6 Highway Networks

The travel model uses coded representations of the Sacramento region's highway network, which provides the basis of estimating zone-to-zone travel times and costs for the trip distribution and mode choice models and for trip routing in the vehicle assignments. The highway network serves not only as the basis of highway travel times and traffic assignments, but also as the basis of bus running times and zonal walk- and drive-access for transit travel time and assignment. This section provides an overview of the coding of the highway network.

6.1 Opening and Editing the Highway Network

SACSIM's highway network is a Cube NET file. To open and edit the file, use Cube Base modeling software.

Table 6-1 lists the network variables used in the SACSIM highway base network. Most link attributes are intuitive and modelers can use Table 6-1 as a reference for coding updates to the highway network. However, the conventions for coding the CAPCLASS values are more nuanced and we recommend users refer to the sections below on Capacity Class and Other Highway Network Characteristics.

Table 6-1 SACSIM Highway Network Variables

Property (SACSIM variable name)	Convention
SPEED (Free Flow Speed)	"Free-flow" speed, or average travel speed with no congestion.
DISTANCE	Link distance (miles).
CAPCLASS (Capacity Class Code)	Points to a lookup table of capacity values, in vehicles per hour per lane.
USECLASS	0 = General-purpose lane 2 = Restricted to vehicles with 2+ occupants 3 = Restricted to vehicles with 3+ occupants
LANES	Number of through-lanes in the link's direction
SPDCURV (Speed-flow Curve Selector)	1 = Freeway 2 = Two-Lane Transitional Roadway 3 = Urban/Suburban Arterial
DELCURV (Ramp Meter Indicator)[1]	0 = Not Metered 1 = AM 3 hours only 2 = PM 3 hours only 3 = AM and PM periods (6 hours) 4 = AM, Midday, and PM periods (12 hours) 5 = Metered 24 hours
HOVLINK (Access Codes for Path Building and Assignment)	0 = All trips permitted 1 = Walk and bicycle trips only 2 = HOV-only facility in freeway[2] 3 = HOV-only bypass lane at metered on-ramp
BIKE (Type of bicycle route or facility present on link)	0 = No bike lane 1 = Class 1 bike route 2 = Class 2 bike route 3 = Class 3 bike route 8 = Surface street over- or under- crossing of a freeway, with ramps present, and NO bike lane 9 = Same as type 8, but WITH Class 2 bike lane

Notes:
1 – Only DELCURV values 0, 1, and 2 were used in 2020 MTP-SCS submission
2 – HOVs, or high-occupancy vehicles are vehicles with two or more occupants.

6.2 Capacity Class

The capacity class, or CAPCLASS, attribute determines the capacity of a link in the model network. Capacity classes should not be treated as black-or-white categories. While the definitions of some categories are relatively clear (e.g. "freeway"), most roadways are not "textbook" examples and exhibit some, but not all, characteristics of a specific capacity class. Users must exercise professional judgment to classify a specific existing roadway, based on its observed characteristics, or future roadway, based on the best planning information available. Note that SACSIM capacity classes have no intentional relation to Federal Aid functional classifications.

The definitions below should provide background for the categories used in SACSIM, and guidance to modelers who are using SACSIM networks. Following the definitions is Table 6-3, summarizing basic operating characteristics for each capacity class.

6.2.1 Freeways

A ***freeway*** is a restricted access roadway facility, with all access mediated by ramps. Freeways are intended primarily for longer trips, including: through trips to a region; longer inter-regional trips which begin or end outside the region; and longer regional trips, such as commute trips. There are several "sub-classes" within the general capacity classification:

- General-purpose lanes allow access to any vehicle at any time of day, regardless of occupancy within the vehicle.
- Auxiliary lanes are freeway lanes which connect from an on-ramp to the next downstream off-ramp. They operationally serve as extensions of the subject on-ramp and off-ramp, providing more distance to complete merges and weaves entering or leaving the freeway between the subject ramps. Additionally, auxiliary lanes provide lanes for shorter, ramp-to-ramp trips to use.

  Auxiliary lanes are further split into two types:

  - Lanes of one-mile-or-greater length, which are coded to full freeway capacity, but with free-flow speed 5 mph less than the "through" lanes.
  - Lanes of less-than-one-mile length, which are coded to 1500 vplph, and with free-flow speed 5 mph less than the "through" lanes.

High-occupancy vehicle lanes, or HOV facilities, are typically lanes on freeways that require vehicles to have a minimum number of occupants in order to access them. The USECLASS value, detailed above in Table 6-1, determines the minimum number of occupants required to enter a given HOV facility.

6.2.2 Expressways

An ***expressway*** is a multi-lane surface street with widely spaced signals (one-half mile or greater) and high level of driveway access control. Driveways to or from fronting properties are limited (e.g. by connecting to a frontage road or side street, or consolidated with other properties). Expressways have continuous median barriers between traffic signals, and turning lanes at intersections are heavily channelized. Traffic signal cycle lengths are generally greater than 120 seconds or more during peak periods.

A ***high capacity river crossing*** is a special category for Watt Avenue, Sunrise Boulevard and Hazel Avenue crossings of the American River. These streets have higher than normal capacity for a "surface" or non-freeway street. Although this capacity class could be used for future proposed crossings, it is currently only used to represent streets which, through a combination of design features, operational strategies, and unique driver characteristics or behaviors, are observed to operate at super-normal flows.

6.2.3 Other Urban/Suburban Surface Streets

A ***major arterial*** is a multi-lane surface street with less widely spaced signals and moderate level of driveway access control. Traffic signals are generally spaced at about one-half mile, with turning movements heavily channelized. Medians barriers are present, but breaks between traffic signals (i.e. to a mid-block driveway or un-signalized cross street) may exist. Most driveway access to major arterial streets is for larger commercial uses (shopping centers, office buildings, etc.). Traffic signal cycles are usually about 120 seconds during peak periods.

