A55 North Wales coast road St Asaph to Aber

R. Lober and R. L. Wilson

M. Springett and T. D. Stevenson

S. B. Rowland, K. A. L. Johnson and J. Wendes

Mr A. Goldstein, *Travers Morgan*

This North Wales Coast road project was known in the Travers Morgan office as the job that had everything. In engineering terms little technology that one learns as an engineer has not in one aspect or another found its way into the design and construction of the project. The fact that, including a long lead time, it will have taken from 1969 to 1994—a quarter of a century—indicates that a great many engineers have given a high proportion of their professional life to its realization.

2. In terms of route selection, the project manager had a number of aspects that were at that time unusual. For example, the Secretary of State published the consultants' report, which does not happen often, and he did so notwithstanding the fact that he dissented from the consultants' recommendations. That hardly ever happens. The real argument about the consultants' recommendations was neatly sidestepped that way as the argument about the Conwy crossing would normally have been taken as a choice between the high-level bridge and the tunnel. The decision not to accept the high-level bridge and to proceed for public inquiry with a low-level bridge near the castle was a totally legitimate political decision. Travers Morgan, as consultants, at the time did not know the political considerations that determined the Secretary of State's mind.

3. Were there any parts of the project that the Authors of the papers might have done differently, with hindsight? Were there any things that went awry during construction, which had to be dealt with immediately?

4. One peculiarity of the traffic analysis used to evaluate benefits of the new road, was the necessity to include a factor for holiday traffic. The basic economical model for traffic evaluation assumes that the trip end benefit is kept constant, the travel time is a disutility, and a reduction in travel time for the same trip end benefit is therefore a measure of the benefit of the particular route. That is absolutely right normally, but how are holiday-makers' two-hour drives to see the scenery and sites to be evaluated? The model assumes a driver will save journey time, but someone on an afternoon trip intends to drive for two hours and is not seeking to save journey time. There are a number of such holiday-makers. This aspect was rationalized at the time by inserting into the model a benefit attributable to that driver in spite of an unchanged journey time. Instead of being limited to going to Conwy castle for instance, once the project was complete day-trippers could go much further. They need not experience only the visual benefits to the west of Conwy, but will, in two hours, experience both those benefits and the

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benefits to be enjoyed by travelling to the east of Conwy. I rationalized it by saying that the benefit attributed to them in the model is really a proxy for the benefit of experience enrichment. It is only in peculiar circumstances such as on this project where there is a list of holiday traffic that these considerations arise.

Dr D. Hall, *formerly Welsh Office*

The decision to depart from a high level bridge was a carefully considered one and the then Chief Planning Officer in the Welsh Office had a great contribution to make.

Mr A. Donaldson, *Clywd County Council*

There can be no doubt as to the efficacy of the Colwyn Bay–Conwy route and the high standard of the workmanship of the schemes. There are, however, inconsistencies in the Collcon scheme because part of it is a dual carriageway but has near motorway restrictions. Collcon 1A has a full hard shoulder, 1B has not. Would the Authors of Paper 9175 comment on that, particularly as the rest of the A55 to the east—most of which has been done by the former Denbighshire and Flintshire and now Clywd county councils—is only standard dual carriageway.

7. The route of the A55 is extremely good but there are problems with the interchanges. Was the A55 pushed through by the Welsh Office without sufficient thought being given to the design of the interchanges for traffic moving between the dual carriageway and county council roads?

8. When the works were under construction I was concerned about the Dolos units. It was arranged for spare units to be kept in stock and moulds were acquired from the contractor, in case the Dolos units were washed away in a storm. There has not been a storm but I wonder if I was being too pessimistic in expecting them not to withstand one.

Mr H. E. Davies, *Gwynedd County Council*

In 1963, together with other postgraduate students, I was given the project of selecting a line for a new dual carriageway from Chester to Bangor. The possibility of locating such a road through Colwyn Bay, Llandudno Junction and Conwy appeared to me at the time to be impractical.

