

Zeitschrift: IABSE reports = Rapports AIPC = IVBH Berichte
Band: 55 (1987)

Artikel: Energy conserving structures
Autor: Izumi, Mitsuaki
DOI: <https://doi.org/10.5169/seals-42793>

Nutzungsbedingungen

Die ETH-Bibliothek ist die Anbieterin der digitalisierten Zeitschriften auf E-Periodica. Sie besitzt keine Urheberrechte an den Zeitschriften und ist nicht verantwortlich für deren Inhalte. Die Rechte liegen in der Regel bei den Herausgebern beziehungsweise den externen Rechteinhabern. Das Veröffentlichen von Bildern in Print- und Online-Publikationen sowie auf Social Media-Kanälen oder Webseiten ist nur mit vorheriger Genehmigung der Rechteinhaber erlaubt. [Mehr erfahren](#)

Conditions d'utilisation

L'ETH Library est le fournisseur des revues numérisées. Elle ne détient aucun droit d'auteur sur les revues et n'est pas responsable de leur contenu. En règle générale, les droits sont détenus par les éditeurs ou les détenteurs de droits externes. La reproduction d'images dans des publications imprimées ou en ligne ainsi que sur des canaux de médias sociaux ou des sites web n'est autorisée qu'avec l'accord préalable des détenteurs des droits. [En savoir plus](#)

Terms of use

The ETH Library is the provider of the digitised journals. It does not own any copyrights to the journals and is not responsible for their content. The rights usually lie with the publishers or the external rights holders. Publishing images in print and online publications, as well as on social media channels or websites, is only permitted with the prior consent of the rights holders. [Find out more](#)

Download PDF: 20.02.2026

ETH-Bibliothek Zürich, E-Periodica, <https://www.e-periodica.ch>

Energy Conserving Structures

Économie de l'Énergie dans les structures

Energieeinsparende Bauten

Mitsuaki IZUMI

Prof. Dr

Meijo University

Nagoya, Japan

This paper presents energy conservation in construction from the viewpoints of economy and energy consumption subject to uncertain oil supply and price fluctuation.

1. ECONOMICAL ANALYSIS

In general, an economical analysis for public works is supplementally carried out to know the effects of investment on projects in Japan. In the analysis, the Ratio of Cost-Benefit (B/C) is generally estimated by a method in which the investment and the profit during all periods of the project are based on the prices of standard year. However, it is supposed that the rising cost of energy has an effect on the price of all goods used in the construction process, and that said effect differs according to each good's degree of dependency on energy for its production. For example, A and B projects will be investigated. In A, the initial investment is larger than in B. Also, in A, the cost of running and maintenance are smaller than those of B, but other factors are the same for the two projects. Although the project is the same, the feasibility of the project differs according to the pattern of investments and energy goods. From Fig.1, it is clear that:

- 1) Project A and B are feasible until the rising rate of energy costs at c and b, respectively.
- 2) Project B is better than A, until the rising of energy costs at a.
- 3) Project A is better than B, if the energy costs sharply escalate.

When the estimation with energy assumed to be spent on construction is carried out, it is better to estimate the recovering years of initial energy consumption (ne).

$$ne = \frac{Ce}{be - me} \quad (1)$$

where, Ce: total consumed energy quantity. be: production or conservation of energy quantity. me: running energy consumption.

The Eq(1) shows clearly that in order to raise the efficiency of the project, (ne) has to be made small. For the sake of minimizing (ne), in the Eq (1), (Ce) and (me) should be made small, and (be) should be made larger.

This process represents the energy conservation in construction.

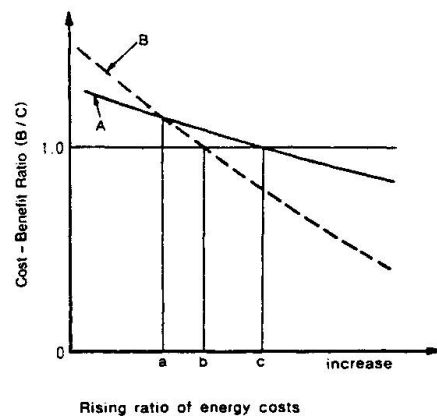


Fig.1 Comparison of the projects with different investments



2. ENERGY CONSUMPTION IN CONSTRUCTION

The flow of consumption in construction is shown in Fig.2. In the life cycle of a constructional project, the total energy consumption (E_t) consists of:

$$E_t = E_1 + E_2 + E_3 - E_4 \quad (2)$$

where, E_1 : energy quantity consumed in construction. E_2 : energy quantity consumed in maintenance and service. E_3 : energy quantity in destruction. E_4 : energy quantity conserved by recycle of materials.

