IN REAL LIFE: Building for Communities with Motorcycles

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World Bank:
Vietnam Central Highlands Connectivity Improvement project

- To improve the connectivity, safety and climate-resilience of the National Highway 19.

GRSF MAIN ROLES

- **Safety Assessments**
  - Road safety assessments for NH19

- **Mentoring and Capacity Building**
  - Safe System approach and safe infrastructure
  - Safety at Road Works
  - Review and road safety improvement of 2-wheeler lanes standard

World Bank – NH19

- Road safety assessment of the whole National Highway 19. Road Safety Audits and Road Safety Inspections were carried out for a total length of about 255 km.
- A speed management analysis included, with a focus on school zones along the NH19; treatments are proposed for sections where speed is a critical factor.

Table 4 – Synthesis of Star Rating of baseline under CHCIP (2021)

	Vehicle occupant		Motorcyclist		Pedestrian		Bicyclist	
Star Rating	Length (km)	Percent	Length (km)	Percent	Length (km)	Percent	Length (km)	Percent
5 Stars	0.00	0.00%	0.00	0.00%	0.00	0.00%	4.90	3.42%
4 Stars	31.40	21.94%	20.50	14.33%	11.20	7.83%	24.60	17.19%
3 Stars	55.70	38.92%	42.70	29.84%	49.80	34.80%	42.40	29.63%
2 Stars	35.30	24.67%	55.40	38.71%	46.00	32.15%	43.00	30.05%
1 Star	20.70	14.47%	24.50	17.12%	29.20	20.41%	28.20	19.71%
Not applicable	0.00	0.00%	0.00	0.00%	6.90	4.82%	0.00	0.00%
Totals	**143.10**	**100.00%**	**143.10**	**100.00%**	**143.10**	**100.00%**	**143.10**	**100.00%**

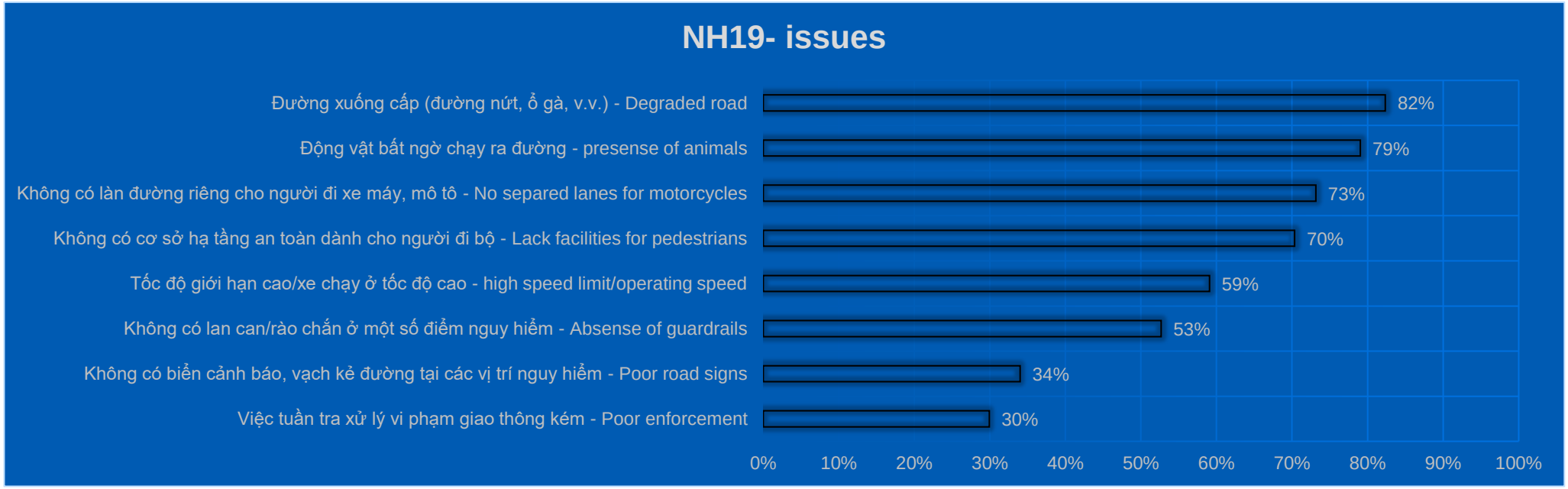
The baseline assessment shows that:

- For vehicle occupants 60.9% of the existing road is rated as 3-star or better
- For motorcyclists 44.2% of the existing road is rated as 3-star or better
- For pedestrians 42.6% of the existing road is rated as 3-star or better
- For bicyclists 50.2% of the existing road is rated as 3-star or better

AIP FOUNDATION
SAFE ROADS FOR LIFE

Findings and Recommendations from Citizen Engagement Study in strategic locations along NH19

KEY FINDINGS – Road Safety issues and concern



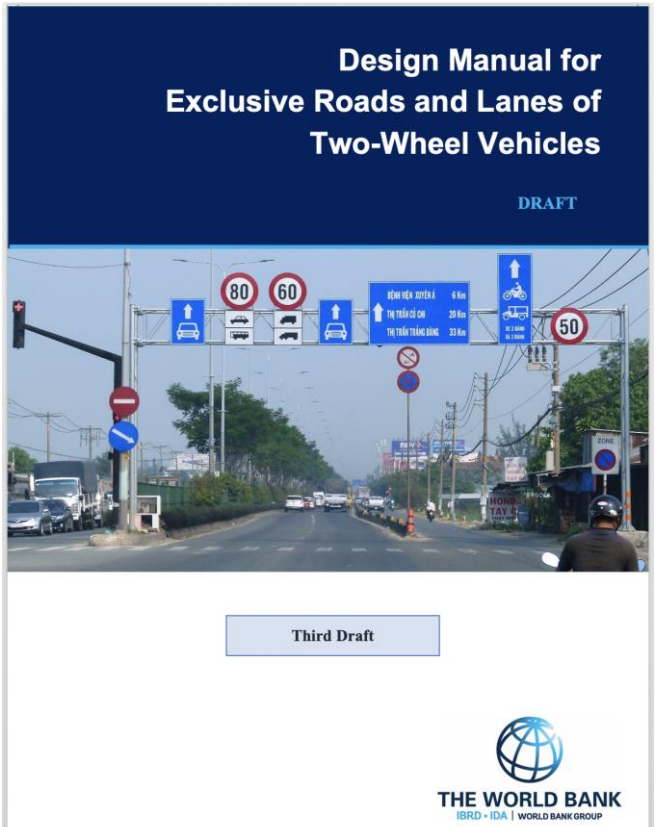
Due to sharp crabs, high out of sight. Many accidents have caused loss of life and property. It is recommended to widen the road, remove the corner, and launch the road