10. In 1966 I was involved in a further study of the area when an analysis of traffic figures indicated that a route through Conwy was absolutely necessary. It seemed at the time that a high level bridge over the River Conwy at the Deganwy Narrows would be the best traffic solution, the best engineering solution and could be designed to be aesthetically acceptable. In the event, the solution considered to satisfy best the environmental constraints of the area was a submerged tube. While it is pleasing that increasing attention is paid to environmental aspects, it is interesting to speculate whether, if engineers had created a better image of caring for environmental aspects, such a costly solution would have been chosen by the politicians.

11. To the west of Conwy, however, in stark contrast, economies have been made. By constructing only one new tunnel at Penmaenbach the opportunity of constructing two tunnels has been missed and furthermore two at-grade junctions have been provided in place of the grade-separated junction as originally proposed.

Mr F. H. Hughes, *Cementation Piling and Foundations Limited*

The route of the present A55 expressway owes much to the excellent alignment of the Chester and Holyhead Railway which has provided a seaside corridor through Colwyn Bay itself. The goods yard in the central area of Colwyn Bay was a borrow pit for the railway, and has provided useful land for the interchange. The old goods yard access tunnel is now replaced by the road underpass. The reduction of the busy pre-war seaside rail traffic enabled the four track Llandudno Junction line through the Afon Ganol valley to be reduced to a twin track. This, coupled with the earlier removal of the coal-fed gasworks provided a useful corridor. The Authors have shown how well these opportunities have been grasped.

13. I was involved with the preliminary borehole investigation undertaken in 1971. There have been a few geotechnical surprises on the various routes considered. One of the preliminary boreholes near the summit of the Sychnant Pass struck artesian water. However, and correctly in my view, the present overall alignment stays mainly with the coastal railway.

14. As noted in the Paper 9175 Cementation Ground Engineering undertook the first major site investigation in 1973-74. This consisted of 362 exploratory holes with agreed testing, sampling and laboratory work and analysis. The most challenging part of the investigation for stage one was that in the Llanddulas area. Here the terrain is steep, with coastal boulder clay cliffs. Part of the route was on an active slip area known for many years. Indeed there was a slope movement here in the closing stages of the field investigation. Displacement of the railway point rods near the then Llanddulas signal box was a novel slope movement monitor at the time. Three main types of boring and drilling equipment were employed in this area: light cable percussive boring rigs, rotary drilling and coring machines and rotary percussive air operated drills. Because of the difficult terrain special arrangements had to be made for access and rig mobility. Most light cable percussive bores were to 200 mm dia. Deep holes sometimes had to be reduced to 150 mm. Occasionally a starting diameter of 250 mm was used. Where the boulder clay was very thick (i.e. beyond 20 m depth) rotary drilling was used.

15. One of the rotary coring machines was track mounted for inter-tidal work on the boulder strewn beach and for work alongside the railway. Coring in the upper fractured limestone proved difficult and a heavy steady drill base was helpful. Most cores were taken with TNX thin wall double tube barrels at 64 mm dia., but in the broken rock a PF bit was used giving 95 mm cores. The smaller rotary percussive wagon drill rig enabled proof drilling to check the depth to the limestone horizon below the steep hillsides above the railway. Air flush drilling at 50 mm dia. was employed for this operation. Trial pits were sunk in the slip area to enable a search for shear planes. As the water pressures in the rock and superficial deposits were so vital to the design special piezometers were installed.

16. In contrast with the work at Llanddulas the flat valley of the Afon Ganol is underlain by soft alluvium. Here 150 mm dia. thin wall piston samples were taken for fabric inspection, and for Rowe cell consolidation tests.