Now, we can only calculate E_1 because data are very scarce about E_2, E_3 and E_4 . However, it is quite useful to estimate the conservation of energy for construction projects using only E_1 within the limit of subsystem 2 in Fig.2.

For example, the energy consumption of construction of actual bridges was estimated using 52 bridges, and is shown in Fig.3. In Fig.3, the relation between energy consumption and span in bridge structure is shown by means of the liters of oil converted into energy consumption per bridge area in square meters. From other data, it is demonstrated that the concrete bridges and tanks use less energy in comparison to the steel and concrete ones. The following is clear:

- 1) There are considerable differences in energy consumption due to selection of structural system and material used, in the same construction project with the same profits.
- 2) It is very important to decide and check the method of conserving energy for the project, during the stage of planning and design, as well as doing an economical check of the project.

However, there is a serious problem in that energy conservation in Japan is not presently economically feasible.

3. CONCLUSIONS

There are many means of conserving energy in various branches of construction, thus it is important to collect data on the means of conserving energy. Constructional projects must be treated as a total system, and then greater energy conservation may be expected in the future.

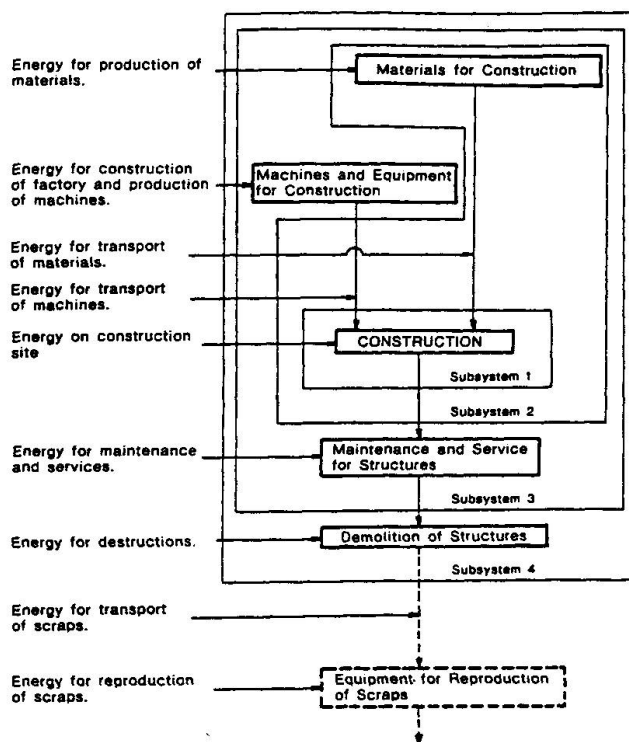


Fig.2 Flow chart of energy consumption in construction

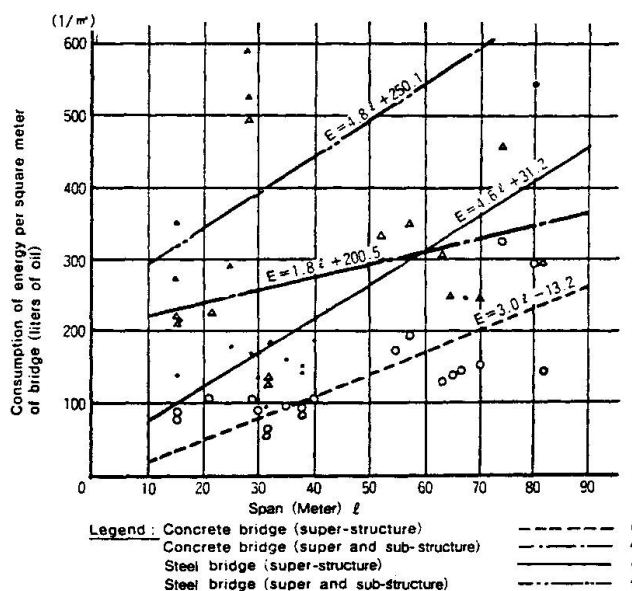


Fig.3 Relation between energy consumption and span in bridge structure.