FGD, Community members

RECOMMENDATIONS

- Separate lanes for motorcycles
- Upgrade items to road sections, bends, slopes, road sections passing through densely populated areas, intersections
- The deployment of speed calming measures, and speed regulation (i.e., installing speed limit signs, rumble strips, and cameras)
- Modifications to non-motorized vulnerable road users' attributes (i.e., adding sidewalks, pedestrian crossings, fencing, and parking areas), especially around school zones
- Add surveillance cameras
- Assess and maintain road infrastructure frequently

Outline of the ORIGINAL manual (2019) and SUMMARY OF COMMENTS



(applied for National Highways)

GENERAL INFORMATION

LEGAL PROVISIONS

- Legal regulations, policies at national level
- Legal regulations, policies at local level

TECHNICAL INSTRUCTIONS

- Classifications
- Data collection & investigation
- Design guide
  - *geometric elements,*
  - *traffic organization,*
  - *road surface,*
  - *drainage facilities,*
  - *traffic safety system*

- ❑ Adjust and further improve the design manual/standards for considering **important factors**, such as road function, speed limit, traffic composition (% mode), while making decision on **lane segregation** between two-wheelers and four-wheelers
- ❑ Improve **safety specifications** for two-wheelers (including motorcycles and bicycles)
- ❑ Consider **Safe System** approach in design, consutruction and operation of road infrastructure with consideration to the dominance of motorized two-wheelers (motorcycles)

PRINCIPLES FOR UPGRADING THE MANUAL

- ✓ Expert consultations
  - ➢ (national and international)
- ✓ Literature review
  - ➢ (taking stock of relevant design manuals and standards and studies in ASEAN and Asia)

- ❑ Focus on safety specifications for two-wheelers
  - ▪ Lane design (width, # of lanes, lane separation)
  - ▪ Speed (design speed, limits & signpost)
  - ▪ Rumble strips to reduce speeding
  - ▪ Road restraint technical standards
  - ▪ Guideposts (made of flexible material)
  - ▪ Roundabouts & intersections
- ❑ Improved readability
  - ▪ Rewording explanatory texts
  - ▪ Adding scientific evidences

SUMMARY OF KEY POINTS / IMPROVEMENTS

- Sustainable transport development
  - Current and future role of motorcycles
  - Inducive environment for motorcycle user safety
- Classification of roads/lanes for two-wheelers
  - (A, B) & speed, design features
  - (C, D) & speed, design features
- Geometric design
  - Horizontal alignment
  - Vertical alignment
  - Cross-section
  - Traffic separator
  - Night visibility
- Traffic organization
  - Principles for national HW and urban roads
  - Methods for two-wheelers in urban areas
  - Lane segregation at bus stops
  - Traffic organization at intersections
- Traffic safety system
  - Structures
  - Signs
- iRAP assessment (NH19)
  - iRAP limits in assessing motorcycle safety
  - Several examples & implications

SUSTAINABLE TRANSPORT & MOTORCYCLE SAFETY ISSUES

- ✓ Period 2010-2020: motorcycles doubled from 31.3 mil to 63.4 mil
- ✓ Year 2020: 670 MC/1000 pop vs 44 automobiles/1000 pop
- ✓ By 2030, about 70% people would still choose motorcycle for their daily travel
- ✓ Safe System for protecting MC users & VRUs

Four-Pillar Strategy for M-cycle Traffic Safety in Vietnam

▸▹Creating a favorable environment for safely riding motorcycles

1. Policy & Regulation - Incorporating MC into Transport & Safety Policy
- ❑ Road Safety policy should include motorcycles
- ❑ Recognition of the economic and social contribution of motorcycling
- ❑ Adapting Policies to Local Situations

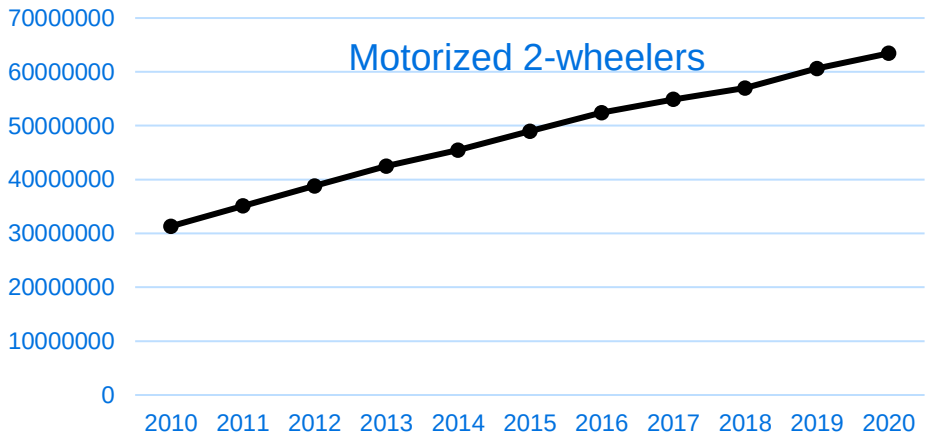
2. Infrastructure - Committing to Safe Infrastructure
- ❑ Safe system principles in all stages (planning, design, construction, operation) for motorcycle use
- ❑ Contextual applications & guideline of the principles

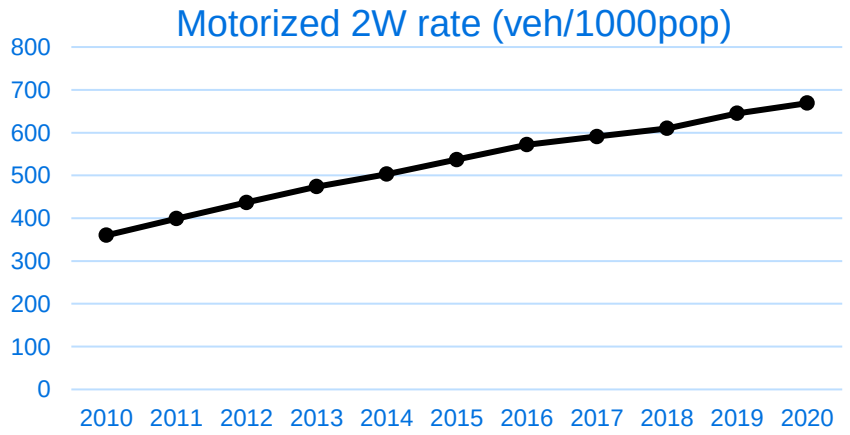
How? What?