17. Cementation Ground Engineering also acted as specialist band drain sub-contractor to Laing at the approaches to the Glan Conwy interchange. The vertical band drains mentioned in Paper 9176 were installed using a crane mounted system. Mebra band drain of approximately 95 mm $\times$ 3.5 mm was employed. The mandrel was entered by crowding, the rig vibrator being used only to penetrate the granular blanket. It is understood that these drains have performed satisfactorily, and that the embankment is about to take traffic.

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Mr D. J. Pain, *Messrs Sandberg*

Messrs Sandberg were appointed by Travers Morgan & Partners to be the materials testing and inspection consultants on this stretch of road. A laboratory was installed on each of the two sites. These covered soils, concrete and blacktop, with a maximum staff of four engineers and 12 technicians. On both these contracts more testing than usual was undertaken so as to build up a data base of information on local materials for use on the following contracts, which has proved invaluable.

19. With reference to the sea defence works, underneath the embankment, laboratory staff carried out a large amount of work in conjunction with McAlpine technical staff. They were deeply involved in the initial classification of soils encountered along the line of the embankment and in the identification of suitable sources for the six different rockfill materials required for the sea defence system.

20. It seemed as though every quarry in North Wales was visited, particularly when grading analyses had been done on minimum specified 50 t samples for the core (650–100 mm). With practice such a sample could be completed in about 2.5 h, with the use of six men and a little assistance from high-tech quarry plant. Several items of plant used in the selection of this rock were fitted with load cells which produced a digital read-out of weight in the cab, which was a useful aid. However, in the end operator experience proved to be the most critical factor that affected this work.

21. The casting of the Dolos units was an exercise which would have taxed a well established precasting yard. In order to produce 80 units per day, a rapid shutter turn-round was required; a high early strength was achieved by the use of heated water at 60°C. Numerous mix variations were tried for the required 45/37.5 concrete, including cement replacement, but those designs found to be most successful had a straight OP cement content of 420 kg/m³ at a target slump of 75 mm. The degree of air entrainment necessary to control plastic cracking was at the lower end of the DTp specification for concrete pavement, (i.e. $4.5 \pm 1.5\%$). Air contents, determined before placement, gave mean values of less than 4%, with a measured loss of between 0.5 and 0.7% after pumping and compaction.

22. There was considerable investigation for alkali reactivity. Although not at that time part of the specification, it has proved invaluable since then.

23. On the embankment rafts of rolled concrete a nuclear density meter was used, one of the first times that such a meter had been used. It was essential because the three layers had to be placed quickly one after the other and for sand replacement tests a four-hour wait is needed before a test can be done. The nuclear density meter was therefore used to test all three layers and sand replacements were performed as a double check in the top layer.

Mr K. Sriskandan, *formerly Department of Transport*

Paper 9175 mentioned an elasticity model. It has apparently been used in two schemes in the UK. Has this elasticity model been verified anywhere and are there any plans to do before-and-after studies to check whether this will correctly predict travel behaviour in Wales or anywhere in the UK?

25. In the UK, motorways are the only roads on which certain vehicles are prohibited and the signs conveying this information are blue. The green sign is used for a principal road and the white for other roads. Leaving aside the legality, has there been any confusion on the part of the travelling public and have any of these prohibited vehicles used the road after it was opened?

26. With reference to concrete strength, there has been a preoccupation with it and rather less with durability. What precautions were taken as far as durability was concerned?

Mr B. H. Hawker, *Welsh Office*

The reasons for the actions taken have been considered but no mention has been made on whether objectives have been realized. The Landscape Advisory Committee, when first looking at this particular route, made a comment which it rarely makes elsewhere

The Committee is not often invited to deal with an area so complex geographically and topographically, with its blend of precipitous coast and splendid mountain hinterland, its noble estuary, its tourist resorts and rich historic remains. Indeed one might wonder whether all the conflicting requirements—a strategic route, urban bypasses, inter-town links and local circulation—could ever be met by one single road project. We have therefore in this report tried to analyse rather than settle the problem, partly to focus attention on areas of special difficulty where environmental studies which we hope will be undertaken might lead to either less costly or more acceptable and less damaging solutions.

