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Preface

In May 1970, the Central Treaty Organization Economics Committee Council for Scientific Education and Research, Scientific Coordinating Board, sponsored a panel meeting on regional cooperation for research in highway engineering at the University of Tehran. In the course of this meeting which was attended by highway engineers representing Iran, Pakistan, Turkey and the United Kingdom, the panel recommended establishment of an effective means for disseminating information on road research to highway engineers in the three local Cento countries. In November 1970, Dr. M.L. Smith, Secretary, Cento Scientific Coordinating Board, proposed establishment of a Road Research Documentation Centre. Also, he suggested that this center be established at the Iranian Documentation Centre, that a serial bibliography of road research be published, and that Cento funding be used to support the Road Research Centre. Consequently, the Centre was established in the Iranian Documentation Centre Reference Department, and plans were made to acquire a large number of serials as well as index and abstract publications containing scientific papers in this field. Finally, plans were made to publish a semi-annual bibliography of road research, and the present volume is the first issue.

This bibliography includes all books and general papers concerning highway research which the Iranian Documentation Centre has been able to acquire thru Cento and other channels. Only material actually on file at the Iranian Documentation Centre is included. The material is classified according to the Universal Decimal Classification. If available, abstracts of the material are given.

Subscription to this bibliography can be obtained free of charge by sending a written request to the Publications Department, Iranian Documentation Centre, P.O.Box 11-1387, Tehran, Iran. Photocopies of the originals of the bibliographic items listed here are available from the Iranian Documentation Centre at a cost of 5 Rials (7¢) per page.

614.8 *Accident: Prevention, Protection, Safety Measures.*

Quenault, S.W.

Driver Behaviour-Safe and Unsafe Drivers.

Road Research Laboratory Ministry of Transport, RRL Report
LR 70, 1-58

Two groups of 10 car drivers were given a picture-test, the Shipley Abstraction test and the Maudsley Personality Inventory; these subjects also drove in their own cars around a 12-mile route under normal traffic conditions, accompanied by two observers who tape-recorded their observations on certain aspects of the subject driving behaviour as they drove.

One group of subjects consisted of drivers who had been convicted of Careless driving (C Group); the other group consisted of drivers selected at random (R Group). The only significant differences found between these two groups of drivers on all the tests used were with respect to four drive indices, derived from observation of driver behaviour. These four indices were-the frequency of occurrence of unusual manoeuvres, the frequency

of occurrence of near-accidents, the ratio of rear-view mirror usage to manoeuvres and the ratio of overtaking to being overtaken.

On the basis of these four drive indices, a tentative classification of drivers into four sub-groups was set up, the four subgroups being-safe, injudicious dissociated active and dissociated passive. Numbers of drivers in each sub-group were, respectively-C-18,6,8, 18 and R-36,3,3,8

The office of Research and Development Bureau of Public Roads.

Erosion Control, Safety, and Esthetics on the Roadside-
Summary of Current Practices.

Public Roads, 1970, 36(2), 29-43+47

Turf, an indispensable element of the highway, is almost as important as good design to control erosion and provide the roadside conditions necessary for safe highway travel.

Properly developed, grasses and native species also provide a bonus for the highway user-a complete highway that is esthetically desirable and pleasing. Current practices used to establish grasses, encourage natural regeneration, and manage roadside turf are summarized by the author who also reviews turf uses and design elements of cross section, grade, and earth stabilization.

U.S. Department of Transportation.

Second Annual Report to the Congress on the Administration of the High Safety Act of 1966, For the Period January 1, 1968 to Dec. 31, 1968. vol. 1 & 2

Washington: 1969

Wall, J.G.R.N. Kemp and Harris, J.

Comparative Head-on Impact Tests of Cars with either Front Transverse or Rear Mounted engines.

Road Research Laboratory, RRL Report LR 155,1-119

The Impact performances of three models of car with front engines (transversely mounted) and front wheel drive and three models with rear engines and rear wheel drive have been determined by driving them head-on into a massive concrete barrier. Dummy occupants provided with different types of safety belt were carried in fifteen of the total of sixteen cars.

The shape of the deceleration-time curves of all but one model approximated to a half-sine wave which is probably the best that can be achieved in practice; the exception was one model of rear engined car.

The transverse engines of the front wheel drive cars did not penetrate the passenger compartment and there was little penetration of the steering column into the passenger compartment because the steering boxes were inclined fairly steeply. There was however some dis-

tortion of the floor in the area near the feet of the front seat occupants.

The front ends of the rear engined models tended not to be stiff enough to give optimum energy absorption. When the front was crushed, either the structure suddenly became extremely rigid or deformation of the passenger compartment started to occur. Excessive intrusion into the passenger compartment of the steering column occurred in two models.

620 *Material Testing.*

See UDC. 624.1 & 666. 97 & 691.32

622 *Mining and Mineral Dressing.*

Bond, Fred. C.

Studies in Crushing and Grinding.

Cement, Lime and Gravel, 1971, 46(2), 42-43

624.012 *Concrete Structures.*

Nagaraja, R. and Lash, S.D.

Ultimate Load Capacity of Reinforced Concrete Beam-and-Slab Highway Bridges.

Journal of the American Concrete Institute, 1970, 67(12), 1003-1010

A procedure for estimating the ultimate load capacity of reinforced concrete beam-and- slab highway bridges of moderate span is described. This procedure takes into account the resistance provided by bending hinges, torsional hinges, and slab yield lines. Mechanisms of failure are proposed, and ultimate load tests of 1/10 and 1/4 scale models demonstrated that these mechanisms are in fact developed if secondary failures, particularly those caused by the interaction of shear and torsion, are prevented. The ultimate load capacity of a beam-and-slab bridge may be predicted with reasonable accuracy using assumed mechanisms of failure and ultimate strength design methods.

Tamberg, K.G. and Smith, Peter.

System for Strength Evaluation of Concrete Bridge.

Journal of the American Concrete Institute, 1970, 67(11),
888-894

A logical framework is developed for the strength evaluation of existing concrete bridges. To establish estimates of the physical conditions of a structure, any distress present is taken into consideration by determining its cause and effect to date, and likely rate of progression. Using analytical or analytical and experimental means, the strength of the structure can then be evaluated, and load ratings specified as a function of time.