3. Awareness, Education and Training for all Road Users
- ❑ Awareness Raising for All Road Users
- ❑ Lifelong Training of MC Riders
- ❑ Preventing Impaired Riding
- ❑ Protective Riding Gear
- ❑ Regular maintenance of the vehicles

4. Technology Advances
- ❑ Safety of the product is committed
- ❑ Advances in preventive, primary, secondary safety

Source: VGTRC (2018)





Source: MOPS (2021)

CLASSIFICATION OF ROADS AND LANES FOR TWO-WHEELERS

- **Dedicated roads/lanes – separated from 4W**
  - **Category A: min 2 lanes (min 3 m totally)**
  - **Category B: min 1 lane (min 2 m totally)**
  - **National HW, Urban arterials Class I & II : Speed > 70 km/h**

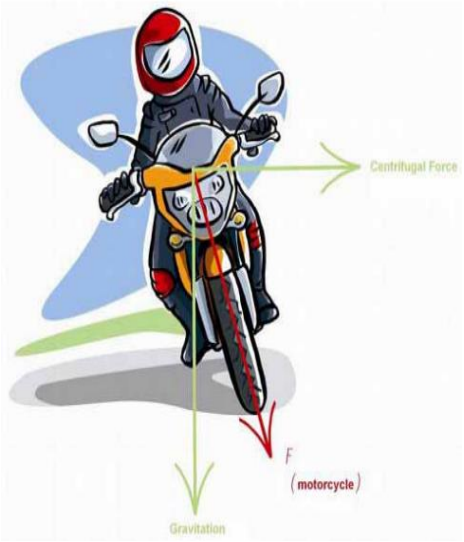
- Inclusive roads/lanes – sharing with 4W
  - Category C: min 2 one-way lanes (min 3 m total)
  - Category D: min 1 one-way lane (min 2 m totally)
  - National HW, other roads below Class II: Speed < 70 km/h (hard median), < 50 km/h (no median)

Source: WB (2019)

GEOMETRIC DESIGN – Horizontal Alignment

- Min curve radius
- Min curve radius without super-elevation
- Max super-elevation rate
- Sight distance
- Roadway extension

Forces on a motorcycle moving in a curve



Source: WB (2019)

Minimum curve radius & sight distance

Design Speed (km/h)	Min Sight Distance (m)	Min Radius (m)			
		e=0%	e=3%	e=6%	e=8%
90	145	490	400	335	305
80	120	360	300	250	230
70	95	275	230	190	180
60	75	190	160	135	125
50	60	120	100	90	80

Roadway extension in a curve

Curve Radius (m)	30	25	20	15
Roadway Extension (m)	-	0.1	0.2	0.3

GEOMETRIC DESIGN – Vertical Alignment

- Max longitudinal grade, max slope length
- Vertical curve
- Clearance: min 2.5 m

Max longitudinal grade, max slope length

	Category A, B
Max longitudinal grade (%)	11
Max length of the slope for 2W at max grade (11%) (m)	60

Minimum radius of crest and sag vertical curve

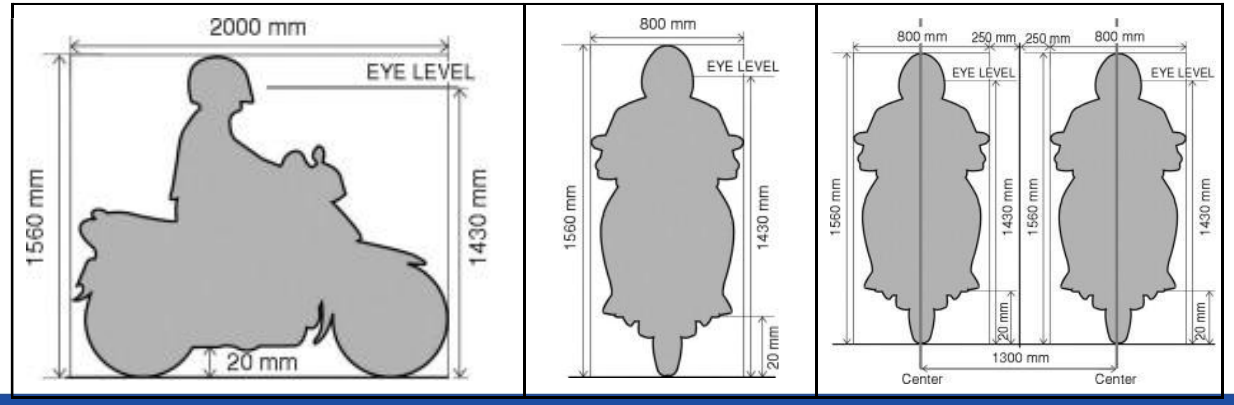
	Category A	Category B
Radius of crest vertical curve (m)		
Limited minimum	400	200
Normal minimum	600	200
Radius of sag vertical curve (m)		
Limited minimum	2500	100
Normal minimum	400	200
Minimum length of vertical curve (m)	25	20

Source: WB (2019)

GEOMETRIC DESIGN – Cross-section

- Operating spaces required
- Optimum roadway width (ASEAN studies)
  - Dedicated: 3.0 – 4.0 m (divided into 2 sub-lanes)
  - Inclusive: 2.0 – 3.0 m (not allow cars to enter)
- Min roadway width
- Traffic volume and the number of lanes