At the inquiry the Inspector who, after 102 days, must at the very least be attributed with an informed understanding of the problem said

A question to be answered is how, with the severe effect on urban environment, could such a scheme possibly be justified.

28. There are likely to be problems which were not addressed properly, analyses which were incorrectly concluded and consequences not foreseen. The reality is that an improved strategic route has resulted that provides a major corridor of opportunity for commercial and industrial development which is currently under way in north-east Clwyd and is extending along the North Wales coast. Tourism has been boosted and people from Manchester and as far away as Birmingham are being provided with an opportunity to enjoy a day trip to Llandudno, Snowdonia and even Anglesey.

29. It is worthwhile in terms of the controversy to gauge what local people are saying. A recent press report states

In Llandudno people are falling over themselves to build superstores and take advantage of development opportunities. What is becoming clear and what was predicted by some is that the benefits of the A55 are far from clearcut and uniform and that the new road is not by itself going to bring prosperity to each and every town in the vicinity. Llandudno is superbly placed to reap the benefits. The road passes near but not through it. The town has certain unique and traditional features. This is not the case of Colwyn Bay, whose development is certainly less apparent. However, in Colwyn Bay they now enjoy a peace which they have not enjoyed for many years and the local council have expressed their appreciation of it.

Mr D. R. Culverwell, *Consulting Engineer*

As the person who conceived the immersed-tube tunnel scheme at Conwy and prompted the adoption of the inland tunnel scheme at Pen-y-Clip, I would like to say something about their origins. Some of the credit for the Conwy Tunnel should go to Miss Margaret Smith who was local secretary to the Council for the Protection of Rural Wales at the time. She had read an article I had written in the *NCE* on the proposed immersed-tube tunnel across the Tees and phoned me at

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Freeman Fox & Partners in London and said, 'Could we have one of these here?' I gathered some maps and other data and met her at the site.

31. The solution seemed immediately obvious, so much so that we at Freeman Fox could not see why it had not been proposed by the Welsh Office. This was an immersed-tube tunnel, about 1000 m between portals, laid diagonally across the estuary, with open approaches, the south approaches passing beneath the end of the Telford Causeway. This is, with minor development, the scheme shown as the intermediate route in Fig. 11 of Paper 9175 and is that currently under construction. Aberconwy District Council then adopted the scheme and appointed FFP as their consulting engineers to develop it and propose it at the public inquiry. The solution was subject to the ground conditions being satisfactory. We had little money and could not afford marine borings but a local firm did a geophysical survey for us and from this and other data we felt we knew sufficient to be reasonably satisfied.

32. In their earlier studies RTM had considered an immersed-tube at Deganwy Narrows and this featured again in the 1978–79 study. This location might have suited an opening bridge but, in my view, did not exploit the potential of the immersed-tube method. The main issue at the public inquiry concerned environment. Conwy Castle and the town walls are excellent examples of mediaeval architecture. They are unique in Great Britain in their extent and quality of preservation and have few comparisons elsewhere in Europe. We argued that the immersed-tube scheme followed an alignment well away from the castle and the town and that its adverse effect on the estuary would be minimal. In contrast, the crossing proposed by the Welsh Office would spoil the environment of the adjacent Gyffin Valley and would destroy the atmosphere and appearance of the castle and the adjoining town walls. It was estimated that the immersed-tube scheme would cost about £24 million and the scheme proposed by the Welsh Office about £21 million (January 1974 prices), with the travel benefits of the two schemes being similar. We argued that the additional £3 million was a small price to pay to preserve the castle, its walls and the valley.

