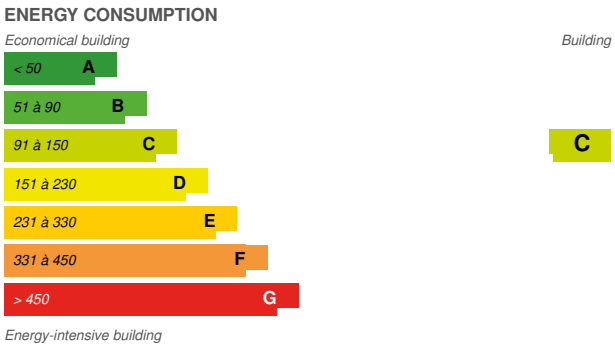
MACH - House Comforted by Humidification

by Lamine IGHIL AMEUR / 2020-07-09 22:30:24 / France / 7893 / FR

Primary energy need :

90 kWhep/m^2.an

(Calculation method : Other)



Building Type : Isolated or semi-detached house
Construction Year : 1967
Delivery year : 1968
Address 1 - street : 10 rue d'Auvergne 41500 MER, France
Climate zone : [Cfb] Marine Mild Winter, warm summer, no dry season.

Net Floor Area : 200 m^2
Construction/refurbishment cost : 15 000 €
Number of Dwelling : 4 Dwelling
Cost/m2 : 75 €/m^2

General information

In a **global context of disruption and climate change**, natural phenomena are multiplying in a recurring manner with greater intensity. The year 2020 is an extraordinary year: the hottest in France since 1900 [1]. The 2020 temperature in France, consolidated with the forecasts for December 28, is 14 ° C, thus exceeding that recorded in 2018 (13.94 ° C). Thus, in 2020, we experienced the warmest winter since the beginning of the 20th century [2], the driest summer (from June 21 to September 20) since at least 1959 [3] and an exceptional episode of heat in September [4]. Even more recently, we experienced the hottest November 2020 on record worldwide [5].

In **2019**, **drought was ranked 1st natural risk** in terms of costs of damage caused, estimated between € **600 and 870 million** by the Caisse Centrale de Réassurance (CCR), and a third of the French territory affected [6]. The current trend is not likely to be reversed in the future in the context of climate change, with **6,265 applications** for recognition in a state of natural disaster (Cat-Nat) drought 2019 processed, of which **47% are favorable** and **2.1 million houses in the medium-strong RGA zone** [7]. In the long term, projections illustrate this trend through an increase in the cumulative cost of drought insurance by **+ 162%** over the period **from 2014 to 2039** [8].

Cerema, awarded the Carnot Institute "Clim'adapt" label in 2020, is stepping up its efforts in favor of **adaptation to climate change** through **applied research** and **innovation** .

From the end of 2016 to the end of 2020, Cerema experimented with a new **remediation solution**, **MACH**, based on the **re-humidification of clay soils** during the drought period by making use **of rainwater**, previously collected and stored (during the wet period preceding the period of drought). drought). The **principle** of the MACH solution aims to **maintain a balanced water state** at the level of the foundation soil, despite the **phenomenon of shrinkage** and **aggravation** under the effect of **evapotranspiration** and **vegetation**, in order to stabilize the opening of **existing cracks.** in the structure and prevent the initiation of new cracks. The

results, recorded during the last 4 years of intense droughts, are **encouraging** in terms of stabilizing the opening of existing cracks instrumented by crackometers.

Sustainable development approach of the project owner

The house was built on very plastic clay soils, subject to the phenomenon of **RGA** (shrinkage swelling of clay soils), with shallow foundations. With the effects of **climate change** and the **increasingly intense droughts** since the summer of 2015, **structural damage** has appeared inside and outside the house.

In fact, the differential settlements of the foundation soil due to the **phenomenon of shrinkage** during the drought period, then the **swelling** undergone during the wet period in a cyclical manner under the effects of climatic disturbance affect the mechanical properties of the soils and can induce instabilities at the level of the structure.

The objective of the **MACH** solution is to maintain a balanced water state during the drought period to limit the phenomenon of subgrade shrinkage and thus stabilize existing damage and prevent the appearance of new damage.

