Lecture T1 – Introduction

Contents

History

Course Structure

The Compleat Designer

Urban Versus Rural Geometry

History

The Geometric Design Course has been presented by the South African Road Federation since 1976. It was initiated by Mr David Giddy, previously of the Johannesburg City Council.

The course content grew over time to include traffic engineering, statistical analysis and drainage components that whilst necessary as part of the overall picture, were not actually Geometric Design. With the advent of modern computing power, and the proliferation of computer aided design tools and programmes, the SARF considered the need to re-evaluate the course content and to focus back onto the Geometric Design component only.

History

The course is aimed at graduate engineers, technologists and technicians with the intention of sensitizing and advising designers as to the whole cycle of a road design, and how other considerations such as drainage, signage, pedestrians, pavement layers, and roadside furniture interact with, and influence final geometric design parameters.

The flow chart presented in this section gives a broad overview of how the various activities interact in achieving the final product.

Course Structure

The course is split into three sessions, being :

- Theoretical considerations;
- Alignment – Horizontal, Vertical and Cross
- Intersections and Interchanges

The theoretical session introduces the fundamental principles underpinning geometric design and, in this session, we also discuss some of the topics that you should be aware of and have some sort of understanding of how they impact on geometric design.

Course Structure

The alignment session deals with the three major components that the designer is concerned with, those being horizontal alignment, vertical alignment and cross section parameters.

The last session deals with intersecting alignments both at grade (intersections) and grade separated (interchanges).

The Compleat Geometrician

Way, way back a gentleman by the name of Isaac Walton wrote a book which he proudly entitled "The Compleat Angler". This did not mean that, back in 1653, PCs were short in the spell checker department. It actually means that, back then, people spelled things differently.

The question thus is "What should the compleat geometrician know?" This course attempts to answer the question and also point attendees in roughly the right direction to acquire this knowledge.

The Compleat Geometrician

We could start off by suggesting that a comprehensive knowledge of geometric design would be necessary. This is certainly necessary but is it sufficient? The answer, unfortunately is a resounding "No".

It must be realised that what the geometric designer is really trying to do is to find the solution to a problem. The first step, thus, is to define the problem.

It is a fact of engineering life that problems that have only one solution do not exist outside the classroom.

The Compleat Geometrician

There may be many solutions which are plainly unimplementable but, equally, there could also be many which, to some greater or lesser extent address the problem. However many adequate solutions are found, only one can be implemented.

The world the geometric designer lives in revolves around the movement of people and freight in a manner that is convenient, affordable, safe and with minimum side effects.

The Compleat Geometrician

Techniques to find answers to these questions lie in the field of Transportation Engineering about which the geometric designer cannot be totally ignorant.

The compleat geometrician must be able to carry out Capacity and Level of Service analyses so that he or she can say with confidence, “Here we need a six-lane freeway. Over there, a two-lane two-way road will be fine and back there a piece, we could get by with a gravel road.”

The Compleat Geometrician

The gravel road is, of course, not something to be dismissed lightly. Sight should not be lost of the fact that the bulk of the South African road network is, in fact, gravelled. Don't think that gravel roads are easy to design – they're not.

Minimum side effects suggest that, for preference, the environment should not be wrecked in the process of creating the ultimate in freeways. The compleat geometrician requires more than just a little environmental sensitivity.

The Compleat Geometrician

Everyone will no doubt feel comfortable with the word "safe". We know what we have to do to design a safe road. Design to the standards and you've got safety – right? Wrong. You can design to every last standard in the book and still produce a total disaster.

We need to know something about the limitations of the vehicle we are designing for. More importantly, we need to have an understanding of the limitations of the people we're designing for.

The Compleat Geometrician

In the good old days, we designed for what vehicles CAN do. We now believe it to be more important to design for what people WANT to do.