Min spaces required for motorized 2W operation



Minimum roadway, roadbed by 2W road category

Category	Min # of lanes	Min width of roadway (m)	Min width of road shoulder (m)	Width of side ditch (m)	Min width of roadbed (m)
A	2	3.0	0.5 – 1.0	0 – 1.0	3.5 – 4.5
B	1 – 2	2.0	0.5 – 1.0	0 – 1.0	2.5 – 4.0
C	2	3.0	0 – 0.5	0 – 0.5	3.5 – 4.0
D	1	2.0	0.5 – 1.0	0 – 0.5	2.5 – 3.5

Design volume, # of lanes, and min roadway width (2W)

Design volume (MC/h)		1000 - 1500	1500 - 3200	3200 - 4500
# of lanes		1	2	3
Min width of roadway (m)	Non-urban	1.5	2.5	4.0
	Urban	2.0	3.0	5.0

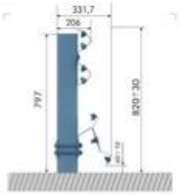
Source: Hussain et al. (2005)

GEOMETRIC DESIGN – Traffic Separator

- TCVN 4054: 2005 Standard
- TCXDVN 104: 2007 Standard
- Soft separator (painting & reflective stud)
- Hard separator (w-beam guardrail, concrete pillar, reinforced concrete, curb, island, tree,…)
- Flexible delineator post

Soft separator

Hard separator



Delineator

San Francisco, CA. (Source: Dianne Yee)

Seattle, WA. (Source: Seattle DOT)

GEOMETRIC DESIGN – Night Visibility

- Single-vehicle crashes often occur at night when visibility is low
- Night visibility must be ensured

Clearance btw the lighting column and 2W carriageway

At tunnel or underpass which is longer than 10m, it is recommended that the full length of the structure be lit at all times. The designer shall take into account in hid design the transition lighting requirements at the entrance and exit to these tunnel/underpass so that minimum vision adjustment is experienced by the motorcycle riders.

The clearance between the lighting column and the carriageway should be not less than the minimum distance recommended in the table below for the appropriate design speed. The lowest point of overhang of luminaires or bracket arms that overhang the carriageway or area within the respective horizontal clearances in the table should have vertical clearances of at least 5.7 m from the level of the carriageway surface.

TABLE 7.2 : HORIZONTAL CLEARANCES (m) REQUIRED

Design speed, km/h	Horizontal clearances, m
20-50	0.8
60-80	1.0
90-100	1.5

Source: Kerajaan Malaysia (2016)

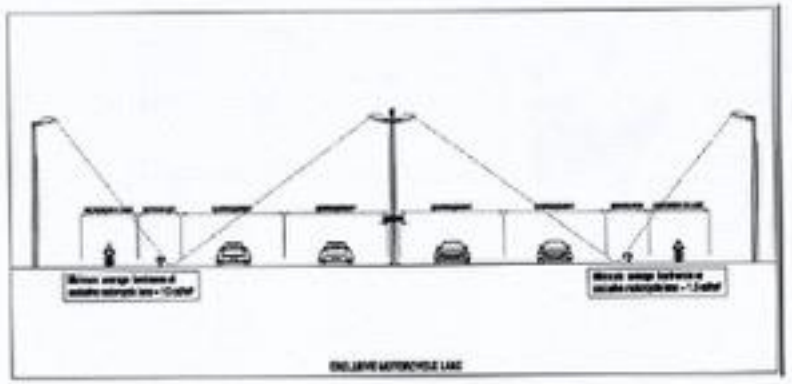
Road lighting may improve the safety of a motorcycle lanes and the ease and comfort of operation thereon. The primary purpose of street lighting is to provide safe and comfortable vision during the night on motorcycle lanes. It also has a wider social role, helping to reduce crime and can contribute to commercial and social use. The benefits of such lighting include reduction of accidents and facilitation of traffic flow.

Minimum average motorcycle lane luminance expressed in table below are to be used as a general guideline in the design of street lighting system for motorcycle lanes. The guidelines are intended to establish the level of street lighting which covers the various sections of motorcycle lanes. The lighting layout should provide a uniformly bright carriageway to the desired levels. Nevertheless it should also be designed to prohibit glare, and to minimise glare and adverse impacts on all road users.

TABLE 7.1: MINIMUM AVERAGE MOTORCYCLE LANE LUMINANCE

Area	Minimum Average Motorcycle Lane Luminance, cd/m^2
Merging & diverging Gore Areas	2.0
Underpass (>30m)	1.5
Others	1.0

FIGURE 7.6: TYPICAL CROSS SECTION FOR INSTALLATION OF LIGHTING



TRAFFIC ORGANIZATION – Principles for Urban Roads & National HW

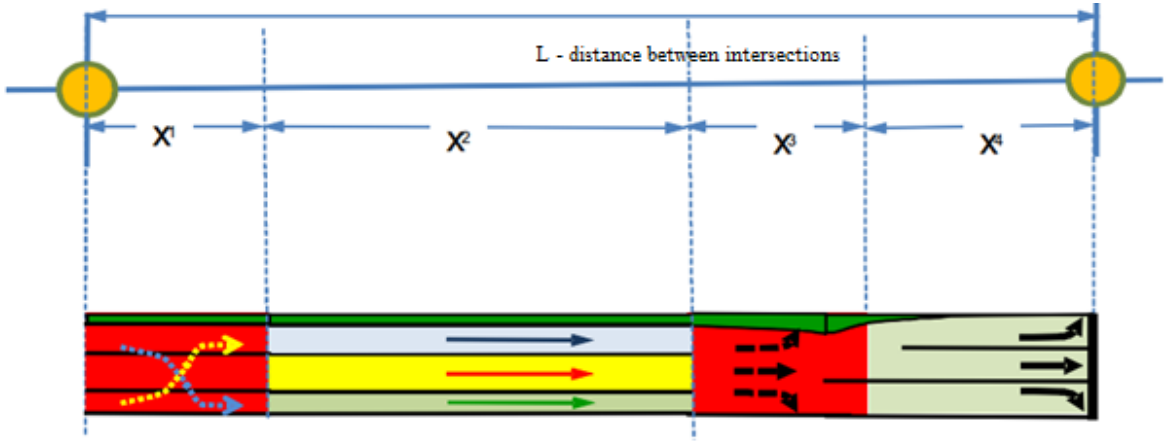
- Specific objectives:
  - Ensure traffic **safety**
  - Increase traffic **capacity**
  - Reduce **delays** at intersections
  - Improve traffic **efficiency** for a route/network
- Data collection and analysis
- Scope and targets for study
  - Intersections
  - Road network
  - Traffic control facilities