The advantages of the **MACH** solution are numerous, the main ones being:

- **ecological** : the only resource for the operation of the **MACH** solution is the **recovery of rainwater** previously collected and stored,
- **economical** : compared to the conventional solutions available, the cost of which is at least 50 to 70 k € HT, the cost of the **MACH** solution at around **15 k € HT** makes it **accessible to all** disaster victims,
- **light** installation: the installation of the **MACH** solution does not require the moving or rehousing of the occupants,

To summarize, our **innovative approach** makes it possible to provide a new **effective concrete response** to the growing problem of RGA while being ecological and economical.

Architectural description

The reinforcement work provided by the MACH solution vis-à-vis the natural phenomenon of RGA does not concern the architecture of the building but the stability of its structure.

See more details about this project

https://www.cerema.fr/fr/actualites/stabilisation-du-phenomene-retrait-gonflement-sols-argileux

Photo credit

Ighil Ameur © Cerema 2020

Stakeholders

Contractor

Name : M et Mme Noblecourt (propriétaires de la maison MACH)

Construction Manager

Name : Cerema
Contact : Lamine IGHIL AMEUR (lamine.ighil-ameur[a]cerema.fr)
https://www.cerema.fr/fr

Energy

Energy consumption

Primary energy need : 90,00 kWhep/m^2.an

Calculation method : Other

Renewables & systems

Systems

Heating system :

- Gas boiler

Hot water system :

- Individual gas boiler

Cooling system :

- Others

Ventilation system :

- Natural ventilation

Renewable systems :

- Other, specify

Environment

Urban environment

Detached house with garden.

Products

Product

MACH

Cerema

lamine.ighil-ameur[a]cerema.fr

https://www.cerema.fr/fr

Product category : Management / Others

See the description in the "Project highlights" section in the identity card.

Moistening the foundation soil with rainwater during drought re-hydrates the shrinking clay soil and thus limits the structural vulnerabilities of the house.

Costs

Construction and exploitation costs

Total cost of the building : 15 000 €

Additional information on costs :

This is the total cost of installing the MACH solution

Contest

Reasons for participating in the competition(s)

Suite aux **reconnaissances géotechniques** initiales (G5) du sol en place, une couche d'**argile plastique** de 2 m d'épaisseur (sensible au RGA) a été identifiée au niveau des **fondations**. Il est à noter également dans l'état des lieux initial la présence de la **végétation** (arbres et haies) à proximité des façades endommagées. Le **principe** de la solution MACH est inspiré de l'**irrigation agricole** contrôlée via la mesure de la succion du sol. Ainsi, l'opération consiste à réaliser une **humidification** du sol de fondation pendant la période de sécheresse avec l' **eau de pluie**, récupérée puis stockée en amont. L'humidification dépend de la **mesure** continue de la **succion du sol** et s'effectue manuellement au moyen d'ouverture de vannes. L'objectif est de **réhydrater le sol** argileux plastique à proximité des fondations et ainsi tenter de **maîtriser** la propagation des **fissures** existantes et empêcher l'amorce et la propagation de nouvelles fissures.

Le **suivi** de l'expérimentation, réalisé par le Cerema, a permis d'enregistrer des **données** pendant 4 années de sécheresse intense 2017, 2018, 2019 et 2020. Ces données concernent la **tensiométrie** du sol, la **fissuration** et la **météorologie**. Les premiers **résultats** en termes de stabilisation des fissures existantes pendant les périodes de sécheresse sont **encourageants**.

MACH est une solution **innovante** et **résiliente** : (i) **écologique**, en limitant l'impact sur la **ressource en eau** en utilisant les eaux de pluie et **en réduisant l'empreinte carbone** par rapport aux techniques de réparation classiques, (ii) **économique**, avec un coût de pose et fourniture des matériels d'environ **15 k€ HT** la rendant ainsi **accessible à tous les sinistrés** indemnisés ou pas via le dispositif cat-nat et (iii) permet, avec une **mise en œuvre légère**, de **limiter** les **vulnérabilités** des constructions exposées au risque sécheresse et au phénomène RGA.

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