



KENYA ROADS BOARD



MINISTRY OF TRANSPORT  
AND INFRASTRUCTURE



**AfCAP**  
Africa Community Access Partnership

INTERNATIONAL CONFERENCE ON TRANSPORT AND ROAD RESEARCH

15<sup>TH</sup>-17<sup>TH</sup> MARCH 2016 | WHITESANDS HOTEL, MOMBASA, KENYA

# A Paradigm Shift in Geometric Design of Low Volume Rural Roads

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# Presentation Outline

- Introduction
- Geometric Design
- Road Safety
- Maintenance
- Conclusion
- Recommendations for further research

# Introduction

- Basic access is key to socioeconomic development of rural communities and should be viewed as a human right
- Current rural road network in Sub-Saharan Africa (SSA) about 1 million km, mostly unsurfaced and large parts often untraffickable in wet season
- Real need estimated at 5-6 million km to realise SSA agricultural potential
- Affordable geometric standards imperative to enable SSA governments to extend and improve Low Volume Road (LVR) network and satisfy the needs of rural population estimated at more than 500 million people

# Purpose and scope

- Motivation for a paradigm shift in geometric design philosophy and principles for LVR
- Brief review of current LVR geometric standards
- Proposes set of basic, affordable LVR geometric standards based on actual road use coupled with road safety measures to achieve satisfactory safety level.
- Does not deal with detailed design elements which are well documented and can be applied to the extent that they are relevant

# Methodology

- Extensive literature search on LVR geometric design and road safety
- Little research specifically on LVR as defined in the paper, however, some research findings still relevant and applicable
- Research findings coupled with practical considerations and field observations used to determine appropriate standards

# Geometric Design

- **Definition of LVR**

- Basic access function
- Traffic volume up to about 300 vpd with typically less than 20% being heavy commercial traffic and MESA < 1 million
- Often need to cater for significant amounts of pedestrians, bicycles, motorbikes and animal drawn carts
- Not expected to change function over its design life

- **Purpose**

- To provide appropriate service level and safety for all road users at minimum life-cycle costs

# Geometric Design

- LVR design principles
  - Reconsider traditional design concepts based on design speed and consistent cross section along entire road
  - Let the alignment fix the operating speed, not vice versa, and allow for variable operating speed and cross sections
  - This will significantly reduce earthworks and total project costs
- Review of current design standards
  - ORN 6 reference document for design manuals since first issue in 1988
  - Two example randomly chosen from the region
  - Most country manuals would be quite similar

# Comparison of Standards

Example	Design class	ADT	Surface	Width (m)	
				C/way	Shoulder
ORN 6	D	100-400	Paved/unpaved	5.0	1.0
	E	20-100	Paved/unpaved	3.0	1.5
	F	0-20	Paved/unpaved	2.5/3.0	Passing places
Example 1 (Table 2)	DC5	200-400	Paved	6.5	1.0
	DC6	50-100	Paved/Gravel	6.0	1.0
	DC7	20-50	Gravel	5.5	1.0
	DC8	< 20	Earth/Gravel	4.0	1.0
Example 2 (Table 3)	DC 4	100-300	Paved	6.5	1.25/0.5
	DC 3	75-150	Paved	6.0	1.0/0.5
	DC 2	25-75	Paved	3.3	1.5/1.0
	DC 1	< 25	Earth/Gravel	4.5	n/a



# Accident Rates on LVRs

*“Oglesby and Altenhofen (1969) found accidents to be rare on low-volume rural roads. Furthermore, there was almost no evidence to indicate that higher standards of formation width or surface type would reduce the already small number, **although they found that highway engineers appeared to believe the opposite.** From an economic standpoint, accident costs were found to be of a lower order of magnitude than construction and operating costs”.*

Ref: Boyce, McDonald, Pearce & Robinson (1988):

