

CHAPTER 1
INTRODUCTION

The Research on the Interrelationships Between Costs of Highway Construction, Maintenance and Utilization (PICR) was conducted in Brazil to provide a fundamentally new data base for estimating the economic benefits and costs of alternative highway design and maintenance standards. The measurements made to create this data base required the use of over US\$750,000 of equipment. Because of the dimensions and the innovative aspects of the Research many of these instruments had to be modified and/or modernized *in loco*. Other instruments were quite original and were designed and constructed specially to suit new needs.

The purpose of this Volume is to give the reader a brief description of the instruments used in the project, including explanations regarding what they measure, why they were selected, their accuracy, how they were used, and their reliability. The reader will also be referred to more detailed information concerning technical aspects of the equipment and to reports explaining how the various devices were used to collect data in the field by the research team.

At the outset of the project few instrumentation facilities existed. GEIPOT provided a large parking garage which was modified to provide shops and laboratories with work benches and storage cabinets. The workshop is described in a Project Instrumentation Memo (Buller, "Workshops"). As project equipment was gathered and delivered to the Texas Research and Development Foundation (TRDF), it was checked out and forwarded to Brazil by the international staff instrumentation engineer. By March of 1976, the bulk of equipment had been purchased and shipped, and the international staff instrumentation engineer joined his counterpart in Brasilia. Subsequent equipment and spare parts were handled by TRDF's Texas staff.

All of the test and measurement equipment required for the project was purchased in the United States. Other difficult-to-obtain or expensive items needed for the project were also purchased and shipped to Brazil. During October, 1975, the core of the Instrumentation Group was hired and its training initiated. The Instrumentation Group was one of the smaller study groups in terms of manpower, with three electronics engineers, one electronics technician, two electrical technicians, a carpenter and a mechanic.

Many of the measurement devices were designed and built by the Instrumentation Group to meet particular project needs when no such devices were commercially available. Such cases are identified in the

ensuing chapters, and detailed fabrication information is presented in the referenced working documents.

The location of the project headquarters in Brasília caused the Instrumentation Group some inconvenience, since Brasília is not an industrial city and therefore has virtually no demand for the type of materials and spare parts that such a team required. The purchase of these items in Rio de Janeiro or São Paulo proved infeasible because of administrative problems. Consequently, many items were imported through the auspices of the United Nations Development Programme, in cooperation with the Brazilian Government.

The rural roads on which the instruments were required to operate were decidedly detrimental and caused severe damage. Vehicles travelling over unpaved roads received onslaughts of dust in the dry season and mud in the wet season. At times, temperatures in full sunlight exceeded 40°C. The research teams required data from the roughest road surfaces available, exposing the instruments to considerable abuse.

The project was divided into three main research groups which hired and administered their own data gathering force. Since there is normally little demand for such technicians and operators in Brasília, it was difficult to locate qualified people for these positions. The volume and variety of data collected made it impossible for a senior researcher to always be present during data collection. This caused some unnecessary abuse to equipment, and on occasion resulted in incorrect data, requiring data collection efforts to be repeated.

Despite such difficulties, a trained and experienced Brazilian staff was formed to undertake the project and which is prepared for future work. Most of the project equipment survived the hard use and was adapted as necessary to serve in the test environment. The equipment assembled during this project was reconditioned and stored in Brasília in October, 1979, to serve in future research.

A description of the project instrumentation follows. This Volume is organized as much as possible into types of measurements, such as those of road roughness, fuel consumption, and vertical and horizontal geometry.