See UDC. 624.2 & 625.7

624.1 *Substructures. Earthwork. Foundations. Tunnels.*

Grimer, F. J. and Krawczyk, J.

Relations between Strength and Age for Soil-Cement,
with Particular Reference to the Prediction of Later
Strengths from Earlier Strengths.

Magazine of Concrete Research, 1963, 13(43), 21-28, 29-30

The relations between strength and age were determined for four soils stabilized with cement for a range of cement contents, moisture contents and cement consignments. Two methods of predicting the 7-and 28-day strengths of cement-stabilized soil from the 1-and 2-day strengths were examined: prediction using a mean ratio of later to earlier strength; prediction by graphical extrapolation from 1-and 2-day strengths. It was concluded that, with both methods, determinations of early strength would provide a satisfactory estimate of later strengths for many soils, and that stabilization works might often be controlled more effectively by an early strength than by a 7-day strength.

624.2 *Bridge Construction.*

Gifford, F. W.

Test on a Prestressed Concrete Hollow-Box Bridge Deck.

Magazine of Concrete Research, 1961, 13(39), 149-156

Hollow-box pre-tensioned beams laid side by side and held together transversely by prestress or other means are advocated for bridge decks of spans from 30 up to about 90 ft. A detailed account is given of tests on a one-third scale model of a 30 ft span. Comparisons, both general and with reference to tests by the Cement and Concrete Association, are made with the type of deck comprising inverted T beams transversely reinforced and completed with in situ concrete above.

Gifford, F. W.

Tests on a Prestressed Concrete Hollow-Box Bridge Deck.

Magazine of Concrete Research, 1962,14(41),119-120

Cusens, A.R. and Abbasi,A.F.

The Influence of Transverse Prestress on the Strength of Prestressed Concrete Bridge Slabs.

Magazine of Concrete Research, 1963,15(44),107-114

The paper describes the results of tests on eight square prestressed concrete slabs having unbonded wires. The ratio of transverse prestress to longitudinal prestress(λ) was varied between 0 and 100%. A system of wheel loads based on AASHO specifications was used and it was found that, for the upper range of values of λ , ultimate loads were considerably in excess of those predicted by the use of yield-line theory. It is sugges-

ted that at least part of this increased load capacity could be utilized if a suitable design criterion were adopted.

Tamberg, K.G. and Smith, Peter.

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The Bureau of Public Roads.

Effect of Absorptive form Liner on Surface Durability of Concrete.

Public Roads, 1970, 36(3), 53-59+68

At one time it was believed that research had established absorptive form liner (AFL) as the technique needed to produce architecturally-pleasing, dense, hard concrete surfaces that are more resistant to freezing and thawing and to mechanical abrasion than surfaces

formed otherwise. Even though much research data supported the practicality of AFL and specifications were developed for its application by industry, this promising advance in concrete technology was never fully implemented.

The state-of-the-art summary presented here reviews much of the research that established AFL as a worthwhile method of concrete casting and ~~restates~~ the physical properties of concrete cast against absorptive form liners that were presented in reports from both research and construction projects. The author presents a case for further research on AFL, particularly to determine absorptive performance of form liners used on highway pavement and bridge deck surfaces.

625 *Railway and Highway Engineering.*

Ministry of Transport, Road Research Laboratory, Tropical Section.

List of Research, Laboratory and RRL Technical Notes,
Papers and Publications on Roads and Road Traffic in
Tropical and Sub-Tropical Countries Issued to April,
1968

RRL Technical Note TN 289, April 1968, 1-40

This Note lists the various notes, reports, bulletins and other publications issued by the Road Research Laboratory about roads and road traffic in tropical

and sub-tropical countries to April 1968.

Nelson, Harold E.

Concrete in Chicago's Rapid Transit System.

Journal of the American Concrete, 1970, 67(1), 1-6

Describes two of the uses of concrete in the development of a rapid transit system for Chicago, Ill. The use of median right-of-ways in existing expressways required special barriers in certain locations to protect people and property from possible harm due to automobile accidents. A precast unit that was selected for this purpose is described. Wood ties for the tracks were difficult to obtain and expensive. The search for alternates is discussed and two type of concrete ties were investigated. The ties are described and the manufacture of the tie chosen is discussed.

New Method of Classifying Commercial Traffic.

Municipal Engineering, 1970, 147(46), 2314

The Office of Traffic Operations.

Photologging-an Aid to Highway Engineering

Public Roads, 1970, 36(4), 69-74+91

Photologging, a photographic process that can be used to acquire visual data on the highway and roadside (a photolog) has captured the interest of highway

officials and engineers in many State highway departments. Because of this interest the study reported in this article was conducted to evaluate this rather new technique and to determine what types of equipment are suitable for the purpose, as well as what problems are likely to be encountered by those intending to produce photologs.

To distinguish between the different types of cameras and other equipment used in the study, equipment names and model numbers are given. The mentioning of any product is not to be construed as an endorsement of that product, as comparisons of the different makes of equipment were not intended.

See UDC. 666.97

625.7 *Highways, Roads.*

Bicknell, D.A. et al

All Comers, All Day from All Over London.

Municipal Engineering, Supplement: Car Parking, 1970

11 Dec., s2640+42

Greater Efficiency Could Save 10 per Cent on Costs.

Municipal Engineering, 1970, 147(45), 2271

Millard, R.S.

Road Planning in Developing Countries.

Road International, 1969, (64), 28-34

Morrell, Brian

Big Change in Road Note 29 is the Loading Parameter.

Municipal Engineering, 1971, 148(4), 121

Morrell, Brian.

Marshall Report May Be Late But It's Worth the
Struggle.

Municipal Engineering, 1970, 147(47), 2435

Nagaraja, R. and Lash, S.D.

Ultimate Load Capacity of Reinforced Concrete Beam-
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Russell, B.C. M.Sc., A. M. Inst. H.E.

Assessment of the Cost/Benefit Ratio for Road Improvements in Developing Countries.

The Journal of the Institution of Highway Engineers, 1970, 31-34

Taylor, Alonzo.C.

Highway Planning in Developing Countries.