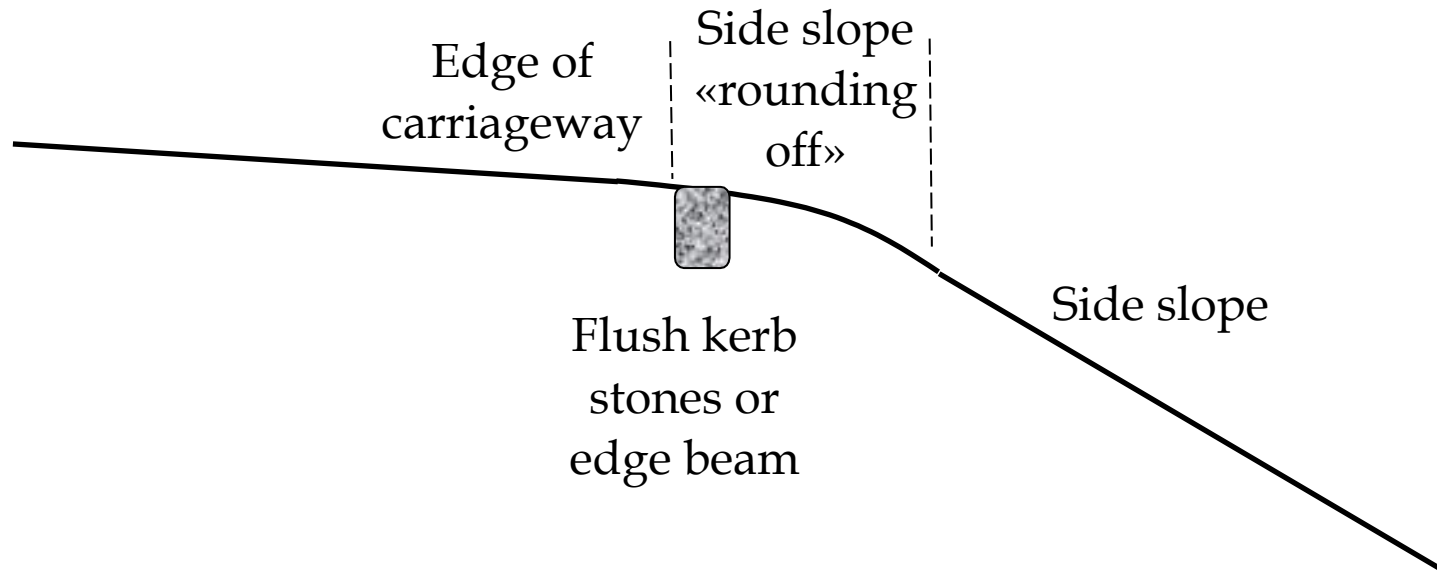
# Passing Incidents on LVRs

AADT	300		100	
Speed (km/h)	Avg. Conflicts/km		Avg. Conflicts/km	
	Per Day*	Per Hour	Per Day*	Per Hour
40	45	2,8	5,0	0,3
60	30	1,9	3,3	0,2
80	22,5	1,4	2,5	0,2

AADT	300		100	
Speed (km/h)	Avg. time between conflicts / km		Avg. time between conflicts / km	
	40	21 min		3 hr 12 min
60	32 min		4 hr 48 min	
80	43 min		6 hr 24 min	

Conflicts/km/hr =  $AADT^2 / Speed / 50 / 16$   
 assuming AADT distributed over 16 hours.

# Edge Protection of Paved Roads



- Used in older designs, seldom in recent projects
- Very effective in preventing edge breaks, thereby contributing to increased safety and pavement life