33. The Welsh Office scheme aroused enormous objection, both locally and nationally. The Royal Fine Arts Commission were much opposed to it, as were also, we suspected, other advisory bodies. Before the inquiry, we submitted the immersed-tube scheme to the Commission and they strongly supported it, as did other bodies concerned with the environment. It seems that, in pursuing their scheme, the Welsh Office did not appreciate how inappropriate it was in the circumstances. At the inquiry an official from the Welsh Office was asked why their scheme had been adopted in preference to others, including the high-level bridge scheme at Deganwy which had been recommended by RTM. He replied that it was a decision by a former Secretary of State and that no reasons were available. We thus had the bizarre situation at the inquiry of the official scheme giving rise to wide and strong objection but no one able to explain why it had been chosen. A further matter of concern was the large amount of site investigation work and design development that had been undertaken for this scheme, at considerable cost, and the reluctance of the Welsh Office to make sufficient of this information available. One wished that such resources had been available to objectors.

34. The adoption of the final solution at Pen-y-Clip was also fortuitous. This is a large and magnificent headland. The official scheme caused concern as it comprised a viaduct around the seaward side which would be very exposed to winds,

and it was also believed that the structure would seriously detract from the appearance of the headland. We later perceived a danger from falling rocks, breaking free from the crags high up the headland. We were uncertain about our misgivings regarding the appearance but took advantage of a visit to Conwy by the landscape architect, Dame Sylvia Crowe, who was advising us on the crossing, to show her the headland. She had no hesitation in endorsing our views and the Council decided to oppose the official scheme and pursue the alternative of a tunnel through the headland. This tunnel had, in fact, been proposed by Howard Humphreys & Sons in a report to the Ministry of Transport in 1928 and is referred to in Paper No. 5085, given to the Institution in 1937. The scheme was successfully argued at the public inquiry and, as explained by the Authors, subsequent estimates showed it to be the cheapest solution.

35. Both the Conwy and Pen-y-Clip schemes are major works and involved important environmental issues, especially at Conwy, yet the solutions finally adopted were those put forward by objectors. One might perhaps applaud this as demonstrating the effectiveness of the inquiry system, but not when one realizes how much the solutions depended on chance. Had Miss Smith not telephoned, or had Dame Sylvia not visited, then the official schemes might have gone through.

36. There are also the inherent shortcomings of the adversary system used in inquiries when applied to technical issues, which often makes sensible comparison difficult, especially where there is such disparity of resources as between objectors and the Government and where the latter sometimes pursues its case so determinedly. Of concern also, in the present instance, although in a different sense, is the long 23-year period between feasibility period and completion, shown in Fig. 15.

Mr A. W. Shilston, Consulting Engineer

The A55 North Wales coast road has been referred to as a European route: Ireland–Wales–continental Europe. Later it was observed that the A55 was not just for tourist traffic. The aim was to encourage development in North Wales as well. Was there a truly continental European dimension in the promotion of this scheme? The papers do not appear explicitly to say so.

38. Mr Goldstein sought to establish lessons learnt. The public inquiry lasted 102 days. How might the objectives of such an inquiry conducted in 1988 be better achieved, procedurally, with a hoped-for reduction in time and cost?

39. For purposes of the several forecast price re-appraisals necessarily carried out during the attenuated gestation period of this project, how were the price assessments made? Not, one imagines, from historical tendered prices obtained from other schemes but rather by analytical estimating methods.

40. Could Mr Stevenson (Paper 9176) enlarge on the detailed design of the new railway track work, treating as a composite whole the formation (and its protection), drainage, depth and specification of top ballasting and track details, including the weight of rail and sleeper spacing, commensurate with the stated 75 mile/h standard. In what material respects would the track design (rail curvature apart) be different for the conduct of high speed trains? Are track standards ubiquitous throughout the British Rail network for identical design speeds?

Mr C. J. Polack, Associate Member

In § 32 the Authors mentioned the problem of degradation of railway ballast and the co-operation of British Rail in overcoming this problem. How did the traffick-

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ing and compaction of the ballast lead to its degradation? What specification was used for the supply and placing of railway ballast? How did BR assist in overcoming this problem?