World Highway, 1969, 20(12), 18-21

The Office of Development.

Photogrammetry for Highway Planning, Location and Design-Review of Current Methods.

Public Roads, 1970, 36(4), 83-87+91

Some of the ways in which aerial photogrammetry is used for highways and some of the problems associated with large scale map compilation are discussed in this summary of photogrammetric practices. The author reviews procedures for route selection and topographic mapping, and discusses the more recent technique of strip analytical aerial triangulation using wide angle photography in terms of highway engineering needs.

The Office of Research and Development Bureau of Public Roads.

State Highway Department Management Part.1-Organization.

Public Roads, 1970, 35(12), 265-278+286

Beginning with this issue, the Public Roads research staff will report on management studies that were conducted in several States to upgrade the quality of highway administration. The findings that related to the organization, or structure, of the highway departments surveyed in the studies are reported in this part. Findings on other aspects of highway-department management will be presented in future issues.

It is hoped that all State highway departments will be motivated to modify and adapt those findings that may be suitable for specific application.

The Office of Research and Development Bureau of Public Roads.

State Highway Department Management Part 22-Training and Manpower Development.

Public Roads, 1970, 36(1), 9-15

This is the second part of a report on management studies that were conducted in several States to upgrade the quality of highway administration. The findings related to highway department organization, or structure, were presented in the February 1970 issue of PUBLIC ROADS, vol. 35, No. 12. Additional findings of other aspects of highway department management will be presented in a future issue.

The information in this part is not intended as a

comprehensive guide for developing training and manpower programs. It reports on the significant findings of the State-conducted studies that might be of general interest to highway department personnel who deal with training and manpower-development matters. Although many of the findings have general application, some are specifically suited to the State that conducted the study.

The Office of Research and Development Bureau of Public Roads.

State Highway Department Management Part 3-Personnel Management.

Public Roads, 1970, 36(3), 60-65+68

This is the third and final part of a report on management studies that were conducted in several States under the Highway Planning and Research program to upgrade the quality of highway administration. The findings related to highway department organization were reported in the February 1970 issue PUBLIC ROADS, A JOURNAL OF HIGHWAY RESEARCH, vol. 35, No. 12, and those on training and manpower development in the April 1970 issue, vol. 36, No. 1.

This final part reports on the findings of the studies that relate to personnel management. The research consultants in the studies uncovered many deficiencies in highway personnel management, but the research was

conducted several years ago, and many highway departments have since implemented the consultants' recommended improvements. Others currently are reorganizing their management functions or plan to do so in the future.

The Office of Research and Development Bureau of Public Roads.

Asphalt Hardening-Fact and Fallacy.

Public Roads, 1970, 35(12), 279-285

Control of asphalt hardening during construction and service of highway pavements will provide longer pavement life and result in better economy. According to the results of a study of 11-to 13-year-old pavements, the mixture design and the mixing, spreading, and compaction of the mixture at the time of construction are probably the most important factors governing the hardening of asphalt.

The Office of Research and Development Bureau of Public Roads.

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Weighing the Pros and Cons of Underground Urban Routes.

Municipal Engineering, 1970,147(42),2125

Wilson, D. G. and Older, S.J.

The Effects of Installing New Zebra Crossings in Rugby and Chelmsford.

Road Research Laboratory Ministry of Transport, RRL Report LR 358, 1-16

Some effects of doubling the number of zebra crossings in Rugby and Chelmsford are described.

The proportion of all drivers stopping or slowing voluntarily for pedestrians on crossings showed no change in the experimental towns after the new crossings were installed and was greater than in the towns used for controls.

Additional studies at four sites in Rugby and three sites in Chelmsford where the new crossings were installed showed that,

- 1) at given sites vehicle journey time tended to be lower with pedestrian flows below about 400 peds/hour, and higher with pedestrian flows above this level, after crossings were installed,
- 2) at given sites pedestrian kerb delay tended to be lower where vehicle flows were more than about 300 vehs/hour, after the crossings were installed,
- 3) pedestrians crossed the road more quickly with the crossings than they did without them.

Pedestrian casualties were little changed in total by the introduction of the new crossings, but there were some inconsistent changes in the location of casualties in the towns studied.

625.8 *Paving of Roads. Wearing Surfaces.*

Kesler, Clyde H. et al

Expansive Cement Concretes-Precent State of Knowledge.
Journal of the American Concrete Institute, 1970, 67, (8),
583-610

This state-of-the-art report outlines the historic

background of the development of expansive cement concretes abroad and in this country, presents the relevant nomenclature, and summarizes the current status of expansive cements in the United States.

The hydration chemistry of expansive cements is described, with emphasis on the components necessary for the formation of ettringite. The important factors in the choice of proportioning of materials are discussed, as well as the products of reaction, and heat of hydration.

Various factors are discussed, which influence the rate and amount of expansion of all three types of expansive cement concretes. These include the chemical composition, fineness and age of cement, water-cement ratio, mixing time, admixtures, aggregates, curing, temperature, restraint, and size and shape of specimens,

The properties of expansive cement concretes are reported separately for shrinkage-compensating and self-stressing concretes. The properties considered include workability, bleeding, time of setting, unit weight and yield, expansion, creep, shrinkage, compressive and bond strengths, modulus of elasticity, Poisson's ratio, coefficient of thermal expansion, and the resistance to various actions (deicer scaling, sulfate attack, cracking, and abrasion). Properties are also indicated on which no data are available at present.

Field performance of shrinkage-compensating concrete is summarized. The influences of restraint, aggregates, additives, ambient temperatures, forms, consistency, finishing, and curing are discussed. Examples of structural installations are presented, which include flat slabs, one-way pan joists, and two-way waffle slabs for parking garages, a folded plate roof for a bank, topping on a prestressed single tee parking deck structure, grade slabs and tilt-up panel walls for a department store, and an industrial floor. Five highway installations are described, including various spacings of contraction joints, continuously reinforced pavement as well as an unreinforced one, an application of self-stressing concrete, and the use of two bridge decks. The results of 17 tests on laboratory made structural elements of self-stressing concrete are summarized. These include tests on pipes, slabs, beams, frames, columns, and hyperbolic paraboloid. A brief review is given of some overseas experience.