People may be in vehicles, in which case their performance as drivers is of interest, or outside them. Either way, inside or outside vehicles, the compleat geometrician must be able to model their behaviour to provide a solution. Modelling is part of systems analysis and the types of models we construct fall in the realms of traffic flow theory, about which the compleat geometrician should be reasonably informed.

The Compleat Geometrician

Having acquired all this supporting knowledge and bringing a strongly developed sense of aesthetics to bear on the design, a dream is converted into lines on paper. Pity – we should have told the compleat geometrician about storm water and its management.

To be able to manage storm water, it is necessary to know how much has to be managed and where it is supposed to be taken. This requires some knowledge of hydrology if drainage structures are to be properly sized. The size of required structures is going to have a definite impact on the vertical alignment.

The Compleat Geometrician

Given all the things that the compleat geometrician must know, the final question is "What can we do about it, seeing this course is only two days long?" The short answer is "Not very much". But what we can do is to provide a framework that will serve as the basis on which students can build their own store of expertise over time. Anybody who expects any one topic to be dealt with in great depth is doomed to disappointment.

Urban versus Rural Geometry

The main focus of the course is obviously geometric design and, quite rightly, that is where we are going to be spending the majority of our time.

The person who tells you that a car travelling at x km/h needs y metres to stop regardless of where it is, is telling the perfect truth but is also missing the point completely.

Urban versus Rural Geometry

What one typically finds in the rural environment is relatively low volumes of vehicles moving at high speeds for considerable distances whereas the urban environment is characterised by high traffic flows moving at low speeds.

High speeds require high values of horizontal and vertical curvature. In consequence, cuts and fills several metres high can occur in the rural environment. The lower speeds prevailing in urban areas mean that it is possible to get the vertical alignment closer to ground level.

Urban versus Rural Geometry

Intersections in the rural environment are spaced at anything up to kilometres apart and their effect on the smooth flow of traffic is minimal. Urban intersections are closely spaced and can be as little as 100 metres apart.

Competing activities, i.e. activities other than vehicle movement that also require a share of the road space are just about zero in the rural areas. Whether in a vehicle or walking, everybody on the road is going somewhere.

Urban versus Rural Geometry

In the rural environment, differences between the various vehicles found on the roads are, generally, not critical.

In the urban environment physical dimensions of vehicles start to play a role simply because they are that much closer to each other. An articulated vehicle takes about as much space as three passenger cars.

Urban versus Rural Geometry

The urban designer must be aware of the operational differences between vehicles. In addition, modes of travel become a serious consideration in the urban environment.

Historically, this problem was addressed by providing more infrastructure. If we were to continue in this mode, all buildings ultimately would be destroyed and cities converted into endless seas of bitumen.

Urban versus Rural Geometry

It is necessary to consider demand. For an unaltered number of person trips, vehicle trips could be slashed by their taking place through the medium of buses. One bus could take the place of a queue of passenger cars that is three-quarters of a kilometre long.

Using the bus as the design vehicle for a road or street also suggests that maximum gradients and minimum curve radii are going to be a critical feature of its location. The rural designer is not beset by this problem.

Urban versus Rural Geometry

Storm water drainage in the rural area simply means getting excess water off the road as soon as possible and providing culverts or bridges to accommodate cross-flows that are already concentrated in water courses. In the urban area, the road reserve is, in fact the conduit for storm water transported from surrounding areas.

The approach to storm water drainage differs totally between the rural and the urban environment.

Urban versus Rural Geometry

What has been described so far is the operational difference between the urban and rural environments. As can be seen, the differences are legion. This does not mean that urban design is necessarily more complex than rural design. The fact of the matter is that the two have different sets of problems and, correspondingly, call for different approaches.

Urban versus Rural Geometry

By now it should be clear that urban and rural geometric designs are two totally different animals. The reason for drawing this distinction even before the course has properly started is that, as the course progresses, we are not going to be dwelling on these differences in any great detail but will rather be focussing on the principles that govern design.