left turns are prohibited from the main lanes at all intersections except northbound Octavia Boulevard and Fell Street, where the majority of traffic turns left.)

Looking at the five-year police reported collisions for Page Street and Octavia up to June of 2009, there have been a total of six reported collisions with varying patterns (2 broadsides, 1 sideswipe, 1 rear end, 1 head on, and 1 hit object). Four of the collisions are classified as injury collisions (in San Francisco many minor non-injury collisions are

not reported by the police). Two collisions involved a bicycle and none involved pedestrians. Only one collision (the sideswipe) was related a specific boulevard movement: a northbound side road vehicle colliding as it weaved into the main road. The approximate reported collision rate of the intersection (average daily traffic of 45,000 on Octavia Boulevard and 5,500 on Page Street) is 0.06 collisions per million vehicles entering the intersection. In San Francisco this signalized intersection collision rate is below average.

5. Lessons for Future Boulevards?

As already noted, Octavia Boulevard is short and many intersections have features that are unique. Octavia Boulevard runs through a residential neighborhood, lacking the higher parking and pedestrian activity of some of the more famous classic boulevards. Most traffic is using the Boulevard to bypass the area, minimizing boulevard-related turning conflicts. Even with all these considerations that make Octavia Boulevard a limited test case, some preliminary recommendations can be mentioned:

● Side roadways should be controlled by STOP signs or flashing red lights at intersections. If the side road is shown the same signal indication as the main roadway, it defeats the intent of making the side road unattractive to through traffic.

● It may not be necessary to prohibit all the movements that are possible from the side roads. Along Octavia Boulevard it is theoretically possible for a vehicle on a side road to make a U-turn back into the main road lanes, or to make a left turn across four lanes of main road traffic, all while the main road has a green light. In our experience few motorists attempt the more difficult turns when there are no signs prohibiting left turns from the side roads. However, any street's circulation context is unique and experiences elsewhere could be different.

● Boulevards work best when the traffic volumes on the side roads remain low. In San Francisco's case, the southbound side lane has fewer than 1,000 vehicles a day and operates relatively free of complaints. Meanwhile the northbound side lane did not work as well when it reported over 3,000 vehicles a day and thus received additional traffic calming. Features should be added to discourage the use of the side roads by through traffic (narrow lane width or traffic calming) while keeping the main road moving freely. Without these measures, side roads are vulnerable to becoming by-pass routes when main lanes are congested or used as de facto turn lanes into cross streets.

● Octavia Boulevard was possible because of the available right-of-way created by a freeway. Those opportunities may not be available in many high-density urban cores. The property line to property line width of Octavia Boulevard is approximately 133 feet. While it is debatable whether some of the lanes and medians along Octavia Boulevard could have been a few feet narrower or wider, overall Octavia Boulevard was designed to be compact in order to maximize

developable land on the east side. When the two 12-foot sidewalks are subtracted, the net roadway width is 109 feet.

6. Summary

Octavia Boulevard was made possible by a special combination of factors. First, a controversial freeway segment had to be demolished to make room for the new roadway. A well-organized neighborhood rallied behind replacing a freeway with a boulevard and was able to obtain approval after three tries at the ballot box. Civic leaders felt the boulevard was the best way to carry the former freeway's through traffic while minimizing its impact on adjacent residential frontages. Academic experts on boulevard designs around the world were personally involved and helped ensure that the project was completed close to the original design vision. Finally, city staff carefully considered all the options and issues of building a non-conventional roadway.

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8. End Notes

1. "Bicyclists vs. drivers – who's in the right?" *The San Francisco Chronicle*, September 21, 2005.
2. "An Urban Success Story," *The San Francisco Chronicle*, January 3, 2007. For a fuller range of popular reactions see internet discussion pages such as the "Octavia Boulevard" page of *www.yelp.com*.
3. Elizabeth Macdonald, "Building a Boulevard," *Access*, The University of California Transportation Center, Spring 2006, page 9.
4. Allan B. Jacobs, Elizabeth Macdonald, and Yodan Rofé, *The Boulevard Book: History, Evolution, Design of Multiway Boulevards*, The MIT Press, 2002, page 6 and 116.
5. Letters to the Editor, *San Francisco Chronicle*, January 6, 2007.
6. Allan B. Jacobs, from the lecture "The People Dimension of Public Space," San Francisco City Hall, April 4, 2006.
7. *The Boulevard Book*, page 240. The book was first published in October of 2001, four years prior to the completion of Octavia Boulevard.
8. Elizabeth Macdonald, "Building a Boulevard," *Access*, page 9.
9. *The Boulevard Book*, page 242.