Mr Lober, Paper 9175

Mr Goldstein queried whether the construction of the A55 schemes might have been dealt with differently with hindsight. With contracts yet to be started and others under construction, it is too soon to draw firm conclusions. When the whole coast road is completed it will be easier to assess where improvements could have been made. At present construction has proceeded pleasingly well. There are always many problems to sort out on major schemes of this size and complexity, but these do not appear to be related to the methodology of design or construction.

43. *Mr Goldstein* has suggested the value of the new road for holiday day-trippers was not that it saved time but that the real benefit was it allowed journeys to be extended. This is profound thinking. The new road will certainly save journey time which in my opinion must be valued as a benefit even for the day-tripper who chooses to use the time saved to travel further to see more of beautiful Wales. He and I both agree that benefits will arise, but differ as to where. The travel benefits of the new road accrue not only to holiday-makers, but also to industry, and time savings by industry are vital. When the whole project is completed the two-hour plus journey that until recently it took to travel between Chester and Bangor, will be reduced to under one hour. This is an enormous time saving and it should do much to encourage developers and industry to North Wales. It will also encourage journeys previously deterred by the long delays experienced on the old A55. It took more than an hour in peak periods to travel through Colwyn and Conwy, and many people would not volunteer to make the journey unless they had to. The new road is expected therefore to generate traffic and an allowance for this was made in the traffic model.

44. *Mr Donaldson* has pointed to variations in carriageway standards along the route, particularly parts of the Colwyn Bay Bypass which are built to near motorway standard. The Colwyn Bay bypass is not a motorway because it is too short in length and too isolated from the motorway network. However, to cope with forecast traffic growth and to provide a high speed road with good safety features, it was necessary wherever practical to design the bypass to near motorway standard and to impose similar traffic regulatory orders. A significant length of the bypass is of urban or semi-urban character, and the adoption of full motorway width and alignment standards throughout would have meant greater demolition of property and more land acquisition. A sensible and sensitive balance between the needs of traffic, cost and the effect on local communities and the environment needs to be achieved. This is especially so with urban interchanges, where it is important that the layout provides full standards for forward visibility, and stopping, in relation to traffic speed. Even so, limited space and lower traffic speeds will generally lead to more compact layouts for urban interchanges compared with their rural counterparts.

45. There is a unique aspect about the Colwyn Bay bypass. It is classified a 'special road', but is not a motorway. The reason for the special road status, was a legal one. It provided enabling powers under special parliamentary procedures for diversion of the railway between Colwyn Bay and Mochre. Unfortunately, its status created an anomalous situation for the choice of colour and legend for some

of the traffic signs. Further to Mr Goldstein's question about whether or not anything would be done differently second time round, legal procedures for diversion of a railway would be investigated closely, because although the advice given was intended to ensure a smooth passage for the scheme, it gave Welsh Office some unique traffic signs and a headache as to whether or not to erect them.

46. In reply to *Mr Davies*, most civil engineers now recognize the importance attached to the environment. Perhaps in the past, this was less true. Certainly in the Department, the comments and advice of landscape and planning advisors and if the Landscape Advisory Committee and the Royal Fine Arts Commission are taken account of. Nobody has a monopoly of wisdom with regard to the environment and aesthetics. When the environment, the planning constraints of the Conwy estuary and the need for economic solution are considered together, the difficult judgement in choosing an acceptable route becomes apparent.

47. Whatever route was chosen—and I believe the best solution was chosen, the choice must have been a difficult one. There were so many conflicting factors to weigh up, and I do not imagine for one moment that the solution was blindingly obvious, although with hindsight it may appear so. People and authorities objected to the immersed tunnel route, as indeed objections were received to all the proposed routes. There was no consensus view. Another point worth noting is that the Secretary of State took a great personal interest in the estuarial crossing. He visited Conwy and looked at the various options before deciding on the immersed tunnel route. It could not have been an easy decision and it was by no means the cheapest solution but it saved the exceptional heritage of the castle and its environs which many consider to be priceless. Admittedly the decision making process took a time to finally arrive at the adoption of the immersed tunnel solution, but perhaps the final choice is a vindication of the procedures.

