Centre d'Etudes et de Recherches de I Industrie du Beton. Manufacture
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SOFTWARE FOR DESIGNING ROADS PAVED WITH CONCRETE BLOCKS AND FLAGS IN FRANCE

WHAT, WHY, HOW ?

ABSTRACT

Although the fact is often unknown of the public, road design requires calculation in the same way as other civil works.

It has long been a common misconception that the structural design of road projects for low or moderate traffic is less important than heavily trafficked roads and this aspect has often been overlooked. But it should be stressed that close to 90% of the French road network is for low or very low traffic densities.

Given this proportion it represents and the corresponding economic importance, this sector of road building obviously deserves special attention.

It is the reason for which the CERIB (Centre d'Etudes et de Recherches de 1'Industrie du Beton) has developped a specific software for designing roads paved with concrete blocks and flags. This paper gives the principal characteristics of this software.

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WHAT, WHY, HOW ?

WHAT ?

Simple, fast and inexpensive computer software for caculating, optimizing and appraising the design of low and moderately trafficked roads.

The software developed by the Centre d'Etudes et de Recherches de 1'Industrie du Beton (CERIB) runs on IBM-PC compatible computers using 3"1/2" or 5"l/4" diskettes. It is designed to :

- Facilitate the optimum choice of surfacing

- Calculate aggregate traffic throughout the lifetime of the pavement

- Help in choosing the type of road-foundation materials

- Calculate the advisable thickness of the road foundation

- Edit the corresponding design calculations, if required.

FIELDS OF APPLICATION FOR THE SOFTWARE

♦ *"PAVING BLOCK" PROGRAM*

- Paved with concrete blocks bearing the "NF" mark (this mark guarantees the product's conformity with French standard P 98-303, "Concrete Paving Blocks").

- Made in accordance with *Fascicule 29 CCTG** - Works - Construction - Maintenance of roads, squares, and other public places paved with concrete or natural-stone blocks (setts) or flags.

- Subject to traffic up to T3+ (150 HGVs with payload of more than 5 tonnes per day and per direction of traffic, as per *SETRA*** classification).

- Made with the following road-foundation materials : unbound graded aggregate, emulsified fraded aggregate, graded aggregate with hydraulic binders or cement concrete.

♦ *"PAVING FLAG" PROGRAM*

The roads concerned are :

- Paved with concrete flags bearing the "Qualif-IB" mark (this mark guarantess the product's conformity with specifications issued by the *Federation de Findus trie du Beton (FIB)).*

- Made in accordance with *Fascicule 29 CCTG** - Works - Construction - Maintenance of roads, squares and other public places paved with concrete or natural-stone blocks (setts) or flags.

- Subject to traffic of 60 vehicles with wheel loading no more than 6,5 tonnes per day and per direction of traffic, in accordance with the *"Guide de conception et realisation des chaussees de dalles en beton"* issued by the FIB.

- Made with the following road-foundation materials ; unbound graded aggregate, graded aggregate with hydraulic binders or cement concrete.

WHY ?

Although the fact is often unknown to the public, road design requires calculations in the same way as other civil works. In France, in the case of heavily trafficked roads, these calculations are generally performed by SETRA or private design offices.

It has long been a common misconception that the structural design of road projects for low or moderate traffic is less important and this aspect has often been overlooked. But it should be stressed that close to 90% of the nations's road network is for low or veiy low traffic densities.

** General Technical Specifications applicable to public works contracts*

*** Service d'Etudes Techniques des Routes et Autoroutes*

Given the proportion it represents and the corresponding economic importance, this sector of roadbuilding obviously deserves special attention. And by virtue of their numerous advantages (aesthetics, strength, quality, durability, ease of placement), concrete paving blocks and flags occupy a privileged place in this sector and one that is constantly growing. In response to this need and on the initiative of the Roads and Environment section of FIB, CERIB has developed special design software.

The programs are intended for public and private design offices, project owners, engineers, municipal technical services and product suppliers.

They are easy to use, and result in optimum traffic/paving/structure tradeoffs, thus making for savings in overall cost of roads.

HOW ?

In general terms the design of a pavement structure* involves calculating the thickness of the road-foundation courses so that stresses caused by traffic remain within acceptable levels throughout the design lifetime of the road.

Depending on the type of materials used, the behaviour of the road foundation is described as "FLEXIBLE" (unbound grated aggregate, emulsified grated aggregate) or "RIGID" (grated aggregate with hydraulic binders or cement concrete).

DESIGN PRINCIPLES FOR FLEXIBLE FOUNDATIONS**

Taking traffic, surfacing characteristics and road foundation materials into account, the design principle consists of calculating the required thickness of the road foundation so that the allowable pressure on the subgrade is not reached.

The design criteria are :

- The allowable punching stress in the subgrade when the road is opened

- The allowable stress in the subgrade under normal traffic conditions, taking account of fatigue phenomena

- Deflection of the subgrade under loading

- Minimum construction thickness for the materials used.

* *The term "pavement" is used in its broad sense here, i.e, pvement for moving or parked vehicles or pedestrians (roads, footpaths, car paries, public places, etc*

** *The method is discussed in detail in CERIB technical, publication n° 91, "Etude du comportement structurel des chaussees revetues des paves en beton"*

DESIGN PRINCIPLES FOR RIGID FOUNDATIONS

"RIGID" behaviour features flexural behaviour of the road-foundation similar to that of a slab, inducing tensile stress at the base of the road foundation. Taking traffic, surfacing characteristics, and road foundation materials into account, the design principle involves calculating the road-foundation thickness so that the allowable tensile stress is not attained.

The design criteria are :

- Stress in the subgrate, taking account of fatigue phenomena

- Allowable tensile stress in the road foundation, taking account of fatigue phenomena

- Acceptable deflection of the subgrade under loading

- Minimum construction thicknesses for the materials used.

The method is based on that developed by SETRA and adapted by CERIB for application to concrete block and flag paving.