

**Zeitschrift:** IABSE congress report = Rapport du congrès AIPC = IVBH  
Kongressbericht

**Band:** 11 (1980)

**Artikel:** Design management for Hong Kong Metro

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**DOI:** <https://doi.org/10.5169/seals-11261>

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### III

#### **Design Management for Hong Kong Metro**

Direction de projet pour le métro de Hong Kong

Entwurfsleitung für die Hong Kong Metro

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This note summarises Paper IIIC of the introductory report and emphasises the important features. The design of an urban railway is a project requiring planned design management because of the complexity of organisations involved and the many types of work as illustrated in Fig. 4 of the paper. In Hong Kong there were about 20 organisations to be consulted about 20 different aspects of engineering required for the 15.6 km of line and 15 stations.

Design planning is difficult because potentially difficult decisions cannot always be identified well in advance. Hence there is always a risk of delay if difficult decisions cannot be taken quickly when the need arises. Very detailed programmes for all foreseeable activities help to identify correctly the critical path and likely causes of delay.

The difference of a metro from a power station or chemical plant, for example, is that design must make the whole metro system attractive to passengers in order to get the maximum revenue. Some passengers will be attracted by comfort, others by speed, others by low fares. Design features to improve attractiveness in these or other areas usually increase cost and are therefore against financial viability for a given revenue level. So all design features in Hong Kong are carefully analysed to ensure value for money if not minimum cost. The financial aspect was an important consideration in approving a design feature.

The objective of design management is to produce good designs within both the budget and the construction of the project.

Detailed design programming is difficult because often key work rests on a single man whose holidays and illness have to be considered. But a detailed programme may show up this risk.

A pyramid of levels for decision-taking is essential but it is difficult to foretell those decisions which need to be taken to the top. Provision must therefore be made for meetings at the appropriate level, to be arranged at very short notice, or as at Hong Kong to be held regularly and frequently.

Design development from concept to working drawings has to follow an orderly linked sequence, providing for co-ordination between the types of engineering at each stage in development.



The co-ordination of civil, electrical and mechanical engineering designers requires working together in the same office at detailed layout stage.

Two of these features are now considered in more detail. The first one is the complexity of the many disciplines involved and the way they have to be linked together to ensure co-ordination of design. This is illustrated in Fig. 3. To illustrate the co-ordination required take as an example the planning and layout section for a station. This involves not only the station layout, entrances and vent shafts, architectural layout and finishes but also the electrical and mechanical equipment layout. The last operation will involve the engineers specialising in telecommunications, power supply, escalators and lifts, fare collection equipment, environmental control equipment, lighting and plant and even the overhead current collection. In addition all those electrical and mechanical specialists have to be co-ordinated between themselves and that operation in turn has to make sure that the details are compatible with the overall electrical and mechanical system design.

Those layouts of stations have to be translated into civil engineering structures for underground and overhead stations. At any stage in this design sequence factors can arise which require a review and perhaps change of earlier decisions. As an example a station plant room may have to be made bigger than planned in the preliminary stage when the size of the ventilation equipment has been finally established. As another example architectural finishes may be changed for economy.

These essential co-ordination steps and the interrelation between them are illustrated in another way in Fig. 5, design development. The purpose of this diagram is to illustrate how at each stage in design development the compatibility of the whole design of the system must be ensured. The outline conceptual design is by a small team so that the co-ordination is not difficult. When detailed design is started then a much wider range of expertise is involved and steps have to be taken so that when their work has reached the tender design stage all aspects are compatible. When contracts have been awarded and each contractor starts to develop the outline design for the electrical and mechanical equipment, and in the case of many Hong Kong contracts the civil engineering design, incompatibilities can occur which must be eliminated. When their outline designs have been approved as compatible they have to be further developed to detailed designs which in turn have to be approved to ensure compatibility. It is easy for incompatibility to occur even at this stage - for example, access panels on standard switchgear may be changed which might require an alternation to room layout or even the size of the room.

This careful management of design contributed to the opening of the first line of the Hong Kong metro on 12 February 1980 within the agreed construction period programme of four years and within budget.