# Proposed Basic Geometric Design Standards for LVR

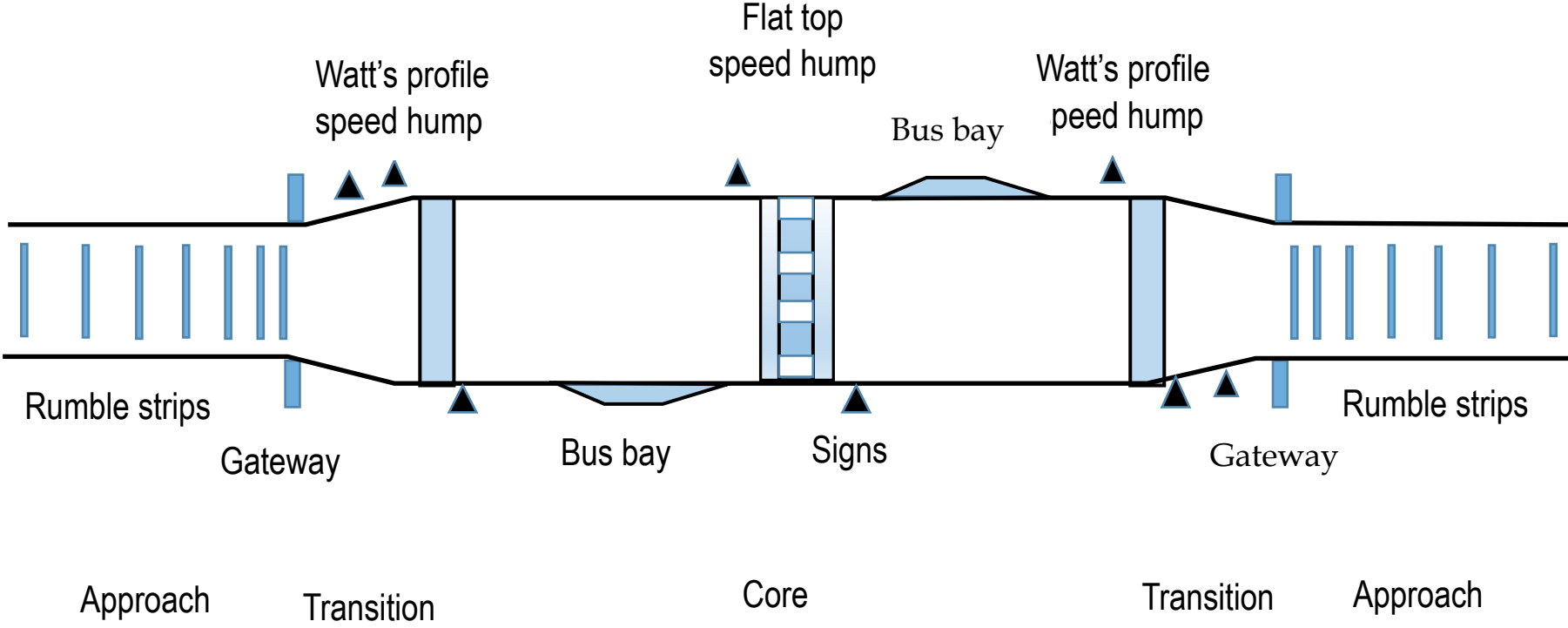
Road function	Design class	Traffic ADT	Surface type	Roadway width (m)	Passing places
Access	D	100-300	Paved/Unpaved	4.5 – 5.5	As required
	E	20-100	Paved/Unpaved	3.5 - 4.5	As required
	F	<20	Earth/Gravel	3.0 - 3.5	As required

- Will be much more affordable than current LVR design standards
- Will provide adequate service and safety levels when coupled with:
  - Speed reducing measures
  - Removal of danger spots with properly engineered solutions

# Road Safety

- Much research carried on rural road safety, but mostly in a rural highway context
- Research findings can be adapted to low speed LVR environment
- Controlling vehicle travelling speed key to road safety
- Judicious use of speed reducing measures and innovative road marking (perceptual countermeasures)
- Special road safety measures in villages and built up areas (The Village Treatment)
- Road Safety Education to be integral part of LVR projects
- Lack of law enforcement in rural areas, villagers encouraged to form road safety committees

# The Village Treatment



# Maintenance

- Road Safety cannot be upheld unless the road is adequately maintained
- Further strengthens the need for affordable standards and to reallocate resources from capital to recurrent expenditure budgets

# Conclusions

- The massive demand for Rural Transport Infrastructure (RTI) in the SSA region requires a paradigm shift in geometric design of LVR
- Rural population can only be given their right to reliable basic access if appropriate design philosophy and standards are embraced by engineers and manifested in government policy
- Proposed design standards will provide adequate service and safety levels on LVRs

# Recommendations For Further Research

- Traffic accidents and disaggregated accident statistics
- Effect of speed reducing measures and perceptual countermeasures / road marking on LVR
- Trials with access restrictions for heavy/oversized vehicles
- Use of different coloured asphalt as stand-alone or complementary measure to road marking
- Road Safety Education Schemes – formulation, implementation & effect



**Thank you**