Needed areas of research and development are discussed with respect to expansive cements, material properties and behavior, and applications. An extensive bibliography is presented.

The Bureau of Public Roads.

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The Office of Research.

Soil-Portland Cement Thickness Design-Summary of
Current Practices.

Public Roads, 1970, 36(4), 75-82+91

Highway Research Board Committee A2J04, Soil- Portland Cement Stabilization, sponsored a conference session on soil-cement thickness design at the January

1970 annual meeting. In an effort to bring together the latest information, the authors conducted a survey and compiled a summary on current practices for thickness design of soil-cement or cement-stabilized materials. This summary was presented and discussed at the conference session.

In this article the content of the questionnaire used in the survey is presented, and the authors review the current practices of agencies concerned with thickness design and construction of cement-stabilized layers for pavements.

656 *Land Transport (Road and Rail)*

Blackmore, F.C.

Capacity of Single-Level Intersections.

Road Research Laboratory, 1970, (RRL Report LR 356), 15pp.

Full-scale experiments on the Road Research Laboratory track and on public roads have shown simple and economical ways of improving the capacity of, and reducing delays at, single-level junctions of a given size.

With any method of control the highest capacity in a given area was achieved with a layout providing the greatest width for each movement particularly at the point of entry into the junction.

At 4-way intersections with traffic signals the best results were obtained with non-hooking right turns and cycle times shorter than one minute.

With the priority-from-right rule the highest capacity was obtained with a marked deflection of the traffic to the nearside on entry and a very small roundabout central island.

The track experiments at 4-way symmetrical intersections with symmetrical traffic demand have shown little difference in the capacity obtainable with the best traffic signals or offside priority arrangements.

The public road experiments at 3-way, 4-way and 5-way junctions, previously controlled by traffic signals or conventional roundabouts, have shown improvements ranging from 20 to 35% within the same outer kerbline. This was achieved with a roundabout central island smaller than one-third of the circle inscribed within the outer kerblines and entrances brought forward to afford a greater width.

Booth, Michael L. CEng.

Helping to Keep Drivers on the Right Lines.

Municipal Engineering, 1971, 147(5) 159-160

Hosea, Harold R. and McDonald, J.N.

Fatal Collisions with Fixed Objects on Completed
Sections of the Interstate Highway System, 1968.

Public Roads, 1970, 36(1), 9-15

Meyer, John R.

Economic Development: Advanced Technology for Poor
Countries.

American Economic Review, 1966, 71(2), 83-90

Ministry of Transport, Road Research Laboratory, Tropical Section.

List of Research, Laboratory and RRL Technical Notes,
Papers and Publications on Roads and Road Traffic
in Tropical and Sub-Tropical Countries Issued to April,
1968.

RRL Technical Note TN 289, April 1968, 1-40

Morrell, Brian.

Optimism has Ousted Uneases at Road Research Laboratory.

Municipal Engineering, 1971, 148(1), 8

Morrell, Brian.

Is huge Investment the Last Chance for Public Transport.

Municipal Engineering, 1971, 148(3), 81

Morrell, Brian.

Cheaper Aggregates Would Help Cut Skid Accidents.

Municipal Engineering, 1970, 147(51), 2667

Nelson, Harold E.

Concrete in Chicago's Rapid Transit System.

Journal of the American Concrete, 1970, 67(1), 1-6

Describes two of the uses of concrete in the development of a rapid transit system for Chicago, Ill. The use of median right-of-ways in existing expressways required special barriers in certain locations to protect people and property from possible harm due to automobile accidents. A precast unit that was selected for this purpose is described. Wood ties for the tracks were difficult to obtain and expensive. The Search for alternates is discussed and two types of concrete ties were investigated. The ties are described and the manufacture of the tie chosen is discussed.

Second Amendment to Bulletin No.2

Roading in the National Economy.

Insert Issued with Australian Road Research, Dec 1969

The Office of Traffic Operations Bureau of Public Roads.

Relationship of Fatality Rates and Fatal Accident Rates to Travel Densities on the Interstate System.

Public Roads, 1970, 36(2), 48-49

The Office of Traffic Operations.

Photologging-an Aid to Highway Engineering .

Public Roads, 1970, 36(4), 69-74+91

Photologging, a photographic process that can be used to acquire visual data on the highway and road-side (a photolog) has captured the interest of highway officials and engineers in many State highway departments. Because of this interest the study reported in this article was conducted to evaluate this rather new technique and to determine what types of equipment are suitable for the purpose, as well as what problems are likely to be encountered by those intending to produce photologs.

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The Office of Planning Bureau of Public Roads.

Travel by Motor Vehicles in 1968 and Related Data.

Public Roads, 1970, 36(1), 9-15

The Office of Research and Development Bureau of Public Roads.

Driver Judgments as Influenced by Vehicular Lighting at Intersections.

Public Roads, 1970, 36(1), 1-8+15

The effects of headlight glare on drivers' judgments

and decisions at a right-angle, nonsignalized intersection were examined in an experiment conducted in a dark rural environment on an airport runway. Twenty male drivers, in two age groups of 10 drivers each, were exposed to different degrees of glare from both conventional and polarized headlights and were asked repeatedly either to judge the last safe moment to start across the intersection ahead of an approaching test vehicle on the crossroad or to actually perform the crossing maneuver.

Statistical analyses of the results of the experiment, reported here, indicate that different lighting modes produced significant differences in drivers' reactions. Under the more glaring conditions, longer gap-acceptance times were required, and there was more variance in the data. According to the drivers' evaluations of glare discomfort, the two polarized high-beam systems studied were superior to conventional high beams, but conventional low beams were least bothersome.

The Office of Research and Development Bureau of Public Roads.

How Drivers Locate Unfamiliar Addresses- an Experiment in Route Finding.

Public Roads, 1970,36(2), 44-47

656.1 *Road Transport.*

Capelin, M.A.

Sophisticated Complex Will House 6000 Vehicles

Municipal Engineering .Supplement: Car Parking, 1970,
11 Dec., s2637+39

Cave, F. J. et all

How Westminster Deals with Its Commuter Drivers.