Data collected for traffic organization plan

Data type		Data description
Traffic conditions	- Traffic volume on routes (distribution by time and vehicle composition)	Traffic volume at off-peak and rush hour; Traffic flow composition; pedestrian and bicycle.
	- Vehicle speed; vehicular queue length; Other factors such as parking lots, etc.	
	- Data on road crash	Collect data on road crashes within the last 3 years.
	- Current traffic control	Traffic control status of local road system.
Road conditions	- Local road network	Road system: arterial roads, connectors, access or frontage roads, etc.
	- Local topographic and natural conditions	Local topographic and population conditions
	- Current road conditions (if repairing or upgrading)	Current road conditions: surface type, width, etc.
Auxiliary structures conditions	- Drainage conditions - Type and position of safety signs - Lighting condition - Landscape and clearance on road sides	

TRAFFIC ORGANIZATION – Methods for Urban Roads

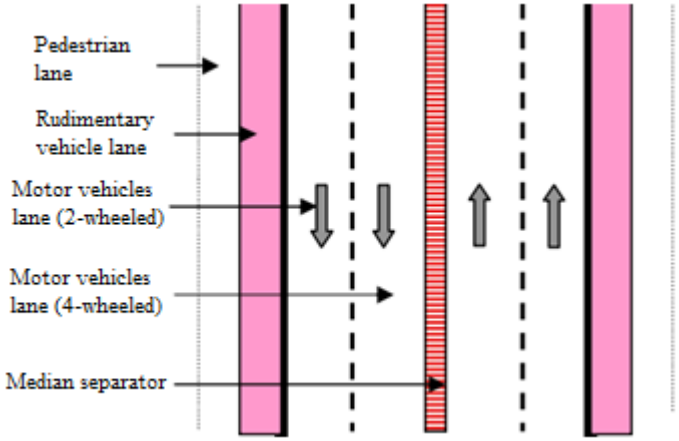
- Arterial roads
- Urban freeways
- Distance between intersections (depending on traffic capacity and intersection delay impact)



X_1 : lane changing distance

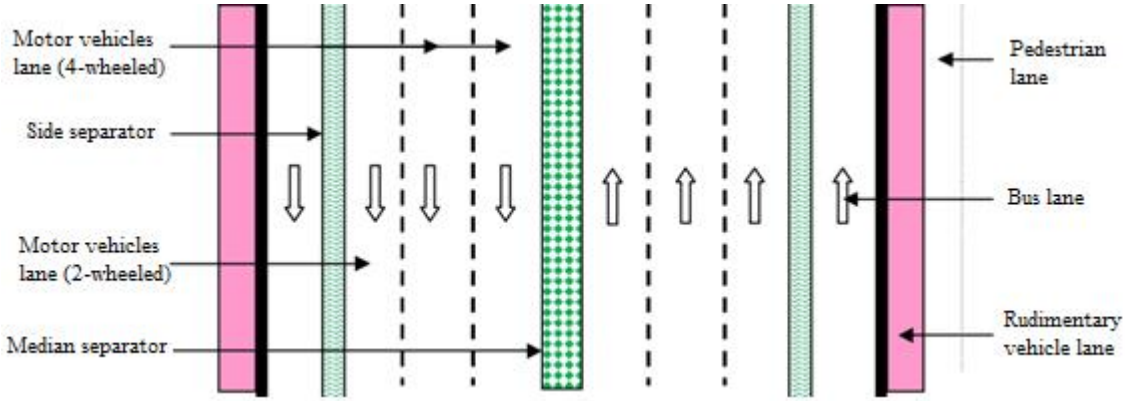
X_2 : distance in which vehicles travel in a specified lane