48. *Mr Srisikandan* asks whether the special green-backed prohibitory traffic signs have caused confusion. There is no simple solution to these signs and they are unique. As the Colwyn Bay bypass is a special trunk road, rather than a motorway, a green primary route background is the appropriate colour. Blue is used solely for motorways. The main signs are very large because of the need to accommodate the legend and illustrative smaller signs incorporated in the main sign for the large number of prohibitions. Each prohibition had to be individually identified in the sign. They are legally authorized by the Secretary of State. These signs were therefore erected for well founded legal reasons. Environmentally they are intrusive and possibly difficult to assimilate at a glance, and it would not have been surprising if, soon after the opening of the road, the public had complained and requested their removal. Surprisingly this did not happen. Initially some motoring organizations complained, but later appeared satisfied with the Department's explanation. There has been a remarkably small number of complaints. The local people have understood their meaning. A few people may have misunderstood the signs and disregarded them but the number must be small otherwise they would have been noted.

Mr Wilson

49. The question of what the Authors would do differently next time is always an appropriate one to ask. The planning of highways is constrained by the legislative procedures that have to be followed at the particular time. Therefore, if there was another similar problem what would one hope to be allowed to do? I am a keen supporter of earlier consultation before a route has been put on paper. It was

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fortunate that with the consultation for this section of the A55 a consultant's report was available to the public and a model of the preferred route: all discussion and debate was informed on both sides. There was an equality of information.

50. What I would hope we would not have to do is to ask people which route they preferred on a voting basis. If planning had worked within that framework neither a coastal route nor an intermediate route would have resulted, rather an inland route. However, it will be seen from the sections that have been completed that a major highway has been created in a built environment with a reasonable degree of success in environmental terms.

51. What would I hope would happen differently? We go to the inquiry too late with a referred (published) route already chosen. There was one time when there was a group of people, informed, who really knew what the right answer was, and that was at the end of the inquiry. The only decision the inspector could recommend (and the Secretary of State take) was whether to confirm the published route or not. He could not say: 'I am not going to recommend that one. I am going to recommend the tunnel route' or whatever. A full-circle statutory process had to be entered into once more. Public inquiries ought to be able to consider a number of alternatives. They can, but the powers are very seldom used. If they were, highway planning time would be shortened.

52. The publication of the route as a special road under the Highway Act related to the acquisition of land for diversion of the railway through Colwyn Bay. The Welsh Office could not be certain British Rail would put the railway diversions and the acquisition of land and so on into their annual railway bill. Publishing the draft orders under section 11 allowed the land for the railway to be acquired under section 13. In the event, British Rail had to put the proposal into their annual bill in order to have powers to run a railway over the land that had been acquired for them. So to some extent this would not be done again. However, it was thought inappropriate for the road which passed through the built-up area of several coastal towns to be a motorway. The motorway regulations were not applied and the prohibited traffic on the special road is indicated on the huge signs at each end of the section of route. Perhaps one day the Secretary of State will forget his original reasons for the special road, make it into an all-purpose trunk road and get rid of these terrible signs, which are a blot on the landscape.

53. The interchange design was very difficult. What one would like to be able to do particularly where urban traffic conditions apply is to be able to develop the interchanges on the trunk road as the traffic flows increased. Some of the junctions which were designed for future peak traffic were inappropriate for current traffic levels.

54. In answer to Mr Donaldson's comment, the Dolos units have been successful. Although it is a fairly well-protected coast and storms from the north-west are infrequent, they have nevertheless occurred. There are two layers of Dolos units on top of the primary armour and the design allows for Dolos units to break in use. At some stage there will have to be a major survey inspection and replacement of broken ones.

