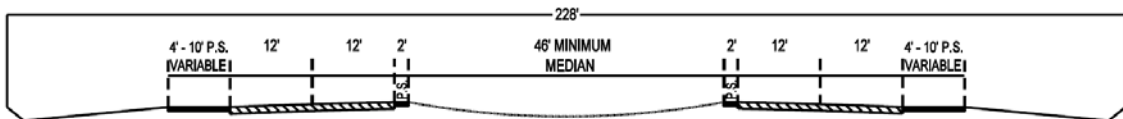


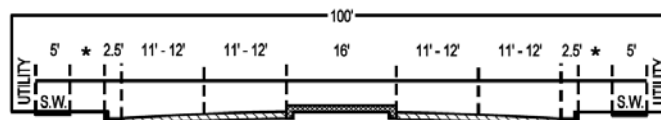
Appendix 5 – Cross Sections and Safety Countermeasure Guidelines

DCHC MPO policy is to promote the cross-section designs and safety counter measures presented in this appendix with the objective to create roadways that are multi-modal, sensitive to the local context (e.g., land use, non-automotive trips), and safe. These designs and counter measures are guidelines. The final cross-section and design of a road depends on many operational, planimetric, contour and land use factors, and thus design decision must be made on a case-by-case basis.

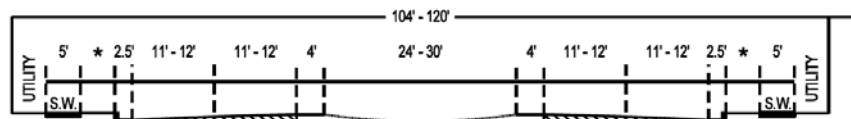
TYPICAL ROADWAY CROSS-SECTIONS



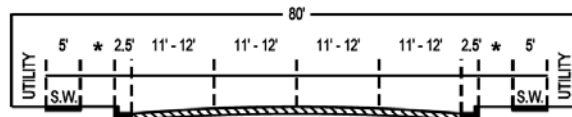
FOUR LANES DIVIDED WITH MEDIAN - FREEWAY



FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER



FOUR LANES DIVIDED - BOULEVARD WITH GRASS MEDIAN

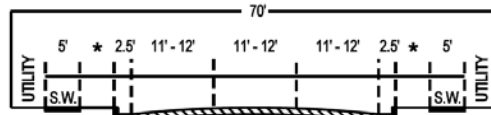


FOUR LANES - CURB & GUTTER

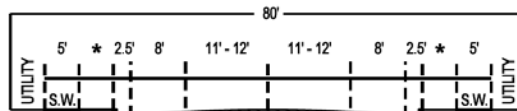
* - VARIABLE WIDTH
S.W. - SIDEWALK
P.S. - PAVED SHOULDER

NOT TO SCALE

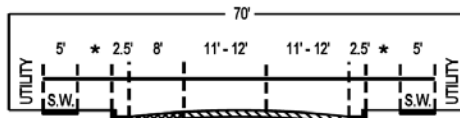
TYPICAL ROADWAY CROSS-SECTIONS



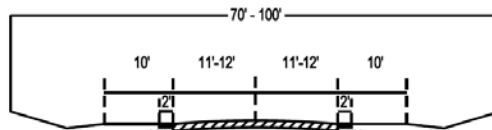
THREE LANES - CURB & GUTTER



TWO LANES - CURB & GUTTER
PARKING ON EACH SIDE



TWO LANES - CURB & GUTTER
PARKING ON ONE SIDE

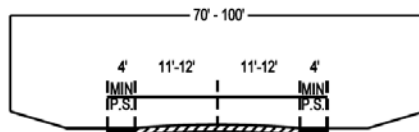


TWO LANES - PAVED SHOULDER

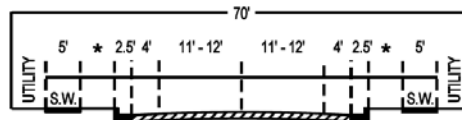
* - VARIABLE WIDTH
S.W. - SIDEWALK
P.S. - PAVED SHOULDER

NOT TO SCALE

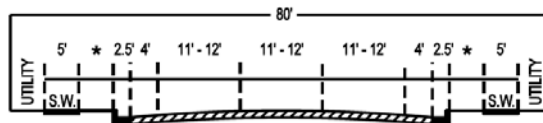
TYPICAL ROADWAY CROSS-SECTIONS FOR ACCOMMODATING BICYCLES



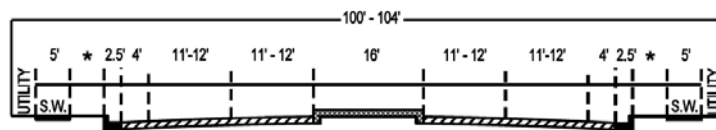
TWO LANES - SHOULDER SECTION



TWO LANES - CURB & GUTTER
WITH BIKE LANES



THREE LANES - CURB & GUTTER
WITH BIKE LANES



FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER
WITH BIKE LANES

* - VARIABLE WIDTH
S.W. - SIDEWALK
P.S. - PAVED SHOULDER

NOT TO SCALE

SAFETY COUNTERMEASURES

The FHWA Safety Program has developed nine safety countermeasures that show great potential to reduce highway fatalities and injuries to pedestrians. As both the Capital Area MPO and Durham-Chapel Hill-Carrboro MPO develop plans to address capacity and safety challenges, they are to consider the benefits and use of these proven roadway safety tools and techniques.