$X_3 + X_4$: length of left-turn bay



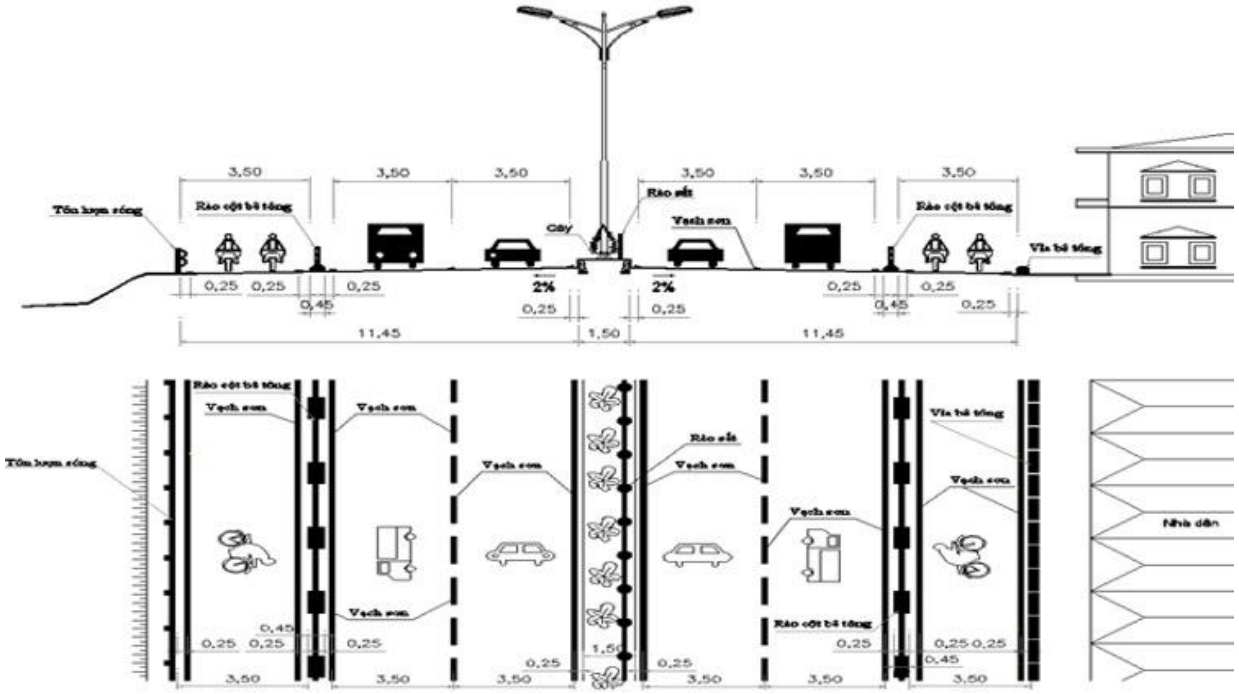
Lane segregation for urban arterials

Lane segregation for urban freeways

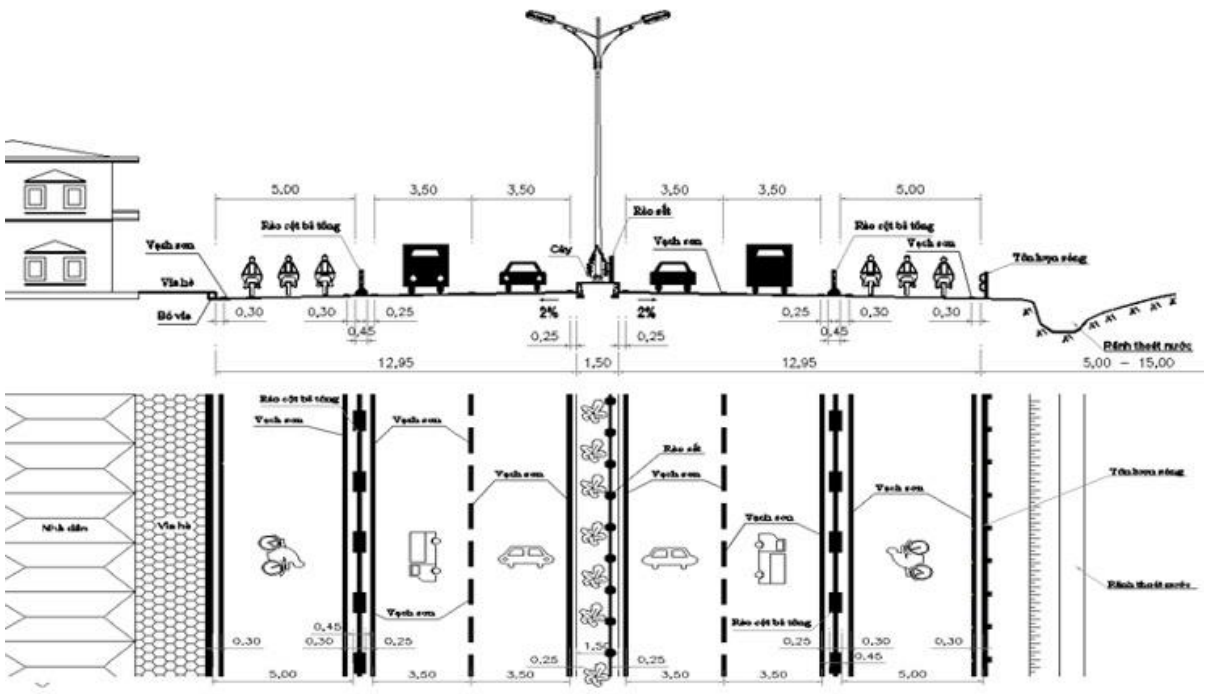


TRAFFIC ORGANIZATION – Methods for National Highways

- **Lane separation for two 2W lanes**

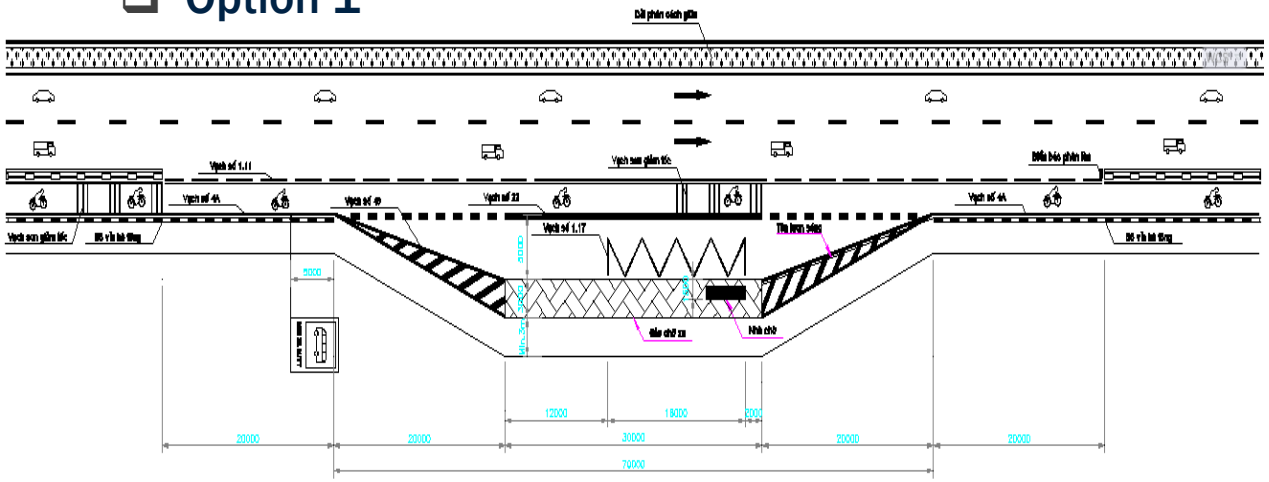


- Lane separation for **three** 2W lanes

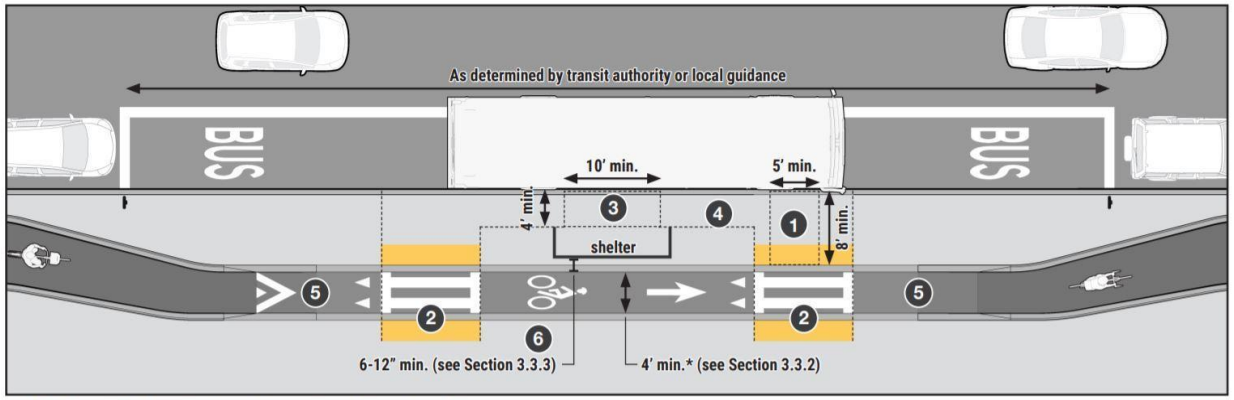


TRAFFIC ORGANIZATION – Methods for Bus Stops

Option 1



Option 2



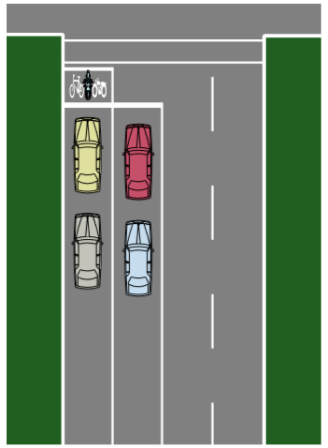
* A bike lane width narrower than 5 ft. requires a design exception.

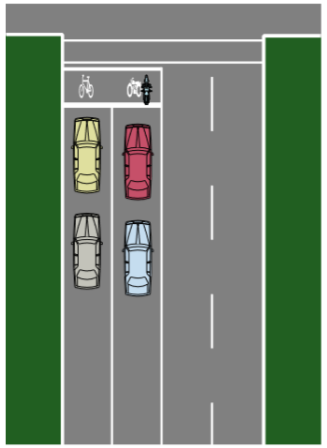
60% bus stops only require reallocation without expansion

TRAFFIC ORGANIZATION – Methods for Intersections

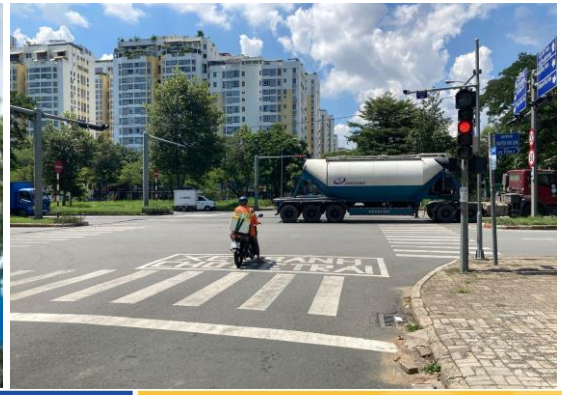
- Ensuring **safety** and improving **capacity**
- Building bridge or tunnel (expensive)
- Signalization (3 phase control)
  - Phase 1: Allow cars in both directions of the primary road to go.
  - Phase 2: Allow motorcycles in both directions of the primary road to go.
  - Phase 3: Allow cars and motorcycles on the secondary roads to go.
- Motorcycle box
- Left-turn box

- Motorcycle box to increase MC visibility (Taiwan)





- Two-stage left turn box for MC (HCMC)



TRAFFIC SAFETY SYSTEM – Structures

- Help solve conflicts at intersection
- Overpass/Bridge
- Underpass/Tunnel

- Overpass

- Tunnel

TRAFFIC SAFETY SYSTEM – Signs

- **Traffic Signs and Signals QCVN 41: 2016/BGTVT**

- Signal signs

- Signs on road surface

- Signs for lane segregation

R.415 Sign

P. 127c Sign

P. 127d Sign

- Cantilever signs/signposts

iRAP ASSESSMENT (NH19)
Limits of iRAP methodology in assessing 2W safety

- iRAP Star Rating is a simple and objective measure of the level of safety, which is 'built-in' to the road for vehicle occupants, motorcyclists, bicyclists and pedestrians