Municipal Engineering. Supplement: Car Parking, 1970
11 Dec. s2633-35+37

Glanville, John. et all

Cologne's Approach a Model for Other European Cities.

Municipal Engineering .Supplement: Car 1970, 11 Dec.,
s 2629-32

Lee, A J.A. e

Meters' Limited Contribution to Off-Street Car-Parks.

Municipal Engineering. Supplement: Car Parking, 1970, 11 Dec
s2642+45

Raip, R. J.

Catering for the Motorist at the Design Stage.

Municipal Engineering. Supplement: Car Parking, 1970, 11
Dec., s2646+48

The Office of Research and Development Bureau of Public Roads.

Asphalt Hardening-Fact and Fallacy.

Public Roads, 1970, 35(12), 279-285

Control of asphalt hardening during construction and service of highway pavements will provide longer pavements life and result in better economy. According to the results of a study of 11-to 13-year-old pavements, the mixture design and the mixing, spreading, and compaction of the mixture at the time of construction are probably the most important factors governing the hardening of asphalt.

Young, J.F.

Hydration of Tricalcium Aluminate with Lignosulphonate Additives.

Magazine of Concrete Research, 1962, 14(42), 137-142

Lignosulphonates modify the hydration of tricalcium aluminate: acicular crystals form instead of the usual hexagonal plates, and by X-ray diffraction, DTA* and optical data it has been shown that these can represent more than one hydration product. The differences in reaction products are attributed to small changes in hydration conditions. In pastes of tricalcium aluminate, C_2AH_8 and C_4AH_{13} crystallize with a new crystal habit, rather than forming a new hydrate. Current theories explaining the effect of lignosulphonates on the mechanical

strengths of concrete are discussed.

666.92 *Lime, Chalk and Magnesia Products.*

Midgley, H.G.

Hydrothermal Reactions in the Lime-Rich Part of the
System $\text{CaO-SiO}_2\text{-H}_2\text{O}$

Magazine of Concrete Research, 1960,12(34)

The mineralogy of autoclaved products from various forms of calcium silicate and from lime and silica has been investigated. The results are as follows. With a CaO/SiO_2 ratio of 1, the product is always well crystallized tobermorite. With a CaO/SiO_2 ratio of 2, the product varies: starting with lime and silica, dicalcium silicate alphahydrate is the first product; this eventually changes into dicalcium silicate beta-hydrate, the stable phase; starting with calcium silicate hydrate 1 and lime, the first product comprises Flint's CSH(A) and dicalcium silicate alpha-hydrate, and it seems likely that the Flint's CSH(A) will eventually convert to dicalcium silicate alpha-hydrate and the dicalcium silicate alpha-hydrate to dicalcium silicate beta-hydrate; if one starts with B-2CaO.SiO_2 , the product in the first place is dicalcium silicate gamma-hydrate; in the length of processing used in the experiments reported in this paper, no other phase was found, but it is considered that dicalcium silicate gamma-hydrate is only metastable.

With a CaO/SiO_2 ratio of 3, again the products vary with the starting minerals: with mixes of lime and silica and with mixes of $2\text{CaO}.\text{SiO}_2$ and lime, the first product is dicalcium silicate alpha-hydrate which is eventually converted to the beta-hydrate; with mixes of calcium silicate hydrate (1) and lime the product is always Flint's CSH(A) with or without some dicalcium silicate alpha-hydrate; with $3\text{CaO}.\text{SiO}_2$ as the starting material, the product is always $3\text{CaO}.\text{SiO}_2. 1\frac{1}{2} \text{H}_2\text{O}$.

Som, A.P

Properties of Magnesium Oxychloride Cement.

Cement, Lime and Gravel, 1971, 46(2), 43

666.94 *Cement , and Portland Cements.*

Best, C.H. and Polivka, M.

Creep of Lightweight Concrete.

Magazine of Concrete Research, 1959, 11(33), 129-134

Creep data covering periods of up to 18 months for concretes made with expanded-shale aggregates and having compressive strengths of 3,000 and 5,000 lb/in² at 28 days are reported. These are compared with data for sand-gravel concretes of comparable strength. It was found that, contrary to current

opinion, creep in light-weight concrete was essentially equal to or less than that in normal-weight concrete of comparable strength.

The aggregates used in this investigation are typical of expanded-shale aggregates and natural sand-gravel aggregates available on the west coast of the United States, and the results may, therefore, not be directly applicable to materials available in other countries or in other parts of the United States. However, since the three expanded-shale aggregates used are typical of products that can be obtained by sintering clays and shales to incipient fusion, the results reported should be generally applicable to concretes containing such aggregates.

A Brief description of the hydraulic loading equipment used in the creep tests is included. The equipment performed satisfactorily throughout this investigation with very little maintenance; it may be expected to perform similarly at any stress level normally encountered in creep studies. Some brief comments relative to the merit of current techniques for studying creep in concrete are made, and a new approach to the problem is suggested.

Chatterji, S. and Jeffery, J.W.

A New Hypothesis of Sulphate Expansion.

Magazine of Concrete Research, 1963, 15(44), 83-86

On the basis of published data and their own observations, the authors suggest that sulphate expansion is caused by the solid state conversion of C_4AH_{13} to calcium aluminate monosulphate and that this expansion may or may not be accommodated depending on the concentration of lime in the liquid phase.

Hansen, Torben C.

Physical Composition of Hardened Portland Cement Paste.

Journal of the American Concrete Institute, 1970, 67(5)

404-408

Formulas are presented from which numerical values for the physical composition of hardened portland Cement paste can be determined. These formulas are based on earlier work by Powers. A numerical example is given for an ordinary portland cement paste.

See UDC. 624.1 & 625.8 & 666.95

666.95 *Pozzolanic materials. Sulphate and trass cements*

Jaromir Jambor, Dr Ing.

Relation between Phase Composition, over-all Porosity and Strength of Hardened Lime-Pozzolana Pastes.