1. **Road Safety Audits** – A road safety audit (RSA) is a formal safety performance examination of an existing or future road or intersection. Audit teams are independent and multidisciplinary. The team reports on potential road safety issues and identifies opportunities to improve safety for all road users. Both MPOs receive Traffic Engineering Accident Analysis data (TEAAS) data from NCDOT's Transportation Mobility & Safety Division. The aforementioned division uses the data for Road Safety Audits for state maintained roads. Both MPOs will work with NCDOT's Transportation Mobility & Safety Division to utilize this data to identify roadways that might benefit from a safety audits.
2. **Rumble Strips and Rumble Stripes** – Rumble strips are raised or grooved patterns on the roadway that provide both an audible warning (rumbling sound) and a physical vibration to alert drivers that they are leaving the driving lane. They may be installed on the roadway shoulder or on the centerline of undivided highways. Rumble stripes are rumble strips that are placed at the centerline or edge-line. Local governments within both MPOs, as well as NCDOT have studied the benefits of rumble strips and will continue to examine the benefits of rumble strips to improve the general public's safety.
3. **Median Barriers** –Median barriers are longitudinal barriers used to separate opposing traffic on a divided highway. They are designed to redirect vehicles striking either side of the barrier. Median barriers can significantly reduce the number of cross-median crashes and the overall severity of median-related crashes. Both MPOs will encourage its local governments to address the use of median barriers in new road design, as well as improving traffic flow and safety on existing highway facilities. The NCDOT recently undertook an effort to improve maintenance of its median barriers.
4. **Safety Edge** –The Safety Edge asphalt paving technique minimizes vertical drop-off safety hazards. A Safety Edge shape is created by fitting resurfacing equipment with a device that extrudes and compacts the shape of the pavement edge at a specific angle as the paver passes. This mitigates shoulder pavement edge drop-offs immediately during the construction process and over the life of the pavement. Because the technique involves only a slight modification of paving equipment, it has a minimal impact on project cost. NCDOT has indicated that they are in the process of trying this technique on a few projects across the state and then monitor it to see if it has positive results. The Capital Area MPO and the Durham-Chapel Hill-Carrboro MPO will encourage NCDOT to inform them of the outcome and examine where the technique can best utilized along the roadway network.
5. **Roundabouts** –A roundabout is a circular intersection where entering traffic yields to vehicles on the circulatory roadway. Roundabouts are designed to channel traffic at the entrance and provide collision deflection around a center island. Modern roundabouts are geometrically designed to reduce speeds and deflect collision forces, which substantially improves safety, while providing excellent operational performance at the intersection. There are local governments in both MPOs that have ordinance provisions for roundabouts; and both MPOs will encourage their use as needed for transportation system measures.

6. **Left- and Right-Turn Lane at Stop-Controlled Intersections** – Left-turn lanes are auxiliary lanes for storage or speed change of left-turning vehicles. Left-turn lanes reduce the likelihood of intersection crashes. They also make turning easier for drivers and improve the intersection’s operational efficiency. Right-turn lanes provide a separation at intersection approaches between right-turning traffic and adjacent through-traffic. This reduces conflicts and improves intersection safety. Both MPOs will support safety countermeasures at stop-controlled intersections where needed to ensure safety for the travelling public.
7. **Yellow Change Intervals** – Yellow signal lights that are not timed appropriately are a safety hazard. Yellow change intervals that are not consistent with normal operating speeds create a “dilemma zone” in which drivers can neither stop safely, nor reach the intersection before the signal turns red. Both MPOs will support efforts by NCDOT and local transportation/engineering department to improve signal timing for appropriate yellow change intervals.
8. **Medians and Pedestrian Refuge Areas in Urban and Suburban Areas** – Medians reduce traffic conflicts and increase safety by providing a buffer area between opposing lanes of traffic. Medians can be open (pavement markings only), or channelized (raised medians or islands) to separate various road users. Pedestrian Refuge Areas—also known as crossing islands, center islands, refuge islands, pedestrian islands, or median slow points—are raised islands placed in the street to separate crossing pedestrians from vehicles. Both the Capital Area MPO and Durham-Chapel Hill-Carrboro MPO will support the efforts to apply medians and pedestrian refuge areas where needed to support safety and reduce conflict between motor vehicles and pedestrians.
9. **Walkways** – Appropriately designed walkways increase safety for all road users. Both MPOs have active stakeholder and advisory groups that encourage the planning of pedestrian accommodations as a component of the regional transportation network. Types of walkways include:
 - *Pedestrian Walkway (Walkway)* – A continuous way designated for pedestrians and separated from motor vehicle traffic by a space or barrier.
 - *Shared Use Path* – A bikeway or pedestrian walkway physically separated from motor vehicle traffic by an open space or barrier, either within a highway right-of-way, or within an independent right-of-way. Shared use paths may also be used by pedestrians, skaters, wheelchair users, joggers, and other non-motorized users. Shared use paths also are referred to as “trails” or “multiple-use trails.”
 - *Sidewalks* – Walkways that are paved and separated from the street, generally by curb and gutter.
 - *Roadway Shoulder* – In rural or suburban areas where sidewalks and pathways are not feasible, gravel or paved highway shoulders provide a safer area for pedestrians to walk next to the roadway.

The Durham-Chapel Hill-Carrboro MPO and Capital Area MPO will continue to support the development of this needed infrastructure, and will encourage local governments to incorporate pedestrian accommodations as a part of their overall plan development.