- It offers a useful framework for validating the safety features highlighted in this manual
- Only some of the topics addressed in the manuals can be coded using iRAP's methodology
- However, many of the topics, when assessed individually, have a little impact on the Star Rating (i.e., no difference if included or not compared to the base case)

Topic/Measure	Comment
Topographic, geotechnical, and hydrological aspects	Not considered in the iRAP methodology
Geometric design	Some aspects are not considered in the iRAP methodology (e.g. superelevation or radius of crests and sags); Other features are not significant for coding (e.g. min radius of horizontal curve, since it does not distinguish radii less than 200 m)
Traffic organisation and intersections	Mostly not considered in the iRAP methodology, e.g. the iRAP Coding Manual classifies the intersections in a generic way (it only distinguish the type and whether there is a channelization or not), so the detailed solutions proposed in the manual cannot be assessed
Small drainage structure	Not considered in the iRAP methodology
Road surface	iRAP methodology only takes into account whether road surface is paved or unpaved and its skid resistance

iRAP ASSESSMENT (NH19) – Examples

Base case: no facilities for two-wheelers

Bicycles and motorcycles share the roadway with four-wheeled vehicles

Description

Type of facility: no specific provisions for bicycles or motorcycles.

Road type: undivided standard national highway (Vietnam) with two lanes (one in each direction).

Traffic separator: no separation between two-wheelers and other traffic.

Motorcycle lane: Class 1 – Grade A

Classification of dedicated roads and lanes for two-wheeled vehicles

Description

Type of facility: exclusive motorcycle road, designed and constructed separately from the road surface used by cars.