Magazine of Concrete Research, 1963, 15(45), 131-142

By means of X-ray analysis, differential and gravimetric thermal analysis, electron microscopy, and chem-

ical analysis, the main hydration products of 22 pastes made from lime and various pozzolanic materials and hardened in water for 400 days were found to be calcium hydro-silicates of the tebermerite group (approximate formula $C_{0.8-1.1}S.H_{0.9-1.5}$) and Strating's compound, C_2ASH_n . A formula is developed giving the compressive strength of the pastes in terms of the volume of the hydration products produced.

666.97 *Mortars. Concrete*

Baker, A.L.L.

An Analysis of Deformation and Failure Characteristics of Concrete.

Magazine of Concrete Research, 1959, 11(33), 119-128

The paper shows that the aggregate grading and compaction required for strong concrete produce an internal structural system which approximates to a series of lattices in two directions at right-angles. The diagonal members of the lattice are stiffer than the cross members, which represent the mortar in the "voids", bonded to the diagonal members. The idealized system is analysed in terms of the relative stiffness of the lattice members, and equations are derived and curves plotted from which Poisson's ratio is related to stiffness ratios for various values of the ratio of axial compression to transverse tensile strength. The curves give a reasonable explanation of changes in Poisson's ratio and compres-

sive strength due to changes in the secant elastic modulus of mortar due to creep.

The paper also introduces a useful model technique by which the internal structural system of concrete can be represented. Ordinary draper's elastic is used to form a lattice having members of appropriate relative stiffness. The elastic is prestressed to prevent buckling. External compression acting on concrete specimens may be studied as external tension on the model, since changes of internal stresses and strains are sufficient to indicate internal distribution. Such models may be used to obtain the distribution of maximum tensile stresses in a concrete specimen under test, and hence the crack pattern and mode of failure for various shapes and external restraints.

Best, C.H. and Polivka, M.

Creep of Lightweight Concrete.

Magazine of Concrete Research, 1959, 11(33), 129-134

Creep data covering periods of up to 18 months for concretes made with expanded-shale aggregates and having compressive strengths of 3,000 and 5,000 lb/in² at 28 days are reported. These are compared with data for sand-gravel concretes of comparable strength. It was found that, contrary to current opinion, creep in lightweight concrete was essentially equal to or less than that in normal-weight concrete of comparable strength.

The aggregates used in this investigation are typical of expanded-shale aggregates and natural sand-gravel aggregates available on the west coast of the United States, and the results may, therefore, not be directly applicable to materials available in other countries or in other parts of the United States. However, since the three expanded-shale aggregates used are typical of products that can be obtained by sintering clays and shales to incipient fusion, the results reported should be generally applicable to concretes containing such aggregates.

A brief description of the hydraulic loading equipment used in the creep tests is included. The equipment performed satisfactorily throughout this investigation with very little maintenance; it may be expected to perform similarly at any stress level normally encountered in creep studies. Some brief comments relative to the merit of current techniques for studying creep in concrete are made, and a new approach to the problem is suggested.

Buchan, A.R. and Hawkes, J.M

Variations in Concrete Proportions Due to Side Vacuum Treatment.

Magazine of Concrete Research, 1961, 13(39), 141-148

A technique for the analysis of fresh concrete into its constituent parts was perfected. Tests using this

nique were made on concrete which had been subjected to side vacuum treatment to determine the effect of: the duration of treatment; the application of vibration; variations in the initial water/cement and aggregate/cement ratios; redistribution of the water content after treatment. The results indicate that: treatment causes migration of the finer particles (sand and cement) towards the processed face (this is increased if the concrete is vibrated); as the initial water/cement ratio increases, the movement of sand and cement increases, but raising the aggregate/cement ratio decreases the movement of sand; immediately after treatment the water content is non-uniform, with a minimum value at the vacuum face, but gradual redistribution occurs after treatment stops.

Dougill, J.W.

The Effects of Thermal Incompatibility and Shrinkage
on the Strength of Concrete.

Magazine of Concrete Research, 1961, 13(39), 119-124+125-126

The effect of shrinkage of the mortar on the strength of a concrete specimen is demonstrated by means of a lattice analogy for concrete. The strains due to the thermal incompatibility of the cement paste and the aggregate in a concrete heated to high temperatures are taken as a particular example and it is shown that the results deduced from the lattice agree closely with those obtained experimentally by other workers.

The limitations of the lattice approach are discussed; it is emphasized that the method is qualitative and that any extension to give quantitative results would be most unlikely to be successful.

Dougill, J.W.

The Effects of Thermal Incompatibility and Shrinkage
on the Strength of Concrete.

Magazine of Concrete Research, 1962,14(41), 117-118

Green, H. and Roberts, A.B.

A Note on the Effect of Frequency on the Behaviour
of Fresh Concrete During Vibration.

Magazine of Concrete Research, 1963,15(44),115-117

The behaviour of fresh concrete during vibration varies with the frequency of the vibration applied. For each mix there is a particular frequency at which a drastic change in the acceleration of the mould and the mix takes place during vibration with constant power input. The strongest concrete is produced at this frequency of vibration.

James, P.R.

The Design and Construction of a Device for Recording
Small Displacements.

Magazine of Concrete Research, 1961,13(37),37-39

The paper describes the design and construction of

an electro-mechanical device for remote, continuous recording of displacements of the order of one millimetre.

Johnson, Paul, R.

Strength Tests on Scaled-Down Concretes Suitable for Models, with a Note on Mix Design.

Magazine of Concrete Research, 1962, 14(40), 47-53

The paper describes procedures for testing the strength of "scaled-down" concrete mixes suitable for models of concrete structures. The effects of the scale of mix and the size of test specimen on the magnitude and scatter of the results are given in detail. It is concluded that tests on $1\frac{1}{2}$ in. diameter cylinders 3 in. long give a satisfactory measure of the strength of concrete made with aggregate passing a $\frac{3}{16}$ in. sieve. Mix design curves are given for a limited range of mixes of medium workability.

Kaplan, M. F.

The Relation Between Ultrasonic Pulse Velocity and the Compressive Strength of Concretes Having the Same Workability but Different Mix Proportions.

Magazine of : Concrete Research 1960, 12(34), 3-8

Experiments have been made to investigate whether, for concrete of a given workability, the relation be-

tween ultrasonic pulse velocity and compressive strength is independent of variations in age and in mix proportions (i.e. aggregate/cement and water/cement ratios).