55. *Mr Culverwell's* contribution confirms that the procedures are not designed to rubber-stamp the proposals. Very significant changes came out of the inquiry process. It is unfortunate that one has to go round the circle again in order to re-adopt the revised proposals. Why cannot the inquiry be left to say 'That is what should be done' and get on with it?

56. Environmental issues and good quality design, revised by Mr Davies, are not things you add on afterwards. They are part of the design process. The design team included Travers Morgan's landscape architect Mr John Evans. The impact on our firm of engineers in having another discipline in the design team was dramatic. There is no way we could have achieved whatever we have achieved in Colwyn Bay and other built up areas without there being a total commitment within the team to get good quality design in all aspects. It was a question of sound concept and attention to detail. However, in today's perception of the environmental impact of road construction in urban areas—based perhaps on viaduct solutions—the route through Colwyn Bay would not have been achieved, given the alternative of an inland route through a mainly rural environment.

57. The choice at Conwy was a balanced one: a judgement had to be made in the public interest weighing a large number of issues which defied direct comparison. The Secretary of State might have stuck to his original choice of a fourth bridge by the Castle which provided better views of the Castle than from the Castle: in the event he decided the immediate environment of the Castle was worth the additional expenditure. Whether or not it was a right decision depends on individual views. I think he got it about right.

58. To pick up on Mr Srisikandan's question—there was sufficient traffic information to validate the elasticity model from data collected in 1966 and repeat data collected in 1973. With that information we at Travers Morgan satisfied ourselves that the coarse mix of elasticities for the various traffic types and purposes did produce forecasts of traffic reasonably comparable with the flows that occurred. The initial elasticities were selected from research by Quarmby of Leeds University and TRRL. Until the Conwy bottleneck is relieved, it will be difficult to make a full comparison between forecasts and actual flows. In the current intermediate position, traffic flows are slightly less than forecast: one third of traffic is destined for Llandudno and flows on the new trunk road are sensitive to the choice of junction used for such journeys. The shorter route by way of Brompton Avenue is very similar in journey time to the longer route by the new connecting road at Glan Conwy. We would certainly use the A55 type of traffic model again if there was a similar problem. Given that it is applicable to situation where existing traffic levels are constrained by congestion it might perhaps be applied more widely.

Mr Stevenson, Paper 9176

59. In answer to *Mr Shilston* the four bridges, which were designed by British Rail to carry the railway over the A55 North Wales Coast road or the side roads, were constructed to comply with the British Railways specification which has been drawn up over many years, as they remain in British Rail ownership. There appears to be that there are similarities in most aspects to the Department of Transport Specification covering bridge work.

60. Durability of concrete, to my mind, is a product of applying the correct specification to the particular circumstance, and this includes specifying the correct concrete mix design and adequate cover to reinforcement; sampling and testing of materials, and ensuring that the specification is complied with by providing adequate site supervision.

Mr Springett

On the question of stability, the forshore has stabilized. Measurements were con-

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tinued after construction for a number of years and, with Welsh Office agreement, those measurements were stopped because the stability of the foreshore appeared to be satisfactory. There was an order under the Highways Act to reclaim land from the Irish Sea. This order was called the Diversion of Colwyn Bay and Conwy Bay.

Mr Johnson, Paper 9177

To comment on the durability aspect from the contractor's point of view, there was a situation where the use of plasticisers was needed, in this particular case a super-plasticiser. There is no way that the requirements of the contract could have been achieved without the plasticisers. That was the object of the histogram. In terms of answering the question relative to durability, the priorities of the contractors and the engineer are a little different. The engineer is looking for strength and durability and the contractor is looking generally for workability and early strength. So there is a slight conflict of interest there but they do cross over. The difficulty comes when the contractor is faced with a specification that becomes not only an end product specification but virtually a method specification. In other words, it specifies everything and yet still asks for an end product. Sometimes these are not always compatible. In terms of how durability is achieved, the keys are water/cement ratio and cement content.