Cross section: two lanes (one way, or two ways with a raised surface/median curb dividing opposing directions).

Traffic separator: separated from the four-wheeled vehicle lanes by a safety barrier (metal or concrete), fence, or wide (≥1m) raised island/curb.

iRAP ASSESSMENT (NH19) – Examples

Motorcycle lane: Class 2 – Grade C / soft separators

Classification of dedicated roads and lanes for two-wheeled vehicles

Description

Type of facility: dedicated lane for two-wheeled vehicles lying on the same surface as the cars.

Cross section: two lanes (one way).

Traffic separator: separated from the four-wheeled vehicle lanes by soft separators (line markings and/or reflective nails), or <1m wide raised island/curb cast in place or precast.

Motorcycle lane: Class 2 – Grade C / hard separators

Classification of dedicated roads and lanes for two-wheeled vehicles

Description

Type of facility: dedicated lane for two-wheeled vehicles lying on the same surface as the cars.

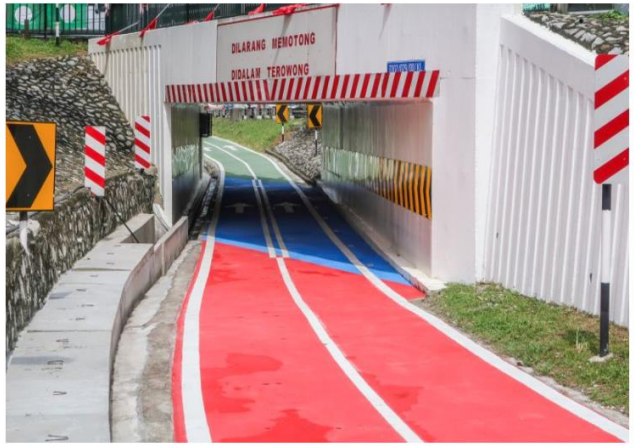
Cross section: two lanes (one way).

Traffic separator: separated from the four-wheeled vehicle lanes by a safety barrier (metal or concrete), fence, or wide (≥1m) raised island/curb.

iRAP ASSESSMENT (NH19) – Examples

Grade separated intersection / Overpass and underpass

Intersections on National Highway grade I, II or main urban roads

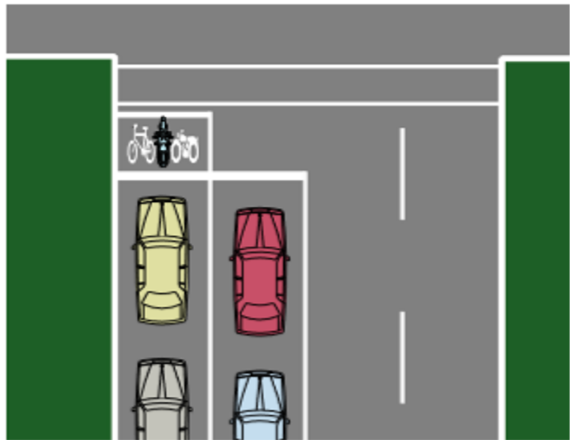


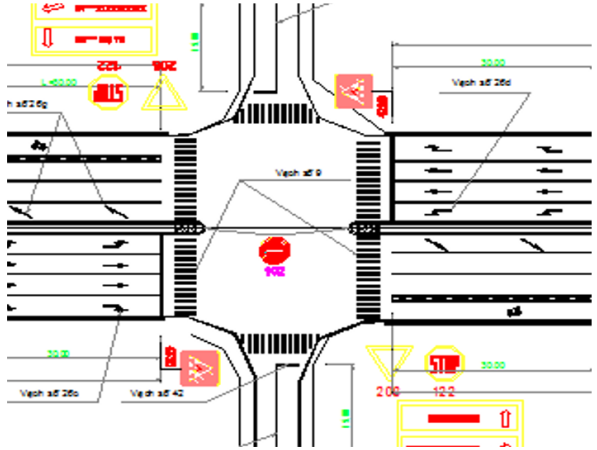
Description

Overpass or underpass for two-wheeled vehicles.

At-grade intersection

Intersections on National Highway grade III, IV, V or VI





Description

Well-designed 4-leg intersection signalised with traffic lights and equipped with protected turn lanes. The motorcycle lane is interrupted at the intersection (not present). The dedicated red light waiting area cannot be coded as it is not considered among the attributes of iRAP.

CONCLUSIONS & WAYS FORWARD

- The upgraded manual is useful to study, plan, design and audit exclusive roads and lanes for 2W in order to ensure road safety for motorcyclists, bicyclists and pedestrians
- Solutions recommended in the manual should be piloted, assessed and adjusted as the rollout is progressive
- It is important to study and adapt the iRAP methodology into the context of dominant motorcycle traffic in Vietnam and elsewhere

- ***The Upgraded Manual for Exclusive Roads and Lanes for Two-wheel Vehicles is now in EN and VN and is being revised in detail by the corresponding authorities, who may approve it, publish it and transform it (or part of it) into standard(s).***

Discussion

Upcoming opportunities for Vietnam

- Activities and Indicators within MeRRCoP (3NHs new project)
- Joint actions with provinces involved

Activities and opportunities

Within the project and along with Provinces' support/joint actions

- Guard rails/barriers and infrastructure design with special consideration for motorcyclists.
- Minimize risks due to roadside hazards, creating “forgiving roads” (*i.e., clear zones, shoulders, bridge and barrier ends have appropriate attenuators to absorb impacts, eliminate/relocate side hazards, etc.*)
- Speed management (*regulation, infrastructure/design, signs, enforcement and associated communication*).
- Motorcyclists and pedestrian facilities (*specially around social infrastructure i.e., schools, hospitals, markets*) – *considering persons with disabilities and elderly needs.*
- Safe Intersections designs (*ex. roundabouts preferred for crossroads and ‘Y’ intersections, raised platforms for intersections or pedestrian crossings, protected turns for signalized intersections, etc.*)
- Capacity development and hands-on trainings on required themes (ex. detailed engineering designs, plus *based on stakeholders and provinces inputs*).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