It is concluded that, for concrete made of the same type of material, curves relating pulse velocity to compressive strength may be drawn for concrete of the same workability but different mix proportions, provided that the tests are done at the same age. When tests are done at different ages the relation is dependent on both mix proportions age. This dependence is , however, not so apparent at low compressive strengths.

Kaplan, M.F.

The Effects of Age and Water/Cement Ratio Upon the Relation Between Ultrasonic Pulse Velocity and Compressive Strength of Concrete.

Magazine of Concrete Research, 1960, 12(34), 50-51

Keene, P.W.

The Effect of Air-Entrainment on the Shrinkage of Concrete Stored in Laboratory Air.

Magazine of Concrete Research, 1961, 13(38), 55-60

Tests are described comparing the shrinkage of air-entrained concrete with that of concrete of similar workability and strength but without entrained air.

Changes in length of 3 x 3 x 10 in. .prisms were

measured by means of a micrometer screw gauge. Some specimens were cured in moist air for the first 7 days before being transferred to the air of the laboratory; the others were stored throughout in the air of the laboratory. Some time after the specimens had reached maximum shrinkage they were measured for moisture movement.

The conclusions drawn from the results of the tests are that the shrinkage of concrete of medium strength and workability is not significantly affected by air-entrainment, but with or without entrained air the shrinkage is greater for concrete cured in moist air for the first 7 days than for concrete allowed to dry immediately.

Kroone, B. and Crook, D.N.

Further Studies of Pore Size Distribution in Mortars.

Magazine of Concrete Research, 1962, 14(40), 43-46

The method of mercury penetration was used to study the influence of variations in the sand/cement and water/cement ratios on the pore size distributions of mortars, down to pore sizes of 0.01 diameter. It was found that the total volume of the pores with diameters greater than 5 increased as the sand/cement ratio increased, but decreased as the water/cement ratio increased, within the limits of the experiments.

It was also found that the cross-section of the pores became more irregular as the sand content increased, and that at low water/cement ratios an increase of the water/cement ratio tended to produce pores of more regular cross-section.

Larsen, Gunnar.

Microscopic Point Measuring: a Quantitative Petrographic Method of Determining the $\text{Ca}(\text{OH})_2$ Content of the Cement Paste of Concrete.

Magazine of Concrete Research, 1961, 13(38), 71-76

Studies of deteriorated concrete have led to the development of a new quantitative petrographic method of investigation, which has been called the "point measuring" method. In this, the $\text{Ca}(\text{OH})_2$ content of the cement paste is measured at a number of points in thin sections by means of a polarizing microscope fitted with a micrometer eye-piece. The main advantage of this method over the "traditional" methods is that it provides information on both the average value of the $\text{Ca}(\text{OH})_2$ content and its variation in the paste.

McKeen, Robert G. and Ledbetter, W.B.

Shrinkage-Cracking Characteristics of Structural Lightweight Concrete.

Journal of the American Concrete Institute, 1970, 67, (10), 769-778

Tests were conducted to determine the effect of

coarse aggregate type, cement content, and curing environment on unrestrained volume changes and restrained shrinkage cracking behavior. Measurements of restrained shrinkage stress and ultimate tensile strength were made for purposes of comparing these properties with the above characteristics. Two synthetic lightweight aggregates, commercially produced in Texas and having widely different saturation characteristics, were used along with a natural siliceous river gravel as coarse aggregates. After a 5 day initial moist curing period, the specimens were placed in four different curing environments. Unrestrained volume changes were measured on standard type specimens, 3 x 3 x 11.25 in (7.5 x 7.5 x 28.1 cm). cracking was evaluated as the number of cracks occurring on a specimen 4 x 4 x 48 in. (10 x 10 x 120 cm) with a # 8 reinforcing bar through the center.

Using concrete made with one of the lightweight coarse aggregates, specimens were cast for measurement of restrained shrinkage stress. After 60 days, these specimens were loaded to concrete failure in tension and ultimate tensile strength was determined. The effective or usable tensile strength was greatly affected by the curing environment. Results indicated that both unrestrained shrinkage and concrete water loss relate to restrained shrinkage stress. Unrestrained shrinkage did not indicate cracking tendency while water loss provided an indication of cracking tendency.

Meininger, C.

Delivery Time for Ready-Mixed Concrete.

Cement, Lime and Gravel, 1971,46(2),35-40

Murdock, L.J.

The Workability of Concrete.

Magazine of Concrete Research, 1960,12(36),135-144

An analysis is made of a large number of tests for workability as measured by the compacting factor, in order to determine how workability is related to the grading and shape of aggregate, the mix proportions and the water/cement ratio.

An index is developed which takes account of the influence of particle size on workability, and largely overcomes the limitations of the fineness modulus and surface area coefficients. Similarly,, an angularity index is introduced which is based on a test on the aggregate and is shown to take account of its shape.

The relation between workability and mix proportions is assessed. It is established that a proportion of the water, equivalent to a water/cement ratio of about 0.25, is required to wet the cement, and that any additional water may be regarded as available to make the mix workable.

An approximate relation is given for the calculation

of compacting factors, and a worked example illustrates the use of this relation for mix design.

Nelson, Harold E.

Concrete in Chicago's Rapid Transit System.

Journal of the American Concrete, 1970, 67(1), 1-6

Describes two of the uses of concrete in the development of a rapid transit system for Chicago, Ill. The use of median right-of-ways in existing expressways required special barriers in certain locations to protect people and property from possible harm due to automobile accidents. A precast unit that was selected for this purpose is described. Wood ties for the tracks were difficult to obtain and expensive. The search for alternates is discussed and two types of concrete ties were investigated. The ties are described and the manufacture of the tie chosen is discussed.

Newman, K.

The Effect of Water Absorption by Aggregates on the Water/Cement Ratio of Concrete.

Magazine of Concrete Research, 1959, 11(33), 135-142

Tests were made on damp and dry aggregates to discover how the definition of "effective water/cement ratio" is affected by aggregate absorption. Analysis of the results indicates that mixes with saturated river gravel aggregates give higher strengths and compacting

factors than supposedly similar mixes made with dry aggregates. The coating of cement paste considerably reduces the rate of absorption, which ceases when the paste hardens.