A ***minor arterial*** is a two-to-four lane surface street with traffic signals spaced at one-quarter to one-half mile intervals. Median barriers may or may not be present. If present, breaks in the median for driveways or un-signalized side streets are more frequent. In some cases, no median barrier is present, and a continuous turn-lane or median stripe is present. Driveway access to the roadway is more frequent. Most driveway access is for commercial uses, but some residential uses may have driveway access. Traffic signal cycles, where applicable, are generally less than 120 seconds. If an intersection is un-signalized, however, generally only the side street is controlled.

A ***collector*** is most often a two-lane roadway but can be up to four lanes. In many ways, collectors are similar to minor arterial, but have even less control of driveway access and potentially more closely spaced intersections. Collectors generally do not have median barriers.

6.2.4 Ramps

A ***ramp*** is a roadway facility which connects to or from the freeway system. There are several sub-classes within the general capacity classification:

- A standard ramp connects from the surface street system to the freeway system. No distinction is made between diagonal and loop ramps of this type. However, there are several types of standard ramp:
    - Metered ramps signalize access from the ramp to the freeway system during peak hours.

    - HOV bypass ramps allow vehicles with two-or-more occupants to bypass a ramp meter.
- High capacity connector ramps connect from one freeway to another.
- Low capacity ramps connect from surface street to freeway, but because of unique features such as slope, curvature, etc. they have very low capacity. An example of a low capacity ramp is the South River Road on-ramp to eastbound US-50 in West Sacramento.

6.2.5 Rural Roadways

A ***rural highway*** is a two-lane surface street in a rural area, generally controlled only on side streets, and with relatively high design speeds. Examples of rural highways are State Highway 65 north of the City of Lincoln and State Highway 70 north of Marysville

A ***rural arterial*** is similar to a rural highway, but with more stop signs and lower design speeds.

6.2.6 Special Highway Links

Centroid connectors are abstract links in the travel demand model, intended to represent local street access to the collector-and-above roadway network.

Exclusive bike or walk links are special links added to the highway networks, but only accessible for non-motorized (i.e. bike/walk) path building. In most cases, bike or walk links have a one-to-one correspondence with an actual physical facility (e.g. the Guy West Bridge from Campus Commons to Sacramento State University, or one of the several pedestrian bridge overcrossings of freeways). However, in some instances, bike or walk links are intended to represent a combination of bike/walk routes or generalized bike or walk connectivity between two areas. Exclusive bike links are coded as "Class 1" facilities.

Bike lanes on roadways are coded with a special "bike"' identifier. The coding is used for Class 2 or Class 3 lanes on roadways. Chapter 8 on the bike and walk networks provides details on how the bike route coding is used in path building and skimming for the bicycle mode. Bike and Walk

Park-and-ride connectors are abstract links which provide connections from the highway network to park-and-ride lot nodes, which are only used in the transit network. These connector links must be present for paths to the park-and-ride lot to be built in the transit skimming process. Park-and-ride connectors also work to connect drop-off, or "kiss-and-ride" locations to the highway network.

HOV connectors are abstract links which mediate access between the mixed flow and HOV lane links on a freeway segment.

Disabled links are links in the master network which are not active in the scenario being modeled.

6.2.7 Tolling Attributes

Table 6-2 provides a quick description of the link attributes used to code tolled facilities into the highway network. For a more comprehensive review of how to use SACSIM's tolling capabilities, refer to Chapter 9.

Table 6-2 SACSIM Highway Network Tolling Attributes

Property (SACSIM variable name)	Convention
TOLLID	ID for a set of links comprising one tolled facility
GPID	ID corresponding to the general-purpose links that run parallel to a tolled facility. The toll for the links with the TOLLID are based on congestion on links whose GPID is the same as the TOLLID.
AUXID	ID corresponding to auxiliary lanes that run parallel to a tolled facility. Must be same value as GPID.

Source: SACOG 2020.

Table 6-3 Capacity and Free-Flow Speed

Capacity Class		Capacity	Free Flow Speed				
#	Description	(vplph)	Median	Average	Std.Dev.	Min	Max
1	Freeway (Mixed Flow)	2000	63	61	4	40	70
8	Freeway Lane (Pk Period HOV)	2000	60	51	13	20	63
51	Freeway (Auxiliary >= 1 mile)	2000	58	58	1	55	58
56	Freeway (Auxiliary <1 mile)	1500	58	55	3	50	58
12	High Capacity River Crossing	1500	42.5	43	3	40	45
2	Expressway	1000	50	49	6	35	55
3	Major Arterial	850	40	37	7	15	55
4	Minor Arterial	800	35	33	9	5	50
5	Collector	700	25	29	7	10	50
6	Freeway Ramp	1500	20	21	4	20	55
36	Ramp (Metered AM)	1500	20	21	4	20	55
46	Ramp (Metered PM)	1500	20	20	0	20	20
26	Low Capacity Ramp	500	20	18	4	10	20
16	High Capacity Ramp/Connector	2000	45	42	10	20	63
6	Ramp (HOV Bypass)	1500	20	21	4	20	55
22	Rural Highway	1000	55	51	5	35	55
24	Rural Arterial	750	40	40	6	20	55
7	Walk/Bike	n/a	3	3	0	3	3
9	Connector (Mixed Flow-HOV)	1500	63	63	0	63	63
62	Connector (PNR-Roadway)	n/a	20	20	0	20	20
63	Centroid Connector (TAZ to roadway)	n/a	20	20	0	20	20
99	Disabled	n/a	0	0	0	0	0

Source: SACOG 2020.