The effective water/cement ratio for strength should be based on the free water content available when the paste hardens. This is known more accurately when saturated aggregates are used. For dry aggregates, crushed rock material becomes saturated to the same degree as after immersion in water for 30 min, but for uncrushed river gravels the degree of saturation depends on the amount and consistence of the cement paste.

The effective water/cement ratio for workability is more difficult to define. It can be assumed, provisionally, that initially dry aggregates will have achieved, at the time of the workability test, the same degree of saturation as they would have in water.

These effects of absorption only apply to high-strength mixes. Rich, uneconomical site mixes can be avoided if laboratory trials are based on the effective water/cement ratio as defined in this paper.

Plowman, J.M

Young's Modulus and Poisson's Ratio of Concrete Cured at Various Humidities.

Magazine of Concrete Research, 1963, 15(44), 77-82

Tests are described designed to determine values of E and σ for concretes of various mix proportions and water/cement ratios. The influence of age (maturity) and humidity of curing have also been investigated.

Popovics, Sandor.

Relation Between the Change of Water Content and the Consistence of Fresh Concrete.

Magazine of Concrete Research, 1962, 14(41),99-108

The assumption that a change of consistence in a concrete mix that is due solely to a change of water content is independent of the composition of the mix (type of cement, cement content, original water content, original water/cement ratio, air content, grading and maximum size of aggregate) is tested and shown to be valid within wide limits. This assumption is called "assumption of independence" and its use in the prediction of consistence is called "k procedure".

In the appraisal of this assumption, it is first proven mathematically that the assumption of independence is identical with the assumption that the consistence of concrete is a parabolic function of the water content, and the degree of the parabola is independent of the composition. Then it is shown that for six methods of measuring consistence the experimental results substantiate the existence of such a parabolic relation within wide limits.

A parabolic formula for the k thinning factor is derived, and its numerical forms for six methods of measuring consistence are presented. It is shown for various cases that the use of the k factor in the prediction of consistence is simple and the calculated results are in accordance with experimental data.

Professor Inge Lyse,

The Shrinkage and Creep of Concrete.

Magazine of Concrete Research, 1959, 11(33), 143-150

This paper describes an investigation made at the Laboratories du Batiment et des Travaux Publics at Paris into the principal factors influencing the creep and shrinkage of concrete. The main conclusions drawn are that both creep and shrinkage are directly proportional to the amount of cement paste in the concrete, that creep is directly proportional to the sustained stress, and that both creep and shrinkage are greatly affected by the relative humidity of the atmosphere. Three equations are given from which shrinkage, creep, and total shortening can be calculated.

Sandor Popovics,

General Relation Between Mix Proportion and Cement Content of Concrete.

Magazine of Concrete Research, 1962, 14(42), 131-136

Semi-empirical equations are presented for the

relation between cement content and mix proportion of concrete. Other variables are the consistence, specific gravities of cement and mineral aggregates, grading of aggregate, and air content. The paper shows equations for the case in which only one material is used as mineral aggregate (equations 1-4), and for the more general case in which a blend of two materials is used (equations 5-8). The form of the equations is relatively simple considering the large number of variables involved.

The values calculated from the equations are compared with results of experiments performed by various research workers, and it is shown that there is good agreement between calculated and experimental values.

See UDC. 691.32 & 624.2 & 625.8 & 691.33

681 *Instrument Making. Measuring apparatus.*

See UDC. 666.97

691.32 *Reinforced Concrete.*

Campbell-Allen, D. and Thorne, C.P

The Thermal Conductivity of Concrete.

Magazine of Concrete Research, 1963,15(43),39-48

A simple theory is developed which gives the thermal

conductivity of concrete in terms of the thermal conductivity of its constituents. The predictions of this theory concerning the variation of the thermal conductivity of concrete with moisture content have been tested by experiment and have been found correct; this experimental work covers the effect of moisture content on the thermal conductivity of concrete made with three different aggregates, namely, dolerite, haematite and barytes.

Shirayama, Kāzuhisa.

The Estimation of the Strength of Concrete Made with
Lightweight Aggregate.

Magazine of Concrete Research, 1961,13(38),61-70

In an earlier paper the author proposed an experimental formula for estimating the compressive strength of lightweight aggregate concrete by an extension of Abram's water/cement ratio theory. The present paper describes compressive strength tests performed on concrete made with expanded clay aggregate produced in Norway which show good agreement with the formula. The relations between cube strength and cylinder strength and modulus of elasticity are discussed, and a Table of mix proportions for this lightweight aggregate concrete is proposed.

Snowdon, L.C. and Edwards, A.G.

The Moisture Movement of Natural Aggregate and Its

Effect on Concrete.

Magazine of Concrete Research, 1962,14(41), 109-116

This paper summarizes the background and development of the work carried out at the Scottish Laboratory of the Building Research Station on the quality of concrete prepared from various aggregates. It establishes that many natural crushed rock and gravel aggregates undergo changes of volume, to a greater or lesser extent, as they take up or lose water, and shows how this characteristic influences the shrinkage and durability of concrete in which they are incorporated.

See UDC. 656 & 601.32

691.5 *Building materials. Limes. Mortars. Cements*

See UDC. 666.97

727 *Building for Education Science.*

McIntosh, J.D.

The Materials Testing Laboratory of the Cement and Concrete Association.

Magazine of Concrete Research, 1963, 15(43),49-56

A new laboratory for research on the engineering properties of concrete and its constituent materials

has been erected for the Cement and Concrete Association at its research station at Wexham Springs to re-house various departments which had been operating in temporary accommodation. The paper describes the measures taken to deal with problems applicable to all buildings of this type.

Air-conditioning of many of the rooms influenced the siting, planning and method of construction of the building. Particular problems included reducing nuisance from the dust and noise of many operations, preventing the spreading of shock and vibration to the rest of the structure, planning a convenient flow pattern for routine operations while allowing adequate versatility for other techniques, and filtering "live" cement from liquid waste. Although all the desirable refinements were not included at the time of erection, provision was made, where possible, for them to be incorporated later.

778.3 *Scientific and technical applications of photography*

See UDC. 625.7

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